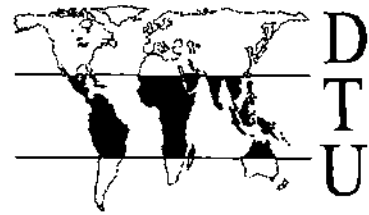


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Low-cost rural transport for Sierra Leone

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LOW COST RURAL TRANSPORT FOR SIERRA LEONE

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0. Abstract

This short paper reviews the demand for rural transport services and discusses the present inadequacy of such provision in Sierra Leone. It examines the main transport modes that might meet its transport needs and concludes that both animal power and assisted human-powered transport have the potential for a significant contribution. The focus of the paper is on the provision of vehicles rather than on the provision of roads and paths, and various interventions are suggested relating to the use and manufacture of such vehicles. In this context manufacturer training, marketing and vehicle design, are discussed. It is concluded that small town manufacturers and artisans are the most appropriate sources of vehicles for rural transport and that their needs for profit and return on labour must be met if there is to be any hope of sustainable development.

1. Introduction and general comments

Transport is essential to rural development and future prosperity. But in most countries in sub-Saharan Africa, from the Sahel to the Zambesi, the cost and inconvenience of transport for farmers is very high. Each person in a rural community in Africa is likely to spend an average of over two hours per day on transport tasks, despite walking less than 10km with a payload of only 20kg or so. This represents a poor level of effectiveness when compared with some of the more sophisticated transport methods shown below. Such ineffectiveness adds to the burden already carried by the farming community and severely inhibits improvements in productivity and hence development.

Improved transport is needed to allow ready movement of materials and tools around the farm to improve the timeliness and efficiency of farming operations and reduce wastage of crops. Farmers often generate surpluses which cannot command proper prices because the goods cannot be sold in a favourable market. Such produce must rather be disposed of at much less advantageous rates by the nearest roadside, itself often at such a distance that spoilage occurs. (Highly perishable goods may even be unmarketable.) In Sierra Leone the paucity of roads and the general absence of suitable vehicles makes these problems more acute than the African average. Clearly the rural community will operate at a depressed financial status, when compared to urban areas, and in such situations it is difficult to accumulate capital which might be invested in improved infrastructure and farming inputs.

One of the major factors contributing to the shortage of transport is the cost, and in particular, the initial outlay on vehicles. Farmers are understandably reluctant to increase their risk as this may increase their exposure to money lenders and credit schemes. Cheaper transport modes, of greater effectiveness, are likely to make smaller demands on scarce capital and allow faster and more thorough development. With limited resources and skill levels, most countries find however, that provision of suitable vehicles is difficult. Little effort has been

invested anywhere, either in the developed or the developing world, into designing low-cost and, more particularly cost-effective vehicles, for use in the rural areas of developing countries.

What is required are vehicles which can be made locally and repaired locally. Many studies have suggested that mutual proximity benefits the user and the producer of goods in rural areas, by facilitating dialogue between the two (Starkey, 1988, Kanu, 1988). Users become aware of the limitations of the technology, and producers become familiar with the needs of the users and adapt designs to suit local conditions. Regarding the types of vehicle most beneficial to rural dwellers; analysis of the data in the table below suggests that animal carts represent a considerable increase in transport power or effectiveness over head-loading. They are relatively cheap and cost effective. They cannot compete however, with motorised transport, if sufficient capital is available to purchase it.

Whilst this position paper attempts to give a general view of low-cost transport in sub-Saharan Africa and of transport in Sierra Leone in particular, it concentrates upon the animal cart because this is the most powerful and accessible innovation which could be introduced into the country. It is recognised however that a major constraint to the growth of this transport mode is the very low numbers of draught animals in the country and the cultural resistance to their use. Only about 1% of the national herd in Sierra Leone is used for draught purposes and by about only 5% of the farming population (Kanu and Sankoh, 1990).

A danger during any period of change is that the interests of women will be overlooked and that they will be left worse off as a result. To combat this danger, one trend over the last few years in other countries, has been to emphasise donkey-cart rather than ox-cart development because there is generally less resistance to women handling equines than bovines. Women are then able to retain a stake in an income generating activity. Sierra Leone has very few working equines and so it is likely that other measures will have to be taken to protect womens' income in the areas affected by animalisation schemes.

2. Present Transport Use

There have been a number of studies of rural transport in developing countries, (eg Barwell 1985). About two thirds of the total transport demand in rural Africa is met by women headloading payloads of up to 30kg. Headloading occupies the average adult for up to three hours per day and represents a daily transport output of about 100kg.km. Three-quarters of trips are less than 6km in length, but they absorb major proportions of rural dwellers' time - perhaps 20% of the average women's active day. Table 1 below (Dennis, 1993) shows typical labour time demand and usage of rural transport and Table 2 (Adeoti et al 1989) gives an idea of trip lengths in a Guinea Savannah environment similar to that in some areas of Sierra Leone. Of the remaining one quarter of trips, most are less than 15km and are over unsealed (ie dirt) roads.

TABLE 1: Household transport statistics for rural Africa.

purpose	time input [hrs/year]	transport output [kg×km/yr]
domestic: firewood+water	600-1500	20 000-60 000
agricultural	200-450	6 000-10 000
social	200-600	zero payload

TABLE 2: Trip lengths undertaken by rural dwellers.

purpose	avg distance [km]	relative frequency [%]	proportion total travel distance [%]
to farm	3	70	23
to market	25	10	25
for domestic needs *	6	6	4
social and religious	45	10	40
medical, educational	30	4	8
total	11	100	100

* The figures for domestic purposes are low and may perhaps reflect the difficulty of obtaining data from women in an Islamic society.

Demand for transport in connection with farming activities is very seasonal and transport owners use various means of spreading out total transport demand over the year. Thus building and maintenance work, often requiring the transport of significant amounts of material, is undertaken away from periods of high agricultural demand and there is normally also a great deal of informal transport hire or borrowing and barter. Cart operators appear very conscious of their animals' condition and nutritional status and usually regulate the load they carry to reflect this. It is fairly rare to encounter a badly overloaded cart.

3. Characteristics of Present Transport Modes

The main transport vehicles or transport modes used in rural areas in Africa are shown in the Table 3 below. The values shown in the table are estimates, but are believed to be representative of West Africa. They demonstrate the power of the more sophisticated modes. (The column 'power' is deliberately included to highlight the somewhat irrational attractiveness of the more powerful modes). Not shown in the table is the ox-drawn sledge, which is generally regarded as being too destructive of road surfaces and is banned in some countries.

TABLE 3: Characteristics of rural transport modes.

transport mode	average payload [kg]	speed [km/hr]	'power' (payload x speed) [kg.km/hr]	daily range [km]	capital cost [\$ _{US}]	total cost/day* [\$ _{US}]	'power' x hrs/day /daily cost [kg.km/\$]
human-powered							
head loading	15	5	75	15	1†	2.0	112
wheelbarrow	25	5	125	10	30	2.0	123
handcart	100	5	500	10	30	2.0	494
bicycle	17	12	210	50	100	2.1	420
animal-powered							
four pack donkey train	100	5	500	20	100	3.1	648
donkey cart	150	5	750	20	125	3.1	966
ox cart	200	4	800	20	150	3.1	1 280
engine-powered							
2-wheel tractor+trailer	200	20	4 000	50	2 000	6.7	1 490
mini-bus/ pick up truck	750	80	60 000	200	10 000	20.5	7 320
lorry	7 500	70	525 000	200	50 000	64.5	23 300

* The daily cost includes the daily wages of an operator (\$_{US} 2) or driver plus the cost of fuel/feed and depreciation of vehicles.

† The price of a pair of shoes.

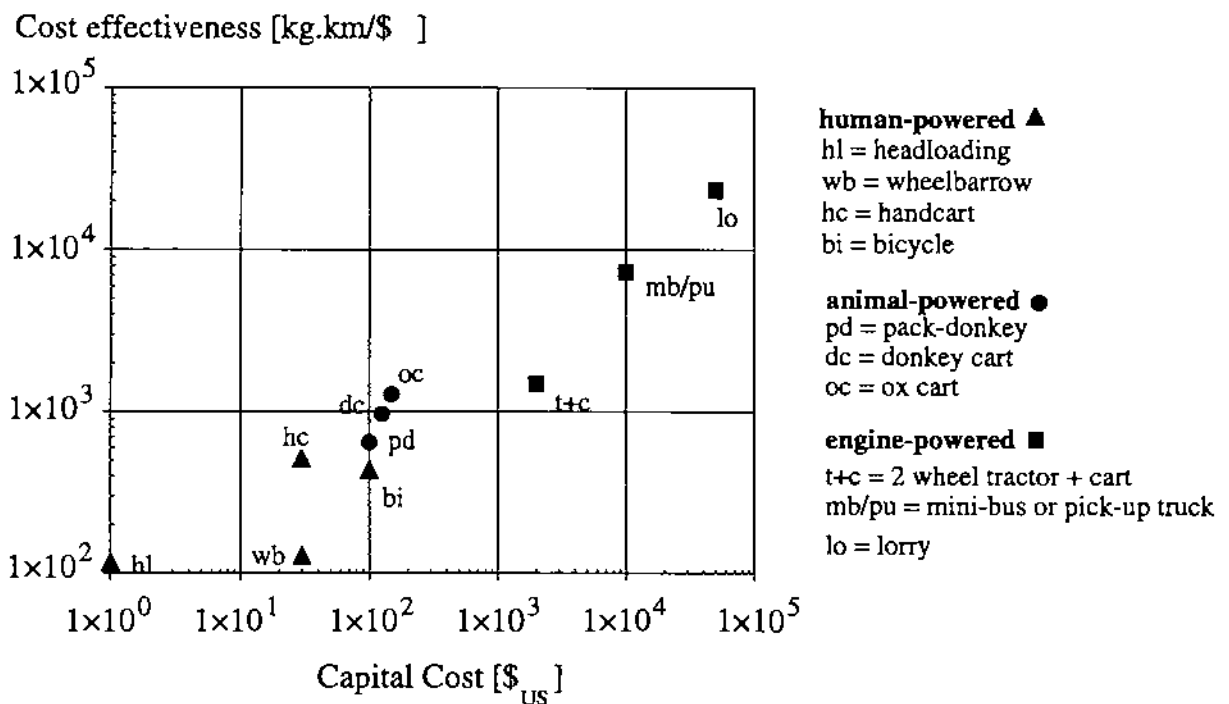


Figure 1: Cost effectiveness versus capital cost for a range of transport modes.

The graph below demonstrates that the cost-effectiveness of transport (the typical daily output divided by the cost per day) rises with capital cost. In other words more capital-expensive transport modes are more cost effective. This confirms the commonsense view that it is probably the high capital cost of more powerful transport devices that mainly prevents their more widespread use.

The graph clearly shows a progression in productivity and cost effectiveness from human to engine-powered vehicles. It does not however take into account the nature of the transport demand or the environment in which transport operates. For the great majority of trips, as illustrated by Table 2, the apparent economics of using motor vehicles are not obtainable for a number of reasons. Loads are usually small and users must wait before vehicles become available, suitable roads and tracks may not be available, and the costs in the table do not include maintaining vehicles in areas where spares are not available at any reasonable price.

The following three sections examine human, animal and engine-powered vehicles in turn, to identify opportunities for improvement in their performance, supply or operating economics.

4. Human Powered Transport

Head loading has been mentioned elsewhere as being a large user of time; it is also suspected of causing significant injury to neck and spine. Damage to neck joints may manifest itself later in life with arthritis and deformity. Support of a large load, whilst not requiring energy in a physicist's theoretical sense, involves considerable muscle tension and therefore much energy use and fatigue.

A fairly recent innovation, in many urban areas, is the introduction of wheelbarrows, usually operated by children. Wheelbarrows are able to carry higher loads over reasonable surfaces with slightly less chance of physiological damage to the user than headloading methods. It should be understood that wheelbarrows are deliberately designed to load the operator through his/her hands in order to provide better control and grip on poor ground surfaces. Patented and novel devices, such as the Chinese wheelbarrow, claimed by some agents to reduce operator fatigue by reducing handle forces, may not therefore secure an overall benefit.

Two-wheel handcarts are also used in large numbers in African towns where road surfaces allow low traction forces to be effective. In rural areas the narrowness of paths as well as their roughness discourages their use. Two types are widely in evidence; the water bowser and the heavy wooden-body cart. The former appears, like the wheelbarrow, to be a relatively recent innovation. Two light motorcycle wheels support a body made from angle iron and steel reinforcing bar and carry up to 500 litres of water, propelled by several children. Design of the the latter carts is very similar to that of oxcarts, but payloads are inevitably less. The economic status of these carts is, if anything, lower than that of animal carts and most are made from scrap vehicle components - very few are made new.

Bicycles are popular where road surfaces are adequate and where they are affordable - prices are usually high by European standards. Punctures in very worn and old tyres are frequent. It is not in general realised how variable is the susceptibility of rubber to puncture - old brittle rubber may be one thousand times more likely to puncture than new rubber. The major benefit

from bicycle use is increased speed - bicycle adaptations to carry high loads do not appear very successful. By contrast with the Asian situation there is very little if any use of cycle rickshaws and cycle trailers and this probably arises from the poorer road conditions and the greater distances. Indeed the spread of rickshaws into the rural areas of India followed the progress of rural road building.

5. Animal Powered Transport

5.1 General Characteristics

The introduction of animal power into most of sub-Saharan Africa, with the exception perhaps of Ethiopia, is a phenomenon of the twentieth century. Rural dwellers in many areas are still unfamiliar with the care and feeding of animals and this, and the problems of harnessing and disease, have acted to restrict their introduction. Where these problems can be overcome, animal-powered transport is usually a cost-effective and appropriate technology by which to improve rural productivity. This has been shown by its success in certain other countries in west Africa - Senegal and Niger, for example.

Whilst animal traction has not, in the past, been popular with the farmers of Sierra Leone because of cultural attitudes and government policies (Bangura 1988), the realisation that there is little alternative to their use is beginning to gain currency. Technical and engineering literacy among many farmers is at only a modest level and there is considerable attraction in a device that 'makes and repairs itself', and which is able to use almost any plant material as fuel. Draught animals too are unusual in another respect: few industrial products appreciate in value, but that is the case with a draught animal. Up to about ten years of age, animals gain weight and add value - the European taste for young tender meat is not common in Africa.

Many different animals are used for draught purposes including goats, camels, horses and buffalo, but the main ones are donkeys and oxen. These two are sufficiently disease resistant and adapted to tolerate heat stress, to be widely popular. Draught animal physiology and performance has been investigated by a number of expert teams worldwide and quite a good understanding of their behaviour, characteristics and needs is beginning to be assembled. Draught animals cannot usually eat whilst working and may require high quality supplementary feeding if they are not to lose weight during periods of sustained labour, such as at harvest time. The nature of this supplementary feeding and its quantity have been investigated in a number of different countries and animal breeds. A fairly recent innovation to be investigated by modern scientific methods is the use of cows as draught animals even when pregnant. Such comprehensive use of an animal requires a considerable skill and understanding of its physiology, but does appear to give an improvement in the economic return from many animal breeds.

Until the turn of the century in the now industrialised countries, animals were not only used for transport purposes, they were used to provide shaft power for both portable and stationary machinery as well. Animal power units (APUs) or animal 'gins' were extensively used to drive hay elevators, grain kibblers and flour mills for example. These traditional machines are unsuitable for production in Sierra Leone and most other countries in Africa, but the Sierra Leone Work Oxen Programme has been investigating some of the recent German

assisted attempts to design locally manufacturable animal power units. The importance of APUs to Sierra Leone's transport programme lies in their potential to increase year-round utilisation of animal power and thereby improve the economics of operation. Keeping animals in work throughout the year preserves training and fitness, which are otherwise lost quickly. However the present and future supply of animal carts is probably the key determinant of whether animal-powered transport can be expanded in Sierra Leone.

5.2 Present Supply of Animal Carts

Farmers' carts come essentially from three sources:

- i) manufacturers outside the country, operating in the international market, who produce new carts, either assembled or more often, in knocked-down form;
- ii) urban manufacturers in-country, with perhaps 50 employees, also producing new carts;
- iii) local artisans who produce carts using scrap automotive wheels, tyres and axles for the moving parts, and new timber and steel for the body.

International manufacturers produce high quality products, sometimes at attractive prices (one UK/Italian supplier is quoting about \$_{US}80 for a 2½ tonne axle suitable for fitting to animal carts and equipped with commercial roller bearings). International suppliers are able to benefit from a ready supply of materials at the best prices; they are able to submit credible tenders to international development organisations and thus obtain large orders; and they are able to smooth their production over many different markets, probably not all experiencing poor economic performance at once. But they do have to support a large international sales team and cover high distribution costs both internationally and in-country. Furthermore they cannot afford to produce anything less than the highest quality, which may well not be affordable or attractive to farmers. (Honouring warranty/guarantee failures with poor communications is very expensive.) There is another important point too: because of the high capital costs an essential component of any improved transport scheme involving major imported products such as carts, is credit. Credit managers are not farmers and engineers, but often end up deciding which products to support, thus distorting any local preference or opinion. The result is often inappropriate products, lack of sustainability, local debt and high foreign exchange costs.

Local supplier companies (type ii above), are usually able to benefit from the lower labour costs in-country, but are often faced with material prices above those paid in industrialised countries because of local import duties. They do not have the expensive international sales team however, nor the international transport costs, but they are still faced with in-country communications difficulties and distribution costs, which may render the concept of dealerships and spares networks completely unworkable. They are able to make lower quality and cheaper products and those more appropriate for local conditions and tastes, but the quality is often reduced more than the price.

The availability of scrap automotive parts in developing countries for cart production is usually poor and scrap may even be imported from industrialised countries. There are

additional problems with the quality and methods of use of such components. Although the loads and speeds to which these scrap components may be exposed in animal carts is usually within the original design envelope, such components are often badly worn or partly broken, and such damage may be compounded when the parts are adapted for cart use. A very common procedure for example, with scrap vehicle axles for animal carts, is to remove the 'banjo' unit - the central final drive unit and differential - to lighten the axle and reduce friction. Often the hole is not covered, leaving the remaining bearings unlubricated and exposed to abrasive dust. More significantly, these bearings are not designed to carry wheel loads without the support of the banjo unit bearings and consequently they fail fairly quickly. The poor supply, and the consequent high price of scrap, has acted as a lid on the activity of indigenous carpenters and blacksmiths engaged in the cart construction business.

Cart bodies built by local artisans are usually of fairly complicated design - perhaps attempting to copy the sophisticated products which their customers would like to obtain from overseas - but construction is often poorly executed, with the result that overall utility and longevity is low, whilst construction costs and times are high. Considerable improvement could be made here, but only if there is good communication between customer and user. The education and training of users is necessary both to help them make best use of what is available and for them to understand the costs and difficulties of making what they want, as opposed perhaps to what they need.

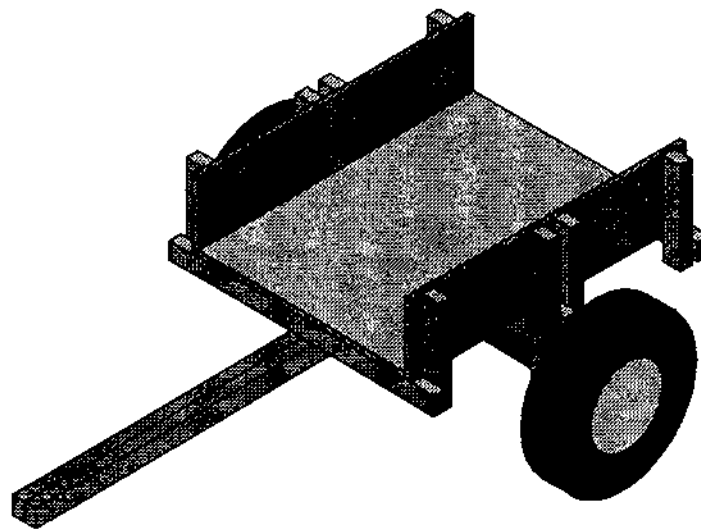


Figure 2: DTU low-cost wooden oxcart with clenched re-bar fixings.

5.3 Animal Cart Design

Current standards of design of animal carts are fairly low, which may arise from a variety of causes. In general, there is at best, only a very weak market; purchaser choice is almost invariably very restricted, and price is a very poor indicator of quality. Most purchasers appear technologically unsophisticated and unlikely to be able to judge desirable qualities in their tools. There is a massive lack of what, in the industrialised countries, would be called salesmanship, so that communication between customer and manufacturer is poor or non-

existent. The producer does not know what is wanted or needed, and reluctantly or otherwise, must guess. The user is unaware of what is expensive and difficult to produce and, if asked, requests adjustability and complicated features. The result is expensive, inappropriate and inefficient products.

Compounding these difficulties is the need of the manufacturer to avoid failure and a bad name. There is thus a reluctance to try lightening, cheapening or unconventional features and no natural mature product can develop as a result. Where there is intervention, in the shape of animalisation programmes or the like, the outside scheme administrator cannot afford failure either and buys his way out of it with expensive products, often with imported components which need credit arrangements and foreign exchange.

Only a very few organisations have devoted any significant effort, whether to quantifying existing standards, to measuring needs, or to developing guidelines for carts. Recently however there has been activity in Zambia (Dogger, 1990) and Malawi (Malawi Bureau of Standards, 1986), which has measured cart usage in terms of distance travelled and has developed standard tests for durability and strength.

Hub uses unhardened water pipe and mild steel bar and can be made without machining if appropriate sizes of pipe are available.

Axle may be constructed of angle iron or other section if cheaper than pipe.

Wheel mounting studs

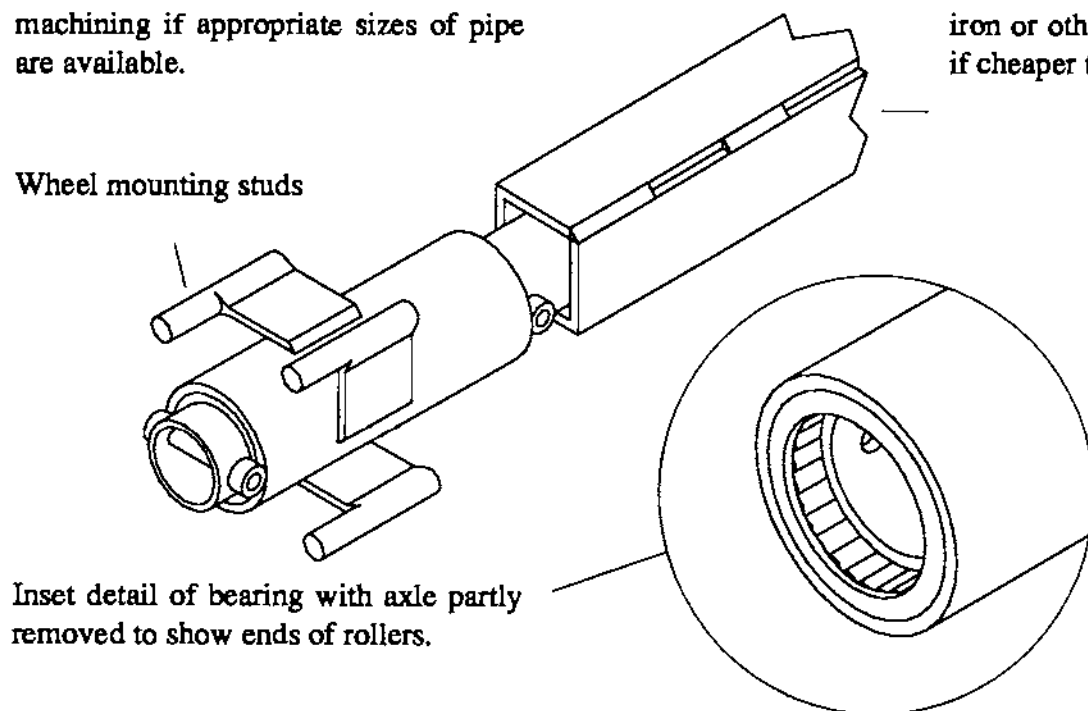


Figure 3: low-cost axle, rolling element bearing and hub for animal carts.

There exists no clear understanding or rationale for even the most basic requirements of cart design including:

- lifetime of running gear (wheels, axles and bearings),

- longevity of bodies,
- height of load trays (oxcarts are usually made with low trays, whilst donkey carts usually have high ones),
- optimum load tray lengths and widths,
- the need for head, tail and sideboards.

High load tray height, and the consequent high load centre of gravity, might be expected to have an effect on animal fatigue in areas with poor road surfaces. Not only are animals then subject to changes in draught as the wheels traverse bumps, but they also experience rapid changes in vertical load. This is because of the offset between centre of mass and any retarding/ acceleration force acting on the wheel, this causing a fore and aft pitching effect on the cart. On the other hand low tray height may allow load wetting whilst fording rivers, and does not necessarily ease loading if the people engaged in loading must bend their backs twice; once to pick up the cargo from the ground and then again to set it down on a low tray.

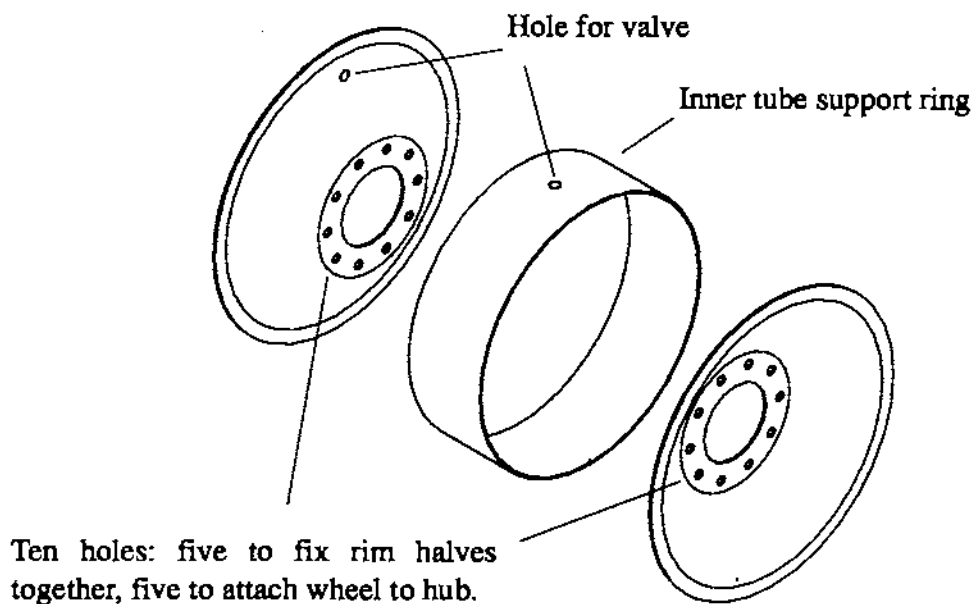


Figure 4: pressed steel wheels for local manufacture.

Notwithstanding the comments above regarding the rationale for existing designs, there appear to be several extant cart styles in west and southern Africa. Body height has already been commented upon, body lengths are around 1.9m, and widths around 1m. Most bodies are equipped with sides, sometimes removable. Wheels are generally pneumatically tyred and large sizes such as those from Land Rovers are preferred because of their reduced rolling resistance. Where there is no established axle supplier like the SISCOMA plant in Senegal, most carts use a scrap vehicle axle with a locally built body. In west Africa this is usually in timber but in eastern and southern Africa steel is preferred.

6. Motorised Transport

The most basic level of motorised transport in most countries in sub-Saharan Africa is the light motorcycle. Such machines, up to 200cc, are used both privately and for hire as taxis. Relatively little goods transport is undertaken by them, though it is possible to see things as large as beds and mattresses transported on them. Just as there are no rickshaws in Africa, so too are there very few of the light three-wheeled trucks and people-carriers seen widely in Asia. Another popular innovation in China and elsewhere, the single-axle tractor and trailer combination, is also almost unknown. Most mechanised transport in Africa is by mini-bus, pick-up truck and rigid lorry. Overloading in all vehicles is almost universal - thirty-five people plus baggage on a pick-up is commonplace, and vehicle breakdown as a result of this practice, poor maintenance and a shortage of spare parts, is frequent.

The most obvious potential improvement to motorised transport in Sierra Leone is to fill the gap identified above; that occupied by the three-wheeled light truck in India and the single-axle tractor and trailer combination in China. Such machines might be copied from Asian sources or developed specifically for Sierra Leone conditions and might be popular especially if the cost can be reduced significantly. A number of organisations are involved in improving or developing new small motorised vehicles for rural use and it is not inconceivable that a light single-axle tractor and trailer combination of adequate strength to withstand the abuse discussed above, could be marketed for \$_{US}1500 or even less.

7. Interventions

To improve the status of rural and low-cost transport in Sierra Leone a number of different interventions might be considered. A choice has consciously been made below to discuss only those interventions which require modest investment and which can be made in an incremental manner. For completeness some other interventions, which are considered to be less appropriate, are also listed. But the preferred interventions are as follows.

- i) Introduce new designs and production processes appropriate to the needs of Sierra Leone, which will make local manufacturing of animal carts easier to carry out. A number of innovations in the design and production of animal and human-powered carts have been made in the last few years and promise to change the cost effectiveness of such transport significantly. Such improved products and methods include pressed steel and cast aluminium wheels, low-cost ball and roller bearings, some of which require no machine tools (Oram 1992), and low-cost body designs in both steel and wood using cheap fixing techniques. These modified cart designs can be produced with only two or three days labour per cart, and with a total cost including body, axle and bearings, and scrap wheels and tyres, of as little as \$_{US} 50.
- ii) Provide technical training of metal and woodworkers to complement these improved cart manufacturing techniques, This is very important if they are to advance and adapt the designs to cater better for their customers needs. The designs suggested above are specifically tailored to require little improvement in skill level to make adequate working products. Nevertheless training of artisans and manufacturers, including rudimentary book keeping, would be very beneficial to improve financial viability and

longterm sustainability.

- iii) Improve the communication between producer and user by providing training to extension agents and farmers. The market for low-technology equipment for the farming sector has already been described as poor, and the maintenance of a sales and spares network too expensive for companies supplying low-cost vehicles. As a consequence the customer often has unrealistic expectations and has no good idea of the cost of the provision of particular features.
- iv) Undertake a programme of standards testing of vehicles and equipment by a government body and make the results widely available. The various parties would then become aware of inadequacies and should be able to make informed purchasing decisions. Such an approach is being followed in Zambia and has already been mentioned above.

These measures to improve animal traction equipment no doubt hinge on good working relations and cooperation with the Sierra Leone Work Oxen Programme and with its drive to increase the numbers of available draught animals in the country. The farmers' preference for engine-powered machinery is probably more difficult to support in the country's present circumstances and their technical proficiency may be too low to allow effective and sustained economical use of such machinery.

Other interventions considered less realistic or easy to introduce are listed below.

- Introduce extra credit facilities to allow farmers to buy already existing vehicles, either in-country or more probably, internationally.
- Introduce hire facilities through government or other agencies, so that suitable vehicles and resources are shared effectively over the rural population. This indeed was the method by which tractors were provided by the Sierra Leone government up until 1986 for field operations.
- Guarantee raw material availability to encourage the engineering and manufacturing sectors. But subsidies and special imports of materials are likely to be expensive and difficult to achieve, and to require intervention at high level. An easy-does-it approach using existing materials suppliers may be more productive.

It is the DTU's opinion that any sustainable improvement in rural transport must rest on local manufacture of appropriate vehicles. Interventions solely with users have not succeeded, nor those that assume the availability of imported equipment. Interventions must be concerned to improve the lot of farmer and that of the rural artisan and small town manufacturer. Because the linkage between the manufacturer and the user is often unsatisfactory, one feature of all interventions should be to strengthen them - to support what would normally be the work of the sales team.

8. Conclusions

The rural transport needs of Sierra Leone appear to be poorly met and to be a severe check on rural development. This document has set out to provide some analysis of the situation and suggest some interventions. Firstly the present transport needs in rural areas have been examined and an overview of present transport modes, including those based upon human muscle power has been given. Then animal-based transport modes, in particular animal carts, have been examined in more detail and small motorised options discussed briefly. The document closes with an examination of the interventions which might readily be made by an agent, either governmental or non-governmental, to improve rural transport provision. The report specifically avoids issues surrounding the provision of track (paths and roads) and notes the difficulties which have been (and might be) experienced with the provision of motorised facilities to the rural sector. It notes also the difficulties facing animal traction - the general lack of familiarity with draught animal husbandry and the poor status of animal power in the rural community.

Some points stand out from this analysis and from other considerations.

- i) Improvements in rural transport demand increased availability of vehicles and lower prices. Any sustainable development in vehicle production must secure a profit for the artisanal and small town manufacturing sectors involved. Too often there has been a concentration on the requirements of the user and on how these may be satisfied, whilst relatively little effort has been expended on expanding local provision of equipment. Resisting urban drift, a problem in almost all the developing nations, requires that wealth be generated locally and spent locally. Income generated in the farming sector is better spent on local infrastructure, including transport, and on rurally produced vehicles if possible.
- ii) An important cause of low profitability in the small manufacturing sector is the preponderance of fairly poor designs of vehicle, both from the manufacturing and from the use points of view. Significant improvements could be made here to reduce the cost of vehicles and their demand on foreign exchange.
- iii) Inspection of the existing transport infrastructure of Sierra Leone suggests that, in common with much of sub-Saharan Africa, a significant gap in the capacity (payload×speed) spectrum exists. On the one hand, the major portion of the transport demand is met by headloading, whilst on the other, mini-buses, pick-up trucks and lorries, handle a much smaller proportion. Apart from handcarts, small and intermediate capacity vehicles (such as bicycles, rickshaws and three-wheeled motorised vehicles) are scarce or absent.
- iv) A survey of the availability of small engines in Sierra Leone would be appropriate to determine the potential to supply small-scale motorised vehicle manufacture. There is little doubt that small motorised vehicles could be developed to provide a useful alternative to cheap but slow headloading and expensive but fast pick-up trucks.
- v) Training of artisans and small entrepreneurs, particularly in elementary book keeping and marketing, is of great importance to their longer term survival, let alone prosperity. Their failure to understand the consequences of poor pricing and sometimes even of the

difference between sale price and profit, means that artisans often struggle to cover their costs and renew their tools.

By these means, the DTU feels that the level of rural transport in Sierra Leone may be brought up to a level from which more sophisticated development can take place. There is little doubt that the present difficulty experienced by farmers attempting to market their spare produce, acts as a severe constraint to their drive to improve their standard of living. Incremental and evolutionary changes such as those suggested in this document are probably the best way to help them.

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