TRANSPORT REVIEWS, 1999, VOL. 19, NO. 3, 205–220

Transporting the yield: appropriate transport for agricultural production and marketing in Sub-Saharan Africa

NIKLAS SIEBER

Heidestr. 47, Stuttgart, D-70469, Germany

(*Received 29 June 1998; accepted 18 October 1998*)

The conventional approach towards agricultural transport in Sub-Saharan Africa focuses mostly on motorized transport. This approach is too narrow because it does not reflect the transport requirements and purchasing power of small-scale farmers. This paper explains why a broader approach that includes not only roads, but also paths and tracks; not only trucks but also intermediate means of transport such as donkeys, bicycles and animal carts can considerably improve agricultural transport. Even though the effects of an appropriate approach on agricultural production, marketing and income can be significant, it is more often rejected by decision-makers as primitive and backward.

1. Introduction

Since 1985, per capita income and food production of most Sub-Saharan (SS) Africa countries have declined. The Food and Agricultural Organization (FAO) estimates that chronic under nutrition and hunger currently affects 180 million people world wide and anticipates that this amount will probably increase to 300 million by 2010. One of the main reasons for the failure to increase agricultural production is a very inefficient local transport system.

In SSAfrica, the conventional transport approach focuses mainly on roads and motorized vehicles. Undoubtedly both are essential for the agricultural production and marketing of farmers in SSAfrica. They give the producers access to inputs and enable them to sell their products in distant markets. But within and around the village farmers have to transport inputs to the field, crops from the field to storage facilities and to collection points or local markets. Motorized vehicles cannot do this, because (1) motorized transport is often too expensive, (2) motor vehicles are often not available and (3) many fields do not have road access. Studies (Barwell *et al.* 1985, Barwell and Dawson 1993, Barwell 1996, Howe 1997a, b) have revealed that agricultural transport is mostly by foot, which implies large diseconomies:

- transport is time-consuming and thus expensive;
- high losses occur due to low carrying capacities;
- opportunities for production of more profitable crops are missed; and
- energy is lost to walking that could be productively used on the fields.

Therefore Barwell and Dawson (1993) argue that 'Roads are not enough'. Following their arguments, this paper tries to illustrate a broader approach towards agricultural transport. It includes not only roads, but also paths and tracks; not only trucks but also intermediate means of transport (IMT) such as donkeys, bicycles and

Transport Reviews ISSN 0144-1647 print/ISSN 1464-5327 online
http://www.tandf.co.uk/JNLS/trv.htm
http://www.taylorandfrancis.com/JNLS/trv.htm

animal-drawn carts. The main aim is to show the economic potentials and limits of IMT in agricultural transport and to give some empirical evidence of the impacts of appropriate transport on rural income.

Section 2 gives an overview of the performance indicators of IMT and compares them with conventional vehicles. Agricultural transport can be split into (1) on-farm transport to and from the fields and (2) transport to markets or collection points. Sections 3 and 4 describe the potentials that IMT have to fulfil these two tasks and to increase production and marketing. Section 5 gives a short overview of the research done on the economic effects of IMT in agriculture; Section 6 describes the economic constraints of IMT. Section 7 gives a conclusive overview.

2. What are IMT?

IMT are defined as those 'means of transport which are intermediate in terms of initial cost and transport characteristics between the traditional methods of walking and headloading and conventional motor vehicles [and] intermediate in time, i.e. they are a stage in the process of developing a traditional to a modern transport system' (Howe 1994: 5). Studies concerning IMT (Barwell *et al.* 1985, Barth and Heidemann 1987, de Veen 1991, Airey 1992, Barwell 1993, Dennis and Howe 1993, Edmonds and van de Veen 1993, Heierli 1993, Howe 1994, Malmberg-Calvo 1994) have been carried out in many developing countries. They emphasize the economic role that IMT can play in the development process. IMT are more appropriate for local transport, because:

- costs of purchase are relatively low;
- maintenance is low-level;
- paths, tracks and trails, which are inexpensive to construct and maintain, are designed for IMT;
- IMT are designed for small and medium loads;
- production of IMT is often local; and
- less foreign currency is needed.

Table 1 gives an overview of the available means of transport in developing countries. While motorized transport can carry bigger loads over longer distances, the IMT are more appropriate for smaller loads at short distances. Wheelbarrows and handcarts are suitable if loads have to be moved on a flat terrain and for short distances around the farm. Bicycles can transport medium loads up to 40 km at a reasonable 10 km/h. Sidecars or trailers can increase the load up to 150 kg on flat terrain; and animal-drawn carts up to 1 ton. Pack animals are more suitable where the topography is accentuated or the tracks are passable by vehicles. Also, motorcycles can be appropriate for narrow footpaths and are comparatively cheap. Animal-drawn carts can transport heavy loads over short-to-medium distances, while pickups or trucks are unbeatable for long distances. Single-axle power tillers are operating very efficiently in Asia, especially rural China, where they transport a large share of the harvest. Ellis (1996: 35) emphasizes their multipurpose use for pumping, ploughing and transport. The transport performance of power tillers is comparable with animal traction.

A salient criterion for the choice of the mode of transport is the costs, which are plotted in figure 1. Transport costs differ according to road conditions, utilization of the loading capacity and trip length. The graph shows typical costs per tonne km of medium distance transport (50 km) on good roads and short distance transport (5 km) on poor roads. Trucks are the cheapest if operated on good roads over long distances, and have a high capacity utilization. Owing to small transport volumes,

Table 1. Performance characteristics of basic vehicles.

Vehicle	Load (kg)	Speed (km/h)	Range (km)	Terrain
Carrying pole	35	3–5	10	unlimited
Improved chee-ke	70	4–5	10	unlimited
Western wheelbarrow	120	3–5	1	reasonably flat, smooth surface
Chinese wheelbarrow	180	3–5	3–5	reasonably flat, tolerates rough surface
Handcart	180	3–5	3–5	reasonably flat, smooth surface
Bicycle	80	10–15	40	reasonably flat, paths
Bicycle and trailer or sidecar	150	10–15	40	reasonably flat, wide paths
Tricycle	150–200	10–15	40	reasonably flat, wide paths
Pack animal	70–150	3–5	20	unlimited
Animal drawn cart (horse, donkey)	500	5–7	40	reasonably flat, wide track
Ox cart	1000	3–5	20	reasonably flat, wide track
Luggage on bus	15	30–60	> 100	wide track
Motorised bicycle	100–150	20–30	50	reasonably flat
Motorcycle 125cc	150–200	30–60	100	moderate hills
Motorcycle 125cc and trailer or sidecar	250–400	30–60	100	moderate hills, wide path
Motor tricycle 125cc	200–300	30–60	100	moderaet hills, wide track
Single-axle tractor and trailer	1200	10–15	50	moderate hills, wide track
Tractor	10 000	10–15	50	moderate hills, wide track
Pickup	1000	30–60	> 100	wide track
Truck	10 000	30–60	> 100	wide track

Source: Sieber (1996), p. 30.

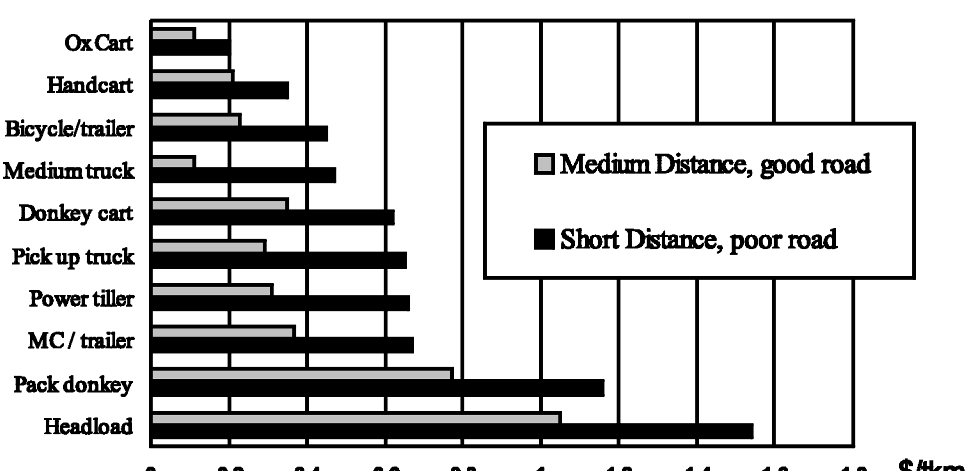

Figure 1. Transport costs for different vehicles in developing countries (data from Crossley and Ellis 1997).

short distances and bad road conditions, many rural areas are only served by pickups, which are more expensive than ox carts, handcarts or bicycles with trailers. Restrictions for using the latter vehicles are not costs, but lower speed and the smaller range. Transport on paths and tracks around the farm is mainly undertaken by the most expensive mode, walking.

IMT can reduce the transport costs significantly. For example, a shift from headload to donkey cart can reduce costs by 60%, and a shift to an ox cart by nearly 90%. The reduction in transport costs might have a significant impact on agricultural production and marketing. This issue will be reviewed below.

3. Potentials of IMT for agricultural production

Agricultural production involves a considerable amount of transport activities in and around the village. Fields are usually reached by walking and walking transports the produce. Research in Zambia, Uganda and Burkina Faso (Barwell 1993) revealed big variations for production-related transport. Rural households spend 75–460 h annually to reach fields and the annual transport burden amounts to 5–10 tkm. IMT can reduce time constraints and transport costs.

3.1. *IMT reduce time constraints*

Transport involving walking is very time consuming and tiring and thus restricts agricultural production. An example from subsistence farmers in Makete, Tanzania clarifies this: an adult takes > 1 h to reach the fields and makes nearly 160 trips per year to the plots. Each adult spends 340 h annually walking to and from the fields (Barwell and Malmberg-Calvo 1989). This travelling decreases time available for productive work in the fields and reduces the productivity of labour. With increasing distance to the plots, the amount and quality of labour input and the preharvest care decreases (McCall 1985: 328). The time constraints explain also why headloading causes higher pest damage and spoilage post-harvest.

Agricultural production entails seasonal distribution of labour inputs and transport activities. Especially during harvest, time is scarce due to increased workloads along with large transport needs. In Makete, each adult had to travel 180 km, which required 45 h to transport 1.4 tons of harvest in 1986. In 1994, the harvest had increased to 2.1 tons, which expanded the distance to 290 km or and the travel time to 70 h.

IMT can reduce transport constraints significantly. Bigger carrying capacities decrease the number of trips and faster speeds save time for travelling to the fields. In Makete, a bicycle would reduce the time for transporting the harvest to 17–25 h and an ox cart to 5–7 h. This enormous increase of transport efficiency allows the farmer to expand production.

Women produce 70% of the agricultural yield while the division of labour ensures that women carry the biggest share of the transport burden. They carry three to five times as much as men, using 22–25% of their active time (McCall 1985, Barwell 1996).

The question arises whether the time saved using IMT will be utilized to increase for production. A theoretical use of the household's time budget (men and women) is shown in figure 2. Assuming 8 h of sleep, the farm households can use 16 h of their daily time budget for labour, leisure and transport tasks. The time used for transport tasks determines how much is left for leisure and for labour. *Before* IMT are introduced, transport tasks restrict the maximum available time for leisure and for

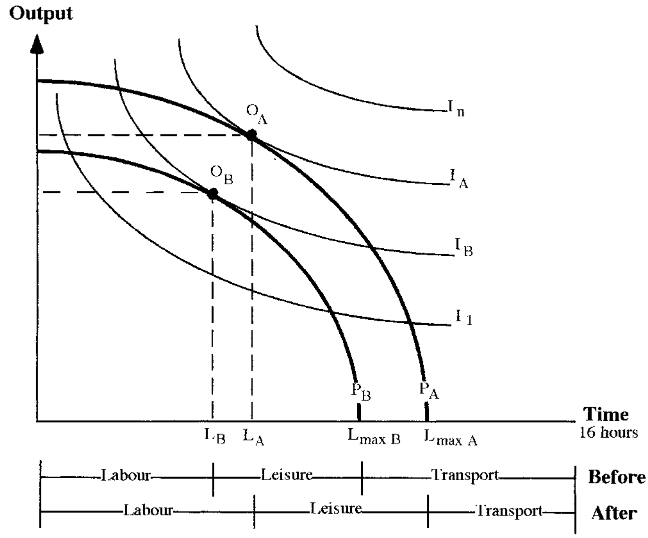

Figure 2. Effects of the introduction of IMT on the household's time budget.

labour to L_{maxB}. The production frontier P_B indicates how much output can be produced with different inputs of labour time within the given time restriction L_{maxB}. The decision of how much time is used for crop production and how much leisure time remains can be visualized by a set of indifference curves I_1, I_2, ... I_n, each symbolizing a different level of utility of a given utility function. The farmers will choose the indifference curve I_B to find the optimal production O_B, which necessitates a labour input of $L_{maxB} - L_B$ and leaves leisure of L_B. The point O_B is an optimum because any other point of the curve P would be on an indifference curve with a lower utility.

The above shows the individual choices of farming households under time restrictions. A different situation occurs *after* IMT have reduced the time requirements for household tasks; the maximum labour time moves from L_{maxB} to L_{maxA}, the production frontier shifts from P_B to P_A and a new indifference curve I_A is chosen resulting in an output of O_A. The graph shows that the saved time will be partly used for leisure, but the remaining time is used to increase agricultural output. The inclination of the indifference curves determines how much of the 'saved time' is used for additional labour. Thus, a reduction of the household's transport time will enable production to increase.

A study by Ahmed *et al.* (1995: 10) on the effects of a hypothetical introduction of IMT corroborates these theoretical findings: rural households in Bangladesh would use 44% of the saved time to increase their working time, 18% for social activities or leisure and 27% would be used for additional domestic activities, which otherwise cannot be carried out due to time constraints. The more households were engaged in commercial activities, the more time they spent on work.

3.2. *IMT reduce transport costs*

The most important economic criterion for the modal choice is transport costs. Table 2 shows the variations of the costs for transport from the field to storage or collection point (the assumed distance is 5 km). Transporting the yield of 1 hectare

Table 2. Transport costs for the evacuation of the annual yield of 1 hectare.

	Yield (kg/ha)	Transport cost $/ha				
		Walking	Animal cart	Cycle trailer	Hand cart	Ox cart
Cocoa	900	7	3	2	2	1
Rice	1500	12	5	3	3	2
Maize	1900	15	6	4	3	2
Cocoyam	7000	54	22	16	12	7
Yams	8000	62	25	18	14	8
Plantain	9000	69	28	20	16	9
Oil palm	10 000	77	31	23	18	10
Cassava	10 000	77	31	23	18	10

Assumption: distance field to collection point= 5 km.
Data from Riverson and Carapetis (1991); Crossley and Ellis (1997).

of cacao, rice or maize is much cheaper than yams, plantains or palm oil. The use of IMT for high yielding crops can considerably reduce transport costs. If the farmer uses an animal cart instead of headloading his plantains a saving of $41 is made for every hectare he cultivates. If an ox cart is used, income will increase by $60/ha.

Next to agro-ecological factors, transport costs have a significant influence on the cropping patterns. More than a century ago Thünen (1783 – 1850) observed circular structures of the agricultural land use around the market towns; with the intensity of agricultural production decreasing with further distance to the market. More often than not this holds true for the cropping patterns on farms in SSAfrica: some authors have found that heavy crops are only cultivated around the farmstead and collection points, whereas high-value crops like cocoa are grown further away from the road network. Often new fields are not taken under cultivation if the distance to collection points is long and therefore transport costs too high. Table 2 also indicates that the radius of cultivation can be extended if farmers use IMT to transport their produce. Müller (1986: 116) observed that ox carts in Zambia can extend the agricultural area to a radius of 20 km around markets and depots.

3.3. *Conclusion*

Walking, the dominant mode of on-farm transport, can restrict any increase in agricultural production. IMT can improve the efficiency of on-farm agricultural transports by reducing transport costs and time. The effects on agricultural production can be manifold:

- cultivation of bigger areas;
- utilization of more fertile, but remote, soils;
- production of heavier corps;
- increased utilization of fertilizer and manure;
- reduced pest damage and spoilage at crop harvest time;
- reduction of transport time, partly used for income generation;
- reduced effort and drudgery involved in human porterage; and
- spill-over effects if animals are used for ploughing and transport.

Thus, IMT enable the farmers to respond better to markets by augmenting or changing their production. Additionally, they reduce losses, save transport costs and time.

4. Potentials of IMT for marketing purposes

In SSAfrica the marketing of agricultural produce is often restricted by poor transport. Many reports show that harvests are rotting in the fields and at collection points due to a lack of transport to markets. Table 3 shows that in 1987 – 88 a considerable amount of the Tanzanian harvest was not collected due to both bad road conditions and lack of transport services.

As this section will show, IMT can significantly improve access to markets and can create new opportunities for farmers. To analyse the role of IMT, it is necessary to distinguish between markets within and beyond walking distance and markets that can only be reached by motorized transport.

4.1. *If markets are within walking distance*

Headloading can play a considerable role in marketing of agricultural produce. Sieber (1996) observed in Makete that more people used a footpath to travel to a local market than were transported by vehicle on a comparable road. Some villages preferred to transport a large proportion of their products by walking instead of selling it to traders with trucks because the traders would pay them less than they receive at the market. A footpath improvement was found to reduce travel times, increase transport loads and diminish accidents (p. 80). This caused stronger market integration and reduced rural isolation.

However, transport by walking is restricted by weight carried or distance to market if more than half-day walk is involved. IMT can increase the carrying capacity and speed, reducing transport costs. IMT create additional economic opportunities; for example, farmers could grow more or heavier crops (in terms of $/ton). IMT enable farmers to sell their produce when road conditions are bad, motor vehicles rare and, therefore, producer prices are high. In Kenya, farmers report that they pass roads in the rainy season with their ox carts, where trucks are stuck in the mud.

4.2. *If markets are too far to walk*

IMT enable farmers to reach distant markets. Three-to-four hours of walking (one way 10 – 15 km) is the threshold for access to markets. A pack animal can extend the distance to 20 km in hilly areas, a bicycle to 30 km in flat terrain and a single-axle tractor with trailer covers up to 50 km. Thus, IMT make new markets

Table 3. Share of 1987–88 harvest in Tanzania stranded.

Region	Crop Type (% stranded)
Northeast Highlands	cotton (24%), coffee (38%), cardamon (13%)
Coastal Belt	food crops (13%), cash crops (35%)
Centra and Western	cotton (89%), maize (13%), paddy (22%)
Southern Highlands	all crops purchased by Union (27%), paddy (80%)
Lake Victoria	cotton (50–60%)

Source: Gaviria (1991), p. 168.

accessible where producer prices might be higher; new products might be demanded; or inputs might be cheaper.

4.3. *If markets are beyond the reach of IMT*

Use of motor vehicles is essential. However, an appropriate approach can be applied, if multimodal transport is considered. The conventional approach, focusing mostly on roads and cars, has drawbacks that shall be discussed briefly to explain the appropriateness of multimodal transport.

The World Bank (Carnemark *et al.* 1976) economically justifies new rural roads by using the 'producer surplus approach'. This approach assumes that economic effects occur due to reduced transport costs: inputs will be cheaper and producer prices higher. This approach has been widely criticized. Even the authors admit that there might be a low development impact, if transport cost savings not being transmitted to producers, through government controls or non-competitive transport services. Hine (1993) confirms that investment in Ghana had a very low impact on the producer prices that increased by < 1% after road improvements from earth to gravel surface. However, the conversion of a footpath into a road entailed benefits to the order of 100 times greater than the benefits of road upgrading.

Another cause for poor rural transport is inadequate transport services, restricted by road conditions, low demand and short supply with vehicles. In 1988, only nine motor vehicles per 1000 inhabitants were registered in SSAfrica (excluding the Republic of South Africa, UNCTADA II: 52). Since then this ratio has probably not increased significantly due to the economic crisis and a foreign exchange shortage. Most vehicles are used in big cities and not in rural areas.

In rural areas of SSAfrica the static or declining transport fleet has created a situation that favours the sellers of transport services and not the buyers. In many rural areas the competition among service providers is very low and therefore they are not under pressure to transmit cost reductions to their clients. A non-competitive environment might be one of the reasons why transport costs in the Côte d'Ivoire are six times higher on rural roads than on major highways. The quasi-monopolistic rural transport market enables operators to charge excessive fares that directly reduce farmers' income.

Rizet and Hine (1991) corroborate that a competitive environment can reduce transport costs significantly. Costs in West Africa are four times higher than in Pakistan, where trucks run twice the number of kilometres, register less empty trips and have lower maintenance costs due to low speeds and the responsibility involvement of the driver. In Pakistan, a competitive environment encourages the purchase of cheaper appropriate vehicles, while Africa buys sophisticated vehicles, which are operated at low utilization levels. Delaquis (1993: 121) confirms these findings in Ghana where transport costs are high due to badly utilized vehicles, long waiting times, small payloads and frequent overloading.

In can be resumed that the conventional approach to rural transport focusing mainly on road infrastructure has problems:

- insufficient provision of transport services, especially during harvest times;
- low competition of service providers on rural roads;
- high vehicle operating costs on bad roads; and
- inefficient vehicle operations.

Multimodal transport may solve many of these problems: using the comparative advantages of IMT in the transport chain from the field to the market. IMT can efficiently carry small quantities from the field or storage facility to collection points, where trucks operate to their optimum: fully loaded on long distances and good roads. Assuming free market entry for transport operators, the use of IMT will increase competition because (1) IMT operate at low costs between collection point and village and (2) more efficient transport operations between collection point and market will be an incentive for other enterprises to offer their services.

Increased competition will break the monopolies of rural transport operators, forcing transport costs down and, thus, raising the income of rural producers.

Additionally, IMT can use low-cost infrastructure, reducing public expenditure for infrastructure provision and maintenance: bicycles and pack animals can operate on footpaths, animal carts and rickshaws on low cost tracks. Low-volume roads can be downgraded to tracks; wooden bridges or fords can be built instead of concrete bridges.

4.4. *Conclusion*

If markets are within walking distance than headloading is important. Transport efficiency can be significantly increased by improvement of footpaths or the use of IMT. If markets are more than half a day's non-motorized travel, a multimodal transport system is a cost-effective solution. Trucks are unbeatable on long distances, good roads and fully loaded, and IMT operate more efficiently on short distances with small loads and on bad roads making a multimodal approach the best solution for rural transport problems.

5. Empirical evidence of the impacts of IMT

Reports from SSAfrica give evidence of the impacts of IMT: Dankwerts (1994) calculates that the use of 40 pairs of oxen on a large-scale commercial farm in Zambia reduces fuel consumption by tractors and saves $8900 annually. Scheinmann (1986) reports about reduced post-harvest losses, increased use of fertilizer and manure, and increased producer prices due to animal based transport in Tanga, Tanzania. Smith and Dawson (1989) state that animal transport increased the use of farming implements in Kenya; and Löffler (1994) explains that the use of ox carts in North West Zambia gave a boost to agricultural production in the project area by giving farmers access to depots. Grisley (1995) reports that bicycles had positive effects on marketing of agricultural produce in Uganda; and Malmberg-Calvo (1994) describes how rural traders make a living by transporting bananas with a bicycle.

However, little comprehensive research has been done on the economic effects of IMT. Airey (1992) compared the transport activities of economically successful, average and unsuccessful households in five study areas in Zambia, Uganda and Burkina Faso. The study revealed that successful households owned more IMT than typical or unsuccessful households. The study corroborated many of the findings explained above. IMT:

- shorten the time required for trips to the fields;
- increase the efficiency with which loads are carried;
- reduce human effort and drudgery involved in porterage;
- reduce pest damage and spoilage at harvest time; and
- increase the use of fertilizer.

The study concludes: 'In economic terms these benefits of IMT can be considered as releasing latent factors of production, principally land, and increasing the efficiency with which the existing labour endowment is utilized. IMT enable the household to extend the distance over which agriculture is practised' and they free up the household's time for productive activities. Households are able to expand agricultural production by cultivating more plots.

Barwell (1993) summarizes the effects of IMT: 'Thus, IMT alleviate the task of moving large quantities of agricultural inputs and outputs, facilitate local crop marketing, support small enterprise activities and provide access to employment and are used for social travel by men'.

As this study did not quantify the economic impacts of IMT, Sieber (1996) made a field study in Makete District, Tanzania. A comparison of households with similar socio-economic structures (figure 3) shows that the use of donkeys has strong impact. They enable farmers to cultivate bigger plots, as transport from the field is made easier, and use more fertilizer. Bigger fields and higher inputs double the harvest and tonnage marketed. The marketing revenue increased from $120 annually for non-donkey households to $241. A higher income gave rise to bigger expenditures and a better endowment of the household with consumer goods such as kerosene lamps, radios, sewing machines and tin roofs. Similar effects were observed for households with bicycles.

Unfortunately, the survey did not take into account the economic performance before as well as after the purchase of the donkey. It is possible that households with a donkey were already wealthier before they bought the animal. However, a comparison of the production function, corroborates the strong impacts of IMT on

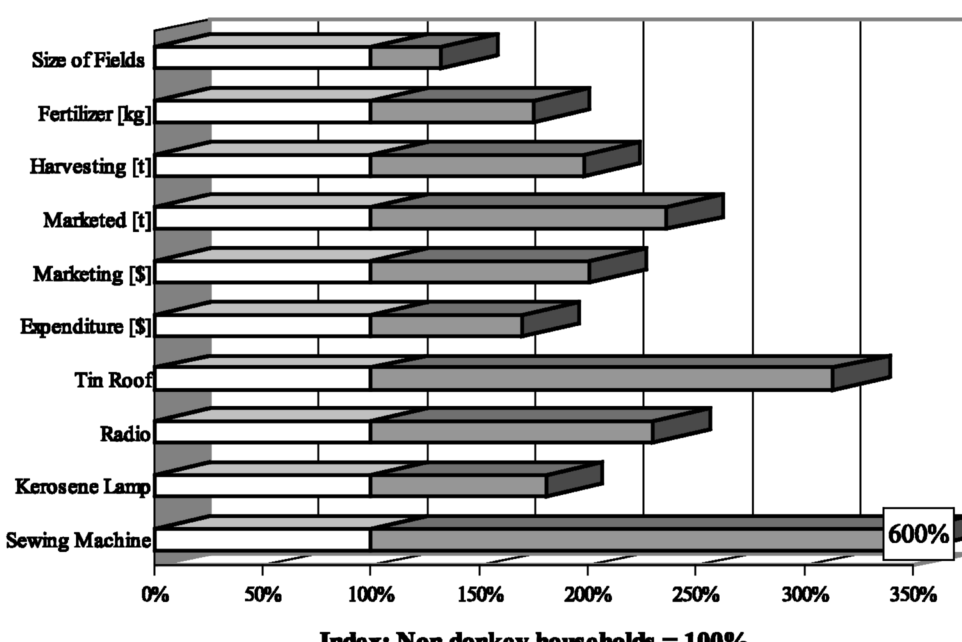

Figure 3. Comparison of households with and without a donkey. [*Source*: Sieber (1996), p. 91].

agricultural production. The production function was estimated with a multiple regression using a Cobb–Douglas-function. Figure 4 shows the growth of the production of different household types. If households that do not possess an IMT increase their inputs by the factor λ, their production will grow by $\lambda^{0.9}$. Households owning a bicycle will increase their production by $\lambda^{1.1}$, households with donkeys by $\lambda^{1.3}$ and with several IMT by $\lambda^{1.6}$. This means that the possession of donkeys or bicycles will enable the household to change its productivity from decreasing to increasing returns of scale.

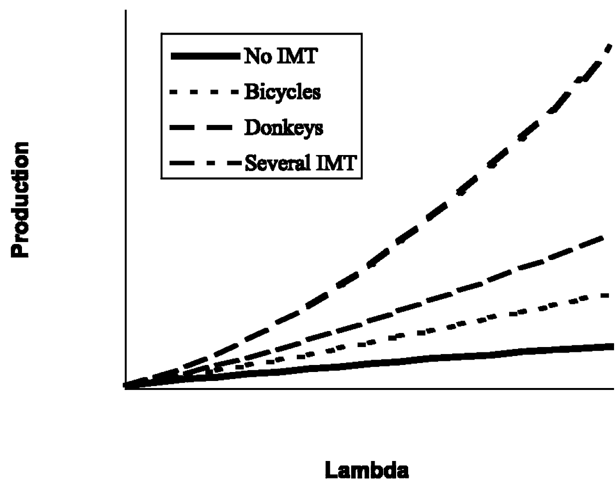

Figure 4. Production function for different households in Makete. [*Source*: Sieber (1996), p.125].

Sieber (1998) quantifies all the benefits of IMT in Makete and compares them with other transport interventions such as feeder roads and transport-avoiding measures. The benefits, which were not only related to agricultural transport, comprise agricultural marketing, salaries and timesavings. The benefit–cost ratios of different transport interventions in Makete, as in figure 5, show that non-motorized transport interventions have a cost efficiency comparable with, or better than, conventional transport projects.

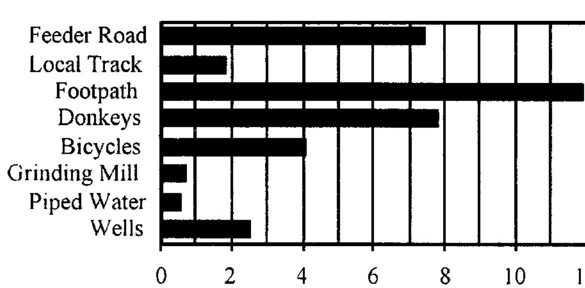

Figure 5. Benefit–cost ratio of different transport interventions in Makete, Tanzania.

Table 4. Price for IMT and GNP per capita.

IMT	Country	Cost ($)	GNP ($ per capita)
Animal cart	Zambia	150–450	450
Animal cart	Tanzania	150–450	110
Animal cart	Malawi	up to 1000	200
Bicycle	Tanzania	77–120	110
Bicycle	Burkina Faso	210	330

Source: Barwell and Dawson (1993), p. 48.

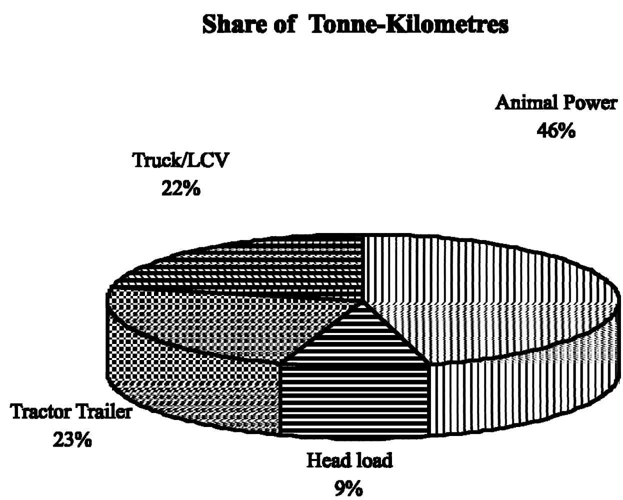

Figure 6. Modal split in rural India. [*Source*: Asian Institute of Transport Development (1996)].

5.1. *Conclusion*

The economic effects of IMT on production and marketing are poorly researched. Existing studies indicate important economic effects, but they lack a monetary quantification of impacts or only allow to draw conclusions for a special region.

6. Restrictions against the use of IMT

IMT may be efficient, but they are not widely used in SSAfrica. Among the many constraints on IMT (e.g. terrain, climate, cultural restrictions, gender division, lack of awareness, etc.) low purchasing power is probably predominant. In the Makete District, 80 – 90% of the households claimed high costs for not purchasing an IMT. In Malawi, a rural household would have to spend 19 times its monthly income to purchase a wheelbarrow, 27 for a bicycle and 113 for an ox cart (Degwitz 1992: 53). Table 4 shows that the price of IMT lies around the annual per capita GNP. Thus, often IMT appear affordable only by the wealthier classes.

Burkina Faso is the African country where IMT are most wide spread; they are proliferating in the countryside and are used intensively. This might be attributable to the long-term disbursement of small-scale credits by the Caisse National de Crédit

Agricole used as well to purchase IMT. Loans made to rural saving groups have exceptionally high rates of repayment. The positive financial effects of IMT enable the farmers to service the debt at commercial interest rates.

Much can be done to promote IMT: improvement of existing IMT, introduction of new IMT, small-scale credit schemes, training of mechanics and artisans, public awareness campaigns, etc. The sad realty is that worldwide very little is done in this field. Why? A major reason is that decision-makers are biased on roads and cars. Howe (1997a: 4) says that 'owning of a car has often been seen as embodiment of development, while rail, water transport and NMT (non-motorised transport) have frequently been neglected'. In the eyes of transport planners and policy-makers, non-motorized transport is usually regarded as marginal and is therefore often ignored. The example of India (figure 6), where an estimated 15 million animal carts are transporting 1500 – 1800 million tons annually, demonstrates their importance. Seventy-three percent of the weight and 55% of tonne-km in rural India are transported by animals or human power (AITD 1996). Most probably the widespread use of IMT contributed to the 3.1% annual growth of the Indian agricultural during the past 10 years. In China, single-axle tractors with trailers are used to transport a large proportion of the agricultural production and, thereby, contributing to the world's fastest growth rates. This is in contrast with SSAfrica where IMT are often scarce and per capita production has been stagnating over decades.

The importance of IMT with their improved efficiency and their economic potential are often ignored by governments and planners. In fact, government regulations often restrict the proliferation of IMT. In Kenya, imported bicycles were classified as sports equipment and, like many luxury items, charged with a high import duty. Figure 7 shows that the reduction of import taxes entailed an enormous increase in bicycle imports. Dennis and Howe (1993: 6) quote import taxes in Ethiopia and Ghana between 200 and 425% and in Tanzania even as high as 500%. Other government regulations have been targeted to reduce foreign exchange spending. In Malawi, the price of bicycles immediately decreased after the

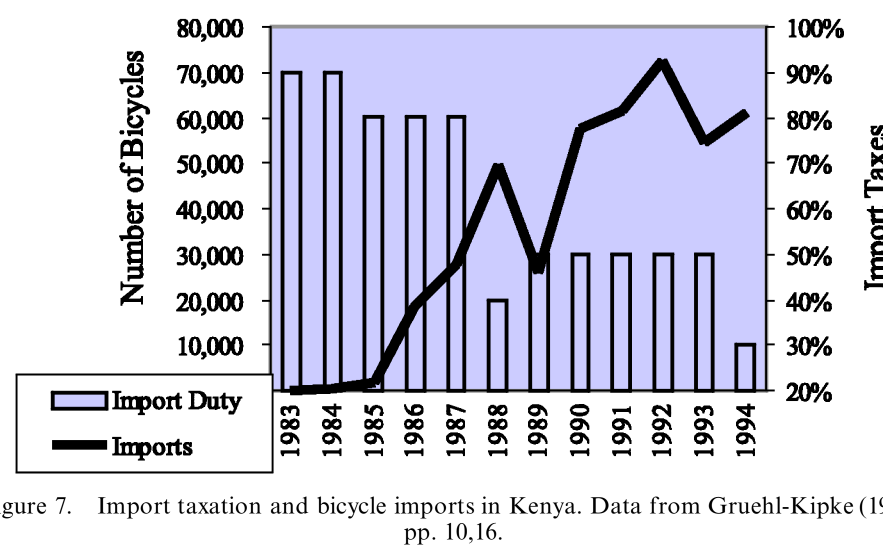

Figure 7. Import taxation and bicycle imports in Kenya. Data from Gruehl-Kipke (1996), pp. 10,16.

government liberalized the distribution of import licences, causing an immediate increase of imports (IT Transport 1996: 25).

6.1. *Conclusion*

Low purchasing power is the main economic constraint to the growth of IMT. Small-scale credit schemes have proven to ease this constraint. Governments tend to disregard IMT and give insufficient emphasis on IMT or, even worse, hamper their proliferation.

7. Conclusion: IMT have an unrecognized potential

The conventional approach towards agricultural transport in SSAfrica focuses mostly on infrastructure for motorized transport between farm and market. Many studies have demonstrated this approach as being too narrow as it does not reflect the transport requirements of small-scale farmers in developing countries, small loads and short distances. The conventional transport approach does not take into account that a large proportion of the transport volume is undertaken on-farm in and around the village mostly on paths and tracks. Walking, the dominant mode of transport, implies large diseconomies and restricts agricultural production and marketing.

Even where there are roads, transport conditions lead to high motor vehicle operating costs. Often the supply with transport services is insufficient causing damage or loss of harvests. Low competition among service providers tends to increase transport charges, raises input costs and reduces farmgate prices.

The solution to the agricultural transport problems of SSAfrica is a broad approach, which not only concentrates on roads, but also includes paths and tracks; focuses not only on trucks, but also on low-cost means of transport. Theoretical discourse and empirical evidence show that IMT have a strong potential to increase agricultural production. However, there is little information about the economic impacts, cost effectiveness and conditions for successful implementation of this approach. Some studies show evidence of important effects in selected regions, but do not allow generalized conclusions.

Among the many constraints against IMT, low purchasing power of the farmers and the ignorance of decision-makers are dominant. IMT are seen as primitive and their potential impact on agriculture is frequently ignored. Often governments and donors give insufficient emphasis for IMT and, even worse, restrain their proliferation instead of supporting credit schemes. Other reasons might be the concern of transport planners with long-distance transport, and agricultural experts disregarding transport as a priority.

Only if the agricultural transport problems in SSAfrica are solved, then the continent might be able to feed itself. The increased use of intermediate means of transport can have a tremendous impact on agricultural production and marketing.

References

Ahmed, F., Carapetis, S. and Taylor, M., 1995, Rural transport in Bangladesh: impact of non-motorised transport on household's activity patterns. Paper presented at the International Conference of the Eastern Asia Society of Transportation Studies (EASTS), Manila 28–29 September.

AIREY, T., 1992, *Transport as a Factor and Constraint in Agricultural Production, Local Level Transport in Sub Saharan Africa, Rural Travel and Transport Project* (Ardington: World Bank/ILO).

ASIAN INSTITUTE OF TRANSPORT DEVELOPMENT, 1996, *Non-Motorised Transport in India, Current Status and Policy Issues* (New Delhi: AITD).

BARTH, U. and HEIDEMANN, C., 1987, *Rural Transport in Developing Countries — A Synopsis of Findings and a Framework for Studies* (Karlsruhe).

BARWELL, I., EDMONDS, G. A., HOWE, J. and DE VEEN, J., 1985, *Rural Transport in Developing Countries* (London: ILO).

BARWELL, I., 1993, *Final Synthesis of Findings and Conclusions from Village Travel and Transport Surveys and Related Case Studies, Local Level Rural Transport in Sub-Saharan Africa* (Geneva: World Bank/ILO).

BARWELL, I., 1996, Transport and the village, findings from African village level travel and transport surveys and related studies. World Bank Discussion Paper 344 (Washington: World Bank).

BARWELL, I. and DAWSON, J., 1993, *Roads are not Enough* (London: IT Publ.).

BARWELL, I. and MALMBERG-CALVO, C., 1989, *The Transport Demand of Rural Households: Findings from a Village Travel Survey* (Geneva: ILO).

CARNEMARK, C., BIDERMANN, J. and BOVET, D., 1976, *The Economic Analysis of Rural Road Projects.* World Bank Staff Working Paper No. 241 (Washington: World Bank).

CROSSLEY, P. and ELLIS, S., 1997, *A Handbook of Rural Transport Vehicles in Developing Countries* (Bedford: Silsoe College, TRL).

DANCKWERTS, B., 1994, A note on the profitability of a large scale commercial farm in Zambia through the use of oxen. In: P. Starkey *et al.* (eds), *Improving Animal Traction Technology. Proceeding of the 1st workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA)*, 18 – 23 January 1992, Lusaka, Zambia (Wageningen: CTA).

DE VEEN, J., 1991, Appropriate use of available resources and technology. In: *The Road Maintenance Initiative, Sub-Saharan Transport Program* (Washington: World Bank), pp. 115 – 122.

DEGWITZ, U., 1992, *Rural Transport in Peripheral Areas of Southern Malawi* (Gießen: Universität Gießen).

DELAQUIS, M., 1993, Vehicle efficiency and agricultural transport in Ghana, MS thesis, University of Manitoba, Winnipeg.

DENNIS, R. and HOWE, J., 1993, The bicycles in Africa: luxury or necessity? In: *Velocity Conference 'The Civilised city: Response to New Transport Priorities'*, 6 – 10 September 1993, Nottingham. Working Paper IP-3 (Delft: International Institute for Infrastructure, Hydraulic and Environmental Engineering).

EDMONDS, G. A. and VAN DE VEEN, J., 1993, *Technology Choice for the Construction and Maintenance of Roads in Developing Countries* (Geneva: ILO).

ELLIS, S., 1996, The economics of the provision of rural transport services in developing countries, PhD thesis, Bedford.

GAVIRIA, J., 1991, *Rural Transport and Agricultural Performance in SSA: 6 Country Case Studies.* Joint SSATP/MADIA Study (Washington: World Bank).

GRISLEY, W., 1995, *Transportation of Agricultural Commodities by Bicycle: Survey on Bombo Road in Uganda.* Transportation Research Record 1441 (Washington: Transport Research Board), pp. 39 – 43.

GRUEHL-KIPKE, B., 1996, The Bicycle Supply Situation: How to Make the Wheel go Around. In: *Urban Mobility and Non Motorised Transport, Eastern and Southern Africa, Phase II, Pilot Projects Tanzania and Kenya.* SSATP report (Horb: SSATP).

HEIERLI, U., 1993, *Environmental Limits to Motorisation* (St Gallen: SKAT — Swiss Centre for Development Cooperation in Technology and Management).

HINE, J. L., 1993, Transport and marketing priorities to improve food security in Ghana and the rest of Africa. In: H.-U. Thimm and H. Herwig (eds), *Regional Food Security and Rural Infrastructure.* International Symposium in Gießen/Rauischolzhausen 3 – 6 May, pp. 251 – 266.

HOWE, J., 1994, Enhancing non-motorised transport use in Africa — changing the policy climate. In: *International Symposium on Non-Motorised Transportation*, Beijing, 23 – 25 May. Working Paper IP-5 (Delft: IHE).

HOWE, J., 1997a, Creation of enabling environment for non-motorised transport use — changing the policy climate. In: *Seminar of Bangladesh National Forum Group for Rural Transport (BNFRT)*, 28 – 29 October, Dhaka.

HOWE, J., 1997b, *Transport for the Poor or Poor Transport? A General Review of Rural Transport Policy in Developing Countries with Emphasis on Low-income Areas* (Geneva: ILO).

IT TRANSPORT, 1996, *Promoting Intermediate Means of Transport*. SSATP Working Paper (Washington: World Bank).

LÖFFLER, C., 1994, Transfer of animal traction technology to farmers in the North West Province of Zambia. In: P. Starkey *et al*. (eds), *Improving Animal Traction Technology. Proceeding of the 1st workshop of the Animal Traction Network for Eastern and Southern Africa (ATNESA)*, 18 – 23 January 1992, Lusaka, Zambia (Wageningen: CTA).

MALMBERG-CALVO, C., 1994, *Case Study on Intermediate Means of Transport: Bicycles and Rural Women in Uganda*. SSATP Working Paper No. 12 (Washington: World Bank).

MCCALL, M. K., 1985, The significance of distance constraints in peasant framing with special references to Sub-Saharan Africa. *Applied Geography*, **5,** 325 – 345.

MÜLLER, H., 1986, *Oxpower in Zambian Agriculture, Performance, Potential and Promotion* (Göttingen: Arbeiten aus dem Institut für Rurale Entwicklung der Georg August Univesität Göttingen).

RIVERSON, J. and CARAPETIS, S., 1991, *Intermediate Means of Transport in Sub-Saharan Africa: Its Potential for Improving Rural Travel and Transport*. Technical Paper No. 161 (Washington: Africa Technical Department, World Bank).

RIZET, C. and HINE, J. L., 1993, A comparison of the costs and productivity of road freight transport in Africa and Pakistan. *Transport Reviews*, **13,** 151 – 165.

SCHEINMANN, D., 1986, *Animal Draft Use in Tanga Region, Tanga Integrated Rural Development Project* (Tanga).

SIEBER, N., 1996, *Rural Transport and Regional Development: The Case of Makete District, Tanzania* (Baden-Baden: Nomos).

SIEBER, N., 1998, Appropriate transport and rural development. *Journal of Transport Geography*, **6,** 69 – 73.

SMITH, A. and DAWSON, J., 1989, *ITDG Animal Cart Project, Action aid Kenya, Report of Field Visit to Kenya, July 1998*. Report 263 (Ardington: IT Transport).

UNITED NATIONS TRANSPORT AND COMMUNICATIONS DECADE II, 1990, *Roads Sub-Sector Working Group, Strategy Paper* (UNCTADA).