Rural Travel and Transport Progam
Sub-Saharan Africa Transport Policy Program

Local transport solutions:
people, paradoxes and progress

Lessons arising from the spread of intermediate means of transport

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The opinions expressed in this paper are those of the author. They do not necessarily represent the views of the Rural Travel and Transport Progam or the Sub-Saharan Africa Transport Policy Program for whom the document was prepared

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Preface and acknowledgements

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The main published sources used in the preparation of this publication have been cited within the text and are listed in the references.

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Paul Starkey
Reading, February 2000

Acronyms and Abbreviations

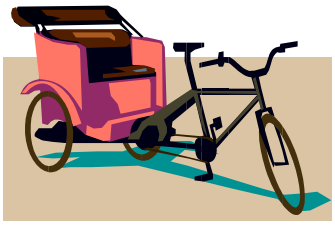
ACT	Association de coopération technique (an NGO), Brussels, Belgium
AITD	Asian Institute of Transport Development
ATNESA	Animal Traction Network for Eastern and Southern Africa, Harare, Zimbabwe
Camartec	Centre for Agricultural Mechanization and Rural Technology, Tanzania
CAPART	Council for Advancement of People's Action and Rural Technology, Delhi, India
CTA	Technical Centre for Agricultural and Rural Cooperation, Wageningen, The Netherlands
DFID	British Department for International Development (DFID), London, UK
eg	for example
GATE	German Appropriate Technology Exchange, GTZ, Eschborn, Germany
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH, Germany (German bilateral development agency), Eschborn, Germany
hr	hour
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, Hyderabad, India
IERT	Institute of Engineering and Rural Technology, Allahabad, India
IFRTD	International Forum for Rural Transport and Development, London, UK
IHE	International Institute for Infrastructural, Hydraulic and Environmental Engineering. Delft, The Netherlands
ILO	International Labour Organisation, Geneva, Switzerland
IMAG-DLO	Instituut voor Mechanisatie, Arbeid en Gebouwen, Wageningen, The Netherlands
IMT	Intermediate means of transport
IRF	International Road Federation, Geneva, Switzerland.
ISBN	International Standard Book Number
IT	Intermediate Technology
ITDG	Intermediate Technology Development Group, UK
ITDP	Institute for Transportation and Development Policy, New York, USA
ITSL	Intermediate Technology Development Group Sri Lanka
KAEC	Katopola Agricultural Engineering Centre, Chipata, Zambia
kg	kilogram
km	kilometre
LFRTD	Lanka Forum for Rural Transport Development, Colombo, Sri Lanka
MACE	Medak Agricultural Centre Equipment, Andhra Pradesh, India
mm	millimetre
NGO	Non-governmental organisation
NWIRDP	North-Western Integrated Rural Development Programme, Zambia
p	page(s)
PDR	Projet de développement rural de la province de L'Est, Bafata, Guinée-Bissau
PTMR	Programme de Transport en Milieu Rural (= Rural Travel and Transport Program), World Bank, Washington DC, USA
RGTA	Réseau Guinéen sur la Traction Animale, Kindia, Guinea Conakry
RTTP	Rural Travel and Transport Program, World Bank, Washington DC, USA
SANAT	South African Network of Animal Traction, Fort Hare, Alice, South Africa
SISCOMA	Société Industrielle Sénégalaise de Constructions Mécaniques et de Matériels Agricoles, Senegal
SISMAR	Société Industrielle Sahélienne de Mécaniques, de Matériels Agricoles et de Représentations, Senegal
SSATP	Sub-Saharan Africa Transport Policy Program, World Bank, Washington DC, USA
TAMTU	Tanzania Agricultural Machinery Testing Unit, Tanzania
TDAU	Technology Development Advisory Unit, University of Zambia, Lusaka, Zambia
UK	United Kingdom (of Great Britain and Northern Ireland)
USA	United States of America
WDS	Water Development Society, Andhra Pradesh, India



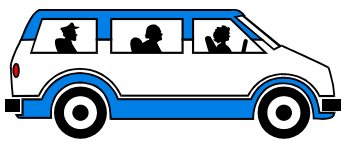
Between walking and carrying . . .



Intermediate means of transport (IMTs) – local transport solutions



. . . and large-scale motorised transport


Some pictures on this page have been removed to reduce the file size for downloading and e-mail transmission.

Box 1 What are IMTs?

Intermediate Means of Transport and Local Transport Solutions?

The most basic transport involves people walking between locations and carrying things themselves. Goods can be carried in a container (bag, pot, box, suitcase), wrapped in a shawl around the back, balanced on the head, carried in a backpack, or balanced on a yoke or pole. If they are too heavy, things can be dragged. Walking and carrying are simple, cheap and efficient technologies for short distances and for small loads.

At the other end of the spectrum are large-scale transportation devices, including lorries, buses, motorcars, trains, aeroplanes, and ships. These are generally designed for moving long distances with large loads. These technologies are intrinsically complicated and very expensive. Nevertheless, economies of scale can make the cost per tonne-kilometre or per person-kilometre carried quite low, provided operations involve long journeys with full loads.

Between these extremes, there is a wide variety of intermediate means of transport, sometimes known by the acronym 'IMTs'. Intermediate means of transport are local transport solutions that increase transport capacity and reduce drudgery at a relatively low capital cost. Land-based intermediate means of transport include wheelbarrows, hand carts, trolleys, bicycles, tricycles, animal-powered transport, motorcycles and power tiller trailers. Equivalent intermediate water based transport technologies include canoes, rafts and small boats.

Intermediate means of transport are 'intermediate' in the sense that they fill the gap between human walking and carrying and large-scale transport. Their carrying capacity (generally in the range 50 kg to 1000 kg) is greater than humans can conveniently carry themselves, but below that of large-scale transportation systems (usually in the range of one to one thousand tonnes). Intermediate means of transport are mainly used for short distances (fifty metres to one kilometre in the case of trolleys and wheelbarrows and one to twenty kilometres in the case of cycles, carts and pack animals). Large-scale transport is normally used for journeys of between five and five thousand kilometres.

For short distances and small loads, large-scale motorised transport can seldom be cost-effective (see Box 7). For such journeys, intermediate means of transport are often appropriate, convenient and affordable. Intermediate means of transport are particularly well suited for local collection and distribution ('feeder' transport) in the first and/or the last links of marketing chains. In addition, many intermediate transport technologies have very good environmental and aesthetic qualities.

Intermediate means of transport are, and will continue to be, complementary to large-scale transport. They should not be dismissed as an 'intermediate' stage in technological evolution. While the need for some transport systems is temporary (eg, domestic water carts become unnecessary once all houses have tapped water), many intermediate means of transport will continue to be used whatever the technological environment. In all countries there will continue to be appropriate, complementary niches for transport technologies such as bicycles, riding animals, wheelbarrows, delivery carts, farm trailers and supermarket trolleys. Special transport devices can assist the old, the young and the handicapped. Intermediate means of transport are very important, providing solutions to local transport problems.

Summary

Context, adoption patterns, diversity, complementarity and profitability
Despite investment in roads, inadequate transport and accessibility constrain rural development. In sub-Saharan Africa, most village transport still involves people (mainly women) walking and head loading. Between walking/carrying and large motorised transport is a wide range of intermediate means of transport (IMTs). These increase transport capacity and reduce drudgery at relatively low cost, solving local transport problems. Local transport solutions include wheelbarrows, hand carts, bicycles, tricycles, animal-powered transport, motorcycles and power tiller trailers.

International patterns of adoption are varied and paradoxical. Some technologies spread rapidly, others slowly and some are never adopted. The use of intermediate means of transport is higher in Asia than Africa. In Africa, relatively few motorised intermediate means of transport are used, but motorcycles are increasing.

Within countries, adoption of transport technologies is not homogenous: there are clusters of particular devices. Distribution is partly explained by differences in population density, incomes, cultures, topography, climate, farming systems, transport needs and project activities. Other influences are more random or 'chaotic', depending on human inventiveness, entrepreneurial skills, personal preferences, fashions and 'chance'. Complex combinations of environmental and socio-economic factors and fickle human reactions make the adoption transport technologies unpredictable.

Profitability is a key factor in the adoption of intermediate means of transport. Most transport devices generate income, save time or assist profitable ventures. Concentrations of intermediate means of transport exist in urban areas and near markets, where there are profitable transport activities, production and repair facilities and raw materials. Development of transport technologies and services is assisted by urban trade patterns, information flows, cultural diversity and year-round economic activity. Where transport demand is high, different technologies coexist, fulfilling specialised niches. Processes of innovation, assessment and adoption are rapid. A 'critical mass' of mutually-reliant users and support services develops.

The use and diversity of intermediate means of transport is low in rural Sub-Saharan Africa. Processes of innovation and adoption can be slow, affected by low economic activity, low availability of key materials, limited information exchange and high seasonality of cash flows and transport demand. Relatively simple transport technologies (eg, normal bicycles, flatbed carts) that can be used for many different tasks are most appropriate where transport demand is low. Similarly, multipurpose animals (eg, oxen and cows) or machines help spread the cost of ownership. Profitable rural use of local transport solutions can come from greater use of manure and forage, increased production, more timely harvesting, larger circles of trade and income from hiring. Examples include ox carts in Zambia and bicycles in Uganda.

The promotion of intermediate means of transport has had varied results. Examples (eg, Mauritania, Sri Lanka, Tanzania and Zambia) show both the effectiveness and the lack of success of promotion by projects, NGOs, the private sector (formal and informal) and person-to-person exchanges. Most Asian transport technologies have been promoted by the private sector. Bicycles and donkeys have mainly spread in Africa through private sector and user-to-user promotion. Informal diffusion can be

rapid and effective, but the existing patchy distribution of transport technologies illustrates its unreliability.

Methodological implications for transport programmes
There is need for an integrated approach to the promotion and development of intermediate means of transport. Alternative interventions should also be considered. Programmes must understand the different perspectives of users. These vary according to gender, income, occupation, age and ethnic background. Participatory techniques (eg, focus groups, discussions) assist development programmes to predict the transport needs, preferences, priorities and purchasing power of women and men, children and old people. Irrespective of economic logic, adoption can be influenced by social status, prestige and aesthetics. Attitudes evolve and projects must understand changing perspectives. Stakeholders should be involved in identifying, testing, monitoring and evaluating intermediate means of transport. Reasons for adoption (or non adoption) should be analysed (examples are cited from Ghana and Tanzania). Even if transport programmes adopt holistic approaches and use participative methodologies, they cannot be sure of rapid success in rural communities, due to the very complex problems experienced by impoverished and marginalised people.

Critical mass, credit, subsidies, supply and demand and safety
It is difficult to buy, use and maintain intermediate means of transport when they are rare and supporting infrastructure for their manufacture, supply and repair is scarce. They need a 'critical mass' of users to make ownership socially acceptable and to justify the establishment of service providers. A vicious circle hinders early adoption, with insufficient support services for easy adoption and insufficient users to sustain sales and maintenance services (examples include ox carts in Guinea and bicycles in Madagascar). Programmes can help achieve the critical mass by stimulating viable support services around markets with economic activities (eg, ox carts in northwest Zambia). Income-generating activities for users can be encouraged.

Credit or subsidies (for users, traders, manufacturers or importers) can stimulate adoption. Examples are given of credit stimulating cart adoption in Guinea Bissau, Senegal, Tanzania and Zambia. However, intermediate transport technologies have also spread without institutional credit or subsidies (eg, carts in Ethiopia, Mauritania and Tanzania). Credit and subsidies proved insufficient incentives for the adoption of cycle trailers in Ghana. Subsidies and credit linked to specific technologies distort choices and markets. Credit programmes should consider the specific needs of women.

In many rural areas, adoption is limited by inadequate supply. Limiting factors that may need to be addressed include inadequacies in components and material supplies (local or imported), production facilities and skills, technology designs, capital/credit availability and/or marketing systems.

Intermediate means of transport may pose safety problems to owners, road users and animals. Problems include unbalanced or excessive loads, poor brakes and inadequate lights. A combination of legislation, enforcement and education is required. Prohibition of intermediate means of transport is popular with motorised users, but disadvantages many people. It is better to create separate lanes for slow vehicles to reduce accidents and improve traffic flow.

Gender issues

There are major gender inequalities in rural transport. In Africa, women are the main transporters but most transport devices are owned and used by men. Women have less access to information, capital, credit, cash incomes and profitable transport activities. Their viewpoints are less heard. Men determine most transport programmes and men are the major beneficiaries. Few transport projects have incorporated gender analysis. Some programmes promoting intermediate means of transport have involved women in planning and project actions. An example is provided from Tanzania.

Village transport research (for example at Makete in Tanzania) has increased understanding of women's problems. This knowledge has yet to have a major impact: women still carry most of the transport burden. Development programmes should involve women, address gender imbalances in the adoption of transport technologies, and ensure information and credit systems are suited to women's needs. Domestic transport (eg, water collection) may have insufficient direct financial benefits to justify investment in transport technologies and women often lack of cash income. Intermediate means of transport introduced for income generation (for women or men) may have secondary benefits in domestic transport. In many areas, bicycles and ox carts are considered 'male' domains (but perceptions can change). Donkeys are not prestigious and are relatively gender-neutral, so their adoption by women may be socially acceptable.

Poverty reduction goals and achievements

National authorities and aid agencies must recognise that poverty reduction, economic development and enhanced rural transport requires more than road provision and motorised transport. Rural development also depends on local transport solutions achieved by increasing intermediate means of transport. Success will depend on stimulating numerous, local initiatives that are clearly appropriate to specific areas and particular stakeholders. Public, private and/or NGO concerns and partnerships may devise and implement them. The inclusion of intermediate means of transport in national transport strategies and the development of policy environments conducive to their use will influence success.

While local transport solutions should reduce drudgery and stimulate the overall economic development of communities, the benefits will not be shared equally. The more marginalised members of society may even be impoverished (relatively or absolutely) by the entrepreneurial activities of richer people able to afford transport technologies. Women, the elderly and people with special needs are unlikely to benefit proportionally unless there is specific targeting, in relation to technological choice, information, subsidies, credit, income-generating opportunities and/or the formation of appropriate empowerment groups.

National and international networking

Self-critical monitoring and objective evaluation are vital for transport programmes. Faster progress can be achieved by stakeholder-involvement at all stages. Lessons concerning the success and failure of intermediate means of transport should be widely shared to accelerate overall progress. This requires active networking at national, regional and international levels. Broadly based national and international networks should encourage information exchange and programme collaboration. They should promote greater understanding at all levels of the many factors that influence the adoption, ownership, use, social value and economic benefits of intermediate means of transport as local transport solutions.

Table 1 Means of transport with indicative characteristics and important requirements*

Transport type	***Indicative characteristics***					***Some important requirements***			
	*Indicative cost price * ($ relative)*	*Indicative load * (kg)*	*Indicative speed * (km/hr)*	*Indicative range * (km)*	*Indicative cost/tonne/km* ($ relative)*	*Foreign exchange*	*Animals and vet services*	*Mech-anics*	*Good roads or tracks*
Carrying/head load	0	20	5	10	1.50	Low	None	Low	Low
Sledge	10	100	4	3	0.80	Low	High	Low	Low
Wheelbarrow	30	100	4	1	0.40	Low	None	Low	Low
Hand cart	60	150	4	5	0.35	Low	None	Low	Medium
Pack donkey	60	80	7	20	0.70	Low	High	Low	Low
Bicycle	100	60	10	20	0.60	Medium	None	Medium	Medium
Cycle rickshaw	170	150	8	15	0.45	Medium	None	Medium	High
Donkey cart	300	400	6	15	0.60	Medium	High	Medium	Medium
Ox cart	500	1000	5	10	0.20	Medium	High	Medium	Medium
Motorcycle	900	100	50	50	1.30	High	None	High	Medium
Power tiller trailer	5000	1000	10	15	0.70	High	None	High	Medium
Pickup	12000	1200	80	200	0.70	High	None	High	High
Truck	60000	12000	80	200	0.50	High	None	High	High

* *Notes:*
This table provides order-of-magnitude indicative figures only. The costs, prices, loads, speeds and distances vary greatly with the country, the people, the environment, the infrastructure and the vehicles or animals. It is not uncommon for the transport systems mentioned to carry much greater loads and to travel much longer distances. The figures are simply indications of what is commonly achieved. The costs per tonne-kilometre are very approximate, and highly sensitive to assumptions on costs, loads and distances: they are mainly based on the model of Crossley and Ellis (1999) for 5 km journeys.

Introduction

Transport problems and the raising of awareness

Production, trade and daily life require the movement of goods and people. Different transport technologies exist employing human energy, animal power or the use of motors. They range from basic walking and carrying to large-scale motorised transport, including motorcars, large trucks and buses, trains, aircraft and ships. Between these extremes, there is a wide range of intermediate means of transport (IMTs) that can increase transport capacity and reduce human drudgery without the high costs associated with large motor vehicles. Options include single-wheel technologies (eg, wheelbarrows), two-wheel hand carts, bicycles and tricycles, motorcycles, animal-powered transport and low-cost boats.

The many transport options available have different ranges, capacities and operating costs. These overlap and provide a continuum of complementary transport options, each with advantages and disadvantages. They vary in purchase price, payload, complexity and their requirement for work animals, mechanics, foreign exchange and road quality. Some of the options and different requirements are summarised in Table 1.

The development of transport systems in sub-Saharan Africa has been given high priority by national governments and by development agencies. Government ministries concerned with transport and regional development, with the support of donor agencies, have concentrated on transport infrastructure, including roads, railways, ports and airports. Since 1985, about 15-20% of World Bank loans have been for transport investments (roads, ports, railways, etc), with nearly US$ 40 billion in loans/credits, of which about US$ 2.5 billion (about 6%) has been specifically for rural transport (World Bank, 1999; Bamberger and Lebo, 1999). However nearly all this money has been for infrastructure and large-scale transport systems. Transport planners have paid little attention to intermediate means of transport. The bias towards infrastructure and large-scale transport still exists in national governments and donor agencies, and is reflected in terms of budgets, personnel and professional training.

In the 1960s and 1970s, the first two post-independence decades for most sub-Saharan countries, national governments and donor agencies put emphasis on expanding road networks with little regard to the problems of sustainability. However, it became increasingly obvious that inadequate rural transport and poor accessibility remained serious constraints to rural life and development. The International Labour Organisation (ILO) in collaboration with the Intermediate Technology Development Group (ITDG) commissioned a number of village-based transport studies in Africa, notably in Makete in Tanzania. These studies proved influential by highlighting the importance and magnitude of human-powered transport (Howe and Zille, 1988; Barwell and Malmberg Calvo, 1989; Airey and Barwell, 1991; Dawson and Barwell, 1993). It became clear that large-scale investment in infrastructure was having very little impact on family and village-level transportation problems. Rural people, particularly women, still walked long distances each day carrying heavy loads, such as water, firewood, grains, agricultural produce and goods for marketing.

By the 1980's, there was seen to be a need for alternative approaches to transport. Several 'appropriate technology' organisations, including the ITDG and the German Appropriate Technology Exchange (GATE) had been promoting the importance of intermediate means of transport, with early emphasis on developing new prototypes.

ILO supported studies on intermediate means of transport and also stressed the potential for sustainable road construction and maintenance using labour-based methods (Barwell and Hathway, 1986). The World Bank, in association with a number of European bilateral development agencies, established the Rural Travel and Transport Progam (RTTP) within the Sub-Saharan Africa Transport Policy Program (SSATP). This was intended to assist countries develop more appropriate transport policies. In a complementary multi-donor initiative implemented by ITDG and ILO, the International Forum for Rural Transport and Development (IFRTD) was established to promote transport policies more orientated to the needs of rural people.

Notwithstanding these new initiatives, transport ministries and supporting donor agencies continued to concentrate transport resources on major infrastructure projects. However, within many donor agencies, including the World Bank, poverty reduction had become a clearly stated mission statement. Potential investments in transport had to be considered not only from the viewpoint of economic development, but also in terms of their potential to reduce poverty. Further studies were undertaken on rural transport problems and the possible poverty-alleviating interventions.

A series of transport papers were published by RTTP/SSATP, ILO, ITDG and IFRTD that addressed some of the social, economic and technical problems of transport for the rural poor (Riverson and Carapetis, 1991; Malmberg Calvo, 1992; Dawson and Barwell, 1993; Malmberg Calvo, 1994 a and b; Connerley and Schroeder, 1996; Howe, 1997; Ellis and Hine, 1998). These stressed the potential of intermediate means of transport for alleviating poverty by reducing isolation and drudgery. One RTTP/SSATP paper provided an analytical framework with which to approach the promotion of intermediate means of transport (IT Transport, 1996). The various papers concluded that the promotion intermediate means of transport should become an integral component of national transport strategies, with important roles for the private sector and non-governmental organisations (NGOs) in implementing new initiatives.

As a result of these and other initiatives, the importance of, and potential for, intermediate means of transport is now widely recognised within many development agencies. However, policies relating to intermediate means of transport have yet to become ‘mainstreamed’ within national ministries of transport and decentralised development programmes in Sub-Saharan Africa. The RTTP (known in francophone countries as the Programme de Transport en Milieu Rural or PMTR) has been arranging a series of national workshops on rural transport issues and the need for local transport solutions. Civil servants trained in planning and implementing roads programmes have been considering, perhaps for the first time, the on-going problems faced by women and men in villages where head-loading remains the dominant transport system. Such transport planners may accept the potential benefits of local transport solutions, but question the practical implications in terms of national strategies and programmes. In particular, which transport technologies should be promoted and how? What has been the experience in other countries?

In practice, in all parts of the world, there have been many paradoxical experiences relating to the adoption of transport technologies. In some parts of some countries, there have been very positive lessons concerning the adoption of intermediate means of transport. There have also been many disappointing experiences. In some situations technologies seem to have taken off spontaneously, without government assistance. In others, adoption only occurred after extension campaigns. In some countries, potential

users rejected particular transport technologies, despite subsidies, credit provision and strong promotional campaigns. The diverse experiences illustrate the importance of technical appropriateness of transport devices to local transport needs within particular environments. More significantly, they highlight lessons relating to user-perspectives and the overriding importance of social, economic and cultural issues.

An analytical planning framework

The World Bank SSATP has published an approach paper on 'Promoting intermediate means of transport' (IT Transport, 1996). This provides an analytical framework and envisages a very detailed five-stage planning process.

The first planning stage involves a broad contextual analysis that considers environmental factors (topography, infrastructure stocks, demography) and economic, industrial and social factors. These categories include markets and household economics, technological options, finance for production, distribution and purchase of transport devices, cultural and gender factors, community groups and complementary initiatives. The initial analysis also considers some non-project factors including national planning, regulatory and fiscal processes that affect the costs and use of intermediate means of transport.

As a second stage, it is then suggested that the problems of access be considered, including the possibilities of using non-transport solutions to tackle the problems of isolation. The third proposed step is a detailed diagnostic survey using a logical framework approach.

The transport problems and needs to be tackled are defined with clear objectives, assumed costs, envisaged benefits and realistic time-scales. The fourth proposed feature is a detailed demand and supply analysis, with targets set. The final planning stage involves the development of detailed action plans. These relate to the supply of intermediate means of transport (adaptation, improvement, manufacture), the introduction and promotion of these technologies, and the provision of credit (preferably through NGOs). It is suggested that the action plans be implemented in an integrated way, in the context of broader rural development interventions. The crucial importance of subsequent progress and performance monitoring is stressed (IT Transport, 1996).

To date, clear national programmes relating to the promotion of intermediate means of transport have yet to be planned in the way envisaged in the approach paper. However the general ideas and approaches appear to have influenced several RTTP-PTMR programmes as they start to develop coherent strategies relating to transport technologies. In the past, national transport policies in Sub-Saharan Africa have seldom articulated the importance of intermediate means of transport and the desirability of promoting them. The promotion of transport technologies has generally been left to the private and informal sectors and to area-specific development projects (public sector and NGO).

In the past few years, RTTP-PTMR programmes in several African countries have been bringing together national planners and many stakeholders to facilitate the development of relevant strategies and programmes. As a result of national workshops, stakeholder meetings, studies and field visits, the RTTP-PTMR programmes have recognised the importance of local transport solutions. However, the meetings made it clear that the national and local planners require more

information and concrete examples concerning successful and unsuccessful promotion of intermediate means of transport, to help them prepare their new initiatives.

Scope of this study

This paper will review a range of case histories in different countries, in an attempt to address and analyse the factors that have influenced the success or failure of particular intermediate means of transport. This study will discuss land-based technologies. Around rivers, lakes, canals and coastal areas, transport may depend largely on boats (Palmer, 1998). The importance and complementarity of small water-based transport systems (canoes, rafts, small boats, etc) is fully acknowledged but is not specifically addressed here. Nevertheless, many of the conclusions will be directly relevant to water transportation systems.

This study, in conjunction with other RTTP initiatives, is designed to highlight some of the main implications of recent adoption and non-adoption experiences involving intermediate means of transport, whether 'spontaneous' or project-led. These lessons should assist planners and other stakeholders in formulating plans for the promotion of intermediate means of transport.

This paper is not intended to provide answers and prescriptions. Rather it aims to address the complex issues involved in the adoption of transport technologies and to challenge people to come up with effective processes that can be incorporated into national programmes. It is intended to complement past and present papers relating to the analytical framework, the political economy, financial and marketing issues as well as national and regional analyses.

Box 2 Wheelbarrows: slow early diffusion, much subsequent adaptation

Wheelbarrows, made of wood, metal or plastic are seen worldwide. They are often used for short-distance transport of heavy goods, such as construction materials, water or agricultural produce. Wheelbarrows are often employed around markets to move goods between larger vehicles and market stalls. Petty traders may use them for selling wares. Wheelbarrows have not always been used in this way. It is quite possible that wheelbarrows have been 'invented' many times and in many different countries, but there do seem to have been patterns in their spread and adoption.

The first records of wheelbarrows appear to come from China in the 3rd Century. On the traditional Chinese wheelbarrow, the load is balanced high over a central wheel. Although the centre of gravity is high, making it somewhat unstable, the operator does not have to bear much of the load. This design is not commonly seen outside Eastern Asia, although some modern single-wheel water carriers have adopted the design principal. It seems that the wheelbarrow concept gradually spread westwards in Asia.

There seem to be few, if any, records of wheelbarrows being used in Europe before the 13th Century. Prior to this, on construction sites large loads were transported using rollers or carts, while two people sometimes transported smaller loads using a wooden platform or stretcher. Soldiers returning from crusades may have brought the wheelbarrow idea to Western Europe from the Middle East. The first recorded medieval wheelbarrows comprised a long load-bearing stretcher, supported at one end by a wheel and at the other by the operator. The idea of the wheelbarrow then spread, the design being modified and re-invented numerous times. Wheelbarrows became common in Europe and navigators and colonialists subsequently carried technology throughout the world. Numerous variations on the design have been made, and new designs are still being 'invented' each year.

Some lessons relating to the adoption of intermediate means of transport

- *Simple technologies may not arise spontaneously, but they may spread once an idea is shared.*
- *Once a technological idea has been introduced, there is great scope for local adaptation.*
- *Programmes may need time: wheelbarrows and carts evolved and spread over centuries!*

Reference: Matthies, 1991

Paradoxical adoption patterns

International adoption patterns of transport technologies

The patterns of technology adoption are very varied and frequently paradoxical. Some technologies spread rapidly, others slowly and some innovations are never adopted. Some alternative technologies may coexist for years, while in other situations one rapidly replaces another.

In Nepal, people carry loads with back baskets, with forehead straps. In East Asia, loads may be carried with poles. Shoulder yokes have been used to carry water, milk and other loads in parts of Europe. While head loading is dominant in most of sub-Saharan Africa, there are several other human-based technologies. In Chad people of different traditions in neighbouring villages use three different water-loading systems: head loading, shoulder loading and back loading. These three transport technologies, with very different ergonomic profiles, have coexisted for centuries.

Tricycles of various designs, including cycle-rickshaws, are common in parts of India, parts of Bangladesh, parts of The Philippines and parts of Indonesia. They are not uniformly distributed within these countries, and are seldom seen in some other Asian countries such as Sri Lanka. In Sri Lanka, Indonesia and in Europe, load-carrying tricycles often have the two wheels and load in front of the driver. This is also the case in Peru and Colombia, where front-load tricycles have spread rapidly in the past twenty years. The tricycle taxis in Peru are very different design from those used in Cuba. Tricycles have not yet been widely adopted elsewhere in Latin America. In Africa, there are very few tricycles in use, but bicycle taxis operate in East Africa.

Wheelbarrows of different designs are found throughout the world (see Box 2). Human-pulled rickshaws, each with a passenger seat and canopy are used in Madagascar. Nowadays most carry freight rather than people, but the common rickshaw design has not yet changed to reflect this. In Madagascar ox carts with wooden spoked wheels are common and such cartwheels have been made on Zanzibar and Pemba, as well as in North Africa and South Africa. A few initiatives to make similar cartwheels have been made in several African countries, but cartwheels are now seldom encountered anywhere on the African mainland. Animal-drawn sledges are common in Madagascar, and also in eastern and southern Africa (Box 3). Such sledges are seldom, if ever, seen in West Africa, but they are used in Cuba.

Motorcycles with sidecars are common in the Philippines, but not in other Asian countries. It is common to see men and women driving mopeds (mobylettes) in Burkina Faso, Benin and Togo but this is uncommon in Guinea, Ethiopia and Tanzania. Large numbers of power tillers are used to pull trailers in several countries in south Asia. Some power tillers are used for transport in countries such as Côte d'Ivoire, but this technology is yet to become common in Africa.

India has 14 million ox carts. Ethiopia has 14 million work oxen and five million donkeys, but very few animal-drawn carts. There may be one million donkey carts in use in West Africa, but in Madagascar and Cuba oxen are generally used to pull carts. Milk-giving cows, rather than oxen, pull carts in Portugal and Romania.

These examples illustrate the some of the fascinating similarities and differences in the use of intermediate means of transport around the world. By reference to case history examples, this paper will explore some of the reasons for different patterns of adoption of transport technologies. The examples will stress the relevance and

appropriateness of the technology to the local transport needs, the economic implications and the socio-cultural context. The issues of promotion, economic incentives and social pressures will also be seen to be important. However there is also another set of issues that are more difficult to identify and analyse. These more 'random' elements relate to human inventiveness, entrepreneurial skills, personal preferences, fashions and simple 'chance'. The many interacting factors that influence the adoption of intermediate means of transport will be analysed in the subsequent sections of this document.

Box 3 Wooden sledges: simple and widespread but paradoxical distribution

Animal-drawn, wooden sledges are common in parts of Cuba, the Philippines, Madagascar and Eastern and Southern Africa. There are many different sledge designs, but most are very simple to make and use. Sledges have been used in Egypt for over 3000 years. Three main types have been identified in Zambia, the dug-out log (*umulangu*), and the flatter carved board (*mula*) and the simple Y-branch. All of these, but particularly the Y-branch, may be modified with superstructures made from poles and/or basket work. In Africa and Madagascar, one or more pairs of oxen pulls the sledge using a steel chain attached to the withers yoke. In the Philippines, a single buffalo pulls a sledge using bamboo shafts.

There have been several recent examples of sledges being developed by farmers into simple carts, using wheels made from tree-trunks. One such example in north-eastern Zimbabwe appears to have been a farmer response to the banning of sledges by the authorities (who feared that sledges accelerated erosion). Four-wheel, articulating carts were developed from Y-branch sledges using cross-sections of tree-trunks and simple wooden axles. Similar but independent innovations have been seen in the Mbeya region of Tanzania.

These simple carts and sledges co-exist with larger carts, and one family may own several complementary devices that are used for different transport operations. Sledges are often used for transport on small paths between homes and fields for carrying tillage implements, manure and harvested produce. They may also carry fuel wood and water.

Animal-drawn sledges are seldom, if ever, seen in West Africa, where they could be similarly useful as basic and cheap means of transporting materials.

Some lessons relating to the adoption of intermediate means of transport

- *It appears paradoxical that sledges are common in East Africa but not in West Africa.*
- *The main merits of sledges are their low cost and simplicity of use rather than technical efficiency.*
- *Users may own several transport technologies, selecting between them depending on load, distance and path.*

References: Müller, 1986; Starkey, 1999.

Within-country adoption patterns are not uniform

Within any country, the adoption of intermediate means of transport is not homogenous and clear clusters of certain technologies use can be seen. This is particularly clear if one takes a rapid journey around the country. Naturally the observations in each country and region will be different. However, one might, for example, start by passing through one area where many people can be seen carrying water in wheelbarrows. Within 50 km, for the first time on that journey, one may start to see people carrying water on the rear carrier of a bicycle. Further on, water is carried in drums on the front of bicycles. One may then pass an area with very few cycles at all. One notices the first ox cart, and within ten kilometres you have seen twenty more. They are all painted blue and with black designs and have axles made from old pick-up differentials. They become increasingly common, and then, for no obvious reason, they are seldom seen. As one approaches the next town the number of bicycles and motorcycles increase, and one starts to see hand-pushed carts on the road again. On the other side of the town, out in the rural area cycles are now rare, as are ox carts. You pass through a sparsely populated area, with secondary bush interspersed with shifting cultivation. Here for more than one hundred kilometres the

only system of transport you can see appears to women head loading water, wood and produce. As the bush gradually gives way to drier savannah grassland, one sees a pack donkey for the first time, and within a few kilometres more than one hundred others are seen. You then see your first donkey cart, and then some more. You start to see lightweight yellow ox carts and in the same area another concentration of bicycles. And so it goes on. The various transport technologies are not uniformly distributed. Some intermediate means of transport (for example, the wheelbarrows and bicycles) are very widespread, but vary greatly in concentration. Others (perhaps the water carrying bicycles or yellow ox carts) appear clustered in one locality only.

Other changes may have been observable at the same time: changes in population density, variations in house styles (different cultures, different incomes), changes in topography, climate, crops and animals (different farming systems, transport needs, rural incomes) and changing administrative areas (different infrastructure and project influences). Some of these can be associated with the changes in the transport technologies used. The motorcycles may be associated with richer, higher density areas. Bicycles are found mainly in flatter and richer areas. Donkeys are found in the drier zones and in hilly areas. Ox carts are generally seen in flatter areas away from forest zones. Hand pushed carts and wheelbarrows are most common in urban and peri-urban areas.

Other aspects of the distribution of transport technologies appear more random. The blue ox carts made from old axles may have been the initiative of one artisan at a regional market. Other artisans in the surrounding area have since copied them, but they have not (yet) spread to other regions. The yellow ox carts, using imported components, may have been supplied through one specific provincial rural development project. One particular, unusual method of carrying water with a bicycle may have started just a few years ago with one person's successful trials. Other people in the area have copied the good idea so that it has become well accepted. It may have become almost 'traditional' in that locality, but it has yet to spread to other areas.

Explicable patterns and 'random' or 'chaotic' elements

In the example above, the system of carrying water on the back of the bicycle and/or the idea of painting carts blue may have started with just one person. Perhaps they were entirely original ideas. It is also possible the person(s) had learned of similar uses elsewhere through conversation, the media or personal travel. In any case, the ideas and action of one person may have provided the first example. This may have been influenced by many unique and 'random' events (previous education, previous encounters, the chance of being around at a particular moment and having the necessary materials/resources to be inventive). The human inventiveness concerned may have been inherited or acquired, but would have been strongly influenced by a large number of environmental factors and 'random' events.

The reaction of the community to the 'inventions' would have been influenced by many social, cultural and economic factors, with many 'random' chance elements. Had the first person to witness the innovation been very negative and critical, the idea may have died immediately. On the other hand, had the family/neighbour been very entrepreneurial, the idea might have been quickly turned into a marketable product. The same technology at one time and in one place may be acclaimed as valuable, yet in comparable circumstances in the next village be dismissed out of hand. An innovation can be ridiculed in one situation, and become very fashionable in another.

In mathematics, such ‘random’ processes are described as ‘chaotic’. Chaos theory helps the understanding of situations in which a small event at one time or location can lead to major effects subsequently or elsewhere (Gleick, 1987). It also makes it easier to see patterns in apparently ‘chaotic’ situations, and makes it easier to model or predict events. The invention and spread of intermediate means of transport can be considered in the context of chaos theory. Some clear principles relating to adoption operate in a wide range of situations where complex combinations of environmental and socio-economic preconditions together with fickle human reactions make it difficult to predict the outcome of any initiative.

If one views the distribution of plants and animals, one can also see patterns of distribution that are influenced by a combination of definable factors and random, chaotic events. This analogy is explored in Box 4.

Box 4 Seed dispersal analogy: natural clusters, nurturing and random successes

If one examines the national distribution of a particular type of plant, whether wild or cultivated, one can see patterns that are not dissimilar to the patterns of adoption of intermediate means of transport.

There are areas of a country that have the plant, and other areas without it. This may be partly explained by a range of environmental factors, and partly by chance. Where there is one plant, there will probably be more similar plants nearby. The seeds from that plant that fall close by may well produce a clump of plants. The fruits and seeds (like transport technologies or ideas) may well be carried to other areas, where some may grow and reproduce leading to new local concentrations. Fruits/seeds are likely to be dispersed by many methods, but many fail to germinate and others fail to thrive.

If someone wishes to promote such a plant (or transport technology) in a new area, it would be logical to first understand the favourable and unfavourable environmental factors. It would then seem sensible to start by concentrating resources in one or more favourable settings, and ensuring the plants received appropriate attention. If the plants thrived, there would soon be local concentrations and sources of seeds for further dissemination.

Concentrating the introduction programme in one area could be problematical if (by chance) the area selected had some unforeseen unfavourable conditions. This eventuality might be overcome by choosing a large number of diverse planting locations, in the hopes that, even without special care, some seeds would germinate, thrive and reproduce. This strategy would require more resources to monitor progress, and it might be difficult to find out what happened in the many locations.

If the main objective were the successful dissemination of the plant (or transport technology), the most successful strategy would probably be to concentrate most resources in an apparently favourable area, with a few seeds (technologies) dispersed into a range of possible locations.

Key lessons

Diversity, complementarity and levels of use

The range and diversity of designs of intermediate means of transport currently in use in the world is remarkable. Some examples of the extent and levels of use are provided in Box 5. Different transport technologies can coexist alongside each other, fulfilling different specialised niches. This is particularly clear in some Asian countries, where the scale of use of different transport devices can be very high.

Box 5 Examples of scale and diversity of intermediate means of transport

- *India has five million cycle rickshaws in use.*
- *In Bangladesh the cycle rickshaws of Dhaka carried 18 million passenger kilometres in 1995 (roughly double the load of the London Underground system)*
- *40,000 tricycles were dumped into the sea by the Jakarta authorities in an attempt to ban them.*
- *China has more than 270 million cycles with annual production of 40 million (1988)*
- *Chinese annual production of hand carts has exceeded 10 million (1978 data)*
- *Indian cycle production reached 10 million in 1994, of which 2 million were exported*
- *99% of rural people in Sub-Saharan Africa do not have personal motor transport*
- *Most African countries have fewer than one motorcycle per 1000 inhabitants (1997)*
- *A few African countries, including Benin, Burkina Faso, Egypt, Togo and Zimbabwe have more than 10 motorcycles per 1000 inhabitants (1997)*
- *Malaysia, Thailand and Uruguay have more than 100 motorcycles per 1000 inhabitants (1997)*
- *Benin has six mopeds or motorcycles for every car, while Namibia has 50 cars per motorcycle.*
- *Sub-Saharan Africa had 35 bicycles per 1000 inhabitants compared with 400 bicycles per 1000 inhabitants in South Asia (1985)*
- *Nigeria imported about 450,000 bicycles in 1981*
- *Kenya imported fewer than 2000 bicycles in 1985, but as many as 100,000 in 1989*
- *India has 14 million ox carts in regular use that carry more freight daily than the rail network*
- *Transport donkeys in Sahelian countries increased from 1,000,000 to 2,500,000 (1950-1999)*
- *In Mauritania, the number of donkey carts increased from almost zero to 75,000 in 30 years*
- *In Senegal, more than 150,000 animal-drawn carts have been sold from one factory*
- *Several thousand pack donkeys play key roles in supply and distribution systems of Addis Ababa and its major grain market.*

Note: These figures are provided simply as illustrative order-of-magnitude examples. The various figures have been calculated in different ways and at different times. They are not directly comparable.

References: Howe and Dennis, 1993; Gallagher, 1995; AITD, 1996; Starkey, 1996; Howe, 1997; IRF, 1999; Metschies, 1999; Sisay Zenebe and Tilahun Fekade, 2000; Starkey and Starkey, 2000.

The highest concentrations of intermediate means of transport are generally seen in, and around, urban areas, particularly in the vicinity of markets. Markets involve the inward and outward transport of a wide range of goods, and they attract many people (large and small traders and customers). This creates many different potential transport markets:

- people and/or goods
- nearby and/or more distant locations
- light loads and/or heavy loads
- prestigious and/or economical devices.

Close to markets, one may see (depending on the country):

- human porterage
- human-powered wheelbarrows, trolleys, carts and rickshaws (hand carts with two wheels, three wheels, four wheels, large wheels, small wheels, wooden wheels or cycle wheels and ‘porter trolleys’, simple trolleys using old vehicle bearings, etc)
- cycle based technologies (bicycles, delivery bicycles, tricycles, cycle-ricksaws)

- animal-drawn carts (two wheels, four wheels, one animal, two animals, cart wheels, rubber tyres, oxen, horses, donkeys, camels, etc)
- pack animals (horses, mules, donkeys, camels, etc)
- motorised intermediate means of transport (motorcycle-based tricycles, autorickshaws, 'itans' [locally-made Thai pickups], power-tillers with trailers).

The fact that so many different transport technologies may be seen in close proximity illustrates not only the diversity, but also the complementarity of the various local transport solutions. Each transport device offers a different combination of design compromises between cost, weight, carrying capacity, manoeuvrability, speed, durability, ergonomic efficiency and aesthetic characteristics.

Complementarity does not exclude competition between different intermediate means of transport. Customers, whether vehicle purchasers or hirers, may have a great choice of technologies and operators. Very occasionally the stress of competition becomes excessive, resulting in physical violence, punctured tyres or poisoned animals.

The intermediate means of transport are also complementary to motorised transport systems and to human carrying. Again this is most obvious at markets and transport depots. The goods for long distance lorries (trains, boats or planes) may be brought to and from the depots in a wide range of intermediate means of transport (Box 6) and smaller motor vehicles.

Box 6 'Hand trucks' in Ghana: a local innovation that spread 'spontaneously'

In Ghana, four-wheel load-carrying platform trolleys or 'hand trucks' are now widely used for short distance transport, mainly in urban areas and around markets. Depending on the load and road conditions, they are pulled or pushed by one or more operators. They are made from two scrap axles from pickups. The front axle is mounted on a turntable to allow steering. The platform is quite narrow (about 750 mm by 1500 mm) so that pick-up axles are cut and joined.

It is not clear, when and where the first one was made, but the idea has been copied my many small workshops and they have been spreading since the 1960s. They are now found in most towns and at rural marketing centres. In 1987 there were estimated to be around 10,000 in use, with numbers increasing. As they are strong, they can carry heavy loads of up to one tonne, provided the road conditions are good. Having four wheels, they are very stable and more convenient for loading and unloading than two-wheel carts. The need for four wheels, two axles and a turntable mechanism makes them significantly more expensive than two-wheel carts. Some are equipped with brakes.

Despite their cost, the 'hand trucks' can be profitable to own and operate, as evidenced by their spread. Some transport entrepreneurs own several 'hand trucks' that they hire out to full-time operators, who seek out paid transport work. They are mainly used for delivering and collecting goods with typical journeys of 2-3 km. One of their roles is to move goods between bus and lorry parks, wholesalers and retailers. The 'hand trucks' have spread without public-sector promotion or credit provision. In some towns they have been regulated and licenses are now required to operate them.

Some lessons relating to the adoption of intermediate means of transport

- *Transport hire services in urban areas and around markets can be very profitable, justifying strong, stable and relatively expensive intermediate means of transport.*
- *Intermediate means of transport can fulfil a valuable, complementary role in 'feeder' distribution and collection for large-scale motorised transport systems.*
- *Once profitable transport niches have been identified, transport technologies can spread spontaneously and rapidly through the informal private sector.*

Reference: Howe and Barwell, 1987.

This complementarity of motorised and non-motorised transport technologies that is seen in many countries in the world has a strong economic basis. Studies by Ellis and Hine (1998) have illustrated how intermediate means of transport, including bicycles and ox carts are cheaper for short distances and lighter loads. This makes them ideal for small-farm, around-village and 'feeder' transport tasks in rural areas, as well as

short-distance ‘feeder’ supply and distribution in urban areas. Large motor vehicles are cheaper for long-distance journeys and for heavy loads (see Box 7).

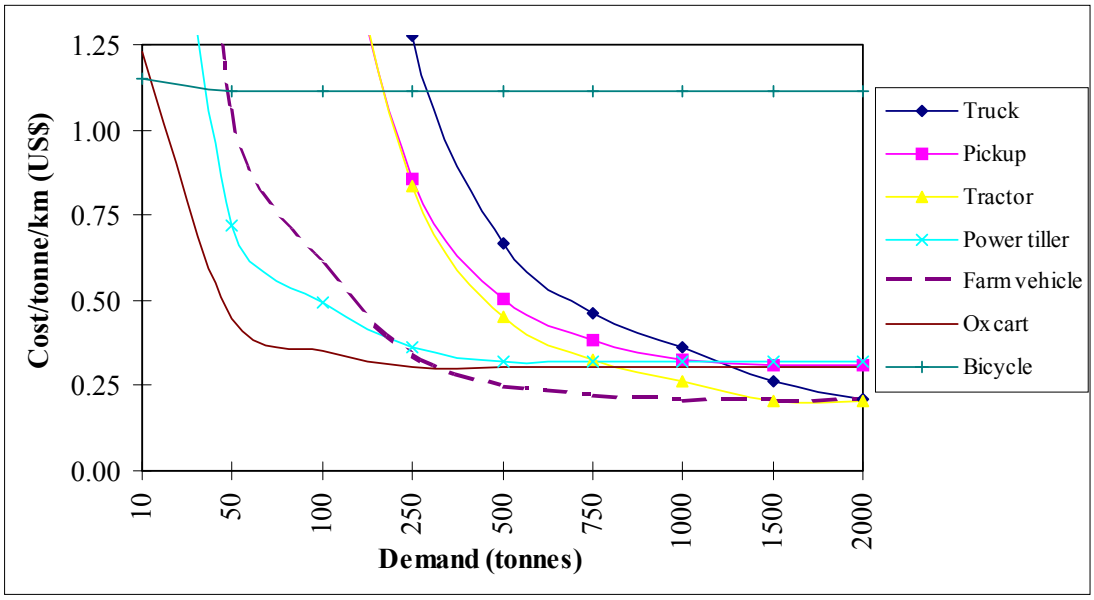
Box 7 Transport costs: effect of distance and demand

Ellis and Hine (1998) have used data collected from a number of countries in Africa and Asia to develop models of how the operating costs of vehicles vary with distance and transport demand. According to their models, bicycles have the lowest operating costs at short distances and where demand is low. Much rural transport does involve small loads over short distances. Moreover, bicycles can be used on paths and tracks as well as on roads. This means bicycles are often the most appropriate, convenient and affordable local transport solution where loads are light. Bicycle ownership is increasing rapidly in many countries, including most of Sub-Saharan Africa.

In the theoretical models, ox carts were the lowest cost option over a 10 km distance until the demand reached about 250 tonnes per year. The on-farm and farm-to-market requirements of most smallholder farming families would fall into this category. This helps explain why ox carts (and carts pulled by cows, donkeys, horses and other work animals) remain important for smallholder farmers in Africa, Asia, Europe and the Americas.

Motorised transport only becomes cheaper than ox carts when loads are high and distances long. This emphasises the complementarity of motorised and non-motorised transport technologies. Intermediate means of transport may be appropriate for small-farm, around-village and ‘feeder’ transport tasks in rural areas, as well as short-distance ‘feeder’ supply and distribution in urban areas. Trucks, tractors and pickups may be appropriate for larger-scale farms, long-distance journeys and for consolidated market loads.

Vehicle operating costs assuming a 10 km distance and varying levels of demand (Ellis and Hine, 1998)



Some lessons relating to the adoption of intermediate means of transport

- *Intermediate means of transport have comparative economic advantages for short distances and light loads.*
- *Cost comparisons strengthen the case for multiple transport systems, with intermediate local transport solutions complementing the larger, consolidated, long-distance transport systems.*

Reference: Ellis and Hine, 1998.

The diversity of intermediate means of transport in Sub-Saharan Africa is generally less than that seen in Asia. This may reflect different histories of urbanisation, population densities, available resources, trade patterns, economic activities and cultures. Within Sub-Saharan Africa, as elsewhere in the world, the broadest range of transport devices and the highest concentrations are found around towns and marketing centres. This reflects the higher levels of economic activity and returns

achievable in urban areas and marketing situations. It also reflects the presence of production and repair facilities and raw materials. These include workshops with welding equipment, carpenters, blacksmiths, steel stockists and scrap yards. The concentration of transport devices in towns may also relate to patterns of trade, information flows, cultural diversity and the relative lack of economic seasonality. In towns it is easy to achieve a 'critical mass' of mutually-reliant transport users and related support services. The spread of 'hand trucks' in Ghana illustrates this (Box 6).

The combination of high density of transport technologies, concentrations of workshops and artisans, availability of materials and significant economic opportunities provides much scope for synergy, innovation and adaptation. New transport ideas and options are rapidly realised, evaluated and adopted (or rejected).

In rural areas in Sub-Saharan Africa, the uses and diversity of intermediate means of transport are much less. The processes of innovation and adoption take longer. Depending on the circumstances and the technologies, they may be affected by low population densities, low levels of economic activity, low material availability, limited cultural exchanges and information flows and by high seasonality of cash flows and transport demand.

Ecological and geographical factors may also contribute to limited use of intermediate means of transport (see Box 8). This is particular true in humid forest areas, where work animals seldom thrive and muddy, bush-encroached paths make it technically difficult to use cycles or carts.

Box 8 Intermediate transport in Guinea: influence of climate, terrain and frontiers

There are relatively few intermediate means of transport in Guinea. Most are locally manufactured by artisans and are used in urban areas to assist marketing and the distribution of materials and water. Wheelbarrows and hand carts of various sizes are used in all towns. Small numbers of motorcycles are used in urban and rural areas, mainly for personal transport. Bicycles are rare in Conakry and the west of the country. They are most common in the northeast, which is a relatively flat and dry area. It is also close to Mali, and some bicycles may be entering the country from Mali. Donkeys can only survive in the north of the country and some farmers/transporters have brought in carts privately from Guinea Bissau and Senegal. Ox carts are not very common, and they are generally found in the eastern and central areas. There are few cattle in southern and western areas, while the north tends to be mountainous. In the south of Guinea, rainfall is heavy and forest growth is strong. Village paths are often narrow and muddy, and very few intermediate means of transport are used.

Some lessons relating to the adoption of intermediate means of transport

- *Adoption of intermediate means of transport often starts in urban areas where there are both manufacturing facilities and economic opportunities.*
- *Cross-border influences can be strong.*
- *Climate and topography influence animal distribution and the suitability of transport devices.*

Source: Reports of field visit and discussions, RTTP workshop, Guinea Conakry, June 1998.

Economic efficiency and profitability

Financial profitability is arguably the most important single factor determining whether or not transport technologies are adopted. Many other factors, including status and social benefits play a part. Nevertheless, most intermediate means of transport are used because they generate income, save valuable time or increase the efficiency of a profitable venture. This is one reason why most intermediate transport technologies are found in urban areas and around markets, where the income-generating potential of transport devices can be high. The concentration of intermediate means of transport in areas of high economic activity contrasts with the shortage of transport technologies available within rural households. This is despite

very clear needs (arguably more social than economic) to reduce the drudgery and time requirements of household transport tasks, including water collection.

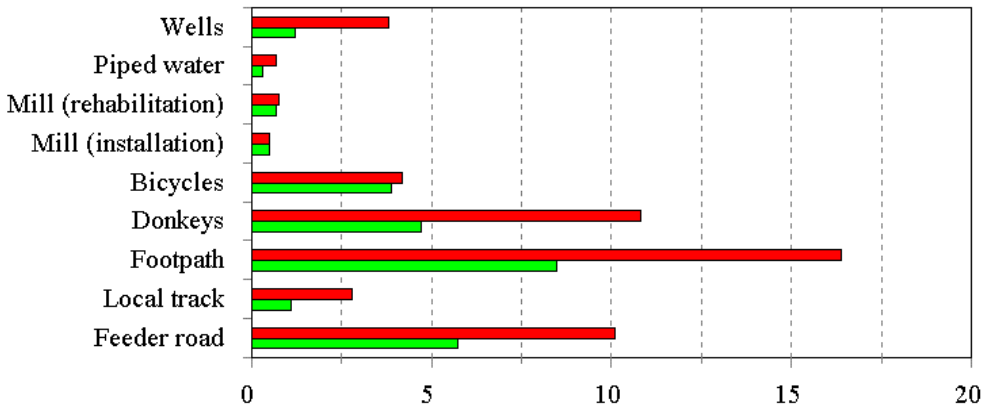
Many successful introductions of intermediate means of transport have been associated with transport hire (boda-boda bicycles, 'hand trucks' in Ghana, Asian cycle and motor rickshaws) or marketing opportunities (pack donkeys in Makete, Tanzania, Box 9, ox carts in Zambia, Box 10). Animal-drawn carts have often been associated with greater use of manure and forages, increased production, timelier harvesting, larger circles of trade and opportunities for income from local hiring arrangements. Rural people without carts may be willing to pay very high prices for transport services (examples from Zambia included one bag retained for every four or five transported—Starkey, Dibbits and Mwenya, 1991).

Box 9 Profitable pack donkeys in Makete, Tanzania

The Makete Integrated Rural Transport Project operated for many years in a remote, hilly area of south-west Tanzania (see also Box 22). From 1988 to 1993 the project worked on improving roads and paths and introducing transport technologies, suitable for use on narrow paths, including pack donkeys.

The project aimed to develop the use of donkeys and to introduce new panniers. At the start of the project, few people in Makete District gave serious consideration to donkey technology. During an initial household survey, the only donkeys in the area were in the very north of the District As the project progressed, the acceptance by both men and women (but mainly men) of donkeys appeared quite high, although the numbers of actual adopters grew only slowly. Donkeys increased from about 100-150 in 1988 to 250-500 in 1998 (estimates varied considerably!). Pack donkeys were found particularly useful for the transport of potatoes from field to village and from village to market. Women and men (but mainly men), who previously transported headloads of 20-30 kg, could now transport 80 kg with a single donkey. One woman used three donkeys in a profitable beer brewing business. Some families used donkeys for water collection but the panniers were not suited to carrying firewood. The theoretical benefit-cost ratio of donkey investment (7.5:1) was one of the highest of the project (see figure below). Donkey-owning households in Makete were found to have higher levels of agricultural inputs and outputs, higher incomes and more wealth indicators than other households (although no evidence of cause and effect was offered for this correlation).

Some benefit/cost ratios of possible transport interventions in Makete
Optimistic (upper) and pessimistic (lower) views. (Sieber, 2000)



Despite their apparent popularity, the rate of donkey adoption was quite low, constrained by the limited supply. The project was unable to develop sustainable supplies by breeding or outside purchases. It was also unable to develop sustainable animal health services (the provision of de-worming chemicals remained a problem). By the end of the project, although donkey use was slowly increasing, its level was below the 'critical mass' needed to stimulate local support services and make adoption easy.

Some lessons relating to the adoption of intermediate means of transport

- *Acceptance of pack donkeys by women and men appeared high and associated with profitability.*
- *The rate of adoption of a successful transport technology (pack donkeys) appeared constrained by limited local supply and maintenance services (donkey breeding/trading and animal health).*

References: Howe and Zille, 1988; Howe, 1989; Jennings 1992. Sieber, 1996, 2000; Relf and Mkwizu, 1998.

Since the adoption of transport innovations leads to time saving and economic opportunities, it also results in greater economic and social differentiation. Those able to profit from investments in transport have greater productive capacity than those who cannot. While those with transport devices gain financial benefits and/or enhanced social status, those without feel increasingly impoverished in comparison. The impoverishment may be relative (no actual change in circumstances) or absolute (those with transport may take away income generating options or employment from those without). Since men are the main adopters of intermediate means of transport, gender differentiation often increases, with women increasingly marginalised. An example of this was reported from Mali, where marketing systems changed as men increasingly used animal-drawn carts (and motor vehicles). Women traders without donkey carts were tended to be restricted to within-village transactions, reducing their incomes and independence (Ruthven and Koné, 1995).

Many socially important transport tasks, particularly those of women, old people and the handicapped, do not have easily quantifiable financial benefits that would justify investment in transport technologies. Examples include the collection of water and fuel wood in poor rural areas. Local transport solutions could lead to large savings in people's time. However, with few income generating options in rural areas, time saved is likely to be invested in activities of long-term benefit to the family (subsistence agriculture, child care, improved family education, nutrition and health). Increased rest may also be socially important for chronically overworked people. Such activities are valuable within the community, but do not generate the income necessary to purchase transport technologies.

As communities become richer, and income-generating options increase, investment in intermediate means of transport to save time for domestic tasks increases. It is ironic that there is often greater use of intermediate means of transport for water collection in peri-urban areas (where distances are relatively short) than in remote rural areas (where distances may be long).

While rural women are often expected to walk to collect water and fuel, in peri-urban areas there are often entrepreneurial delivery services. Men and boys generally operate these income-generating businesses. However as families start to buy water and fuel for cash, the women and children of the family benefit, for it is probably they who would otherwise go out to transport them.

Intermediate means of transport that are economically justified in their own right are often used for socially beneficial transport activities as well. There are many examples of bicycles, trailers, carts and pack animals carrying domestic water in addition to activities associated with production and income-generation. In some cases gender roles change, and instead of women collecting water on their heads, men or boys start to collect the water using an intermediate means of transport. However secondary social benefits from economically important transport devices are not universal. Some men are reluctant to risk the condition of 'their' transport solutions 'merely' to assist their wives.

Many, perhaps most, programmes working with intermediate means of transport have developed models or benefit-cost analyses that have demonstrated to the planners and project staff that the transport technology was potentially profitable and affordable. In some cases, user experience verified this (eg, ox carts in Zambia, Box 10). In other cases, it did not (eg, cycle trailers in Ghana, Box 12). Organisations, projects and

enthusiastic individuals tend to be over-optimistic about the financial benefits of their preferred technologies. This is clearly dangerous and leads to the wastage of valuable time and resources. Models should have entirely realistic assumptions and a variety of economic scenarios. If the models predicted profitability, but the technologies on offer were rejected, either the models contained unrealistic assumptions or the project failed to take account of alternative options and important social factors. In either case, much greater attention to user perspectives would be required.

Box 10 Ox carts in Zambia: increasing transport supply, production and demand

There had been little experience of intermediate means of transport in the remote North-Western Province of Zambia, when the North-Western Integrated Rural Development Programme (NWIRDP) started operations in the late 1970s. The programme, supported by the German development agency (GTZ), was based at Kabompo located 700 km from the developed infrastructure of the Copperbelt. Most (90%) of the rural population depended on smallholder production, with farms of 1-2 ha. During participatory appraisal surveys, farmers identified agricultural marketing as a key constraint to development, and rural transport as the main constraint to marketing. The project therefore established rural depots where farmers could sell maize. It aimed to introduce ox carts, so farmers could transport maize to the depots.

There were few cattle, no existing carts or scrap axles and steel was difficult to obtain. Wood was in plentiful supply, and so the project evaluated 'appropriate technology' carts using wooden wheels and wooden bushes or block bearings. These were not a success. The programme then brought in steel axles fitted with roller bearings and pneumatic tyres from the Copperbelt. The cart bodies were locally made of wood in the local market town. Although the axles/wheel combinations accounted for 90% of the cart cost, they were appropriate. The ox carts proved popular and their adoption, assisted by extension and credit, was quite rapid. Carts were used to carry maize to depots as envisaged, and income from their hire allowed those who had taken loans to repay them.

The programme had estimated the number of carts it should introduce based on existing maize trade. Once the target (one cart per ten households) was reached, promotional assistance and credit were stopped. The programme did not wish to saturate the market. The original static planning model had not accounted for how much transport provision would stimulate economic development and growth. This growth, in turn, had stimulated further transport demand. With the transport constraint removed, more maize was being grown, providing more work for the ox carts. The carts were also transporting a wide variety of other goods. Farmers growing and marketing fruits and vegetables had previously been limited by the transport constraint of head loading. With ox carts, this limit was removed and production and sales increased. Some farmers started trading between villages. Carts collected water and fuel wood and sometimes acted as ambulances. The initial theoretical limit was not sufficient to meet the new economic activity in the areas, nor the aspirations of the people. The ox cart programme had been a greater success than planned, and it targets were revised upwards.

Some lessons relating to the adoption of intermediate means of transport

- *Adoption of the necessary 'critical mass' of transport devices was facilitated by extension, credit, suitable cart design and the creation of marketing depots to ensure transport income.*
- *Even in poor, rural communities, good quality transport devices can be profitable, allowing credit repayments.*
- *Planning models should be updated as adoption takes off, as intermediate means of transport (eg, ox carts) can stimulate production and economic growth, further increasing demand for transport.*

References: Müller, 1986; Starkey, Dibbits and Mwenya, 1991; Löffler, 1994.

User perspectives

Intermediate means of transport are bought and operated by men and women, rich and poor, with a wide range of personal needs, aspirations and preferences. Users are not a homogenous group. They differ according to gender, income, occupation, age, ethnic background and other social and cultural characteristics, all of which influence their perspectives. Programmes involved with transport promotion need to understand these diverse user perspectives. The importance of user perspective was recently highlighted during an RTTP meeting in Madagascar (Box 11).

Box 11 Policy-makers' assertions, farmers' viewpoints and dialogue in Madagascar

In Antananarivo, Madagascar, many senior civil servants in the transport sector attended an RTTP workshop held in 1999. During the first day, the serious problem of rural road maintenance was addressed. It was agreed that the traditional wooden cartwheels with their narrow metal-rims caused damage to rural roads. Several senior policy makers asserted that such carts must be banned to protect the roads. It was suggested that only modern carts with pneumatic tyres would be allowed.

The workshop participants then visited villages and put such ideas to local farmers, transporters and village authorities. The farmers recognised that cartwheels did make ruts and caused damage, but pointed out that ox carts were actually the main users of the rural roads. There was no point in protecting empty roads. As for pneumatic tyres, they were not as suitable as the traditional wheels for use on cart tracks. The traditional wheels were cheaper, easily available in the villages, puncture-free and lasted much longer (ten to twenty years). They had very good brakes and high clearance (necessary on the poor-quality roads) and people could easily assist a cart by pushing or pulling on the spokes. The trundling cartwheels also gave the 'right sound' and people could hear them coming.

The cartwheel issue was clearly much more complex than people had imagined, and will not be easy to resolve. Immediate prohibition is not a realistic solution. The great importance of such dialogue with transport users was recognised. The workshop was widely acclaimed by the participants who wrote (in anonymous evaluation forms) that the most valuable and educational aspect had been the field visit discussions with farmers. Many participants added that such visits and dialogue between civil servants and transport users would be important in the future.

Some lessons relating to the adoption of intermediate means of transport

- *Many transport planners still think in terms of roads rather than rural transport needs.*
- *Alternative transport technologies (traditional or modern) generally have both advantages and disadvantages. The final choice(s) may involve compromises between competing criteria.*
- *Prohibitions in the interests of roads or traffic may cause problems for resource-poor users.*
- *Dialogue with rural communities and transport users is extremely valuable.*

Source: PTMR (Madagascar), 1999.

With the expertise of hindsight, it is clear from many case histories that projects have failed to understand users' needs and wants before they launched their promotional programmes. Examples include the promotion of cycle trailers for women in Ghana (Box 12) and wheelbarrows for women in Tanzania (Box 22).

When commercial firms are considering launching or re-launching products, they take great care to try to understand the requirements, attitudes and preferences of potential customers. Marketing research organisations are charged with predicting the needs and wants of people, and the likelihood of particular products being purchased or used. Great attention is given to the perspectives of the potential users and analysing the factors that may influence the making of decisions. The different requirements and adoption capacities of women, men and children are studied. Reasons for the success and failure of product initiatives are closely examined, in order to learn the lessons.

Development programmes must also learn about the viewpoints of their potential 'customers', their families and their communities in order to understand past experiences and to predict the results of future initiatives. This may involve diagnostic surveys and market research tools such as attitude surveys and focus group discussions. Programmes must take time to listen in depth to those with transport problems. This is not always simple, for many different factors influence the opinions of users and potential users.

Listening to users is not always straightforward. Planners and the users of intermediate means of transport are generally separated by differences in their work, education, income, gender, age, language group, class, religion and ethnic background. Development programmes have to find ways of overcoming these potential barriers in order to learn the users' perspectives.

Talking honestly to people and conveying concern and sympathetic interest is as important as using interviewers from comparable social groupings. One of the most effective ways, though not always easy to arrange, is learning by listening ('like a fly on the wall') as people talk about the advantages and disadvantages of transport technologies with their close associates (family, friends, neighbours or colleagues).

Some user preferences are related to aesthetics. People may prefer white oxen, blue carts or green wheelbarrows. Such preferences may be based on long-standing cultural traditions or may be based on more recent experiences of quality products. Commercial companies take great care to identify such preferences and develop brands that respond to them.

Willingness to adopt technologies may involve many socio-cultural factors. Social status and prestige and are often very important, and may influence the purchase and use of local transport solutions in a variety of ways. Depending on the local circumstances, intermediate means of transport may be seen as prestigious or lowly. Surveys in rural Uganda repeatedly emphasise the prestigious nature of bicycles (Malmberg Calvo, 1992; 1994b). Motorcycles have even higher prestige. Animal-drawn carts now have high prestige in rural Mali (young women may think it is important their future husband should own a cart). However, in peri-urban South Africa, people may even deny they own and use a cart. Transport and development programmes would need different promotional strategies in such situations.

Gender relationships may inhibit adoption. While women are the main transporters, they are not the main purchasers of intermediate means of transport. This is sometimes explained by socio-cultural attitudes, for men and/or women may not wish women to use such devices 'for cultural reasons'. More often, the reason relates to the financial inequalities of many gender relationships: women do not have access to the money, credit or income-generating options required to make a purchase.

Some people regard intermediate means of transport as lowly and backward. In India, Indonesia and Pakistan urban planners have banned cycle rickshaws from some cities, due to 'traffic congestion' even though congestion has seldom been reduced (particularly if they were replaced by autorickshaws: see Box 24). During recent RTTP seminars, African transport planners expressed surprise on learning that intermediate means of transport are 'still' used in Europe and North America. In simple terms, they were surprised to see 'low status' technologies being used in 'high status' and economically developed countries in the North.

People may put social costs and benefits above financial ones. A low-cost transport device may make economic sense, but people will spend more money to obtain one associated with higher status (eg, mountain bicycle, Mercedes car). They may be prepared to spend money on painting or decorating (decorated ox carts, multiple reflectors on tricycles). Similarly, people (women and men) may choose not to use an intermediate means of transport for fear of social ridicule, even though its use would bring financial benefits. In either case, a project concerned with improving transport and accessibility would have to understand the users' perspectives and, where appropriate, make adjustments to their products or marketing strategies.

People's attitudes and preferences are not static. Attitudes can change gradually or quickly. Fashions come and go: today's prestigious images and preferred designs become tomorrow's has-beens. The older generation may have aspired to own a

conventional bicycle or possibly an ox cart. Their children think in terms of mountain bicycles and motorised transport. However, it is important to recognise also that items and practices considered socially unacceptable, may become acceptable. Women may start to ride bicycles and donkeys may be brought into the village for transport. Attitudes may change due to changes in the social and economic environment or they may be induced by promotional activities. Development projects need to keep abreast of cultural changes and regularly update diagnostic and attitude surveys.

Box 12 Cycle trailers for women in Ghana: early euphoria—then disappointment

1987: Consultants recommend promotion of cycle trailers, suggesting a potential demand for 36,000.

1989: "First cycle trailers tested in Africa". "The first IT Transport cycle trailers seen on the African continent have been constructed and put to use in the Ghanaian city of Kumasi. The initiative is part of a Ministry of Transport programme sponsored by the World Bank to improve the country's transport network."

1991: Cycles and trailers supplied 'in bulk quantities' in northern Ghana through two participating NGOs, with generous subsidy and credit terms to encourage rapid adoption. Mood of participants was generally ecstatic and more women and men wanted to join the exercise. Two engineering workshops at Tamale were commissioned to start commercial production.

1992: Initial project experiences are shared widely by the World Bank as a positive case history: "Rural women have been the main beneficiaries. Reception of these IMT vehicles, mainly the trailers, has been enthusiastic. The women in northern Ghana who did not previously ride bicycles have taken to bicycle riding. They use the trailers with bicycles or as pull-carts."

1993: A consultant reported that the cycle trailer scheme was not assisting the poverty alleviation goals of the Northern Region Feeder Roads Program. This had a labour-intensive component involving women. Compulsory saving schemes had been set up for the purchase of cycle trailers, with wage deductions at source. The cycle trailers were not popular. They were expensive, relative to incomes, and most women did not have access to bicycles. One interviewed woman asked: *"What are we supposed to do with the cycle trailers if we don't own bicycles, tie them around our waists?"* The trailers were intended for village-to-market transport on the new roads, but market trucks were now available and widely used on the roads. The trailers did not work well on village footpaths. It was recommended to end the compulsory schemes and to give less attention to cycle trailers.

1994: A Ghanaian researcher reported that the cycle trailers were "an inappropriate technology" and the initiative a "failure". They were too expensive and commercial sales were minimal. The trailers were not strong enough to carry large loads, and if laden, the trailers were heavy to pull. Women did not generally own or use bicycles, and strong women's bicycles were not available. Most importantly, the ordinary bicycle was a very flexible transportation device capable of carrying significant loads, and was half the price of a cycle/trailer combination.

1999: While some cycle trailers exist in Ghana, their manufacture and use is not widespread.

Some lessons relating to the adoption of intermediate means of transport

- *In this project, cycle trailers were promoted quite rapidly as a ready-made 'solution' without clear understanding of the social, economic and technical problems and issues involved.*
- *Initial response to demonstrations of transport technologies can be euphoric, but careful participatory research is needed to establish likely benefits, costs, usage patterns and constraints.*
- *The cycle trailer 'solution' was affected by the gendered pattern of cycle use.*
- *Other poverty alleviation options to assist women's transport needs should have been explored.*

References: Howe and Barwell, 1987; IT News 1989; World Bank, 1992; Kauffman, 1993; Salifu, 1994.

Promotion

There are many lessons from project attempts to promote intermediate means of transport. Some experiences appear paradoxical. If seen from the viewpoint of the users, without the filtration of project optimism, these paradoxes are generally removed.

There are many examples of successful promotion by projects, including ox carts in north-west Zambia (Box 10). There are other examples where active promotion by

projects has not succeeded, such as wheeled toolcarriers in many countries (Box 31) and 'Flintstone' carts in Zambia and Tanzania (Box 13). There are other examples where project promotion has had some impact, but less than initially envisaged, for example cycle trailers in Sri Lanka (Box 14).

Box 13 "Appropriate technology" and "Flintstone" ox carts

Most animal-drawn carts in Botswana, Namibia, Nigeria, South Africa, Tanzania, Zambia have been made by local workshops using old automotive parts (old pick-up axles or car stub axles and bearings together with old wheels and tyres). These carts have generally been quite heavy but strong and long-lasting. The limiting factor has usually been the shortage of scrap axles, wheels and tyres.

During the 1970s and 1980s, several ox carts were developed in these countries that were considered "appropriate technology" designs. They were intended to be low-cost carts that used mainly local resources. They were designed to be puncture proof. Some used wooden wheels, some used metal-spoked wheels and others made use of old tyre rubber. One prototype used spokes made of sisal. They generally used wooden bushes or bearings soaked in old oil. Examples include the Camartec, Iringa and TAMTU carts (Tanzania), Kasisi Mission carts (Zambia), the Katopola cart (Zambia) and the Technology Development Advisory Unit (TDAU) carts (Zambia). In Zambia, some of these were colloquially referred to as "Flintstone" carts, as they were of low prestige and people likened them to the Stone Age transportation devices seen in cartoons. While there were examples of carts lasting for over ten years, with little maintenance, this type of cart generally suffered from serious problems with their wheels and bearings.

Despite many local promotional attempts, these "appropriate technology" designs were seldom popular and there was little sustained adoption. The wooden bush bearing wore very quickly. Unless alignment was unusually good, wooden block bearings were considered 'heavy', with high draft requirements. They were generally cheaper than carts made with automotive parts, but they were not as effective (they were heavy, with high draft and wore quickly). Certain 'improved' "appropriate technology" designs (eg, TDAU cart) became comparable in complexity and cost to cheap automotive carts. All were more expensive than really simple sledges and village-made carts that used tree-trunk wheels.

Some lessons relating to the adoption of intermediate means of transport

- *While traditional wooden artisanal technologies have remained popular in some countries (Madagascar, India) and modern automotive artisanal technologies have proved popular in most of sub-Saharan Africa, attempts to introduce "appropriate technology" wooden wheels and bearings have not been very successful.*
- *Carts are expensive but transport can be profitable and farmers/transporters may be willing to pay extra for more efficient products.*
- *Technologies perceived as backwards are liable to be mocked or rejected for their low prestige.*

References: ITDG undated; Thoma, 1979; SFMP, 1984; Ayre and Smith, 1987; Hinz, 1988; Starkey 1989; Dogger, 1990; Starkey, Dibbits and Mwenya, 1991; Starkey and Mutagubya, 1992; Helsloot, Sichembe and Chelemu, 1993; Wirth, 1994; Mujemula, 1994; Vroom, 1994.

Box 14 Cycle trailers in Sri Lanka: participative processes but disappointing adoption

Sri Lanka has about three million bicycles in use. IT Sri Lanka has been involved in the evaluation and promotion of cycle trailers of the type introduced by IT Transport into India during the 1980s. After almost ten years, only about 400 cycle trailers have been made and few people now seem optimistic about their widespread adoption in Sri Lanka. This is despite (or possibly because of) a participatory and inclusive methodology involving partner organisations in the disadvantaged rural areas.

1990: First five cycle trailer prototypes introduced to Sri Lanka. IT Sri Lanka studied the technology in relation to the transport needs of the rural poor. Monitoring revealed that trailers addressed the need to carry loads from villages to towns. They encouraged self-employed work among owners/users. A few small-scale workshops were assisted to make cycle trailers with the provision/fabrication of jigs, wheel-benders and training. Supporter literature in UK reported: *"Enthusiastic response to cycle trailers in Sri Lanka. ... Initial results show that small-scale farmers and transporters could save substantial sums by purchasing or hiring a trailer."*

1994: Three-year promotion project commences. Initial constraints identified to the widespread use of the cycle trailer were both economic (low incomes, low agricultural production, lack of credit) and socio-cultural (expectations of public transport services and desire for prestigious products). ITDG annual report states: *"Over 150 trailers have been made. Many are being used to set up small businesses. ... They are also reducing women's work-loads. Men have begun using them to fetch water and firewood – traditionally a woman's job. The pilot project has been so successful that IT now aims to bring 800 trailers into use in five districts by 1997."*

1995: Project works with and through small partner NGOs responsible for credit provision and promotion. Mid-term review notes lack of encouragement of women users and adds additional project objective of "considering women's need in technology development and dissemination".

1996: Project aware of continued credit problem and need for partner organisations to effectively manage their revolving funds. Further constraining factors identified were: user expectations of 'handouts', low visibility and availability of cycle trailers and lack of quality raw materials in workshops.

1997: Project extended for one year to implement a marketing strategy and to develop the capacity of two partner organisations to take over project functions. Selected bicycle retailers were linked to the small-scale workshops to assist with sales. Quality control guarantee certificates were introduced and an advertising campaign was mounted.

1998: IT Sri Lanka cycle trailer project ended. About 400 cycle trailers had been made since 1990. Most probably remain in active or intermittent use in 14 out of 25 districts. Work relating to cycle trailers continued in the context of five small NGOs and 16 small-scale manufacturers. Numbers of cycle trailers in use seem unlikely to change rapidly in the immediate future.

User benefits: Individual owners of cycle trailers have benefited in a variety of ways including income generation (reported by 95% of owners) and increased access to market (55% of owners). Many cycle trailer owners reported easier access to water and greater use of water in the home. They also reported major savings in the time required for transport. A few trailers were used for transporting sick people or school children. IT Sri Lanka and the partner organisation are convinced the disadvantaged rural poor families using the cycle trailers gain real social and financial benefits. However, there seems little evidence that these benefits are likely to result in a significant economic demand.

Institutional benefits: The IT Sri Lanka project costs were modest but totalled US$ 2400 per cycle trailer made. IT Sri Lanka gained from the project experience which resulted in valuable institutional links with small NGOs and workshops, a greater understanding of rural transport needs and the stimulation of a national network (Lanka Forum for Rural Transport Development).

Some lessons relating to the adoption of intermediate means of transport

- *Cycle trailers have brought social and financial benefits to some disadvantaged rural people.*
- *Organisational problems of small-scale manufacture and credit provision can be solved.*
- *Cycle trailer uptake is much slower than envisaged in Sri Lanka and lacks clear momentum.*
- *It is unclear whether 'mainstream' adoption could be achieved through such small-scale workshops (or through large-scale manufacture).*
- *Reasons for the relative 'failure' [disappointing levels of adoption] of cycle trailer technology have yet to be clearly understood and articulated by the implementing organisations.*

References: IT News, 1990; ITDG, 1995; ITSL, 1997, 1998.

There are examples of successful promotion of technologies by the private sector, formal and informal. The diffusion of different transport technologies in India, and many Asian countries has been almost entirely due to private sector initiatives. In Madagascar, the diffusion of cycles, rickshaws and ox carts has been achieved through the private sector. The spread of donkey carts in Mauritania was a recent example of the effectiveness of the informal private sector in Africa (Box 15) as was the spread 'hand trucks' in Ghana (Box 6) and *Masale* carts in Tanzania (Box 29).

Box 15 Animal-drawn carts in Mauritania

For centuries, animals (mainly camels and donkeys) have been used in Mauritania for riding and pack transport. With the settlement of many nomads, and the use of heavy trucks for long-distance trans-Saharan trade, the importance of camel transport has been gradually declining. Pack donkeys remain very important for the transport of water and goods in rural areas. Small numbers of animal-drawn carts, including ox carts, were introduced during the colonial period, but at independence in 1960 there were probably fewer than 1000 carts in use.

In recent years, there have been large increases in the numbers of donkey carts and horse carts. In 1996, there were estimated to be over 75,000 donkey carts in use. Most are based on the Senegalese Sismar design, using a metal chassis, flat wooden platform, tapered roller bearings and pneumatic tyres. Some carts have been privately imported from neighbouring Senegal and Mali but many carts are manufactured in small, local workshops, often using components from Senegal.

The very rapid increase in the use of donkey and horse carts has been largely the result of entrepreneurial activity, and not government intervention. Donkey carts in Mauritania cost about US$ 180-260, so that some US$ 15 million has been invested in donkey carts in the past 20 years. Most have been purchased for cash, since credit for carts has been minimal. This is a huge investment by urban transporters and rural families, and illustrates the capacity of such people to invest in technologies seen to be profitable. The carts have greatly increased the capacity of donkeys to transport water, forage, agricultural produce, building materials, traded goods, people and urban waste. Donkeys (and to a lesser extent horses) now play extremely important roles in the urban and rural economies of Mauritania, and the present trends suggest a further increase in the ownership and use of donkey carts.

Some lessons relating to the adoption of intermediate means of transport

- *Government funding and promotion are not prerequisites for rapid adoption of technologies.*
- *If a technology is appropriate/profitable, rapid adoption is possible within one generation.*
- *Entrepreneurs can establish supply systems based largely on informal cross-border trade.*

Reference: Starkey, 1996

Although the diffusion of bicycles in Africa has been influenced by projects, national programmes, trade arrangements and tax regimes, it has been the private sector that has been responsible for most distribution and sales. This has not been a universal success. Bicycle usage has increased relatively slowly in Africa and is still a very long way below levels seen in Asia. Certain established private sector firms have developed and promoted intermediate means of transport, but failed to capture a market. For example, in Zambia, Northland Engineering developed and promoted an ox cart with solid rubber tyres, but it was not a commercial success.

Technologies have also spread through individual farmer-to-farmer contact. The recent spread of donkeys in Southern Africa and West Africa (Box 16) has been mainly a farmer-led innovation. Once the adoption trend became apparent, some traders responded by helping to meet the new demand, but the early initiatives were generally those of individual users. User-to-user promotion is probably a major factor in the spread of innovative ways of using intermediate means of transport (eg, water-carrying bicycles or bicycle taxis). However, there are numerous examples where technologies have been adopted by some people, but have not (yet) diffused to nearby areas. The water-carrying bicycles and bicycle taxis illustrate both the success of informal diffusion and its limitations.

Box 16 Introducing donkeys for packing and cart transport: successes and failures

Donkeys are increasingly used for transport in Africa. The total African donkey population (now about 14 million) has increased by 60% in the last fifty years. Ethiopia has five million donkeys. In Sahelian countries (Burkina Faso, Mali, Mauritania, Niger, Senegal, The Gambia and Chad) the total number of donkeys has increased from about one million in 1950 to about 2.5 million today. Significant increases in donkey populations have been reported from Botswana, Lesotho, Namibia and Zimbabwe.

Donkeys are adapted to arid conditions. Their drought resistance has been a major factor in their increasing popularity, particularly in southern Africa. The distribution of donkeys reflects their preference for arid and semi-arid conditions. They are mainly found in areas with less than 800 mm annual rainfall. In West Africa, the southern limit of the donkey population follows (more or less) an East-West line very similar to the rainfall isohytes in that region. In the 1950s, that 'donkey line' ran north of The Gambia. At the southern limit of their range, donkeys were often in poor health, with low reproductive rates and short lives. However farmers and transporters kept on bringing in donkeys from further north, because donkeys were cheap and very useful for transport. As environmental conditions changed (decreased rainfall, less bush and lower disease challenge) donkeys were able to thrive in areas that had previously been unsuitable. The 'donkey line' reached and crossed The Gambia and continued southwards into Cassamance and Guinea Bissau, with similar southward movements right across West Africa. The 'donkey line' is continuing to move steadily southwards.

There have been similar gradual movements of donkeys in Eastern and Southern Africa. Donkeys have been gradually moving northwards in Namibia, Botswana, Zambia and Zimbabwe. However, with more complex patterns of rainfall and bush clearance in this region, it is less easy to draw a single advancing boundary line for these donkey populations.

The gradual introduction of donkeys into new areas has been due to farmers and traders purchasing donkeys in existing (drier) breeding areas and bringing them into the new areas. The overwhelming, overall success of the introductions (several million donkeys are now used in 'new' areas) has been based on large numbers of small successful attempts—and also very many failures particularly in the early years. Farmers and traders have arranged most introductions of donkeys without any government intervention or support.

Some projects have seen the value of donkeys for transport and have assisted farmers to obtain donkeys. Such projects have often been successful, provided the target area was quite close and had a semi-arid climate (eg, southern and western Zambia, north-east and south-west Tanzania). Major project failures have occurred when projects have attempted to bring donkeys large distances and into humid conditions (eg, The Gambia to Sierra Leone, Botswana to central Malawi, Zimbabwe to northern Zambia, northern Uganda to Rwanda).

Some lessons relating to the adoption of intermediate means of transport

- *Ecology, climate and diseases can influence the success of animal-based transport.*
- *Moving animals long distances into new ecological zones is risky.*
- *Most successful adoption of donkeys for transport has been at the initiative of farmers and traders (without government intervention and sometimes across national boundaries).*

References: Starkey, 1994a; Sieber, 1996; Mwenya and Chisembele, 1999; Starkey and Starkey, 2000

From these examples, it is clear that, depending on the circumstances:

- the promotion of transport technologies by projects, programmes and NGOs can be effective *or ineffective*
- the promotion of transport technologies by the private sector (formal and informal) can be effective *or ineffective*.
- the promotion of transport technologies through person-to-person exchanges can be effective *or ineffective*.

Clearly, the situation is complex, and the success or failure of any promotional system depends on a large number of other factors, including the value and appropriateness of the technology to the people who may adopt it.

Appropriate technology enthusiasts and/or idealistic organisations interested in assisting disadvantaged people have implemented many of the transport/development programmes mentioned in the boxes. Such people have generally had little knowledge

of commercial marketing practices. They have often been suspicious of commercial techniques, and the very idea of persuading people to buy things they may not want. However, some lessons from commercial sector promotions may be relevant.

In large-scale companies, market research establishes the requirements, attitudes, purchasing power and other characteristics of the target group prior to product development and/or promotion. Considerable attention is paid to user profiles: their requirements and their likes and dislikes. 'Focus groups' are encouraged to talk among themselves, in their own way, and their ideas, attitudes and expressions are recorded and analysed. Products are developed and promoted for clearly specified markets. In pre-marketing trials, individuals are asked to assess products for several months, recording their patterns of use. The researchers themselves may use the products over quite long periods. 'Focus groups' of pilot users are asked to talk among themselves about the product advantages and disadvantages. Potential problems are often identified during peer-to-peer pilot user exchanges concerning drawbacks.

Commercial advertising and promotional campaigns are always tested on representative user panels before being finalised. The advertising may relate to product characteristics or may simply associate the product with a favourable image. Advertising may be very expensive, accounting for a significant part of the product price. A localised test marketing campaign is launched. This is monitored through sales and market research surveys. The impact of the test marketing is also assessed through independent consumer panels. The product, or its presentation, may be modified as a result of the pilot marketing, in which case a further test marketing exercise may be undertaken and critically evaluated. Large commercial firms conduct their own market research before, during and after product development and promotion. They also contract independent market research firms to carry out surveys of customer attitudes in general, their own products and alternative options. Commercial firms are prepared to pay for information from reliable third party organisations, in order to obtain greater objectivity than is feasible through in-house assessment.

Many programmes involved with local transport solutions would argue that they have followed broadly similar processes, but perhaps with less emphasis on advertising. However, what has often been lacking in the development of intermediate means of transport has been the close attention to consumer ideas and attitudes, particularly those expressed during peer-to-peer discussions (as opposed to project interviews). Programmes promoting intermediate means of transport have seldom obtained a comprehensive picture of both customer opinions and actual sales experiences, as revealed separately through in-house 'market research' (diagnostic surveys and talking directly to consumers), independent broadly-based panel research (objective information on sales and use patterns) and objective third party monitoring and evaluation. Many programmes would have benefited from more self-critical monitoring and regular evaluation by independent organisations. This is clearly illustrated by the case in Box 17, where nine years of training effort, in the absence of realistic feedback on the technologies, led to minimal impact on local transport.

Box 17 Training artisans to make transport devices: training may not be enough

Katopola Agricultural Engineering Centre (KAEC) near Chipata in Zambia provided services relating to vocational training and rural structures. During the 1980s, the Sida (Swedish International Development Agency) provided nine years' funding including the services of Swedish personnel. The Vocational Training Section aimed to train male and female school leavers and upgrade rural carpenters, metal workers and blacksmiths. It offered courses on the making of a range of intermediate means of transport and farm implements as well as blacksmithing and rural technology for women. During the final three months of the six-month woodwork course, participants were taught how to make wooden ox carts, hand carts, wheelbarrows and farm implements.

Despite more than six years of these training courses, no one went on to manufacture the heavy wooden carts and wheelbarrows they had been trained to make. Most trained carpenters worked on furniture production and house carpentry. KAEC staff were unaware of any rural people actually using the various transport technologies with wooden wheels that they had promoted for many years. The only ox carts in use in the area were ones with pneumatic tyres that had been purchased in nearby Malawi.

Some lessons relating to the adoption of intermediate means of transport

- *The project had no obvious impact on transport use in the area.*
- *The project had predetermined the technologies it promoted and did not offer design choices.*
- *The project addressed one perceived element (shortage of trained artisans) but did not assist in other aspects of the production and marketing processes (there was also some general promotion of the technologies through the local extension service).*
- *The wooden-wheeled technologies did not prove popular.*
- *There was no self-critical or participatory evaluation of progress that might have allowed the project to react to the situation and change its direction.*

References: Starkey, Dibbits and Mwenya, 1991

Credit and subsidies

Some of the lessons relating to credit are similar to the paradoxical lessons relating to promotion systems. There are many examples where credit provision appears to have been important in stimulating adoption. Examples include the introduction of animal-drawn carts in Guinea Bissau (Box 18), Senegal (Box 30), Tanzania (Box 23) and Zambia (Box 10). However, there have also been examples of animal-drawn carts being introduced in the absence of institutional credit. Examples include Ethiopia (Box 21), Mauritania (Box 15) and Tanzania (Box 29). There are also examples where credit was made available for the purchase of a particular technology, but this was not a sufficient incentive to lead to sustained sales and wide adoption. Examples include cycle trailers in Northern Ghana (Box 12) and wheeled toolcarrier schemes in Botswana, The Gambia, Mozambique and Uganda (Box 31).

It is clear that credit can be important in the adoption of transport technologies, but it is not always essential. Sometimes, organisations have used credit to improve the access of users with fewer resources. Innovative credit schemes have enabled women with little cash to have access to local transport solutions. In the short term, credit may encourage some people to purchase and assess a technology. However, if a product is not popular, credit provision will not lead to sustained adoption.

Credit provision for specific technologies can distort markets. Users may opt for second preference technologies that are being promoted with credit, rather than purchasing their preferred technology. An example of this was seen in Guinea Bissau when initially ox carts qualified for credit but donkey carts did not (Box 18).

Box 18 Credit affecting choice of cart purchase in Guinea Bissau

The PDR-2 development project in Guinea Bissau attempted to improve rural transport through the promotion of ox carts. Credit was made available to assist ox cart purchase. Although the project initially planned to promote ox carts, project staff noticed that donkey carts from neighbouring Senegal were becoming popular and farmers confirmed this. The project decided to sell donkey carts too. The following information derives from on-farm survey data and project records.

Type of transport	*Ox carts*	*Donkey carts*
Carts owned in the project area (estimate)	310	3718
Carts sold by the project for cash	444	2579
Carts sold on credit	389	104

From these data, it can be seen that the number of ox carts in use was less than the number sold. Some may have been converted to donkey carts. Almost half (47%) of the ox carts were sold on credit but most (96%) of donkey carts were sold for cash. It seems clear that donkey carts were popular and profitable with many farmers prepared to buy donkey carts for cash. In contrast, the diffusion of the ox carts was much slower and seems to have been strongly influenced by the availability of credit. While credit may have boosted the sale of ox carts, in the early years it may have distorted choices, encouraging some farmers to buy an ox cart when their true preference may have been a donkey cart.

Some lessons relating to the adoption of intermediate means of transport

- *Credit provision can promote adoption but may distort technology choices.*
- *If user preferences are monitored and evaluated, alternative technologies may be suggested.*
- *Donkey carts have proved very popular in West Africa.*

Sources: Affani, 1989; Herbel and Camara, 1990; Starkey, 1991a

The same general lessons apply to subsidies. Subsidies can help launch intermediate means of transport, but they are not always necessary. If a product is unsuitable, high levels of subsidies may stimulate initial sales, but they cannot prevent rejection (eg, cycle trailers in Ghana, Box 12). Subsidies tend to distort markets, and alternative products may be unfairly disadvantaged. Subsidies tend to be offered on expensive formal-sector and imported products, leading to unfair competition with cheaper informal sector and indigenous products.

Some indirect subsidies are widely used by private firms, public sector projects and NGOs. These are tooling up and training costs, large-scale production run assumptions and the provision of free product support. The producers of intermediate means of transport do not (initially) try to recover product development costs. Early models, produced by expensive small-batch production techniques, are costed as if they were part of longer runs with materials/components obtained in bulk. In pilot marketing arrangements, distribution costs and the value of staff time and travel needed for early product support and promotion are not (initially) reflected in prices.

Critical mass

The concept of 'critical mass' is important in relation to the adoption of intermediate means of transport. It is generally more difficult to own a technology if only small numbers are in use. Socio-cultural inhibitions may constrain the public use of an unusual technology, particularly (in the case of intermediate means of transport) if it is not perceived as prestigious. This was the case in Sri Lanka, where women were embarrassed to use cycle trailers for fear of ridicule (Pannilage, 1999). Once the technology is well known, accepted and commonly used, it is easy for people to make use of it. For example, it is now quite easy for a woman to ride a bicycle in Ouagadougou, Burkina Faso, for there are thousands of women cycling every day. A critical mass of adoption already exists. For socio-cultural reasons, it would be much more difficult for a woman to ride a bicycle in Conakry or Addis Ababa, where bicycles are few and women cyclists are most unusual.

Intermediate means of transport require supporting infrastructure for their manufacture, supply and repair. Conditions favouring such infrastructure often occur near urban or rural markets. In most big cities in Africa, there are areas where clusters of artisanal metal workers and/or traders compete to sell locally-made wheelbarrows. In the hardware sections of weekly rural markets in Senegal, Mali and Burkina Faso, there are many traders selling cart bearings and other spare parts. In the bicycle repair zones in Tororo town and elsewhere in Uganda, it is easy to buy new, second-hand and locally-adapted bicycle components. Once a critical mass has been established, the customer has a wide choice of service providers for both purchases and repairs.

Box 19 Cart and cycle repairs in Madagascar: importance of a critical mass

In the village of Anjanadoria, 70 km from Antananarivo in Madagascar, there are about 800 ox carts in use and most families own a cart. There are very few bicycles in use. There are two carpenters that make and repair ox carts in the village. However there is no one in the village who repairs bicycles. Bicycles needing repairs are taken by ox cart 15 km to the local market town, where there are artisans who repair bicycles. According to local people, one reason why so few people own bicycles is the problem of repairs. No one had started to offer bicycle repair services in the village, as there were few bicycles and little demand. People believed that in a few years there would be more bicycles and a bicycle repairer in the village. The number of ox carts would also slowly increase.

Some lessons relating to the adoption of intermediate means of transport

- *Ownership and maintenance of ox carts was facilitated by the presence of artisans.*
- *The lack of bicycle repair facilities slowed bicycle adoption.*
- *There were sufficient bicycle owners in the town and surrounding area to provide work for repair services*
- *There was not yet a 'critical mass' of bicycle users to justify repair services at the village level.*

Source: Field visit reports from RTTP workshop, Antananarivo, Madagascar, May 1999

The 'early adopters' have to obtain and maintain their transport devices without local technical support. Such support services do not develop until there is a good market. In a 'chicken and egg' situation: it is difficult for a critical mass of adopters to develop without the support services, while sustainable support services are unlikely to develop in the absence of a critical mass of users. It is particularly difficult to establish the necessary critical mass in rural areas with low density of population. The examples from Madagascar (Box 19), Guinea (Box 20) and Sierra Leone (Box 20) illustrate this point in relation to bicycles and ox carts.

In the Guinea and Sierra Leone examples, it is suggested that putting one new cart in each of ten villages, may result in ten unused carts with punctured tyres. However, with ten new carts in just one village, someone will start a village puncture repair workshop. Although this may sound like a simplistic caricature, it illustrates a very important principle of the adoption of intermediate means of transport. There may be advantages in concentrating resources on a few villages or areas to achieve the critical mass for adoption, rather than having isolated demonstration examples. Nevertheless, some isolated examples may be justified, as chaos theory suggests these may increase the chance of adoption by a random combination of events (see Box 4).

Box 20 Ox carts in Sierra Leone and Guinea: failure to achieve critical mass

Prior to the 1980s, few, if any, animal-drawn carts were in use in Sierra Leone. The Work Oxen Programme was aware of rural transport problems and imported ten Sismar carts from Senegal for assessment and demonstration. Eight of these were placed in relatively remote villages in different areas. and extension agents monitored their use. There were few bicycles or motorcycles in these villages, and there were no regular bush taxi services. The metal-framed ox carts had roller bearings and pneumatic tyres. Most carts developed punctures. Although pumps and repair materials were provided, the repair of the tyres proved frustrating. Project resources were stretched trying to monitor and support innovations in several remote locations. The project and the farmers concluded such carts were not really suitable and the project started to work with puncture-proof 'appropriate technology' cart designs. These were considered 'heavy' and were not very popular. Although some carts continued in use, the cart programme was not a success.

During the 1990s, similar attempts to introduce animal-drawn carts took place in Guinea. The Réseau Guinéen sur la Traction Animale (RGTA) supported by ACT, a Belgian NGO, arranged for the local manufacture of similar 'Sismar' type carts. The extension strategy was similar. Individual carts were placed in remote villages and their use was monitored. Most carts developed punctures and many were abandoned. All farmers agreed they needed transport, but they provided a variety of reasons for not using the cart. Some farmers said they wanted to use the cart, but they were worried that their neighbours would think they were being cruel to their oxen if they made them pull a cart. Although some carts continued in use, the cart programme was not considered a success and the NGO thought about abandoning that aspect of their work.

With the wisdom of hindsight, it appears that both projects failed to consider the importance of critical mass. They did nothing to assist the development of a self-reinforcing group of users and repair services. It might have been better to place all eight carts in one village and to train a village artisan in puncture repairs and cart maintenance. With many carts around, people should have soon overcome their worries or embarrassment at using the new technology. Furthermore, both projects were concentrating on helping poor, remote villages overcome chronic transport problems. They did not examine which villages had the most favourable conditions for cart adoption (eg, those villages in flat areas about 5 km from a weekly market or main road). Had they done so, they could have first concentrated getting the novel technology accepted under relatively favourable conditions. With a critical mass established in a propitious village, there would be a local nucleus of adoption available for all to see. Many lessons would have been learned about ox cart use and extension. It might then have proved easier to start work in the more remote villages.

Some lessons relating to the adoption of intermediate means of transport

- *Programmes should facilitate the development of a 'critical mass' of users and support services.*
- *It may be better to place several transport devices in one village rather than one in each of several villages.*
- *When introducing innovative technologies, the preconditions for success should be considered. It may be sensible to start work (and to learn lessons) in relatively favourable extension sites.*

References: Starkey, 1991b; Starkey, 1994b; Starkey, 1997

There are many examples in Sub-Saharan Africa where the critical mass required to make transport technology adoption easy has developed slowly and 'spontaneously' (ie, there was no formal promotion). Some technologies, such as the wheelbarrows used by traders in many West African towns, have been based on market-related artisanal infrastructure. Others have involved the cross-border transfers of technologies, such as bicycles from Mali to Guinea (Box 8), boda-boda bicycle taxis from Uganda to Kenya, donkey carts from Senegal to Mauritania (Box 15) and donkeys from Senegal to The Gambia and Guinea Bissau (Box 16). One example of the rural spread of ox carts developed around the market town of Shinyanga in Tanzania (Box 29). One particularly interesting example of the 'spontaneous' development of a critical mass in a rural area can be seen in Ethiopia. In the past twenty years, 'indigenous' donkey carts have spread quite rapidly in the Ethiopia's Rift Valley (Box 21).

What cannot be known is how many other examples of spontaneous adoption might have also taken place had the environment for adoption been slightly more conducive. As noted in the example of donkey movements (Box 16), the overall picture of successful adoption hides numerous individual failures.

Box 21 Donkeys, horses, mules and animal-drawn carts in Ethiopia

Most intermediate means of transport in Ethiopia involve animal power. With five million donkeys, Ethiopia has the second largest population of donkeys in the world. Pack donkeys are extremely important in both rural and urban economies. A wide variety of loads are carried on the backs of donkeys, including grains, forage, wood, water and construction materials. The packing technology is very simple: most loads are balanced on back blankets, although wooden panniers are used for carrying water containers and stones. Pack donkeys are well suited to transport in the rural highlands: few other intermediate transport devices can operate in areas with many steep paths and few roads. However, even in and around the city of Addis Ababa, several thousand pack donkeys operate, bringing in and distributing produce. The success of recent military campaigns in Ethiopia and Eritrea owed much to the use of pack donkeys for carrying munitions and supplies. Despite the large numbers of pack animals employed in Ethiopia, transport of heavy loads by humans (mainly women) is still common in rural and urban areas.

In rural areas, horses and mules are primarily used for riding (mainly by men). Simple passenger-carrying two-wheel horse-drawn carts became common in Ethiopian cities about fifty years ago. The authorities banned them from central Addis Ababa around 1963, but they remain common outside the prohibited area and in other towns. They are generally used as passenger taxis for hire, and there is little use of horse carts for freight purposes.

There has not been a tradition of using donkeys to pull carts in the Ethiopian highlands. However, an innovative design of low-cost donkey cart appeared in the relatively flat Rift Valley in the 1970s. In most of the world, carts pulled by one donkey have two parallel shafts with a load-bearing saddle. The donkey pulls the cart using a collar or breast band. In contrast, the Ethiopian carts have converging shafts attached to a simple packsaddle. The carts, made from wooden poles, appear of recent, indigenous design, and have evolved in a country where donkeys have always been used to carry on their backs rather than pull from harnesses. These carts, that have steel spoke wheels without elaborate bearings, have been spreading rapidly in the Rift Valley. They are used for the transport of water, straw and other materials. They sometimes serve as ambulances. The development and rapid spread of these carts has been within the informal sector. It contrasts with the very low uptake of cheap 'appropriate technology' ox carts developed in 1988. To date, the adoption of relatively expensive steel ox carts with pneumatic tyres promoted by government agencies in the 1980s and 1990s has been minimal.

Some lessons relating to the adoption of intermediate means of transport

- *Simple pack animal technologies suited to hilly areas can also operate in an urban environment.*
- *Urban horse cart taxis can be profitable and beneficial unless the authorities prohibit them.*
- *Appropriate and affordable indigenous innovations can spread quite rapidly.*
- *The success of a simple (technologically inefficient) donkey cart contrasts with the lack of uptake of more expensive, higher quality ox carts.*

References: Bierig, Derebe Kasai and Tadelle Dereba, 1988; Wilson, 1991; Kebede Desta, 1994; Starkey, 1998b; Geta Kidanmariam, 2000; Sisay Zenebe and Tilahun Fekade, 2000.

The concept of critical mass also has implications for zones where particular technologies are declining. For example, declining use of wooden cartwheels in Mexico and Zanzibar, horse collars in Eastern Europe and pack camels in Mauritania. Such technologies will already have systems of artisanal support. If the demand for their services drops, the remaining users will have increasing difficulty in sustaining their use of the technologies. If the declining technology is being replaced by affordable and accessible alternatives, then the change may be an inevitable social and technical evolution. However, if there are no affordable and accessible alternatives, interventions may need to be considered to maintain viable populations of users and support services. Many support services are family enterprises, with skills passed on from artisan to apprentice or from parent to child. Once such services have died out, it is difficult to re-establish them. Under apartheid South Africa, there was active

discouragement of the use of donkeys in some areas. This was despite the lack of accessible alternative technologies for the poorer members of the communities. As the market contracted, there was a gradual decline in the established artisanal support services (cart production, leather harnesses, retail supplies, training). Members of the South African Network of Animal Traction (SANAT) are now working to re-establish and develop viable support services for what is now a re-emerging transport sector (Starkey, 1995).

Gender

Three key issues relating to gender and transport are: the unequal distribution of the transport burden, the unequal access to transport technologies and the 'invisibility' of women's transport needs in transport planning (Fernando, 1997). Several transport studies, including the well-documented case of Makete in Tanzania, have shown that women often spend 15-30 hours a week on transport activities, much more than the men of the communities (Howe and Zille, 1988; Doran, 1990; Airey and Barwell, 1991; Dawson and Barwell, 1993; Malmberg Calvo, 1994a). Women are often responsible for the transport of domestic water, firewood, crop harvests and grains for milling, and they often have to carry children at the same time. They also may have to walk long distances to fields and to markets. Girls may be kept out of school to assist with gender-related transport and domestic tasks.

Many intermediate means of transport are well suited to assisting the transport of women and their domestic, agricultural and trading loads. However they are mainly owned and operated by men. Many fewer women than men ride bicycles, use oxcarts or wheelbarrows or hire transport services. Reasons for the imbalance are cultural, social and economic. Men and women often explain the difference in terms of culture, but economic factors (perhaps cultural in their origin) are often fundamental in determining gender patterns of adoption. Women generally have less money and less access to credit and to income-generating options.

In small-scale studies in Zimbabwe around grain mills and water points, the predominance of head loading was apparent. Equally apparent were the big discrepancies between men and women, with much greater use of transport devices (wheelbarrows, carts, donkeys, sledges) by men. The main reason given by women for their low use of intermediate means of transport was cost, but there were also questions of design and convenience (Mudzamba, 1998). In Makete in Tanzania, women considered wooden wheelbarrows were inappropriate their needs (see Box 22).

Box 22 Inappropriate wheelbarrows for women in Makete, Tanzania

The Makete Integrated Rural Transport Project operated for many years in a remote, hilly area of south-west Tanzania. Its first phase (1985-1987) involved transport studies that clearly identified and recorded the scale of village-level rural transport problems. A sample survey of 431 households showed that 90% of all journeys and 95% of total weight transported took place within and around the village. Women transported 85% of the overall load carried, men 11% and children 4%. Very few motor vehicles or intermediate means of transport were used in the area. Roads were very circuitous in the hilly terrain. Head-loading was the main transport technology. Small paths were very important and much shorter than the roads.

During Phases 2 and 3 (1988-1991 and 1991-1993) development interventions concentrated on improving and maintaining roads and paths and introducing some transport technologies. Given the terrain and infrastructure, emphasis was placed on technologies suitable for use on narrow paths, notably wheelbarrows and pack donkeys. Then (as now) wheelbarrows in Tanzania tended to be found mainly in urban and peri-urban areas. No wheelbarrows were recorded during an initial household survey in Makete.

Among project objectives, was the establishment of local capacity to produce wooden wheelbarrows. However, the people of Makete thought these wheelbarrows were heavy, awkward and expensive. In that hilly region, the effective payloads of the wheelbarrows were not much greater than normal head-loads. Some men used wheelbarrows for construction work. Women reported that they had seen wheelbarrows used by men to carry bricks and sand. However, women considered wheelbarrows unsuitable for themselves, as they were heavy and difficult to use on the steep paths of the area. Women also noted that both hands were needed at all times to push a wheelbarrow, and this could be a disadvantage when carrying or walking with children. Women expressed no interest in using wheelbarrows. The wheelbarrows were never widely adopted. Head-loading remained the main transport technology.

Some lessons relating to the adoption of intermediate means of transport

- *Following a huge research input, spanning more than a decade, the transport problems of Makete's women and men are well-known and widely quoted, but little has actually changed.*
- *One project 'solution'—wooden wheelbarrows—failed: they were expensive, heavy and awkward.*

References: Howe and Zille, 1988; Howe, 1989; Jennings 1992; Relf and Mkwizu, 1998.

In one study relating to the low use of bicycles by women in Uganda, bicycles were perceived as prestigious devices that allowed men to travel faster outside of the village and facilitated trade. Men and women often felt that if women used bicycles, people would consider that they were 'behaving like men'. Men were suspicious about the implications of such liberated behaviour, particularly if it concerned their wives. Bicycles, which only had small carriers, were not particularly suited to many of the transport tasks of rural women (within-village movements and the collection of water, fuel wood and crop harvest along narrow, and sometimes steep, paths). Women's bicycle designs were not widely available, and most women did not have access to sufficient cash or credit to purchase bicycles (Malmberg Calvo, 1992, 1994b).

Despite women's clear need for transport and their clear disadvantage and under-representation among the users of intermediate means of transport users, women have tended to be 'invisible' to transport professionals and transport-related programmes (Fernando, 1997). Conventional transport planning has focused on road networks and the long distance movement of produce that is important to the national and urban economies. This has neglected the importance of intermediate means of transport for short-distance transport in general, and the transport needs of women in particular. Calls for increased gender sensitivity in transport programmes are growing (Fernando, 1997; Bramberger and Lebo, 1999). Nevertheless, there remains considerable inertia, gender-insensitivity and even overt sexism among transport-related organisations and within target communities. The perception of women as the 'natural' transporters,

particularly in African societies, still militates against initiatives and investments to reduce women's transport burden (Fernando, 1997).

Few, if any, transport and development programmes have been intentionally biased against women. However, few projects have incorporated gender analysis or taken into account that women have less access to information, capital, credit, cash incomes and financially profitable transport activities. Some programmes have made an effort to address the gender imbalances in the use of intermediate means of transport. They have involved women in planning processes and targeted information, credit and project actions at female transporters. One such project was the Tanga Draft Animal Power Project (Box 23) that assisted women to adopt donkey carts (Fischer, 1994a, 1994b; Makwanda, 1994; Starkey and Grimm, 1994). Donkeys have been seen to have particular transport benefits for women, because they are relatively affordable, easy to manage and their ownership is less 'macho' or prestigious than are cattle, horses and camels (Starkey, 1998; Fernando and Starkey, 2000). Family ownership of water-carrying technologies (cycles, trailers, hand carts, animal-drawn carts) may benefit women as some traditional water collection tasks may be taken over by men and boys using the transport device (Malmberg Calvo, 1992, 1994b; ITSL, 1998). One bicycle trailer initiative in Ghana, funded by the World Bank, was specifically intended to help women (Box 12). However the project had not fully appreciated the gendered nature of bicycle ownership and use. The project had also failed to fully understand and address the women's transport needs and options (Kauffman, 1993; Salifu, 1994).

Programmes have tended to promote unisex technologies, based on designs developed for men. Even programmes promoting the use of bicycles for women have used bicycles with crossbars, as these have been more readily available and considered stronger for load carrying. Women's bicycles and child-carrying seats have seldom been available to make it easier for women to use bicycles. Women have complained that loaded bicycle trailers have been too difficult for them to pull. They have also observed that wheelbarrows are unsatisfactory since they need two hands at all times, leaving no hand available for a child. Thus, gender-sensitive programmes should consider design and technical aspects of all transport devices in addition to the more obvious socio-economic issues.

Box 23 Donkeys for transport and road construction in Tanzania

When the Tanga Animal Draft Power Project started in north-eastern Tanzania in 1981, lack of farm power and transport were identified as crucial constraints for smallholder farmers. The Project therefore started to introduce work oxen and ox carts. Farmers did not use donkeys, although pack donkeys had been in the area for many years, owned by Masai pastoralists and some traders on the coast. During appraisal discussions, farmers expressed interest in using donkeys, but they were sceptical. They doubted that donkeys could pull carts.

There were few axles available in Tanga, so the project imported cheap scrap axles from German cars, complete with tyres and rims. This seemed a good short-term solution for the project, but it provided farmers with long-term problems. The axles used were of a type rarely found in Tanzania, and farmers struggled to find spare parts. (Another project in Tanzania imported Canadian axles with very unusual bearings, rims and tyres).

The Tanga project tested designs of cart with two shafts, suitable for single donkeys. Following favourable farmer reaction, local artisans were contracted to make relatively light cart bodies, mounted on the imported axles. The donkey carts proved more popular than the ox carts.

Farmers wanted donkey carts but could not really afford them. Rural incomes and employment opportunities were low, so even credit repayments were difficult for such expensive items. This was partly solved by a labour-intensive, rural road maintenance programme. Farmers were contracted to bring gravel to resurface roads, and the income from this programme made it possible for farmers to repay loans. The carts were used for many other purposes besides gravel haulage.

The project started at a time when it was normal to work mainly with male farmers. However, project gender sensitivity increased, and more attention was paid to women farmers. Women started to benefit from the spread of donkey carts. Women found it easier (socially, financially and practically) to own and manage donkeys than oxen. The donkeys carts could be used for carrying water and fuel wood, harvest products, forage for animals, goods for trading and people themselves. The donkeys could also be used for plowing and weeding. Initial prejudice against donkeys was rapidly overcome through practical demonstrations of donkey employment.

Some lessons relating to the adoption of intermediate means of transport

- *The need for spares should be considered when designing/importing transport components (imported scrap axles, wheels or tyres should be similar to those used by local vehicles).*
- *Cart introduction can be assisted through the contracts/credit of labour-based road programmes.*
- *Women can be major beneficiaries of donkey adoption and intermediate means of transport.*

References: Starkey and Mutagubya, 1992; Starkey and Grimm, 1994; Fischer, 1994a, 1994b; Makwanda, 1994

People with special needs

Some people, including the elderly, the handicapped, the sick and the very young have particular problems relating to mobility and access. Local transport solutions may be important for improving their independence and quality of life (Clarke, 1999). Such people may benefit from access to standard intermediate means of transport and/or from specialised devices such as hand-operated tricycles, wheelchairs and simple ambulances (eg, cycle-based, animal-based, motorcycle sidecars).

With increasing life expectancy and survival rates, these smaller ‘niche-markets’ are likely to increase in importance, as societies wish to improve the productivity, independence and quality of life of the elderly and people with special needs. Development programmes should be aware of special needs and consider ‘mainstreaming’ these, perhaps in collaboration with other organisations (eg, specialised NGOs, Ministry of Health).

Safety, welfare and environmental considerations

There are many ways in which intermediate means of transport can be misused which endanger the health, safety or welfare of the users, of other road users or of any transport animals involved. With bicycles and motorcycles, there is a big danger with unbalanced or unsafe loads. Instability may result in the bicycle swerving, causing traffic accidents or injuries to the user or pedestrians. Overloading carts, rickshaws or

pack animals may cause physical injuries to the humans or animals. Unstable loads may topple causing injuries. Inadequate brakes on any vehicle may result in accidents, particularly with heavily laden vehicles in wet conditions. Poorly designed harnesses and packsaddles can injure animals. Night time movement with inadequate lights and/or lack of reflectors can be a danger for all concerned.

The users of intermediate means of transport are often poor and disadvantaged people trying to maximise income for minimum expenditure. Income is often maximised by loading to physical limits (rather than safe limits). Expenditure is minimised if money is saved on animal feed, equipment maintenance and 'inessential' items such as crash helmets or reflectors (if available). Such people's lives often contain many risks and dangers, so there seems little point in reducing loads or spending money just to increase transport safety or animal welfare.

Many users seem unaware of the risks and simple welfare considerations. They may need educating in relation to welfare and safety. However, there are some people who are aware of safety and welfare issues, but choose to ignore them. Some even seem to take pleasure in beating animals or risking taking an unstable load onto the road.

Most safety legislation concerns motorised systems of transport. Safely regulations relating to intermediate means of transport can be important, but legislation is of little value unless there is an appropriate enforcement system. Most countries have laws and regulations that can be used to prohibit dangerous vehicles or make compulsory certain safety devices (helmets, reflectors). The level of enforcement varies greatly within and between countries. Some countries have animal welfare laws, but few have active enforcement systems. In most cases, there is a need for a combination of legislation, enforcement and education. People need to be convinced of the value of welfare and safety, with some consistent enforcement policies to ensure compliance.

The safety of intermediate means of transport can be improved through planning and appropriate infrastructure (Guitink, 1996; Vidanpathiranage, 1999; Litman et al, 2000). The creation of separate lanes and/or routes for small or slow moving vehicles can be particularly valuable. Bicycle lanes are found in many cities in the world, from Amsterdam to Beijing. Bicycle lanes have to be designed carefully to minimise conflicts between pedestrians, bicycles and motorised transport, particularly at turnings and junctions. In Bamako, Mali, a recently constructed road bridge and its access roads have separated pedestrian pavements and cycle lanes (used by bicycles and motorcycles). In some Indian cities, there are separate lanes for pedestrians, cycles, rickshaws and motor vehicles. Such infrastructure has important planning and cost implications, as well as social and economic benefits. Attention to social and poverty reduction criteria ensured that international credit for the Yamuna road bridge over the Ganges in Bangladesh was made conditional on the inclusion of lanes for intermediate means of transport.

Where there are concentrations of transportation devices, there may be adverse environmental effects. This is particularly true in urban areas, as well as around rural markets. Exhaust fumes from motorcycles, cars, trucks and buses cause pollution. Air quality problems are often greatest where there are large numbers of inefficient motorcycle engines. Moving from human-powered cycle rickshaws to motor rickshaws increases air pollution. This has been seen in Jakarta and some other Asian cities. The increasing use of motorcycles for transport in Nigeria poses problems of air quality, as well as the risk of accidents (Howe and Iyioa Oni, 1996).

Transport animals deposit excrement on roads, with concentrations in areas of loading and unloading. This may be considered unsightly and unhygienic by some, although there are generally people willing to collect such fertiliser. In some urban areas, the users of work animals are required to collect and dispose of dung, and a variety of simple collection devices (eg, 'bun bags') are available.

Regulation and prohibition

Some transport authorities have prohibited certain intermediate means of transport (Box 24). Sometimes it has been a matter of prestige. The authorities have banned the human- and animal-powered technologies because they are perceived to be backward and towns wished to present modern images. This was said to be the case with the banning of cycle rickshaws from Calcutta and Jakarta and the prohibition of most intermediate means of transport from Islamabad (ITDP, 1996). Arguments about modernisation and relevance were also used when horse taxis were banned from Addis Ababa and Bamako and also when donkeys were prohibited in parts of apartheid South Africa (Starkey, 1995).

In some cities, certain slow-moving transport devices, such as animal-drawn carts, hand carts and cycle rickshaws have been banned from certain routes in congested areas to improve traffic flows. For example, in Madagascar, human- and animal-pulled carts are banned from certain areas, such as those near markets and public transport stations, where traffic congestion is often severe. Such prohibition may have little effect on traffic, since loading and unloading of vehicles (motorised or non-motorised) is generally more of a problem than traffic speed. In Bamako, banning horse carts led to an increase in hand carts, which increased traffic congestion. In many urban situations, traffic of all types actually moves at walking speed whatever the rules.

It is quite common for intermediate means of transport to be banned from major roads, such as motorways, with fast-moving traffic. Safety is given as the main reason, since there can be a risk of serious accidents when fast moving vehicles swerve to avoid slow-moving carts or cycles. It is to everyone's advantage if such prohibition is combined with special lanes or special routes for carts and/or cycles. Unless such alternative options are provide, the users of intermediate means of transport may suffer.

In some cases, intermediate means of transport are not formally prohibited, but modern road designs have made it difficult to use them. Frequently, local users of non-motorised transport experience difficulties after a road running through a village is 'improved' or 'upgraded' (for the benefit of inter-urban users). Common problems include steep road embankments, deep drainage channels and high steps or curbs between the new road and the surrounding land. Such obstacles make it very difficult to pass with laden carts, whether drawn by people or animals.

There are some instances, where pedestrians and intermediate means of transport are allowed, while motor vehicles are banned. Examples include city centres, historic areas and tourist sites. Tourists may be willing to pay high prices to ride in intermediate means of transport (eg, horse carts in Rome and Egypt and cycle rickshaws in Agra and Oxford).

Box 24 Prohibition of tricycle taxis in Indonesia

During the 1960s and 1970s, human-powered tricycle taxis, known *becaks* were common in Jakarta, the capital of Indonesia. There were estimated to be over 100,000 *becaks* operating, providing low cost taxi services in areas of low and moderate incomes. These sustainable transport devices provided work for poor people without causing pollution.

In 1972, the city council passed a law to phase out their use by 1979. It was argued that the cycles caused traffic congestion and the use of human labour for transport was degrading. Despite the ban, *becaks* continued to be widely used, since they provided employment and an affordable service. Women were among the main beneficiaries. In the early 1980s there was a crackdown and *becaks* in use were confiscated. An estimated 40,000 tricycles were dumped into the Jakarta bay. Becak operators lost their livelihoods. Customers had to use the more expensive and more polluting motorcycle taxis (*ojeks*) or motorcycle rickshaws (*bajaj*) instead. As the ban and intermittent confiscations continued, numbers declined to about 30,000 in 1996 and 8000 in 1999. As a result of increasing motorised traffic, Jakarta became one of the most polluted cities in the world.

With a change of government in 1998, it was thought that the *becaks* might be reprieved. However, the new President was reported to say that the ban was still needed to eradicate poverty and maintain the status of Jakarta as a capital city. Some transport groups and environmentalists have been trying to get the ban lifted, but the authorities remained unconvinced in 1999.

Some lessons relating to the adoption of intermediate means of transport

- *Tricycles can provide low-cost, flexible short-distance transport services that are popular with customers and provide employment.*
- *While non-motorised transport devices are environmentally friendly, authorities may need convincing that they are 'modern'.*
- *Operators and customers can lose out if authorities decide to prohibit certain transport devices.*

References: ITDP, 1996; ITDP, 1999

Implications and ways to move forward

Alternative solutions to transport problems

In the previous sections, factors influencing the adoption of intermediate means of transport have been reviewed. Before considering the implications and proposing ways to move forward, it is important to recall the developmental context. Intermediate means of transport have been presented as potential solutions to local transport and accessibility problems. However, in some situations, transport problems may be best solved through non-transport solutions (see Box 25). Where there are problems transporting water and firewood, it may be possible create a water source nearby (a well or piped water) and reduce the demand for distant firewood (eg, more efficient stove, woodlot, electricity, gas, solar). Village infrastructure and services may be improved to reduce the transport needs for marketing, grinding and attendance at schools, clinics and banks. In some circumstances, transport problems may be best addressed through the combination of human walking/carrying and large-scale motor transport (eg, new truck and bus services between villages and markets). Although intermediate means of transport are clearly useful in many different situations, they should not be promoted actively unless their technical, social and financial appropriateness has been clearly established by the main stakeholders (particularly the potential users).

In the following sections, some suggestions will be made for projects and programmes concerned with rural development and the promotion of intermediate means of transport. This should not be taken to imply that specific organisational structures are necessary. In most cases, an integrated approach to transport and development is required. Organisations implementing programmes concerned with intermediate means of transport may well be private sector manufacturers and retailers, and/or broadly-based development organisations (regional projects, NGOs, women's groups, farmers' associations). The term 'development programme' (and simply 'programme') is therefore employed in a loose way and is intended to cover all initiatives relevant to the manufacture, promotion and use of intermediate means of transport.

Box 25 Non-transport solutions

Some local transport and accessibility problems can be solved without intermediate means of transport. Sometimes, the best solution is to reduce the need for transport. For example, if the transport of firewood from distant locations is a problem, this might be reduced by local woodlots and the introduction of more fuel-efficient stoves. The transport problem might also be solved by the provision of electricity or cooking gas.

In some circumstances, the problem of transporting goods from a village to the local market can be solved with intermediate means of transport, such as carts or bicycles. An alternative solution to the same problem could be the creation of a new market or sales depot within the village. Similarly, increasing the number of schools and village clinics can reduce the transport problems of schoolchildren and the sick. In some rural areas, women may walk ten kilometres to a grinding mill. As additional mills are installed, the local availability of grinding services increases, and the transport problem is reduced.

Water transport is a major problem in many communities. Water may be carried by people or by using wheelbarrows, carts, cycles or pack animals. If water is piped to houses, the transport of water ceases to be a domestic problem. Similarly, the provision of additional wells or communal taps may be more important to a community than the supply of water-carts.

In Makete, Tanzania, the introduction of piped water reduced household transport requirements by 1400 person kilometres and 350 transport hours per year. Village grinding mills saved another 100 transport hours per household per year, with women the main beneficiaries. It was suggested that the introduction of more efficient stoves would reduce fuelwood use, saving 73-145 transport hours per year.

In Kabompo in the North-Western Province of Zambia, a main constraint to development was the farmers' inability to sell agricultural produce. Farmers had no means of transporting their maize to the distant marketing depots. The local rural development programme decided on a twin strategy to reduce the transport constraints. It established a network of local marketing depots, so no village was far from a place where farmers could sell maize. The programme also introduced ox carts, so farmers could easily transport maize to the nearby depots. The transport constraint for marketing was relieved by a combination non-transport solutions and intermediate means of transport. This allowed agricultural production and economic development in the area to increase.

Some lessons relating to the adoption of intermediate means of transport

- *Development planners and practitioners should consult with rural communities and jointly identify solutions to transport constraints.*
- *While intermediate means of transport can be local transport solutions, it is sometimes possible to reduce or remove the main problem by bringing services nearer to the villages.*

References: Starkey, Dibbits and Mwenya, 1991; Löffler, 1994; Malmberg-Calvo, 1994

Technical choices, diversity and complementarity

Many different types of intermediate means of transport are available and have been successfully used in certain situations. It is not the aim of this paper to provide specific technological recommendations, but some general lessons emerge from the analysis of recent experiences.

Hand carts and wheelbarrows appear well-suited to short distance transport in towns and around markets. Bicycles with simple carriers are very widely and increasingly used for personal transport and some load carrying. Ox carts and donkey carts, using automotive technologies, are increasingly used in the rural areas of Sub-Saharan Africa, particularly in semi-arid areas. Pack donkeys can have important local roles, assisting women and men, particularly in dry zones and hilly areas. To date, most carts and bicycles are owned and used by men. While there are a large number of technologies that can be used by rural women to transport domestic water, this common transport problem has yet to be adequately resolved.

Motorised intermediate means of transport are common in Asia but have yet to be widely adopted in Africa. While there is a steady increase in motorcycles for personal

transport, their present use affects only a small proportion of the population. There are parts of West Africa (Benin, Burkina Faso and neighbouring countries) where motorcycles and mopeds have achieved a 'critical mass' and become quite common (IRF, 1999). In parts of Nigeria, passenger-carrying motorcycles ('Okadra') have developed 'spontaneously' (Howe and Iyiola Oni, 1996).

Power tillers have yet to be widely used for rice production or transport. Trends from Asia suggest this technology may first be adopted in areas of irrigated rice production with high population densities, close to towns where motorised vehicles are widely used and maintained. The conditions for adoption of other motorised intermediate means of transport (motor tricycles, autorickshaws) are most likely to be met in peri-urban areas, where there is economic demand and supporting infrastructure.

Box 26 Multipurpose power tillers for transport in Sri Lanka and Côte d'Ivoire

Power tillers are widely used for rice production in South Asia. They are also used with trailers to transport goods and passengers. In some countries, including Sri Lanka, power tillers and trailers are sometimes purchased and operated with the aim of providing transport hire services. Such transport vehicles are seldom used for cultivating rice swamps. Since they have been designed as multipurpose devices for agriculture and farm transport, they are not ideal for full-time transport on roads. However, the trailers can carry loads of over one tonne (or up to forty people) in flat areas. In Sri Lanka, and some other countries, operators are able to make a profit on transport operations. This is partly as a result of lax road transport regulations and the lenient taxation of 'agricultural machinery'.

In Western Côte d'Ivoire, power tillers have been imported with Japanese assistance, and sold on credit at 40% below market prices. The aim of the programme has been to increase rice production. However, the single axle tractors were supplied with trailers, and the owners found transport operations to be very profitable. The power tillers, known as *katakata*, have been operated by youths and have started to transport goods and people on a regular basis.

Local officials expressed concern about the rate of accidents (their single headlight can be mistaken for a motorcycle, which is much narrower). Agricultural extensionists felt that the regular use of the power tillers for transport might decrease agricultural work (the tillers were cultivating an average of only five hectares, whereas ten hectares had been envisaged).

Since the power tillers have been heavily subsidised, it is too early to know whether their employment for transport, for agriculture or for combined, multipurpose use prove will be economically sustainable in Côte d'Ivoire.

Some lessons relating to the adoption of intermediate means of transport

- *Tractors (two wheel and four wheel) are multipurpose devices with valuable transport functions.*
- *Transport operations can be more profitable than agricultural production and large or small tractors, though not designed for road use, may be operated in profitable transport hire services.*
- *The long-term viability of a technology cannot be assessed while it is heavily subsidised.*

Reference: Plumbe and Byrne, 1981; Biggs, Kelly and Balasuriya, 1993; O-Dji, 1997; Ellis, 1999.

Lessons from Asia and Africa suggest that a wide range of complementary intermediate transport technologies can coexist. Conditions in urban areas and around markets often favour their production, adaptation and use. The various intermediate means of transport complement motorised transport systems, fulfilling needs for collecting and distributing goods and people over relatively short distances.

Given the wide range of possible transport technologies, programmes should try to offer choices to the potential users. There are some advantages in concentrating on the establishment or improvement of one technology, as this may provide economies of scale for the support systems, accelerating the achievement of critical mass. However, working with a range of technologies may lead to greater understanding of the issues and more appropriate technologies being adopted. As transport needs are many and diverse, overall adoption may be higher if several technologies are promoted. While

there may be specialists working with cycles, carts, donkeys or small motors, programmes should try to support a range of transport options.

Women and men may require access to different types and designs of transport. Factors to be considered may relate to different physical characteristics (eg, muscle power, size, strength and weight), cultural norms (eg, dress codes affecting bicycle design) and conventional gender roles (eg, carrying babies and water collection). In promoting the diversity of transport technologies, programmes should ensure they have technologies suited to the different requirements of women and men.

Multipurpose devices and transport services

While some transport devices have very specialised niches, most have several different functions. Specialised intermediate means of transport include water carts, motorcycle ambulances, ice cream tricycles and supermarket trolleys. Multipurpose devices include wheelbarrows, basic flatbed hand carts and animal-drawn carts. Ordinary bicycles fulfil many different social and economic functions when they are used for the personal transport (for one or more persons) and to carry small loads.

The general rule is that where transport demand is relatively low, benefits will be maximised through the use of unspecialised designs that can be used for many different transport purposes. As transport demand increases, there is greater scope for specialisation. In remote rural areas, a transport device (truck or cart) may be expected to transport people and a wide range of goods and materials. In urban areas and around rural markets, there are usually separate transport devices for people and also for different types of load.

There have been several attempts to develop a multipurpose animal-drawn implement that can be used as a cart and for agricultural operations. Such wheeled toolcarriers, or bullock tractors, were not successful, being heavy, complicated, expensive and less flexible than the combination of a simple cart and separate agricultural implements (see Box 31; Starkey, 1988). Similarly, attempts to combine carting with grinding operations have not led to widespread adoption.

The power units (work animals, two wheel tractors and four wheel tractors) may also be considered multipurpose. They can be used for soil cultivation, pumping and post-harvest operations as well as transport. This can allow greater utilisation, and spread the costs of ownership over several operations. The versatility of tractors units, with agricultural, transport, and power-take-off operations appears to have been important in South Asia, but African experience is less clear.

Cattle have additional multipurpose functions, in that they not only work, but also provide their owners with manure, milk, calves, meat and wealth/status. Multipurpose power sources are particularly important in remote rural areas, where transport demand is relatively low and highly seasonal. In much of sub-Saharan Africa, work animals (and to a much lesser extent tractors) have been initially acquired for plowing. The adoption of carts has followed fairly slowly, due to lack of financial resources and supplies. The use of animals for pumping and post-harvest operations is possible, but specialised small machines usually have a comparative advantage for operations requiring many revolutions per minute.

Once agricultural power sources (animals or tractors) start to be used profitably for transport, their agricultural and post-harvest roles may decline. Where transport

demand is high, the 'agricultural' power units may start to be used solely for transport (see Box 26 and Box 27).

Box 27 Multipurpose oxen and cows for transport

Cattle are multipurpose animals that provide meat, milk, manure, offspring and hides as well as work and (in many societies) social status and capital reserves. Although they can be expensive relative to rural incomes, they can be profitable to own, even without work functions. Thus they are often ideal work animals in remote rural areas, where demand for agricultural and transport operations can be low and highly seasonal.

Male animals are stronger than females, and oxen (castrated males) are the preferred animals where work is hard and regular. Full-time transporters generally use males. However, in situations where the workload is light, females (cows) may be used for work. Where transport demand is intermittent, it can be more profitable for farmers to give their limited feed resources to work cows, as these also provide income from milk and calves. In some rural areas of Europe, including Portugal, Spain and Romania, smallholder farmers use dairy cows to pull carts and wagons. While smallholder farmers in Portugal invariably use cows rather than oxen, neighbouring fishing communities prefer to use oxen. The oxen are used for several hours each day to launch boats and pull nets. This is much harder work than that expected of the multipurpose cows.

In Malawi, the Lilongwe Agricultural Development Division assisted farmers to purchase oxen and plows to improve agricultural production. The project also provided credit for the purchase of ox carts. One farmer interviewed explained that until he had oxen, he cultivated his fields using a hoe. For three years, he used his oxen successfully for plowing his own land, and that of neighbours. He then obtained credit to purchase an ox cart. Income from transport hire was so good, as his village was quite close to the capital city. Transport became more important than farming. The following year he did not use his animals for plowing, but kept up the transport work, and hired labourers to hoe his fields instead. Transport demand was high, so that the financial advantage of spreading costs through the use of multipurpose (agricultural and transport) animals became less important.

Some lessons relating to the adoption of intermediate means of transport

- *Where transport demand is low, benefits may be gained from use of multipurpose agricultural and transport animals.*
- *Cows have many productive functions and can be profitably used for light transport work.*
- *Where transport demand is high, multiple functions become less important, and specialised work animals may be more appropriate (oxen, mules, horses and donkeys).*

References: Starkey, 1985; Starkey, 1999

Cost and affordability

The adoption of intermediate means of transport is strongly influenced by their cost and their potential to provide financial benefits. Their overall affordability may depend on income generation prospects. Provided funds or credit are available to allow the process to start, the potential to gain income, rather than actual cost may be the more crucial issue. Thus relatively expensive transport devices may be adopted in peri-urban areas (Box 6). In contrast, there may be little uptake of time-saving, low-cost transport technologies by disadvantaged people (including women) in rural areas. Users have been willing to pay the premium for steel carts with rubber tyres rather than cheaper wood options. A large number of people (mainly men) have purchased bicycles, even when their price has been high relative to average incomes. Increased personal mobility has a high social as well as economic value. On the other hand, few people have felt it was justified to spend the extra needed to buy a cycle trailer or even an extended bicycle (Box 28).

Box 28 Extended bicycles in Sri Lanka: not worth the extra money?

When the members of the IT Sri Lanka team started to promote bicycle trailers, they became aware of how much the ordinary bicycle was used for load carrying. A cycle trailer, with a safe load of up to 200 kg, could carry more than was practical with a normal bicycle, but its cost was similar to that of a second bicycle. It seemed that there might be benefits from increasing the load-bearing capacity of the normal bicycle. This would allow greater loads to be carried, but without the expense and complexity of a cycle trailer. The extended bicycle was developed as a reversible modification of a 'normal' bicycle. The extension produced a larger frame that allowed a larger 'carrier' to be fitted behind the saddle. This could carry a safe load of up to 100 kg. Extending the frame required several modifications including a longer chain. The cost was about 25% more than a normal bicycle, whereas the cycle trailer was almost 100% more.

It was initially anticipated that sales could be high, since 'normal' load-carrying bicycles were very common and the additional cost was relatively modest. It was planned to sell 1250 extended bicycles and 800 bicycle trailers between 1994 and 1997. In fact uptake of the extended bicycles was minimal. Users did not consider the possible benefits justified the costs. Only 32 extended bicycles were sold. IT Sri Lanka continued to exhibit the extended bicycle as one technology option, but without much expectation of further uptake.

Some lessons relating to the adoption of intermediate means of transport

- *The engineers believed the extended bicycle was genuinely better and affordable* ***AND***
- *Potential users indicated they would pay a modest amount for a significant improvement* ***BUT***
- *In reality, users did not perceive the 'improvement' was worth the extra cost.*

References: IT News, 1994; Pannilage, 1998 (personal communication).

One implication for transport programmes is that efforts should be made to keep the costs of local transport solutions low. Some programmes have felt it worthwhile to subsidise local transport technologies. The types and rates of taxes and duties might be well reviewed: there have been cases of very high mark-ups on imported intermediate means of transport and their components (Howe and Dennis, 1993). Other options may include support to develop low cost manufacture, marketing and distribution systems. Initiatives could include bulk purchases of materials/components for resale to small workshops, possibly through decentralised depots.

Another implication that is potentially more important is that transport and rural development programmes should endeavour to identify or stimulate income-generating activities for the users of intermediate means of transport. Examples have been provided of carts being afforded thanks to marketing opportunities (Box 10) and road construction (Box 23).

Supply, distribution and maintenance systems

The low adoption of intermediate means of transport in Sub-Saharan Africa is related to problems of availability and supply. Clearly there is a 'chicken and egg' situation, with a vicious circle of low demand and low supply. There are many examples where the creation of improved supplies (of carts, axles, bicycles or donkeys) has stimulated demand and led to more rapid adoption (see Box 29).

In order to increase availability, it is necessary to identify the limiting factors. These may be components and raw materials (local or imported), manufacturing/assembling facilities and skills, designs of transport devices, capital availability and/or marketing systems. Each one of these may have to be addressed.

In some cases, shortage of supply can be overcome by training artisans or workshops to make the intermediate means of transport. In many cases, technical training is not enough (see Box 17). Technical training may need to be combined with credit and/or

training in marketing, the management of small businesses and the establishment of stocks of raw materials.

In many cases, the problem of supply may be linked to the low purchasing power of the users (particularly women). Suppliers will not invest in manufacturing or stocks if they do not believe there is an economic market (as opposed to a felt need). Such situations may be over come through credit provision, income-generating schemes (eg, labour-intensive road construction) or possibly subsidies.

Box 29 Artisanal cart production and marketing in Shinyanga, Tanzania

In Tanzania, Shinyanga market became a centre for the manufacture and sale of animal-drawn carts. This appears to have been due to local entrepreneurial activity, rather than any public sector initiatives. Several small workshops now manufacture cart axles using old vehicle bearings and water pipes. Some traders specialise in selling the axles, bearings, rims, tyres, tubes and spare parts. Carpenters make complete cart bodies, and paint them with distinctive blue and black patterns (decorative cart design is a characteristic of indigenous cart industries in several countries including Madagascar, Costa Rica, and Portugal). Painting their carts distinctively has helped the manufacturers develop a recognised and known brand image known as *Masale* carts. Users have started to request and talk about *Masale* carts, so other artisanal manufacturers have started to copy and imitate the successful carts, using similar blue and black designs.

Entrepreneurial skills have been exhibited in an unusual marketing system for carts that has developed. Traders travel out to villages with ox carts, and exchange them for cattle (for example, four animals for a cart). The animals are taken back to Shinyanga and sold. The traders take some profit as income, but most of the proceeds are reinvested in the purchase/manufacture of more carts and components. This simple barter system is said to increase sales and benefit all concerned.

Some lessons relating to the adoption of intermediate means of transport

- *Sustainable private sector systems for manufacturing and marketing intermediate means of transport may arise 'spontaneously'.*
- *Local transport solutions can be given clear brand images, stimulating pride in manufacture and ownership.*
- *Innovative marketing systems, including bartering, can assist technology adoption.*

Reference: Starkey and Mutagubya, 1992

Credit and subsidies

There is ample evidence that points to the importance of credit in stimulating the adoption of intermediate means of transport (see Box 30). As noted before, credit is not always essential, and some credit programmes linked to particular technologies have failed. Credit provision may allow users (men and women) to purchase technologies. Just as important can be credit to workshops to fund the cost of manufacturing, or credit to traders/retailers to allow them to stock transport options and spare parts.

The choices of manufacturers, distributors and customers may be distorted if credit is restricted to particular technologies. However, if it is not limited, the credit may be used for entirely different purposes. Distortions may be limited if the credit is made available for a range of transport technologies, although this may favour the 'safe' choices, such as basic bicycles.

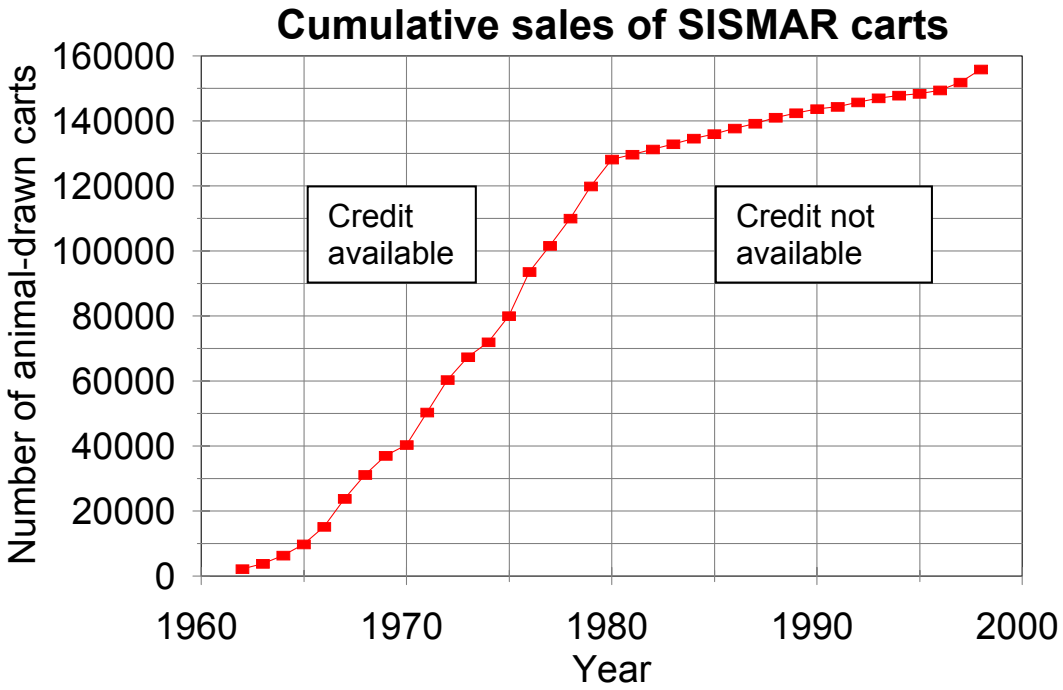
Credit-providing programmes may need to make special efforts to ensure women benefit. This may include making information and application systems easily accessible to women, and ensuring credit and repayment conditions are appropriate.

Subsidies may be used to help introduce new products. However, subsidies do distort markets, and may create problems when they are removed. Particular attention must be paid to ensure subsidies do not create unfair competition. In particular, imported or

urban manufactured technologies (eg, motor-based intermediate means of transport) should not normally be subsidised when comparable indigenous technologies exist.

Box 30 Large-scale cart production in Senegal affected by credit policies

In 1960, Siscoma established a factory at Pout in Senegal to manufacture carts and agricultural implements. Sales in the 1960s and 1970s were high, boosted by agricultural credit schemes. The sudden termination of credit in 1980 caused sales to plummet making Siscoma bankrupt. With some government support, the Sismar Company was formed in 1981 to take over the factory and diversify. Sismar manufactures commercially a range of carts and implements and has exported carts and equipment to many countries.



Sismar (Siscoma) has sold more than 150,000 carts since 1960. It has also sold axles and components in Senegal and the region. The carts are popular because they are strong but relatively light and easy to pull. The roller bearings and pneumatic tyres are efficient. Due partly to the strength of the CFA Franc (until recently), the carts have been relatively affordable, particularly when credit was available.

The Sismar cart design has been 'cloned' many times and workshops in Senegal and other West African countries manufacture similar carts. In the 1950s few carts were used in West Africa. Now there are hundreds of thousands of similar carts. The Sismar carts (and clones) now have a clear 'critical mass' of users (assisted by credit). This makes it easy for traders to stock spare parts (eg, bearings) and it allows artisans to specialise in repair services. At large numbers of weekly markets in Senegal and neighbouring countries, it is easy to buy cart spares and to arrange repairs.

The supply of good factory-made standard axles with roller bearings has allowed local artisans to make similar carts. The use of factory-made axles ensures wearing parts are of high quality. The local fabrication of bodies keeps distribution costs down and provides rural employment.

The situation in francophone West Africa differs from Nigeria, Ghana and most of Eastern and Southern Africa. In these countries, factory-made axles have not been readily available. Most carts have been made from old car parts (which make carts heavier). In many countries the adoption of such carts has been constrained by the shortage of scrap axles in rural areas and by lack of credit.

Some lessons relating to the adoption of intermediate means of transport

- *Credit provision can assist rapid cart adoption, but its withdrawal can cause problems.*
- *The rapid growth of carts in West Africa has been associated with a good supply of carts/axles and the widespread availability of spares and repair facilities in local markets.*
- *The availability of factory-made axles and components allows artisans to combine the comparative advantages of centralised production (of precision parts) and decentralised fabrication/assembly.*

References: Havard and Faye, 1988; Sismar, 1999 (personal communication).

Critical mass

The concept of critical mass has major implications for programmes promoting intermediate means of transport. If a technology is to be viable and quickly adopted, there is a need to establish as soon as possible a 'critical mass' of users. This means sufficient users to make potential adopters comfortable with the idea of using the technology and sufficient users to justify support services (manufacture, sales, repairs).

Strategies designed to achieve a 'critical mass' may involve a variety of promotional techniques. There may be demonstrations, field days, training, media coverage, advertising and other forms of publicity. The provision of credit to manufacturers, retailers and/or purchasers may prove particularly effective. Promotion may also include some form of direct or indirect subsidy. Direct subsidies tend to distort markets and are unfair to alternative products. Credit is often provided on easy (subsidised) terms. Credit for pre-financing production runs and retail stocks may be an effective subsidy. If production credit is provided on a 'sale or return' basis, the promoting organisation is effectively funding the risk of production or the holding of stocks. A common form of indirect subsidy involves intensive in-kind support and training from the promoting organisation to the manufacturers, retailers and/or purchasers.

The private sector may try to develop a critical mass of users in a variety of ways. Following product development and optimistic market research results, pilot marketing is attempted. Early promotional attempts may involve advertising, fairs and events, discounted prices, free samples, goods on trial and linking of products with important personalities and events. Consumer reaction is monitored and evaluated in the pilot area, before wider campaigns are initiated.

If 'achieving critical mass' is accepted as an important adoption strategy, this raises some interesting questions about scale and sustainability. Should programmes go for massive introductions to achieve the necessary critical mass? Such an interventionist approach goes against the grain of participatory evolution and development, and gambles rapid progress against the risk of large-scale failure.

A possible example was discussed during an RTTP (PTMR) workshop in Guinea in 1998. Bicycles are the most common intermediate means of transport in Africa, but they are not found everywhere. In Guinea, they are seldom used in the south and west, despite major mobility problems in Conakry and elsewhere. One possible strategy discussed, was supplying (say) ten thousand bicycles to the people of an area where they were not common (eg, Conakry), hoping that this would establish a 'critical mass'. In such circumstances, this could lead to the purchase by local inhabitants of another (say) ten thousand bicycles within a few years. Alternatively, traders in the informal private sector might rapidly transfer the bicycles for sale in areas already using bicycles. Perhaps rapid success could be achieved with higher numbers, say 50,000 or 100,000. Importations of this size have been seen in countries such as Kenya, Nigeria and Uganda where bicycles have achieved localised 'critical mass' and appear to be having a major influence on personal mobility and economic activity.

However, there is a major problem with such a strategy to achieve rapidly such a 'critical mass'. This relates to the great optimism and lack of self-criticism of previous transport programmes. The great majority of programmes working with intermediate

means of transport have concluded that the technology being introduced was highly appreciated by the potential users. They therefore would conclude that the next stage was active promotion to achieve critical mass. The programme optimism applies to clear successes (eg, donkey carts in West Africa; Box 15, Box 16, Box 30), technologies of unproven status (eg, cycle trailers promoted in several countries; Box 12, Box 14, Box 32 and Box 33) and technologies that appear to have been rejected (eg, wooden wheelbarrows, Box 9, wheeled toolcarriers, Box 31 and 'Flintstone' carts, Box 13). Many people involved in these technologies have blamed the 'failure' not on the technology, but on the lack of effective marketing and promotion. It is interesting to speculate what would have happened if all these technologies had put resources into the rapid achievement of critical mass. For example, if a project had supplied (say) twenty thousand cycle trailers to the people of one area, would this have led to a 'critical mass', sustained use and continued adoption?

If all these technology programmes had opted for achieving critical mass, it is likely that there would have been some very expensive 'failures'. However, some technologies may have been adopted or adapted, with resulting economic and social benefits. In any case, overall progress may well have been faster if there had been quicker adoption of some technologies and faster realisation that other technologies were not appropriate.

Box 31 Animal-drawn toolcarriers: combined 'bullock tractors' and carts

Animal-drawn wheeled toolcarriers are multipurpose devices designed for both tillage and transport. The wheeled chassis can be used as a cart and also for ride-on agricultural operations. Early designs were produced in Senegal in 1955 and researchers in Europe, Africa, Asia and Latin America subsequently developed over 45 designs. Early toolcarriers were tested in many countries in the world, and they were actively promoted with credit and subsidies in Senegal, Uganda, The Gambia and Botswana. In the 1970s, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) started a major research programme involving wheeled toolcarriers which resulted in the development and refinement of the Tropicultor and Nikart designs. In India, credit and subsidies of up to 80% were offered to stimulate demand and encourage local manufacture. Projects disseminated 1200 toolcarriers in this way.

The wheeled toolcarriers were technically competent and often proved highly effective under the optimal conditions of research stations. The technical successes were widely reported, together with some enthusiastic comments of local farmers. Economic models demonstrated the potential profitability of the implements (given optimal assumptions on utilisation patterns).

Encouraging reports of the 'successes' of wheeled toolcarriers stimulated much wider international interest in the technology. Toolcarriers were subsequently imported or made in almost all African and Latin American countries. Significant numbers were imported by development projects in Mozambique and Angola and large-scale manufacture was started in Brazil and Mexico. In all, over 10,000 wheeled toolcarriers were made, but in no country was there successful adoption. The number ever used by farmers as multipurpose implements for several years was negligible. Most were either abandoned or only used as carts.

Wheeled toolcarriers were rejected because of their high cost, heavy weight, lack of manoeuvrability, inconvenience in operation, complication of adjustment and difficulty in changing between modes. Their designs involved compromises between the many different requirements. In many cases for a similar cost a farmer could use a simple cart and a range of single-purpose implements to achieve similar results with greater convenience and with less risk. These lessons were apparent as early as the 1960s but published reports were invariably highly optimistic and created an illusion of success. Over a period of thirty years projects in many countries spent much time and money trying to achieve similar 'success'. However the technology that had been 'perfected' by engineers was invariably rejected by the users.

Some lessons relating to the adoption of intermediate means of transport

- *Technologies developed by researchers tend to over-emphasise technical efficiency rather than appropriateness to the users within the realities of their environments*
- *Users must be involved at all stages of planning, implementing and evaluating technology programmes.*
- *Enthusiasm for transport innovations must be balanced with constructively-critical monitoring and evaluation.*
- *Organisations should report disappointing adoption patterns so the lessons are shared.*
- *Credit and subsidies can stimulate initial sales but long-term adoption requires user satisfaction.*

Reference: Starkey, 1988

Programme focus, prioritisation and poverty alleviation issues

Programmes promoting intermediate means of transport must undertake thorough 'market research' in order to understand the needs, wants, preferences, priorities and purchasing power of the diverse users in their target groups. Priorities should be set in terms of specific target groups (eg, disadvantaged rural women) and programmes based on the special requirements of such groups. A distinction should be made between access and ownership, noting that for some target groups access may be sufficient. Once suitable technologies have been identified, promotional activities should be carefully targeted, in terms of area of intervention and beneficiaries.

The low use of intermediate means of transport in rural sub-Saharan Africa provides rural development programmes with many challenges and opportunities. With low levels of economic demand for rural transport, programmes cannot create all the (urban) conditions that favour transport diversification and adoption. They may,

however, be able to emulate certain key characteristics. It is logical to locate facilities for the production, sale and repair of intermediate means of transport close to markets (depending on the technology, the 'local production' may be based on factory-made components). Introducing local transport technologies in association with marketing systems can also be very effective (Box 10).

With innovative technologies, there may well be a case for commencing work in areas and conditions where adoption is most likely. The idea would be to establish the technology firmly under favourable conditions, before trying it in conditions where the physical, socio-economic and infrastructural environmental conditions may be less auspicious. What constitute favourable conditions will depend on the technology. As noted before, favourable conditions for local transport solutions are likely to include centres of trade and population, with transport demand and income-generating prospects. In such conditions, men are more likely to be the first adopters. Thus while programme goals may suggest targeting remote villages, it may be pragmatic to concentrate initially on small rural towns (where viable support services can develop) and neighbouring villages. Once the technology has become well established near a local or regional market, it should be much easier to introduce it into the outlying villages, and then to the more remote and impoverished areas.

Programmes trying to introduce innovative transport technologies to reduce the domestic drudgery of women in remote rural areas are likely to face many practical problems. If adoption of the preferred devices is low, a pragmatic strategy might be to also work with more economically attractive intermediate means of transport (even if they are ones generally owned and operated by men). These can have important social benefits (such as domestic water collection) as by-products. Emphasis might therefore be placed on increasing the employment of these technologies while encouraging their use for 'secondary' transport activities.

The importance of viable economic options for transport technologies has been stressed, as well as their affordability and issues relating to credit and subsidies. However, programmes must recognise that the corollary of the economic options for those with intermediate means of transport may well be greater social, economic and gender differentiation. Some people (particularly women) will feel disadvantaged. Their marginalisation may be relative or absolute. Most programmes have social goals, relating to equality of opportunities, poverty alleviation and improvements in the quality of life for all members of society. They will have to reconcile these goals, with the probable economic and social differentiation resulting from the adoption of local transport solutions. Strategies to overcome marginalisation may require targeting subsidies and credits (potentially distorting market development), stimulating formation of empowerment groups for the marginalised and/or developing (socially-targeted) income-generating opportunities.

Gender

Transport studies have shown there is not only gender inequality in the transport burden, but also in the interventions designed to alleviate that burden. Organisations and programmes must ensure there is gender-disaggregated data relating to rural transport problems, needs, priorities and programme impact.

Integrating gender into transport and mobility strategies requires ways of identifying gender differences in transport needs and priorities as well as ways in which the gender inequalities in transport interventions can be addressed. There is a need to

involve women and women's perspectives in decision-making processes concerning transport policies and initiatives to promote local transport solutions at national level, at decentralised regional level and within communities. Programmes working with intermediate means of transport should make a point of involving women. They should work closely with local organisations that target women and provide innovative information provision systems and credit arrangements for women. Programmes (public, private or NGO) should aim to address gender imbalances in the adoption and use of intermediate means of transport, and this involves more than being 'gender neutral'.

For some transport technologies, there are differences in the design requirements for women and men users. Since the market for intermediate means of transport has been dominated by sales to men, there have been few economic incentives to produce designs more appropriate to the needs of women. Programmes may wish to address this issue, and help create a 'critical mass' of women users that will justify the manufacture and sale of suitable designs of transport technologies.

Monitoring and evaluation

Self-critical monitoring and objective evaluation are fundamental to the success of any programme to develop and/or promote the use of local transport solutions. In the past, there has been clear evidence of enthusiasm for particular technologies running into 'hobbyism', lack of objectivity and irrational optimism in the face of disappointing adoption patterns. Such problems may be overcome through mechanisms that include potential users (of different genders, status, purchasing power, etc) and other interested parties in programme planning, monitoring and evaluation procedures. Methods need to be developed to enable programme staff to understand the viewpoint of the diverse users. The various stakeholders must be allowed to talk honestly about their needs and concerns and realistically about their willingness to buy or use transport technologies. This 'attitude' information needs to be regularly cross-checked with objective information from actual sales and use patterns, and any discrepancies investigated at an early stage.

Regular objective evaluation is also vital. Many programmes and individuals fear the potential for criticism that may come with external evaluations. Sympathetic evaluators are often selected. This may be more comfortable in the short term, but restricts the potential for learning and programme changes. Self-evaluation, aided by an independent external person, can be useful and may involve both programme staff and key/representative stakeholders. If someone from a comparable transport project in another country assists the evaluation, the learning process may benefit two programmes simultaneously.

The lessons from evaluations should be documented and widely shared (see Box 32). Many of the positive and negative lessons concerning intermediate means of transport that have been shared in this document have been identified through the circulation or publication of evaluation reports. More lessons could be learned more quickly, if there were more open and rigorous evaluations. The sharing of both successes and failures is an important networking function that speeds up learning and progress for all concerned.

Box 32 Cycle trailers in India: what happened and why?

India has a huge number of bicycles and cycle-based transport technologies. Bicycle production is about ten million a year and there are about five million cycle rickshaws in use. All towns and many villages have small workshops capable of servicing cycle technologies. Entrepreneurial activity in the small-scale manufacturing sector is high. The environment and infrastructure would appear ideal for supporting cycle trailers, provided there was an economic demand for them.

1987: "Popular demand for the IT Transport-designed cycle trailer has prompted an engineering company in Andhra Pradesh to take up production. . . The cycle trailer is proving very popular for a wide range of agricultural and small business uses. Sale of the first batch of 100 has generated substantial interest from a number of NGOs".

1988: "Cycle trailer manufacture accelerates in India. Some 200 units are now in circulation. Most users report considerable savings on transportation of goods associated with businesses, as well as improved convenience and speed, in comparison with other available methods of transporting goods. A promotional campaign to make the cycle trailer more widely known to potential users has started."

1990: "The cycle trailer … developed by IT Transport and tested in partnership with organisations in India ... is well established in four states: Andhra Pradesh, Uttar Pradesh, Bihar and Tamil Nadu."

1992: The Water Development Society (WDS) in Andhra Pradesh had been training small-scale cycle trailer manufacturers. The Council for Advancement of People's Action and Rural Technology (CAPART), a Government of India body involved in technology transfer had provided funding for this. CAPART however considered the cycle trailer project had been a failure, primarily because it was a "weak technology". The various partner organisations (WDS, MACE, IERT) were not actively networking with each other. They considered the lack of success was mainly due to lack of programme coordination (by IT Transport), competition from cycle rickshaws, lack of marketing and too much individualism/hobbyism. The trailers were relatively expensive due to costly jigs and fixtures. The target group of users lacked purchasing power and credit, making the market outlook poor. There were no large-scale production and marketing initiatives.

1999: The external organisations involved in the funding and implementation of the Indian cycle trailer initiative during the 1980s were unaware of the present situation. There appeared to be no recent reports of significant on-going manufacture or of widespread or sustained adoption.

Some lessons relating to the adoption of intermediate means of transport

- *There should be many valuable lessons to learn from the attempts to introduce cycle trailers into India, but there appears to be insufficient accessible information to allow this.*
- *There is a need to follow-up and evaluate technology programmes, and share the lessons learned.*

References: IT News, 1987, 1988, 1990; de Silva, 1992.

Networking and information exchange

The record of inter-institutional information exchange and collaboration in the field of rural transport and development has been good. For many years, the strong links between IFRTD, ITDG, IT Transport, ILO, World Bank have resulted in knowledge sharing and synergetic programme development. However, the field has tended to be dominated by anglophone experience. This seems to have been reflected in what may prove to have been a disproportionate interest in particular technologies (eg, wheeled toolcarriers – see Box 31, 'appropriate technology' carts – see Box 13, some wheel making technologies and cycle trailers – see Box 33).

IFRTD has been advocating the development of national and international networking activities to improve understanding on rural transport issues (Starkey, 1998). Affiliated national networks (transport forums) have been formed in several countries, and are engaged in bringing together transport stakeholders and enhancing the understanding of rural transport issues through information exchange, research, advocacy and policy recommendations.

In separate, but complementary, initiatives, RTTP and PTMR have been facilitating the formation of national steering committees, with comparable roles. These national networks should play important roles in both information exchange and transport

policy development, provided they aim to include all stakeholders. Continued strong national and international networking is required, with increasing emphasis on inter-African networking and honest exchanges concerning the success and failure of initiatives to promote intermediate means of transport.

Although indigenous experts have implemented most national transport programmes in Africa, international programmes have been slow to build on African expertise. The 'expert meeting' for which this paper was first prepared helped to identify ways of increasing the influence of African experts in planning and implementing national and international programmes relating to intermediate means of transport (RTTP, 1999).

A positive development in recent years has been the collaboration between transport programmes and the Animal Traction Network for Eastern and Southern Africa (ATNESA). This active regional network has stimulated the formation of several national networks that are working on animal-powered rural transport. ATNESA has been promoting user-orientated, participatory methodologies. ATNESA indigenous experts have much to contribute to rural transport programmes, which have had a reputation for being rather 'top-down'.

There are many other active, participatory networks in the fields of agriculture, water, gender and zonal development that have overlapping interests in the field of rural transport. There is much scope for further collaboration with other networks involving synergetic exchanges and joint activities.

West Africa has not benefited from such active networking in recent years. There are some national networks (in transport and animal power) and these have organised inter-country exchange visits and small workshops, in association with IFRTD, RTTP (PTMR) and other organisations. However, the lack of strong regional networks is severely limiting information exchange relating to local transport solutions in West and Central Africa. The extra difficulty associated with bilingual meetings has also limited inter-programme initiatives within West Africa, and between the various African regions (including Madagascar and Central Africa). Given the great importance of exchanges of experiences, the stimulation of more active African networking on transport issues, particularly in West and Central Africa is likely to highly beneficial.

Much of the evidence and case history material presented, makes is clear that lessons from one part of the world, can be highly relevant to other circumstances. While different countries have distinct social, cultural and economic conditions, many lessons relating to intermediate means of transport are relevant in Africa, Asia, Latin America and Europe. This is true of the spread and evolution of hand carts, bicycles, cycle trailers, pack donkeys, donkey carts, ox carts, cow wagons and small motorised vehicles. There is a need to combine regional networking with valuable inter-network exchanges.

Box 33 Will cycle trailers 'take off' soon – or not?

In many countries of the world, individuals have invented and used bicycle trailers as one-off solutions to local transport problems. Some have been further developed and manufactured by entrepreneurs and organisations in South Asia, Europe and North America. Cycle trailers can increase the weight and volume that can be safely carried by a bicycle. They are detachable (unlike load-carrying tricycles and cycle rickshaws) and so allow the bicycle to be used for personal transport as well as carrying loads.

During the 1980s, the British-based Intermediate Technology Development Group and IT Transport identified cycle trailers as an intermediate means of transport with much potential for developing countries. As a result of their recommendations, projects promoted the manufacture and use of cycle trailers in several countries including Ghana, India, Kenya, Sri Lanka and Tanzania. In all these cases, the trailers seemed technically capable, but adoption was much less than envisaged, even when credit was made available (see Box 12, Box 14, Box 32). Some people said the bicycle trailers were heavy to pull when laden; some said they were too expensive (similar in price to the bicycle); some found them difficult to manoeuvre along paths; some thought them complicated as it was easier to carry a smaller load on a bicycle. Some people found them useful and profitable.

Many of the problems cited also apply to load-carrying tricycles and cycle rickshaws: but cycle rickshaws are a clear 'success story' with millions of them in use in South Asia. Load-carrying tricycles are also successful, and are spreading 'spontaneously' in Peru, Bolivia, Colombia, Cuba and elsewhere.

During an 'expert meeting' on intermediate means of transport held in Nairobi in 1999, it was acknowledged that the adoption of cycle trailers had been much less than predicted. Some participants thought it was simply a matter of time and promotion: cycle trailer adoption was going to 'take off' soon. Other participants felt that the disappointing adoption had been due to the lack of clear comparative advantages between cycle trailers and alternative options. Whether or not cycle trailers will ever become widely-used is a sensitive topic for the organisations and individuals that have promoted this technology and published optimistic forecasts.

The matter remains unresolved: time will tell. Clearly project initiatives should encompass participatory methods to clearly establish the likely benefits, costs, usage patterns, gender issues and the technical, social and economic constraints to the adoption of a technology. Overall learning will be most rapid if programmes involved in the development of intermediate means of transport share information concerning the technologies, their uptake and the associated problems. Such exchanges can be facilitated through broadly-based national and international networks.

Some lessons relating to the adoption of intermediate means of transport

- *Rapid adoption of technologies identified as 'appropriate' by 'experts' cannot be guaranteed.*
- *Optimism and enthusiasm for technologies must be matched by critical monitoring to ascertain the reasons for disappointing uptake and to share this information with all stakeholders.*
- *Programmes involved in intermediate means of transport in different parts of the world should share their experiences in constructively-critical national and international networking activities.*

References: Barwell and Howe, 1980; Howe and Barwell, 1987; Starkey, 1988; Dennis, 1999.

Conclusions

This study has highlighted the importance of intermediate means of transport as local transport solutions, and the very uneven nature of their use. Disparities noted include differences between countries and continents, between urban and rural areas, and between men and women transporters. There is a tendency for intermediate means of transport to be seen as 'backward', and for them to be ignored by planners and to be marginalised by the motoring elites. However, there will always be a need for intermediate means of transport for small-scale movements that complement large-scale transport systems. In most countries of the world the use of intermediate means of transport will continue to expand. They will be used primarily for personal mobility (men and women, young and old, and those with special needs), for the short-distance movements of small loads and for the first/last links of marketing chains. Depending on the circumstances, economic and social benefits can accrue from both local transport hire services and individual ownership.

Examples have been given of the 'spontaneous' adoption of intermediate means of transport, involving local inventions or technologies derived from other places. The technologies have spread through user-to-user contacts and private supplies (formal or informal sectors). In many cases these have started with transport around markets, areas normally rich in information exchange, cultural diversity, profitable transport opportunities, raw materials and artisanal skills. Spread of transport innovations into new areas, is initially quite slow. The innovation is perceived as unorthodox, and there is insufficient demand to justify reliable and affordable supplies. Only when the necessary 'critical mass' of transport devices and users has developed, does adoption become easy. At this stage, the numbers of users are sufficient to ensure that the technology has won social acceptance and that demand is sufficient for the development of sustainable support services.

Although private sector promotional mechanisms can work well, they cannot be relied on. This is particularly true in resource-poor areas, with low population densities, where transport is important but not necessarily very profitable. Much of rural sub-Saharan Africa falls into this category. In these areas, rural women and men invest much time in essential transport tasks involving walking and carrying. This reduces the time available for more productive activities and reinforces their state of poverty. Agricultural production, trade and economic activity are often constrained by inadequate transport between fields, villages, local markets and the large-scale transportation networks. The main transport burden falls on women, particularly for time-consuming, domestic transport tasks. Helping to remove transport constraints for women and men through intermediate means of transport should help to alleviate poverty and stimulate rural development.

There are examples of intermediate means of transport spreading 'spontaneously' in rural areas, including bicycles, ox carts, donkeys, wheelbarrows and hand carts. Most are relatively unspecialised technologies that can be used for a wide range of different transport jobs. These have generally been associated with men, rural markets and income-generating options. Adoption of such transport innovations has tended to result in social and economic differentiation. Those able to profit from investments in transport gain more time, more income generating options and/or greater productive capacity than those who cannot.

In recent years, development programmes and NGOs have attempted to introduce intermediate means of transport into rural areas in sub-Saharan Africa. Examples have been given of successful initiatives, including projects to introduce donkey carts, ox carts and hand carts. Successes were often (but not always) associated with participatory methodologies with built-in monitoring, facilitating reliable and affordable supplies, credit (for users and/or producers) and opportunities for transport hire. Men have been the main direct beneficiaries. Women have sometimes benefited though secondary use of transport devices.

Some attempts to introduce transport technologies failed due to top down approaches, failure to appreciate local user preferences and through lack of financial justification. Some programmes were over-optimistic, about the qualities of the transportation devices, people's ability (or willingness) to pay for them and the timescale of adoption. Generous subsidies and credit could stimulate interest, but could not guarantee sustained adoption.

The case histories cited make it clear that adoption of transport technologies involves complex processes and that simplistic solutions are unlikely to be correct. Nevertheless, there are clear methodological lessons to be learned. Improvement of rural transport requires participatory and gender-sensitive methodologies to ensure suitable transport solutions are identified and promoted. Low demand may favour transport devices, animals or machinery with several functions. Emphasis should be on ensuring reliable, private sector supplies and facilitating the development of a 'critical mass' of users. Consideration should be given to income generating transport options that makes ownership of intermediate means of transport both economically and socially beneficial. Enthusiasm for particular technologies must be matched by objectivity and self-criticism. To speed up overall progress, programmes need to evaluate and share their experiences, openly, involving all stakeholders.

Even if all the recommended methodologies are applied, there will still be problems in targeting the more marginalised members of society. These may even be impoverished (relatively or absolutely) by the entrepreneurial transport activities of the initial adopters. While local transport solutions should reduce drudgery and stimulate the overall economic development of communities, the benefits will not be shared equally. Women and old people are unlikely to benefit proportionally unless there is specific targeting, in relation to technological choice, information, subsidies, credit, income-generating opportunities and/or empowerment group formation.

Poverty reduction, economic development and enhanced rural transport need more than roads and motorised transport. Rural development also requires local transport solutions, with increasing use of intermediate means of transport. Success will depend on stimulating numerous, local initiatives that are clearly appropriate to specific areas and particular stakeholders. Public, private and/or NGO concerns and partnerships may devise and implement them. The inclusion of intermediate means of transport in national transport strategies and the development of policy environments conducive to their use will influence success. Progress will be faster if there is improved information exchange at project, national, regional and international levels, facilitated by networking activities. Broadly based national and international networks should encourage information exchange and programme collaboration and promote greater understanding (backed by empirical data) of the many factors that influence the adoption, ownership, use, social value and economic benefits of intermediate means of transport as local transport solutions.

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