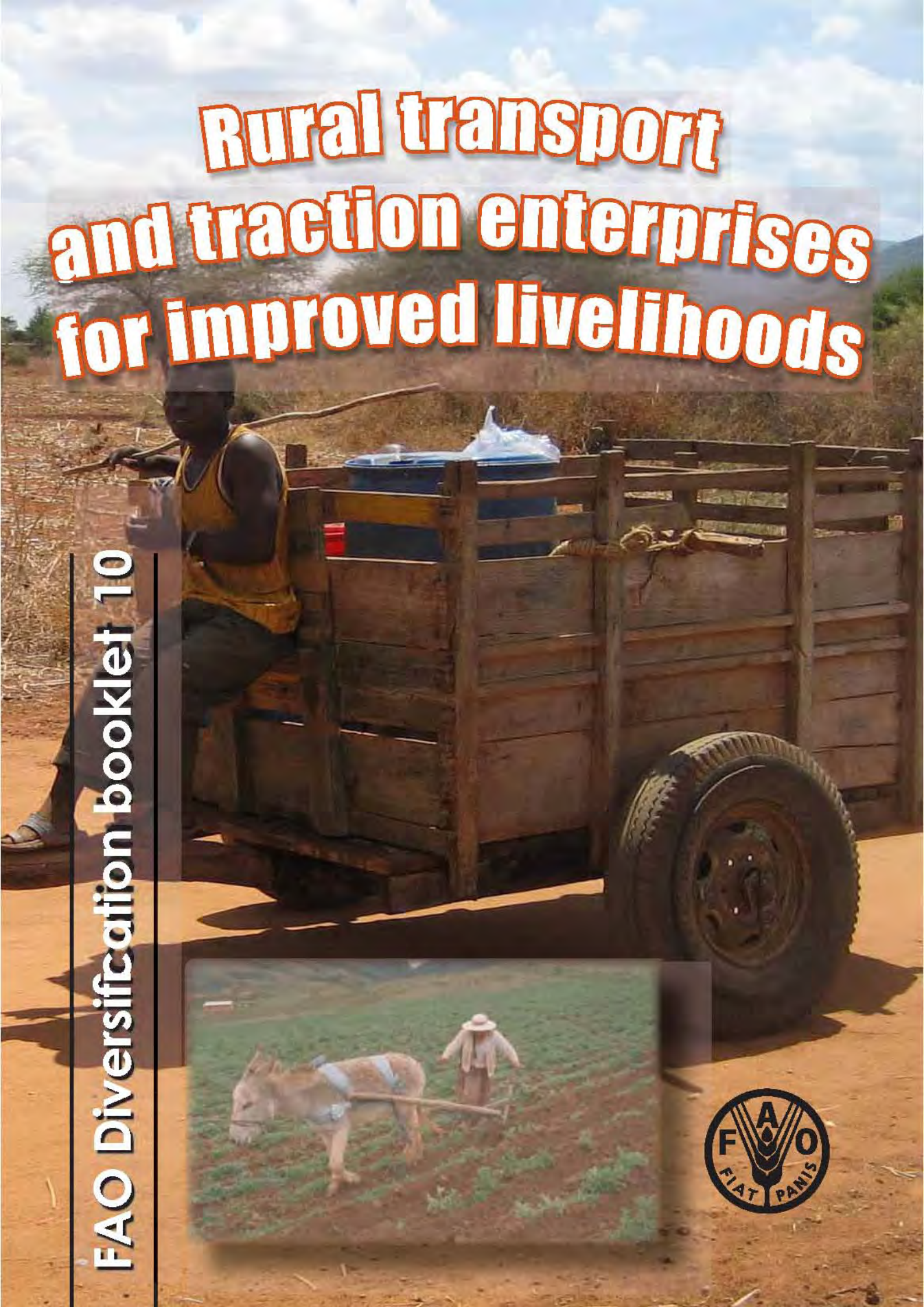
Rural transport and traction enterprises for improved livelihoods



FAO Diversification booklet 10

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Rural transport and traction enterprises for improved livelihoods

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Food and Agriculture Organization of the United Nations
Rome 2009

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Preface

The purpose of the FAO Diversification booklets is to raise awareness and provide decision support information about opportunities at farm and local community level to increase the incomes of small-scale farmers.

Each booklet focuses on a farm or non-farm enterprise that can be integrated into small farms to increase incomes and enhance livelihoods. The enterprises profiled in the FAO Diversification booklets are suitable for smallholder farmers in terms of resource requirements, additional costs, exposure to risk and complexity. The products or services generated by the enterprises are suitable for meeting demand on a growing, or already strong, local market and are not dependent on an export market.

The main target audience for these booklets are people and organizations that provide advisory, business and technical support services to resource-poor small-scale farmers and local communities in low- and middle-income countries. It is hoped that enough information is given to help these support service providers to consider new income-generating opportunities and how these might enable small-scale farmers to take action. What are the potential benefits? What are farmer requirements and constraints? What are critical 'success factors'?

The FAO Diversification booklets are also targeted to policy-makers and programme managers in government and non-governmental organizations. What actions might policy-makers take to create enabling environments for small-scale farmers to diversify into new income-generating activities?

The FAO Diversification booklets are not intended to be technical 'how to do it' guidelines. Readers will need to seek more information or technical support, so as to provide farmer advisory and support activities relating to the introduction of new income-generating activities. To assist in this respect,

each booklet identifies additional sources of information, technical support and website addresses.

A CD has been prepared with a full series of FAO Diversification booklets and FAO technical guides, together with complementary guides on market research, financing, business planning, etc. Copies of the CD are available on request from FAO. FAO Diversification booklets can also be downloaded from the FAO Internet site.

If you find this booklet of value, we would like to hear from you. Tell your colleagues and friends about it. FAO would welcome suggestions about possible changes for enhancing our next edition or regarding relevant topics for other booklets. By sharing your views and ideas with us we can provide better services to you.

Acknowledgements

Gratitude is owed to Clare Bishop-Sambrook, for a series of technical reviews and contributions to the booklet. A special thank you goes to Roberto Cuevas, Senior Officer, Divine N. Njie, Agro-industries Officer, and Alexandra Röttger, Agribusiness Economist, Rural Infrastructure and Agro-Industries (AGS) Division, FAO, for their reviews and contributions. Thanks are also owed to Brian Sims for technical reviews, proofreading and providing some photos for the booklet; Martin Hilmi provided for reviews, and followed the entire production and post-production process of the booklet.

Acknowledgements for the series

Gratitude is owed to Doyle Baker, Chief, Rural Infrastructure and Agro-Industries Division (AGS), FAO, for his vision, encouragement and constant support in the development of the FAO Diversification booklet series. Thanks are also due to Josef Kienzle, Agro-Industries Officer, AGS, FAO, for his patience, commitment, and contributions to the production and post-production of the series. Clare Bishop-Sambrook, principal editor of the series, provided technical support and guidance, both during the development and finalization of the booklets. Martin Hilmi provided both technical and editorial inputs and managed the post-production phase of the series. Fabio Ricci undertook the design and layout of the booklets and desktop publishing.

Introduction

Rural transport, traction and mobility

Smallholder farmers are vulnerable to a multitude of factors in their agricultural work. Vulnerability can arise from such factors as weather, pests, plant and livestock diseases, changes in prices for farm products and inputs. These can all seriously jeopardize the farm as a business and consequently the livelihoods of farmers and their families. If enterprises fail or yields are low and prices are not sufficiently high to cover production costs, farmers and their families find themselves in distress. Smallholder farmers, to avert such perils and to improve their livelihoods, need to diversify their farming operations and can choose from a range of fairly simple and easily accessible enterprises. Examples of such diversification enterprises are: poultry; beekeeping; basic vegetables; goats and sheep and also simple value adding enterprises, such as tomato processing. These can all be fairly easily integrated into farming systems, provided that they are promoted in an appropriate manner and training is given.

Diversification enterprises do not only need to be based on crop, livestock or fish farm production. Successful diversification enterprises can also derive from services related to production and marketing of farm produce. Transport is a critical service that, if promoted, planned and accompanied by appropriate training, can turn out to be a profitable enterprise for smallholder farmers. Production, trade and daily life require movement of goods and people. At its most basic level, smallholder farmers can offer transport services to market for farm produce 'on foot' or 'on hoof'.

Different transport technologies exist which employ human energy, animal power or the use of motor vehicles. They range from basic walking and carrying to large-scale motorized transport, including motorcars, large trucks and buses. The many transport options available have different ranges, capacities and operating costs. These overlap and provide a continuum of complementary 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.

Lack of transport is in fact one of the many barriers that impede access to markets and hence to revenues which are much needed by smallholder farmers. However, there is little point in promoting development and diversification to smallholder farmers in rural and remote areas, without giving them an opportunity to access markets.

Traction is an input enterprise to the farm. Animals and simple motorized vehicles, such as small tractors, carry out land preparation, harvest and post-harvest operations. Further, animals such as donkeys, oxen and camels, as well as motorized vehicles, can also be used importantly for transport. This dual use for animals and motorized vehicles can be turned into a viable business enterprise, if managed properly.

FIGURE 1 Donkeys being used for traction
(Photo by J. Kienzle)

Transport and traction enterprises do not only bring about improvements for smallholder farmers, but can bring benefits to local communities. For example, transport provides mobility; it enables rural populations to move, to benefit from social and educational interactions, health care and technology transfer. However, unfortunately it is often true that the majority of people in a rural community are not in a position to afford mobility for its own sake. For them, the only way that rural transport can really be justified is when it can be used to generate revenues which are greater than the costs involved. It is only a minority with higher disposable incomes that can afford transport for leisure activities.

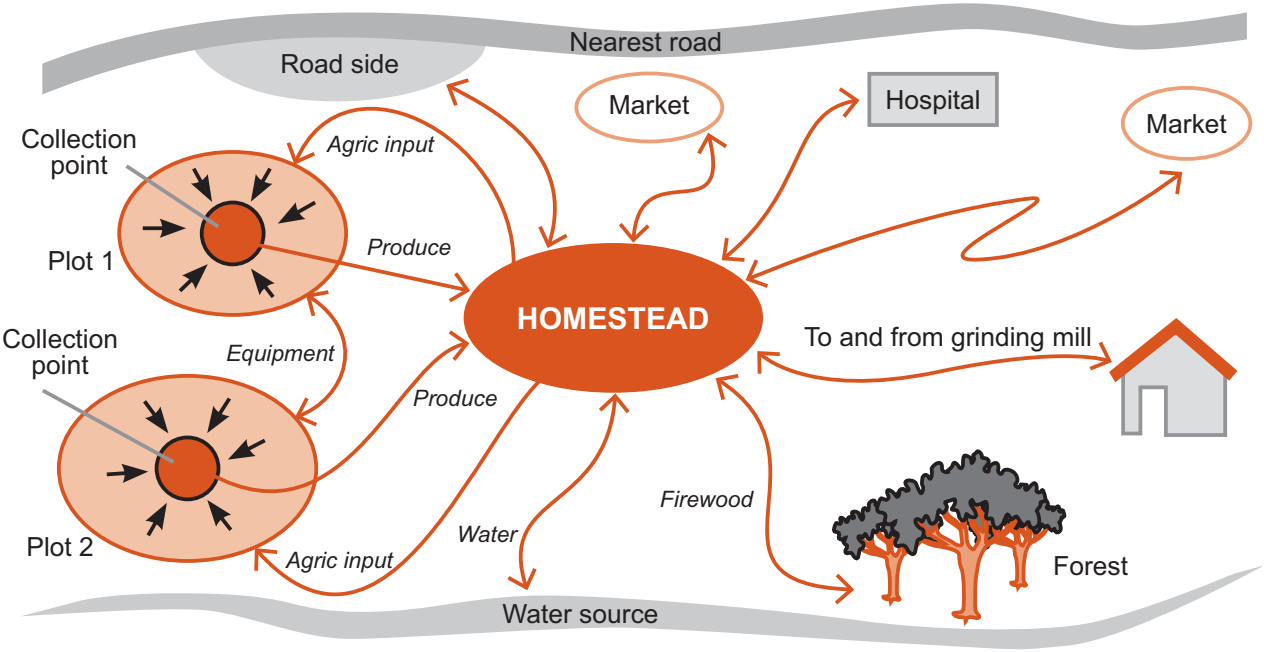
There are many parts of the world that have transport problems, these keep people in isolation, (usually the poorest people), with little chance of changing, developing and improving their livelihoods. These difficulties also hinder people in meeting their most basic needs for food, education and health. Transport greatly influences the businesses associated with storage, processing, and distribution of food products, which in turn gives rise to a large volume of activities and demands for infrastructure, thus generating jobs where unemployment can be very high.

Transport operations are a basic component of agricultural input and produce supply chains. Transport can be the decisive factor for the success of a farm or business activity, or else the one constraint that makes costs prohibitive or renders a project economically non-viable. The costs of supply chains and the prices of the final food product are affected by transport operations in a multitude of ways. Transport is commonly a major component of the operation cost in the food chain. Transport is so important that a lack of it may become a barrier for small-scale producers and for the development of efficient, lucrative agribusinesses. Transport is, in short, a key link in the supply chain.

Transport and traction services should be promoted in such a manner that they are viable enterprises in defined localities. This requires surveying the area to ascertain: demand for such services, the existing systems of transport and traction, the estimated costs and profits for such enterprises and if there is a viable infrastructure to support them. Also the survey should verify that such enterprises can be integrated into local farming systems, complementing them rather than competing with them. It needs to identify the possible training requirements together with target groups and how such training can be delivered.

Rural transport not only concerns the movement of farm produce, but also helps in household tasks such as procuring food and other essential inputs like water and fuel wood, it also supplies the basic needs of mobility and access to social services, including schools and health centres (Figure 2).

FIGURE 2 Common transport routes of a small farm in sub-Saharan Africa



Source: O'Neill, D. H. 2005. Ergonomics in the improvement of rural transport in sub-Saharan Africa, International Ergonomics Association Press. (Adaptation by Fabio Ricci.)

CASE STUDY 1 **Transport and poverty alleviation in rural Pakistan**

Rural areas in Pakistan are home to 100 million people or two thirds of the total population; they are also home to more than three quarters of the poor or 42 million people living below the poverty line. One in every five villages is still not accessible by all-weather roads. Confined by a lack of transport services in three of every ten villages, a large proportion of rural Pakistan lacks access to markets and basic services, as well as physical, social and political opportunities. Poor people and poor communities in rural Pakistan are least likely to have access to transport services and infrastructure. At the same time, low accessibility to roads and transport services are associated with lower human development outcomes. For instance, data suggests that girls' net primary school enrolment rate is 50 percent higher in communities with all-weather roads and transport services. These communities also have higher incidence of pre-natal medical consultation for women, a higher proportion of childbirths attended by skilled personnel, higher incidence of post-natal consultation, and a lower probability of births at home. Within villages, rural households and, to a large extent, rural women bear a very high transport and travel burden associated with basic and social needs as well as economic activities.

Source: Essakali, M. D. 2005. Rural access and mobility in Pakistan: A policy note, The World Bank, Washington D.C.

Transport and traction enterprises

By starting transport and traction enterprises, smallholder farmers are diversifying their income base from traditional crops and livestock activities. Such diversification enterprises offer a number of direct revenue sources that may be important for smallholder farmers, as well as other benefits such as cost reductions and greater social integration. Revenue sources can derive from transport and traction services carried out directly by smallholder farmers, but can also derive from simply renting out the vehicle to others to use. This can produce profits as well as cash flow over a longer season than that usually associated with agricultural production. Furthermore, in periods of low agricultural yields, hence reduced calls for transport and traction services, smallholder farmers may still have a market for transporting other goods, people, and construction materials; mobility is a prerequisite for many rural dwellers.

Cost reductions may also occur. When, for example, a smallholder farmer is taking produce to market, he or she may rent out space to other farmers for a price and hence reduce his or her transport costs. Smallholder farmers may also have returns which are not strictly in monetary terms. For example, making space available on a transport journey to market in a nearby town for a person who needs medical treatment may create gratitude, enhance social ties and reputation.

FIGURE 3 A tractor and trailer transporting both rice and people
(Photo: © FAO/17679/A. Conti)

Vehicles for transport and traction can be used in multiple ways and can prove to be highly versatile (bicycles and other vehicles can be used both for carrying goods and for carrying people, for example). Vehicles offer different combinations (and design compromises) of cost, weight, carrying capacity, manoeuvrability, speed, durability and aesthetic characteristics. Having such multiple uses and versatility fits in very well with the numerous demands that can be made upon transport and traction enterprises. For example, donkeys can be used for tillage with various kinds of farm equipment, they can be used for weeding, can be used in threshing and other post-harvest operations, they can be back-loaded and carry people, they can be harnessed to two wheel carts and four wheel wagons.

Vehicles have the ability to be complementary and hence can carve out competitive niches for themselves. For example, light-weight loads, such as the transport of flowers to market, can be carried out by human or animal 'vehicles', while for larger quantities and heavier loads, motorized vehicles are more appropriate. Some vehicles will be more appropriate for certain terrains and weather conditions than others; a narrow uphill path is more easily negotiated by donkey or mule transport than a bicycle with trailer.

The individual and group in transport and traction enterprises

The individual smallholder farmer is an important asset in rural areas for creating businesses that are farm related. Smallholder farmers can be seen as the 'entrepreneurs' of rural areas and with their entrepreneurial spirit can guide others to follow and also create business opportunities. Training in farm management and entrepreneurship is needed to foster such growth potential. After training has been provided it is important to mentor smallholder farmers with regular checks to see how the transport and traction enterprises are doing and schedule additional training where required.

From a purely business perspective, many benefits can be generated by organizing smallholder farmers into formal or informal groups. Vehicle maintenance, be it mechanical or veterinary, will be carried out regularly and the common interest in the vehicles can ensure that regular checkups are not forgone for cost reasons. Further there will be increased knowledge within the group, not only about transport and traction methods (for example, the best method of applying a back pack on a donkey or for attaching a plough to a draught animal) but also about possible users in other

communities, spare parts location and where good veterinary services can be obtained, etc. Groups also have increased bargaining power, not only for transport and traction tariffs, but with spare part traders, repairers and veterinarians. For training purposes, smallholder farmer groups are ideal. Not only can training sessions reach more farmers in a single session, but can be scheduled more easily. Groups may even have the ability to pay for training and hence encourage private sector training services to enter the market, so that the burden of training is not all on public budgets.

Enabling environments that foster entrepreneurial activities also need to be created and nurtured. Making and implementing laws that encourage rather than hinder entrepreneurial enterprises are also important, for example, enabling credit services to be widely distributed and accessible to smallholder farmers. Training can be given to local communities in setting up savings and credit groups. Support infrastructure services are critical for creating an enabling environment, for example, keeping roads in good condition through regular maintenance schedules.

Local communities have a large role to play in enabling transport and traction enterprises. The first and most important role local communities can play is that of providing social capital. By their very nature, transport and traction enterprises rely on support systems and networks to operate in a sustainable manner. Local communities that have a culture of mutual help can possibly provide for improved access to credit and savings that can be of enormous help in starting up a transport and traction enterprise. Local communities can also provide necessary support services for the enterprise; for example, the local blacksmith can become a repairer and provider of spare parts for hand carts. Community approval for adoption and support of defined types of vehicles can be of great help to individuals and also generally encourage the proliferation of an entrepreneurial culture. Smallholder farmers that are already entrepreneurial by nature, or are becoming more commercialized, are key targets for promoting transport and traction diversification enterprises.

Local communities provide an immediate market for transport services, for example transport used to access health care, collect water for community or hiring traction services for cultivating community land. Transport and traction enterprises have large community binding connotations and thus in turn can help reinforce social unity in communities.

CASE STUDY 2 **Transport repairs in Madagascar**

In the village of Anjanadoria, in Madagascar, most of the 850 families own an ox-cart but few use bicycles. Two carpenters make and repair ox-carts in the village, but no one repairs bicycles as there are few bicycles and little demand. One reason why few people own bicycles is the problem of repairs. Bicycles are taken by cart 15 km to the local market town, where artisans have established small bicycle repair workshops. Ox-carts already have a 'critical mass' in that village, but bicycles have yet to achieve this. People anticipate that in a few years there will be more bicycles and a bicycle repairer in the village.

CASE STUDY 3 **Spread of donkey carts in Mauritania**

Pack donkeys have been used for centuries in Mauritania to transport water, goods and people. Recently there has been a large expansion in carts pulled by donkeys and horses. Over 75 000 donkey carts have been bought in the past 30 years. This rapid increase has been primarily encouraged by an entrepreneurial culture and activities, importantly with the acceptance of such a culture at the local level. Government did not have a role in the rapid increase in the spread of this transport technology. The cart components derive from workshops in Senegal and Mali. Most have been made from components in small workshops in Mauritania. Carts cost US$180-260, implying some US$5 million has been invested in them in 20 years. Credit for carts has been minimal. Urban transporters and rural families have found cart investment profitable. The carts have increased the capacity to transport water, produce, forage, materials, traded goods, people and urban waste.

Source: Starkey, P. 2001. Local transport solutions for rural development, people, paradoxes and progress: Lessons arising from the spread of intermediate means of transport. World Bank, Washington D.C.

Purpose of the booklet

This booklet is targeted at public and private advisory institutions providing technical and advisory support to rural communities, in particular advisory service providers involved with developing and enhancing revenue-generating rural enterprises for farmers. The booklet focuses on promoting transport and traction services as a viable business enterprise for smallholder farmers. It looks at the dual role that 'vehicles', such as donkeys, oxen and smallholder motorized equipment can have for either transport and traction and their significance for the development of smallholder farmers and their surrounding communities. For transport enterprises the booklet concerns land-based farm to main road linkages, since this is the most critical for smallholder commercial development. Note that in this booklet the term 'vehicle' means both a mechanical device as well as an animal for transport and traction and indeed even a load-carrying man or woman.

Benefits of transport and traction enterprises

Efficiency for farm businesses

At farm level, traction performed by animals or small tractors can increase land and labour productivity, provide for a larger area of land to be cultivated, help in harvest and post-harvest operations and all in all speed up such tasks. This will allow smallholder farmers to be more efficient and effective with their labour needs. For example, time and human energy can be saved by using animals to replace such tasks as hand hoeing. But animals for such a task need to be trained and this takes time and effort.

Transport can help farm 'movement' requirements to be carried out more efficiently, for example, harvested crops can be moved from field to homestead in less time and with a larger payload per trip. Transport operations for marketing can be made more efficient, with the reduction in costs per trip to market. Operations can be combined, for example, by transporting other farmers' produce and maybe also people to market on the same trip.

Relief of drudgery

Household tasks that are carried out mainly by women, (transporting food to the household, collecting water and firewood) can be considerably reduced in terms of time, and energy and enable smallholder farmers to devote these resources to other more productive activities, such as marketing of farm produce.

BOX 1 **Household work in the United Republic of Tanzania**

Studies in two areas of the United Republic of Tanzania found that, on average, each household spent a total of 40 to 50 hours per week just on transport activities devoted to household needs. Women undertook about 80 percent of this and men 20 percent.

Source: World Bank. 2003.

Transport and traction systems that base themselves mainly on human labour, for example, carrying produce to market as a 'back load', are high in terms of time and energy inputs, but give little in terms of output. Improved transport and traction technology can improve this input-output relationship for drudgery. For example, by the introduction of a simple handcart, it may be possible to carry more produce to market and require less effort in terms of labour. However, the mere reduction of drudgery in itself – while extremely beneficial to the people involved – may not generate the revenue required to sustain ownership of a transport and traction vehicle.

However it is important to note that the time and effort saved may not necessarily be devoted to productive activities. For example, women may choose to use the time saved from collecting water to improve their quality of life, spending it with the family and children, or using it to collect more water for household use. Traction time saving may also encourage a smallholder farmer to cultivate more vegetables, but this decision needs to be based not only on markets i.e. can he or she sell the vegetables?; but also on the important factor of transport i.e. can he or she transport the extra produce to market, and still keep the transport function efficient?

CASE STUDY 4 **Improved traction technology in sub-Saharan Africa**

Households using traction technology, i.e. animals and tractors, rather than the hand-hoe, gain considerable advantages in terms of area cultivated, crop diversity, yields, levels of drudgery, opportunities to redeploy family labour and household food security. While hoe households typically cultivate 1 to 2 hectares per year, animal hirers cultivate 2 hectares, households owning animals cultivate 3 to 4 hectares, tractor hirers cultivate up to 8 hectares and household owning tractors cultivate more than 20 hectares. Households relying on family labour for all their farming needs survive at the margin of subsistence. Households headed by women tend to be over-represented among this group, partly as a result of the loss of assets typically associated with widowhood.

Source: FAO. 2005. Contribution of farm power to smallholder livelihoods in sub-Saharan Africa, by C. Bishop-Sambrook, Agricultural and Food Engineering Technical Report No.2, Rome.

CASE STUDY 5 **Gender and transport services**

Bicycles can empower women and change their lives. A project in Tamil Nadu, India, in the 1990s introduced bicycles as part of a women's literacy campaign. The bicycles increased women's mobility, giving them quicker access to schools, hospitals, and markets. Gender roles changed as women undertook some previously male-dominated tasks such as marketing, taking children to school, and running errands. Bicycles allowed women to complete their tasks faster and easier, freeing time for other activities.

Outcomes are especially impressive when projects involve women in planning and when they target information, credit, and project activities to female transporters. For example, a project in a low-density region of northeast Tanzania introduced oxen, ox carts, donkeys, and donkey carts to address shortages of farm power and transport. As the project became more sensitive to gender issues, it became clear that although women had equal legal rights, they were underrepresented in decision-making at all levels of society.

Thus efforts were made to empower women by forming women's groups and targeting project activities and credit schemes to female farmers. Oxen tended to be owned and herded by men, and donkeys were not taken seriously. Women therefore found it easier socially, financially, and practically to own and manage donkeys. Because women were responsible for most transport around the village, they benefited from the spread of donkey carts, which could be used to carry people, water, firewood, crops, forage for animals, and goods for trading.

Source: Ellis, S. et al. *2002. Improving rural mobility: Options for developing motorized and non-motorized transport in rural areas, World Bank, Washington D.C.*

Gender equality can develop with diversified enterprises devoted to transport and traction. Normally it is women who carry much of the burden of drudgery on farm, for example, weeding the crops. They typically have little voice in the family in terms of economic decisions and may have even less in the local community. Promoting and training women in diversification enterprises can help them. It can mean that they spend less time doing domestic chores such as water collection and can spend more time in productive activities. The prospect of gaining extra revenue for the family may enhance the perception and acceptance that women can carry out such enterprises as transport and traction. As an added boost for gender development, transport can enable women to access markets, become involved directly in economic activities and create contact and networks with other women.

Improved access and market linkages

Traction enterprises offer the opportunity to increase productivity in a local area comprising many farmers. This can also be coupled with increases in yields, if there is market demand for such increases in quantities for sale. The related transport enterprise can thus enable access to markets for selling such farm produce and can also offer the potential to reach a wider and more varied range of markets in less time. Transport, in other words, can provide smallholder farmers in a local area with the prospect of capturing more business opportunities for themselves, creating market linkages, enabling first hand access to market information and making contacts with other producers and traders. With an increase in trade, inevitably there will be an increase in demand for transport and traction services.

The development of transport enterprises for trade can also encourage other opportunities to arise in rural areas. For example, milk processors who may be aware of a transport service in a particular rural area, may hire the transport enterprise to collect milk from rural dairy collection points.

Market linkages will be easier to implement as smallholder farmers will have increased productivity, more produce to sell and direct access to more markets. Farmers will be able to spend more time in marketing and be able to interact directly with buyers.

Financial rewards

As noted earlier, transport and traction enterprises can provide for steady flows of financial rewards for smallholder farmers. Direct financial returns can arise from tariffs for hiring transport and traction services. Indirect financial returns can arise from time saving

CASE STUDY 6 **Profitable transport to market**

In Makete in the United Republic of Tanzania, some people use donkeys for the transport of potatoes from field to village and from village to market. While women and men transport head loads of 20-30 kg, a single donkey can carry 80 kg. In one study, 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. The benefit-cost ratio of a donkey investment was 7:1.

Source: Starkey, P. 2002. Local transport solutions for rural development. DFID.

that can be used for other activities which generate revenues. Further social services, such as transporting for health reasons, may result in eventual financial returns, as when for example, the community may recognize the need to have such a service available on a constant basis and thus will expect to pay for it. Furthermore the simple use of the travel component could make the smallholder farmer come into contact with a myriad of different people, which may result in business leads that eventually may lead to financial opportunities.

Smallholder farmer organization

The very nature of transport and traction enterprises encourages smallholder farmers to group together, either in formal or informal associations. For example, the initial investment cost of an animal or a bicycle can be quite high compared to local incomes. A group of smallholder farmers may join forces to have better access to credit and obtain better credit terms.

Organizations of smallholder farmers have many advantages. They are set up to serve the interests of the members and to be directed and managed by them. The provision of services is driven by members' and market needs. The association also provides a forum where all members have equal rights and can voice their concerns, for example, they could raise the issue of road maintenance and lobby for better service. The formation of associations among smallholder farmers enables donor sponsored projects to be delivered in a far more cost-effective manner and training can be more easily carried out. Other advantages may be: knowledge sharing, for example: What are the best breed characteristics for traction animals? What type and kind of feed is best for these animals? Further advantages are sharing risks, being able to reduce costs on feed, veterinary services, repairs and maintenance, more bargaining power in setting rental rates and having more capacity to transport materials and offer traction services. In some cases, professional staff may be hired to manage an association of smallholder farmers.

Such associations not only provide an effective means for self-realization and capacity building of their members, but have important spill over effects within the wider community. Associations can also increase rural mobility and create a demand for associated services, and also generate employment opportunities, strengthen the democratic process, and encourage dialogue in the local community.

BOX 2 Characteristics of successful tractor associations from Uganda

Common interest. Common interests among members were important, but the strongest and most binding common interest was that of trade.

Origins and motivation for forming the association. The factors that were instrumental in bringing members together and providing joint ownership were crucial to the long-term success of the association.

Characteristics of members. Members needed to have a sense of commitment to the association, have integrity and honesty, have networking and leadership skills and be personally motivated to be members.

Knowledge about members. Members had a basic level of information about each other.

Size of association. Small enough to be in touch with individual members needs, but large enough to exert influence.

Source: DFID. 1999. Guidelines for the development of small-scale tractor-based enterprises in the rural and transport sectors, by R. Petts & W. Hancox, draft, MAMCon and Intech Associaties.

Benefits to the community

Transport and traction provide advantages to smallholder farmers not only on their farms and in their marketing operations, but also as a business enterprise. Smallholder farmers can hire their traction service to other farmers, thus improving productivity and yields on other farms and also increasing the amount of farm produce available for trade, via the transport service, to market. Thus smallholder farmers with such enterprises not only increase their own prosperity, but those of others in the community. All this can lead to a more prosperous local economy.

Related services that are required for transport and traction services, such as blacksmithing and spare part trading, among many others, spur the creation of jobs in rural areas that were not present prior to the initiation of the enterprise. Smallholder farmers may also diversify into some of these related jobs, for example, a smallholder farmer who owns a tractor may become knowledgeable on its mechanics and be able to provide maintenance and repair services to other farmers who have tractors. Such a repair enterprise can become profitable if managed in an appropriate manner over time.

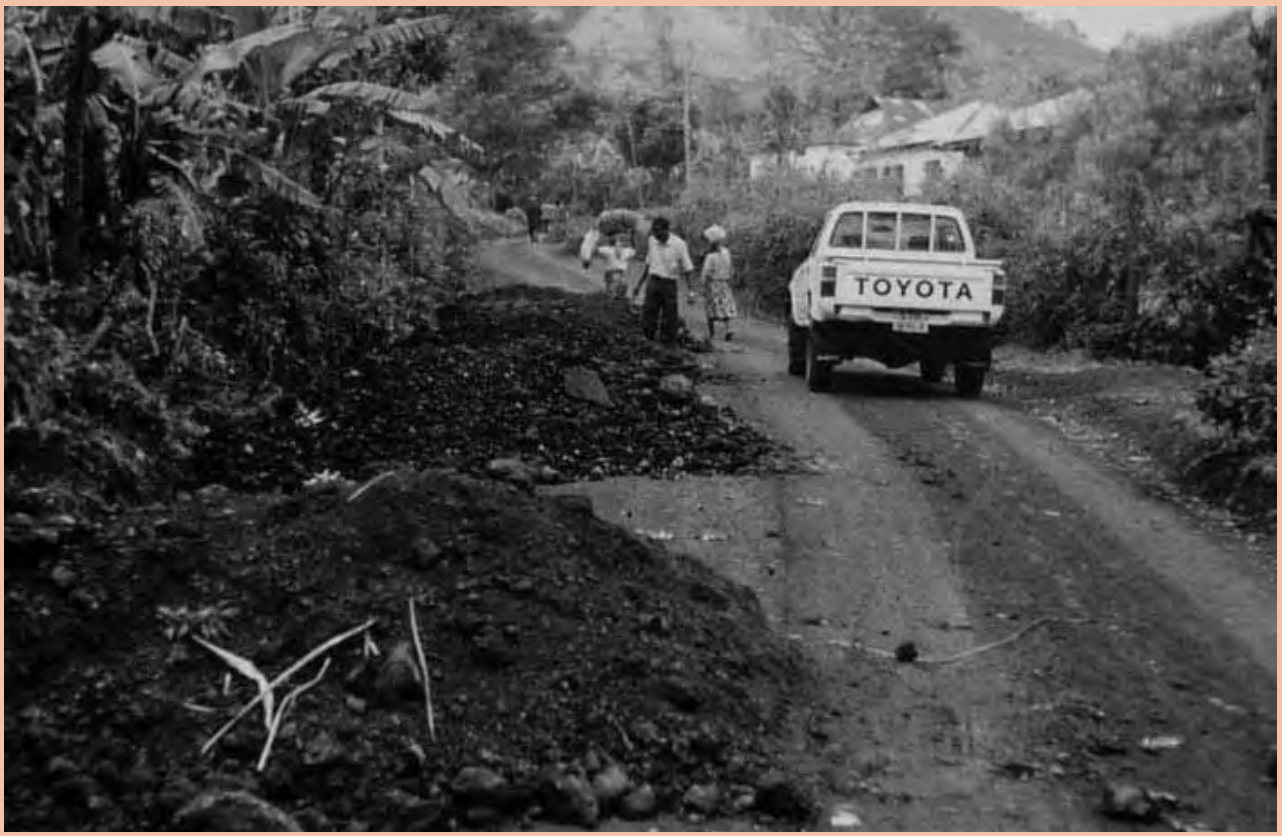


FIGURE 4 Upgrading of a road in northern Tanzania paid for by the community it serves (Photo: P. Crossley)

Many children in rural areas often have to walk long distances to reach school and often, such travel is combined with work. For example, children may be required to walk many kilometres to school every day carrying firewood to sell before they attend classes. A transport enterprise can help these children, not only in transporting the fire wood, but in reducing fatigue, and ensuring that they get to school on time. A transport enterprise can also be beneficial for healthcare reasons, where simple mobility can provide for access to doctors, hospitals and other health services.

Women can also enjoy advantages from transport and traction enterprises for these will reduce the time that they spend working on household tasks, carrying heavy loads, and may provide better safety for them. Importantly such enterprises may allow women to be more economically independent, enable social contacts with other women on a more frequent basis and can increase their decision-making role within the family. For the less able, having mobility may be a great advantage and allow them more frequent access to healthcare and other needed services.

Types and modes of transport and traction

Over time a wide range of local transport and traction solutions have been created, the main reason for this has been entrepreneurial capacity in the private sector. The various technologies developed offer combinations (and design compromises) of cost, weight, carrying capacity, manoeuvrability, speed, durability and aesthetic characteristics. These factors must be included and given their due importance in any appraisal of appropriate vehicles for diversification enterprises. Despite a wide range of vehicles in rural areas, much transport and traction involves either manual labour (walking, carrying, hand hoeing) or large-scale motorized technologies. What smallholder farmers really need are mainly intermediate means of technologies that increase capacity and reduce human drudgery at an affordable cost.

Population density, incomes, culture, topography, climate, farming systems, transport and traction needs and project activities all affect the success of promotional programmes for transport and traction enterprises. Complex combinations of environmental and socio-economic factors, together with human preferences influence vehicle adoption. Perceptions, especially among the young members of a population, at public policy level and in development organizations, often view non-motorized vehicles as old-fashioned options. This misperception can be very damaging in the development of enterprises based on transport and traction, as human (and even more so animal) technologies will always have appropriate and valuable applications at the local level in rural areas. Such relevance needs to be acknowledged in development projects and intermediate solutions promoted where appropriate. However, the benefits of 'motorization' and 'mobility' cannot be underestimated or even forgotten about. The most appropriate machinery and power source for any operation will depend on the work to be carried out and the relative desirability, affordability, availability and technical efficiency of the options. Careful evaluation is required for motorization adoption.

Vehicles in this booklet are divided into four classes:

1. Human based
2. Animal based
3. Simple mechanical types and modes
4. Motorized types and modes

1 Human based

Human power is normally widely available. However, human power means human labour (which translates as drudgery). The tasks of transport and traction are often very time and energy consuming. At the same time it is very often women and young people who carry out heavy transport tasks such as fetching water and firewood, and carrying goods to and from markets. In the case of land preparation and tillage (hand hoeing, digging), it is estimated that 65 percent of all such work in sub-Saharan Africa is carried out by human labour. Hence there is a high 'felt need' or incentive for smallholder farmers, NGOs, and projects to support the diversification from human based systems for transport and traction towards other means such as animal based or even motorized alternatives for these services.

Besides the economical or small-business paradigm of 'making a profit' through diversification options in transport and traction (at least at the level of human power); a second equally important aspect is that of 'reducing drudgery' or simply saving human labour and human power inputs. This is why innovations to facilitate transport and traction are often also referred to as Labour Saving Technologies.

BOX 3 What are labour saving technologies?

1 Labour saving practices, for example growing crops which require less labour than traditional crops, practicing minimum tillage, inter-cropping leguminous cover crops to suppress weeds or planting woodlots close to home.

2 Tools and equipment which reduce the drudgery and/or improve the efficiency of performing various farming or household activities, such as using draught animals for land preparation and rural transport, cooking on fuel efficient stoves, or harvesting roof water for domestic purposes.

3 Other potentially labour saving inputs, such as herbicides.

Source: FAO Labour Saving Technologies http://www.fao.org/ag/ags/subjects/en/farmpower/lst.html

FIGURE 5 Freshly harvested table tomatoes using human 'traction' for harvest and transport in the People's Republic of China
(Photo: © FAO/23180/Shanghua)

Nevertheless, human power is widely available and often cheap, as well as fairly adaptable to many terrain types and weather conditions, and in certain situations it can be the only available transport and traction solution. For example, smallholder farmers mainly rely on their own labour and that of their families to prepare land, irrigate and harvest. Commonly this method is preferred for it is immediately available and costless in the eyes of the smallholder farmer. Many small farmers also 'sell' their labour to other farmers for financial gain and/or social obligations.

However, such an enterprise can have its advantages, for smallholder farmers can constitute the only effective 'power source' that can perform certain jobs. For example, on a small-scale farm, picking and transporting table tomatoes or lettuces along plant rows can only be done effectively by human power. Further, human power is often used for land preparation, digging and tillage because other methods are either not available or not cost effective. Animals, for example, need to be bought and/or trained for draught animal power operations. And they may need additional feed if they are

to perform high-draught tasks. Simple mechanized equipment will also need to be bought and maintained, plus fuel cost and availability need to be considered. In summary and taking into consideration such factors as topography, access to the area, costs, input-output relationships, human power may prove to be the most profitable solution.

Human power is principally related to hand, arm, back and leg strength. Human power depends on physical constitution, gender, health, strength, age, climatic conditions, altitude and topography of the terrain. As a 'vehicle' human power can be 'trained' for best practices in transport and traction, especially handling operations and ensuring product quality. It can also be converted readily for both traction and for transport i.e. it has a high dual use value.

For transport purposes, human power is based on head, back and pole loading. Head loading has a defined load which can be carried, normally around 20 to 25 kilograms, but there are exceptions. Distances that can be covered are not excessive as fatigue

FIGURE 6 Head loading in Tanzania
(Photo by J. Kienzle)

sets in after hours of walking with loads and rest is required. Speed is very low compared to other vehicles, for example, it can be around 5 kilometres per hour.

Back loading offers the possibility of loading slightly more in terms of kilograms, but distance covered can be very much the same as head loading. One method of human-powered transport, common in Nepal, combines head loading (by means of a head sling) attached directly to the back load or to baskets. Pole based transport can carry a high payload, the operating cost on a long trip is about half that when head-loading. But on shorter trips the advantage is not so clear cut. The culture of this type of transport exists mainly in the Asian continent and is not common in Africa.

To assess the profitability of human based enterprises requires calculating the operating costs involved, the money that can be received, and the input-output relationship for the enterprise.

FIGURE 7 Head-back loading in Nepal
(Photo by B. Sims)

2 Animal based

Domestic work animals exist in all regions of the world. Animal power is often readily available, is more expensive than human power, is fairly adaptable to many terrain types and weather conditions, and in certain situations it can be the most viable transport and traction solution available. Animals can contribute directly to agricultural production, harvesting, post-harvest operations and rural trade. Animal power can provide for carrying inputs, an expansion in the cultivation area, better soil preparation and improved yields. Animals can also save farm household time, effort and drudgery. Animals can also be used for earth moving, road construction, logging and transporting farm produce for marketing. Animal power is a renewable energy source (it can be sustained in rural areas with little external input), is accessible to small farmers (even though for many small farmers animals are expensive), requires little or no foreign exchange and the money invested in animal power circulates within rural areas.

Many animals can be used in transport and traction enterprises: oxen, bulls, cows, water buffaloes, mules, horses and donkeys. In certain regions of the world camels, yaks, goats, reindeer, dogs, llamas and even elephants can be used. The kind of animals used will depend on local availability and the resourcefulness of the local population in raising and training them and devising hitches, pack frames, carts and wagons for load carrying. Furthermore, animals can adapt easily both to transport and traction i.e. they have a high 'dual use' value. In some instances it may be thought that animals can have a 'triple use', that of providing products such as milk and meat. In terms of economic viability, transport and traction animals do not make good milk animals (see FAO Diversification booklet No. 6 'Milk for health and wealth'). For meat, hides and other products, normally these can be realized when animals are a certain age, (not fit for work anymore), and depend on local culture and traditions of consuming meat and using other animal by-products. Manure can be an important by-product, depending on the animal (for example, donkeys produce more fibre and fewer nutrients in comparison with bovine manure). Manure needs to be managed (e.g. in corrals) and judiciously applied (usually to higher value crops) for its benefits to be achieved.

The breed of the animal is important as certain types can perform better and be more apt for transport and traction. Draught animals do have high costs in relation to smallholders'

incomes and can be out of the reach of many. Organizing farmers into groups for improved benefits is advisable when benefits can include such things as having access to credit services, opportunities for collective animal training programmes and combating peak work loads. Ownership of animal-powered transport and traction services can be advantageous, especially if the initial investment is considered in the light of future breeding, which can provide for successive generations of animals. Thus, rather than a high initial cost, animal power can be seen as a long term, profitable investment. As farmers increase productivity and earn more money, they will be able to purchase more animals and equipment, be able to look after the animals better and can eventually replace animal power with motorized power, if the circumstances deem it feasible.

However, animals used for transport and traction need to be trained properly and many smallholder farmers may not have complete knowledge about the best practices for using animals in these ways. Many smallholder farmers, whose communities have already used animal power for generations, may well need improved methods for transport and traction unknown in the local culture. Smallholder farmers who have never used animal power need training as a basis for starting a profitable enterprise. Typically animal characteristics that are important for transport and traction are: breed; character (animals that are calm and tranquil are preferred to the more nervous and aggressive type. They respond better to commands and can be trained more easily); physical constitution; age; adaptation to diverse weather and terrain conditions; and resistance to disease. Best practice for work animals dictates that they be looked after properly, fed correctly and not worked excessively. For example, oxen on average should not be worked more than 5 hours per day, they need to work in the early morning and late afternoon when the sun is not too hot, feed supplements need to be provided over and above fodder for maintenance, and rest time and veterinary care for the animal need to be considered.

Harnessing, hitching, pack frames, carts and wagons need to be considered carefully for the kind of animal in question and training is advisable for basic and improved methods. For example, back loading a donkey with two heavy baskets tied simply with a rope, may not only be uncomfortable for the animal, but can cause abrasions and cuts of the skin. Animals for transport and

traction have to be adaptable and fit in with local climatic and terrain conditions, for example, in hot and dry areas camels may be the best animal power, if available, and for mountainous regions with uneven terrain the best option will possibly be mules.

Clearly choosing the right animal for the required performance depends on many factors: initial acquisition cost of the animal, type of work to be carried out, loads that need to be transported, weather, terrain, fit within the farming system and local culture of farming. There are evident advantages from using animals for transport and traction enterprises; but care needs to be taken when adopting animal power in situations where it has been absent and humans have been the only power source. Factors that need to be considered are: a change in one part of the farming system may affect other parts; without training and good planning the transfer from human to animal power can disrupt existing labour patterns and family organization; initially it can also disrupt production and trade and have negative effects on yields and income; new technology can increase the reliance of smallholder farmers on outside technical assistance and veterinary services that may be difficult to find in the local area.

Donkey

Donkeys are not as strong as oxen or horses and for traction can be used only for light work such as harrowing, weeding and sowing. Donkeys are, though, somewhat faster in such operations compared to oxen. In transport the donkey is appreciated for its steady speed, 5 to 6 km per hour, much like human power transport, and can sometimes trot at greater speeds, keep a good pace, even on difficult terrain and narrow paths, travel long distances and can produce surges of power that may be critical in certain situations, for example, muddy roads and steep hills. A donkey's intelligence is underestimated: it can be trained, responds well to commands and whereas donkeys are sometimes branded as stubborn this is usually because they realize that the task at hand is too difficult or too burdensome.

Donkeys are an undervalued source of power. They cannot only contribute to household and small farm activities, but also to transporting farm produce and over their 14 (or more) year working life can considerably contribute to the 'power needs' of farm enterprises. For example, a simple calculation of a donkey that works for 4 hours per day, 3 days per week, in a year can contribute 624 hours of work. If this

CASE STUDY 7 The potential of donkeys in Kenya

The donkey has been used since the 1920s to transport goods in the Lari area in central Kenya on diverse terrain and sometimes harsh climatic and road conditions. The range of goods transported has widened over the years to include firewood, building materials and wood products, farm produce, water for domestic use, manufactured goods for household use and fodder for dairy cows. Despite the growth in the range of goods transported by the donkeys and their economic value to the community, little has changed in the last 70 years to ease the load burden on the animals. Goods are still strapped on the animals' bodies and the few carts used are badly designed, poorly maintained and overloaded. Little attention is given to the health and nutrition requirements of the donkeys.

A study carried out in the area revealed that the great potential of improving the efficiency in the area by promoting the use of appropriate cart designs, harnessing and proper health care were undermined by various actors involved in development projects. Further opportunities were found for other potential uses of donkeys such as lifting water from underground wells, land preparation, food and animal feed processing.

Source: Mutua, J. M. & Mwangi, J. N. 2000. Animal powered transport of goods in a diverse temporal and spatial environment: a case study of Lari division in Kenya, In: Kaumbutho, P. G., Pearson, R. A. & Simalenga,T. E., eds, Empowering farmers with animal traction, Animal Traction Network for Eastern and Southern Africa (ATNESA).

FIGURE 8 Donkeys for traction (Photo by B. Sims)

is considered over a 14 year working life it equates to nearly 9 000 hours of work output. This gives donkeys great value, not always reflected in their price, as in many countries they are cheap compared to other work animals.

Donkeys live well in arid, semi-arid and mountainous areas. They normally do not thrive as well in humid and semi-humid areas, but have good resistance and are reputed to survive better than Zebu cattle in tsetse-infested areas. In drought areas they outlive cattle and can feed, for some time, on poor pasture land. They are friendly to humans, are willing to work, are fairly easy to train both for transport and traction, and have a transport load capacity of between one third and half of their body weight, between 40 to 60 kilos, depending on size. If two donkeys are harnessed to a cart, they can pull up to 4 times what they can back load. (Normally it is better that donkeys pull carts rather than have back loads, because most of the weight is not borne by the animal, but by the wheels). Donkeys need little supervision, are not affected extensively by external parasites, are seldom ill, need little water, and are strong compared to their size and can be used to protect other animals. However donkeys are social animals, they do not like being left alone and can suffer from separation from other donkeys, thus affecting their willingness to work.

Donkeys like all 'assets' need to be looked after properly to obtain the best from them. Training in donkey husbandry, transport and traction is advisable, even to the experienced smallholder farmer who is already involved in transport and traction enterprises. Training can range from simple health care, such as small wound treatments, to improved feeding for better work performance, to improved methods of back packing, harnessing and hitching.

Oxen

Oxen are much stronger, though slightly slower than donkeys, but in transport and traction they are appreciated for their capacity to pull large loads. Normally oxen transport loads only on carts and/or wagons. They are not as sure-footed as donkeys on difficult terrain, on the other hand, they can travel long distances and in adverse weather conditions. They are generally friendly to humans, but are shy and can become aggressive if ill treated. They need, especially in their younger years, to constantly have the same human presence in work, as they will learn to recognise and become familiar with the driver's commands. Oxen are normally fairly

FIGURE 9 Oxen being used in post-harvest operations: threshing of rice paddy
(Photo: © FAO/14273/J. Arboleda)

willing to work (even though some have a lazy character) and can pull cart loads of up to 900 kg. Oxen can be easily trained and respond well to commands, but the training period is long and must start from an early age (about two years). Oxen usually come to full work maturity at around 3 to 4 years old. If an ox is not used on its own for transport and traction, the two or more oxen used should ideally be of the same age, size and strength. Although it is common for animals being trained to be harnessed to more mature and fully trained ones during the learning process.

Oxen can live in diverse climatic conditions, but are not suitable for very hot and dry areas. They need a good water supply and need time to eat. Good pasture, fodder and feed supplements ideally need to be given for without such feeding, oxen will not be so effective in their labour. Normally they can work for up to 5 hours per day and this can contribute extensively to an enterprise. For example, if an ox works for 5 hours per day, 4 days a week, in a year it can total 1 040 work hours in transport and traction.

Oxen are fairly expensive for smallholder farmers, but can prove to be a good investment. This is not only for their transport and traction enterprise value, but also for the products that can be provided at the end of their working life. Further,

being sturdy animals, they can be used for heavy load jobs, such as those involved in road construction, logging, etc. This adds to the value and versatility of the ox as an enterprise animal.

Ox training is a necessity and it has to be provided for a transport and traction enterprise to be successful and profitable. Such training will enable oxen to be more productive, pull better, able to work longer and easier to control. Attention needs to be given to health issues as oxen are prone to diseases and external parasites (ticks), as poor animal health will result in severe problems for transport and traction work. Thus basic training in oxen health and care is advisable, as well as the provision of support services, such as easy access to veterinary services, etc.

FIGURE 10 Oxen and traditional cart in Paraguay
(Photo: © FAO/12003/F. Mattioli)

FIGURE 11 Training oxen by pulling a log of wood
(Photo: © FAO/21476/X. van der Stappen)

Other animals

Transport and traction enterprises can also be 'powered' by other animals such as mules, camels and horses. Yet other animals can also be used for transport enterprises only, for example goats, although this is only likely to be a sideline from the meat and milk production enterprise. (See FAO Diversification booklet No. 8 'Higher value addition through hides and skins'; and FAO Diversification Booklet No. 9 'Sheep and goats for diverse products and profits'). Mules are intelligent, strong animals and have a good resistance to disease. They are particularly adapted to difficult terrains and mountainous areas. Mules need the same care and treatment as donkeys, but their character tends to be a lot more stubborn. This requires that training for them needs be provided without harshness and with a lot of patience. This may render them calmer and more obedient. Mules can work on poor feed quality in harsh conditions and their work life can be up to 35 years.

Camels are primarily found in hot and arid areas of the world and are particularly adapted for working in such conditions. Commonly they can be used for both transport and

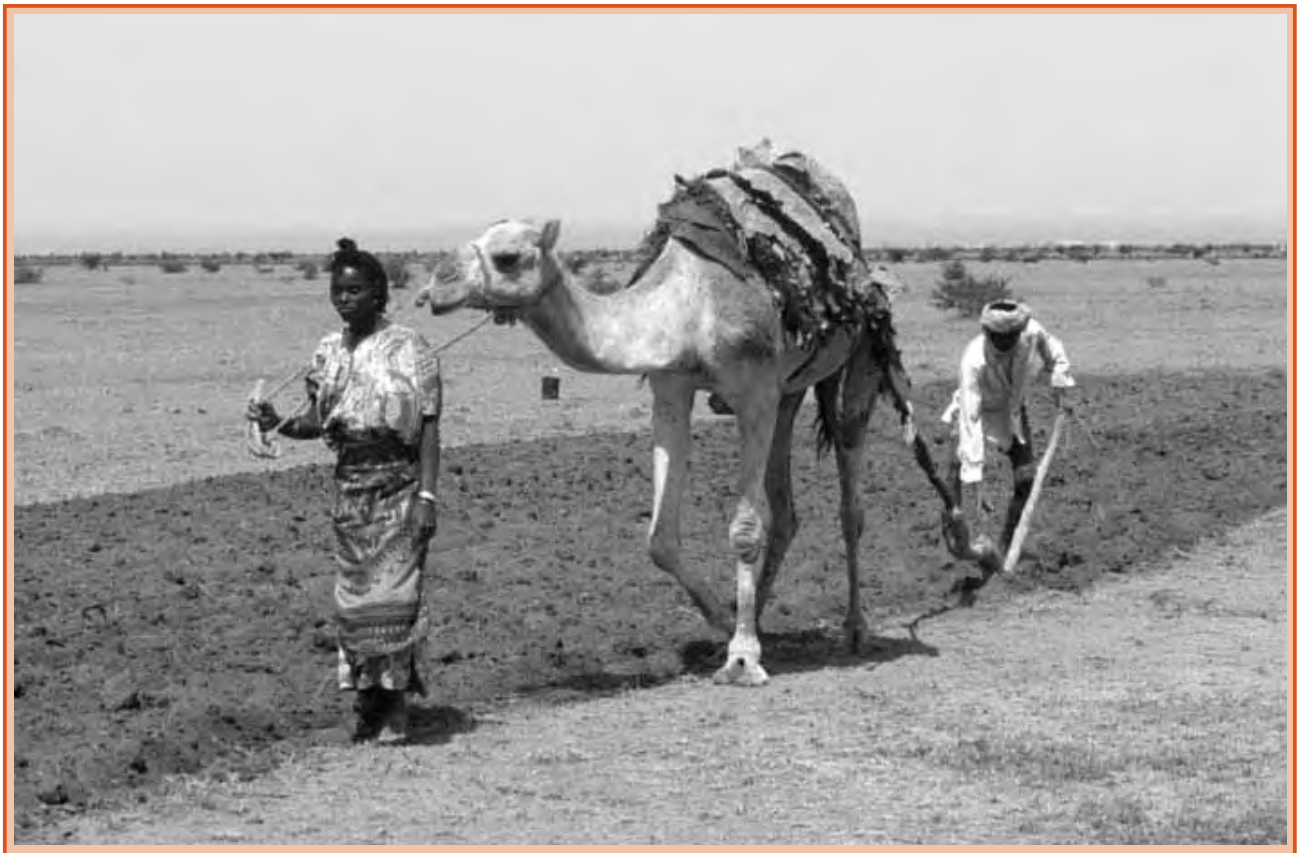


FIGURE 12 A camel being used for traction
(Photo: © FAO/11773/W. Gartung)

traction, have a good resistance to diseases and drought, they can drink once every 3 to 4 days, eat rough and coarse herbage and are strong.

Usually horses are used for riding, but often can be used for transport and traction. They are more difficult to train than donkeys, have less resistance to diseases and their cost can be high. All the same, they can prove to be good enterprise animals.

3 Simple mechanical types and modes

Simple mechanical aids for transport comprise sledges, wheelbarrows, two wheeled carts, bicycle trailers, four wheel wagons, powered by humans and animals. Power transmission and control methods are also required for transport and traction and include: head, horn, neck or withers yokes, collar and breast band harnesses, hitches, reins, etc.

Humans and/or animals are used to power different vehicles, for example a wheelbarrow is propelled by humans, while a four wheel wagon can be pulled by two oxen. Normally such technology enables human and animal power to increase the load they carry, making each journey more efficient as less energy is consumed per kilogram-meter travelled.

FIGURE 13 A camel being used for transport
(Photo: © FAO/23899/D. Minkoh)

Importantly simple mechanized vehicles can be developed locally and can be adapted better to local conditions. This though will often require training for the promotion of such vehicles as viable options in transport and traction enterprises.

Sledge

This is a very basic technology: it is cheap, simple to make and easy to maintain. It can increase transport loads and their design allows them to be used on tracks too narrow or steep for carts. They can also be used in muddy and sandy conditions where a wheeled cart might get stuck. However, because of the lack of wheels, and friction, they require more effort to pull than a cart. They have no clearance and can be stopped by stumps. Most importantly they tend to accelerate erosion by leaving rutted tracks, often only passable by other sledges, which become watercourses during heavy rains.

Carts

Carts are one wheeled or two wheeled vehicles that can be powered by humans or animals. Wheelbarrows (the simplest of handcarts) are one wheeled, need to be lifted and pushed and can be operated easily

by human power. The load depends very much on the capacity of the wheelbarrow and the strength of the person pushing it. It is typically good for short distances and narrow paths, even though it may not be suited for all terrains. It is versatile in that it can carry many different types of loads, including transporting a single person. Local models can be built and the technology is not complex, however there is often an issue with low load capacity and durability affecting useful life. One of the main problems is the wheel, if it is made of wood, it tends to break easily, while if made of hard rubber it can provide for more durability and smoothness in travel.

Hand carts and animal pulled carts are often fitted with two wheels and an axle, and a loading surface on which to place the payload.

Animal two-wheel carts may be small, light and pulled by a single animal; or of more massive construction when they are pulled by two or more animals. In some instances light animal carts may also be powered by humans. Typically carts comprise an axle, two wheels and a wooden platform. Small wheels (usually with rubber tires) have been used, but they tend to get stuck more easily in uneven terrain and holes.

In some areas of the world, carts are made using scrap car axles. Old car axles and wheels often come with

FIGURE 14 A hand cart for water transport
(Photo: by J. Kienzle)

CASE STUDY 8 **Wheelbarrows vs hand carts in sub-Saharan Africa**

The most common handcart type currently in use in sub-Saharan Africa (SSA) is the wheelbarrow. Wheelbarrows, however, are relatively expensive, have a small volumetric capacity, are not suited for carrying long loads like lumber or poles, and they require the operator to lift up to half of the weight of the combined load-plus wheelbarrow and balance it laterally over the one wheel. The solid or semi-pneumatic tyres of most wheelbarrows have a high rolling resistance, provide little shock absorption, and their wheel bearings are crude. Wheelbarrows are, therefore, ergonomically inefficient and inappropriate for long-distance transport. Owing to this inefficiency, the typical wheelbarrow load of 80 kg carried at 3-4 km/h, will have a typical daily range of only 5-6 km (Dennis, 1993).

The Chinese-style wheelbarrow, with its single large centrally-positioned wheel, is far more efficient than the conventional type, is unknown in SSA, being relatively difficult to build, load and balance.

The two-wheeled handcart is a great improvement over the wheelbarrow: it is more stable, since its weight, when properly loaded, is balanced over the axle connecting the two wheels. It then requires neither lifting nor balancing by the operator; and its large-diameter wheels enable it to negotiate relatively uneven terrain. Because a handcart is simply pushed or pulled, when fitted with ball bearing hubs and pneumatic tyres considerable loads 200-250 kg can be carried impressive distances in it (>20 km according to Dennis 1993).

Source: Wendroff, A. P. 2000. The Malawi cart: An affordable bicycle-wheel wood-frame handcart for agricultural, rural and urban transport applications in Africa.

worn down tires which are prone to punctures which can be a problem if repair services are not close by. The use of retread tires would add reliability to cart operation. However, it has been observed that with the increase in use of rubber tires (on carts, motorcycles, cars and pick-ups) in an area, puncture repair services quickly become available even in small villages as entrepreneurs recognize the market.

Cart brakes are important for emergencies, but they can also save animals from excessive burdens on steep downward slopes. Even on flat ground, a loaded cart pulled at normal speed has a considerable momentum, and absorbing this through the harnessing system in an emergency stop can be very uncomfortable for the animal. However, the choice of harnessing system does influence the efficiency with which animals can brake with their own bodies (a breeching strap is needed unless the draw pole is attached to a head yoke). Basic wheel brakes can be made from concave wooden blocks or simply bars or logs that are pushed against the wheel or tire surface. Second hand vehicle axles will usually be equipped with drum brakes which can be refurbished.

CASE STUDY 9 **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, 700 km from the developed infrastructure of the Copperbelt. Most (90 percent) 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 axle/wheel combinations accounted for 90 percent 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 its targets were revised upwards.

Source: Starkey, P. 2001. Local transport solutions, people, paradoxes and progress. Lessons arising from the spread of intermediate means of transport, World Bank, Washington D. C.

Typically the designs of most carts are made to withstand payloads of up to 1 000 kg. The ability of animals to pull such loads depends on the wheel bearings, rolling resistance, road surfaces and slopes. For example, a single donkey can usually pull a cart loaded with up to 500 kg, a single horse can pull one of 700 to 1 000 kg, while a pair of oxen can cart with loads in excess of 1 000 kg. Critical in animal two-wheel cart transport is the balancing of the load. If the load is not balanced properly it can cause upward or downward forces on the animals harnessing system. The axle should be placed in such a position that a small load is always resting on the harnessing system when the cart is empty. When a heavy load

shifts backwards, an animal can be literally lifted off its feet. Some cart manufacturers place the axle quite far to the rear to reduce the danger, but this produces an unnecessary load on the animal's back.

Wagons are carts with four wheels and because of this have the capacity of carrying heavier payloads and can be relatively faster in their operations. The four wheels carry the whole burden of the payload and animals are only needed for pulling. Wagons can be left with payloads on the platform even when the animals are not present. However, wagons have a more complicated design to ensure manoeuvrability and stability, which makes them heavier and more costly. They are best suited to tarred and level roads and to areas where the increased load capacity is cost-effective.

Hand carts, animal carts and wagons can all be used for profitable enterprises. All can have a positive effect on making the enterprise more efficient and effective, provided that they are used properly, built properly and that support services are available for repairs and spare parts. They can provide for convenient 'moving retail sales points', where small farmers can hawk their products through the

FIGURE 15 A bicycle made of wood in the Republic of Congo
(Photo: © FAO/23438/M. Bleich)

streets or sell them by the roadside. In some cases, delivery can be made to the doorstep, this is very common in regions of India, where farmers from rural areas sell their produce door to door.

Bicycle

Bicycles can prove to be a very good enterprise on their own. They have a low cost relative to other means of 'movement', are adaptable, can usually run in nearly all weathers and can speed up transport operations, both of people and produce. Bicycles can have side panniers, thus incrementing the load they can carry. Extensions, such as a small container can be placed over the front and/or back wheel. Trailers can also be attached at the back of the bicycle, to transport more produce and in some cases can enable taxi services to be performed, by carrying people. For example, in Uganda a seat is attached to the back of the bicycle and in the Indian sub-continent rickshaws are very common.

However bicycles are still expensive for smallholder farmers as they can cost a good portion of annual income. Maintenance, repairs and spare part costs have to be considered as inhibiting factors for their adoption. Some foreign exchange costs are involved in bicycle purchase and parts supply, because in many countries these are unavailable locally. It must be said though that local resourcefulness, creativeness and entrepreneurial spirit can generate locally made bicycles. Bicycles can even be made locally with wood.

Bicycles are human powered, versatile and can increase speeds compared to other human powered and animal powered transport; but they carry less payload than hand carts, animal-drawn carts and wagons. They can use narrow paths and can also be pushed when required and in some cases their 'movement system' (pedals) can be used for other purposes, for example with the appropriate additional equipment they power grindstones for knife sharpening. Bicycles can be good vehicles for street hawking, even though the quantities able to be carried for sale may be small. True, a trailer extension of the bicycle can increase quantities transported and possibly sold, it enables bicycles to carry on average up to 200 kg of payload, but in hilly conditions it would be a struggle and pushing such a load up and down slippery tracks would probably not be safe. This is a transport mode that could not normally be used on a footpath, unless the path is at least 1 m wide.

FIGURE 16 Bicycles for work and transport
(Photo: © FAO/21678/K. Pratt)

Equipment for transport and traction

The equipment used for transport and traction will also determine the effectiveness and efficiency of the enterprise. Back pack frames, harnesses, yokes, hitches, etc. are the common types of equipment used for transport and traction. For example, pack frames can be used on donkeys to improve payload and comfort for the animal while working. Correct harnessing methods are also important as they will enable the animal to work more efficiently and transmit higher forces. Effective harnessing needs to tap the power of the animals in the right place. For example, a donkey's chest is the best place for harnessing its pulling force, hence the harness equipment and methods need to consider this. A yoke can also be used, but it is not recommended as it may cause skin lesions and the donkey will work with its neck down rather than high, so they can see where they are going. It is generally recognised that for equines breast bands are the best harnesses for obtaining the most power. On the other hand cattle work best with withers yokes which, in comparison with head or horn yokes, allow free movement of the head.

4 Motorized types and modes

Motor-powered options for transport and traction comprise vehicles that use engines for power production. Human intervention is devoted to control, maintenance, repair and fuelling. The main advantages of motorized enterprises are that farm and transport operations can be done in a relative short time, there is a greater relief of drudgery, and there are inherent gains in productivity. For example, a reasonably fit adult can sustain a work output throughout the day of about 40 Watts[1]; compared with a small tractor which may have a rating of over 10 kW. Clearly this vastly increases productivity and enables enterprises devoted to transport and traction to develop at the same fast pace as other businesses and can provide for increased returns if the costs and benefits are carefully judged. Returns can be increased considerably, not only for the transport and traction enterprises themselves, but benefits also accrue to the customers of such services in terms of increased farm productivity and trade. For example, more farm power facilitates an expansion of cultivated land and greater distances can be covered in less time for trade in agricultural produce. Motorized vehicles make achievement of pre-determined minimum standards of output. This is in contrast to animals and humans, as motors usually do not suffer bad days through ill health or poor nutrition.

Motorized vehicles can travel on many different types of terrain and at high altitudes, with only minor effects on work and travel speed. Commonly they can operate in nearly all weather conditions and depending on their power, can transport higher payloads, at less cost and with more rapidity than alternatives.

However, motorized vehicles do have their disadvantages. The initial acquisition costs are very high for small farmers, even a motorcycle can be well out of the reach of a small farmer's income and savings. Many small farmers in fact can find a solution to this problem by forming associations and/or having better and more appropriate access to credit. Motorized vehicles are not always easy to learn how to operate and smallholder farmers with little or no experience with them may find them challenging and shy away from the option for transport and traction enterprises. In any promotional programme it would be fundamental that training be given to help smallholder farmers overcome this knowledge gap. Training also needs to be promoted for maintenance and repairs. This is a crucial aspect of motorized vehicle management as local services may be non-existent,

[1] *Power (Watts) is the rate of working, i.e. energy expended over time or Newton metres per second*

especially in the early days of adoption. Lack of other support services, like fuel and spare parts availability can also be another great hindrance to successful motorized vehicle operation and there is a need for such services to be present if a motorized transport and traction service is to be profitable and sustainable over time. For example, even the simplest spare part that is not available can bring an enterprise to a halt and endanger its business survival.

A simplified support system for motorized transport and traction requires at least the following: a vehicle or traction user, a vehicle maintainer or repairer, a vehicle provider and the necessary infrastructure services.

Motorcycle

While other means of transport require training for more efficient and effective usage, motorized vehicles normally require learning how to use them. This can be quite a challenge for smallholder farmers as their familiarity with such things as gears, for example, on a motorcycle or small tractor may be limited. Motorcycles can be found locally, but mostly require foreign exchange and convenient and easy access to support services, for fuel, maintenance, repair and spare parts, to make them effective and efficient as an enterprise. The acquisition price for a motorcycle can be high, relative to a farmer's income; and the payload it can transport is fairly low compared with other vehicles.

FIGURE 17 A farmer at the local market selling cauliflowers and spinach from baskets strapped to his motorbike (Photo: © FAO/22265/A. Proto)

However motorcycles can be used on narrow footpaths, but are probably best suited for longer runs in reasonable conditions and speeds are fairly good compared to other vehicles.

A motorcycle can have additional payload with the use of a trailer. There is scope for building trailers locally, using motorcycle wheels and a steel frame/wooden body, the payload is better while the speeds are fairly similar, so the operating costs (per unit of payload) are lower, but the combination cannot be used on narrow paths. The problem of introducing this type of vehicle, motorcycle with trailer, is more cultural than technical – it is not well-known in many areas.

Tuk Tuk (three wheeled small taxi)

This is an engine driven motorcycle type that has one front wheel (such as a motor cycle) and a back axle with two wheels and provides space for up to four passengers. This vehicle type is known in many Asian cities and rural towns. Recently it has found its way to African urban centres such as Wau in Sudan. The investment costs are far cheaper compared

FIGURE 18 Tuk Tuk for urban transport
(Photo by AGS, FAO)

to a standard two axle tractor for example. Asian vehicle suppliers (mostly the People's Republic of China, India, Thailand) commonly establish maintenance and repair services in the areas where the Tuk Tuk is supplied.

As a vehicle it is very good at transporting people over relatively short distances, but it can also be used to carry goods (rural areas to urban centres and vice versa). It can prove to be a viable transport enterprise for smallholders who live within an economically feasible distance from urban areas and who may want to tap into the lucrative urban taxi trade. However, in most urban centres licensing is required to operate such an enterprise and this may be a barrier to trade. Tuk Tuks are well adapted to urban centres as they can drive down narrow streets and fit in well with typical urban street plans. Their operation is not affected by adverse weather conditions, most of them have roofs to protect against sun and rain. The Tuk Tuk is best on good road surfaces, flat and without potholes. The main operational problem encountered with them is that they can capsize easily and they are not versatile in rural areas in off-road situations. They need support services and spare parts which may need to be imported.

Small and medium agricultural machinery

Single-axle tractor with trailer

Single axle tractors are available in various sizes. A common example relates to a machine with a diesel engine of circa 13 kW, manufactured in Southeast Asia. There is a high foreign exchange cost for purchase, fuel and spares. The trailer can be made locally and these are used in Asia, Africa and Latin America. The single-axle tractor makes an interesting comparison with the ox cart, having the same capacity but a higher speed and can be much more expensive, certainly running costs are higher. Thus the final operating costs are greater. Initially single axle tractors were considered only useful for puddling the soil in rice growing areas, but now they are being used in both wetland and dryland farming. In some instances they can be viable alternatives to both animal traction and medium sized four-wheel tractors.

The benefits of a single axle tractor are that it can be used for in-field agricultural operations, stationary power applications as well as transport; it has a triple value use. In general, it is capable of preparing one hectare of land in eight to ten hours, depending on soil type. It can also be used for post-

harvest operations, water pumping and construction work. It can travel under most terrain and weather conditions and unlike animals does not suffer from fatigue.

Standard tractors (four-wheels)
Standard tractors of 75 hp (56 kW) equipped with a trailer and a power take off (pto) for rotary power supply are available in limited quantities and in clusters in some rural areas in Africa and more frequently in Asia and Latin America. Tractors are mainly used for land preparation, especially ploughing services, during the planting season.

Some tractor service providers have specialized in following the planting season across a country or region, and by doing so extend their effective window for land preparation services. However, for the major part of the year these tractors are available for transport provision; or for power supply for post-harvest operations such as milling, hulling and pumping; or for off-farm work. The multifunctional use of tractors is often essential in order to make the investment in them financially viable.

Four wheel tractors are able to move over rough terrain and can even move if weather and road conditions are impossible for other options. In this respect four wheel tractors, with trailers, are ideal for moving goods and people through the so-called 'last mile' from market points to village or household. Also bulky goods as well as materials for construction (cement, sand, and gravel) can be transported. Overall four-wheel tractors can out-perform single axle tractors in service performance (payload capacity) and in operating range.

Like the two wheel tractor and other motorized transport system, they require a fully functioning support system for maintenance, repair and spare parts supply. In Tanzania, for example, there are local blacksmiths who have specialized in tractor overhaul services and use non-genuine spare parts. This is a result of tractor manufacturers or authorized dealers of the genuine parts not being able to supply for various reasons. Nevertheless, the genuine skills of the local repair and service hubs are appreciated as otherwise enterprises powered by tractors would not be operating at all. Moreover, tractor maintenance becomes a viable business for the skilled local blacksmiths and agro-mechanics.

The additional transport option, together with other off-farm possibilities, can help to make the tractor business more viable as transport is an all year-round business compared with the seasonality of most agricultural operations.

CASE STUDY 10 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 sole aim of providing transport hire services. Such transport vehicles are seldom used for cultivating rice paddies. 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 percent 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 subsidized, it is too early to know whether their employment for transport, for agriculture or for combined, multipurpose use will prove to be economically sustainable in Côte d'Ivoire.

Source: Starkey, P. 2001. Local transport solutions, people, paradoxes and progress. lessons arising from the spread of intermediate means of transport, World Bank, Washington D. C.

FIGURE 19 Single axle tractor and trailer
(Photo by J. Kienzle)

CASE STUDY 11 The case of farmer groups and access to tractor services in southern Sudan

Case A ACORD, Juba

The Agency for Cooperation and Research in Development (ACORD) is an active NGO in southern Sudan. The national NGO has a 'livelihoods and food security' perspective. Their approach is to move from 'food security' to 'food sovereignty'. This means that ACORD tries to enable / empower the farmers and groups to take the lead in the selection of interventions.

ACORD has obtained seven tractors, with implements and trailers. The tractors were procured by the NGO as it was very obvious from surveys that small farmers had an urgent need for farm power, transport and traction services. The original intention of ACORD was to hand over the tractors to an 'agricultural extension workers group'. However, it was soon noted that tractor services are for the time being too sophisticated to be handled by small farmers' groups. The alternative approach that is now applied is that the 'agricultural extension workers group' is overseeing tractor services that ACORD provides to the farmer groups. ACORD acts as a direct service provider with regard to tractor services. This indicates that tractor services need to be carefully set-up and human resources development needs to be nurtured along with technical skills of potential business owners, operators and mechanics.

Nevertheless, the fact that ACORD took the initiative to become a tractor service provider only came into being as livelihoods and food security surveys had shown that the lack of traction services and hence the reliance on hand power for transport and traction had a severe impact on the livelihoods of the small farmers. They now benefit from the services offered.

Case B Women for Women, NGO, Rumbek, South Sudan

This NGO has implemented a project entitled 'Women for Women Commercial Integrated Farming Activities'. The approach is to lease land from the community and organise women's groups to be trained in vegetable gardening and production of maize, sorghum and other staple food crops. One community has received 90 ha of land. FAO is collaborating with the NGO in the area of appropriate inputs and hand tools supply. The women's groups produced a good maize harvest and are supplying their vegetable produce to restaurants and a hotel in Rumbek town.

Very recently the NGO management based in Rumbek purchased an 80 hp four wheel tractor, disc plough and trailer. The plough is required to open up more land within the given 90 ha. Most of this land is still virgin bush land. The trailer is intended for transporting produce to the town markets and for bringing inputs to the site. The tractor handling, operation and management rests in the hands of the town office of the NGO. It is perceived that the women's groups are not able to handle the tractor services on their own. Yet, the groups are benefiting most as land clearance does not need to be done by hand and hence their drudgery is reduced and quality of life tremendously improved.

Source: J. Kienzle. 2008. FAO mission in Sudan

FIGURE 20 A group of women in Sudan benefit from a tractor service
(Photo by J. Kienzle)

Feasibility of the enterprise

Transport and traction: starting the business

Smallholder farmers who are interested in starting a transport and traction enterprise need to know about the most suitable type of vehicles for their enterprise. They will need to consider: purchase price and credit options available, operating costs, payload capacity and multiple-usage potential. In another scenario, a smallholder farmer may already own a vehicle, but its use is restricted to personal farm work and transport and its services are not offered for hire. This means that the vehicle has already been decided on, regardless of its performance and appropriateness to an expanded business enterprise.

However, choosing the appropriate vehicle is only one part of the picture. Smallholder farmers will need to consider a number of other matters before entering into business. They will need to appraise: demand in the local area for transport and traction enterprises, the costs involved in starting the business, the availability of support services and compatibility with the entire transport and traction system. Smallholder farmers will often need assistance in this field and advisers will need to support them in their business planning (and subsequent management). It is of paramount importance that smallholder farmers themselves decide on **whether or not** to start a business, after their own evaluations and their understanding of the context they are going to operate in. Advisers have an important support role in this regard and more details are given on the role of advisers section of this booklet.

Market research

Knowledge is crucial for reducing risks and increasing the likelihood of profit. Knowledge about potential users is vital information that a smallholder farmer needs. Market intelligence, however, involves more than simply collecting data related to local users and the possible tariffs that they will pay for transport and traction services. It includes the compilation of a comprehensive and up-to-date picture of all the factors affecting the business. These can range from

the availability and cost of repair (and possibly veterinary) services in the area, to plans for future road construction with its associated maintenance opportunities.

Knowledge of markets and marketing skills are required for more precise prediction of planned service sales, rather than simply relying on chance. For a smallholder farmer who works locally, market intelligence may consist only of information about selling prices and the situation of competitors, but this information is not sufficient on its own as mentioned previously.

Training in market research methods should, therefore be given, since its role is crucial in the process of setting up a transport and traction enterprise. Advisers, with a wider perspective, will also need to keep farmers up dated to supplement their local information sources. This will give a more complete picture of the factors affecting the business.

In summary, if market research has been undertaken correctly and information has been gathered about potential customers, their locations and their requirements, supplemented by information from advisers, this will help in the decision-making process of the smallholder farmer and will reduce the risk of making the wrong decision.

Infrastructure and other support services

Would-be entrepreneur smallholder farmers will have to have an idea of what the infrastructure is like, if there are paths, tracks, or non-tarmacked (murram) roads. For traction enterprises they will also need to know, for example, hectares of land that have potential for agriculture within their local area, the types of soil, harvest and post-harvest activities that may require power input from traction services. This local market information should normally be in the reach of smallholder farmers, but in some instances, the adviser may have to fill in gaps and point out the importance of including all relevant factors in the decision-making process.

Smallholder farmers also need to know about related support services: repair services, spare part dealers, fuelling stations, credit services, etc. If present in the immediate locality smallholder farmers will usually be aware of such services and advisers will not need to furnish the information. In some instances the services may only be found in a nearby locality and be unknown to the local smallholder. In this case the adviser's role, as a source of relevant information, is clear. There is a high risk attached to investing

in an enterprise that cannot be serviced properly, for example if a tractor needs repairs and there are no mechanics in the area and/or the spare parts cannot be sourced locally. In such cases there may be an option of training smallholder farmers or other members of the local community, such as blacksmiths, in basic maintenance for tractors, but this is not always easy and it is a medium term solution. Also trainers must ensure that they have enough potential clients to make their investment, in time and money, worthwhile.

Comparing vehicles and their appropriateness

Having considered the above, smallholder farmers need to evaluate and compare alternative options: whether to start a business by renting a vehicle, or by buying. Factors to be taken into consideration are: the ability to fund the initial investment; the possibility of business failure; and the appropriateness of the various vehicle options related to the local context. These are difficult decisions to make and options need to be examined in the light of the information obtained during the market intelligence gathering phase. The answers unfortunately, may not be clear cut. In some instances, for example, to reduce costs and upfront investment, it may be sensible to rent a vehicle and sell the services at a profit. With this profit, the smallholder farmer can save and later can be able to invest in his or her own vehicle. This option averts the need for a large upfront investment and the risk of large financial losses in case of business failure. Clearly each option will depend on a case by case analysis and one may be more feasible than another in one location whereas the reverse may be true in another. Advisers need to provide location-specific information on the suitability of various vehicles, their characteristics and features.

The first aspect about the vehicle to consider is what the market requires, in other words, What is market demand? For example, if the market demand for smallholder farmers' services is simply to transport farm produce in small quantities to market, then a good option could be animal transport. Usually smallholder farmers will think about cost per unit transported, for example, cost per tonne or cost per bag or cost per head load. But the cost per tonne is not sufficient; it needs to be measured also against distance travelled.

Table 1 on the next page gives **an indication** of the costs per tonne carried per kilometre travelled on a range of different transport options.

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	Mechanics	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
Handcart	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	1 000	5	10	0.20	Medium	High	Medium	Medium
Motorcycle	900	100	50	50	1.30	High	None	High	Medium
Power tiller trailer	5 000	1 000	10	15	0.70	High	None	High	Medium
Pickup	12 000	1 200	80	200	0.70	High	None	High	High
Truck	60 000	12 000	80	200	0.50	High	None	High	High

*** Notes**

The table provides order-of-magnitude indicative figures only. The costs, prices, speeds and distances vary greatly with the country, the people, the environment, the infrastructure and the vehicle 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 indicative 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.

Source: Starkey, P. 2001. Local transport solutions, people, paradoxes and progress. Washington D. C. World Bank

The examples shown in Table 1 are **illustrative only**; the main aim is to bring out key points and identify some popular misconceptions, for example, cheap vehicles do not necessarily mean cheap transport. Advisers thus need to consider these factors and the others mentioned in previous sections when assisting smallholder farmers in their choice of vehicles for business viability.

Credit

Credit availability, ease of access and terms (interest rates and payback periods) are important components of evaluating the feasibility of a transport and traction enterprise. Credit issues need to be considered not only for smallholder farmers, but also for other actors in the supply chain as their business start-up and/or operations also depend on the availability of credit and its access and terms.

Most people involved in transport and traction enterprises will need to invest some capital in order to operate the business. This may be as simple as appropriate equipment such as yokes or harnesses for the smallholder or workshop tools for repairers, to buying and maintaining an ox-cart. If these actors in the transport and traction system do not have funds saved up they must acquire them from other sources. In this case it is good practice that actors in the system carry out a cash-flow analysis to identify possible credit needs prior to engaging in any business activity. Once this is done then it is easier to identify the amount of financial resources needed, the time when they are needed and the best way financing can be determined. Here advisers need to provide advice, and possibly training on financial management as part of a business skills upgrading programme.

In the case of a smallholder farmer needing to buy a vehicle, or a repairer perhaps needing to buy or lease a small workshop in which to operate, a substantial sum of money may be needed, either upfront or as regular payments. These may require long term loans and consequently will take a long time to pay back. In other circumstances the smallholder farmer may need credit to carry out routine maintenance on the tractor, this would normally be paid for by the regular cash incomes of the business, but in difficult times (seasonality of business is common risk in agriculture) may require a short term loan.

The distinction between long-term and short-term financing is significant for a number of reasons. In general, much more work is required to acquire long-term financing (from a bank, for example) but the rate of interest will be lower than for short-

term loans. While long-term loans are relatively less expensive, it needs to be clear that they can burden the business unnecessarily. Moreover, some banks may not be prepared to lend sums of money on a long-term basis below a certain minimum level.

Irrespective of how much long-term and short-term financing is required to run a business, most financial institutions require the owner of the business to provide some portion of the funding themselves. It provides some guarantee of the owner's commitment to the enterprise as well as guaranteeing collateral to secure repayment of at least some of the loan if the enterprise fails as the loan will be less than the total value of the enterprise investment.

Again the role of independent advisers will be to provide pertinent information about credit availability, accessibility and terms.

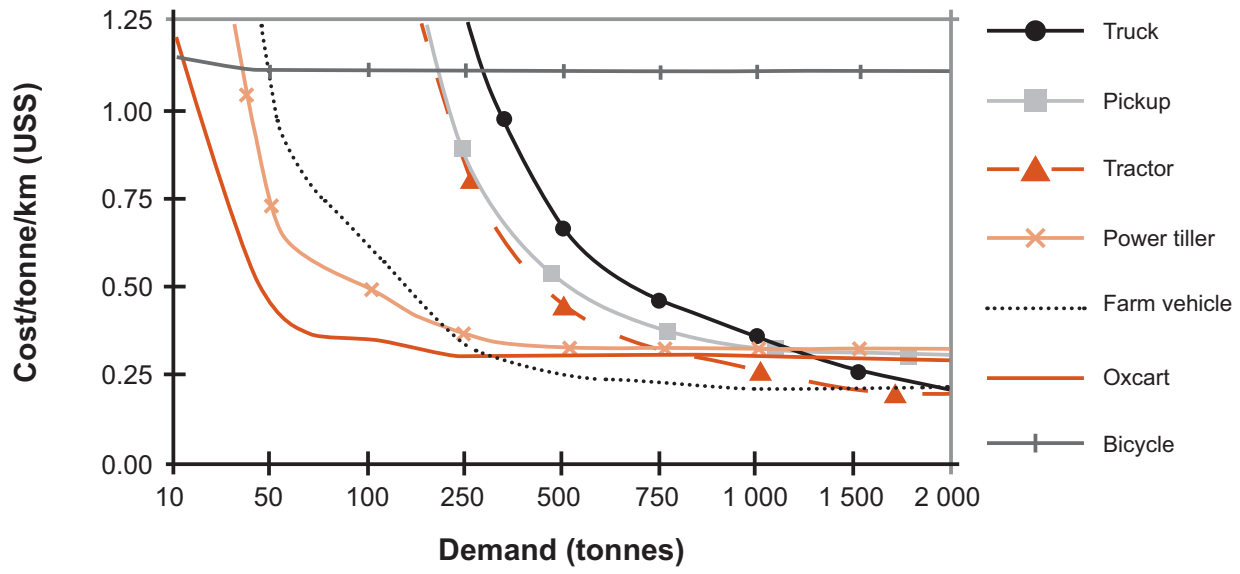
Costs and profits

Investment in a vehicle not only includes the initial start-up cost, but also its operation costs, the potential income that it can generate for the enterprise and the credit availability and access discussed above. Figures 21 and 22 show **indicative** vehicle operating costs taken from a study reported by Starkey (2001).

Costs for operating a vehicle are sensitive to levels of utilization; this becomes more acute for vehicles that have high capital costs, like tractors. For example, operating costs for a tractor per tonne per kilometre can be eight times higher for a 50 tonne payload than for a 750 tonne payload over a 50 km trip. Further, an ox-cart can be 50 percent more expensive (per tonne/km) for a 50 tonne utilization than for a 250 tonne utilization over a 10 km trip (Starkey, 2001). The figures show operating costs per vehicle with different levels of demand (payloads) and distances travelled.

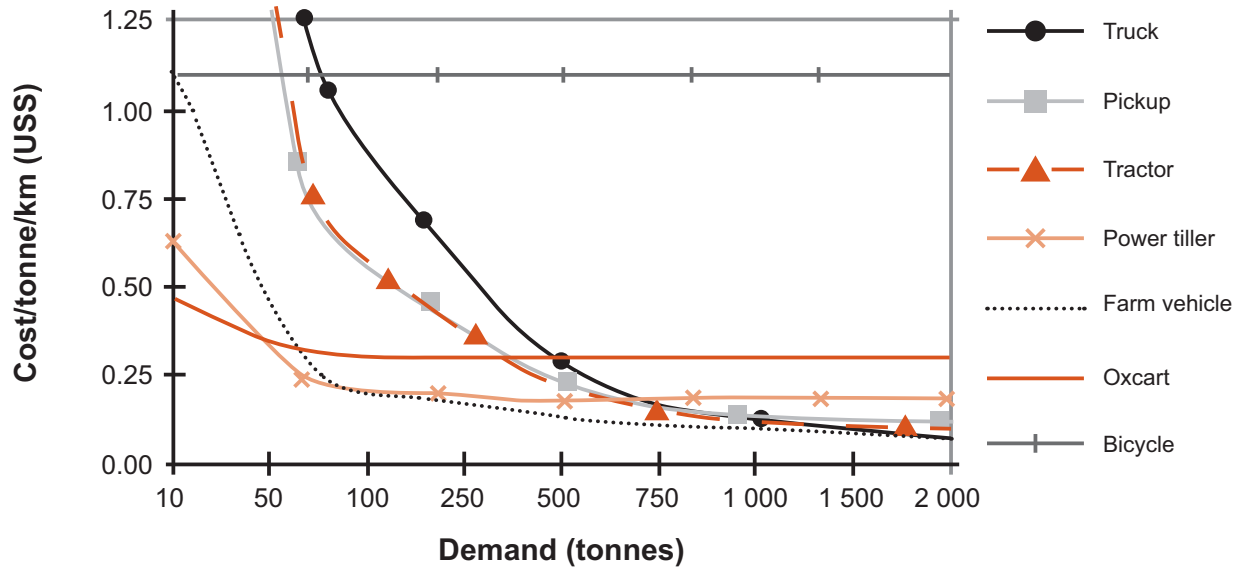
Figure 21, shows that bicycles only have the lowest operating costs with small payloads on short trips (10 km in this case). Transport in rural areas usually takes place along paths and tracks, and considering the affordability of bicycles for households, can explain why bicycle ownership (in Africa) is increasing. As seen previously, bicycle payload can be increased with the use of panniers, load frames and trailers. However, remember that bicycles can only be used for transport and not for traction. On the contrary ox-carts can be used for both transport and traction and, as shown in Figure 22, have decreasing operating costs, for short distances of 10 km, until the payload reaches 250 tonnes. However over a longer distance, see Figure 22, the ox cart has decreasing operating costs only until 50 tonnes of payload.

FIGURE 21 Vehicle operating costs assuming a 10 km distance and varying levels of utilization. (Note that road roughness is not considered and a 50 percent utilization level is assumed)



Source: Starkey, P. 2001. Promoting the use of intermediate means of transport-vehicle choice, potential barriers and criteria for success, World Bank. (Adaptation by Fabio Ricci.)

FIGURE 22 Vehicle operating costs assuming a 50 km distance and varying levels of utilization (Note that road roughness is not considered and a 50 percent utilization level is assumed)



Source: Starkey, P. 2001. Promoting the use of intermediate means of transport-vehicle choice, potential barriers and criteria for success, World Bank. (Adaptation by Fabio Ricci.)

Motorized vehicles, such as power tillers and tractors (Figures 21 and 22) have high operating costs (not to mention initial purchase cost). Power tillers with trailers perform well on both the 10 and 50 km distances illustrated, even if roads are not in perfect condition. Power tiller diesel motors can be used to provide power through the power take off for water pumping, threshing and generating electrical power, which is particularly useful in areas without electrical power supply. Tractors on the other hand are more expensive than single axle power tillers, but can run in nearly all terrain conditions, infrastructure is not a constraint, and in some regions of the world, tractors have proven to be very profitable in transport services only.

One of the main problems with expensive investments in equipment and vehicles is the economic need to utilize them commercially to make business throughout the year. Both power tillers and tractors can be used for many purposes in the agricultural, transport and infrastructure sector. Hence, they have a marked potential for full utilization throughout the year. Yet, more often than not, tractors are left idle outside the cropping season and farmers run the risk that income deriving from the machines is not sufficient to sustain the business as wished. It follows that business diversification into sectors both within and outside agriculture can make the difference and turn a loss into a profit.

Clearly, as can be seen from the forgoing discussion, costs are crucially important; yet it may be more important to strategically seek diversification into other business opportunities with the same investment. Hence vehicle choice should only be made after strategic business decisions are made and sometimes a slightly higher investment in vehicle or vehicle attachment can broaden the business opportunities tremendously. For example, if a tractor is purchased with a grader attachment, additional business opportunities in the rural roads/infrastructure sector can be sourced, provided that local road maintenance is a priority for local governments. These types of options need to be explored prior to purchase decisions.

Costs always need to be compared against prices that potential users (clients) are willing and able to pay for transport and traction services. This will give an indication of the profit potential of such a business or if losses will be incurred and thus starting such an enterprise may not be advisable.

Evaluation of the business option

It is clear that the fundamental profitability potential of a proposed investment is important; but other factors also may need to be considered in determining the attractiveness of an enterprise. For example: status, social capital, gender issues, and necessary changes in production and marketing practices. However the final evaluation of the business for transport and traction needs to consider the factors discussed so far and, importantly, should rest in the hands of smallholder farmers themselves. Advisers need to provide information and advise what is relevant to the decision-making process of smallholder farmers on a series of possible business options, advisers must be flexible and should not stubbornly insist on what, in their view, is the best option.

Support services for transport and traction

Institutional role

Public investments have an impact on people's capabilities to carry out a commercial activity or business, whatever the sector. This is true in the case of transport and traction enterprises which have the potential of improving agricultural and other sector productivity; reducing drudgery and enabling mobility. The development of transport and traction services brings numerous advantages: it enables access to remote areas, it encourages trade, it increases the marketing capabilities of many sectors, it reduces poverty and allows local communities to develop progressively.

The public sector should embrace a broad perspective in supporting transport and traction enterprises. An intervention on extending or upgrading a road should be seen in terms of such factors as: improved access, improved safety, improved mobility, the views and concerns of road users, etc. Interventions need to consider not only the economic aspects, but also those of all stakeholders involved, including the local community. The main role of the public sector is to foster an enabling environment, including providing adequate infrastructure for transport enterprises to operate. Interventions can be in the areas of:

- implementing rural livelihood support policies which go further than the traditionally narrow focus on one sector (such as agriculture, livestock, forestry, infrastructure), and instead support rural populations to implement diversified livelihood strategies (including transport and traction as diversification enterprises);
- providing an enabling environment for all stakeholders and encouraging associations and networking of sector actors, for example by passing laws that reduce red tape for opening up a business enterprise;
- promoting an overall investment climate that will encourage private investments; for example, passing laws that reduce taxes on investments;
- development, where possible, of public-private partnerships

for infrastructure building and maintenance;
- the development of infrastructure and maintenance services;
- definition of responsibilities of the public and private sectors;
- developing training programmes for both potential business managers and technical training for vehicle operators;
- providing training programmes where necessary while at the same time encouraging private sector operators to implement their own programmes.

Veterinary services

Where animals are used for transport and traction, they need 'maintenance' and they are just as vulnerable to misuse as hand carts, bicycles and small tractors. Animal health is essential, so a transport and traction service based upon them needs veterinarians or para-vets who can deal with injuries and who know the pests and diseases typical of the area. Although these services are not something that the smallholder farmers can normally diversify into, they can be trained in appropriate animal management (grooming, feeding, watering, appropriate harnessing and handling, etc.) and basic health methods that can help in the prevention of diseases, pest control and other health issues that may render the animal unable to work.

In order for transport and traction enterprises to be sustainable, services must be accessible and available to smallholder farmers. Services need to be preventative (vaccinations, tick control, etc.) and also curative (diseases, wounds, etc.) and also for breeding. Traditionally the public sector has been the main provider, as well as donor organizations, but the private sector is increasingly being encouraged to offer such services on a commercial basis. There is no single solution that suits all needs. Governments need to examine the question of how best to deliver veterinary services for they are not only essential to support transport and traction enterprises, but also encourage diversification into other enterprises like poultry, dairying and small ruminants (sheep and goats).

Financial services

Gaining access to financial services that adequately meet the needs of the business is often the most important precondition to establishing and managing a successful transport and traction enterprise. Commercial banks are often unwilling to lend to the smallholder farmer sector which they see as dispersed and risky. The result can be prohibitively high interest rates for smallholders and

that is why other solutions need to be found that are more in tune with the needs of the sector. Group savings schemes are particularly relevant in this context.

Agricultural credit programmes are rarely designed to provide loans for purchase of vehicles for transport, and seasonal agricultural loans are unlikely to be large enough or the terms long enough for the purchase of means of transport (motorized or non-motorized). One cost-effective way of increasing credit for transport could be to increase overlap between agriculture and transport i.e. allowing resources for the transport sector to derive from agricultural credit programmes. An example is Thailand's Bank of Agriculture and Cooperatives (see case study 12), which lends for a variety of agricultural and transport machinery. This service concept could be expanded to bicycles and animal carts. However, providing credit for

CASE STUDY 12 **The bank of Agriculture and Co-operatives in Thailand**

In the rural areas of Thailand the most important credit organization is the Bank of Agriculture and Co-operatives (BAAC) which provides loans for agricultural inputs, farm machinery, farm vehicles and longer term agricultural projects such as plantations. Farmers wishing to qualify for a loan must receive their equipment directly from the BAAC who have a department buying machinery in bulk from manufacturers. This has two main advantages. Firstly it means that farmers can buy their machinery cheaper than from conventional retail outlets and have a guarantee that the quality is good. Secondly the BAAC can ensure that the loan is being used for its intended purpose.

The BAAC provide loans at an annual rate of interest of 12 percent repayable over 2-10 years. Commercial banks, finance companies and retail outlets charge an annual rate of interest in the range of 20-30 percent. The traders charge in the region of 5 percent per month. An official from the BAAC will come around every month to collect repayments whereas traders will only collect their money after the harvest.

The BAAC has a novel way of getting around the problem of security for loans. Farmers who do not have deeds to land or other collateral to secure their loan can form groups with other farmers in their village and they all take responsibility for the loan. In this way if the farmer who has applied for the loan defaults on repayments the whole group becomes liable for his debts. This effectively places the borrower under peer pressure to repay and also gives a considerable incentive to the others to make sure he/she does, even to the point where ultimately they will repay the loan themselves in order that they do not jeopardise their chances of receiving a loan in the future. In this way the loan goes to an individual but the security is provided by the group. The more formal institutions require conventional security for loans and the traders rely on detailed knowledge of the trustworthiness of their clients.

Source: Ellis and Hine (1998)

specific means of transport can distort markets. Users may feel obliged to choose the means of transport being promoted with credit rather than something that better meets their needs. The same warnings apply to subsidies. Subsidies can help launch new means of transport, but this is only appropriate if the suggested transport means are adapted to local conditions.

Public services have often been used to supply credit; however, historically these systems have not worked well. There is common consensus that a sustainable credit scheme should be linked to existing or new banking systems, like the Grameen bank in Bangladesh has demonstrated so convincingly. In Bangladesh, for example, microcredit schemes operate a system that involves 'bicycle bankers'. These are people who use bicycles to carry out banking business in rural areas. Financial institutions have to develop credit services that smallholder farmers and others involved in the transport and traction system can use in the prevailing system and, if appropriate, they should also be profitable for the financial institutions. Savings programmes should be developed in parallel with credit schemes. When a microcredit scheme opens in a remote rural area, initially it is generally found that the savings option is used as much as the credit option.

Training services

For transport and traction enterprises training needs will diverge considerably at the technical level. For example, training required for appropriate animal management will be different to that required for those with single axle tractors. Providing the whole spectrum of training services would be a daunting task, not only in terms of the technical subjects to be taught, but the level of knowledge of smallholders on the matter, the need to build on local knowledge and methods of introducing new knowledge learning. A fundamentally important aspect of training schemes is to impart the entrepreneurial skills required if smallholder farmers are to develop and sustain their businesses over time and make them profitable. Training needs to be given on such themes as basic bookkeeping, cash flow, marketing, management, planning and logistics.

The focus of training must not only be on smallholder farmers, but extended to all actors in the supply chain who run businesses or are intending to start one up. For example, training may be needed for a traditional blacksmith, who intends to become a bicycle repairer,

the training required will need to have both a technical and a business management emphasis.

Factors to be considered when determining training needs include:

- Are transport and traction services and related support services traditional enterprises or have they been introduce recently or they are yet to be introduced?
- What are the locally available vehicles and/or newly introduced vehicles?
- Are there local constraints (e.g. gender issues) to training?

Indigenous knowledge should be harnessed and built upon wherever it is relevant. The design of the training programmes and identification of potential trainees should take account of many aspects and the different perspectives of the actors in the entire supply chain. The operating scale and nature of the business of the smallholder farmer and other actors in the system means that training is more likely to be effective if it is delivered face-to-face at community level. Training at this level needs to focus on the 'learning by doing' approach.

'Who should deliver training?' and 'Who will pay for training?' are critical questions to pose. Training may be delivered by central or local government agencies, NGOs, private organizations or farmers' groups, but this will depend on a case by case evaluation. In some areas, public intervention may be required, not only to promote diversification enterprises, but also to offer training services so that smallholders can take up such enterprises with the appropriate skills. In other areas, where transport and traction activities may be already functioning, training can be delivered by the private and donor sectors, since there will be a possible market for such services and actors will be able to pay for them. In some cases manufacturers of vehicles, such as tractors, may (and should) offer traders and repairers training and mentoring services to help them in their endeavours. However, the most appropriate institution to deliver training, and the most appropriate training method, will need to be defined on a case by case basis.

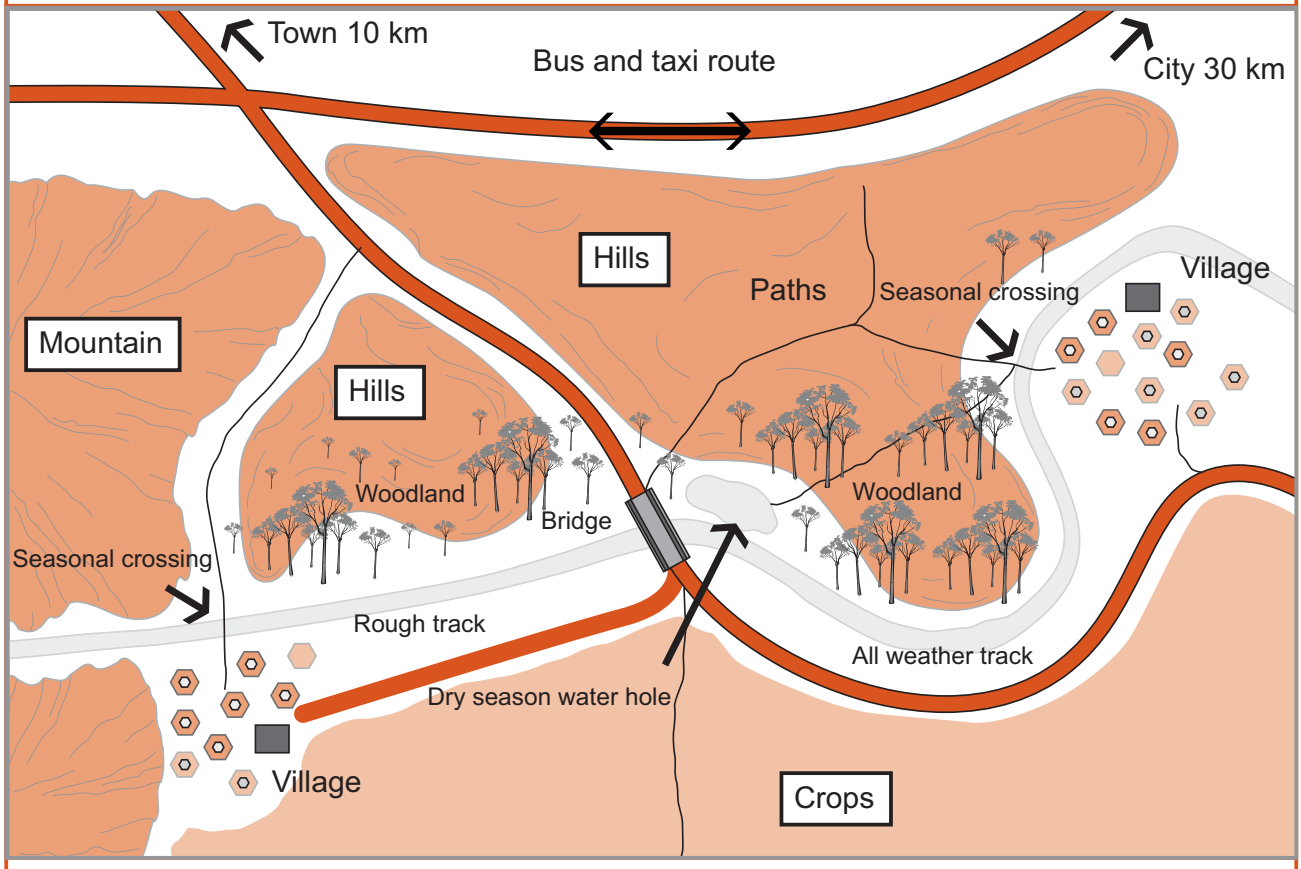
Infrastructure services

The fundamental prerequisites for enabling smallholder farmers to improve their livelihoods are public goods, such as roads, electricity, telecommunications, rural markets and other infrastructure. These types of investments therefore have an impact on the capabilities of rural-sector entrepreneurs to carry out

their activities; and investment in rural education, health, transport, communication infrastructure and skills development, will impact on individual capabilities. As they increase, so will efficiency, while costs, risks and vulnerability will be reduced.

Transport and traction enterprises have the vital requirement that other services need to be present so they can function effectively and efficiently. The enterprises needs suppliers, for example traders who sell replacement parts, they also need equipment repairers and veterinarians. In the case of suppliers, if the enterprise uses a motor vehicle it will require fuel. This is a specialized service and, as far as rural providers are concerned, is normally confined to fuel oils such as diesel and paraffin. Petrol requires a more expensive infrastructure to handle and store safely, and this will require a large critical mass of users to justify the installation costs involved. A local provider of fuels will need specialized transport to purchase, transport and restock storage tanks.

FIGURE 23 Simple map produced by transport sector stakeholders to show major routes and constraints



Source: P. Crossley and T. Chamen. (Adaptation by Fabio Ricci.)

Animal carts or motorized transport may be used, perhaps requiring the collection of fuel from a road tanker at a prescribed stop on a nearby road or from a depot in a neighbouring town. A number of safety issues arise for those handling, storing and delivering fuels, and vary according to the activity and the nature of the fuels.

The existence of such services, along with access means (paths, roads, etc.) is fundamental for such enterprises. In the case of access, interventions need to be carefully planned.

In order to build 'ownership' for such interventions and mobilize local resources, the planning (and monitoring and evaluation) process for such interventions must be participatory. Initial planning for any intervention should include the stakeholders involved, these being local government and community, along with national government representation where appropriate. This participatory planning process can require the use of local engineers and other consultants, in collaboration with communities. The first step could be to conduct a low cost inventory and condition survey of the local transport network, including roads, tracks, paths and footbridges, with a focus on existing obstacles. The survey results can be presented as a simple map.

Drawing a map, however simple, is a useful planning tool for decision-makers. It creates ideas and allows everyone to become more familiar with their surroundings (see Figure 23). It need not be entirely accurate in detail, but it should include transport-related constraints (such as river crossings with notes about seasonal flooding) as well as showing the opportunities provided by existing paths and tracks, and any transport services already in place. Direction and distances to markets and other transport services which are off the map should also be included as well as additional economic, social and demographic information.

Once information has been collected, stakeholders can decide cooperatively on desired improvements, taking into account objectives and available resources. Establishing the priorities of an intervention is not easy and requires a selection process consisting of a combination of screening and ranking procedures. The screening process reduces the number of investment alternatives. The balance of the alternatives will need to be ranked according to priority.

Interventions on this type of infrastructural development

are usually the responsibility of government agencies and in some cases donors. The private sector is not commonly involved, because access (roads) is traditionally regarded as a public asset. Consequently the private sector may be involved only working as a government contractor to build and/or maintain roads. However exceptions do exist and private sector road development is often paid for by levying a road-user toll. A drawback of this arrangement is that it may discourage use in some instances and transport enterprises may seek alternative routes, which may save the cost of the road toll, but make the trip less efficient and more time consuming.

Road construction projects are justified on the basis of different cost/benefit scenarios, including:

- ***Direct financial rewards from toll roads:*** the total revenue obtained from road users' tolls must be greater than the total costs of building and maintaining the road for the investment to be profitable. Depreciation costs must be built in (i.e. the road is costed over 15-20 years or an appropriate period) and future revenues discounted to present day values.

- ***Indirect financial rewards:*** an agency (usually public sector) constructs or upgrades a section of road, having estimated the likely returns in terms of:
  - reduced vehicle operating costs;
  - lower foreign exchange costs;
  - savings in fuel, parts and replacement vehicles;
  - time-savings by road users;
  - reduced accidents, injuries and fatalities.

- ***Quality of life:*** an agency (again, in the public sector) anticipates a benefit to the community in terms of better access to education, health care and dissemination of knowledge (technology transfer, etc.).

Indirect and quality of life benefits can be calculated in a variety of ways, some more quantifiable than others. Improving or maintaining a road costs money but it reduces the operating costs of the vehicle (repair, parts, tires, fuel, etc.) and improves speeds and thus throughput. It also encourages rural enterprises that need to use the transport service, because a faster, cheaper and more reliable service should be offered. It helps with rural mobility and

consequently improves the quality of life of the community. This is particularly important for poor people in rural areas who will benefit a lot through improved access to the outside world with simple means of transport as well as gaining access to public transport systems.

However, the paradox is that the revenues do not accrue to the builders of the road, but to its users. This is why government agencies are mainly involved, as they can take a wider economic view based on the benefits to the economy of the country or region as a whole.

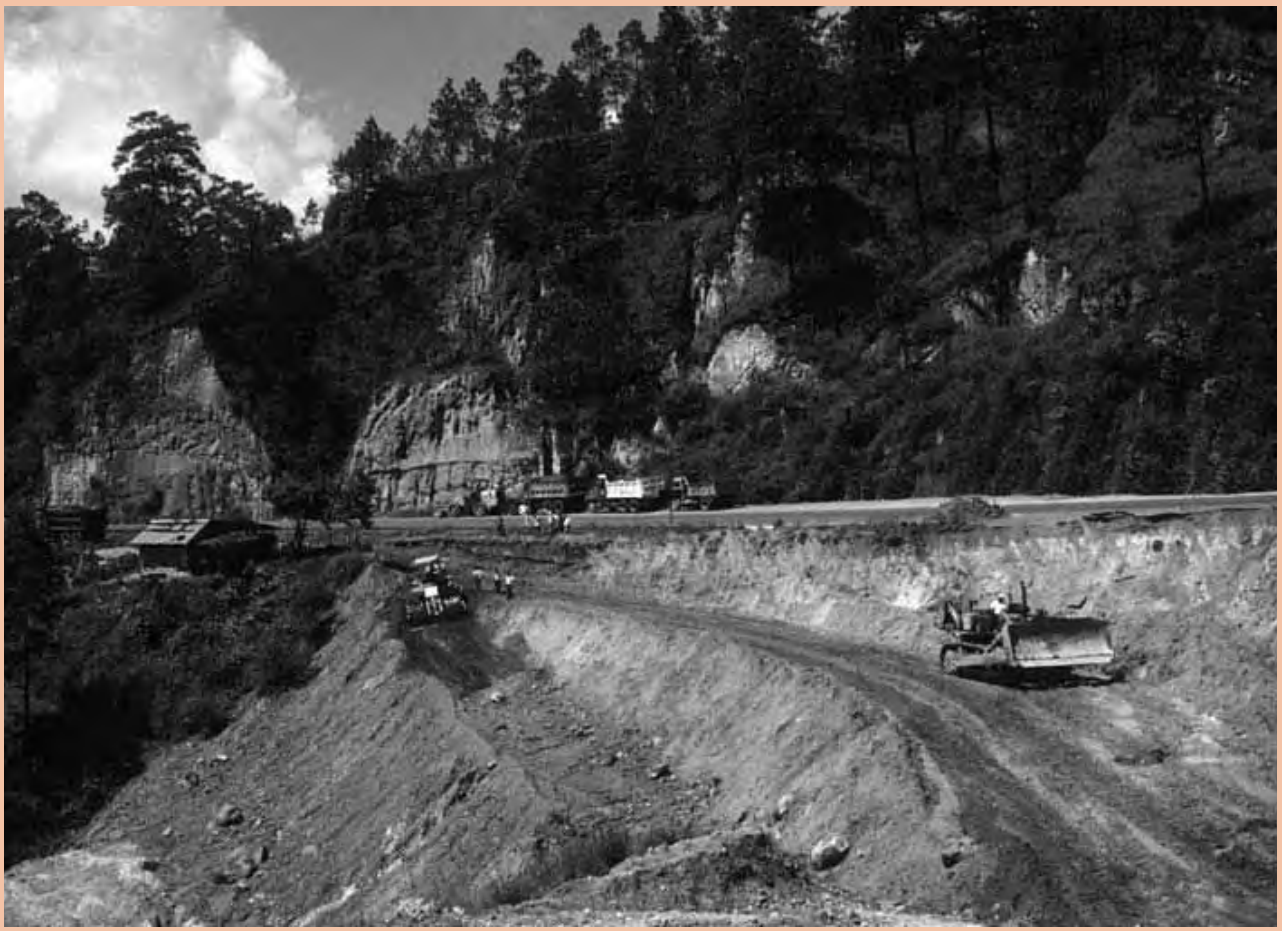


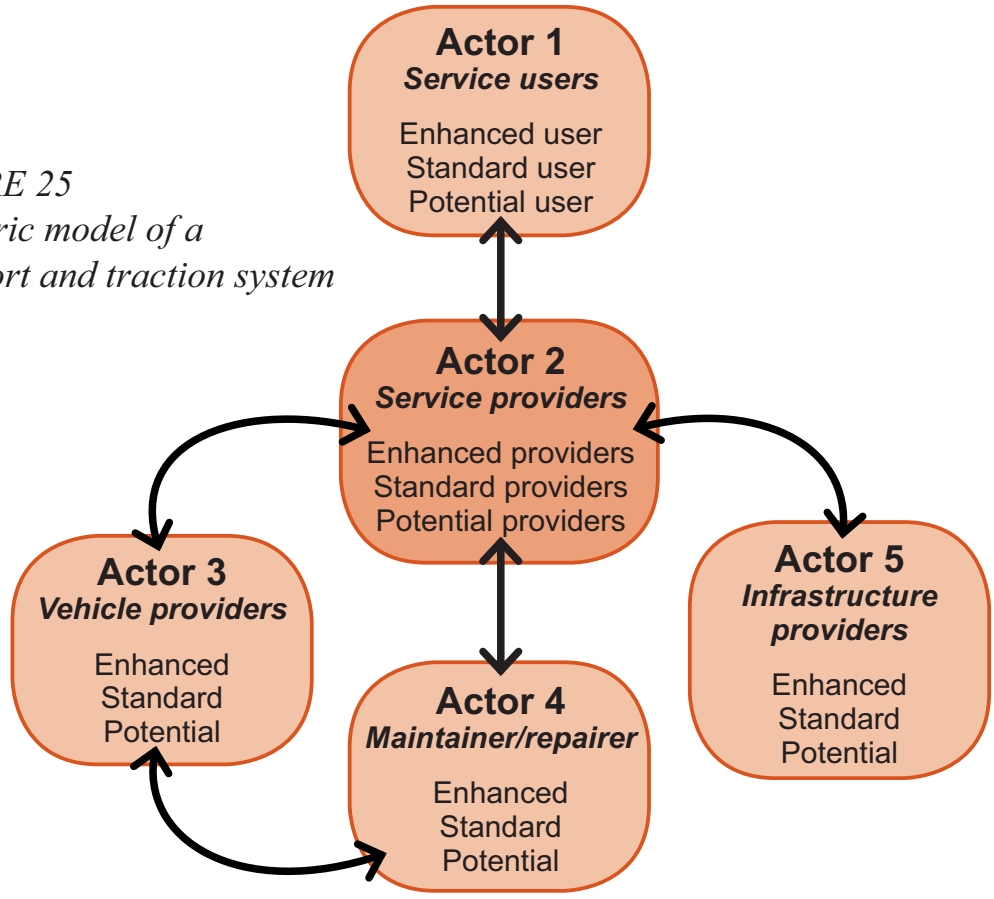
FIGURE 24 A land slide damaged this road after heavy rains in Honduras and is being repaired. This work can be done entirely by the public sector or with the participation of private sector contractors (Photo: © FAO/22096/G. Bizzarri)

The role of advisers

Promoting and advising on transport and traction enterprises, as a way for smallholders to improve their livelihoods, are competencies of the adviser. This though is far from a simple task as the adviser will need to consider numerous issues related to such diversification enterprises. Paramount is that the adviser understands the importance of taking a holistic approach: understanding the complexity of considering all elements involved in such an enterprise and advising smallholder farmers and other actors involved in the system accordingly.

The first step in such an approach is appraising the entire transport and traction system in the locality and understanding the context, functions and roles of the individual actors. Without such an analysis, advising only from the perspective of the transport and traction enterprise would be myopic and the information provided may not be

FIGURE 25
A generic model of a transport and traction system



entirely pertinent to all stakeholders' needs. Providing information to all actors, encouraging them to provide for their own information needs and encouraging them to share information among themselves is an important catalyst. A typical transport and traction system and the interactions among the various actors can be seen in Figure 25 on the previous page.

In most cases actors, actor 2 through 5, can be divided into three categories:

- **a** potential providers: people who have the capability and perhaps the interest to provide a service where it is needed, but may lack the information or encouragement to start doing so;
- **b** standard providers: those who are providing a service but at a quality or intensity which does not fully match the requirements of the current market;
- **c** enhanced providers: people who are operating at a professional level, who are aware of the changing market related to their business and the needs of their customers.

The strategic role of the adviser is therefore to encourage and assist the development and growth of enterprises from 'potential' going through 'standard' towards 'enhanced' (but only where a satisfactory demand or potential demand can be demonstrated).

Tactically, the role of the adviser can be implemented through two alternative processes:

1. find out the facts and present them to the actors with their implications; or
2. explain the need for finding out the facts and encourage actors to do so themselves, sharing the results and the implications with other actors so that they understand the various points of view.

Clearly the second process is generally the better. It increases stakeholder sense of ownership and may make negative facts more palatable to the actors. However, in some cases, actors may simply not appreciate the importance of finding out relevant information and hard facts related to their business and markets, hence the importance of information collection. Sometimes there is no alternative but for the adviser to undertake this work.

Actor 1

The service user

Usually the majority of users do not own their own transport service. In

practice the potential or non-user category is likely to be relatively small in number and confined to isolated areas without access to services. However in such areas the need for revenue generation linked to the provision of viable transport and traction services is as important as it is anywhere else.

The term 'enhanced user' implies the generation of additional revenue arising from better or different uses of a transport and traction service where it exists. Ideally the enhancement is not just in terms of revenue but also in the awareness of the opportunities and constraints of using transport and traction services.

The principal components of the adviser's role for this actor are:

- to help users to identify actual and potential opportunities for increasing revenue within their existing lifestyles through improved transport and traction services;
- to help identify any constraints to these opportunities, and provide advice and liaisons with those involved.

Actor 2

Transport and traction service provider

The group includes non-providers (who in the right circumstances may become providers) as well as existing providers who can become enhanced providers of a more comprehensive service. Although there is a two-way interface between the service user (actor 1) and the service provider (actor 2), it is more important for the service provider (actor 2) to understand and try to match the needs of the user (actor 1), rather than the other way round.

At the centre of the interface is the hierarchy of local value increase, charges and total operating costs. Actors need to gain: the service must result in value increase. For example, taking goods to market at an affordable charge which will cover operating costs and give a profit to actor 2, but it will also allow actor 1, the user, to sell goods in the market and make money. The adviser can assist in helping this interface to be beneficial to both parties.

For existing enterprises, carrying out an approximate estimate of user margins and provider margins is essential. If the hierarchy appears to be in the wrong order (e.g. an over-priced service) then information must be transmitted to the service provider. If the service appears to be under-priced, the attention of the provider and other relevant parties must be drawn to the fact. For example: if a local government sets a statutory transport charge too low this fact

needs to be made clear. Otherwise the transport user, who the government is probably trying to protect, will be worse off in the long-term when the transport service provider's enterprise fails.

For new enterprises the adviser will need to provide information and training for prospective new business start-ups. Feasibility studies need to be conducted, before any investment in vehicles is conceived and business is started.

Actor 3
Vehicle provider

The transport vehicle provider may produce either or both of two product types: vehicles and spare parts. As with the service provider, this actor usually comprises a relatively small proportion of the rural population. If vehicle providers do not exist, there is often a plausible opportunity for starting and creating an enterprise in this area and thus benefits will arise to the entire system.

FIGURE 26 Spare parts
(Photo by J. Kienzle)

The relationship between the vehicle provider and the service provider is, at first glance, straightforward. Ideally the vehicle provider is aware of the requirements of service providers, in terms of vehicle characteristics (size, speed, durability, purchase price) and will design and build a suitable vehicle accordingly. In practice, a vehicle is made to some assumed specification and then sold to a service provider. When this occurs, the users act unwittingly as vehicle developers and testers. Their subsequent complaints about operation or durability may be incorporated as modifications into subsequent vehicle models, and a gradual improvement occurs.

The development of manufacturing enterprises and their relationships with customers is time-honoured and has been in place ever since people started making objects for sale to clients in the community. Nevertheless, there are certain key features that an adviser can help with, either when giving guidance to an existing vehicle provider to upgrade to an enhanced provider or when advising a non-provider about the potential for becoming one.

The latter case is very important because it takes time, effort and some money to set up even a simple manufacturing enterprise, and unsound advice can mean that all three resources are wasted. This negative outcome can have a serious impact on poor people.

There are five principal areas in which an adviser may provide assistance:

1. assess the market, using appropriate (preferably participatory) methods, for the development of simple vehicle construction enterprises (ox carts, donkey carts, cycle trailers, etc.);
2. help existing vehicle providers to examine the local market to establish what type of vehicles are needed;
3. encourage both existing and potential service providers to produce at least an approximate specification for the vehicles they need;
4. assist vehicle providers to calculate their production costs and to set an appropriate margin to ensure enterprise viability without discouraging customers;
5. look into the opportunity of encouraging entrepreneurs to produce locally made spare parts for existing vehicles.

The role of the adviser is likely to be most effective in helping 'standard providers' to become 'enhanced providers' by taking on board the five aspects shown above.

Actor 4

Vehicle maintainer/repairer

The vehicle maintainer/repairer interfaces with actor 2, the service provider, and also with actor 3, the vehicle spare parts provider. The two functions of actor 4 are: vehicle maintenance and vehicle repair. In practice, maintenance may be carried out by the vehicle maintainer/repairer, the service provider or nobody. The repairer's function can be divided into two categories: repairs arising from breakage or break down; and repairs arising from the passage of time.

Most countries have some kind of network of repair enterprises but research has shown that they often possess some unhelpful characteristics:

FIGURE 27 A repairer in his workshop
(Photo by J. Kienzle)

- They have a tendency to 'swarm' into an area where a demand has been demonstrated, thereby diluting market opportunities, rather than identifying an alternative location with similar characteristics (for example a busy crossroads) but with less competition.
- They are renowned for a very poor attitude to their customers, with little regard for the need for high quality work undertaken promptly.
- Some have little appreciation of the need for cleanliness while handling disassembled components, so dust and dirt goes back into the assembly.

Some of the characteristics of this relationship have been touched on already. It is in principle a business-oriented, straightforward relationship in which the repairer is providing a regular (maintenance) or intermittent (repair) service to the customer. However, there are benefits for both parties in keeping the relationship smooth. The vehicle owner (transport service provider) needs to be able to trust the repairer to do a decent job that will last and at a sensible price, but must also provide loyalty in the form of regular work. In that way it is more likely that an emergency job will be done quickly.

The vehicle repairer ideally treats the customer as a long-term asset and avoids over-charging or doing poor quality work. Unfortunately, this is often a common failing with such enterprises. In general, management skills are lacking and that can make a lot of difference to success or failure of an enterprise.

In the role of vehicle spare parts provider, Actor 3 has a relationship with the enterprise that actually uses the parts (Actor 4). Spare parts can be one of the following:

- genuine (from the manufacturer – the quality should be the same as in the original vehicle),
- 'genuine copies' (from a good quality alternative supplier – the quality should be equivalent to a genuine part),
- copies (from informal sources – the quality can range from good to appalling, often with no obvious way to tell the difference),
- fakes (from informal sources – again the quality can vary greatly, but is more likely to be poor than good, since the manufacturer is passing the parts and packaging off as genuine, and has no vested interest in producing anything except a quick profit).

Often the maintenance/repair enterprises are based in the small-scale informal sector and it can be more difficult for an adviser to relate to them, or to encourage others to start up. However, their informal appearance should not detract from their importance.

Formal sector vehicle repair agencies exist in many towns but are usually very expensive and do not deal with low-technology vehicles. In the absence of any viable alternative, small enterprises assume an importance out of all proportion to their size. Without their services many vehicles simply could not continue to run.

The issue about producing spare parts has moral and legal implications in terms of vehicle warranty and road safety, among others, and should be approached with caution. The question of materials quality is critical. Under no circumstances should an adviser become involved

FIGURE 28 Mobile tractor repairers
(Photo by B. Sims)

with enterprises making 'fake' spare parts i.e. those purporting to be genuine. An adviser can assist by:

- checking costs and revenues;
- looking at the market to assess trends in the transport and traction service provider sector (growth or otherwise, types of vehicles, availability of spare parts, etc.);
- assessing the competition;
- advising on the long-term viability of the enterprise (for example re-location if competition is too stiff);
- investigating the availability of spare parts, materials and utilities such as electricity supply;
- assessing the enterprise/customer relationship and advising on ways to improve it.

The adviser may be able to influence local government in a way that an individual enterprise owner cannot do, for example, by encouraging the provision of a legal and reliable supply of electricity to a group of manufacturing or repair enterprises, or a local government-backed training course in business management or even simple customer relations.

In circumstances where there appears to be scope both for an enhancement of users and of service providers, but there is a lack of maintenance and repair facilities, the adviser may look into the possibility and feasibility of setting up additional enterprises to provide the necessary support services.

Actor 5

Infrastructure provider

The characteristics of this actor are very different from the other four. The infrastructure provider has a vital part to play in the totality of related rural transport and traction enterprises and the enterprises related to them. It should be noted that, although this section concentrates on roads because they tend to cause the most problems, physical infrastructure also includes markets, stores and depots, each of which contributes to marketing.

Infrastructure providers, as mentioned previously, are usually government agencies rather than private enterprises because infrastructure (roads in particular) is traditionally regarded as a public asset, available for use by all members of the public using all types of vehicles.

The interface between Actor 5 (infrastructure provider) and Actor 2 (transport service provider) is a very indirect relationship compared with the interfaces between other actors. The vehicle itself and the infrastructure experience a close

(and usually mutually damaging) interrelationship. However, the vehicle owner and the road builder may never meet. How then can an interface exist? Can a vehicle operator become aware of the aims, resources and constraints of a road building agency? Can the agency appreciate the importance to a vehicle operator of having a well built and well maintained all-weather road to use?

The simple answer is that the relationship usually does not work at all well at the actor level. However, there is no reason why it should not be made to work better with the intervention of someone, such as an adviser who has:

- a more informed appreciation of the importance of the relationship;
- a good knowledge of the overall context of rural transport;
- a vested interest in improving enterprise development for all.

There are some examples where a rural community pays a contractor to upgrade or improve a road leading to their village, often with the community providing labour; but in most countries and regions the provision and maintenance of the rural road network falls within the domain of a local government department. These local institutions are usually chronically short of funds and struggle to maintain their rural road network at even a barely acceptable level.

Thus the role of advisers is difficult, but it is most important for rural development that they remain focused on the goal of enhancing progress amongst the actors in the supply chain. The adviser is likely to be the main person who has the necessary overview of the rural transport and traction scene and who appreciates the essential nature of adequate infrastructure.

Poor infrastructure causes damage to vehicles and the produce being carried, slows the transport operation, causes delays or cancellations (particularly during the wet season) and can result in communities effectively being cut-off during certain periods of the year.

The problem gets worse the further down the road network 'hierarchy' one moves. A major arterial highway is heavily used and, if or when it deteriorates, there is a lot of pressure to refurbish it. International agencies may become involved. At the other extreme, a rural road or track leading to a few communities is very low on the spectrum of importance for maintenance or upgrade. Sometimes the criteria used by an under-funded roads department (or equivalent)

for its maintenance regime are that a road should be both heavily used and in a reasonably maintainable condition. Thus a road that is lightly used and in poor condition misses out on both criteria and falls out of the maintenance regime entirely, even though it may be of great importance to the communities it serves.

Small rural roads and tracks do however, have one advantage: they are usually made from earth. Many of the problems of access stem from only part of a road becoming difficult or impassable. The most usual case is a water crossing (bridge, drift or ford) during the rains. Even a small stream can cause a problem as larger vehicles weave around the waterlogged patch in an attempt to get through, and quickly destroy whatever road was there, but still 90 percent of the total road length may still be viable.

The answer is to concentrate on 'spot improvements'. Even a poorly funded roads department may be persuaded to send out a gang to repair (and preferably upgrade) a short section of road and thereby open up the route again. But someone has to persuade them, and the adviser is the one with the knowledge and perhaps a certain amount of influence. Thus the role of the adviser can be summarized as:

- calculate the approximate benefits to rural transport enterprises arising from the repair and upgrading of rural roads and tracks;
- monitor access problems as they arise, particularly in rural communities where enterprises are flourishing;
- encourage villagers to form groups to repair short sections of key routes as they become damaged;
- lobby government departments to release small amounts of resources to repair short sections of key routes in more difficult cases.

Other key points to consider

Once the overall characteristics of the transport and traction system are recognized and roles identified, advice can safely be given to rural people who are operating, or are considering operating, a transport and traction service. The following list may be used to guide.

Justification for vehicle investments and appropriateness of enterprise choice

Do not recommend that anyone buys a vehicle solely 'for their own use', particularly if a loan is involved. If the justification given is 'quality of life' then make it clear

that the vehicle should be regarded as a 'luxury good', and should be bought from savings or disposable income. However, reduction of the drudgery of rural poor people should not be perceived as 'luxury'. Many NGOs and development agencies do undertake special efforts to enable this group to access tools and devices to reduce the burden. This should be supported even if the interventions are heavily subsidized and sometimes devices are donated.

Suggest particular vehicles depending on the background and resources of the person concerned. Some examples are:

Case 1

A farmer who already has a machine for field operations (small four-wheel tractor or single axle tractor).

Suggestion

Buy a trailer, preferably locally made, and undertake some transport service operations.

Note that using the trailer will reduce the working life of the tractor, expressed in years, but the other side of the matter is that the revenue generated can help with regular maintenance and repair costs, and will provide income throughout the year. There is a need to balance costs against benefits in this case.

Case 2

Someone wishing to start in the transport sector in a fairly small way at first.

Suggestion

Buy an ox cart plus two oxen.

Ensure the total cost of animals and cart is included in the financial calculations, with allowance for the final value of the animals when their transporting days are over. The viable transport operational sector is fairly short range (a few kilometres) because of the low speed. Adequate veterinary services are essential.

Case 3

A small-scale farmer or householder who already has a donkey or a bicycle

Suggestion

Buy or make a simple trailer and undertake some transport services for extended family and close community, perhaps with payment partly in kind.

The vehicle may also help reduce the drudgery of family tasks such as fuel-wood or water collection, or bringing crops from the field. Nevertheless, the 'ideal hierarchy' (as applied to an owner/user) should still be viable, that is the revenues obtained from providing a service should at the very least cover depreciation and repairs on the trailer.

Additional revenue options and costs and benefits

If the justification given or implied is 'own use in support of a rural enterprise' look at the opportunities for extending the vehicle's usage by providing a transport and traction service to others. This generates extra revenue and benefits the wider community at the same time. If a 'genuine' transport and traction service is operating or proposed, it is usually helpful to ascertain precise costs and charges to see if the business is viable and operating optimally.

The role of transport associations

Enterprises of whatever nature, be it on 'foot', on 'hoof' or on 'wheel', often prove to be more viable and sustainable if they are incorporated into associations of similar service providers. In many countries associations have been promoted, and with appropriate support projects and advice, have enhanced profitability and are self-sustainable.

Advisers should generally promote such initiatives, especially among smaller enterprises, as many advantages can be derived from association. The main characteristic of a private sector association is that it is composed of people with similar interests who are in the service business, even on a part-time basis. The association is set up to serve the interests of the members and to be directed and managed by members. The provision of services is driven by members and market needs. The association also provides a forum where all members have equal rights and can voice their concerns, for example, they could raise the need for a road safety campaign among school children or lobby for road maintenance. The formation of associations among small enterprises enables donor sponsored projects to be delivered in a far more cost-effective manner.

Such associations not only provide an effective means for self-realization and capacity building of their members, but have important spill over effects on to the wider community. Associations not only increase rural mobility and create a demand for associated services, such as road maintenance and vehicle repair, but also generate employment opportunities, contribute to the democratic process, and encourage dialogue in the local community.

Gender: reducing drudgery for women versus women's investment in revenue generating activities

The overall aim for the adviser is to be balanced and fair regarding gender aspects. If necessary, unfair gender biases need to be pointed out.

However, existing family and cultural norms should be respected or, if possible through a discussion process, inequalities should be gradually reduced.

There are two main reasons why interactions between women and transport and traction enterprises are often problematic:

1. In many societies the role of the male is customarily dominant, and women are constrained in what activities and innovations are deemed acceptable.
2. Many of the transport tasks carried out by women – such as collecting fuel-wood and water – involve often non-revenue generating commodities.

BOX 4 **Recommended initiatives to support the development of Tractor Contractors' Associations (TCAs): the experience from Uganda**

Developing the association

- Membership base developed with an established future strategy.
- Identifying changes in government policy that will improve the enabling environment of tractor-based contractors.
- Establishing the objectives of the association and translating them into achievable benefits for the members, based on market potential.

Demand side (market linkages)

- Establishing and exploiting market linkages in each district where the associations have formed. Market linkages established using a cross- sector approach and providing at least three core tractor services: cultivation, transport and road maintenance. The cross-sector approach will ensure year round work by exploiting the flexibility of the tractor for multi-tasking and the owners' capability to switch their tractors between activities and different sectors of the rural economy.

Supply side (contractor capacity)

- Establish capacity building of members of the associations.
- Support the implementation of the agreed capacity building initiatives.

Source: DFID. 1999. Guidelines for the development of small-scale tractor-based enterprises in the rural and transport sectors, by R. Petts & W. Hancox, draft, MAMCon and Intech Associates.

Thus, the 'mere' reduction of drudgery may not be regarded as a sufficient justification to use the transport mode to assist with what are deemed to be household tasks. Yet this is exactly where a thoughtful adviser has a role to intervene. Household tasks such as collection of fuel wood and water are essential for the household's existence. Vehicles for making these tasks less burdensome are important, resulting in labour savings, thus enabling women to devote more time to other activities and businesses. Nevertheless, the key argument for justifying investment in an enterprise remains the direct or indirect generation of revenue. In the case of a rural enterprise, such as growing surplus produce for sale, the indirect revenue is generated from the higher price achieved after a change of location through transport.

Obviously it is much more difficult to operate a transport service than it is to become a transport user. But if a household has acquired a vehicle of some kind, the financial argument must be set out quite clearly. It should be seen more as an investment which reduces drudgery, but also offers the prospect of welcome additional revenue for the household.

The adviser can assist with assembling the facts and reviewing the options:

FIGURE 29 Women on bicycles and motorcycles for work and transport
(Photo: © FAO/21194/A. Proto)

- looking at all opportunities for revenue generation in the rural community related to enterprises particularly suitable for women to implement;
- calculate the likely costs and benefits and discuss these with the decision-makers in the community with a view to encouraging such gender based enterprises;

It is often challenging for women to become directly responsible for enterprises involving transport and traction vehicle providers or vehicle maintenance and repair, but this needs to be confronted with facilitation from the adviser. The prospect of another member of the family becoming more productive and generating extra revenue for the family can be a valid starting point in the move towards change.

Challenges

Farmer and community groups for transport and traction

Organizing farmers into groups is far from an easy task. The process of group formation is beset with difficulties as is the effort required to ensure that the group remains united, effective and efficient. Yet, recently some good progress has been achieved with the Farmer Field School (FFS) group approach, for example in sub-Saharan Africa. FFSs are formed with emphasis on group responsibility and decision-making from the start. The main question is: is there a *felt need* among group members to embark into transport and traction issues? If the answer is 'yes', the next step is to encourage the emergence of a group dynamic to get an acknowledged chair person, treasurer and other assignments democratically selected. Smallholder farmers may sometimes be overburdened with work and therefore will not easily have time to participate in group sessions. However, if the potential benefits become increasingly clear, their participation will be more easily guaranteed. For example, if access to transport and traction services at a reasonable cost is a potential outcome, the participation of smallholder farmers will be more likely. Sometimes smallholder farmers may have concerns about sharing information and working along side others who may be seen as competitors; usually a good introduction and facilitation will overcome this problem. There can also be cultural and social issues which may hinder smooth group formation and function, for example, reverence for the older generation can prevent groups from forming and/or can result in unhealthy domination by a single person.

Gender issues

Mobilizing women for enterprises in transport and traction can also be a special challenge. This derives from economic, cultural and social reasons. Normally women have less access to income and credit facilities, and are frequently relegated to the homestead in some cultures. Even though certain vehicles may be perfectly apt for women, they are often owned, operated and managed

by men. Furthermore women may not be able to utilize certain vehicle types based on social and cultural factors. In one study (Starkey, 2001) women in Uganda did not ride bicycles because they were perceived as prestigious devices that were used by men. Women who rode them would therefore be considered as 'behaving like men'. It also must be said that some development programmes do not always fully appreciate women's particular roles and their particular situation in many societies.

Local perspectives and perceptions of transport and traction vehicles

Smallholders are not a homogenous group, they differ based on gender, income, farming enterprises, age, ethnic background and other social and cultural characteristics. All these factors influence their perspectives about vehicles. These perspectives will influence the particular needs and wants that smallholders will require from vehicles and therefore the types of vehicles that they will adopt. For example, smallholders may adopt a type of vehicle that is not the best fit for their enterprise; a low cost transport device may make economic sense for the enterprise, but a different type of vehicle may be adopted based not on economic factors alone, but also on prestige and aesthetic considerations. Perceptions also play a large role in vehicle adoption in Uganda, for example, bicycles are viewed as prestigious and motorcycles as having even more prestige; in Mali animal drawn carts have high prestige, while in South Africa people may even deny they own and use a donkey cart (Starkey, 2001).

Transport and traction vehicle costs relative to income

For the adoption of transport and traction as an enterprise one of the main challenges is the cost of vehicles related to meagre incomes. It is true that human based transport and traction enterprises do not need a bought vehicle, but for increased effectiveness, efficiency and relief of drudgery a vehicle is required. Many local, muscle-powered, vehicle solutions can be cheap relative to motorized options, but expensive relative to local incomes and the costs of taking out a loan to buy one. Credit worthiness and the fear of becoming indebted are other challenges for transport and traction enterprises.

Sustainability of the transport and traction enterprise

Nothing ever stays the same and, for smallholders to maintain any improvements that they have made

to create a business, they have to be prepared to accept and react to change. This includes, for example, a change in the market requirements for better quality or different products and availability at different times. Seasonality can also have a big influence on either demand for, or availability of, different transport and traction services. These fluctuations will have an impact on both smallholders and the services themselves – connecting links may disappear for the farmer, and demand for a service may be lost for the operator.

Change may also come in the form of new technologies. This typically can have dramatic impact on the transport and traction enterprise, and can also affect direct competition. For example, a vehicle or transport mode which is more comfortable, faster, cheaper to run, takes bigger loads or carries more people will be potentially highly competitive.

Infrastructure and infrastructure services

Infrastructure, especially roads, does not come cheaply and is not easy to plan for. This challenge can be the most daunting in many cases, but it is fundamental for diversification enterprises. Without proper infrastructure it will be unlikely that transport and traction enterprises can work effectively and efficiently. Other services will be required and they need to be in place. This may be a challenge itself, for example a local blacksmith may not want to diversify into becoming a bicycle repairer because of a lack of will to learn new skills and/or an evaluation that the business will be low-volume and not worth the effort. The holistic integrated systems approach required for a full comprehension of the complexities of transport and traction enterprises can be a true challenge to the promotion of such a diversification enterprise.

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Sources of further information and support

Actions on the integration of rural transport services (ARTS)
http://www.rural-transport.net/

FAO
Rural Transport
http://www.fao.org/ag/ags/subjects/en/farmpower/power/transport.html
Labour Saving Technologies
http://www.fao.org/ag/ags/subjects/en/farmpower/lst.html

Grameen Bank
http://www.grameen-info.org/

International Forum for Rural Transport and Development
http://ifrtd.gn.apc.org/new/index.htm

Institute for Transportation and Development Policy
http://itdp.pmhclients.com/

Practical Action
http://practicalaction.org/?id=transport

Transaid
http://www.transaid.org/

Transport for rural development (RTTP)
http://www.animaltraction.com/index.html

Transport Research Laboratory
http://www.trl.co.uk/content/overview.asp?pid=77

World Bank
Rural Transport
http://www.worldbank.org/html/fpd/transport/rt_over.htm

Notes

Notes

THIS BOOKLET IS TARGETED AT PUBLIC AND PRIVATE ADVISORY INSTITUTIONS PROVIDING SUPPORT TO RURAL COMMUNITIES, in particular advisers involved with developing and enhancing revenue-generating rural enterprises for farmers. The booklet focuses on promoting transport and traction services as a viable diversification enterprise for smallholder farmers and others in rural areas. It considers the benefits that can arise from such enterprises, not only to smallholders themselves, but also to local communities in overall terms through increased productivity, improved and faster marketing, better mobility and reduced drudgery. For transport enterprises the focus of the booklet is on land-based farm to main road linkages, since this is the most critical for smallholder commercial development in the majority of developing countries.

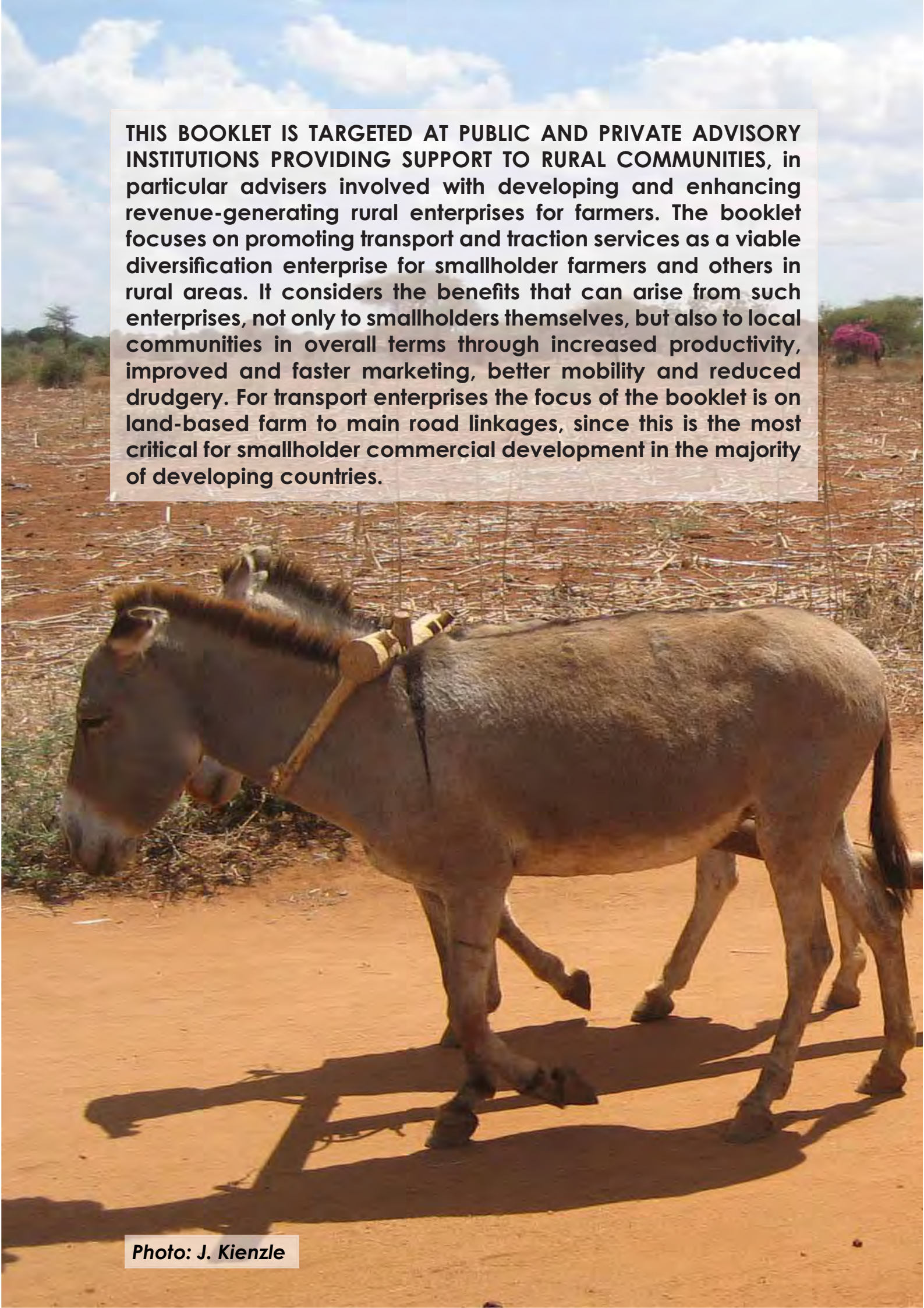

Photo: J. Kienzle