

## 4 Impact Assessment of Transport Interventions

### 4.1 Rehabilitation of the Feeder Road: Matamba-Chimala

The Matamba Region is situated on a plateau of 2000 m altitude in the northern part of the Makete District. Three villages were observed during the survey, which are mainly trading their products to the lowland market Chimala, where a tarmac road provides excellent connections to the capital Dar Es Salaam and to the regional centre Mbeya. Two roads lead down the escarpment. In 1987 the old regional road passing through Ng'onde was the only access to the Matamba Region. In order to improve the transport situation the local authorities decided to rehabilitate an old feeder road leading from Matamba down the escarpment to Chimala. The road was upgraded to all weather standard as a part of the MIRT Project from 1989 to 1992 by paid labour and self-help. The project trained foremen and gang leaders, produced a manual, paid salaries and provided hand tools, machinery and transport. In 1994 the regional road through Ng'onde was no longer passable due to lack of maintenance by the regional administration. The only motorable connection from Ng'onde to the rest of the world is a track to Matamba, which is rarely used by vehicles. The village leadership stated, that the transport situation of Ng'onde has deteriorated over the last few years.

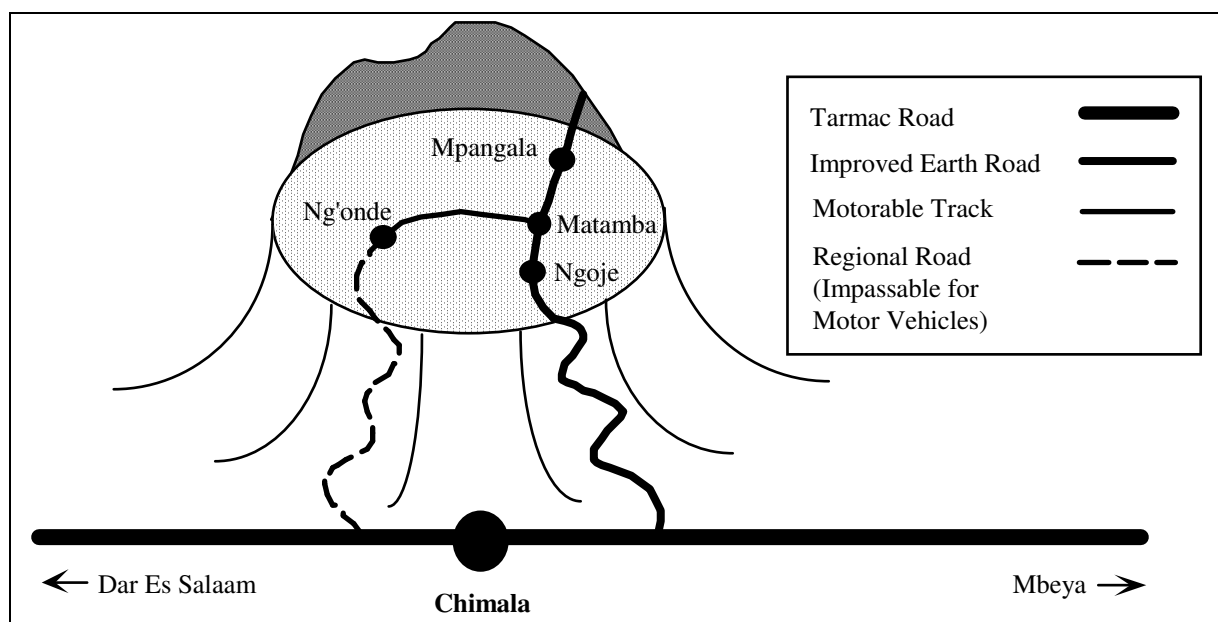


Fig. 4.1-1 Location of the surveyed villages in Matamba.

The maintenance work was initially done with unpaid self-help labour. Because no motorised transport was available the labourers had to walk long distances before starting work<sup>1</sup>. Inefficient work and high opportunity costs of labour were the reasons why it was decided to conduct the maintenance with paid labour. The funds will be raised by a local tax of 40 ¢ per able person and year.

#### 4.1.1 *Transport Volume*

A traffic count was undertaken from Wednesday, June 15 to Saturday, 18 1994 on the Matamba Chimala Road<sup>2</sup>. On an average day 11 vehicles left Matamba in the direction of the lowlands, carrying 31 passengers, 2.4 t of potatoes and 8.8 t of bamboo juice "ulanzi". A comparison of the village leadership discussions indicates that the number of vehicles stayed constant in Mpangala, while it decreased in Ng'onde, where the road has deteriorated. It seems that during the

Village	1987	1994
Mpangala	5/day (May/June)	5/day (May/June)
Ngoje	no data	5/day (May/June) 2/day (rainy season) 8/day (harvesting season)
Ng'onde	7/week	1/week

Tab. 4.1-1 Number of vehicles visiting Matamba villages

harvesting period from July to October most of the incoming vehicles visit the Matamba highlands. Traffic estimates for the whole year can only be done approximately. The number of motor vehicles

driving down the escarpment will be to the order of 3-4,000, carrying about 10,000 passengers and roughly 3-4,000 tons of goods.

An indication of the effects of the road can be given by the example of the export of bamboo juice "ulanzi" from Matamba. In the early morning many of the farmers are busy collecting "ulanzi" from the bamboo bushes. In May and June every day 8 Four-Wheel-Drive Pick-Ups enter Matamba to collect 8,200 l of ulanzi and sell it in Mbeya, which is the biggest town, 90 km away. The price difference of \$ 140 per load allows a profitable operation of the vehicles and gives income to the personnel and the farmers. The average household in Matamba sells 450 l of ulanzi annually, which gives them an income of \$ 10.

#### 4.1.2 *Marketing of Agricultural Products*

The villages in the Matamba Region have to be observed very carefully because their individual situation explains the transport patterns. Ng'onde and Ngoje

<sup>1</sup> A road camp was not constructed on the escarpment, because the villagers were afraid of witchcraft during the night.

<sup>2</sup> The counting was undertaken during daytime at the Matamba road toll station. The traffic during the night time was estimated.

villagers can reach the market in Chimala within 2 ½ - 3 hours, while the people from Mpangala have to walk for four hours. Even though Ng'onde has a bad road access the village earns the highest revenues from marketing activities, followed by Mpangala and Ngoje. All of the households in Ng'onde use fertiliser and the amount per household is higher than in the other villages. The farmers produce mostly high value crops like cereals, beans, peas and onions, which can be more easily transported to the market than e.g. potatoes. Mpangala gives a completely different picture: the more humid and cold climate and the good road access favours the production of potatoes causing big marketing weights of more than two tons per household, which are mainly transported by trucks to the markets. The revenues per ton are much lower than in the other villages. Ngoje represents an intermediate situation: the agro-ecological conditions, which are comparable with Ng'onde do not favour the production of potatoes, but good access to motorised transport enables the production of relatively heavy crops. Ngoje and Mpangala, which have good road access, are marketing a comparable amount of the alcoholic bamboo juice „ulanzi“, in contrast to Ng'onde, where the ulanzi has to be transported by headload to the lowland markets.

1994	Unit	Mpangala	Ngoje	Ng'onde
Distance to Chimala	min walk	235	150	190
Fertiliser used per household	kg/HH	54	130	147
Amount of crops marketed	kg/HH	2,080	623	749
Average revenue per t crop marketed	\$/t	46	127	172
Amount of ulanzi marketed	l/HH	590	577	220
Total revenues from marketing activities	\$/HH	113	100	140

Tab. 4.1-2 Salient features of the Matamba survey villages

In Fig. 4.1-2 the changes in marketing since 1987 are visualised; obviously the weight of crops marketed increased tremendously. The major reason might be the breakdown of the Pyrethrum Marketing Board in Matamba, which was mentioned earlier. In 1987 half of the revenue was earned by the marketing of pyrethrum; in 1994 no farmer was producing pyrethrum after the 1993 harvest was collected, but not paid for by the board. In 1994 private traders took over the role of the pyrethrum marketing board; the light product pyrethrum was replaced by a number of heavy food crops like Irish potatoes, maize, beans, peas and onions. In 1987 most of the products were collected in the villages as shown in Fig. 4.1-2. After the breakdown of the marketing board the farmers had to transport a bigger share of their products to external markets. Nevertheless, many farmers increased their marketing weights by transporting bigger loads by walking.

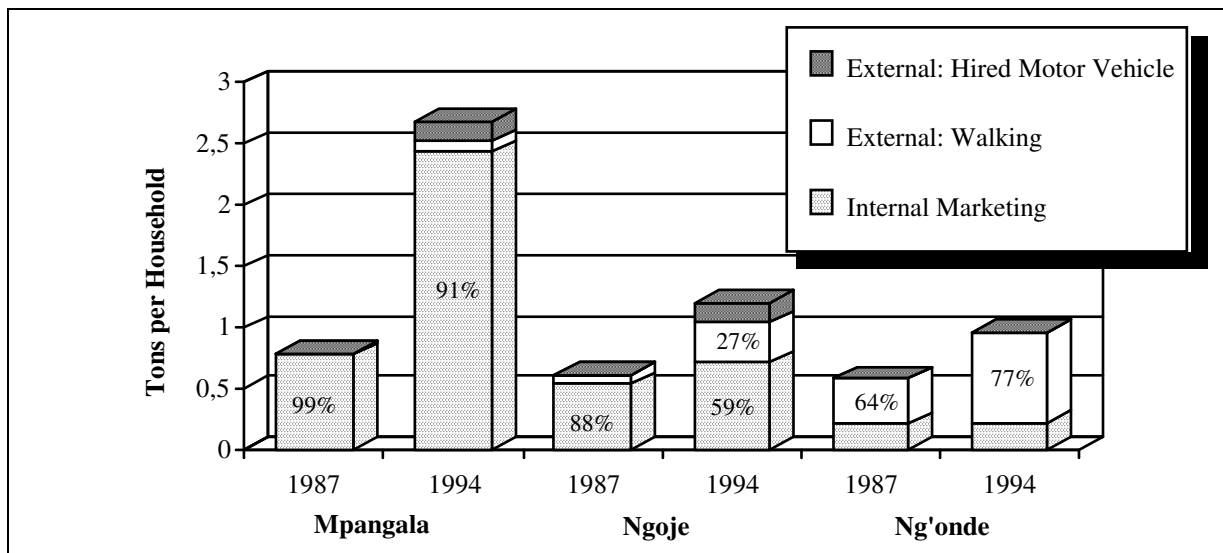


Fig. 4.1-2 Marketing of agricultural products in the survey villages of Matamba

**Mpangala** sells 91 % of the weight of its products within in the boundaries of the village. The heavy potatoes (67 % of weight), are only transported from the field to the nearby road, where they are loaded onto trucks. Most of the trucks belong to private traders, who collect the potatoes and sell them in lowland markets<sup>3</sup>. Some farmers decided to hire a vehicle in order to transport products (6 %) by themselves to the lowland markets, where the producer prices are higher. Only 3 % is carried by headload to a nearby highland market. Ulanzi is collected in and around Mpangala, transported to the street and sold directly to private traders with motor vehicles. The ulanzi and potato marketing were only possible because the conditions of the rehabilitated road allowed the transport of the heavy crops to markets outside the district.

In **Ngoje** 59 % of the products are sold internally in the same way as described for Mpangala, but 27 % are carried by headload to lowland markets. This means that farmers prefer to carry annually 300 kg of their crops by headload for two to three hours and walk back even longer up the escarpment, rather than selling these products in the village directly to traders and receiving smaller revenues<sup>4</sup>. Such an arbitrage is not possible for the farmers in Mpangala, because their potatoes are too heavy and the distance to the lowland market is much longer. In Ngoje good access to the road makes the transport of crops with hired vehicles possible; 13 % of the products are transported in this way to the lowland markets.

In **Ng'onde** bad motorised access does not offer the same opportunities as in the other villages. Nevertheless the households received the highest revenues

<sup>3</sup> The potatoes are quite often transported to the markets in Dar Es Salaam

<sup>4</sup> There are of course a lot of other reasons for travelling to the lowland markets: Social contacts can be made, goods are cheaper to purchase, the wife/husband cannot control expenditures, etc.

compared to all the other villages surveyed! An explanation might be the existence of a 'traditional' barter economy between Ng'onde and Chimala and a strong social cohesion by kinship. 77 % of the products are transported by headload down the escarpment. Part of the products which are marketed internally are probably transported down by other members of the village. The case study about the transport activities of a woman in Ng'onde may elucidate this phenomenon.

#### **Box 4-1: Headload Transport from Ng'onde**

A woman from Ng'onde earns a considerable income by transporting products, which she buys in the village, to lowland markets. Four times per week she transports 20 l of bamboo juice „ulanzi“ to Chimala to where she has to walk for four hours. She brings back the same amount of kerosene, which she sells in the village. In May traders come to the village of Usalimwani, which she can reach in two hours. Even though the producer prices are lower she prefers to walk the shorter distance and compensates the lower prices by walking every day of the week. If the price differences between highland and lowland markets are regarded as the income generated by the transport, then she values in both cases the transport at 19 ¢ per hour. This is 70 % more than the minimum salary offered to government employees.

Market Place	Distance	Trips/Week	Price Difference	Transport Revenue	Income
	[hours]		[\$/20 l]	[\$/hour]	[\$/week]
Chimala	4	4	0.77	0.19	3.08
Usalimwani	2	7	0.39	0.19	2.73

Another restriction for the production of crops is the transport of the crops from the field. The location of the Mpangala potato-fields beside the road favours marketing directly from the field or on the street. Even though the biggest amount is harvested there, only half of it has to be transported home. Ngoje had to transport the biggest loads home from the fields. Here seems to be a restriction for further expansion, which Ngoje reduced by producing high value crops.

Tons per household	Mpangala	Ngoje	Ng'onde
Products Harvested	4.01	3.13	2.38
Transported Home	2.17	2.61	2.04
Not Transported Home	1.85	0.52	0.34

Tab. 4.1-3 Annual transport of agricultural products from the field 1994

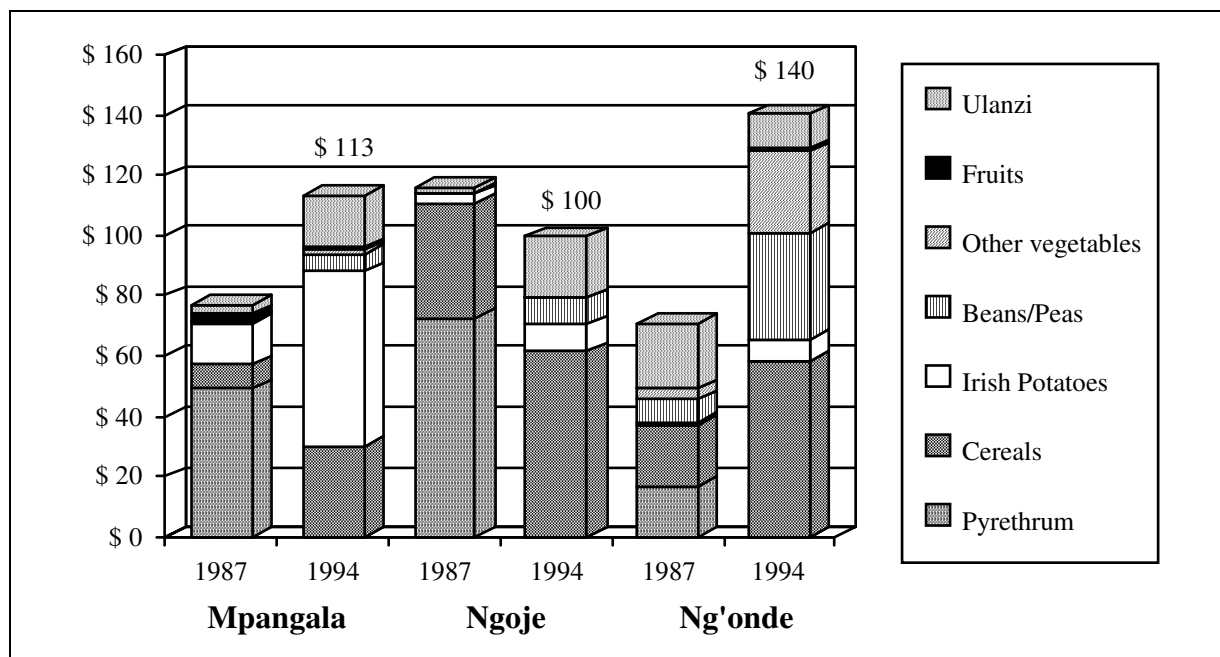


Fig. 4.1-3 Revenues per household from marketing in Matamba villages (1994 prices)

A comparison of the mean revenues<sup>5</sup> before and after the rehabilitation of the road, visualised in Fig. 4.1-3, is an indicator of how farmers were able to react to the changing conditions. **Remarkably the village with the worst road access Ng'onde had the best performance, while the village with the best motorised access Ngoje had to register a decline in income.** One of the reasons is the smaller dependency on pyrethrum in Ng'onde (24 % of the 1987 revenues) compared to the other two villages (63-64 %). Ng'onde reacted to market liberalisation by increasing the output of all its products. Because the road conditions were deteriorating in Ng'onde the marketing concentrated more on high value crops like cereals, beans, peas and other vegetables which were transported by headload to the lowland markets. The marketing of ulanzi, which in 1987 was collected by motor vehicles decreased.

	Mpangala		Ngoje		Ng'onde	
	\$/HH	%	\$/HH	%	\$/HH	%
<b>Mean Values</b>						
Including Pyrethrum	+36	+47%	-17	-14%	+70	+98%
Excluding Pyrethrum	+86	+324%	+53	+113%	+86	+160%
<b>Median Values</b>						
	+28	+47%	-11	-13%	+82	+279%

Tab. 4.1-4 Change in value marketed in Matamba villages 1987-1994

<sup>5</sup> In order to eliminate the distortions caused by changes in producer prices, the 1994 producer prices were multiplied by the 1987 weights marketed.

The performance of Ng'onde is remarkable especially if it is compared with Ngoje, which has comparable agroecological conditions. Although Ngoje increased the production of cereals and ulanzi, the revenue losses from pyrethrum could not be compensated for. Even if the marketing of pyrethrum is not taken into account, as shown on table 4.1-4, the marketing increase in Ng'onde is still much stronger than in Ngoje. If instead of the mean values the median values are compared, the marketing of half of Ng'onde's households nearly triples, while the people in Ngoje suffer from decreasing revenues. Even though Ngoje had an improved motorised access the absolute and relative increases in Ng'onde were by far stronger! This leads to the following conclusion:

**If the markets are within walking distance, no measurable benefits<sup>6</sup> of road rehabilitation on the marketing activities can be observed.** Missing motorised transport can be compensated for by walking, and even villages close to the road prefer to carry more than a quarter of their goods by headload to the markets.

Mpangala is in a different situation than Ngoje and Ng'onde; the distance to the local market is longer and the agroecological conditions favour the production of heavy potatoes. The village could offset the losses from the breakdown of the pyrethrum market by shifting to intensive potato production, but the marketing

of cereals and ulanzi also increased. If pyrethrum is excluded from the analysis Mpangala had even a stronger relative increase in marketing than Ng'onde, while the absolute growth was similar (Tab. 4.1-4). The increase in marketing would not have been possible without the rehabilitation of the road, which allowed the transport of heavy loads to the distant markets. A comparison of Mpangala with another Matamba village with similar agroecological conditions but no motorised access was not possible<sup>7</sup>. Therefore

\$ (1994)	Mpangala*	Bulongwa**	Impact
<b>Mean Values</b>			
1994	106.0	52.3	
1986/87	77.0	31.3	
<b>Change</b>	<b>29.0</b>	<b>21.0</b>	<b>8.0</b>
<b>Median Values</b>			
1994	80.5	27.1	
1986/87	59.5	20.4	
<b>Change</b>	<b>21.0</b>	<b>6.7</b>	<b>14.3</b>
<b>Variation Coefficient***</b>			
1994	104%	129%	
1986/87	82%	92%	
* Impacts by donkey households subtracted			
** Madihani and Kidope			
*** Variation Coefficient = Standard Deviation / Mean			

Tab. 4.1-5 Revenue per household by marketing

<sup>6</sup> It could be argued, that without the rehabilitation of the road the situation of Ngoje would have been worse. Households would have lost income by the marketing of ulanzi, which is sold to the private traders. A quantification of this assumption is not possible.

<sup>7</sup> No other suitable village had been researched in 1987.

a comparison with the changes in the Bulongwa region has to be undertaken. The villages Madihani and Kidope are chosen because no improvements of the transport system occurred and the marketing patterns<sup>8</sup> changed from predominantly internal to external marketing. The impact assessment is undertaken by comparing the changes in the villages listed in table 4.1–5. If the changes in Bulongwa are regarded as general changes due to non-transport interventions (e.g. market liberalisation, breakdown of marketing boards), the benefits can be derived by comparing the growth of the revenues.

$$\text{Impacts}_{\text{Mpangala}} = \Delta \text{Marketing}_{\text{Mpangala}} - \Delta \text{Marketing}_{\text{Bulongwa}}$$

A comparison of the mean changes estimates the annual impacts of the road improvement in Mpangala at \$ 8.00 per household. This value can be regarded as a conservative estimate because a comparison of the median values indicates stronger impacts<sup>9</sup>. A comparison of the median gives a better view how the majority of the population was profiting from the road improvement. An optimistic view would estimate the annual impacts in Mpangala at \$ 14.30 per household.

#### 4.1.3 Marketing with Hired Vehicles

Farmers can increase their income by transporting their crops with hired motor vehicles to the lowland markets. 6 % of the weight of crops in Mpangala and 13 % in Ngoje are transported by hired vehicles to the lowland market Chimala. Even though the distances are different, the costs per ton transported<sup>10</sup> range between \$ 8.50 and \$ 10.90. These costs can be covered by higher producer prices on the lowland market. The profit, which farmers make by hiring vehicles ranges between 25 \$/t for maize and 29 \$/t for potatoes. Unfortunately only a few farmers are able to take advantage of this possibility, probably because of the lack of financial resources. Therefore the annual profit per household is, with \$ 4.36 in Mpangala and \$ 3.90 in Ngoje, relatively low.

<sup>8</sup> In 1986/87 in Kidope 87 % of the crops, in Madihani 46 % and in Mpangala 99 % were marketed internally. Until 1994 no significant changes in crop marketing occurred in Mpangala, while the share decreased to 18 % in Kidope and to 9 % in Madihani. Kidope and Madihani transport all their crops by headload to the external markets. The distances from the three villages to the lowland markets are comparable.

<sup>9</sup> The differing results can be explained by an analysis of the variation in the household data. Since 1986/87 the variation was growing much stronger in Bulongwa than in Mpangala, which had a strong influence on the mean value.

<sup>10</sup> The costs for hired vehicles from Matamba to Chimala range between 33 ¢/tkm and 68 ¢/tkm. This seems to indicate high profit margins for the vehicle owner, when the vehicle operating costs for a four-wheel-drive of 25 ¢/tkm is taken into consideration.



#### 4.1.4 Reduced Vehicle Operating Costs

The rehabilitation of the road could reduce the Vehicle Operating Costs (VOC). A 17 km stretch of road was improved and it is assumed that 3,600 vehicles pass up and down this segment of the escarpment. The reduction of VOC<sup>11</sup> can be estimated at annually \$ 10,000 or \$ 2.24 per household. An optimistic approach would assume, that the total benefits will be passed on to the local population by way of reduced passenger fares, higher producer prices or will be directly earned by the local vehicle owners. A pessimistic approach would assume that the region profits from only half of these benefits because many vehicles entering the district do not belong to Matamba owners. On top of this reduced transport costs will probably cause a reduction of consumer prices for agricultural produce rather than an increase in producer prices. The benefits per household would thus amount to only \$ 1.12.

#### 4.1.5 Time Savings

Ngoje and Mpangala farmers save time by selling their products to traders, who transport them to the markets or by hiring vehicles. These time savings can be regarded as the benefits stemming from the road rehabilitation. It can be postulated that the Mpangala farmers would not be able to transport all their potatoes down the escarpment by headload; they would therefore grow a different set of crops, which are assumed to be similar to those grown in Ng'onde. Tab. 4.1-6 lists the additional transport burden, which would have to be carried, if the same revenues received in 1994 should be earned. In Mpangala annually more than 8 tkm would have to be transported per household and additional 200 hours of

		Mpangala	Ngoje
Additional Weight	tons	0.5	0.2
Trips		26	10
Distance Market	km	15.7	10.0
Tkm	tkm	8.1	2.1
Time	hrs	203	52
Value Time	\$	14.9	3.8

Tab. 4.1-6 Time savings by road transport

time used. If the time savings are valued with the opportunity costs of time<sup>12</sup>, then the benefits can be estimated at \$ 15 per household. The smaller volumes and the shorter distance to the lowland market causes lower benefits in Ngoje. 63 % of the time benefits can be attributed to women.

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<sup>11</sup> The cost savings range between 7 ¢ and 10 ¢ according to the vehicle used and the terrain.

<sup>12</sup> The economic effects of time savings are discussed in the Chapters 2.4.2 and 6.3. The opportunity costs of time equal the marginal productivity of labour which is calculated with the production function estimated in chapter 5.2.3. The marginal value of labour amounts to ¢ 7 in Makete.

#### 4.1.6 Other Benefits

The two surveys give no indication of the effects of the road rehabilitation on external travel activities outside the district. Neither were the villages with good access undertaking more external trips, nor was the increase since 1987 any stronger than in the remote villages. In the most accessible village, Ngoje, the worsening income situation even caused a reduction in the number of external trips. No measurable effects on out-migration from Matamba could be observed. Better motorised access to the lowlands also might account for negative effects on the health situation as described in Chapter 4.3.5 for the footpaths. Furthermore vehicles are more likely to carry flies and mosquitoes which spread lowland diseases like Malaria, Sleeping Sickness and Onchozercosis. Agricultural experts state that lowland pests are increasingly appearing on the Matamba highlands.

The economic performance also had its impacts on the use of fertiliser. In Ng'onde the number of households using fertiliser is higher and it increased strongly, while in the easily accessible villages this amount has decreased since 1987. Thus in the Matamba Region the price has a stronger impact on the use of fertiliser than the motorised accessibility.

#### 4.1.7 Total Benefits

Until now only the benefits for the three Matamba villages Mpangala, Ngoje and Ng'onde could be assessed. The impact of road rehabilitation in the whole Matamba Region, which is considered as the catchment area can be estimated by taking the number of households, the distance to the markets, the accessibility, the transport volume registered in the traffic countings and the agroecological conditions of the villages into account. The traffic counting showed that more than half of the ulanzi collected in Matamba stemmed from the village Mpangala, where the strongest benefits can be expected. Salaries from the road works have to be added to the local benefits, while VOC are not included, because it is assumed they are included in the benefits by increased market production. The total annual benefits per household are estimated at \$ 17 according to the pessimistic view and at \$ 20 for the optimistic approach.

\$/Household	Marketing Activities		Hiring Vehicles	Time Savings	Wages
	optimistic	pessimistic			
Mpangala	14.30	8.00	4.36	14.89	-
Ngoje	0.00	0.00	3.93	3.83	-
Ng'onde	0.00	0.00	0.00	0.00	-
Matamba	6.27	3.51	3.81	8.38	1.09

Tab. 4.1-7 Benefits from the Chimala-Matamba Road

## 4.2 Track Construction: Unenamwa-Bulongwa

In the Bulongwa Region, a trail leading from the village Unenamwa to the ward centre Bulongwa was upgraded to a dry weather motorable track. The work was done with the "self-help" labour of the inhabitants. The village leadership was very enthusiastic<sup>13</sup> about the effects of this local track. In emergency cases the

		Unenamwa	Other Bulongwa Villages	Impact**
Marketing (Mean)* [\$]	1994	45.1	46.9	
	1986	25.3	29.3	
	Change	19.8	17.6	2.2
Marketing (Median)* [\$]	1994	22.8	26.6	
	1986	14.9	16.2	
	Change	7.6	10.4	-2.8
External marketing [kg]	1994	46%	64%	
	1986	92%	28%	
	Change	-46%	36%	
Vehicles/month	1994	15	7	
	1986	2	6	
	Change	13	1	12
* The impacts on marketing from the footpath improvement are subtracted				
** Methodology I described in Tab. 3.4-1				

Tab. 4.2-1 Impacts of the Unenamwa-Bulongwa track

to buy crops from the farmers, which they had to transport on headload to the local markets before the improvement was undertaken. In addition traders using bicycles are now visiting the village. According to the village leadership the track made the village so attractive that 20 new households moved to Unenamwa. The number of households in Unenamwa increased from 170 in 1986 to 220 in 1994. This implies an annual growth rate of 3.2 %, which is well above the regional average.

The frequency of vehicles visiting the villages increased from 2 per month in 1986 to 15 per month in 1994, while in the other villages the increase was nearly zero (see table 4.2-1). The vehicles were collecting the products from the farmers in Unenamwa, which gave incentives for higher market production. The mean increase of the revenues from marketing in Unenamwa was slightly

<sup>13</sup> The group of enumerators was welcomed very warmly and accompanied half their way home. The village presented a chicken as a gift for the research group.

<sup>14</sup> JENNINGS (1992, p. 33) reports, that sick people are carried long distances on stretchers made from bamboo poles to reach health services. "In such instance the bearers slipped in the mud, the woman delivered her baby on the track in the rain, the child died shortly afterwards. This is not an unusual occurrence."

stronger than in the other observed Bulongwa villages. An optimistic impact assessment estimates the benefits by increased market production at \$ 2.20 per household. The pessimistic approach would result in negative impacts, which makes no sense and therefore it is assumed, that the benefits are zero.

Internal marketing 1986	tons	0.01
Internal marketing 1994	tons	0.22
Reduced weight	tons	0.20
Saved trips per annum		10
Distance external market	km	8.2
Saved pkm per annum	pkm	167
Saved tkm per annum	tkm	1.7
Saved time per annum	hrs	42
<b>Value Time Saving</b>	<b>\$</b>	<b>3.06</b>

Tab. 4.2-2 Time savings by internal marketing

Tab. 4.2-1 shows also that the amount of external marketing decreased during the observed period from 92 % to 46 %, while in the other villages an increase of external marketing could be noticed. When mobile traders are collecting agricultural products in the village, the total transport burden of the farmers and the time dedicated to crop marketing is reduced.

These benefits can be quantified by the reduction of the time which it would take to carry the same load to the external markets. Every household would need 42 hours annually more to carry the additional weight of 200 kg of products to the markets. The annual benefits from time savings amount to \$ 3 per household.

The village leadership stated that about 15 vehicles per month visit the village, which are profiting from the better standard of the track. Annually, 1980 vehicle-km are driven on the improved track, causing reduced vehicle operating costs<sup>15</sup> of \$ 153. If a pessimistic approach is chosen, which assumes that only half of the benefits have a regional effect, in the form of reduced passenger fares, increased producer prices or savings by local vehicle owners, the annual benefits can be estimated at 15 ¢ per household in the catchment area. An optimistic approach would double the benefits.

No effects could be observed concerning the use of agricultural inputs, out-migration, the total quantity of products harvested, or the number of trips outside the district. No household was hiring a vehicle to transport crops to the markets. The total benefits per household of the track construction amount to \$ 3 according to the pessimistic view and to \$ 5 according to the optimistic approach.

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<sup>15</sup> The vehicle operating costs are calculated according to data given by the Tanzanian Ministry of Transport: 7 ¢/vehicle-km for a four wheel drive and 9 ¢/vehicle-km for a medium truck.

#### **Box 4-2: The Effects of the Road Improvement in Ihela**

The village of Ihela is located 1-2 km away from the main regional road from Njombe to Makete. During the MIRT Project spot improvements were undertaken on this road, with the result that a regular bus service was operating the whole year on this route. During the rainy season of 1993 the condition of the earth road deteriorated due to unprofessional maintenance.

Although the village has the best external access compared with the other Bulongwa villages it could not benefit from the road improvements. The increase in agricultural production and marketing noticed in all the other villages of the survey could not be observed in Ihela. Farmers were harvesting less agricultural crops and the revenues derived from crop marketing had been stagnating since 1986. The number of households stating agriculture as the main source of cash income declined from 61 % to only 38 %, while households living from transfers from relatives increased from 6 % to 14 % in 1994. This suggests a high out-migration of males, which can be verified by the highest male-to-female ratio observed in Makete; every fourth woman is living without her husband. Ihela was traditionally living from the transfers of migrant labourers on tea plantations or from pit sawing. The improving market conditions in Tanzania, entailing an increasing demand for labour, might be the reason for the growing out-migration in Ihela. **It can be concluded that the exceptional good motorised access to Ihela could not prevent the stagnation of the agricultural market production and the increase of migration.**

### **4.3 Footpath Improvement: Utengule-Ng'yekye**

In Chapter 2.3 the importance of footpaths for the transport in rural Africa was emphasised. In Makete especially during rainy season the paths become slippery like soft soap due to the very fine grain size of the soils derived from lava ashes. Therefore travelling on steep paths during rains is a dangerous undertaking and more often than not these paths are avoided (DIXON-FYLE/FRIELING 1990). Obstacles like rivers, marshes and invading vegetation force the travellers to walk big detours. Often paths have a drainage function during rains and at steep slopes severe erosion problems might occur, sometimes causing deep gullies. The narrowness of many paths makes the use of IMT impossible and creates difficulties when passing travellers in the opposite direction. These restrictions were the reason for the improvement of 27 km of footpaths in Makete. The MIRTTP trained gang leaders and foremen to conduct simple improvements on these paths, such as building wooden bridges and stairs, digging small ditches for drainage and constructing timber guard barriers.

Eight footpaths lead down from the western highlands to the lowland north of Lake Nyassa. The people from the Bulongwa Region use these footpaths to visit the weekly market in Ng'yekye or to catch the bus to Mbeya. Therefore the Utengule-Ng'yekye footpath (Fig. 4.2-1) was classified as a district footpath and integrated into the district roads and path system. The footpath was improved by paid labour during the MIRT Project.

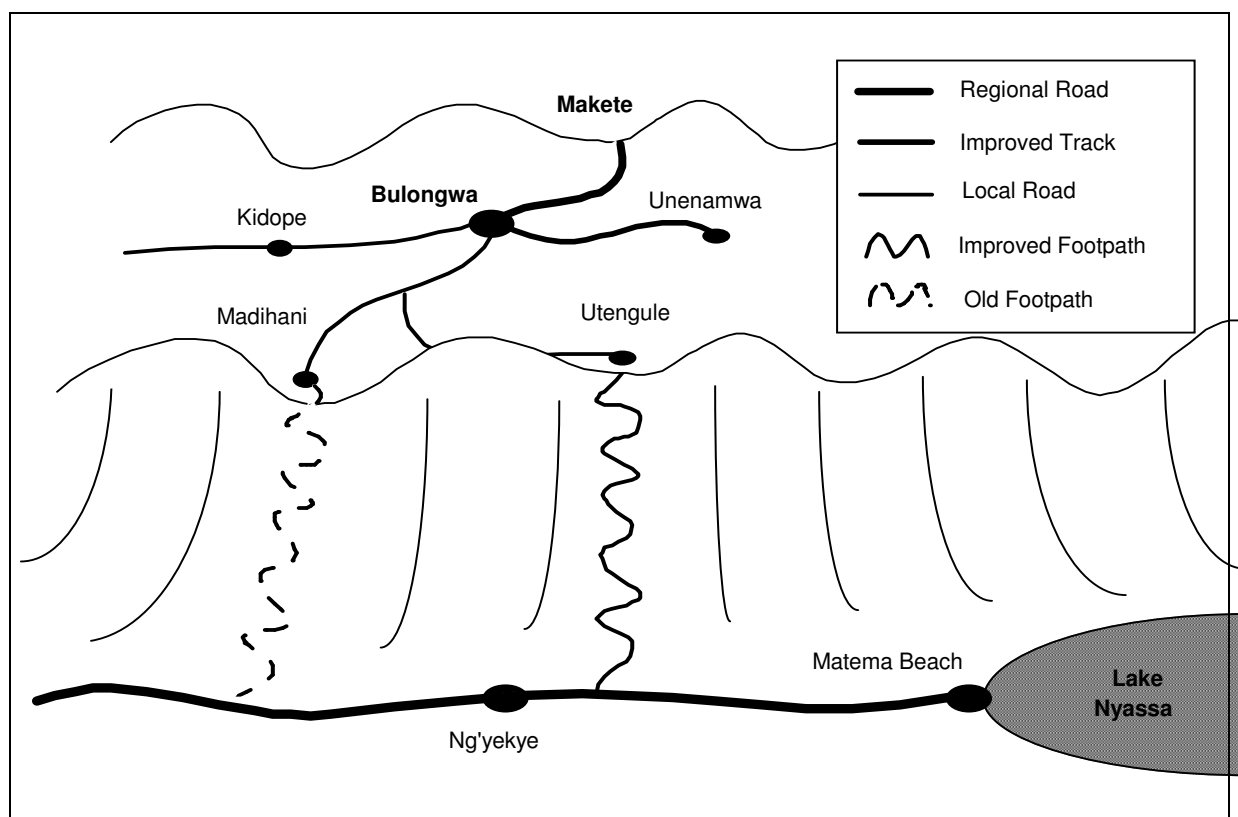


Fig. 4.2-1 Location of the surveyed villages in the Bulongwa Region

The improvement of the path received a very positive reception from the inhabitants of the concerned villages. The village council in Utengule describes the main effects of the path as follows:

- The number of people using the path increased.
- The number of accidents on the footpath decreased.
- The travel time declined significantly.
- More traders travel up the footpath to purchase agricultural produce in the highlands.

Tab. 4.3-1 gives an overview of the statements of footpath users in these two villages interviewed during the household survey. 87 % of the households in Utengule and 52 % in Unenamwa use the path. Over 90 % of the users proclaim that they are travelling much faster, more than two thirds declare that the security increased and one third of the users are able to reach new places. The effects of the latter statement should not be underestimated: 19 % of the

households in Unenamwa and 27 % of Utengule are travelling to places in the lowlands, which they could not reach before and where they can get in contact with other people, exchange goods and opinions and receive wares and information. **Isolation, which is regarded as one of the salient features of poverty can definitely be reduced by the improvement of a footpath!**

Households answering "yes" to the following questions :	Unenamwa	Utengule
There has never been a real advantage	0 %	0 %
The improvements have already disappeared	9 %	0 %
No advantages in the rainy season	18 %	0 %
We can reach places we could not reach before	36 %	31 %
Safety is better	64 %	100 %
Faster travelling	91 %	100 %

Tab. 4.3-1 Improvements in the eyes of footpath users

### 4.3.1 Transport Volume

Next to the improved Utengule path another unimproved footpath leads from Madihani down to Ng'yekye. On both footpaths the traffic was counted before the improvement in October 1988 (BARWELL/HARRISON 1989) and in May 1994. A comparison of the data makes the appraisal of the benefits possible; on Thursday May 27 1994 and the following Friday, which is market day in

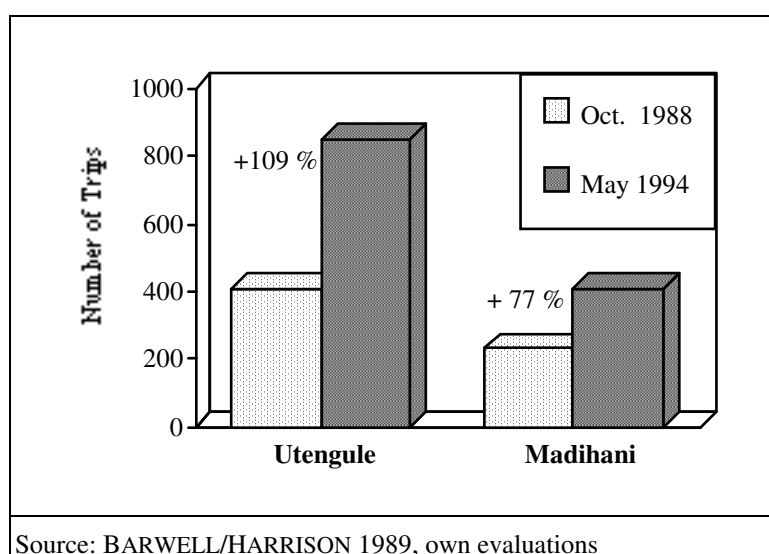


Fig. 4.3-1 Number of trips to and from Ng'yekye on a Thursday and Friday

Ng'yekye, 848 persons from Utengule used the footpath to and from Ng'yekye.

Between October 1989 and May 1994 the number of one way trips on the improved footpath on a Thursday and Friday increased by 109 %, while the transport volume on the unimproved path rose by 77 %. If it is assumed, that the increase on the unimproved path accounts for the regular increase of transport volume to Ng'yekye

between 1988 and 1994 (Methodology I), at least 32 % of the increase is caused by the footpath improvement.

Assuming that the temporal distribution<sup>16</sup> observed in 1988 is also valid in 1994, the annual number of persons using the Utengule footpath (one direction) can be estimated at least at 58,000. Consequently it can be assumed that a minimum of 9,000 return trips per annum are generated as a result of the improvements.

Annual trips per household	Footpath Survey	Household Surveys		
	1994	1994	1986	Change
Utengule	28	46	17	165 %
Unenamwa	10	15	0-1	-
Madihani	15	36	10	131 %

Tab. 4.3-2 Comparison of footpath and household surveys

This estimation is a minimum approach and does not include the seasonal variations of transport activities. BARWELL/HARRISON (1989) made it clear that they conducted their survey in October during the peak period of the year, which is

May/June 1994	Utengule-Ng'yekye Footpath	Matamba-Chimala Road
Households in the catchment area	1,500	4,500
Passengers/day	80	31
Tons/day	1.1	11.2

Tab. 4.3-3 Transport down the escarpment

not true for the 1994 survey, which was conducted in May<sup>17</sup>. The household survey of 1994 gives comparable data for the annual transport activities of three villages in the catchment area. Tab. 4.3-2 shows that the footpath survey tends to underestimate the annual number of trips. An optimistic estimation of the

trips on the Utengule path is not possible due to the uncertainty of the data. Thus the pessimistic approach shall henceforth be the basis of the assessment. However, the household survey confirms the generation of trips: using the same argument as above, 34 % of the increase in trips was generated by the improvement of the footpath<sup>18</sup>.

A comparison of the footpath evaluation and the traffic counting on the feeder road Matamba-Chimala shows that the transport volume reaches the same magnitude, if the population in the catchment area is taken into account; on the road more freight is moved, but less passengers are transported.

<sup>16</sup> The following assumptions had to be made: (1) The weekly distribution of transport activities stated in BARWELL/HARRISON (1989) did not change. (2) The transport volume measured in May represents the annual average.

<sup>17</sup> BARWELL/HARRISON state, that 18 % of the households undertake most trips in May, but 72 % in October. Thus the average probably will be higher than assumed.

<sup>18</sup> Assuming that the increase of 131 % in Madihani is the regular change, the difference of 34 % between Utengule and Madihani would be due to the path improvement. Compare Methodology I in Tab.3.4-2.



Footpath	1988	1994
Utengule	61 %	65 %
Madihani	64 %	58 %

Tab. 4.3-4 Share of female footpath users

The main beneficiaries from the improved footpath are women and girls, who make up 65 % of travellers. Tab. 4.3-4 shows that since the improvement the percentage of women using the path has increased by 4 %, while on the unimproved path the percentage has decreased by 6 %.

### 4.3.2 Walking Time

People travelling down the escarpment on the Utengule path need on average 5h 50 min for the distance of 21 km between their home village and Ng'yekye. Fig. 4.3-2 shows that the distances did not change significantly due to the improvement. This means that even though more people are using the path, they are not coming from more remote locations, but rather that there are more people travelling from the same villages. An analysis of the catchment area of the path

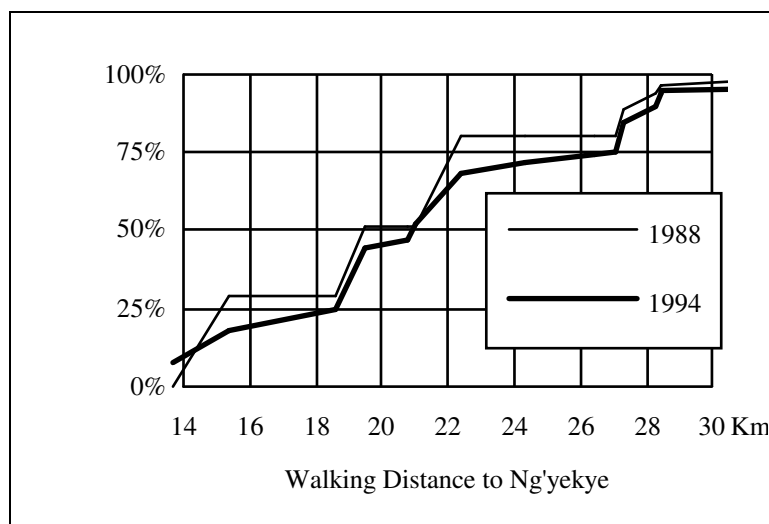


Fig. 4.3-2 Walking distances on the Utengule footpath

shows, that 91 % of the travellers stem from eight villages.

In 1994 the average return trip from Utengule to Ng'yekye on the improved path took 7 <sup>3</sup>/<sub>4</sub> h. Compared with 1988 the journey was 1 <sup>1</sup>/<sub>4</sub>h faster. The walk from Madihani to the market and back took eleven hours on the same days as compared with 1988 when people walked <sup>3</sup>/<sub>4</sub> h longer. The delay can be explained by the strong rainfalls in the

early morning of May 27, 1994, which made the path slippery and reduced the walking speed on the unimproved path, while the speed on the improved path was still faster than during the dry season in October 1988. The delay caused by the rain can be corrected by comparing the absolute changes in travel time on the improved and unimproved path. In dry weather a return trip on the improved path would be 1 <sup>3</sup>/<sub>4</sub> hours faster than before the improvement.

Footpath Section	1988	1994	Absolute Change
Utengule-Ng'yekye	535	466	-69
Madihani-Ng'yekye	620	657	+37
Effect without rain on improved path			+106

Tab. 4.3-5 Average walking time (minutes) for a return trip Utengule-Ng'yekye

A comparison with the 1994 household survey gives similar results: over 90 % of the interviewees in Utengule and Unenamwa stated that the improvement of the path has reduced their travel time. The average time reduction for a one way trip down the escarpment was 83 minutes in Utengule and 68 minutes in Unenamwa. Assuming that on the way back up the escarpment, only half of the time is gained by the improvement, the average time saving for a return journey would be 1h 50 min.

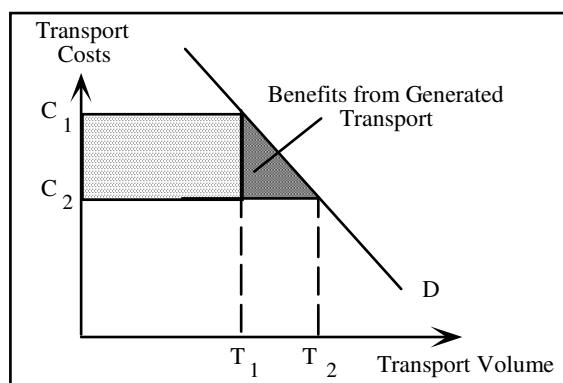
If only half of the benefits to generated traffic are valued<sup>19</sup>, then annually nearly 48,000 hours are saved by faster travelling after the improvement of the path. Every household in the catchment area saves annually 31 hours. If the time savings are valued with the opportunity costs of time the monetarised benefits comprise \$ 2.28 per household.

#### 4.3.3 Weight Transported

Many of the trips are undertaken to sell agricultural produce from the highlands on the market and to buy tropical products from the hot lowlands. The different seasonal harvesting periods in the low- and highlands also contribute to the exchange of products which grow on the different altitudes. On top of the agricultural products a number of consumer goods are transported up the escarpment, most notably smuggled beer and sugar from Malawi. The amount of goods transported annually up and down the improved path can be estimated at 830 tons or 540 kg per household.

The improvement did not only give rise to new trips on the path but also made the transportation of bigger loads possible. In 1988 on the said market days 4.7 t of goods were transported up and down the escarpment below Utengule. Until 1994 the weight increased by 156 % to 12 t. During this period the weight transported from Madihani on the unimproved path increased by only 111 %. Using the same reasoning as above, 45 % of the increase on the improved path can be attributed to the improvements. This means that annually,

<sup>19</sup> It is assumed that the demand curve D for transport is linear. If the transport costs are reduced from  $C_1$  to  $C_2$  then the transport volume increases from  $T_1$  to  $T_2$ . The graph shows that the benefits of the generated traffic can be calculated as  $B_G = (C_1 - C_2) * (T_2 - T_1) / 2$ , while the benefits of the already existing traffic before the improvement amount to  $B_E = (C_1 - C_2) * T_1$ . Thus the total benefits can be calculated as follows:  
 $B = B_G + B_E = (C_1 - C_2) * (T_2 + T_1) / 2$



according to the pessimistic view, 133 tons (90 kg/household) would not be transported without the improvement of the path.

kg/person	1988	1994	Change
Downhill Men	6.3	10.7	+70%
Downhill Women	12,5	15.9	+27%
Uphill Men	11.6	12.7	+10%
Uphill Women	15.5	15.1	-2%
Up and down	10.6	14.2	+22%

Tab. 4.3-6 Weight per person on the Utengule footpath

The bigger transport volumes were only partly due to the increased number of travellers, but also caused by the rising loads per person. The improvement of the path made the transport of heavy loads more secure: Tab. 4.3-6 shows that the average loads increased by 22 %. The increase of loads carried downhill can be attributed to the

improvement of the path, which made transport more secure. Only men were carrying heavier goods up the escarpment. It seems that men increased their share of the loads, but they are still carrying less weight than women: 30 % of the men are using the footpath without carrying anything, while most women (89 %) carry loads. Many of the men are probably using the path for other purposes than selling or buying<sup>20</sup>.

#### 4.3.4 Marketing

The increased weight transported is a strong indicator that the marketing of agricultural produce increased due to the footpath improvement. The weight of the products transported down the escarpment, which had been generated by the improvement of the path can be estimated at 43 kg/household. The goods are transported to the lowland markets where the producer prices are higher than in Makete. The difference of the prices multiplied by the generated weight is an indicator for the revenue generated by the improvement of the path. On the lowland markets crops which obtain high revenues per kg, mainly wheat and beans, are sold. The generated revenues in Utengule amount to annually \$ 1.87 per household. More distant villages will register lower effects, because their share of lowland marketing is lower.

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<sup>20</sup> In 1988 about 30-40 % of the travellers used the path for social purposes or to visit health services. In 1994 no purposes were recorded.

	Share of Weight	Price			Annual Benefits	
		Lowland	Highland	Difference		
	%	[\$/ton]			\$	\$/HH
Wheat	63%	212	157	56	1,513	0.98
Beans	34%	434	350	84	1,243	0.81
Other	3%	-	-	50	130	0.08
<b>Total</b>					<b>2,886</b>	<b>1.87</b>

Tab. 4.3-7 Benefits from food crop marketing in Utengule

The above mentioned approach is a minimum approach, because it only includes the immediate effects of price arbitrage and does not observe the impacts of the increase of the market production. The latter can be achieved by comparing the marketing activities of Utengule and Madihani. Fig 4.3-3 represents the mean changes in revenue which occurred after the path improvement. The average revenue from marketing in Utengule increased since 1986 by \$ 13. Marketing in the lowlands nearly tripled and in 1994 more than half of the revenues (56 %) stemmed from lowland markets. In Madihani the mean revenues increased only by \$ 8.20. No absolute changes of the lowland marketing occurred and the share of the revenues from lowland markets decreased to less than two percent. Assuming that the difference of the changes in Utengule and Madihani represents the benefits from the improvement, \$ 5.20 per household can be attributed to the footpath improvement.

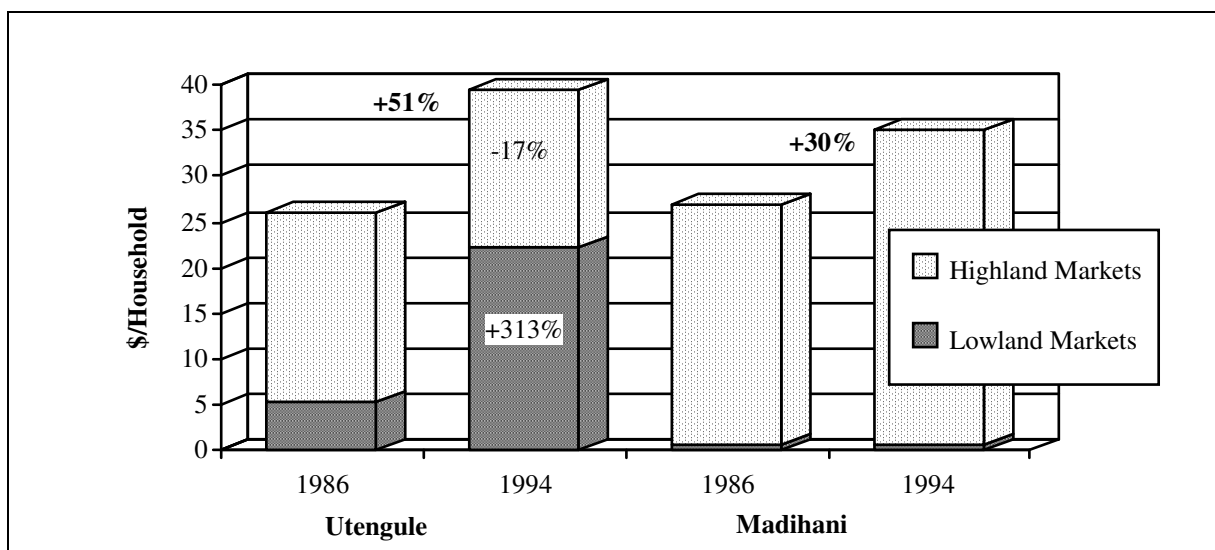


Fig. 4.3-3 Mean revenues from marketing (pessimistic view)

The latter estimation represents a pessimistic approach because the comparison of the mean values might underestimate the changes. The reason is a big change in the variation of the revenues in Utengule. While in 1986 one household was very active which increased the mean revenues significantly, the variation in

1994 is much lower<sup>21</sup>. The median value can give a better assessment of how much the majority of the population was benefiting from the improvements. An optimistic view estimates the changes in revenue generated by the footpath improvement in Utengule at \$ 9.50 per household. Because the expenditure for agricultural inputs is negligible in the Bulongwa region, the increased revenue can be calculated as direct growth of income.

US \$		Pessimistic View: Mean Values	Optimistic View: Median Values	Variation Coefficient*
Utengule	1986	26.10	9.10	221%
	1994	39.50	31.70	86%
	Change	13.40	22.60	
Madihani	1986	26.90	6.80	125%
	1994	35.10	19.90	111%
	Change	8.20	13.10	
<b>Benefits</b>	<b>Δ Changes**</b>	<b>5.20</b>	<b>9.50</b>	
* Variation Coefficient = Standard Variation / Mean ** Methodology I, Tab. 3.4-2				

Tab. 4.3-8 Impact of footpath improvement on marketing in Utengule

The above calculated optimistic and pessimistic benefit assessments only concern the village of Utengule. The values indicate the upper boundary, because the generated benefits decrease with growing distance to the market. The impact assessment for the whole catchment area was achieved by taking into account the number of travellers counted on the footpath. The pessimistic view estimates the annual benefits per household in the catchment area at \$ 3.31, while the optimistic view calculates increased revenues of \$ 6.04. These amounts seem to be very small, but they have to be calculated for the whole catchment area, where more than 1,500 households are living. Here the annual revenues from marketing increased between \$ 5,000 and \$ 9,000. It has to be taken into account that the annual marketing revenues in the Bulongwa region amount to less than \$ 50 per household. Thus the footpath improvement could generate a considerable increase of local income and contribute to a market integration.

Village leaders from Utengule stated that more traders are travelling up the escarpment after the improvement of the footpath. The higher demand for agricultural produce would be the reason for an increase of producer prices, especially for beans and wheat in the village. Due to lack of comparable data it could not be observed whether the price increases in Utengule were higher than elsewhere in Bulongwa. The share of internal marketing is an indicator for

<sup>21</sup> Two explanations can be given: (1) the changes in Makete were directed towards an equal income distribution or (2) the low number of sample households does not give a sufficient statistical evidence of the distribution.

stronger activities of traders in Utengule, where 31 % of the crops are marketed in the village, while in Madihani this share amounts to only 9 %.

#### *4.3.5 Effects on Security and Health*

The village leaders reported, that before the improvement of the Utengule-Ng'yekye path four people died while walking to Ng'yekye. Since the improvement no fatality has occurred. It was reported that the footpath was now so sec-

### Box 4-3: Transport Costs

In Makete most of the households transport tasks are undertaken by walking. A small share of the transport from the field or to the market is done by hired porters, hired donkeys or hired vehicles. Here the costs for the transport service can be calculated:

Hired Vehicle	Transport to Market	15-26 km	0.3 - 0.7 \$/tkm
Hired Porters	Transport to Market	20-24 km	0.8 - 1.0 \$/tkm
Hired Porters	Transport from Fields	1-12 km	0.1 - 1.7 \$/tkm
Hired Donkey	Transport from Fields	1- 7 km	0.0 - 2.1 \$/tkm

Hired motor vehicles are only relevant in Matamba, where the weights marketed are bigger, the revenues per ton lower and the road conditions better. Here 8 % of the weights marketed on external markets are transported by hired vehicles to the lowlands. In Makete hired Porters are either used to transport crops from the fields (14 % of tkm) or to carry the products to the external markets (10 % of tkm). The strong variation in prices indicates that the pure ton-kilometres mileage is not a sufficient measure. Other factors like steepness of the terrain, family relations or combination of trip purposes are relevant as well. The same holds true for hired or loaned donkeys, which are used for a small share of the transport burden (Fields: 2 %, Markets: 4 %) in Matamba only. Most of the donkeys are loaned without direct compensation to the donkey-owner. Only two cases could be registered where donkeys were hired.

In general the lowland prices for agricultural products are higher than on the highlands. Many farmers increase their revenues by transporting their products down the escarpment instead of selling them on the highlands. The value of headload transport can be estimated by calculating the differences of the lowland- and the highland prices and set them into relation with the tkm or the hours of transport time. The transport to lowland markets can be valued as follows:

Porterage	Bulongwa	Matamba	Makete <sup>22</sup>
\$/tkm	2.88	4.51	4.23
\$/hour	0.12	0.18	0.17

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<sup>22</sup> Weighted average

The generated income per tkm is higher than the costs for the above mentioned modes of transport. It has to be mentioned, that the transport of one tonne is associated with 50 return-trips, which are time consuming. The income per hour is above the Tanzanian Minimum Salary of 11 ¢/hour.

ure that it is even used in the night. During the 1988 survey not one journey was observed before sunrise on the Utengule footpath!

The positive role of the footpath improvement in reducing the isolation of the district has been emphasised above. But increasing contacts with the external world also involve negative effects. Especially diseases like Malaria and Aids, which are more common in the lowlands, are spreading nowadays into the district. A survey of pregnant women in Mbeya Hospital (lowland) estimated the share of HIV infections at one third. Medical staff of the Bulongwa hospital reported an increasing spread of the disease on the highlands as well<sup>23</sup>. Out-migration and the increasing external contacts of men in particular contribute to the spread of this disease. JENNINGS (1992, p.20) states, that 22 % of all women interviewed in Makete were widowed, more than half of them in their 20's or 30's. It has to be mentioned that comparative effects occur if roads are improved.

The total benefits per household from the footpath improvement comprise \$ 5 according to the pessimistic view and \$ 9 according to the optimistic approach.

#### **4.4 Intermediate Means of Transport**

The MIRT Project promoted the purchase of donkeys and developed a new wheelbarrow. Bicycles were not part of the project, but their impacts shall nevertheless be assessed. Households were asked which IMT would be most useful for their transports tasks. 58 % named a bicycle, 30 % a donkey, 6 % a wheelbarrow, 3 % an animal drawn cart and 4 % did not believe that an IMT would be of any use.

##### *4.4.1 Donkeys*

The MIRT Project constructed a donkey centre in Bulongwa and one in Matamba where donkeys could be purchased and their use demonstrated. The main reason for the purchase of the animals was the high burden stemming from the transportation of heavy crops, especially potatoes from the field. As explained later on they are never used for water and firewood collection! Donkeys were only bought if their use generated an increase in revenues, which

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<sup>23</sup> During the survey an astonishing high number of funerals was observed . Mainly people in the 30 - 40 age bracket were buried, after suffering from a short disease.



could quickly compensate the high investment costs. Only in regions with a strong market orientation like in Matamba is the purchase of a donkey rational behaviour<sup>24</sup>. The Bulongwa Region is more subsistence oriented, the weight harvested and marketed is much smaller and a donkey is not needed for the transport of crops. Therefore the donkey centre in Bulongwa did not sell the animals which are nowadays used in the region.

In the survey villages of the Bulongwa Region not one household was in possession of a donkey, while in Matamba 33 households could be interviewed, which owned 50 donkeys. These donkeys were found only in the two villages of Mpangala and Ngoje. In 1984 one donkey was counted in Mpangala and two in Ngoje. This number increased over the following ten years to 37 and 19. In the beginning few animals were bought from the MIRTTP donkey centre, later breeding activity and barter with the lowland was the main factor of growth. Today 62 % of the donkeys in the two villages are female and often used for breeding. The growth would have been much stronger, if the mortality rate of the donkeys was not so high. It can be estimated, that 15 % of the animals died during this period, probably mainly because of diseases. The climatic conditions could be one of the reasons for the high mortality; in Tanzania donkeys are mainly used in hot and dry areas, while the climatic conditions in the mountainous region of Makete District are wet and cold. Mules, would have been more appropriate animals to introduce. The high mortality rates were compensated by breeding activities, which increased the number of donkeys in Matamba region probably more, than the purchase of new donkeys from abroad.

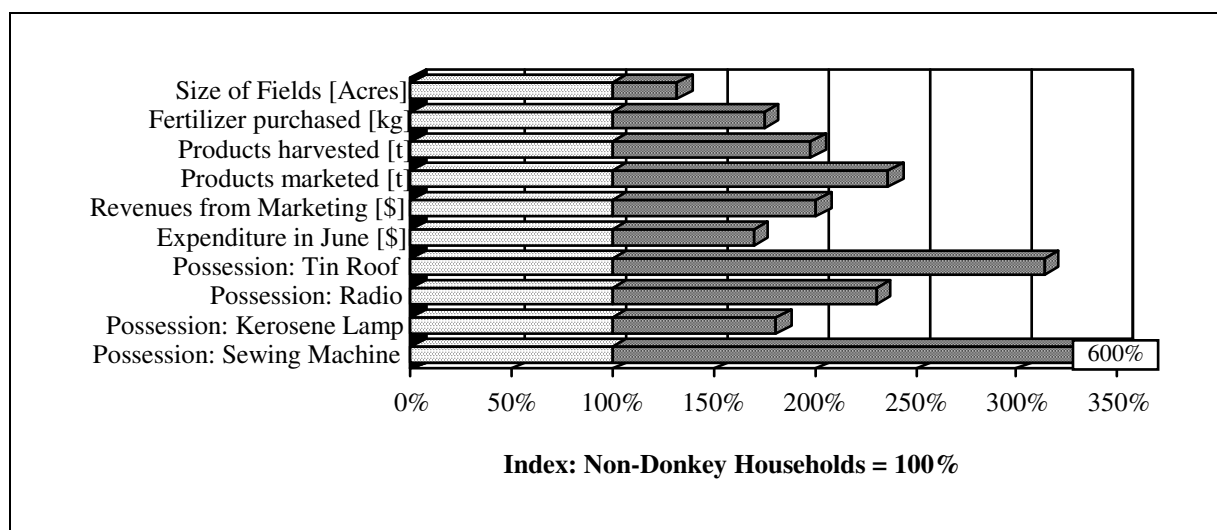


Fig. 4.4-1 Comparison of non-donkey and donkey households

<sup>24</sup> One farmer in Bulongwa Region was reported to own a donkey, but he is regarded as crazy by other inhabitants.

A comparison in the Mpangala and Ngoje villages between donkey and non-donkey households with comparable socio-economic structures<sup>25</sup> shows that donkeys have strong impacts on the welfare of their owners. The donkey enables the household to cultivate bigger plots, because the transport from the field can be managed more easily. The farmers use more fertiliser, because it can be effortlessly carried home and to the fields. The bigger size of the fields and the higher inputs enable the farmer to double the amount harvested as well as the tons marketed. The revenue received from marketing activities increases from \$ 120 annually for non-donkey-households to \$ 241. The higher income gave rise to bigger expenditures and a better endowment of the household with kerosene lamps, radios, sewing machines and tin roofs.

**Box 4-4: Case Study - Donkey Owner in Mpangala**

The farmer bought a donkey in 1990 from the MIRTTP Donkey centre, which in the mean time died. But he could breed three other donkeys, which he uses today for his transport purposes. They carry 4.2 t of crops home and another 4 t from the field to the street, where the products are sold to traders. The owner does not use the donkeys for transport to the grinding mill and to fetch water, because both are located close to the house. He also uses the donkey to transport products to the nearby market in Matamba, which he visits weekly. The donkeys transport 18 tkm annually and save 285 hours of arduous work and drudgery. This fact enabled the farmer to put more plots under cultivation, which were more distant from the homestead. He doubled his cultivation area and increased his income, which nowadays amounts to \$ 168 annually. The higher income enables him to send his children to the secondary school.

*Impacts on marketing*

Non-donkey households market 2.1 t of agricultural products, while the donkey households sell 5.1 t every year. The revenue from marketing activities differs between \$ 120 for non-donkey households and \$ 241. The increased production is only possible with the growing use of agricultural inputs. 91 % of the donkey-households use fertiliser compared with 67 % of non-donkey households. The donkeys carry 87 % of the fertiliser purchased. In order to assess the increased income, the expenses for the additional fertiliser have to be deducted from the revenues. The purchase of a donkey generates a net income of annual \$ 112 per household.

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<sup>25</sup> The following features are comparable: number of household members, number of children, number of members over 45 years, male to female ratio, number of female headed households, profession of head of household and main source of cash income.

The latter assessment can be regarded as an optimistic view, because the possession of donkeys is limited to the wealthy households. FRIELING and MCHOAVU (1991, p. 20) safely state that donkey owners were relatively rich when they purchased the animals. Therefore the above mentioned assessment might overestimate the revenues generated by the donkeys. Unfortunately no study of the market production of households before and after the purchase of a donkey could be undertaken<sup>26</sup>. Therefore a rough assumption has to be taken in order to assess the revenue generation according to the pessimistic view. Fig. 4.4-2 shows that the income gap between donkey and non-donkey households is smaller for the poorer households than for the wealthy ones: about half of the non-donkey households register bigger revenues than about a quarter of the donkey households. Thus they would be in the same position to purchase an animal. The large revenue gap occurs between the richer half of the households. It can be argued that a comparison of the median would be a more appropriate methodology. A pessimistic view, which is using a median assessment estimates the income generation of donkeys at annually \$ 43.

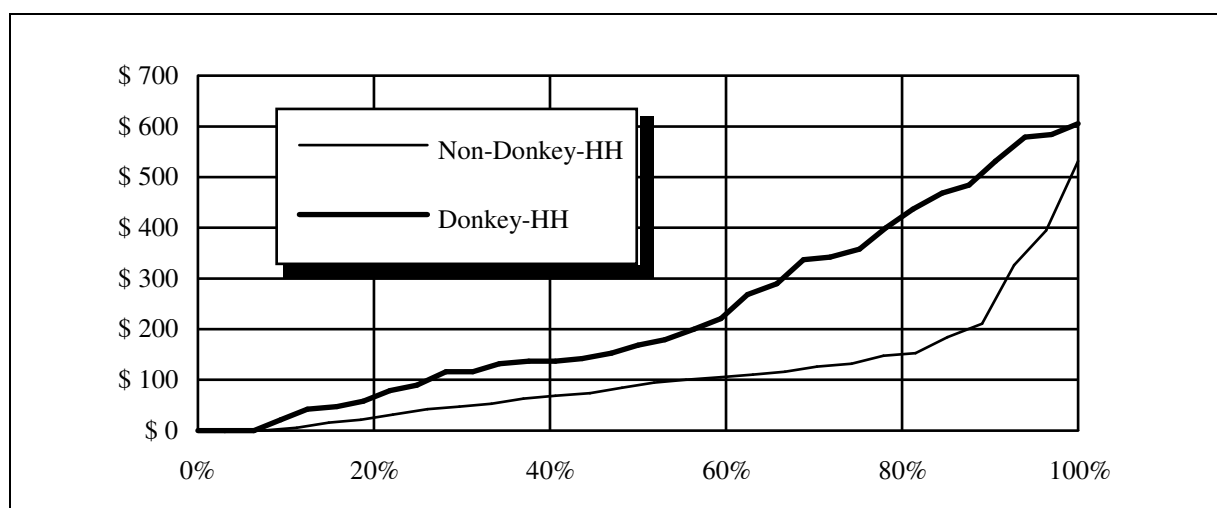


Fig. 4.4-2 Revenue of donkey- and comparable non-donkey households

	t	tkm	Share total
Field	2.17	6.77	64 %
Market	0.39	0.47	7 %
Fertiliser Purchase	0.13	0.52	87 %
Grinding Mill	0.10	0.41	65 %
<b>Total Donkey</b>	<b>2.78</b>	<b>8.17</b>	<b>15 %</b>
<b>Total Household</b>	<b>30.82</b>	<b>56.10</b>	

Tab. 4.4-1 Total transport with donkey

### *Time savings*

Donkeys are used to carry 15 % of the households transport burden measured in tkm. They reduce the effort and drudgery mainly of women. Not a single household was using the animal for water and firewood collection. In the first case there are no containers for the transport of water

<sup>26</sup> The names of the 1986/87 survey households were deleted due to data protection.

and in the second case firewood is transported in long pieces, which cannot be loaded on a donkey. The animals are mainly used for the transport of crops from the field (64 % of tkm from the field). 65 % of the tkm to grinding mills, 87 % to purchase fertiliser, but only 7 % of the tkm for marketing are transported by donkeys. Assuming that the average load of a donkey is three times that of a human being, a donkey saves annually 93 trips, 531 pkm and 133 hours (Tab. 4.4-2). If this time is valued with the opportunity costs of time the annual monetary benefits amount to \$ 9.74 per household. Women benefit with 54 % of the time savings. More time could be saved if donkeys would be used for household tasks like water and firewood collection.

	With Donkey	Without Donkey	Effect
Trips	46	139	-93
Pkm	266	797	-531
Time [Hrs]	66	199	-133
Value Time [\$]			9.74

Tab. 4.4-2 Time savings by donkey transport

### *Generation of Other Income*

15 % of the trips undertaken by donkeys can be classified as transport services for other households in the village. In Mpangala 0.9 tkm per household are transported by hired donkeys. Sometimes the service is given for free, but in many cases a fee has to be paid which varies markedly. The total income generated by hiring donkeys can be estimated at \$ 1.97 per year. Benefits from breeding activities and reduced spoilage of the harvest due to better transport conditions cannot be estimated in this survey.

The total annual benefits per donkey range between \$ 55 and \$ 124.

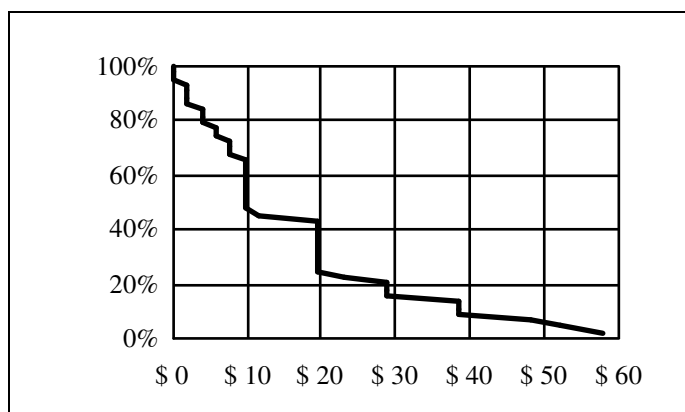


Fig. 4.4-3 Willingness to pay for donkeys

### *Demand for Donkeys*

If households were asked which means of transport would be most useful for their transport tasks 30 % would choose to buy a donkey. At the beginning of the project the price for the animals was highly subsidised in order to accelerate the dissemination of the animal. After the cessation of the subsidies the purchase of donkeys nearly stopped and the remaining animals had to be sold at

a lower price. The average price<sup>27</sup> for a donkey was calculated at \$ 88. The Fig. 4.4-3 shows the willingness to pay<sup>28</sup> of the households preferring to purchase a donkey, which can be estimated at \$ 15 on average. 50 % of the households would be willing to pay \$ 10 or less, 20 % \$ 29 or less and 10 % \$ 39 or less. Without any access to credit none of the non-IMT-households would be able to buy a donkey. A credit scheme could increase the purchase of donkeys. If  $\frac{4}{5}$  of the price for a donkey was financed by a credit scheme then more than 40 % of the households preferring a donkey (13 % of all the households not owning an IMT) would be able to purchase an animal.

#### 4.4.2 Bicycles

In the eight surveyed villages 54 households were in possession of a bicycle in working order, a total of only 3 % of all households. The same number of bicycles was counted, which were not in working order. In Bulongwa, where the terrain is steeper and the farmers have lower income the number of bicycles was very low. In Makete the household structure of bicycle owning households is very different from non-bicycle households. The number of household members is higher, the percentage of female headed households lower and the main source of cash income is different: only 60 % indicate agricultural marketing (non-bicycle households 78 %), 11 % receive regular salaries (4 %), 7 % are trading (1 %) and 11 % are artisans (8 %).

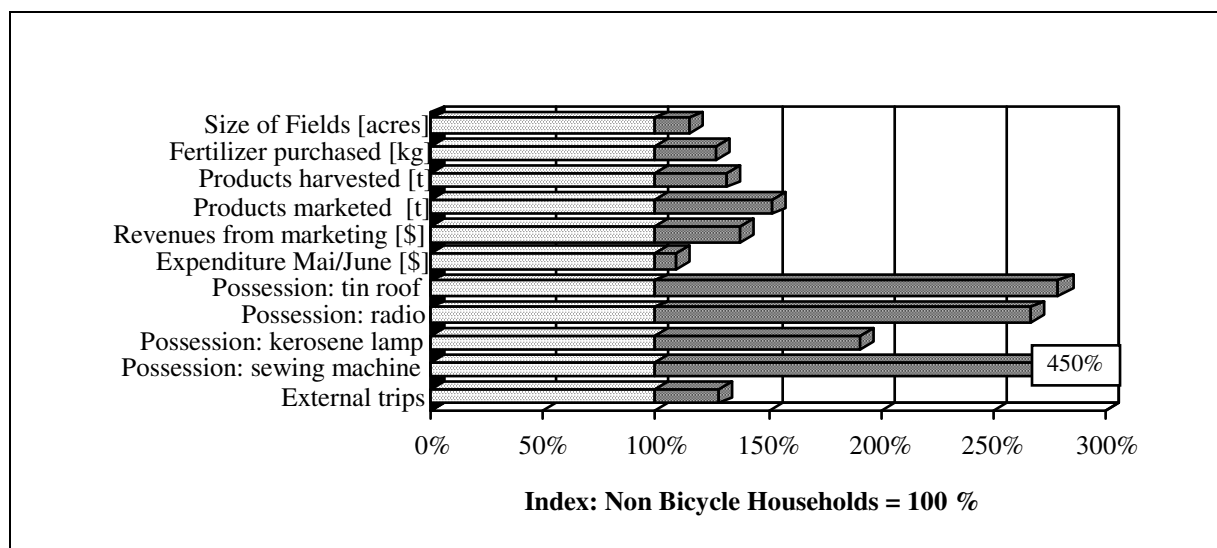


Fig. 4.4-4 Comparison of non-bicycle households and bicycle households

<sup>27</sup> The nominal prices were multiplied with the inflation index of the year of the purchase. Project documents give a price of \$ 50-58.

<sup>28</sup> The non-IMT households were asked which IMT would be most useful for their transport purposes and which price they would be willing to pay for it.

The bicycle households were compared with non-bicycle households with similar household structure, main source of income and geographic location. Generally it can be stated that bicycle possessing households are better off but the difference is not as big as that observed between donkey and non-donkey households. The size of the fields is bigger, they purchase more fertiliser and larger quantities of agricultural produce are harvested and marketed. The bicycle households have higher revenues, they spend more money and they have a better endowment with tin roofs, radios, kerosene lamps and sewing machines. In general, the effects for farmers in Bulongwa are stronger than for farmers in Matamba. Non-farm households register smaller effects than households with agriculture as the main cash income. It is remarkable that bicycle households undertake 28 % more external trips outside the villages. Bicycles seem to reduce isolation, especially in the Bulongwa region where motorised access is worse than in Matamba.

### *Impacts on Marketing*

Bicycle households are marketing 1.8 t of agricultural products, while non-bicycle households only sell 1.2 t. The revenues from these marketing activities amount to \$ 121 and \$ 88, respectively. Higher production is possible because bicycle households purchase 27 % more fertiliser, which is quite often transported with the bicycle. These additional inputs have to be deducted from the increased revenues in order to obtain the net revenues, which can be estimated at \$ 32. Farmers in the Bulongwa region register much higher benefits followed by the group of non-farmers, while the impacts for farmers in the Matamba region are much smaller. They only register 4 % higher revenues than non-bicycle farmers.

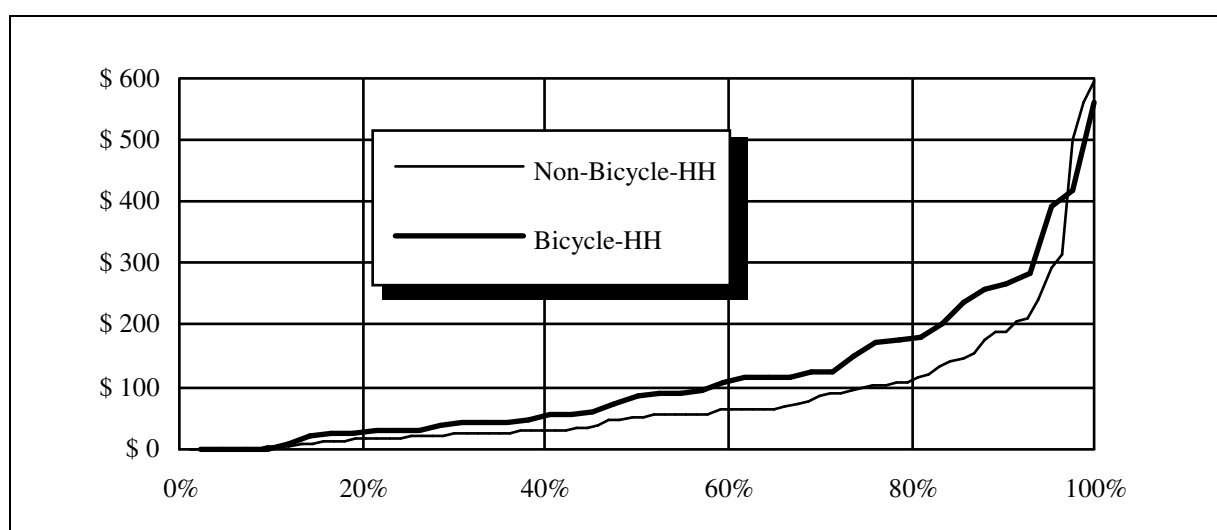


Fig. 4.4-5 Revenue of bicycle- and comparable non-bicycle households

The same argumentation as in the previous chapter could also hold true for bicycles: the vehicles are often regarded as luxury goods and the price limits the purchase to richer farmers. From a pessimistic standpoint the revenues might be overestimated. However, Fig. 4.4-5 shows, that half of the non-bicycle households have bigger revenues than 40 % of the bicycle households. The gap is much smaller than the difference in revenues between donkey and non-donkey households. A pessimistic approach comparing the median values estimates the impacts on the marketing activities at \$ 28.

### *Time Savings*

Bicycles are used to carry persons and goods. Households use the bicycle to travel annually 1,312 pkm, which is 18 % of the total pkm travelled by the household. Because the bicycles are exclusively used by men, the transport patterns reflect the typical male transport purposes: three quarters of the km are rode to external places and markets, 7 % to health facilities and 3 % to the village centre. Only 11 % of the transport volume is undertaken for the female task of water and firewood collection and grinding. Therefore social purposes dominate with 69 % of the trips undertaken.

Bicycles can carry considerable weights, which exceed the average headload capacity of 20 kg. Special carriers can be fitted, which allow loads of 30 kg for water, firewood and flour, 40 kg for transport of the harvested crops from the field and even over 50 kg for various transport services<sup>29</sup>. Annually 5.2 tkm are transported with the bicycle, of which 42 % for the female transport task to the grinding mills, 31 % for water collection, 16 % for evacuation of crops from the field, 6 % for the marketing of crops and 4 % for the purchase of fertiliser.

The bicycle saves time, because its speed is faster than walking and the bigger loads cause a reduction in the number of trips. Annually 203 hours per household can be saved by using a bicycle, 90 % due to faster travelling. Because exclusively men use the bicycle, only 59 hours can be attributed to the women, who profit from the reduction of typical female trips, that are now

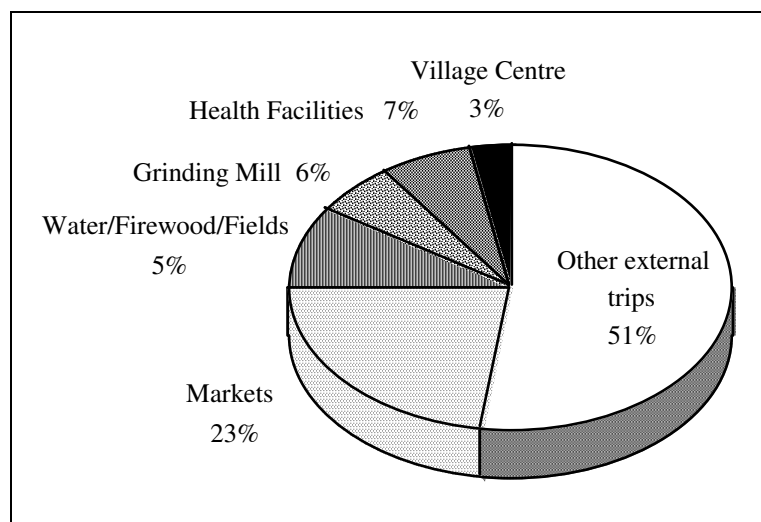


Fig. 4.4-6 Pkm carried with bicycles in Makete

<sup>29</sup> This item was not specified in the questionnaire; it contains a variety of services for goods and persons.

undertaken by men. The monetarised annual benefits from time savings amount to \$ 14.89 per household.

### *Other Benefits*

Because bicycle-households are not undertaking more trips to the public health services, health benefits are only generated by the reduced human portorage. 2 % of the trips with a bicycle can be classified as transport services for other households and 1 % were undertaken for commercial purposes other than marketing. The benefits generated by these trips cannot be estimated. Owners of bicycles undertake twice as many external trips as non-bicycle households, which allow them to reduce social isolation. 62 % of these trips are undertaken by bicycles. The benefits cannot be monetarised. Because generally bicycles are not loaned or hired, no income is generated.

The total annual benefits per bicycle range between \$ 43 and \$ 47.

### *Demand for Bicycles*

The cheapest bicycle on the market, which is assembled in Tanzania, costs \$ 68, imported bikes from China are more expensive. 80 % of the bicycles in Makete were new when they were purchased; the average price for a new bicycle was \$ 74. Every bicycle was repaired 2.8 times per year and \$ 3.74 had to be spent annually for spare parts. 58 % of the households not

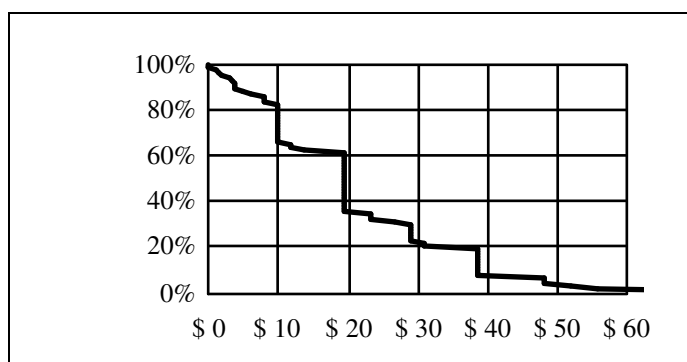


Fig. 4.4-7 Willingness to pay for bicycles

owning an IMT prefer to purchase a bicycle and would be able to pay \$ 19 on average. Fig. 4.4-7 shows the willingness to pay of the non-IMT households preferring a bicycle. 60 % would pay \$ 19 or less and 20 % could afford \$ 39 or less. The lack of funds is the main reason for not buying a bike. If a credit scheme was introduced, covering  $\frac{3}{4}$  of the price, more than 60 % of the households desiring a bicycle (36 % of all households) would purchase a vehicle.

#### *4.4.3 Wheelbarrows*

The MIRT Project developed a wheelbarrow, which had the main purpose of providing a cheap means of transport and which could be produced by local



craftsmen using few imported materials. About 200 wheelbarrows were produced in Makete, of which 58 were sold, 76 used by the MIRTTP and 47 given as gifts during promotional activities until December 1992. Most of the vehicles were used for road works and many are possessed by NGOs or the communities. In the eight surveyed villages, where more than 1,700 households are living, only five households possessed a function-ing wheelbarrow, two more vehicles were not in working order. Two of the heads of these households were regularly employed and not farmers.

In 1994 no carpenter was found, in the surveyed area who continues the production of wheelbarrows. The main reason is the lack of demand: only 6 % of the households not possessing an IMT would purchase a wheelbarrow if they had sufficient funds. In 1994 they were able to pay \$ 4.83 on average. The actual price ranges between \$ 9 and \$ 19 depending on the quality of the timber and type of wheel used. An imported wheelbarrow made of metal is at \$ 40-60 much more expensive. The lack of funds seems to be one of the major restrictions for the purchase.

It is not only the price but also the utility of the vehicles which seems to set strong restrictions. Because the construction is completely of wood<sup>30</sup>, the weight of the wheelbarrow is too heavy to make transport of goods an easy undertaking in the hilly landscape of Makete. Therefore households possessing a wheelbarrow use the vehicle only for 41 trips per year. Only 12 % of the trips were undertaken to fulfil subsistence tasks. The main purpose is for all types of commercial activities, e.g. transport of bricks, soil, dung and meat from the slaughter place to the local market. Social activities and transport services, which were undertaken for other households play an important role as well. No



Fig. 4.4-8 Willingness to pay for wheelbarrows

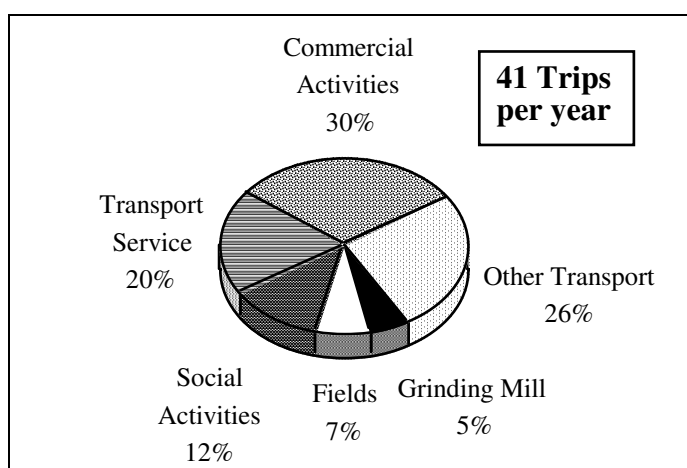


Fig. 4.4-9 Trips undertaken with wheelbarrows

<sup>30</sup> Project documents were even emphasising the advantages of wooden bearings compared with metal bearings.

statement can be given about their benefits. The experience with labour-based road construction and maintenance works showed, that the wheelbarrows are useful for these tasks. Because the effects on the household level are low, the benefits cannot be assessed.

## 4.5 Piped Water Supply

The procurement of water is an arduous and time consuming task: every household transports 33 tkm and spends 800 hours per year only on water collection. 94 % of the trips in Makete are undertaken by women and their children (BARWELL/MALMBERG-CALVO 1989). The installation of a piped water supply can have two main effects: it can reduce the transport burden of women and it can improve the health standard of households by making clean water available.

1994	Number of trips	Distance	Travel Time	Person Kilometres	Tonne Kilometres
	[Trips/a]	[km]	[hrs/a]	[pkm/a]	[tkm/a]
<b>Bulongwa Region</b>					
With piped water supply*	1244	0.9	576	2305	17
Without piped water supply**	1193	1.6	919	3674	31
Effect Bulongwa	52	-0.7	-342	-1369	-14
<b>Matamba Region</b>					
With piped water supply***	840	1.5	541	2162	20
Without piped water supply****	967	2.0	936	3746	34
Effect Matamba	-128	-0.5	-396	-1584	-14
* Kidope ** Unenamwa, Madihani, Utengule *** Mpangala **** Ngoje, Ng'onde					

Tab. 4.5-1 Villages with and without piped water supply (Optimistic view)

A comparison between villages with and without piped water supply gives an estimation of the benefits according to the optimistic view. The distribution of the rainfalls, causing different transport patterns for water collection, necessitates a distinction between the dryer area of Matamba and the wetter highlands of Bulongwa. In Kidope one domestic point supplies 20 households, while in Mpangala 100 households are supplied. The Tab. 4.5-1 observes the villages in 1994 which have piped water supply and compares them with villages where people have to fetch their drinking water from the rivers.

In villages with piped water supply the average distance to the water is 0.5-0.7 km shorter than in villages without pipes, resulting in an annual reduction of transport of 1,370-1,570 pkm or 14 tkm. Annually 340-400 hours per household are saved by the water pipes, which is 14-16 % of the total time used for transportation in 1994. Especially women benefit from these time reductions with on

average more than 300 hours. This optimistic view attributes a monetary value of \$ 27.08 to the total time savings.

A pessimistic approach can be assessed in Kidope where during the observed period a piped water supply was installed by DANIDA. This methodology observes the changes between 1986 and 1994 in Kidope and compares them with the changes in the other villages of the Bulongwa region. The assessment shows that the number of trips and the time spent for water collection increased in all the survey villages. The inhabitants of Kidope reacted to the installation of piped water supply by increasing the number of trips to an even greater extent than people from other Bulongwa villages. This was more than compensated by the reduction of the trip length. Compared with the other villages an average Kidope household saves annually 118 hours of walking time, which is 5 % of the total time devoted to transport. According to the pessimistic view the annual monetary value for the time savings comprises \$ 8.65. The employment generated by the construction activities is added to the total benefits which range between \$ 12 and \$ 31 per household.

	<b>Number of trips</b>	<b>Distance</b>	<b>Travel Time</b>	<b>Person Kilometres</b>	<b>Tonne Kilometres</b>
<b>Installed water supply</b>	[Trips/a]	[km]	[hrs/a]	[pkm/a]	[tkm/a]
Kidope 1994	1244	0.9	576	2305	17
Kidope 1986	655	1.6	537	2148	25
<b>Changes</b>	<b>+589</b>	<b>-0.7</b>	<b>+39</b>	<b>+157</b>	<b>-8</b>
<b>Villages without piped water</b>					
Bulongwa without pipes 1994	1193	1.6	919	3674	31
Bulongwa without pipes 1986	805	2.1	762	3047	36
<b>Changes</b>	<b>+388</b>	<b>-0.5</b>	<b>+157</b>	<b>+627</b>	<b>-4</b>
<b>Effects</b>	<b>+201</b>	<b>-0.2</b>	<b>-118</b>	<b>-470</b>	<b>-4</b>

Tab. 4.5-2 Changes in Kidope after the installation of piped water (Pessimistic view)

## 4.6 Grinding Mills

During the surveyed period 25 grinding mills were repaired in the Makete District. Mainly women use motorised grinding mills to avoid arduous grinding by hand. The traditional division of labour reserves the task of grinding exclusively for women. 70 % of the trips to grinding mills in Makete are undertaken by women and another 20 % by women accompanied by their children. (BARWELL/MALMBERG 1989, p.77). Often the mills are not in working order, causing long walks to the next village, where the mill is still working. The repair or new installation of grinding mills has effects on the transport activities of women and their time budget.

The effects of grinding mills can be estimated by using similar methodologies as in the previous chapter. Tab. 4.6-1 compares the changes in the transport patterns of villages, where a mill was repaired with the changes that occurred without an intervention. Tab. 4.6-2 compares the differences between villages where a grinding mill is working and villages without grinding mills<sup>31</sup>. The benefits calculated with both methodologies show remarkably small differences. Tab. 4.6-3 lists the ranges of the benefits. The installation or repair of grinding mills shortens the walking distance by two thirds. The number of trips does not increase with shorter distances as in the case of piped water supply, because of the constant consumption of flour. A functioning grinding mill reduces the person-km by more than three quarters, the tkm by more than 90 % and the time by nearly 80 %. A motorised grinding mill saves annually over 100 hours per household, which is equivalent to 4.5 % of the total time spent on transportation. Most notably women profit with 88 hours annually. The monetary values for the total time savings range between \$ 7.55 and \$ 7.92.

	Number of trips	Distance	Travel Time	Person Kilometres	Tonne Kilometres
Repaired grinding mills	[Trips/a]	[km]	[hrs/a]	[pkm/a]	[tkm/a]
1994	43	1.6	35	140	2.7
1986/87	47	6.2	130	519	15.4
Changes	-3	-4.6	-95	-379	-12.7
No interventions					
1994	32	4.3	88	350	7.0
1986/87	37	4.8	79	316	7.9
Changes	-5	-0.6	9	35	-0.9
Effects (Difference in Changes)	+2	-4.0	-103	-414	-11.8

Tab. 4.6-1 Villages before and after the improvement of grinding mills (Methodology I)

1994	Number of trips	Distance	Travel Time	Person Kilometres	Tonne Kilometres
	[Trips/a]	[km]	[hrs/a]	[pkm/a]	[tkm/a]
Grinding mill working*	37	1.4	27	108	2.1
Grinding mill not working**	36	7.7	135	540	10.9
Effect	1	-6.3	-108	-432	-8.8
* Kidope, Mpangala, Ngoje, Ng'onde      ** Unenamwa, Madihani, Utengule, Ihela					

Tab. 4.6-2 Villages with and without grinding mill (Methodology II)

<sup>31</sup> If the same comparison is done for the 1986/87 survey the results are remarkably similar.

	<b>Number of Trips</b>	<b>Distance</b>	<b>Travel Time</b>	<b>Person Kilometres</b>	<b>Tonne Kilometres</b>
	[Trips/a]	[km]	[hrs/a]	[pkm/a]	[tkm/a]
Methodology I	+2	-4.0	-103	-414	-11.8
Methodology II	+1	-6.3	-108	-432	-8.8
<b>Mean</b>	<b>+1.5</b>	<b>-5.2</b>	<b>-106</b>	<b>-423</b>	<b>-10.3</b>

Tab. 4.6-3 Impact assessment of grinding mills

The question arises as to whether hand grinding mills could be an alternative to motorised grinding mills. In the Bulongwa Region, where the Diocese distributed hand grinding mills, they are used by 37 % of the households mainly at home or by 16 % at the neighbours<sup>32</sup>. They are mostly used to grind wheat, while maize is preferably ground by motorised mills<sup>33</sup>. This might be the explanation why in the Matamba Region no hand grinding mills are used. The reason for the use of hand grinding mills is different: in the Bulongwa villages where the motor mill is out of order, 86 % of the hand mill users state that the next motorised mill is too far away. In Kidope, which has a working motor mill, 93 % of the hand mill users state that motorised grinding is too expensive. But the hand mill users still carry a large amount of their crops to the motor mills. JENNINGS (1992, p.29) states that in general women prefer the motorised mills especially if they need bigger quantities of flour e.g. to brew beer. They are willing to spend money and time in order to avoid the laborious task of grinding by hand. The households mainly using hand grinding mills at home are living further away from the motor mill and they walk longer to grind flour than non-owners. Even if the local motorised mill is not working, households owning hand grinding mills prefer to walk long distances to grind their flour. Therefore hand grinding mills will not be accepted as alternative to motorised mills. They will only be used to complement motor mills for people living far away from the motorised mill. An impact assessment for hand grinding mills cannot be given.

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<sup>32</sup> The question was: How do you mainly grind your flour? The answers are given to the number of grinding processes and not according to the quantities. Because the hand mills are used for small quantities every day the answers are not an indication of the quantities ground at home

<sup>33</sup> Hand grinding of maize is difficult and gives poor quality flour.

## 4.7 Comparison of Costs and Benefits

Intervention	Location	Standard	Main Features
Feeder Road	Matamba-Chimala	All Weather Standard	Impacts only observed in two villages, effects on agricultural marketing only in one measurable village.
Local track	Bulongwa Unenamwa	Dry Weather Standard	Low impacts measurable, but high non-monetary impacts observed.
Footpath	Utengule Ng'yekye	All weather standard	Regional importance for transport from Bulongwa Region to lowland markets
Donkeys	Mpangala, Ngoje		Donkeys only purchased in two villages in Matamba. Main use for transport from the fields
Bicycles	All villages	Not a MIRTTP Intervention.	Mainly used by men for external trips, small reduction of female transport burden.
Grinding Mills	Utengule, Kidope, Ngoje, Ng'onde		Comparison of transport before and after repair or breakdown of grinding mill.
Piped Water Supply	Kidope	DANIDA Project	Reduced trip length partly compensated by higher consumption of water.
Wells	-	Not a MIRTTP Intervention.	Not observed in Makete, but effects assumed to be similar as piped water supply

Tab. 4.7-1 Main features of the transport interventions

### 4.7.1 Cost Assessment

The first column of Tab. 4.7-2 gives an indication of the total investment costs per unit of the various project components, which comprise the expenditures for purchase, installation or rehabilitation of the item. It is assumed that all of the project components have a durability of ten years. Therefore the investment costs were equally discounted over this period. In addition, the annual expenditure for maintenance and other running costs have to be added. The total annual costs are calculated per household profiting from the project component<sup>34</sup>. The share of wages<sup>35</sup> on the total costs is listed as well in Tab. 4.7-2.

A large share of the project work was fulfilled with self-help labour. It would be wrong to allocate no value to this labour only because it was contributed without any compensation. (1) The self-help labour can be regarded as a sort of tax, which is paid by the community. Often the provision of labour is more or less forced by the village authorities. (2) The opportunity costs of time, especially for women, have to be taken into account. It can be argued that during the construction work income generating activities could be undertaken<sup>36</sup>. Out of these deliberations the self-help and the paid labour was

<sup>34</sup> For the cost assessment the same number of households is used in the catchment area of roads, footpaths and grinding mills, which had been estimated for the benefit assessment.

<sup>35</sup> The share of local wages, which have regional effects is smaller, because salaries for engineers and administration staff have to be deducted.

<sup>36</sup> JENNINGS (1992, p. 32) states that women comprise 80 % of the labourers, who were spending three days per week on village activities. This caused a big reduction in the time

valued at the minimum wage for government employees, which amounted to \$ 19 per month in 1994.

US\$ 1994	View	Unit	Purchase/ Installation/ Rehabilitation	Annual Maintenance/ Current Costs	Annual Costs per Household	Share wages
			\$/Unit	\$/Unit	\$/Household	%
Feeder Road	optimistic	km	3,242	185	<b>1.94</b>	60-70%
All Weather	pessimistic	km	4,862	277	<b>2.91</b>	40-50%
Local Track	optimistic	km	1,129	64	<b>1.86</b>	60-70%
Dry Weather	pessimistic	km	1,693	96	<b>2.78</b>	40-50%
District	optimistic	km	533	32	<b>0.53</b>	80%
Footpath	pessimistic	km	711	43	<b>0.70</b>	60%
Donkeys		Donkey	89	3	<b>11.37</b>	0%
Bicycles		Vehicle	74	3	<b>10.88</b>	0%
Motorised	Installation	Mill	10,918	3196	<b>19.49</b>	19%
Grinding Mill	Rehabilitation	Mill	157	3196	<b>14.60</b>	25%
Piped Water		System	79,500	795	<b>39.75</b>	11%
Wells		Well	2896	145	<b>7.24</b>	11%

Tab. 4.7-2 Cost assessment of transport interventions in Makete

Because the MIRTTP was designed as a low cost project the road rehabilitation was relatively cheap compared to other road construction projects in Tanzania<sup>37</sup>. This was achieved by the low standard of the construction, the labour extensive works and the low wages. The feeder road was more expensive, because it was constructed to an all weather standard on steep terrain, while the dry weather track leads through an undulating landscape. The annual costs for maintenance comprise 6 % of the construction costs and vary with the road standard and the maintenance methodology<sup>38</sup>. If these costs are divided by the number of households in the catchment area the annual costs range between \$ 2 and \$ 3. The annual costs for the improvement of the footpath amount to 50 -70 ¢ per household in the catchment area.

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devoted to agricultural production. „Women indicate, that since they became engaged in MIRTTP activities, they spent less time on their shambas and may expect reduced harvests“.

<sup>37</sup> The costs for the Core Rural Roads Rehabilitation Programme in Tanzania, which comprises 800 km of capital based construction works, range between 8,900 and 22,000 \$/km. A commercial road rehabilitation project in Kilimanjaro Region, using 25 % of its expenditure on wages, costs 9,000 \$/km. The experience with labour-based construction in Kenya and Botswana shows that the share of wages can be more than twice as high while the costs can be significantly reduced (Compare Chapter 2.4.3).

<sup>38</sup> Usually 3 % of the investment costs are calculated for road maintenance. The project documents indicate a higher percentage, because the low standard of the works necessitates more maintenance.

The donkeys in Matamba were purchased for 88 \$/animal<sup>39</sup> on top of which other investment costs like the construction costs of a stable, fences and the purchase of a donkey pannier have to be added. Annual expenditures are medicine and additional fodder. If the investment costs are discounted over a period of ten years a household pays \$ 11 annually for its donkey. The owners of a bicycle paid on average \$ 74 to purchase their vehicle and had to allocate \$ 3.48 annually for repair. A bicycle household thus also pays \$ 11 per annum for the vehicle.

A distinction can be made between installation of a new grinding mill and rehabilitation of a broken down mill. Because of the high running costs, mainly for diesel and personnel, the difference between rehabilitation and installation is not as big as might be assumed in advance. Often churches operate the mills and do not charge the full costs to the users. Instead of full cost coverage social aspects dominate the fixing of the price for the service. Because the price elasticity for grinding is not known, no statement can be given about the effects of the full internalisation of the costs.

The costs for the installation of piped water supply comprise transmission and distribution pipes, a storage tank and 5 domestic points. The investment costs per household, which amount to \$ 360, are relatively high mainly due to the low population density and the small number of households served by one system. The costs can be reduced by 10 % if the construction works are done by Self-Help labour. In the mountainous landscape of Makete the construction of water pipes was preferred, while in the lowlands wells and hand pumps are used, which would cost only \$ 66 per household<sup>40</sup>. Cost/benefit calculations have to take into account that water pipes are five times as expensive as wells. Because it can be assumed that wells would have the same impacts as an equal number of domestic points with piped water, they will be listed in the following tables.

#### 4.7.2 *Benefits of Transport Interventions*

The following graphs show the average annual benefits per household, which are calculated as the mean value between the optimistic and the pessimistic approach. The important benefits are the time saved by the improved transportation, the monetary benefits and the improvement of the health situation. Time savings serve as an indicator for the reduction of the transport burden measured in pkm. Fig. 4.7-1 shows the changes of the time budget of an average household benefiting from the transport improvement. The biggest effects can be

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<sup>39</sup> The price for an average donkey purchased signifies the upper boundary, because many donkeys are not purchased but result from the breeding activities of the owners.

<sup>40</sup> WHO estimations quantify the average costs for water supply in Sub-Saharan Africa at \$ 200 per household.



achieved by the installation of water supply systems followed by bicycles and donkeys. While mainly women benefit from the first intervention, the bicycle reduces the time consumption predominantly for men. Women profit more from grinding mills and donkeys. However, the feeder road also causes a significant reduction in the female time used for crop marketing. The local track and the footpath range at the end of the scale. The time savings from IMT could be significantly higher if they were used for the subsistence transport tasks as well.

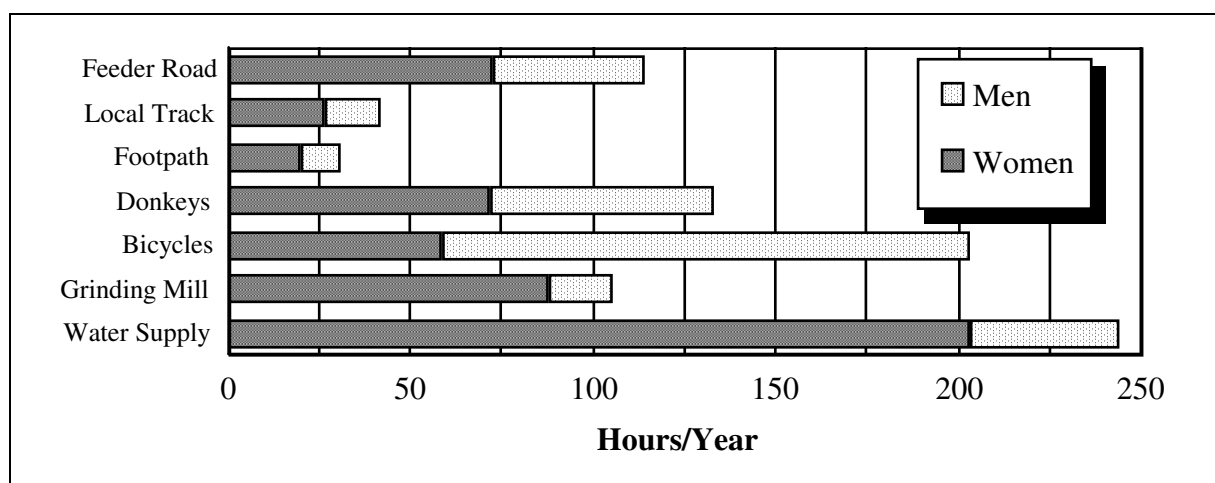


Fig. 4.7-1 Absolute annual time savings per household

European cost/benefit calculations for the assessments of the impacts of road investments include a monetary value for the time savings. In order to compare the monetary benefits of the various interventions, a monetary value for the time has to be introduced by calculating the opportunity costs of time. The marginal productivity of labour in Makete can be regarded as the opportunity costs of time. The marginal productivity was estimated with the help of the production function, described in Chapter 5.2.3. In Makete the average revenue per working hour in the field can be estimated at ¢ 16, the marginal value at ¢ 7 while the minimum wage for government employees comprises ¢ 11. Thus the assumed value of time is lower than the minimum wage. As mentioned in Chapter 2.3 and 2.4.2 the tight time budget is a severe restriction for the growth of agricultural production. Most probably the households will use the 'time savings' to expand agricultural production or for other welfare increasing activities. Hence a monetarisation of the time can be justified.

<b>\$ 1994</b>	<b>Region</b>	<b>Revenues 1986/87 or comparative household 1994 *</b>	<b>Average generated revenue</b>	<b>Increase in marketing</b>
Feeder road	Matamba	\$ 45.90	\$ 4.89	11%
Local Track	Bulongwa	\$ 28.04	\$ 1.10	4%
Footpath	Bulongwa	\$ 28.04	\$ 4.68	17%
Donkeys	Matamba	\$ 120.00	\$ 77.50	65%
Bicycles	All villages	\$ 88.24	\$ 28.60	32%
* Comparison of IMT-households with non-IMT households 1994				

Tab. 4.7-3 Generated revenues from marketing of agricultural products in Makete

Another important feature are the generated revenues by increased marketing of agricultural products. In Tab 4.7-2 the revenue increases observed in the survey villages of Makete are listed. These absolute effects do not give sufficient information, because the Bulongwa and the Matamba Region have different levels of economic activity: while Bulongwa peasants are primarily subsistence oriented, the Matamba farmers are producing predominantly for the market. Therefore the generated percent increase of revenues listed in Tab. 4.7-3 give a better impression of the generated benefits. The major marketing increase is generated by the intermediate means of transport followed by the footpath improvement, while tracks and roads have lower impacts on the marketing activities.

Fig. 4.7-2 lists the total monetary benefits<sup>41</sup>, which are made up of the monetarised time values, the increase in marketing, the salaries earned by the project implementation and other sources of income such as the hiring of vehicles, lending of donkeys etc. They are calculated as the mean between the benefits according to the pessimistic and the optimistic approach. The biggest monetary benefits result from donkeys which are mainly influenced by the strong increase in marketing activities. The same holds true for bicycles, which follow the donkeys at a large distance. The benefits from water supply systems, which are in place three and four, stem mainly from time savings. The benefits of the feeder road, following on place five, consist of time savings (46%), marketing increase (27 %), income by hired vehicles (21%) and income by project employment (6 %). The feeder road is performing better than the grinding mills, which benefit mostly from time savings. The footpath and the local track range at the end of the scale. An explanation for their low benefits compared to the feeder road could be also its location in a region which is primarily subsistence oriented (Bulongwa), while the feeder road connects an area (Matamba) which has traditionally a strong market orientation. The benefits generated by the track stem with 72 % from a reduction of transport time and with 26 % from increased

<sup>41</sup> The benefits from reduced Vehicle Operating Costs are not listed here, because it is assumed they are included in the benefits by increased market production. Compare: Consumer Surplus Theory in chapter 5.2.1 and ADLER (1987, p.34)

marketing. Fig. 4.7-3, which plots the share of effects on the average benefits, shows the importance of the time savings for most of the transport interventions. While the donkeys, the bicycles and the regional footpath have a strong direct impact on market production, the grinding mill and the water supply have the biggest effects on the transport time. Road and track impacts stem from a mixture of various effects.

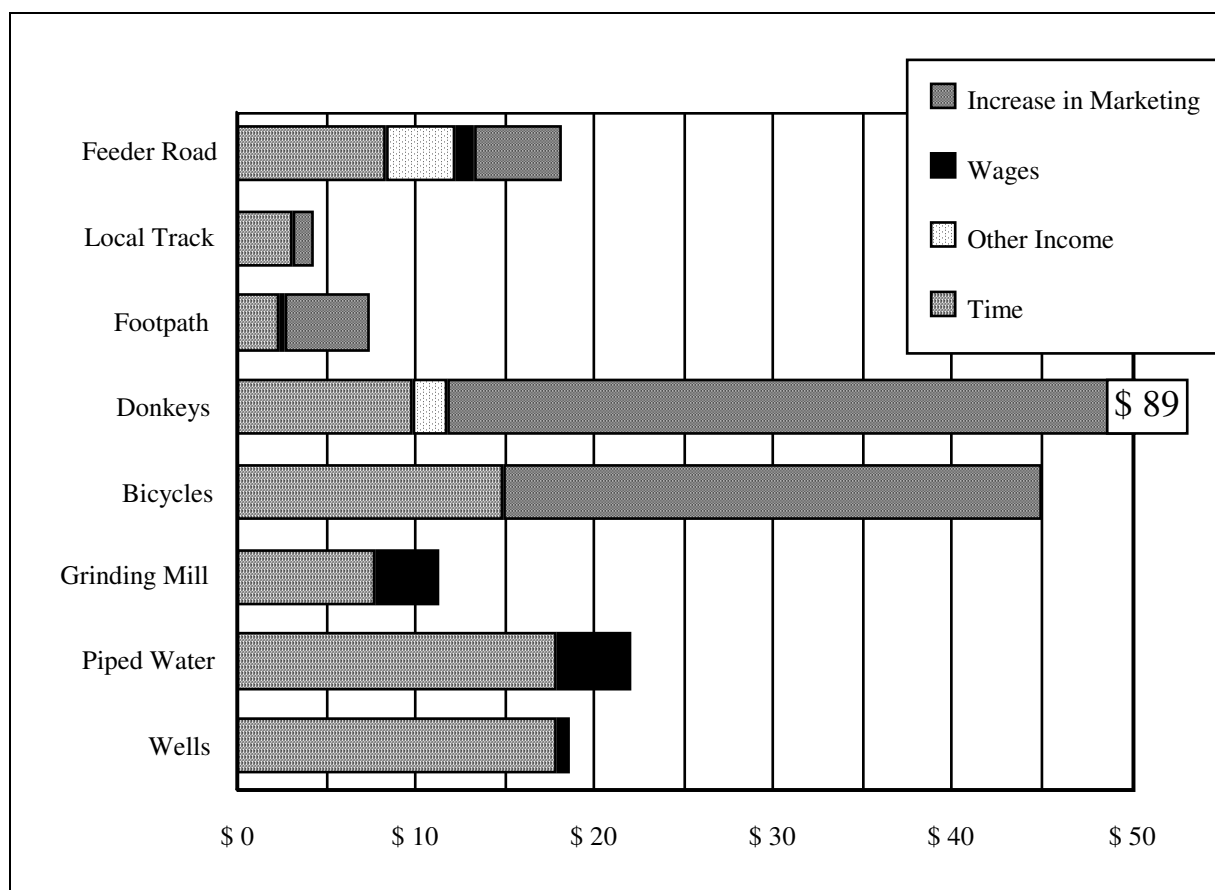


Fig. 4.7-2 Average annual monetary benefits per household

On top of the monetary benefits the non-monetary impacts have to be taken into account as well; most probably a clean water supply reduces infection and mortality rates. The track has strong effects on the health situation because the ambulance can reach the villages, while before the improvement it is reported that people were dying on the way to the hospital. The security measures taken on the improved footpath contributed to the reduction of severe and mortal accidents on the path. A monetarisation of these strong effects was not possible due to missing information.

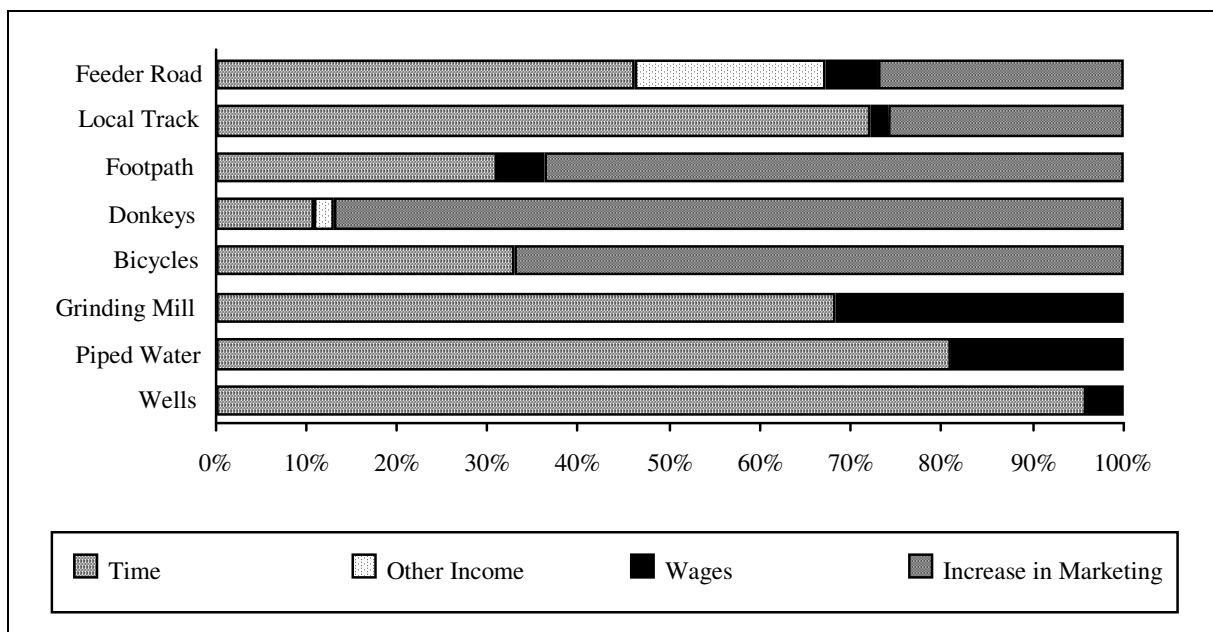


Fig. 4.7-3 Share of effects on average benefits

### 4.7.3 Comparison of Costs and Benefits

The absolute benefits give no impression about the cost-efficiency of the different transport interventions: Fig. 4.7-4 and Fig. 4.7-5 give an overview of the relative benefits related to the annual costs according to the optimistic and pessimistic view. The alteration between the two views is partly caused by the contrasting assumptions and by the variation of both costs and benefits.

Fig. 4.7-4 plots the relative annual time savings, which a household receives for the annual investment of one Dollar. The footpath and the feeder road have the strongest relative effects, followed by wells, local tracks, bicycles and donkeys. The reduction of time requirements by the installation of grinding mills or piped water supply is more expensive per hour saved.

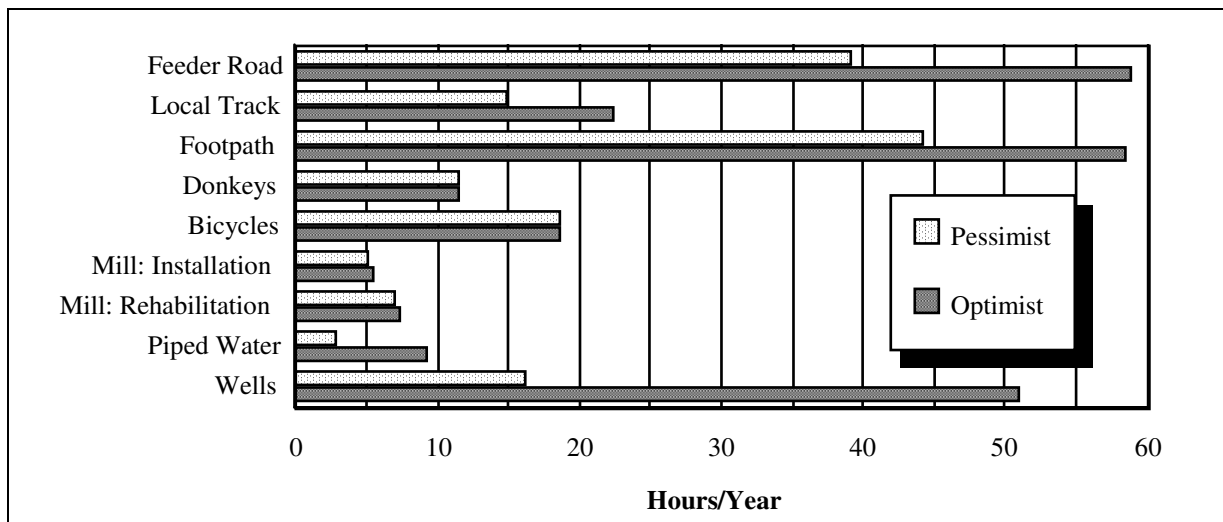


Fig. 4.7-4 Time savings per one \$ annual costs

Fig. 4.7-5 plots the ratio between the total benefits (including the monetarised time savings) and the costs. The best ratio was achieved by the footpath improvement, which shows the second lowest absolute effects. This is mainly caused by the very low costs for the improvement of the path. It has to be emphasised that the improved footpath has a regional importance for transportation and no motorised link from Bulongwa Region to the lowland markets is existent. The feeder road shows the second best ratio. The main reason are the low costs of the road rehabilitation with high labour- and low machinery-input. If the costs of commercial capital based road construction projects in Tanzania was applied, the benefit/cost ratio of the feeder road would decrease to 2! Even though the track was constructed with low costs, the smaller benefits could not be compensated. Donkeys can be located on the third place regarding the B/C ratio followed by bicycles and wells. The poor performance of grinding mills can be explained by the high costs for these interventions. The B/C ratio of water supply systems is very much dependent on the costs for the system. While in the case of Makete water pipes were installed, in lowland regions mainly wells are drilled, which have lower investment costs. In this case the ratio ranges between 1.3 and 3.8.

Because some B/C ratios range below one, not all of the investments can be warranted by the above listed transport related benefits. Probably other benefits occur, which are not included in the estimation; the fact that households use their scarce monetary resources to pay the fees for grinding shows that benefits other than transport time savings must be taken into account. The alternative of grinding by hand seems to be so arduous, that the service is valued more highly than the benefits from the saved transport time. If the annual fees, which households pay for the grinding services are regarded as the total benefits, then the B/C ratio for grinding mills exceeds one. The non-monetary benefits from the improved water supply due to enhanced health situation cannot be assessed.

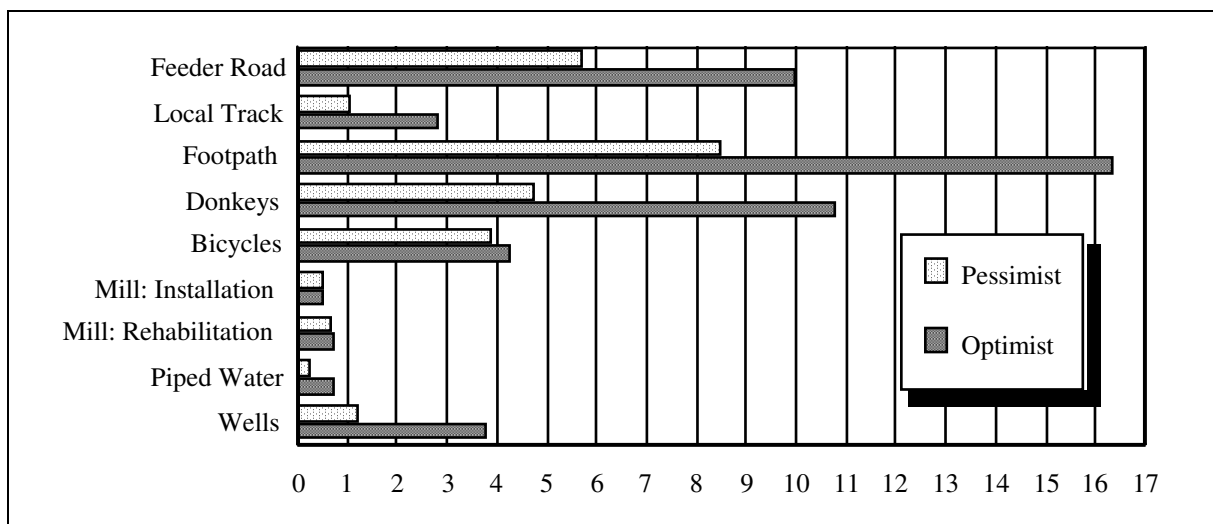


Fig. 4.7-5 Range of benefit/cost ratio according to optimistic and pessimistic view

The B/C ratios are ranked in Tab. 4.7-4 and sorted according to the sum of ranks from the optimistic and pessimistic view. Both views give a similar picture of the cost efficiency of the interventions: the footpath ranges on the first place followed by the feeder road and the donkeys. Bicycles have a higher efficiency than the water supply by wells. The local track follows in the fifth place, while grinding mills and piped water supply come at the end of the scale. All this seems to indicate that non-motorised transport interventions have the same magnitude of impacts as interventions in the motorised sector.

Transport Intervention	Optimistic Approach	Pessimistic approach	Sum of ranks
Regional Footpath	1	1	2
Feeder Road	3	2	5
Donkeys	2	3	5
Bicycles	4	4	8
Wells	5	5	10
Local Track	6	6	12
Mill: Rehabilitation	7	7	14
Mill: Installation	9	8	17
Piped Water	8	9	17

Tab. 4.7-4 Ranking of benefit/cost ratios

## 4.8 Conclusions

The salient feature of the regional development in the Makete District can be described as a shift from a subsistence economy towards a market orientation. The Bulongwa Region is still in an initial phase due to its peripheral location and the bad transport links, while Matamba is traditionally much more market oriented due to better accessibility. In the latter area the agricultural production is much higher, which implies bigger transport tasks for the production and marketing activities. Therefore intermediate means of transport (IMT) are much more common in Matamba than in Bulongwa. The survey found that donkeys and bicycles have very strong impacts on the market production; donkey-house-

holds are marketing twice as much and bicycle-households 40 % more than comparable non-IMT-households. Donkeys are mainly used for the transport of products from the field, while bicycles transport fertiliser and grain to the grinding mills and generate more trips outside the village than in non-bicycle-households. The main restriction for the purchase of IMT are the relative high procurement costs.

The benefit/cost ratio for the donkeys has the same magnitude as the ratio for the rehabilitation of a low cost feeder road, which gives external access to the **Matamba Region**. The biggest share of the monetary benefits from this road is generated by time savings (46 %), followed by marketing increases (27 %). The benefits from road improvements are distributed unequally among the survey villages. Two villages which had the best motorised access were stagnating, while other villages without a good road developed fast. Most remarkable was the development of a village far away from the improved road, which increased its marketing revenues much more than a village directly adjacent to the road, where the revenues even declined. Traditional trading links and walking access to the markets seem to be as important for economic growth as road access. Many inhabitants of villages within walking distance to the market prefer to carry a large portion of their goods by headload to the market in order to profit from price arbitrage. This is even the case when a good road access exists. The biggest road benefits were observed in a village beyond walking distance to the market, where heavy crops are produced and most of them evacuated with lorries. Without the improved road this production would imply long walking trips with heavy loads.

The isolation of the **Bulongwa Region** can serve as an explanation for the lower market orientation compared to Matamba: the travel to the next big external market is long and expensive, the road is in a bad condition and the only access to external markets are footpaths leading down a steep escarpment. The improvement of one of the footpaths generated a large number of new trips, increased security during travel and allowed the transport of bigger loads. The absolute impacts are relatively small mainly because of the low production in the region, but the benefit/cost ratio is favourable because the construction was very cheap. In Bulongwa a local trail connecting a village with the ward centre was widened to a local track. While the village representatives emphasised the large benefits due to increased health care and the appearance of traders in the village, the monetary benefits and the benefit/cost ratio are relatively low. An improved track in Matamba Region would probably generate bigger benefits than in Bulongwa, because the market production is generally higher. Possibly the construction of tracks could be economically warranted if they would be used by bicycle-trailers or animal drawn-carts.

Traffic avoiding measures like the installation of grinding mills and water supply have a significant impact on the time budget of rural households, but the

relatively high costs entail a low benefit/cost ratio. Other non-monetary effects like the improvement of the health and environmental situation probably give higher benefits than in the transport sector itself. A solution can be the installation of low cost infrastructure like wells, which results in a higher benefit/cost ratio. It would be of great interest to research whether low cost measures like the planting of woodlots and the introduction of low consumption stoves would entail bigger effects<sup>42</sup>.

Comparing the different transport interventions it can be concluded that motorised access is a necessary precondition for regional market integration, but it does not automatically stimulate the development process. The improvement of footpaths can be a very efficient and cheap measure to stimulate the marketing of villages within walking distance to regional markets, especially if traditional trading links exist. The increasing market integration entails the growth of production and marketing related transport tasks; in this phase the purchase of Intermediate Means of Transport can induce another sharp increase in agricultural production. The strong effects and the high benefit/cost ratio warrant the promotion of IMT. Traffic avoiding measures can be economically justified only if they are low cost interventions. Other non-transport effects probably entail bigger benefits. Comparing the absolute effects and the cost efficiency it can be safely stated that **non-motorised transport interventions have the same magnitude of impacts as interventions in the motorised sector.**

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<sup>42</sup> Low consumption stoves reduce the firewood consumption by 40 %, thus women would save annually 140 hours for firewood collection. The benefit/cost ratio can be estimated at about 9.