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A study of household travel in the Meru District of Kenya

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Executive Summary

In May 1985, a new 54 km bitumenised road was opened to traffic between Thuchi river and Nkubu town on the eastern slopes of Mount Kenya. It replaced 84 km of winding earth road and completed an all-weather road link between the district capitals of Embu and Meru. As well as providing an important route for through traffic, the new road gave improved access to a fertile coffee and tea-growing area. As part of the economic evaluation of the new Thuchi-Nkubu road, the Overseas Unit of TRL carried out a detailed study of rural travel behaviour. The purpose of this report is to present the main findings of this study. In particular, data is presented on household income levels, the incidence and purpose of household trips, travel costs and the elasticity of the demand for travel.

The household travel study relied on a panel survey methodology in which 300 households in twelve village areas were randomly selected for interview in 1983. This baseline survey collected household socio-economic data and compiled a record of household travel over a four-week recall period. The two subsequent surveys in 1986 and 1989 collected similar information from 291 and 283 households respectively within the original sample.

The key findings are as follows:

i The relative and absolute importance of agricultural incomes were influenced by widely different commodity production and sales experiences quite unrelated to the effect of the the new road.

ii Earnings from non-agricultural activities have been influenced by both the drought in 1986 as well as the improvement in road accessibility.

iii The matatu[1] continued to provide the main means of motorised travel after road construction. Only 17 motor vehicles were owned by the households surveyed in 1983, though this increased to 32 in both 1986 and 1989, with new acquisitions coming mainly from households living away from the road. Many of these vehicles were used as a means of generating extra income and their influence on household travel was not that significant. In contrast, ownership of bicycles saw the reverse trend, with households living along the new road owning more bicycles and using them more intensively than other more distant households.

iv The amount of travel, following the opening of the new road, increased substantially in the short-term, but less so over the longer-term. The travel rate (average journeys per household per month) rose between 1983 and 1986 by 125%. By 1989 the average was 25% lower than in 1986, but still up 68% on the 1983 journey levels.

v Changes in the cost of travel are an important reason for these variations in journey rates. Between 1983 and 1986 average journey length fell by 20% while passenger fares per km (expressed in constant price terms) also fell by 20%. However, these travel cost savings seem to have been lost by 1989 when journey rates fell. By 1989 fare levels had risen again to almost the 1983 levels. The rise in fares may have been due to wet weather during the 1989 survey, deterioration of the unsealed roads in the study area, and a reduction in competition between the public transport operators.

vi These changes did not seem to have a large effect on the nature and pattern of household travel over time. Between 1983 and 1989 the majority of trips continued to be on matatus and for one of four main purposes, namely work, shopping, social and health activities. Analysis of journey destinations also showed only small changes, with most journeys terminating at urban centres

vii A strong positive relationship was found between household income and the frequency of work and shopping journeys. In contrast different income groups appeared to have similar levels of social travel. Initially in 1983 health journeys were only weakly correlated with income, however in later years a stronger relationship was found.

viii Passenger fare levels on earth and gravel roads in the dry season were found to be about 60% higher than fares on bitumen roads. During the wet season these fares rose, on average, by a further 39%. Fares on bitumen roads were largely unchanged between wet and dry seasons.

ix Analysis of household annual travel expenditure, expressed as a percentage of household income, also remained relatively constant. Male household members continued to dominate the use of this budget in the sense of travelling more often and further than females. Similarly, males still dominated most journey purposes except for journeys to health facilities and journeys to the local markets to buy and sell foodstuffs.

x Regression analysis on each of the three data sets showed a link between journey rates on the one hand and fares and household income on the other. The results suggest that the elasticity of demand for journeys with respect to travel cost was around -0.6 and with respect to household income was an average +0.3. In other words, a 1% reduction in fares would lead to a 0.6% increase in journeys undertaken. Conversely, a 1% increase in household income would lead to a 0.3% increase in journeys made by household members.

xi A time series analysis of the data suggested larger elasticities than those given by the cross-section analysis: -1.5 with respect to travel cost and +0.5 with respect to household income. However, this longitudinal analysis is statistically less reliable and the high elasticity with respect to travel cost may have been due to reduction in transport availability in wet weather.

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[1] *Matatus are motorised pick-up trucks, minibuses and 4 wheel-drive vehicles, carrying from 5 to 25 passengers. They are operated by licensed and unlicensed operators and offer transport to fare paying passengers and their goods.*

1 Introduction

1.1 Background

In May 1985, a new bitumenised road was opened to traffic between Thuchi river and Nkubu town in the Meru District of Kenya. Built under British aid, the road runs for 54 km along the eastern slopes of Mount Kenya (see Figure 1). It replaced an 84 km winding earth road and completed an all-weather road link (the B6) between the district capitals of Embu and Meru. As well as providing an important route for through traffic, the new road has given improved access to a fertile coffee and tea-growing area. As part of the evaluation of this road, a series of household and travel and transport surveys were carried out over a six year period to investigate rural travel behaviour and examine how it was affected by the new road.

Although the impact of the new road is considered, the main purpose of this report is to present a detailed analysis of African rural travel behaviour. Information is presented on household income levels, trip making and journey purpose, travel costs and the elasticity of the demand for travel. This information should assist with estimating changes in rural travel demand when new road investment is planned.

1.2 Survey methodology

The main source of data used in this report is drawn from a series of household surveys. The first survey of three hundred households was carried out in 1983, two years before the road was opened. Similar household surveys were repeated in 1986 and in 1989 after the road had been opened. In addition to the household surveys other data were collected from traffic surveys and from surveys of transport services.

The method of household selection used in the 1983 baseline survey was based upon a systematic cluster sampling procedure, adapted to suit the local circumstances. Twelve village areas were selected to represent a typical range of households situated at different altitudes and distances from the proposed road. Within each village area, baseline maps were drawn which focused on the village centre. Then households were chosen systematically by selecting every fourth residence along the roads and tracks leading away from each of the village centres. Typically this resulted in a four-kilometre spread of sample households due to the dispersed settlement pattern common to the area.

The baseline survey sought information from the household head on the socio-economic characteristics of

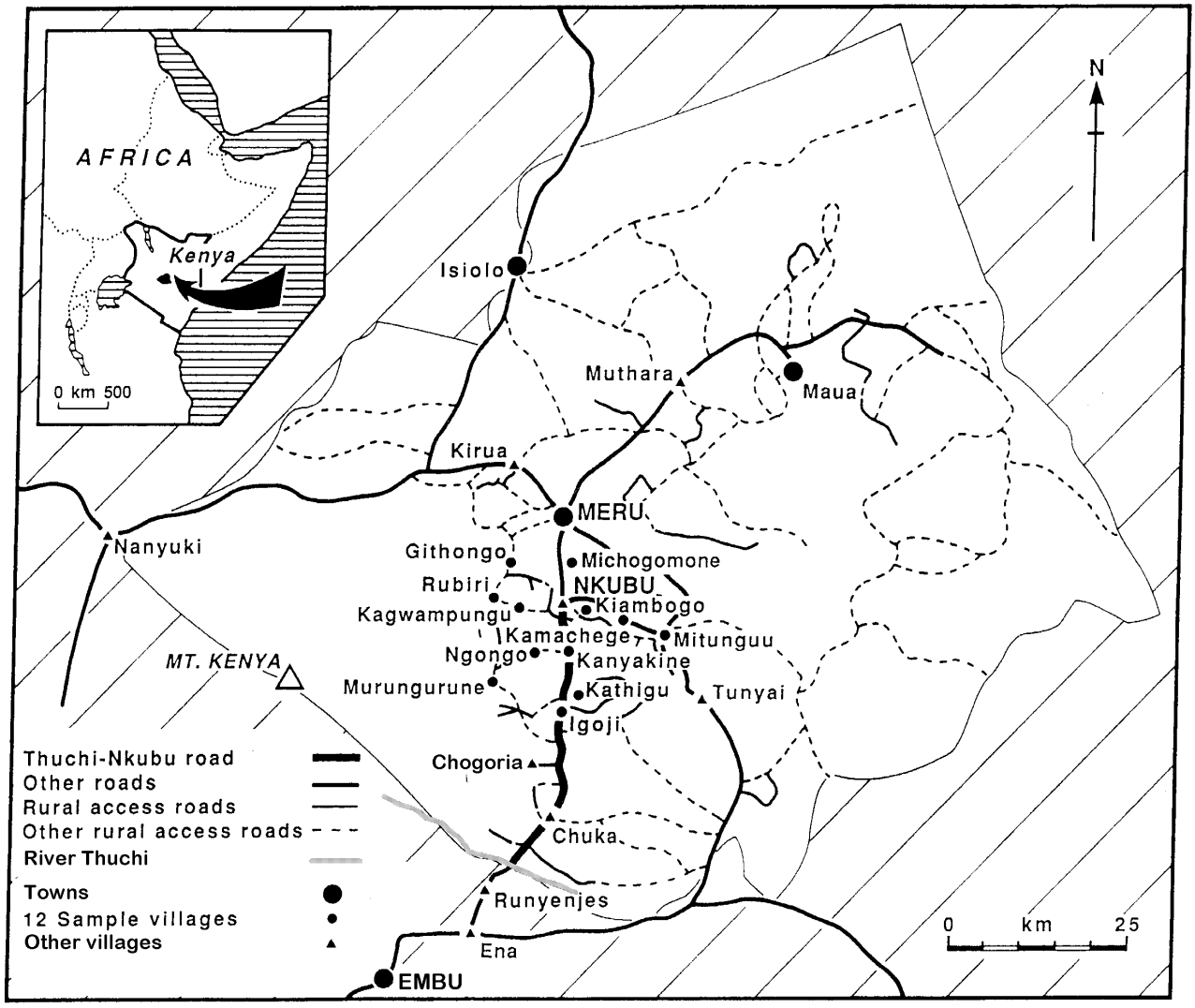

Figure 1 Sample villages in study area

the household, including the size and composition of the household, the number and type of vehicles owned, the amount of land owned and farmed, the range and volume of crops sold, and other income sources.

The household head was also asked to record all journeys made by household members over a specified four week period during the dry season months of late January and February, in the form of a weekly travel diary. A journey was defined as a complete home to home movement in which at least one stage or 'trip' was by vehicle or bicycle. Apart from recording the trips, the travel diary was also used to record characteristics such as origin, destination, travel mode, fare and purpose.

Once the methodology had been developed and applied, it remained as the research framework for interviewing the panel again in 1986 and 1989. These follow up surveys had been timed first to capture the immediate effects of the newly opened road in 1986 and second to assess the longer term impact in 1989. In the six years between the surveys only 17 households could not be located or had radically changed so that comparison with 1983 was impossible.

The analysis of the surveys is presented in four sections:

i The first examines the geographical and economic basis of household income in the study area. This analysis uses the core of 283 households common to the three household surveys.

ii The second examines travel purpose and the patterns and level of household travel before and after road improvements.

iii The third assesses the changing relationship between household income, travel costs and propensity to travel.

iv The fourth gives estimates of the elasticities of demand for travel derived from cross-sectional and longitudinal analysis.

2 The geographical and economic basis of household income

2.1 Geographical background

Meru District is situated on the northern and eastern slopes of Mount Kenya, a 5,200m high mountain lying either side of the equator in central Kenya. This dormant volcano, and its associated lava flows, called the Nyambeni hills, are so large and dominant that they have developed their own microclimates, with cooler temperatures and higher more reliable rainfall than might be expected for this part of tropical Africa. Importantly, this combination of altitude, climate and fertile volcanic soils has produced a series of montane zones ranging from tundra and heathland above 3,000m, through mid-level deciduous and tropical rain forests (1,000-2,000m) to acacia scrubland on the lower slopes of the mountain below 1,000m.

The middle forest zones have been the most favoured environment for agriculture and settlement. Different clans of the Meru have settled into the wedge-shaped interfluves between the rivers radiating from the mountain's summit. Each wedge offered a variety of ecological resources which were enjoyed by each extended household or lineage as they cultivated a range of crops and animals up and down the mountain slopes.

The colonial administrative structure for Meru District utilised this settlement pattern to create a system of dialect-based, often wedge shaped locations and sub-locations. Within these administrative units, localised groupings of households were organised into villages around a 'chiefs camp'. Furthermore, this administrative structure was underpinned by a transport network in which the B6 formed the primary route running from the southern-most chief's camp at Chuka to Meru, the district's administrative headquarters. This section of the B6 was an earthen or murram-surfaced contour road running for about 100 km at an altitude of some 1400m.

With independence, the administrative structure remained, but the transport infrastructure proved to be increasingly inadequate. The B6 was improved in stages, culminating in the Thuchi-Nkubu improvement. In transport terms, it is the impact of both the distance and road surface changes on rural travel behaviour that has been the focus of the study presented in this report.

2.2 Demographic background

Table 1 below presents the average household size as determined in each panel survey, using the 283 households common to each. The average size of survey households is larger than the 1979 Census average of 5.5 (Central Bureau of Statistics, 1981). In 1989, the 283 households had a normally-resident population of 2,105 and an average of 7.4 persons per household, compared with 2,007 and 1,899 people in 1986 and 1983, with mean household sizes of 7.1 and 6.7 respectively. Furthermore, the annual population growth rate of the sample

Table 1 Average characteristics of key socio-economic variables (n = 283)

	1983	*1986*	*1989*
Household size	6.7	7.1 (+6%)	7.4 (+4%)
Landholding (hectares)	1.99	2.29 (+15%)	2.47 (+8%)
Hectares per capita	0.30	0.32 (+7%)	0.33 (+3.4%)
Agricultural income (K£ per household)	430	574 (+34%)	726 (+26%)
Non-agricultural income (K£ per household)	163	289 (+77%)	343 (+19%)
Total income (K£ per household)	594	863 (+45%)	1069 (+24%)

1 Figures in brackets represent change since previous survey.

2 Incomes have been deflated to 1983 levels, reflecting the rises in the retail price index, using the factors 1.35 and 1.57 for 1986 and 1989 respectively (Central Bureau of Statistics, 1986, 1989).

households was 2% per annum, from 1983 to 1986, and 1.5%, from 1986 to 1989, compared with a 3.9% annual District average from the Census.

One explanation for these differences stems from the sampling procedure used to identify the households in the baseline survey of 1983. This focused on mapping the residences in a village area and then randomly selecting households living in these residences. This reliance on maps ensured continuity between the surveys but meant that new households were excluded and that homeless or mobile households also tended to be overlooked. This omission introduced a slight bias towards the more established households in the villages.

The changing age structure of the sample population between 1983 and 1989 confirms this. In 1983 the sample's age structure was very similar to that of the 1979 Census for the District as a whole. However since 1983 the proportion of children reported in the survey has declined, while that of the aged has risen. These trends stem from the inherent methodological problems associated with panel surveys (Goodwin, et al, 1987).

It should, however, be noted that household structures are themselves not very stable (Cundill & Airey, 1990). Although there were only small changes in average household size between the three studies, this belies the changes that took place in individual households. For example, between 1983 and 1986, two households changed in size by ten, and the average household changed in size by two. Moreover, in addition to the changes in numbers, there were changes in the persons making up the household.

2.3 Agricultural economy

In the baseline survey of 1983, all households reported that they were actively involved in agriculture and owned some two hectares of land on average (Table 1). This is higher than the average of 1.5 hectares per household in Eastern Province recorded in surveys conducted in 1978/9 by the Central Bureau of Statistics (1981). The pattern of freehold land ownership had been introduced in the colonial period when all resident households were able to register and demarcate their traditional land rights. The introduction of cash crop farming, particularly for coffee, and the 'modernising' impact of colonial institutions and missions reinforced this trend towards household small-scale farms.

Table 1 and Figure 2 further indicate that the trend over the six years of the survey has been for household land holdings, in both aggregate and per capita terms, to increase. This trend was brought about by the increased planting of tea on the upper slopes of Mount Kenya and runs counter to the district and national view of increasing population pressure on land.

The survey results show that the typical household farms its land as two separate systems, colloquially referred to as shambas:

i The cash crops, mainly coffee, tea, cotton and tobacco, are usually mono-cropped under the management and control of the male household head. These commodities are then sold to formal purchasing agencies. In the case of coffee, the male household head is invariably a registered member of a co-operative society which processes the coffee cherries before delivering the dried beans to the Coffee Board of Kenya. Tea, cotton and tobacco, on the other hand, are bought and administered by crop parastatals. The Kenya Tea Development Authority (KTDA), for instance, deals directly with out-growers, organising the collection, processing and sale of their tea crop.

ii Subsistence agriculture, which meets the food needs of the household, is usually organised and managed by the female household members. Maize is the preferred staple throughout the district, though most maize shambas are multi-cropped with other vegetables.

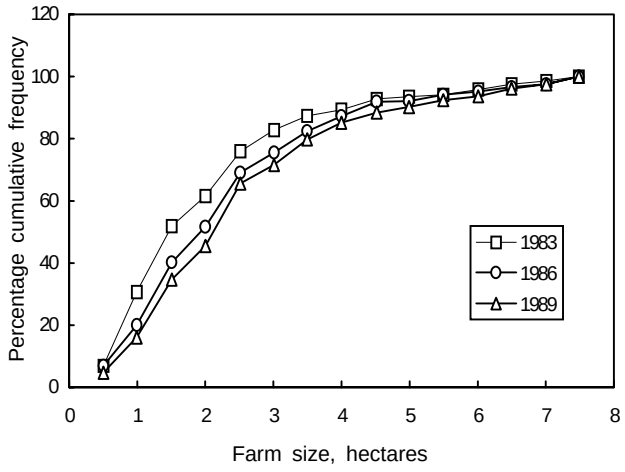

Figure 2 Farm size distribution

The combination of commercial and subsistence farming has a number of implications for this study:

i Most cash crops are formally marketed and it is possible to cross-check household income sources through the examination of payment records. This was done systematically by building up the payment record of the crops sold by each household.

ii Crop payments from the co-operatives and marketing boards are usually staged throughout the year. Coffee payments, for example, are made in three instalments. In contrast, the other crops have monthly payment patterns associated with an annual bonus payment, reflecting the difference between the low buying price and the price realised at auction, after processing and running costs are deducted. This payment pattern dictated both the timing of the surveys, which were designed to coincide with the second coffee payment, and their month-long duration.

iii There is a gender bias in access to and control over the households' major sources of agricultural cash income.

iv All households rely on subsistence production for their basic food needs. This production is a real non-monetary benefit to the agricultural economy and the household budget. However, for the purposes of estimating household income and travel demand, subsistence production posed measurement problems and could not be incorporated into the study.

2.4 Sources of income

The majority of households, ranging between 77% and 85% over the study period, stated that they were dependent on agriculture as their main source of livelihood. Dependence on remittances from family members working away from the household was reported by eight households (3%) in both 1983 and 1986. This had fallen to only three households (1%) in 1989.

2.4.1 Agricultural income

Almost all the sample households grew one or more of the four main cash crops. Coffee is grown by about 80%, and tea by 35% of the sample, while cotton and tobacco were minority crops grown by between 4% and 5% of the households respectively.

Income from the sale of these cash crops was recorded in all three surveys. The overall averages are summarised in Table 1 and while the trend is one of increasing agricultural incomes, individual household incomes were affected by two factors:

i There were significant climatic variations over the three years. During 1984/85 there was a drought in this part of Kenya the effects of which were to bring about the loss of the first coffee crop of the 1985 season (Bates, 1989). This was felt most by farmers in the middle and lower coffee zone which falls roughly along the line of the new road. So the majority of the households growing coffee were affected to some degree.

ii World commodity prices fluctuated widely over the study period. Those for coffee and tea were at their lowest in 1983, peaked in 1986 and fell back in 1989. According to District annual reports, prices for coffee cherries rose from Ksh.3.9 per kg in 1982 to Ksh.6.2 in 1985 and Ksh.4.4 in 1988 (in 1983 terms). Tea prices paid by the KTDA increased in value from K£111 per tonne in 1982 to K£259 in 1985 and K£235 in 1988 (Meru District Annual Agricultural Reports).

2.4.2 Non-agricultural income

Non-agricultural employment among the sample population increased from 107 persons working off the household farm in 1983, to 169 in 1986 and 172 in 1989. These jobs include the provision of services, craft industries, trading and quarrying, in both the formal and informal sectors.

Earnings from non-agricultural employment have become a significant and increasing contributor to household incomes as Table 1 shows. In 1983 non-agricultural income contributed some 28% of the overall average income. This increased to 32% in 1986 and 1989, in spite of higher agricultural earnings.

In all three surveys, there is no significant correlation between distance from urban centres and non-agricultural earnings. This reflects the widespread rural nature of Meru's employment opportunities with 'shops, stores and businesses dotting the wealthy countryside' (Bates, 1989).

2.4.3 Total household income

For the whole sample, total household income shows a progressive improvement from 1983 to 1986 (+45%) and again from 1986 to 1989 (+23%). In only one of the 12 sample village areas was there a lower average income in 1989 as compared to 1983. This positive development reflects in part the strength of the agricultural economy.

The distribution of incomes is shown in Table 2. Unlike 1983, when the surveys showed that households closest to Meru had the largest share of the top income groups, in 1986 and 1989 the western, tea growing villagers dominated the high income categories. Here agricultural activities have been least affected by fluctuations in weather conditions (Sterkenberg et al, 1986) and incomes from tea have been buoyant. Conversely, the distribution of the low income households with reported annual incomes of less than K£100, is associated with the eastern and low altitude village areas.

2.5 Ownership of transport

Table 3 gives ownership details of vehicles in working order. In 1983, there were 17 motor vehicles owned by the sample households and this increased to 32 in 1986 and 1989. Over the same period, the number of bicycles fell from 50 to 45, then increased to 67. The fluctuations, in part, reflected whether the vehicles had been maintained in working order.

Table 2 Cash Income Distribution (adjusted to 1983 Prices)

	Income classes (K£ per annum)	*Number of households and %*					
		1983		*1986*		*1989*	
I	0-40	8	2.7%	15	5.2%	9	3.2%
II	41-75	14	4.7%	12	4.1%	6	2.1%
III	76-100	9	3.0%	12	4.1%	12	4.2%
IV	101-150	30	10.0%	16	5.5%	36	12.7%
V	151-300	64	21.3%	49	16.8%	47	16.6%
VI	301-500	60	20.0%	43	14.8%	27	9.5%
VII	501-750	39	13.0%	38	13.1%	31	11.0%
VIII	751-1000	26	8.7%	26	8.9%	43	15.2%
IX	1001-1500	28	9.3%	32	11.0%	60	21.2%
X	1501 +	22	7.3%	48	16.5%	12	4.2%
Total		300	100%	291	100%	283	100%

Table 3 Number of vehicles owned by the sample population

Vehicle type	*1983*	*1986*	*1989*
Pick-up/minibus	4	6	7
4 wheel drive	7	10	18
Car	3	3	3
Lorry	3	2	0
Motorcycle	0	11	4
Total vehicles	17	32	32
% of households	6%	11%	11%
Total bicycle	50	45	67
% of households	18%	16%	24%

The village distribution of bicycles suggests that those households living along the new road are more likely to own a bicycle as compared with the more remote households. Moreover, this difference had become more pronounced by 1989.

In contrast, motor vehicle ownership patterns among villages have exhibited the reverse trend to that of bicycle ownership. Thus it is the higher tea zone households which have steadily acquired more motor vehicles, notably Land Rovers (83% of the 18 working 4 wheel-drive vehicles are based in the tea zone villages). Here, higher incomes and more difficult roads justify such a vehicle type.

The wealthier households of the lower coffee and cotton zone villages have increased their ownership of pick-ups and minibuses. These tend to be less durable vehicles, more suited to the less rugged terrain of the lower slopes. Residents of roadside villages, on the other hand, seem to have been less inclined to purchase motorised transport. Since vehicle purchase for operating as a matatu[2] transport service is a common form of business enterprise it is tempting to suggest that competition along the B.6 has made such investments more risky here. Wealthier households in these roadside villages may have invested in other non-agricultural enterprises rather than transport.

3 Patterns of household journey making

From the baseline survey in 1983, the household travel rate rose from an average of 5.0 to an average of 11.2 journeys per household per month in 1986, a 125% increase. Between 1986 and 1989 the recorded travel rate declined to an average of 8.4 journeys per household per month, a 25% decrease since 1986, but still a 68% increase since the pre-road improvement baseline of 1983.

3.1 Transport modes

Most journeys began and ended at the residence of the household and were composed of a number of trips, each covering one 'leg' of the journey. A simplified modal classification of these trips is used in Table 4 to identify the modal changes that have occurred since 1983.

Table 4 Number of trips by transport mode

Transport mode	*1983*	*1986*	*1989*
Matatu	3175 (85%)	6126 (74%)	4192 (76%)
Bus	111 (3%)	582 (7%)	216 (4%)
Private Car	162 (4%)	556 (7%)	306 (6%)
Bicycle	23 (<1%)	159 (2%)	158 (3%)
Motorcycle	0	56 (<1%)	108 (2%)
Other vehicle	36 (1%)	156 (2%)	21 (<1%)
Walk*	243 (6%)	638 (8%)	531 (10%)
Total	3750 (100%)	8273 (100%)	5532 (100%)

** Walk trips are recorded only as part of a complete journey which involves a trip by vehicle transport.*

While the matatu can be seen to dominate the trips undertaken by the sample population over the six years, it lost some ground and modal choice became more varied in the later years which saw small increases in the use of buses, private cars, motor-cycles, bicycles and walking.

The new Thuchi-Nkubu road appears to have widened modal choice, particularly for households living close to the new alignment. This is particularly the case for bus, bicycle and walk journeys which seemed to be the most sensitive to roadside location. There is strong evidence to suggest that roadside households have a preference for bus services because of their cheaper fares. Similarly, they are more prepared to walk to the new road in order to gain access to the cheaper bus services. This is confirmed by supplementary information collected on modal choice. Matatu users claim that quickness of service is its main virtue, whereas bus users choose this service because of its greater comfort and low cost.

Bicycles, in spite of widespread ownership, were used very little in 1983. By the later years bicycle travel had increased to become a significant minor transport mode. The majority of these bicycle journeys began and ended in villages next to the new road. It seems likely that the new road surface has encouraged households in these communities to increase both the use and ownership of bicycles for longer distance travel.

In contrast, while the use of private cars and motor-cycles has increased since 1983, there is no suggestion that the villages along the new road have been at the forefront in this trend. It is probable that the ownership and use of these vehicles reflects household economic circumstances rather more than roadside location.

3.2 Journey purpose

The overwhelming majority of journeys were reported to have been made for a single purpose. Multi-purpose journeys constituted less than 5% of the overall journeys and in the analysis they have been classified according to their primary purpose. Table 5 presents the breakdown of journeys by purpose and gender for the three survey periods.

[2]Matatus are motorised pick-up trucks, minibuses and 4 wheel-drive vehicles, carrying from 5 to 25 passengers. They are operated by licensed and unlicensed operators and offer transport to fare paying passengers and their goods.

Table 5 Breakdown of journeys by purpose and gender

	Number of journeys (Per cent of total)			*Per cent of journeys in each category by females*		
Journey purpose	*1983*	*1986*	*1989*	*1983*	*1986*	*1989*
Work	304 (20%)	964 (30%)	787 (33%)	23	30	23
Shopping	272 (18%)	543 (17%)	401 (17%)	43	33	39
Social	326 (21%)	560 (17%)	419 (18%)	48	35	34
Health	192 (13%)	450 (14%)	314 (13 %)	64	63	60
School	27 (2%)	183 (6%)	67 (3%)	48	58	27
Trading	112 (8%)	176 (5%)	114 (5%)	80	51	77
Personal business	191 (13%)	260 (8%)	138 (6%)	16	13	21
Bank	70 (5%)	124 (4%)	132 (6%)	14	21	23
Total	1494	3260	2372	41	37	35

Much greater differences in the distribution of journey purposes are recorded between 1983 and 1986 than between 1986 and 1989. The most volatile categories in this changing pattern are journeys for work, school and personal business. Over this survey period, journeys for work, in particular, have shown a steady growth from 20% to 33% of all journeys. School journeys have shown fluctuations with no consistent trend, while personal business journeys have shown a steady decline. In contrast, the remaining journey purposes retain a more or less consistent share of the total.

3.2.1 Work journeys

Work journeys include journeys made to undertake both paid and self employment and for working on the household farm. These journeys have continued to increase in relative terms and comprised nearly a third of all journeys in 1989. However there has been an absolute decline from the peak of 964 journeys in 1986 to 787 in 1989. Despite this there has been a general rise in the number of people recording journeys to work. In 1983, 47 people recorded work journeys, (2.5% of the sample population). By 1986 this had increased to 78 (3.9%), and then to 137 (6.5%) in 1989. This widening of the journey to work pattern reflects, in part, the continued increase of household members who are in non-agricultural employment.

3.2.2 Shopping journeys

These journeys involve travel to purchase consumer goods. The majority were to Meru, and to a lesser extent Nkubu, to purchase higher order goods rather than daily necessities. The level of demand seems to be relatively stable since it generates a similar proportion of the total journeys in all three years.

3.2.3 Social journeys

Social journeys have marginally declined in importance since 1983 when they constituted 21% of all journeys. This relative decline was greatest in 1986 when the proportion of social journeys fell to 17%, but marginally recovered to 18% of all journeys in 1989. Visiting relatives and friends has continued to be the most important component of social travel.

3.2.4 Health journeys

Visits to hospitals and dispensaries have likewise retained their relative importance, accounting for a more or less consistent share of all journeys in all three survey years. The increased importance to the sample population of Chogoria hospital as a treatment destination is apparent, underlining the importance of the Thuchi-Nkubu road. In 1989 it attracted 63 journeys (20% of all health journeys), compared with 78 journeys in 1986 (17% of health journeys) and only four in 1983 (2% of health journeys). These journeys were generated by households in the roadside communities of Kanyakine, Igoji and Kathigu who benefited from a decrease in the cost of travel to Chogoria, thus widening the hospital's catchment area (Airey; 1989 and 1990).

3.2.5 School journeys

School journeys by vehicle show no consistent trend over the study period. Travel by vehicle to a primary school in 1989 accounted for only 10 (15%) of school journeys, compared with 50 (28%) in 1986. These primary school journeys were usually part of an older family member's routine, using a private vehicle to drop the children off at the neighbouring primary school.

The majority of school trips were concerned with secondary education, which usually involved boarding at a District school and therefore living away from home. Because the timing of the travel surveys coincided with the publication of the secondary entrance examination results, some parents were recorded to have spent several days travelling to a secondary school in Meru District arranging for their child to be enrolled.

3.2.6 Trading journeys

The definition of trading journeys focused on travel to sell and buy agricultural commodities and foodstuffs. The majority of these journeys are made by women to nearby licensed markets to sell any surplus produce from their maize shamba or vegetable garden. The analysis suggests that the absolute number of such journeys has remained stable and as a result their relative importance has declined.

3.2.7 Personal business journeys

This journey purpose, which includes travel for administration and agricultural reasons, has consistently declined in importance since 1983. There seems to have been less involvement by the sample population with the District and Provincial Administrations.

3.2.8 Bank journeys

Journeys to the bank usually involved salaried workers and household heads depositing or cashing Co-operative Society or Crop Parastatal payments. These journeys are the only group that have consistently increased over the study period, indicating greater involvement by the sample households in the formal economy.

3.2.9 Multi-purpose journeys

52 multi-purpose journeys were recorded in 1989 (2% of all journeys), compared with 130 (4%) and 80 (5%) in 1986 and 1983 respectively. The most frequently cited combination of travel purposes is for shopping and social reasons. It is probable that this type of journey is under-represented, but it would seem that its importance has consistently declined since 1983.

3.3 Gender differences in journey purpose

The results of the 1983 survey demonstrated a marked gender bias to journey making among the rural households. In that survey, men constituted 50% of the total population yet made 59% of the journeys. The 1986 and 1989 surveys provide evidence that the bias continued and that it may have strengthened. Thus males were 51% of the sample population in 1986 and made 63% of the journeys. By 1989 males were 50% of the sample population and made 65% of the journeys.

It can be seen from Table 5 that males consistently dominate five of the eight journey purpose categories, namely work, shopping, social, personal business, and banking. This pattern reflects the underlying social and economic dominance of men in Meru society.

Females have consistently dominated only health journeys. This again reflects the norms of Meru society, in which women are the producers of food and carers of the family. Child health-care is therefore a female responsibility, requiring frequent visits to local hospitals or health centres.

Trading journeys lost their female dominance in 1986 but again emerged as a female dominated category by 1989. Female trading usually involves women buying and selling foodstuffs in the local markets. Male trading is more involved with buying and selling of non-food products and consumables from kiosks, stalls and shops throughout the area.

School journeys appear not to have a strong and consistent bias towards either sex. Education in Kenya is open to both sexes and a slight male bias, reflecting the population gender structure, would be expected.

3.4 Main origins and destinations

Classification of the trip ends of the outward legs of journeys by destination was undertaken for all three years. More than 95% of all 1983 journeys were within Meru District, and this proportion increased to 97% in both 1986 and 1989. A strong urban bias was associated with most journey purposes with the exception of work and school journeys. This bias was particularly pronounced in travel for health, shopping, trading, business and banking. Because of its key position within the District, Meru was the natural focus for many of these journeys, attracting 48% of all journeys. Nkubu, with 41% of all journeys, is also a major focus because of its geographical proximity to the study villages.

As noted above, only work and school journeys stand out as having a different pattern dominated by rural destinations. For example in 1983, 64 % of work journeys and 65 % of school journeys were to rural destinations. High rural population densities and a dynamic rural economy are part of the reason for the strong rural direction of work journeys, while the rural location of primary and several secondary schools helps to explain the importance of rural school travel.

3.5 Journey duration

The results of the travel log confirm that in all three years the overwhelming majority of people preferred and were able to travel, complete their business, and return, in the same day. In 1983, 92% of total journeys were completed on the same day. This increased to 95% in 1986 and 97% in 1989.

4 Cost and distance of travel

The main objective of this section is to examine the association between household income and the nature and frequency of travel and how these have changed over the period 1983 to 1989, before and after the completion of the Thuchi-Nkubu road in 1985.

4.1 Household income and journey frequency

Figure 3 shows the average number of journeys per month made by households categorised according to income group. As expected average journeys per month tend to rise with increasing income, for each survey. The Spearman's Rank Correlation Coefficient of income class compared with number of journeys indicate the relationship is weakest (+0.62) in 1983 and strongest (+0.95) in 1986.

Given this pattern, it is noticeable that in 1986 there was a marked increase (+125%) in the number of journeys made by all income classes. In general this increase was lowest in the low income groups and greatest in the higher income classes. This greater propensity to travel can be seen as largely a result of the effect the new road has had in reducing the cost of travel. However, by 1989 this effect had not been sustained, particularly for the low income groups. Their journey making returned to levels similar to those of 1983 before the road was improved. Only the high income groups had managed to maintain high levels of journey-making similar to those that prevailed in 1986.

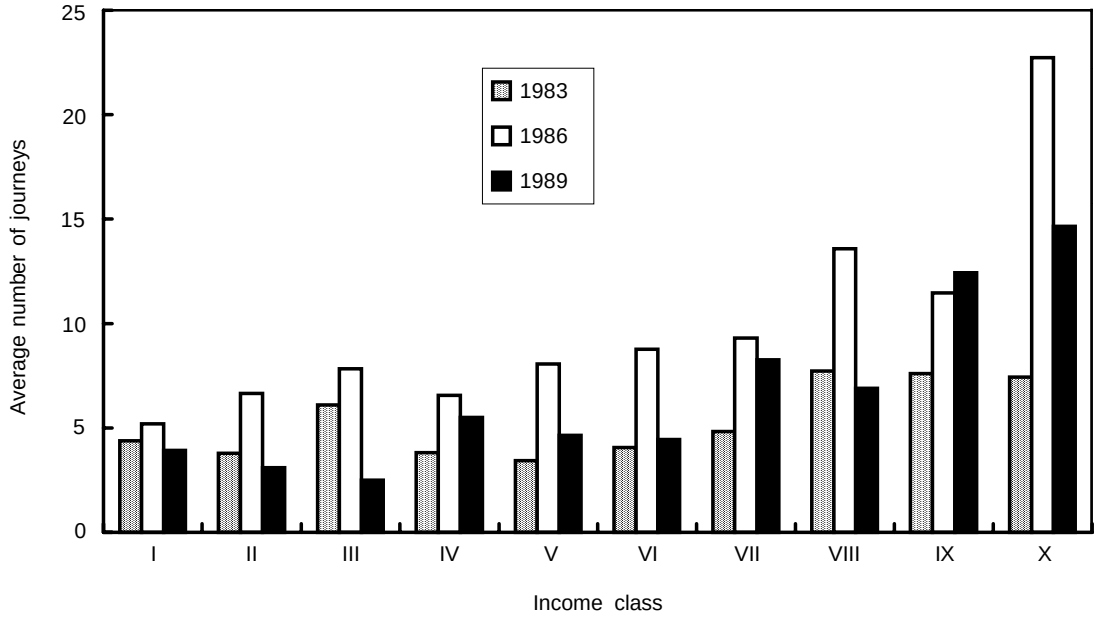

Figure 3 Average number of journeys per month by income class

4.2 Household income and travel purpose

Table 6 summarises the relationship between the household income classes and the four most important journey purposes. Figure 4 graphically shows this relationship for 1989 for all journey purposes. Work journeys are the most important reason for travel and not surprisingly there is a close and significant correlation between the number of such journeys and income class. This reflects the fact that non-agricultural earnings invariably demand travel outside the village. Shopping journeys are similar to work journeys in that they show a strongly positive correlation with income.

Social journeys, the next most important journey purpose, show a slightly different pattern in which all income classes have similar levels of social travel. It appears that the demand for social travel is common to all households regardless of their economic circumstances.

Finally, health journeys show a weak income relationship in 1983, and a stronger relationship in later years. In all years some lower income classes exhibit higher than average levels of health travel. This pattern reflects the chance occurrence of illness among the sample population and the availability of non-fee paying health care at government and some mission facilities. However, since the

Table 6 Average number of journeys per household per month by income class for the four most important journey purposes

Income classes (K£. per annum, 1983 base year)		*Work journeys*			*Social journeys*			*Shopping journeys*			*Health journeys*		
		83	*86*	*89*	*83*	*86*	*89*	*83*	*86*	*89*	*83*	*86*	*89*
I	0 - 40	0.3	0.9	1.0	0.9	1.5	1.6	0.9	0.9	0.2	1.5	0.3	0.8
II	41 - 75	0.5	0.3	0.3	1.4	1.7	0.9	0.7	2.1	0.6	0.4	0.6	0.9
III	76 - 100	0.9	2.3	0.2	0.6	2.3	1.3	0.2	1.1	0.5	0.2	1.2	0.2
IV	101 - 150	0.7	1.2	0.0	1.0	0.9	1.1	0.5	1.1	0.5	0.5	1.6	0.9
V	151 - 300	0.5	2.3	1.2	1.1	1.5	1.0	0.7	1.1	1.1	0.4	1.0	0.7
VI	301 - 500	0.9	1.8	0.7	1.1	1.7	1.1	0.5	2.0	1.1	0.9	1.9	0.9
VII	501 - 750	0.4	2.0	1.9	0.8	1.5	2.4	1.0	2.1	1.2	0.6	1.5	1.0
VIII	751 - 1000	3.0	4.5	1.1	0.8	2.1	1.6	1.2	2.4	1.5	0.5	1.5	1.6
IX	1001 - 1500	1.6	3.4	5.4	1.6	1.6	1.7	2.2	1.6	1.5	1.0	1.5	1.4
X	1501 +	1.7	8.6	6.4	1.3	3.3	1.6	1.6	3.0	2.1	1.0	2.5	1.4
All income groups		1.0	3.3	2.8	1.1	1.9	1.5	0.9	1.9	1.4	0.6	1.6	1.1
Rank correlation*		+0.7	+0.8	+0.8	+0.3	+0.4	+0.5	+0.7	+0.7	+0.9	+0.3	+0.7	+0.7

**Spearman's rank correlation of income class and No. of journeys. Correlation coefficients >0.6 are significant at the .05 level.*

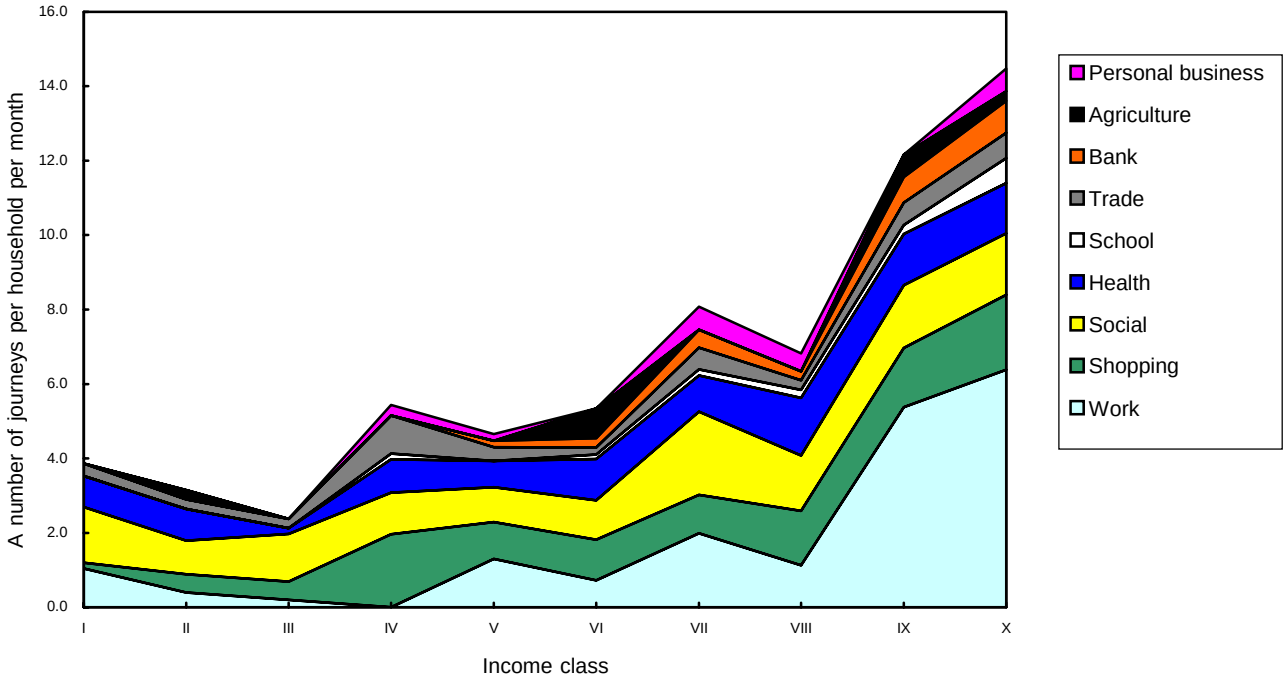

Figure 4 Average number of journeys by journey purpose and income class in 1989

opening of the new road it has been observed that households with significant non-agricultural sources of income were more inclined to travel and use Chogoria (Airey, 1991). This greater use of one of the best hospitals in the District was facilitated by the opening of the new road and may explain the significant correlation between income class and the number of health journeys in 1986 and 1989.

4.3 Journey purpose, fare expenditure and distance travelled by gender

In this analysis, journeys by bicycle, or by hired or own-use vehicles, or those for which no fare was charged, have been excluded from the four-week travel log. In this way the travel log was reduced to 'regular fare-paying journeys'. This reduced data set contained what might be called the normal pattern of public transport usage for the sample population. The data was analysed by gender and to highlight the average distance and cost characteristics for each journey purpose (Table 7).

In 1983, 88% of the total journeys were considered to be regular fare-paying journeys. In 1986 and 1989, this proportion fell to 77% and 81% respectively. This relative decline reflects the greater use of own account vehicles as well as an apparent increase in the availability of free lifts. In spite of this trend the overall data set was large enough to ensure robust averages in all but the minor travel purposes. A number of observations can be made from these averages.

Table 7 confirms that in all three years males travelled further than females. In 1983 and 1986, before and immediately after the Thuchi-Nkubu road was improved, male journeys were some 13% longer than female journeys, but in 1989 this gap widened so that men were travelling on average 24% further. This pattern of males travelling further and by implication spending more on fares is a characteristic of almost all journey purposes except social and banking journeys.

For social trip making this female bias reflects the marriage customs of the Meru whereby wives move to their husband's village to live. This inevitably means that they have a wider circle of blood relatives who have to be visited on social and family occasions. The longer travel by women for bank trips is probably the result of sample bias resulting from a small, but over-proportionate number of female school teachers in the tea zone having to travel to the banks in Meru to use their salaries.

Table 7 also shows that the average expenditure per journey has fallen since 1983 as a result of two processes.

i The straightening of the B6 alignment has reduced the distance travelled by households using the Thuchi-Nkubu road to travel to Nkubu and Meru. This will have affected some five village areas, representing 42% of the sample.

ii There was a fall in the real cost of travel in 1986, immediately after the new road was opened. In 1983, the average journey cost Ksh.17 (Ksh.0.41 per km). In 1986, this had fallen to Ksh.11 (in 1983 terms, equivalent to Ksh.0.32 per km), a 20% decrease in the real cost of travel. By 1989, this cost-reducing effect had been lost as fares reverted to their 1983 pre-improvement levels of Ksh.0.39 per km (in 1983 terms).

Both sexes were affected by these two processes but have responded to them differently. In 1986, it was observed that while both sexes benefited, males took advantage of these reductions to travel more frequently than females. By 1989, when the cost-reduction effect had been lost, women's travel horizons had not changed. Men, on the other hand, continued to travel more often as well as now travelling further.

Table 7 Purpose, distance (in km) and cost (in Kshs) of each normal fare-paying journey by gender

	Average distance travelled (and average cost)					
	Per male journey			*Per female journey*		
Purpose	*1983*	*1986*	*1989*	*1983*	*1986*	*1989*
Work	48.9 (18.0)	35.8 (10.9)	38.5 (14.4)	34.4 (12.4)	23.6 (6.4)	33.8 (12.0)
Shopping	30.3 (14.5)	33.6 (11.5)	25.6 (12.1)	29.8 (13.0)	30.8 (10.2)	24.0 (11.2)
Social	44.9 (17.4)	38.4 (12.4)	54.4 (18.3)	62.3 (22.9)	57.6 (16.1)	54.1 (18.7)
Health	32.7 (14.0)	32.0 (11.0)	26.2 (12.0)	24.7 (11.6)	25.4 (9.9)	27.0 (12.2)
School	134.6 (53.0)	42.8 (12.4)	98.5 (31.6)	67.9 (40.0)	35.8 (11.5)	44.3 (20.0)
Trading	60.1 (24.2)	33.0 (11.0)	55.5 (21.0)	25.2 (10.5)	21.8 (7.0)	16.3 (9.4)
Personal business	46.7 (19.4)	37.8 (12.6)	39.6 (15.9)	91.9 (30.9)	33.4 (11.5)	22.1 (10.9)
Bank	41.6 (18.1)	39.6 (13.0)	31.4 (14.1)	49.5 (21.9)	41.4 (13.3)	39.6 (18.0)
All purposes	44.1 (17.8)	36.0 (11.7)	39.3 (15.1)	38.9 (15.9)	31.8 (10.1)	31.8 (13.1)

Fares have been deflated to 1983 prices for comparative purposes. Fares and distances are totals for both the outward and return trips.

Finally, when the journey data is aggregated as travel expenditure per household, an annual average travel budget can be calculated. In 1983 this stood at K£51 per household, 8.5% of the annual average income of the original 300 households. In 1986 this had increased to K£75 per annum (in 1983 terms) per household, 8.8% of the annual average income of the 291 interviewed households. By 1989, this annualised expenditure had fallen to K£65 per household, only 6.1% of the annual average income of the remaining 283 households.

4.4 Wet and dry season passenger fares

Surveys were undertaken in late 1982-early 1983 and in 1986 to identify the differences in fare levels charged by transport operators for different road types in both wet and dry periods. The main wet season months in this area are October to December and April to May. There was some specialisation, by vehicle type, for different types of road. Buses, minibus and saloon cars tended to be concentrated on the better road surfaces. Four wheel-drive utility vehicles were used more frequently on the poorer earth roads particularly on the higher more rugged terrain with steep gradients. Box type matatus were more frequently found on the lower flatter terrain.

Table 8 shows the fares being charged on bitumen roads. In both survey periods the fares were identical for wet and dry periods for most vehicles types. Bus and minibus fares were lower than for other vehicle types.

Table 9 shows mean, maximum and minimum fares for different road surfaces. Fares charged by operators on gravel and earth roads were, as expected, found to be

Table 8 Passenger fares for different vehicle types on bitumen surface (Kenya Shillings per km at 1983 prices)

					bus	
Year	*saloon/ estate*	*4 wheel - drive*	*box-type matatu*	*minibus*	*dry*	*wet*
1983	0.48	no data	0.43	0.37	0.26	0.30
1986	0.30	0.32	0.26	0.24	0.25	0.25

Table 9 Passenger fares on different road surfaces (Kenya shillings per km, 1983 prices)

	Dry season fares			*Wet season fares*		
	Mini -mum	*Maxi -mum*	*Mean*	*Mini -mum*	*Maxi -mum*	*Mean*
Bitumen						
1983	0.26	0.48	0.39	0.30	0.48	0.39
1986	0.24	0.32	0.28	0.24	0.32	0.28
Gravel						
1983	0.32	0.74	0.50	0.36	0.79	0.54
1986	0.37	0.68	0.52	0.54	1.10	0.81
Earth						
1983	0.36	1.33	0.57	0.45	1.13	0.89
1986	0.44	0.88	0.49	0.45	0.81	0.66

Means were estimated from fare levels for the different vehicle types weighted by their frequency of operation on the different routes. In total five gravel routes, four earth routes and two bitumen routes were covered.

higher than for travel on bitumen roads. Fares were also higher during the wet season for these types of surface. Furthermore, there is greater variability with earth and gravel road fares compared with fares on bitumen routes. For example one gravel road deteriorated to such an extent that dry season fares doubled in real terms between 1983 and 1986. If a locality became particularly wet then the wet season surcharge for roads in that area could be substantially increased.

The overall average rise in fares between wet and dry season for earth and gravel roads was 39 per cent. Compared with fares charged on bitumen roads, gravel road fares were found, on average, to be 57% higher in the dry season and 113% higher in the wet season. Similarly, earth road passenger fares were found, on average, to be 61 % higher in the dry season and 132 % higher in the wet season compared with fares on bitumen roads.

4.5 Relationship between fares and travel

In 1983, before the opening of the new road, average household travel was 5.0 journeys per month and annual household income was K£594. In the 1986 survey which took place shortly after the opening of the new road, average household travel increased to 11.2 journeys per month, a rise of 128 per cent, but household income also increased to K£863 (at 1983 prices), a rise of 45 per cent. It was unclear how much of the increased travel could be attributed to the improved transport situation and how much to the rise in household income.

It was hoped that the 1989 survey would throw further light on the issue. It was expected that in 1989, the cost of travel would be very similar to 1986 and so any change in journey rate would be due to changes in household income. However, it was not quite so straightforward. The 1989 survey measured household travel at 8.4 journeys per month, a fall of 26 per cent from the 1986 level while household income (at 1983 prices) rose by 24 per cent to K£1069. An explanation for the downturn in travel in 1989 can be seen in Table 7. Between 1986 and 1989, the average journey cost did not stay constant, as expected, but rose by about 30 per cent.

It was found that between 1983 and 1986 the sealing of the B6 reduced fares along the road by a factor of around two in the dry season. The reductions arose partly because of lower operating costs and partly because of increased competition from enhanced bus services. Fares on the B6 north of Nkubu also fell, though to a lesser degree, again probably because of the effect of competition from buses. The subsequent rise in fares between 1986 and 1989 could in part reflect the fact that by 1989 the fierce competition between modes had eased and been replaced by a more realistic pricing policy. However, another important difference in 1989 was the presence of wet weather.

During the 1989 survey, there were unseasonably late rains, making travel on some of the unsealed roads very difficult. As noted earlier, local variations in the severity of the wet season can have significant effects on passenger fares, and may have had a considerable impact on travel costs and journey rates for individual villages between 1983 and 1986, and between 1986 and 1989.

A detailed analysis of travel from individual villages shows that Githongo and Michogomone, two villages well north of the new road, exhibited modest changes in income between 1983 and 1986. Their increase in journey rates between 1983 and 1986 could well have been due to reduced fares north of Nkubu in 1986. In contrast, Kanyakine, Kathigu and Igoji, the three villages on or very close to the new road section, also had only modest changes in income between 1983 and 1986 and yet saw large increases in journey making, probably reflecting the much larger impact on them of the new road. Large increases in journey rates for the western villages (Rubiri, Kagwampungu, Ngongo and Murungurune) was probably due to the larger incomes from tea production in addition to any road benefits.

Between 1986 and 1989, the journey rates for most villages fell. However, there were some exceptions. For three of the villages, Michogomone, Kanyakine and Kathigu, all lying on or very close to the B6, the numbers of journeys in 1989 were very similar to 1986. It could be that the fall in number of journeys between 1986 and 1989 was partly due to the wet conditions in 1989 which suppressed travel on the unsealed roads. Not all the results support the hypothesis; Kagwampungu is not on the B6 and yet it showed journey growth between 1986 and 1989, while Igoji is on the B6 and it showed a decline in journeys over the same period. Nevertheless, the fact that three of the four villages on or very close to the B6 showed little change between 1986 and 1989, while seven of the eight villages off the B6 showed decreases in journey numbers, most of them quite large, does seem to be quite indicative.

5 Elasticity of demand for travel

5.1 Cross sectional analysis

Cross sectional analyses were carried out to estimate the price responsiveness in the demand for journey making. Here it is assumed that the number of journeys per household (Qh), the number of journeys per capita (Qp) and the number of journeys per adult (Qa) are a function of the average income per household (Ih), per capita (Ip) and per adult (Ia), as well as the fare to Meru (Pm) and Nkubu the local centre (Pl). The use of the fare to the local centres of Meru and Nkubu is justified since more than 50% of all journeys terminated at these centres in each of the three study years. In the regression analysis both centres were used, but for presentational purposes the centre with the greatest explanatory power is given.

Number of journeys per household:

1983 Qh = 6.530 +	0.024 Ih (+/-0.009)	-	0.245 Pm (r^2 = 14%) (+/-0.100)
1986 Qh = 12.139 +	0.006 Ih (+/-0.001)	-	0.841 Pm (r^2 = 24%) (+/-0.568)
1989 Qh = 8.802 +	0.003 Ih (+/-0.0005)	-	0.443 Pm (r^2 = 12%) (+/-0.217)

Number of journeys per person:

1983 Qp = 0.946 + 0.041 Ip - 0.055 Pl (r^2 =18%)
(+/-0.011) (+/-0.027)

1986 Qp = 2.005 + 0.006 Ip - 0.237 Pl (r^2 = 28%)
(+/-0.001) (+/-0.090)

1989 Qp = 1.754 + 0.003 Ip - 0.183 Pl (r^2 = 18%)
(+/-0.0005) (+/-0.036)

Number of journeys per adult:

1983 Qa = 1.714 + 0.018 Ia - 0.087 Pl (r^2 = 14%)
(+/-0.007) (+/-0.034)

1986 Qa = 3.400 + 0.005 Ia - 0.452 Pl (r^2 = 17%)
(+/-0.001) (+/-0.206)

1989 Qa = 3.037 + 0.003 Ia - 0.287 Pl (r^2 = 15%)
(+/-0.0004) (+/-0.061)

Logarithmic forms of the equations were also calculated to yield estimates of the price elasticity terms as coefficients of the log of price variables:

Number of journeys per household:

1983 Log Qh
= 1.647 + 0.206 Log Ih - 0.477 Log Pm (r^2 = 15%)
(+/-0.085) (+/-0.167)

1986 Log Qh
= 0.461 + 0.284 Log Ih - 0.407 Log Pm (r^2 = 14%)
(+/-0.086) (+/-0.262)

1989 Log Qh
= 0.100 + 0.309 Log Ih - 0.269 Log Pm (r^2 = 13%)
(+/-0.050) (+/-0.153)

Number of journeys per person:

1983 Log Qp
= -0.121 + 0.254 Log Ip - 0.378 Log Pl (r^2 = 18%)
(+/-0.085) (+/-0.156)

1986 Log Qp
= -0.101 + 0.278 Log Ip - 0.551 Log Pl (r^2 = 18%)
(+/-0.084) (+/-0.204)

1989 Log Qp
= -0.319 + 0.394 Log Ip - 0.794 Log Pl (r^2 = 22%)
(+/-0.050) (+/-0.133)

Number of journeys per adult:

1983 Log Qa
= 0.386 + 0.229 Log Ia - 0.387 Log Pl (r^2 = 14%)
(+/-0.035) (+/-0.153)

1986 Log Qa
= 0.212 + 0.246 Log Ia - 0.555 Log Pl (r^2 = 17%)
(+/-0.080) (+/-0.194)

1989 Log Qa
= -0.060 + 0.337 Log Ia - 0.731 Log Pl (r^2 = 19%)
(+/-0.049) (+/-0.128)

The above regressions are all significant at 0.1% but the levels of explanation (r^2 values) are quite low, ranging from 12% to 28% in the three years. The highest set of r^2 values applies to the second set of equations, i.e. per capita travel or the number of journeys per person in the household, which range from 18% to 28% level of explanation.

The logarithmic forms of the equations follow a similar pattern in that journey per person regression equations appear to give the most consistent and highest levels of explanation, ranging from 18% to 22%. Accepting these groups of equations as the most reliable measure of elasticity of demand for journeys, then the estimates of the price elasticity with regard to travel costs (fares) range from -0.38 in 1983 to -0.79 in 1989, averaging -0.57 close to the 1986 value. This suggests that a 1% reduction in fares would lead to a 0.57% increase in journeys.

Using the same set of equations, the elasticity with regard to household income averages +0.3. This suggests that a 1% increase in household income would lead to a 0.3% increase in journeys made by household members.

5.2 Longitudinal analysis

In addition to the cross-sectional analyses described in the last section, longitudinal or time-series analyses were carried out to provide relationships between household travel, household income and travel cost.

To calculate the implied elasticities, the average number of journeys per household for each year was compared with average household income and average journey cost for the year. Using a logarithmic model, the data gave the following relationship:

Log Qh = 1.370 + 0.443 Log Ih - 1.543 Log Jh

where

Qh is the average number of household journeys per month

Ih is the average annual household income

Jh is the average cost per journey.

This implies an elasticity of demand with respect to household income of 0.44 and an elasticity of demand with respect to journey cost of -1.5. This estimate of income elasticity is somewhat higher than that of the cross sectional analyses but the price elasticity is considerably higher. Because there are only three values in the time series, no estimates can be made of statistical accuracy but the coefficients are very sensitive to the input values.

A difficulty with this analysis is that journey length also varied between the surveys. Between 1983 and 1986, average journey length for fare-paying passengers fell by 18 per cent, but it rose again by 6 per cent in the 1989 survey. Average travel cost per km was 0.41 Ksh in 1986, 0.32 Ksh in 1986 and 0.39 Ksh in 1989. An alternative analysis was therefore carried out to compare average travel with household income and travel cost per km for each of the three years. Using a logarithmic model as before, gave the following relationship:

Log Th = 0.073 + 0.552 Log Ih - 1.834 Log Kh

where

Th is the average household travel per month

Ih is the average annual household income

Kh is the average travel cost per km

This relationship implies an elasticity of demand with respect to household income of 0.55 and an elasticity of demand with respect to travel cost of -1.8, both of which are higher than the values of previous analysis. Again, no estimates can be made of statistical accuracy and the coefficients are very sensitive to the input values.

A complication with the longitudinal elasticity analysis is that wet weather may have substantially biased the result. The rise in passenger fares, and the associated decline in trip making in 1989 was also associated with unseasonably late rains, making travel on some of the unsealed roads very difficult. Hence the decline in trip making in 1989 was a combined result of the rise in fares as well as the wet weather.

5.3 Discussion

Several problems were identified in the cross sectional regression analyses. The explanatory powers of the relationships were low and the elasticities differed from year to year. This may have been because the explanatory variables were not sensitive to the processes they are trying to measure. Household income, combining as it does agricultural income and employment income, may be obscuring stronger relationships between households dependent on employment income and those solely dependent on agricultural income. Moreover, travel behaviour may depend more on recent income than on income over the previous year. An ancillary survey showed only a poor correlation between income over the previous month and income over the previous year.

Similarly, the problem of using fixed fares to either Meru or Nkubu, as surrogate indicators of the true cost of travel, is questionable, in spite of the fact that 59% of 1989 journeys terminated in these two towns.

It has been suggested that wet weather in 1989 could have had a strong influence on the results. Passengers are deterred from travelling on unsealed roads in wet weather not only because of the increased fares but also because of increased travel times and uncertainties in transport availability. (Vehicles are often taken off the road in bad conditions). An analysis of travel based on fares alone, therefore, could overestimate the sensitivity to fare levels and this may explain why fare elasticity was highest in the 1989 cross sectional analysis. It may also explain why there is a difference in fare elasticity between the longitudinal and cross sectional analyses.

The changes in journey rates observed in the survey can be compared with observed changes in traffic flows on the B6 just south of Nkubu over the same period. Between 1983 and 1986 when household journey rates increased by 125%, traffic increased by 150%. Between 1986 and 1989, when household journey rates fell by 25%, traffic increased by a further 25%. Only limited conclusions can be drawn from this because only a proportion of the traffic is local, but it seems to suggest that any fall in travel in 1989 must have taken place off the B6.

6 Conclusions

As part of the economic evaluation of the new Thuchi-Nkubu road in the Meru District of Kenya a series of rural household and travel and transport surveys were carried out between 1982 and 1989. Detailed information was collected on household composition, land ownership characteristics, household incomes, travel frequency and purpose, the ownership of vehicles and passenger fare levels.

Over the period of the study it was found that mean household size of the survey sample rose from 6.7 persons in 1983 to 7.4 in 1989. At the same time it was found that land holdings also increased in size. There is no reason to suspect that these changes were due to the impact of the new road; it seems more plausible that the increase in household size is more likely explained by the expected fluctuations in households in the later stages of their life cycle. This result is consistent with the survey procedure involving repeated surveys of the same panel of households.

Mean household cash income was found to rise from K£594 in 1983, to K£863 in 1986, and to K£1069 (measured at 1983 constant prices). In 1983 72% of cash income was derived from the sale of agricultural products and by 1989 this had fallen to 68%. Wide fluctuations in tea and coffee prices occurred during the period which strongly influenced the incomes of the particular farmers growing these crops.

Out of the 300 surveyed households only 17 motor vehicles and 50 bicycles were owned in 1983. By 1989 this had increased to 32 motor vehicles and 67 bicycles. Over three quarters of household trips were made as fare paying passengers of matatus. In 1983 an average of 5 round journeys were made by each household per month. By 1986 this had risen to 11.2 journeys, but by 1989 the average journey rate had declined to 8.4 journeys per month.

Travel frequency was found to be strongly related to household cash income. The main journey purposes were for work, social reasons, shopping and for health. Over the period travel for work increased in relative importance. The richer households tended to make many more work and shopping trips than the poorer households. However the level of social journeys remained fairly constant between different income groups. Men (50% of the sample) made 59% of journeys in 1983 and 65% in 1989. For most journey purpose categories men predominated. The main exception was for health reasons (and to a lesser extent for trading) where women were more dominant. On average men were found to travel further (by between 4 and 7 km) than women.

In 1983 the average trip was 42 km long and cost Ksh 17 (Ksh 0.4 per km). After the new road opened (in 1985) trip lengths fell because of the more direct alignment of the new road. So in 1986 the average trip distance was 34 km, and at the same time the average fare level fell to Ksh 11, at 1983 prices (Ksh 0.32 per km). However by 1989 fare levels had risen to Ksh 14 (at 1983 prices) for a trip distance of 37 km (Ksh 0.38 per km).

It is believed that the fluctuations in fare levels relates to changes in real operating costs, the level of competition between the operators in different years and to the effects of the wet season. Competition was believed to be particularly strong from new bus services in 1986. In 1989 it is believed that fares rose because the fierce competition between modes eased and also there were unseasonably late rains.

Fare levels on gravel and earth roads were found to be about 60 % higher than fares on bitumen surfaced roads. During the wet season fare levels on the earth and gravel roads rose on average, by further 39%. There was no significant rise due to the wet season on bitumen roads.

An analysis of cross-sectional data was carried out which indicated that there was an elasticity of journey making with respect to passenger fares of about -0.6 and with respect to household income of about +0.3. Thus a 1% reduction in fares would lead to a 0.6% increase in journeys, and a 1% rise in household incomes would lead to 0.3% increase in household journeys.

A time series analysis of the data suggested larger elasticities of -1.5 with respect to fares and +0.5 with respect to household income. However there are reasons to believe that this longitudinal analysis is much less reliable and that the high elasticities with respect to fares may be because of the reduction in transport availability in wet weather.

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Abstract

As part of the economic evaluation of the new bituminised road between Thuchi and Nkubu, in the Meru District of Kenya, a series of rural household and travel and transport surveys were undertaken over six years covering the period both before and after the road was opened.

Household size, land holdings and cash income increased over the period of the surveys, although the new road was not thought to have been a major influence on these characteristics. Prices of the main cash crops, coffee and tea, fluctuated strongly and this was an important factor in household incomes. In 1983, before the road was opened, an average of 5 vehicle journeys were made by each household per month. This rose to 11.2 journeys in 1986, but had declined to 8.4 journeys per month by 1989. It is believed that the change in journey making was influenced by a combination of factors including changes in household income and the influence of the new road as well as changes in passenger fare levels and the influence of wet weather at the time of the surveys.

The most reliable estimate of the elasticity of journey making with respect to fare levels was calculated to be about -0.6 and with respect to household incomes about +0.3. Dry season fare levels on earth and gravel roads were estimated to be about 60% higher than on bitumen surfaced roads, rising a further 39% in the wet season. Fares on bitumen roads were unchanged during the wet season.

Travel frequency was found to be strongly related to cash income. Men made more journeys and travelled further than women. Women tended to make more journeys for health and trading.

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