The Economic Significance of Cycling

A study to illustrate the costs and benefits of cycling policy

VNG uitgeverij

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Postbus 30435, 2500 GK Den Haag Fax 070 346 92 01 Internet : www.vnguitgeverij.nl

Foreword

The bicycle has an economic value, although this comes in many shapes and sizes. This could include the New York manager who gains expensive travelling time as (s)he manoeuvres his/her bicycle through the busy city traffic; or the small farmer who, thanks to his/her bicycle, can transport his/her wares to the market in Dar es Salaam; or the ex-heart patient in Amsterdam who keeps his/her hard-won health with the help of his/her bicycle; or the City Council in South America searching for measures to combat air pollution, for which the bicycle could be an excellent alternative to the cars polluting the city. Whichever way you look at it, the bicycle has a high economic value. However, that value is often underestimated and seldom corroborated.

This publication is the first overview of its kind of the various costs and benefits of cycling, and it shows how the necessary calculations can be made. We consider it as an important first step, and also as a contribution towards presenting the bicycle as a serious and versatile solution. Because when it comes down to it, the bicycle is a cheap, healthy and environmentally friendly means of transport. However, governments, interest groups and experts often undervalue the bicycles contribution to well-being and prosperity. Meanwhile, they rightly concern themselves around the world with problems related to the environment, poverty, sustainability, health and the quality of life, all problems for which the bicycle could be the solution they are looking for.

This overview is an initiative of the Habitat Platform Foundation and I-ce, Interface for Cycling Expertise. The Association of Dutch Municipalities VNG contibuted financially to the publication. The illustrations presented in this book may provide valuable information to local administrations.We would like to thank the many experts who have gathered all the information that this initiative required as well as the bodies that made it possible to produce this publication. As the project manager, Jeroen Buis has been exceptional in articulating both the universal and the local character of the information.

The ultimate aim of this publication is to inspire its readers to apply the various results and methods in their own surroundings.

On behalf of the Habitat Platform Foundation,
Ron Spreekmeester, director

On behalf of I-ce, Interface Cycling Expertise,
Roelof Wittink, director

On behalf of VNG
Joop van den Berg, chairman of the board of directors VNG

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About this publication

This publication is an overview of the economic value of cycling policy in urban areas. It uses information from different parts of the world to show the relationship between this economic value and local situations and circumstances. It also includes a literature study and cost-benefit analyses that have been carried out for four cities.

Before discussing the costs and benefits, Chapter 1 describes the contribution that cycling can make to mobility and the advantages this can have for individuals and society. It also discusses a relevant policy framework for the decision process with regard to traffic facilities.

Chapter 2 presents the costs of investing in bicycle facilities and the costs for other means of transport. This includes both investment costs in infrastructure and maintenance and running costs.

Chapters 3 to 9 discuss how and to which extent the benefits can be realized. These benefits relate to the following:

- The bicycle can help to improve accessibility and prevent congestion in cities (Chapter 3).
- The bicycle increases the quality of life in cities and population centres, and this has a positive effect on spending behaviour and stimulates new businesses (Chapter 4).
- The bicycle helps prevent air pollution caused by traffic, and all the consequences thereof for the environment and public health (Chapter 5).
- The bicycle encourages people to take physical exercise and in this way has a positive effect on fitness and health (Chapter 6).
- The bicycle can contribute to an increase in traffic safety (Chapter 7).
- The bicycle contributes to employment (Chapter 8).
- The bicycle increases the mobility of users, limits travelling time and reduces travel costs (Chapter 9).

Chapters 3 to 7 focus on the benefits for society and the government. Chapter 8 considers both social and individual benefits and Chapter 9 focuses on the economic advantages of the bicycle for individuals.

It is good to see that health features in three chapters: in Chapter 5, which deals with the harmful effects of air pollution on health; in Chapter 6, which focuses on improving health through more physical exercise; and in Chapter 7, where the harmful effects on health and deaths caused by traffic are described.

Each chapter includes illustrations of the economic value of the benefits, and it was possible to calculate the costs and benefits and to determine the cost-benefit ratio of investments in the bicycle.

Part two presents cost-benefit analyses for the cities of Amsterdam, Bogota, Delhi and Morogoro. The various results and calculation methods are compared.

The total result is an initial overview of the costs and benefits of cycling in relation to the local situation and circumstances. This study also includes an exploration of various possibilities to chart the costs and benefits of means of transport and traffic facilities.

A more detailed account of the results and calculation methods can be obtained from I-ce in a separate document at I-ce @cycling.nl or I-ce, Predikherenstraat 17, 3512 TL Utrecht.

Introduction

Selling milk in Ouagadougou, capitol of Burkina Faso

Cycle traffic is economically attractive...

A good transport system is an essential part of a well-functioning economy - this is a widely acknowledged fact. To illustrate this: 19% of the loans granted by the World Bank are spent on improving transport. Whichever vehicle is used - be it the car, truck, train, bus or bicycle - the quality of transport must be measured by the factors time, convenience and cost. Those factors apply not only to the traveller or the transporter, but also to society as a whole. Society is responsible for the infrastructure. Moreover, it often shares the burden of running the public transport system and has to deal with the negative side effects of traffic and transport.

When the economic results of investments in various means of transport are compared, cycle traffic would seem to come out on top. The bicycle is a low-cost means of transport, both for the cyclist and for society as a whole. Moreover, cycling is healthy. Motorised transport, apart from making a positive contribution to the economy, results in high external costs related to environmental pollution, energy consumption, use of space and road casualties. For car traffic, these external costs are highest per car kilometre on short journeys in built-up areas. And this is exactly where the bicycle can take over a significant share of the journeys in many cases at least 50% thereby increasing the benefits of cycle traffic even more.

...but it needs to be corroborated

There is very little to be said against this line of reasoning, but it does need to be corroborated. And to do this, it is important to calculate the economic value of cycle traffic. In the Netherlands, this was first done in 1987. Cycle traffic to school was assessed against the cost of running school buses, and was valued at 1.2 billion guilders.[1] Another case in point is Japan, where the intensive use of space in the population centres has stimulated use of the bicycle and public transport. Thanks to the relatively low costs of the transport system, the country has long been able to manufacture goods at lower costs and invest more in its production systems. For example, Japan spends almost 50% less of its GDP on transport than the United States. This has enabled Japanese industry to compete very effectively on international markets.[2]

This publication provides the first overview

This publication contains the first overview of research into the costs and benefits of cycle traffic. The overview is based on a selection of results from a number of reports. More detailed analysis of the research is recommended, however, since different calculation methods are used and the traffic situation being calculated has a radical effect on the results. This publication is mainly indicative, therefore, as it shows the types of costs and benefits that are relevant when deciding on investments in cycle traffic and indicates the size of the economic yield with respect to local circumstances.

The data in this publication has been gathered from both the developed and developing countries. In the wealthier countries, the benefits mainly relate to savings in the external costs of car traffic, while in the poorer countries, they relate to an increase in mobility.

Data and results from one city do not automatically apply to another city. It is always necessary to adjust the data to cater for local circumstances. That is particularly apparent from the calculations performed for four cities in the context of this study: Amsterdam, Bogot·, Morogoro and Delhi. The methods used provide a good basis for discussions on how to determine the costs and benefits of cycle traffic in the future.

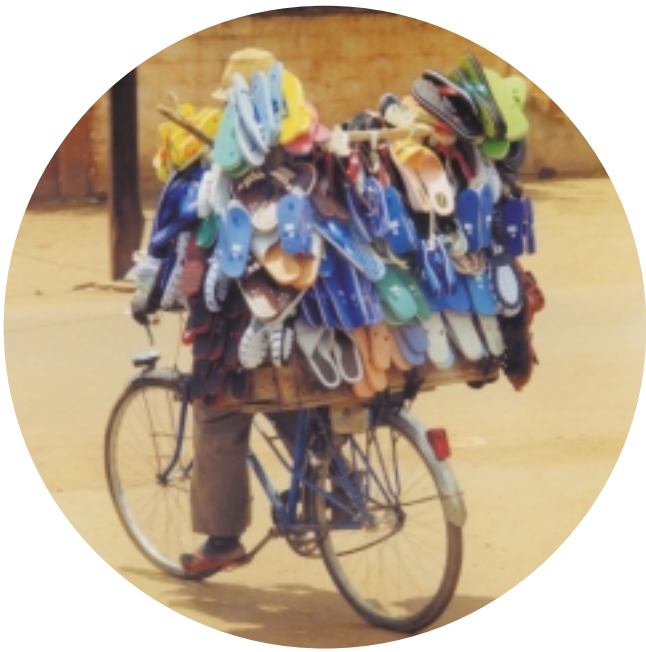
This publication presents the following study results:

- A description of the potential of the bicycle as an urban means of transport, including examples
- A description of eight aspects of bicycle use, with illustrations of their economic value
- The results of studies into the costs and benefits of cycling policy in the four specified cities.

1 De economische waarde van het fietsverkeer (The economic significance of cycling); O.J. Boot and J. Ploeger, Adviesbureau Van Roon, Den Haag, 1987

2 Role of non motorised transportation and public transport in Japan's economic success W. Hook, Transportation Research record 1441

1. Overview: the potential of cycling for the individual and society



On the bike to the market, Ouagadougou, Burkina Faso

From decline to rediscovery

The bicycle is an important means of transport in many countries. All around the world there are cities in which the bicycle is used for more than 20% of all journeys - such as in China, Tanzania, Burkina Faso, the Netherlands, Denmark, Germany, Italy, Peru and Cuba. These cities differ greatly in terms of prosperity, climate and geography, which goes to show that the bicycle enjoys massive popularity under very disparate circumstances. In cases where bicycle use is low, this can often be explained by cultural barriers and the lack of proper provisions. Climate and geographical location are also important factors but they are seldom the main reason, let alone the only one, for people not using the bicycle.

In the first half of the 20th century, the bicycle was one of the most important means of transport in many parts of the world. Then mass motorization, particularly in the Western countries in the 1960s and 1970s, made it possible for many people to purchase cars. Distances between home and work and other destinations subsequently increased, and the bicycle became a less attractive option as cyclists were forced onto other routes and the roads became more hazardous. Consequently, bicycle use diminished rapidly at that time. For example, between 1960 and 1980 in the Netherlands the number of bicycle kilometres dropped from 17 to 10 billion per year, while the number of car kilometres rose from 16 to 104 billion.[1] The same process was and still is evident in many developing countries, where bicycle use particularly dimi-

nished in the larger cities, although car use is still much lower than in the Western world. The situation in Delhi, where the bicycle share decreased from 36% to 7% between 1957 and 1994, illustrates this trend.[3] Conversely, in Shanghai in the 1980s bicycle use increased by 15% to an 87% share of all vehicle journeys. This is mainly because Shanghaiís urban layout is aimed at keeping distances short and because of subsidies for purchasing bicycles.[3] In Africa, bicycle use rose steadily until the 1970s. Curiously enough, the figures levelled out following the oil crisis in 1973. However, although car use became much more expensive, the bicycle suffered the same fate as a result of import costs.[4] This downward trend has since come to an end in a number of countries and cities. In Denmark and the Netherlands, and in various cities in Germany, France and Italy, bicycle use has increased again in the past 10 to 20 years. For example, in 1995 in the Netherlands the bicycle accounted for 13.2 billion kilometres and 27% of all journeys. In cities like Bogota, Paris and Barcelona, however, the mass bicycle use of the past has dropped to under 1% of all journeys. These cities have recently developed policies to reintroduce the bicycle into the urban transport system.

The advantages are becoming more apparent

The bicycle is being discovered or rediscovered thanks to the many advantages of bicycle use:

- the bicycle is cheap to buy, maintain and use, and it increases many people's mobility
- the construction and maintenance of cycle paths and the construction of bicycle parking facilities cost much less than roads and parking facilities for cars
- in comparison to the car, the bicycle saves a lot of space that can be used for other purposes
- used in city centres, the bicycle is almost as fast the car
- cycling, walking and public transport increase the appeal of city centres and stimulate local trade
- cycling does not pollute the environment
- the bicycle does not produce noise nuisance
- cycling has a positive effect on physical health
- in comparison to motor vehicles, bicycles cause very few serious injuries when accidents occur
- bicycle use provides extra employment opportunities, particularly for poor people
- bicycle use provides opportunities, particularly for poor people, to earn more income.

This publication corroborates and illustrates these advantages. However, although it is clearly important to make a distinction between the individuals and bodies that benefit from these advantages, this subject is not covered extensively here, given the exploratory nature of this study. This publication focuses on the benefits of cycling for society and the role that the bicycle can play in reducing travel costs and increasing mobility.

How can bicycle use be promoted?

Short distances

The upward trend towards population growth and spatial distribution means that cities continue to expand and journey distances to increase. This process is evident worldwide and is detrimental for bicycle users. Nevertheless, there are considerable differences between cities in different countries. While Asian cities build in high densities, densities in North America are extremely low. Europe is somewhere in between, while in Africa and South America there are huge differences between affluent districts with low densities and poorer districts with higher densities. When designing new construction and restructuring projects, it is very important for bicycle use, as well as for public transport, to build in high densities so that important destinations are nearby for as many residents as possible. Besides making cities more compact, this also promotes function blending and the decentralization of facilities: for example, a shop on every corner.

The following illustrates the importance of short distances: In a pro-bicycle country like the Netherlands, approximately 70% of all journeys are shorter than 7.5 kilometres, while more than 90% of all bicycle journeys are actually shorter than 7.5 kilometres and more than 80% shorter than 5 kilometres.[5] This large percentage of short journeys means that the bicycle has enormous potential in the Netherlands.

Good facilities for bicycles

It is only possible to take advantage of cycling when the right provisions have been made. Just like all other means of transport, cycling requires investment: on and off the road, for bicycle use and bicycle storage (parking).The Dutch Design Manual for bicycle facilities[6] specifies five requi-

Bikes parked at the Central Station in Amersfoort, The Netherlands

rements for meeting the needs of cyclists:

- direct links
- a cohesive network of routes
- safety
- comfort
- appeal.

The provision of good bicycle facilities can in itself lead to an increase in bicycle use. The main reason for this is the increase in traffic safety and in some cases safer and more secure bicycle parking facilities. In cities where safe cycling has already been realized, bicycle use is mainly increased by shortening routes and increasing the speed of bicycle journeys for example, better road surfaces and shorter waiting times at traffic lights. The above-mentioned Dutch Design Manual[6] contains a lot more information about designing a bicycle-friendly infrastructure.

Flanking policy for other means of transport

A cycling policy is more than just the provision of good cycle routes and bicycle parking amenities. Positive results can only be achieved when plans for the bicycle are part of a fully integral traffic and transport policy. The bicycle must be able to compete with other means of transport on different types of journeys. The construction of bicycle facilities may indeed have made the bicycle a fast, safe, comfortable and attractive means of transport; but if other means of transport are faster and/or more comfortable, the bicycle will be left behind. Even now, although the bicycle is faster and handier to use, people still often opt for another means of transport out of habit, usually the car. These non-rational motorists need extra incentives to convert them to the bicycle or public transport.

Important pro-bicycle measures aimed at motorised traffic include traffic calming, parking policy and the creation of car-free zones. Of course, there are also numerous financial instruments that can give cycling a relative head start such as ‘road pricing’, or higher fuel prices or road tax.

Experiences in Amsterdam show that the increase in bicycle use in the city centre in the last 10 years is mainly due to increased parking rates.

The city of Utrecht in the Netherlands illustrates how a combination of excluding through-traffic and investing in bicycle facilities can influence people’s choice of transport. The following table shows how the transport preference of visitors to Utrecht’s city centre changed between 1996 and 1998.[7]

Diffirent means of transport used by visitors to the city centre of Utrecht

	1996	1998
Walking and cycling	34,4%	45,6%
Local public transport	14,3%	15,2%
Regional public transport	32,9%	26,8%
Car	18,4%	12,4%

Combination with public transport

In the current transport policy, public transport is seen as the primary alternative to car traffic. That makes sense for long distances but the bicycle has greater potential to replace car traffic when travelling short distances. On short journeys, the bicycle always wins in terms of time and flexibility. On long journeys, a combination of the bicycle and public transport is a better alternative to the car than, for example, walking and public transport.

In the Netherlands almost 30% of all rail passengers currently cycle to the railway station and 12% continue their journey by bicycle after stepping off the train. A scenario for improving cycle routes to bus stops and railway stations and providing parking amenities at those stops resulted in an increase on balance of 1290 million kilometres for all public transport.

Create a bicycle culture

In countries where people rarely or never cycle - but also in countries where the bicycle is very popular - there are all kinds of cultural impediments to cycling. These are not rational arguments against cycling, the-

refore, but more a feeling that cycling 'just isn't done'. Examples of such barriers are:

- the idea that cycling is only for the poor. This idea is particularly common in the developing countries. In the affluent Western countries, where people cycle a lot, there is generally no clear connection between bicycle use and income.
- the idea that cycling is unsuitable for women. This idea is also common in the poorer countries.
- the idea that somebody of high status should not cycle. This wide spread obstacle to cycling can occur anywhere. Particularly in countries where cycling is very common, however, such as Denmark and the Netherlands, nobody is surprised to see a company director or even a government minister cycling to work.

How can barriers such as these be broken down? First of all, through information and education. People's preconceptions of cycling can be changed by giving them information (preferably also visual information) about countries or cities where these barriers do not exist for example, the above-mentioned non-income related use of bicycles in the West. Examples from people's surroundings can also be very effective. For example, in the Ivory Coast people cycle very little and women cyclists are a minority, while in neighbouring Burkina Faso both men and women make frequent use of the bicycle.
In addition, well-known people can serve as a role-model to promote cycling. The television coverage in the Netherlands of cycling ministers and even a cycling Prime Minister clearly illustrate this.

Lastly, the inclusion of lessons about bicycles in the school curriculum appears to be a good way of teaching children about cycling at an early age.

Involve cyclists in policy development

In order to meet the local needs of cyclists, it is a good idea to hold inclusive talks with them when drafting policy. In a wide range of countries cyclists have made cycling into a political issue and have prevented planners and designers from making mistakes. For example, pilot projects in Kenya and Tanzania[8] met with great success when road users (particularly women and schoolchildren) and other interested parties were involved in policy development. This resulted in numerous support programmes, such as credit and saving schemes when buying a bicycle with the assistance of employers, bicycle hire, education, bicycle parking facilities and promotional campaigns such as a 'bicycle day' or a bicycle race.

Include cycling policy on the political agenda

It is therefore necessary to give substance to cycling policy by weighing up all other means of transport, and to base that policy on the universal need for mobility, accessibility, quality of life and health. Only a broad political policy agenda can serve as a frame of reference for the social and economic returns from investments in traffic and transport. That agenda must always contain the following points:

– sustainability: we must protect the environment and save fossil energy sources
– the battle against poverty and access to the labour market
– harmonise traffic to what is going on in the surroundings, focusing on freedom of movement particularly for children and older people
– accessibility as a precondition for economic growth
– sufficient physical exercise in the context of preventative health care.

It is now generally acknowledged that cycling must play an important role in such considerations. Various studies that highlight the costs and benefits of cycling have come up with compelling results in favour of cycling. Not that cycling is a universal panacea, but it could certainly play a much greater role in traffic and transport and thereby contribute significantly to reducing the major negative consequences of motorised traffic.

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2 Road Design for Improving Traffic Flow, A Bicycle Master Plan for Delhi G. Tiwari, TRIPP/ITT Delhi, 1998
3 Nonmotorised Vehicles in Ten Asian Cities; trends, issues and policies. World Bank, Washington, 1995
4 The Bicycle in Africa: Luxury or Necessity? J. Howe and R. Dennis, Velocity 1993 Nottingham UK, IHE, Delft
5 Fietsen en andere vervoerswijzen; 1995 vergeleken met 1986 en 1990, (Cycling and other modes, 1995 compared to 1986 and 1990) pag. 23. AVV, Rotterdam, 1997.
6 Tekenen voor de Fiets, Ontwerpwijzer voor fietsvriendelijke infrastructuur (Sign up for the bike, Design manual for cycling friendly infrastructure) . CROW, Ede 1993
7 OPIUM Survey (Operational Project for Integrated Urban Management), 1998
8 Liveable African Cities; a Guideline for Urban Pedestrian and Bicycle Traffic in Africa, M. de Langen, IHE Delft, 1999

2. The costs of traffic and transport facilities

A tunnel for cyclists and pedestrians in Utrecht, The Netherlands

The previous chapter showed that traffic and transport facilities for cycling are a prerequisite for promoting bicycle use. However, the infrastructure costs for pedestrians and the bicycle, car, bus, tram and train will not immediately decrease when there is a shift from one means of transport to the other. This is because a drop in the use of a particular means of transport does not lead to a direct reduction in infrastructure, maintenance or running costs, and sometimes even leads to no reduction at all. Considerable savings in infrastructure costs can be made, however, when investment in bicycle facilities make expansion of the car infrastructure or public transport unnecessary. This chapter looks at the costs of infrastructure and traffic facilities. It does not, however, go into detail about who pays for this, nor do subsequent chapters examine the question of who benefits from an increase in bicycle use. After all, this largely depends on the local financing structure.

The figures in this chapter are purely illustrative and are mainly relevant in a local context. Globally, the differences are very significant, and the cost ratios for the different means of transport can vary enormously from country to country.

Municipal investments in infrastructure

Current practices usually involve treating expenditure for facilities for the car, public transport, the bicycle and the pedestrian separately. Based on the supposition that increased car use is the best solution for mobility and economic progress, money was and still is often spent mainly on cars.

Even in the German city of Freiburg, which has a strict cycling policy and where the bicycle's share of the total number of journeys is 19%, the costs of bicycle facilities amount to just 1% of all the costs of traffic and transport amenities. 57% of investments are for the car, which has a 42% share of all transport. In addition, 42% is spent on public transport, which has an 18% share.[1]

In cities in Kenya and Tanzania, 60% of all spending goes on the car, which has just a 6% share of all journeys and an 8% share of all kilometres travelled.[2]

In the Netherlands, 6% of the money spent on road infrastructure is currently being spent on bicycle facilities, while the bicycle has a 27% share of all journeys and a 9% share of all kilometres driven. Between 1975 and 1992, the number of kilometres of bicycle infrastructure doubled, while the total road length for car traffic increased by 20%.[3]

Construction and maintenance of bicycle infrastructure cheaper

The costs of constructing the infrastructure for motor vehicles and bicycles can vary enormously in real terms. However, if the same quality of asphalt is used for a cycle path as for a motorway, the differences in construction costs per square meter are not very significant. For the maintenance of motorways, the wear and tear caused by traffic, particularly trucks, is the determining factor; bicycles cause much less wear and tear than motor vehicles, but cycle paths do have to be repaired more frequently after suffering just limited damage, because cyclists are more vulnerable than motorists to bumps and cracks in the road surface. Calculation must be based on high quality bicycle facilities, because this is a very important factor in stimulating bicycle use.

One reason why investing in a bicycle infrastructure can still produce savings is that cycle paths needs less space. Or rather, per meter of road surface a cycle path can process more traffic (persons) than a road for cars. See also Chapter 3, which discusses accessibility and the use of space.

In the Dutch city of Dordrecht a comparison was made between the cost of high quality bicycle facilities and the cost of widening roads. A scenario was created in which road widening was no longer necessary because bicycle facilities were sufficient to replace car use. While new cycle paths were needed on the one hand, cycle paths had to be improved on the other hand. In addition, four new cycle tunnels had to be built and the parking facilities had to be improved. Nonetheless, the costs of these bicycle facilities amounted to just 75% of the cost of the road widening alternative.[4]

Parking your bicycle versus parking your car

When car use is reduced in city centres, fewer parking spaces are needed for cars. The policy of reducing car traffic in city centres therefore often consists of reducing parking facilities, and this method is used to cut car use. Parking facilities for bicycles reduce the risk of theft and vandalism and are therefore an important precondition for the further stimulation of bicycle use.

In the Netherlands, the construction costs of a parking space for a bicycle amount to approximately 5% of the cost of a parking space for a car. This does, however, depend greatly on the quality of the facilities. The cost ratio is 1:20, however, when a parking bay on a street is compared to a space in a bicycle rack, but also when a (multi-storey) car park for cars is compared with a covered bicycle parking facility. The real estate price is the main factor here. In Amsterdam, it was calculated that construction of a (multi-storey) car park in the pre-war districts would cost over US$ 15,000 per car, and a parking space for a car under a canal house in the centre costs US$ 50,000.[5]

Some years ago, the Dutch city of Utrecht decided to structurally improve bicycle parking facilities. A bicycle parking company was established as part of the Parking Bureau. There was a lack of good facilities for cyclists. The need for parking facilities had increased because more people were cycling to the city centre after the exclusion of through-traffic from the city centre and the network of cycle routes had been expanded. Yet for the coming years, the planned investment total for car parks is still four times higher than that for bicycle parking areas. The main reason for this is the construction of transfer and other facilities at the edge of the city to stimulate motorists to switch to other means of transport, particularly public transport.[6]

Investing in the bicycle or public transport

In most countries, public transport is not economically cost-effective, or the investment costs are so high that they are never earned back (underground), or the operational costs (including salary costs for drivers) are not covered by the income from ticket sales (bus). The latter often does not apply to (mini)bus traffic in developing countries where the combination of very high numbers of passengers and low salary costs enable services to be run cost-effectively. However, when investments in bicycle facilities make investments in non-cost effective public transport redundant, the bicycle can start generating real benefits.

A good example of this can be seen in South Africa: A study in Kwazulu Natal, which has 1.1 million schoolchildren, showed that the average distance from home to the primary school is 3 kilometres and from home to the secondary school 5.5 kilometres. Almost all schoolchildren walk to school because other means of transport are too expensive. The majority of schoolchildren are therefore often late or tired when they get to school, while 20% do not come at all. When school buses are used for half of the pupils, with a one-way ticking costing 2 Rand (US$ 0.26), the total costs come to 432 million Rand per year. If the government bought bicycles for these schoolchildren – for 500 Rand each – that they can use for five years, the total cost per year, including 50 Rand maintenance costs, comes to 54 million Rand, an annual saving of US$ 50 million per year.[7]

Cost-benefit calculations

In Kenya and Tanzania, cost-benefit calculations were performed for bicycle and pedestrian facilities.[8] An example:

In Morogoro in Tanzania a network of cycle paths and bicycle lanes was designed. Per kilometre, the costs were budgeted at US$ 4,200, including maintenance. The costs per kilometre for a road are three times higher. The capacity of the car lane is 60,000 persons per day, while that of the 2-meter wide cycle path is 9,000 per day, and that of the bicycle lane 5,000. Per vehicle, the investment costs for the car are lower in the case of maximum use, but the costs for the car user are actually 20 times higher. That means that the total costs per driven kilometre for a cyclists are 1.3 to 1.6 dollar cents, for a minibus 4.9 cents and for a car 10 cents. Investment in cycle routes is therefore low risk and the yield in Morogoro is 35%.

In the Swiss city of Berne, a calculation was made on the basis of three scenarios for the future for the period between 1989 and 2005.[9]

1. The trend scenario, in which car traffic is not restricted, nothing extra is done for bicycles and a little extra is invested in public transport
2. The public transport scenario, in which public transport is expanded considerably (extra capacity and network), car traffic is restricted (for example, by increasing parking rates) and investments are made in 'traffic calming' measures.
3. The bicycle scenario, in which bicycle use is promoted extensively (through investments in cycle routes, parking facilities and bicycle promotion), investments are made in 'traffic calming' measures, 1,200 car parking spaces are replaced by 10,000 bicycle parking spaces and the public network is expanded somewhat.

The following table indicates the extra costs for traffic amenities per year for the period 1989 – 2005 in relation to 1989. This therefore only involves the investment, maintenance and running costs. The benefits or saved costs of the various scenarios are not included in the table.

All three scenarios are based on an increase in mobility, partly due to an increase of 10,000 jobs in the city. If only investment costs in infrastructure and running costs of public transport are taken into account, an extra investment of over 3 million Swiss francs in bicycle infrastructure therefore leads to a saving of 34 million francs per year in public transport investments and running costs!

Infrastructure and running costs scenarios for the future 1989-2000 Bern, Switzerland

*1 CHF = 0.58 US$	More costs roads (traffic calming)	More costs Public transport	More costs bicycle	Total More costs infrastructure
Trendscenario	0	CHF 11.5m.	0	CHF*11.5m.
Public transport scenario	CHF 6.2m.	CHF 53.7m.	CHF 0.4m.	CHF 60.3m.
Bicycle scenario	CHF 6.2m.	CHF 19.6m.	CHF 3.5m.	CHF 29.3m.

Partly car-free road on sunday for cyclists and pedestrians in Medellin, Colombia

The trend scenario requires less investment in infrastructure (no traffic calming, no bicycle amenities and hardly any extra expenditure in public transport). In the trend scenario, however, the costs of road casualties and the costs resulting from environmental pollution increase by CHF 24.2 m. while in both other scenarios there is a saving of CHF 12.6 m. When all costs and benefits are taken into account, the trend scenario costs CHF35.7 million, the public transport scenario CHF 47.7 million and the bicycle scenario CHF 16.7 million.

Conclusions

Even in cities where relatively large investments are made in the bicycle and people cycle a lot, the bicycle's share of the municipal traffic budget is very small. This does not mean that investing in the bicycle infrastructure would automatically produce savings in the traffic budget. It is only when bicycle use really increases considerably that investments in road widening are no longer necessary and substantial savings are brought about. However when investments in bicycle facilities make investments in public transport unnecessary or they work out lower, savings can increase considerably, as shown by the examples in Bern and Kwazulu Natal.

1 A least cost approach to transportation planning; T. Bracher, IVU Berlijn, paper for World Conference on Transport Research WCTRs, Antwerp, 1998

2 Liveable African Cities; a Guideline for Urban Pedestrian and Bicycle Traffic in Africa, M. de Lange, IHE Delft, 1999

3 Feiten over het fietsen in Nederland (Facts about cycling in the Netherlands). Min. Verkeer en Waterstaat, Den Haag, 1993

4 Gemeentelijk Fietsbeleid, Interne en externe kosten (Municipal cycling policy, internal and external costs). Mu Consult, Amersfoort, 1994

5 Parkeercatalogus Amsterdam (Parking catalogue Amsterdam); Een leidraad over gebouwde parkeervoorzieningen in de vooroorlogse stadswijken, gem. Amsterdam 1998

6 Kosten van auto en fietsparkeren in Utrecht (Costs of car and cycling parking in Utrecht). Studie verricht ten behoeve van het Ice project Kosten en Baten van Fietsverkeer door K. Dekker, Wonen en Milieu, Utrecht, 2000

7 Kwazulu Natal, Rural Mobility Project, P.Foreshaw, Garsfontein, 1999

8 Liveable African Cities; a Guideline for Urban Pedestrian and Bicycle Traffic in Africa, M. de Lange, IHE Delft, 1999

9 Veloförderung zahlt sich aus (Promotion of cycling has a high return of investments); Kosten und Nutzen verschiedener Verkehrsstrategien am Beispiel der Stadt Bern. IG VELO Bern, 1995

3. Accessibility and use of space

Congestion in Kuala Lumpur

Accessibility is a key concept when indicating the importance of traffic and transport for economic development. The important thing is that people can get to a particular location (shopping center, place of employment) in a short time. However, more and more cities are experiencing the paradox that with the advent of ever faster means of transport, the average speed of urban transport is decreasing and travelling time is increasing. This is the result of congestion due to lack of space. The lack of space is mainly the consequence of the upsurge of the car, which is a means of transport that uses space very inefficiently. Investing in transport that requires less space, such as cycling, walking and public transport, is therefore the only solution to the urban logjam.

Bicycles help reduce travelling time

Whether the bicycle takes somebody to his destination faster than another means of transport mainly depends on local circumstances. The bicycle is more flexible than public transport; it takes you from door to door at your convenience and can easily manoeuvre over different types of roads and between other traffic. Parking your bicycle costs less time than parking your car. Bicycles have to endure fewer delays in traffic jams than cars or buses. For example, during the rush hour the average speed of a car in Bangkok – which is geared to car traffic – is 8 kph, while in Singapore – where bicycles and public transport have more space – the average car speed is 30 kph.[1]

In urban areas in Kenya and Tanzania the average walking speed is 3.5 kph, the bicycle is 10 kph, and the bus and with the car are 15 kph.[2]

The average speed in any city depends on a number of factors, such as the amount of traffic, the number of junctions and the traffic regulatory measures used there, the comfort of the road surface and the degree to which one means of transport is favoured above another. For short distances in city centres, the bicycle is usually faster than the car.

Bicycle is beneficial in use of space and transport capacity

The bicycle is a means of transport that takes up very little space, both when stationary and in motion. Just compare parking a car to parking a bicycle. One parking space for a car needs at least 10 m2 (2m x 5m), whereas around 10 bicycles on stands can fit in the same space.

The capacity of an urban road with two lanes (1 in each direction) is a maximum of around 2000 cars per hour in each direction (usually less). Based on 2 persons per car (average in the Netherlands 1.6), that comes to 4000 persons per hour per lane (3m to 4m wide).

The space occupied by a large bus carrying 50 passengers usually counts for two cars. Theoretically, therefore, a maximum of 1000 buses per hour can travel on one lane. With a maximum capacity 50 persons, that comes to 50,000 persons per hour per lane. This does not take pulling into bus stops into account, when the distances between the vehicles increase. In practice, however, there are examples of 20,000 persons travelling in buses per hour per lane 3.50m to 4m wide – for example, in Curitiba, Brazil.

In the Netherlands, the capacity of a 2.50m-wide one-way cycle path has been calculated at 6,500 cyclists per hour. In practice, examples have been recorded of more than 5000 cyclists per hour on a cycle path 1.80m wide. The capacity of a car lane only comes close to that of a one-way cycle path if there are more than 3 persons in each car, even though the bicycle lane is 50 centimetres narrower. In practice, therefore, the bicycle almost always takes up less space.

Buses with a high maximum capacity are, however, much more efficient with space than cars. Certainly in cities like Delhi, where buses often carry much more than 50 persons, the bus is much more economical with space than the bicycle. The same applies to the underground, which in a number of cities around the world has a capacity of more than 25,000 persons per hour in each direction. This is less relevant for this publication, however, because the bicycle and the underground can scarcely be considered as competitive means of transport.

Good mix of transport

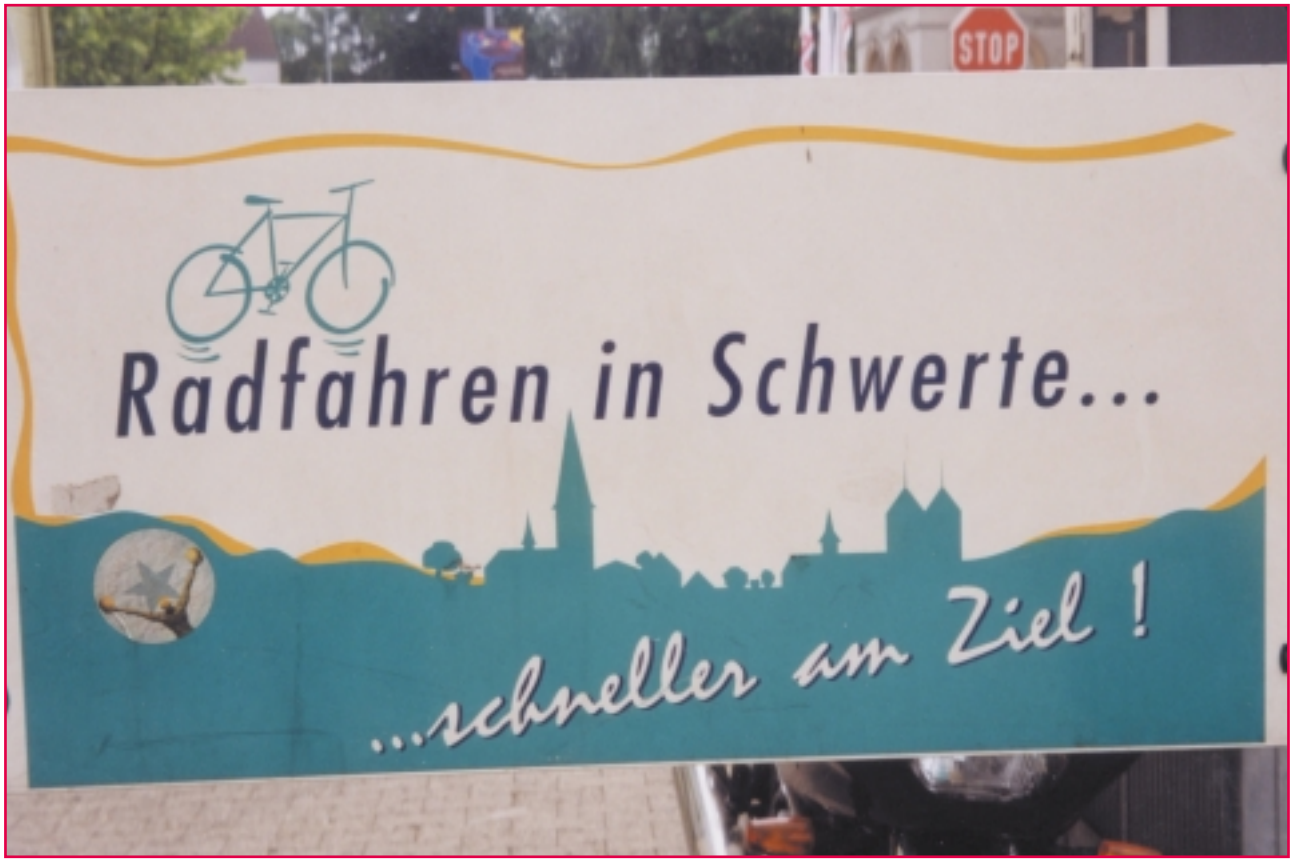
Both poor and wealthy countries need a good transport mix that best serves the economy and the quality of life in the city. In every case, the bicycle requires less space than motor vehicles and is a fast and flexible means of transport. In Delhi, it was analysed how separate paths could be constructed on main roads and then calculated how that would affect the capacity of those roads. This was because the left lane is now mainly used by cyclists, and buses do not use it any more. Instead, they stop in the middle of the road to allow passengers to get on and off. This obstructs the flow of traffic, however, and according to official data, bicycle use is going back fast. The main explanation for this is the lack of infrastructural facilities for cyclists and the traffic risk due to motor vehicles. It was found that cycle paths benefit all means of transport. The traffic capacity on the main road network can be doubled when these roads are provided with separate cycle paths and bus lanes. Good bicycle facilities are therefore very beneficial for the efficiency of all traffic in Delhi.[3]

Congestion costs money

Time costs money. In economic terms, an hour lost by an employee in traffic is calculated as half of the average hourly salary. For Santiago, it was calculated under certain assumptions that congestion makes car use 4 dollar cents more expensive per kilometre, whereas this is somewhat less than 1 dollar cent for cyclists.[4]

Bangkok is a good example of a city where the authorities are trying in vain to solve the traffic problem by expanding the road infrastructure. In this city, walking and cycling have been made almost impossible by traffic jams and air pollution. As a consequence, Bangkok is now missing out on one-third of its economic growth due to congestion. Added to that, the extra fuel consumption due to congestion is costing the city's population US$ 1.5 billion per year.[1]

1. Economic instruments and regulatory measures for the demand management of urban transport. UNCHS, Nairobi 1995
2. Liveable African Cities; a Guideline for Urban Pedestrian and Bicycle Traffic in Africa, M. de Lange, IHE Delft, 1999
3. Safer bicycling and better mobility in Delhi; D. Mohan and G. Tiwari; Transportation Research and Injury Prevention Programme, IIT Delhi. Uitg. Falco Lecture Price, Velo City 1997
4. An analysis of the full costs and impacts of transportation in Santiago de Chile; C. Zegras and T. Litman; IIEC 1997



Conclusions

The convenience and flexibility of the bicycle ensures that for short distances it is often faster than the car and public transport. The distances and the extent to which this applies largely depend on local (traffic) circumstances. The bicycle requires less space than other means of transport, whether it is moving or stationary

On traffic routes, road capacity can benefit enormously from bicycle and public amenities that streamline the various means of transport. Savings in time and use of space both have an important economic value.

4. The urban economy and the quality of life

A bicycle organ

A question that city councils must often look at when considering a specific cycling policy is the extent to which it can impair or actually enhance the city's economy. This question is particularly relevant when choices have to be made between car traffic or public transport and bicycle and pedestrian traffic.

The question is relevant on two levels. Firstly, on the level of the center, either the city center or the center of a district in the city, a shopping and entertainment center or a business center. Secondly, on the level of the whole city, when it involves the image of the city and its effect on attracting business. Cycling policy is known to make an important contribution to the accessibility and quality of life in a city and therefore also contributes significantly to the urban economy,.

Accessibility and quality of life go hand in hand

For most cities, the city center is its calling card. The city center determines the image of the city and generates important earnings. In cities all over the world, increasing car use has made city centres unappealing and difficult to access. In extreme cases, it has led to a mass exodus of shopkeepers, companies and people in the higher income brackets. This has occurred in numerous American cities, but European cities are also faced with the phenomenon. It leads to degeneration and crime as well as damaging the economy of the whole city. Many cities, therefore, have started to reclaim space from the car in the last 10 to 20 years. Pedestrian zones, paid parking, bicycle facilities and improved public transport are the ingredients that can restore a city's heart and bring the city back to life.

A good example of this approach is the Danish capital Copenhagen where, between 1962 and 1996, the number of parking spaces was reduced from 3100 to 2000 and 95,000 m^2 of pedestrian areas were constructed. In addition, provisions for bicycles were improved, the bicycle network was expanded, bicycle parking amenities were constructed, an independent cycle plan was introduced and various campaigns were held to stimulate bicycle use. Public transport was also improved considerably. As a result, street life began to blossom, and markets, music and other social and economic activities appeared. While national car use increased by 80% between 1970 and 1990, car use in Copenhagen actually dropped. With current car ownership at 25% of all households, this figure is clearly lower than the national average. As a result of all these efforts, 28% of journeys in Copenhagen are made by bicycle and 19% on foot.[1]

Underestimation of the cyclist as a consumer

Businesses in city centres overestimate the numbers of customers that travel by car. In the Netherlands, research data was needed to show shopkeepers that their customers are more varied than they thought. Moreover, a dedicated cyclist does not spend any less than a dedicated motorist. Cyclists just have to travel more often to transport all their shopping. In general, therefore, shopkeepers are not dependent for their turnover on the accessibility of their shops by car.

A study of consumers in the city center of Utrecht (the Netherlands) shows that cyclists actually spend more money there than motorists.

Means of transport of consumers to the city center of Utrecht[2]

	Means of transport in %	Average spending in NLG per visit	Total spending in %
on foot	15	40	11
bicycle/moped	26	50	25
car	17	69	22
train	23	51	22
express tram	3	57	3
regional bus	7	58	8
local bus	9	44	8
total	100	52	100

Another remarkable piece of information is the high proportion of public transport (41%), which emphasizes the important regional function of the center of Utrecht.

When shopkeepers are asked what makes their shops attractive, their assessment of accessibility for cars is also less than imagined. In a questionnaire in the Dutch cities of Utrecht and Enschede[3] the most frequently mentioned factors were:

		% respondents
1	Level of rent	88
2	Presence of other shops	80
3/4	Image of the surroundings	76
	Visibility of the shop	76
5	Central location in the region	68
6	Familiarity with place of business	64
7	Accessibility by bicycle/on foot	56
8	Accessibility by public transport	52
9/10	Car parking facilities	48
	Accessibility by car	48

What is remarkable here is that access by bicycle and on foot is considered more important than access by car, while the image of the surroundings (which could also be interpreted as the quality of life) is higher still.

Bicycle parking facility in the city centre of Utrecht

Economic appeal thanks to pedestrians and cyclists

Examples from Dutch cities show how important it is for shopkeepers in city centres to feel that their city is attractive. The city of Utrecht experienced an improvement on balance of city center business after through traffic was excluded from the city center. The consequences for turnover, however, differ for each type of business. In Enschede just 20% of shopkeepers experienced non-access of their shopping area for cars as negative, and the majority was in favour of it. In Tilburg and Leeuwarden, higher parking costs for motorists have not resulted in a drop in turnover. In Groningen, the pedestrian precinct was expanded and cyclists were provided with more direct routes. In the space of three years, the percentage of visitors that remained in the city center for longer than 2 hours increased from 35% to 46%. The number of jobs in the city center rose in 7 years from 17,300 to 18,400. The municipality of Groningen has had talks with shopkeepers about locating shops dependent on motorists at the edge of the city center and building multi-storey car parks there.

Recreational bicycle use can also be an important stimulus for consumer spending. A tourist cycle route on Cape Cod in the United States resulted in 60% of shopkeepers expanding their shops, mainly thanks to the route. More than half have since sold more than 10% of their goods to cyclists and threequarters predicted that the proximity of the route would have a positive effect on their business results in the future.[4]

Customer retention thanks to exclusive bicycle and pedestrian links

The Dutch city of Houten (population 30,000), where pedestrians and cyclists enjoy the most direct routes, demonstrates that giving pedestrians and cyclists precedence over cars ensures good customer retention figures among its own population. Two-thirds of the household budget of its own residents is spent in the city itself, and in the food sector people buy almost everything in their own city. The turnover per m^2 of shopping area in this pro-bicycle city is 2.5 times higher than elsewhere. The proportion of cars in traffic from home to shops is 30% lower than in comparable cities.

Quality of life improves climate for new businesses

It is vital for the economy of a city to attract jobs. Given the increasing globalization and flexibility of companies, it is becoming more and more important for cities to create a good climate for new businesses. Besides things such as affordable office space, a large potential market and a good tax climate, accessibility and the quality of life in a city are now seen as increasingly important. However, not every city realizes that its quality of life is a determining factor for new businesses, even though most companies consider a pleasant location in a city as an important secondary requirement for employees. Employees prefer to live near their work. In addition, it is an advantage when the company is situated in a city that its employees enjoy living in.

British consultancy company William M. Mercer has measured the 'quality of life' of 218 cities according to 39 factors, including environment, safety, health and transport.[5] The Swiss cities of Zurich and Berne top the list. Both cities have very good public transport and a high level of bicycle use. The bicycle cities of Copenhagen and Amsterdam occupy places 6 and 9, respectively. This is not very surprising. Cities where public transport and non-motorised transport are given priority in traffic policy not only have less congestion, they also have a better quality of air and fewer health problems. In addition, because of the emphasis on bicycles, pedestrians and public transport, there are more people (rather than cars) on the street, which improves safety and the feeling of safety.
The Brazilian city of Curitiba is a good illustration of how the quality of life

in a city can affect the choice of a place of business. This city, which profiles itself as 'the ecological city', has developed a very good public transport network using a sophisticated system of free bus lanes. The city has hardly any problems with congestion, certainly in comparison to nearby mega cities like Sao Paulo and Rio de Janeiro. A large area of parks with cycle paths, pedestrian precincts in the center and a social policy complete the image of this city, where the residents are particularly proud of the good quality of life. In the last ten years, when major car manufacturers like Renault, Volkswagen and Audi were looking for a place of business in Brazil, they chose this pleasant city, which has much less traffic congestion, noise and air pollution than most other cities in Brazil. This is all the more remarkable given that the Sao Paulo – Rio region is the engine-room of the Brazilian economy with more than three-quarters of the country's GDP. Its potential market of more than 50 million people and the presence of many other multinationals make this region a more obvious business location. In Curitiba the new companies brought 1.8 billion Real of investments to the region(1 Real is US$ 0.48). There is hardly a better illustration of the economic importance of investing in other means of transport than the car. The fact that it is the public transport in Curitiba that is mainly responsible for the excellent business climate takes nothing away from this example. If Curitiba had improved the quality of life and accessibility of the city by adopting a robust cycling policy, the result would probably have been similar. At this juncture, it is important to emphasize again that a good cycling policy is part of an integral policy. Such a policy must also include regulation and control, curtailment of car traffic, where necessary, and good public transport.

In some cases, residents even leave cities because of increased motorised transport. One example is the Swiss city of Basle, which has around 170,000 residents. Due to the increase in car use in the 1960s and 1970s, the quality of life had deteriorated so much that between 1960 and 1990 30,000 people actually left the city to live in the outskirts.[6] To put a stop to this exodus, a policy was introduced in the 1980s to reduce traffic in the city. The quality of life was enhanced by improving public transport, constructing a bicycle network, creating (car-free) pedestrian precincts and reducing parking spaces for commuters. This put an end to the downward trend and between 1990 and 1995 the population of Basle increased by 3000.

Conclusions

Increasing car use has had a negative effect on the accessibility and appeal of city centres. It has been found that cycling, walking and public transport improve the quality of life of city centres and therefore attract more activities and people, as a result of which consumers spend more. Cyclists are often underestimated as consumers and motorists are often overestimated. Moreover, the bicycle can contribute to a good climate for new businesses and can also attract new employment.

1 Copenhagen Municipality. Traffic and environment plan for Copenhagen, Copenhagen, September 1997

2 Bestedingen fietsers en automobilisten (Spending by cycists and car drivers). Studie verricht ten behoeve van het Ice project Kosten en Baten van Fietsverkeer door B. Verhoek, Grontmij Eindhoven, 2000

3 Detailhandel wijkt niet voor autoluwe binnenstad (Retailers do not budge for a policy to control car use in inner cities) . E.E. van Kesteren, A.I.J.M. van der Hoorn and R.H.Oldenburger, in Verkeerskunde 9, 1995

4 How better Bicycle Facilities can enhance Local Economies. Cara B. Seiderman, City of Cambridge Massachusetts and Robert H. Russell, Conservation Law Foundation, Boston, USA: Falco Lecture Prize winner Velo City 1997

5 'Amsterdam in toptien prettige steden', (Amsterdam in top ten of attractive cities) Volkskrant 13012000

6 Video 'Building Mobility, Controlling Transportation by planning urban spaces. Ministerie van Verkeer en Waterstaat. Rotterdam, Augustus 1995

5. Verbetering van het milieu

Traffic and transport are a major source of environmental pollution around the world. In most urban areas, motor vehicles are the most significant source of air pollution. Because a major part of the increase in traffic involves short journeys, there are excellent opportunities for the bicycle to replace polluting motorised traffic – particularly cars and (mini) buses. Low speeds, driving with a cold engine and frequent acceleration and braking also mean that urban motorised journeys cause more pollution per kilometre than long journeys. This increases the environmental benefits of bicycle use even more. Moreover, the upsurge in car use, particularly in the developing countries, means that air pollution is increasing every year.

Traffic and transport's share in environmental pollution varies from country to country. That is due not only to the differences in modal split and total mobility, but also the local fuel mixture and engine technology. For example, the vehicles on the road in many of the poorer countries are older and cause more pollution than those in the wealthier countries – not only because older vehicles are less economical, but also because fuel is not combusted completely and the older vehicles have not been fitted with catalysers. There are also significant differences in the proportion of vehicles with a diesel engine (particularly high in cities with a lot of bus traffic) and there is a significant difference in lead emission between the OECD countries, where increasingly fewer vehicles use leaded petrol, and countries with an older fleet of vehicles.

The above also shows that it is difficult to specify general indicators for pollution linked to one traveller kilometre by bus, train or car. There are considerable local differences. In addition, various developments in the modal split and vehicle technology will result in changes to the emission figures.

One thing is the same in every case: every kilometre travelled by bicycle or on foot will be a kilometre without environmentally damaging emissions. A cycling policy is not only an inexpensive way of helping to achieve environmental objectives – it can also produce considerable cost savings in health care and in measures to combat the other negative effects of environmental pollution.

Use of fossil fuels and the greenhouse effect

Motorised traffic is a major user of fossil fuels. More than half of the world's oil goes to the transport sector, while oil stocks continue to diminish. Moreover, prices will rise when stocks become scarce. If an economy becomes less dependent on oil thanks to a high level of bicycle use, it will be less vulnerable to higher oil prices.

One of the world's greatest environmental problems is the greenhouse effect, which is mainly caused by CO2 emissions. In most cities, passenger transport is responsible for the majority of traffic-related CO2 emissions. Of all emissions caused by motorised transport, CO2 is the most difficult to reduce because catalysers have no effect. The only solution is to use cleaner engines and travel fewer kilometres. However, car use is continuing to grow worldwide and bigger and bigger cars are being manufactured and sold.

Newman demonstrates how in 32 well-to-do cities in America, Australia, Europe and Asia, the use of fuel in cars is linked to the urban spread of the city. [1] Building compact cities so that they are suitable for journeys on foot, by bicycle and with public transport is therefore a very effective way of keeping energy consumption low.

In the Netherlands, CO2 emissions from cars outside built-up areas (excluding motorways) are 36% less than inside built-up areas.

For buses, the difference is 15%. Moreover, even with the lower than average number of 14 passengers per bus in the Netherlands, CO2 emissions from buses per traveller kilometre are still just half those of car emissions, based on figures of 1.6 persons per car.[2] In cities where buses carry many more passengers, the bus scores even better.

Air pollution

In most cities, motorised passenger transport is responsible for 70% to 90% of all CO emissions and 30% to 50% of NOx emissions.[3] Urban transport also causes smog and other air pollution that is damaging to health. Besides seriously affecting the quality of life in many cities by pollution the air, urban transport is also partly responsible for environmental problems such as acid rain and the greenhouse effect. When a distinction is made between emissions from different means of transport, it is possible to make a more reliable calculation of the environmental benefits when some of this transport is replaced by bicycle use.

The values in the table are per vehicle kilometre. To make a straight comparison, the actual emissions per traveller kilometre should be indicated. This means that a bus with 50 passengers is therefore 5 times more environmentally friendly than a bus with just 10 passengers. Moreover, a full car is more environmentally friendly than a bus that is almost empty.

Emissions in grammes per vehicle kilometre based on European Averages[4]

*Average for all speeds **45 kph. instead of 60 kph.	CO 20 kph.	CO 60 kph.	CH 20 kph.	CH 60 kph.	NOx 20 kph.	NOx 60 kph.	PM10 20 kph.	PM10 60 kph.
Petrol car	17.0	6.0	2.90	1.10	1.80	2.50		
Petrol car with catalyst	2.5	0.7	0.27	0.07	0.42	0.30	0.02*	
Car on diesel	1.0	0.5	0.28	0.10	0.68	0.44	0.30	0.14
Urban bus	8.2	4.4**	0.21	0.10**	18	11**	0.85	0.32**
Moped	1.5*		0.90*		0.05*		?	

The emissions depend on the following factors:

- driving speed: At lower speeds, emissions per kilometre increase for most substances. The CO emissions of a car travelling at 13 kph are more than 3 times higher per kilometre than a car travelling at 44 kph.[5] In congested areas where speeds are even lower, emissions are much higher.

- traffic situation: When accelerating and braking in the city, CO and CH emissions are around 50% higher than when traffic is flowing constantly. The nature of the traffic flow has relatively little effect on NOx emissions.[2] For an average city trip in the Netherlands, de Wolff calculated in 1985 that 21% of the CO and the CH emissions are caused by accelerating and braking and during stops.[6]

- the fleet of vehicles: There are major differences between modern and less modern vehicles, between vehicles with or without catalysers, between small or large cars and between properly or badly maintained vehicles. In some European cities, improved maintenance can reduce CO emissions by 40%, CH emissions by 25% and NOx emissions by a maximum of 10%. In countries with a well-maintained fleet of vehicles, however, the results to be achieved are much lower. In Dutch cities, for example, the figures are closer to a 10% reduction in CO and 5% for CH.

In developing countries, emission reductions can increase considerably when maintenance is improved.

- engine temperature: Driving with a cold engine is one reason why short car journeys are so bad for the environment. Emissions of CO are then approximately 50% higher than when driving with a warm engine. Emissions of CH and NOx from a cold engine are just about 10% higher than from a warm engine.[5]

Numerous other environmental effects are caused by the production of motor vehicles, their maintenance and the processing of waste materials when vehicles are scrapped. In addition, the use of oil products and, for example, heavy metals from tyres cause pollution of the soil and water. A reduction in the number of motorised kilometres also has an indirect effect on these environmental consequences, but they are not covered by this study.

Consequences for health

Numerous emitted substances affect the health of city dwellers. Every journey by bicycle that avoids a motorised journey reduces air pollution and therefore damage to health.

Substances emitted by motorised traffic and the most significant health risks[7,8]

Substance	The harmful effect on health	Proportion of traffic in city centres and other remarks
Carbon monoxide (CO)	- Slows thought and reflexes - Causes drowsiness and headache - Long-term exposure can lead to heart and vascular disease	- Up to 90 to 95 % of the total
Nitrogen oxides (NOx)	- Irritation of lung tissue, which leads to increased susceptibility to viral infections, bronchitis and pneumonia	- Up to 60 to 70% of the total
Hydrocarbons (CxHy)	- Irritation of the eyes, coughing, sneezing and dullness	
Fine dust(PM10)	- Affects the lung function - Premature death as a consequence of respiratory and heart disease - Potentially carcinogenic	- Up to around 50% of the total
Lead (Pb)	- Impairs mental development in children, brain damage. - High blood pressure - Kidney and liver damage	- Up to 100%
Ozone (O3)	- Irritation of the eyes, cough and headache - Reduces the lung function - Can exacerbate chronic heart disease, asthma and bronchitis	- Formed by CxHy and NOx

An extensive study carried out in 1996 in Austria, Switzerland and France[9] resulted in health costs of US$ 27 billion or 1.7% of the GDP of the three countries as a consequence of PM10 emissions by traffic. This comes to US$ 360 per person per year.

Doctor Johannes Spatz estimates that traffic-related air pollution in Berlin causes twice as many deaths as traffic accidents.[10] He calculated that 3% of all deaths from cancer can be attributed to motorised traffic, affecting 250 persons per year. Traffic noise is considered to be responsible for 3% of all deaths from heart attacks – another 100 persons per year. Together, this amounts to more than the 163 traffic deaths in Berlin in 1993.

While the emission of lead by traffic in Western countries is now almost a thing of the past (no new cars using leaded petrol have been sold for years), in non-Western countries this is still a huge problem. An estimate from 1993 indicates that the high concentrations of lead in the air in Bangkok (emitted mainly by motor vehicles) are the cause of 200,000 to 400,000 cases of high blood pressure and around 400 deaths per year.[11] Lead poisoning in Mexico City has a similar effect and has led to an increase of 140,000 in the number of children that requiring special education. The effects on learning capacity and intelligence are permanent.

Although more bicycles can contribute to a reduction in air pollution by motorised traffic, cyclists themselves are also susceptible, of course, to air pollution caused by motorised traffic. Contrary to general opinion, however, cyclists do not inhale a greater quantity of harmful substances than motorists. A study in Amsterdam by the GG&GD[12] shows that concentrations of CO, benzene, toluene and xylene in the air breathed by cyclists are on average 3 times lower than in the air breathed by motorists. However, the air breathed by cyclists does contain 25% more NO2. Because cyclists are exerting themselves, their bodies have to compensate for this, and on the same journey (along the same road) they breathe in considerably more NO2 than motorists. However, when cyclists take other routes with less traffic, it is also quite likely that they breathe in less NO2 than motorists.

Noise nuisance

In most urban areas, traffic is the most important source of noise nuisance. This nuisance causes problems such as insomnia, stress and mental health disorders. In the Netherlands, for example, 25% of the population believes that road traffic is a noise nuisance.[12] In former West Germany the same proportion of the population admits to finding it a serious nuisance while in former East Germany the figure rises to around 40% of the population.[13, 14] Noise levels of 75 to 80, sometimes even 90 dB(A) are not exceptional close to busy roads in cities.

The most important causes of serious noise nuisance by road traffic are high speeds, high intensities and heavy trucks. While a car driving at 20 kph produces less than 65 dB(A), this increases through an average of 70 dB(A) at 50 kph to more than 75 dB(A) at 80 kph. Even at 20 kph, a heavy truck produces more than 75 dB(A), while at 50 kph this is between 80 and 85 dB(A) is.[8, 15] The noise produced by buses is somewhere in between cars and heavy trucks.

Economic assessment of environmental pollution

A lot of studies have been carried out into the costs of environmental pollution. One thing that all of these studies have in common is that they stir up a lot of discussion, but it is actually quite difficult to express environmental pollution in economic values. However, the differences between studies, when they are looking at the same effects, are really not that radical. Various studies carried out in former West Germany arrived at environmental costs for passenger transport of between US$5 and 10 billion per year.[16, 17]

Environmental effects can be measured economically using different methods. One useful method is to determine the sum of the costs of prevention, evasion and damage. Prevention costs are the costs incurred in order to prevent the effect from occurring in the environment, or to prevent part of the environmental pollution. These are measures aimed at the source – for example, the cost of making cars quieter. The costs related to improving public transport and stimulating the bicycle can be seen as preventative costs when they can prevent car journeys. Evasion costs are costs that limit the consequences of the environmental pollution or nullify it completely – for example, positioning baffle boards or making houses soundproof. Because prevention costs and evasion costs are easy to specify, governments, for example, define the sum of both of these costs as ‘environmental costs’ for the sake of convenience. In fact, these environmental costs are used to calculate the costs of environmental policy, or the cost of achieving a particular objective. A major disadvantage of this definition is that the stricter the policy, the higher the environmental costs.

Therefore the damage costs must also be specified in order to determine the effect on the environment. These are the costs resulting from the damage caused by environmental pollution, and are the most difficult to assess economically. It is obvious that the greenhouse effect involves costs issuing from carbon dioxide emissions. However, it is difficult to say how high these costs are. For example, how do you determine the damage costs associated with the emission of 1 ton of carbon dioxide? Or what value do you attach to the insomnia of somebody woken by traffic? However, the costs linked to illness as a consequence of air pollution can indeed be calculated on the basis of hospital bills and income lost by employers and employees. The difficulty here is primarily determining the doseeffect relationship.

Another frequently used method for assessing environmental effects economically is the method of 'Willingness to pay'. What this actually means is that people are asked how high they value clean air or peace and quiet. German bureau Planco[16] used this method to calculate an amount of approximately US$ 0.015 per car kilometre for air pollution in 1990.

This is in the right ratio to the US$ 0.025 that Litman calculated for an average car kilometre.[18] More relevant to this study is the value of US$ 0.033 for a car kilometre in the city outside the rush hour and US$ 0.038 during the rush hour.

A practical example

Various studies have been carried out into the effects of increased bicycle use on environmental pollution. One example is the study in Bern described in Chapter 2.[19] In the three different scenarios, it was found that the agreed environmental objectives (in the period 1989-2005) in the trend scenario (car scenario) will not be achieved. The objectives for CO^2 emissions will only be achieved in the bicycle scenario. The air quality requirements will be more or less achieved in the public transport and bicycle scenarios but will be considerably exceeded in the car scenario. The bicycle scenario also will achieve the best score for noise nuisance. To stabilize the noise nuisance in 2005 to the level of 1989, baffle boards are necessary in all scenarios. However, because the main traffic network can be cut back in the public transport and bicycle scenarios, they require much fewer baffle boards than the trend scenario.
In total, it was calculated that the bicycle scenario saves approximately 40 million Swiss francs per year more than the trend scenario in evasion costs and damage costs related to environmental pollution and noise nuisance. In the public transport scenario, the saving on environmental pollution (by public transport) is 35 million per year. The public transport scenario does, however, require approximately 35 million per year extra investment in public transport compared to the bicycle scenario.

Here, too, the conclusion is that stimulating bicycle use is by far the cheapest way to achieve the specified environmental objectives.

Conclusions

The fact that the bicycle is a clean and silent means of transport is one of the most important arguments for promoting bicycle use, given that traffic and transport's share of global environmental pollution is increasing every year.

In countless cities all over the world, motorised traffic has had such a major effect on the local environment that it is seriously undermining the health and well-being of the urban population. Various European studies show that air pollution caused by motorised traffic leads to more deaths than traffic accidents.

According to research, the repeated contention that cyclists in cities breathe in more pollutant substances than motorists is not true for cities where cyclists have their own bicycle facilities, separate from the main thoroughfares. When cyclists use low-traffic (bicycle) routes, they are exposed to much lesser harmful substances than motorists.

To conclude, it is important to note that when pursuing an environmental policy, investing in the bicycle is very cost effective. For example, much greater investment would be required to achieve the same environmental results by expanding public transport – which is, moreover, not as clean as the bicycle.

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6. Health

Almost 80 years she kept up mobility thanks to the bicycle

Cycling is related to health in different ways. Firstly, cycling is a great way to build up a good physical condition. In this way, cyclists reduce the risk of developing common health problems. However, cyclists are very exposed and vulnerable in the midst of motor vehicles. In a collision with a car, cyclists almost always suffer more serious injuries than motorists. On the other hand, increased bicycle use can have a positive effect on overall traffic safety if it takes the place of car journeys. In traffic, cyclists breathe in the exhaust fumes of motor vehicles – they feel the discomfort and known that it is unhealthy. Nevertheless, the previous chapter showed that motorists actually breathe in more harmful substances than cyclists.

This chapter discusses the preventative effects of cycling and compares them with the traffic safety effects resulting from an increase in bicycle use.

Improved health through more exercise

Cycling a short distance a few days a week – to work, for example – is as good for physical fitness as any sporting activity. The effects on health of a half hour's cycling every day for people who take too little exercise, are: 50% less risk of heart and vascular disease, diabetes and obesity, and 30% less risk of high blood pressure. The greatest preventative benefits can be achieved by cycling for approximately 20 minutes a day (around 6 kilometres). When people cycle even more, the preventative effects do not actually increase proportionately, so it is a question of diminishing returns.

In the developed countries, stress is part of modern life. Many people do not even have time to take part in sporting activities in order to relax. Cycling to work is the most efficient way of compensating for this. Moreover, an employee who lives a distance of 7 kilometres from work will save more than 250 dollar a year in petrol costs if he or she cycles to work every day.[1]

The balance between more exercise and greater vulnerability

It is sometimes claimed that an increase in cycling results in more traffic deaths. That is not always the case, nor is it necessary, as can be seen in Chapter 7. Good bicycle facilities, above all to protect cyclists from fast-moving traffic, can level out the greater risk of injuries through cycling. In the U.K., where the risks for cyclists are relatively high, study was carried out into the possible effects of increased bicycle use on traffic casualties and the prevention of illness. The cost-benefit ratio was found to be 1:20. In other words, preventative health measures save 20 more lives than the lives lost on the road if people cycled more.[2]

In the Netherlands, where road casualties do not increase when people cycle more, there are only health benefits when people who take too little exercise start cycling more. Companies can influence this, as is evident from campaigns organized through the Center for International Cooperation (COS) under the motto: "Cycle to work". An evaluation carried out in three companies found that a third of employees were under the norm for the required amount of physical exercise and a third admitted to being in reasonable to bad physical condition. Of both groups, 6% started cycling more because of the campaign, some of them even in their leisure time. One interesting finding was that 45% of the campaign participants had previously thought that cycling would take up too much of their time. After the campaign, just 4% saw this as a problem.[3]

Economic effects

Major economic effects can be expected in countries where cycling results in a significant improvement in physical fitness. In wealthier countries, many people take too little exercise. Research shows that the Dutch are closer to their correct weight than people in other European countries, and this is sometimes ascribed to the popularity of cycling. However, 60% of adults in the Netherlands still exercise too little.[4] The Dutch business community could save as much as 1.2 billion guilders a year on absenteeism and another 400 million on medical treatment if its employees took enough exercise. A combination of stress and the bad posture causes 60% of complaints, making people unfit for work for a long time or even permanently.[5]

The benefits for the business community are even greater if the following are taken into account:

- Greater feeling of well-being and more immunity to stress in employees
- Better work atmosphere and higher productivity
- Reduced staff turnover
- Improved accessibility of the company
- Fewer parking spaces
- A 'greener' image for the company.[1]

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In Latin America cycling is most popular on sundays: Copacabana, Rio de Janeiro

Conclusions

Cycling for half an hour every day has a significant effect on the prevention of heart and vascular disease, diabetes and high blood pressure. In economically developed countries, the majority of people exercise too little. Cycling is an effective way of getting enough exercise, and at the same time the most efficient way of doing so. The positive effect of cycling on public health is much greater than any negative effect from traffic casualties. The Dutch (business) community could save yearly more than US$ 700 million on absenteeism and medical bills if its employees took enough exercise.

7. Traffic safety

A not unusual traffic chaos in Delhi

Traffic casualties are a major problem worldwide. In 1995, the World Health Organization estimated that approximately 885,000 people die each year in traffic accidents and many more are seriously injured. More recent estimates indicated a million deaths, of which 850,000 occur in developing countries. While the number of deaths per year in the economically developed countries remains roughly the same (and is therefore dropping for each travelled kilometre or vehicle), the number of traffic victims in developing countries is increasing every year. Most of these victims are pedestrians and cyclists, who usually do not have enough money for motorised transport.[1]

The bicycle is in itself a safe means of transport, in the sense that a cyclist will rarely inflict fatal injuries. However, motorised traffic makes cyclists very vulnerable. The danger caused by motor vehicles is one of the main reasons why people choose not to cycle. This results in fewer bicycles in traffic, which in turn increases the risk because motorists are less accustomed to cyclists in traffic. However, if the right measures are taken, cycling can become just as safe as driving a car.

Increased bicycle mobility and bicycle safety go hand in hand

Improving safety for cyclists is an important factor in promoting cycling. The latest strategies for traffic safety ("Working towards sustainably safe traffic" in the Netherlands, and "Zero Vision" in Sweden) are creating the right conditions for this. In short, motorised through-traffic will be separated from non-motorised traffic, or the speed of motorised traffic will be restricted to 30 kph.

The city of Houten in the central Netherlands is very safe. In Houten, there are no direct links for cars between the various residential areas; instead, they are diverted along a ring road. Cities of comparable size (30,000 residents) suffer three times more casualties per capita than Houten.[2]

After a cycling policy was initiated in the Austrian city of Graz in 1984, by 1995 bicycle use had increased by 50%. In the same period, the number of road casualties dropped by 20%. The number dropped even more after a speed limit of 30 kph was introduced in residential areas.[3]

The possibility of increasing safety for cyclists becomes evident when the way cycling and cycling policy have developed is compared to the way the risks have grown. In the Netherlands between 1980 and 1996, the number of bicycle kilometres increased by 25% and the number of cycling fatalities dropped by almost half.[4]

The degree to which cycling policy has a positive effect on the safety of cycling can also be deduced from a comparison of the number of cases of fatal injuries per travelled kilometre by bicycle in a number of European countries. Safety levels are at their highest in countries in which people cycle the most and which have the most amenities. In the Netherlands, the number of cases of fatal injuries per bicycle kilometre is four times lower than in England.[3]

In the Netherlands, it was calculated that replacing bicycle journeys with car journeys would result in an increase in the number of fatalities in the 18 to 45 age group. The elderly are more vulnerable on the bike, but they only become involved in more accidents when they exceed a very high age. Because they become physically more vulnerable, there is a greater chance that their injuries will be fatal.

High costs of road casualties

On average, 2% of GDP is spent around the world on the consequences of road accidents. The European Union considers every investment less than 1 million euros that prevents a traffic death to be economically cost-effective, aside from the suffering that is saved. In the Netherlands, the costs of road casualties amount to more than US$ 5 billion. This includes costs of almost US$ 1.5 billion for risk prevention and informing the public. The costs of absenteeism and material damage make up the greater proportion of the cost of accidents. And then there are the medical costs and the cost of calling in the police and fire services.[5] The total cost of traffic accidents worldwide has been estimated at US$ 500 billion per year.

Cost-benefit comparisons

Cost-benefit calculations of various traffic safety measures using European data show that measures for cyclists and pedestrians result in a more than positive ratio:[6]

- Measures to restrict speed such as those now in use in increasingly more urban areas reduce the average risk of accidents by more than 50%. The ratio between benefits and costs is 9:1
- Separate cycle paths have a positive effect on safety for both motorised vehicles and cyclists and also benefit traffic flow. Here, too, the ratio is 9:1
- A measure that gives cyclists right of way at traffic junctions by means of an advanced stopping line over the full width of the road also improves safety for cyclists and other traffic and has an even more positive ratio of 12:1

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cyclists can be better anticipated and will receive more right-of-way by an advanced stopping line, Basel, Switzerland

Conclusions

New strategies for the prevention of road casualties are good starting points for radically improving safety for bicycle. The increase in bicycle mobility has also been found to bring about greater safety. To a certain extent, it is even a pre-condition for safety improvement.

In the Netherlands, the replacement of car kilometres by the bicycle in cities has already resulted in fewer victims on balance. Good facilities for the bicycle are an essential precondition for this result. In cities without special bicycle facilities, an increase in bicycle use actually results in a net increase in the number of accidents. The costs of road casualties world-wide amount to an average of 2% of GDP.

8. The significance of the bicycle for employment

Mondi Recycling by bike

Bicycle use has a number of consequences for employment. A high level of bicycle ownership and bicycle use gives rise to a substantial business sector engaged in the production, sale and repair of bicycles. Bicycle amenities, including paid parking and bicycle hire, also provide structural employment, as do amenities aimed at recreational use of the bicycle. And lastly, an increase in economic activity and employment is generated as a result of the mobility made possible by the bicycle. This is particularly the case in developing countries. The level of bicycle ownership, the relative position of the bicycle and the country's stage of development will, of course, determine the consequences for employment in each country. In some scenarios that have been created, switching from car use to other modes leads to a considerable increase in jobs. The bicycle sector is a growing market both in terms of the increase in everyday use of the bicycle as well as recreational use. In economically well-developed countries, this also involves a greater variation of bicycle models, while in economically less developed countries it mainly involves an increase in bicycle ownership.

The bicycle as a vehicle

An overview of bicycle ownership in 24 countries (on page 42) shows high levels of bicycle ownership in the wealthier countries, while there are very significant differences between the developing countries. However, bicycle ownership actually says very little about bicycle use. In Europe, for example, bicycle ownership is indeed highest in those countries where people cycle the most, but it is not low in countries where people cycle very little. The latter also applies to countries such as Brazil and the United States, where the bicycle is used mainly for recreational purposes.

When cycling in the Netherlands is analysed historically, it shows that the bicycle has had different economic significance at different times:

1870 - 1900: the bicycle as a luxury item

Only people with a high income can afford a bicycle. A slight price increase causes a sharp drop in demand. The bicycle is not necessary for daily activities.

1900 - 1920: the evolution of the bicycle from luxury item to 'normal item'

With a 'normal item', an increase in the level of income is accompanied by an increase in the demand for that item. These items are usually part of the necessities of life. A price increase usually causes a relatively minor drop in demand.

1920 - 1950: the bicycle as a necessary item

The bicycle plays an important role in everyday life. Price elasticity is low because people need the item.

1950 - 1975: the bicycle as an inferior item

A rise in incomes causes a drop in demand. People buy a car as soon as they can afford one.

1975 – the present: the bicycle as a luxury item, normal item and quasi-collective item

The bicycle is rediscovered by individuals, is used for both utility and recreational purposes and is part of everyday life. The government rediscovers the bicycle as a quasi-collective item, and stimulates its use to reduce the negative external effects of car use – for example, by providing subsidies to reduce the cost price. The most recent measure is reduced VAT on bicycle repairs.[1]

The Dutch bicycle sector

In 1996, the amount spent on new bicycles was approximately 0.5% of all consumer spending in the Netherlands. The country had 2,300 bicycle shops – around 3% of all shops in the Netherlands. Approximately 6300 people are employed in selling and repairing bicycles.

The bicycle shops have a turnover of approximately 1.4% of the total turnover in the retail sector. The gross profit of the bicycle sector is the same as the average for the retail sector. Because personnel costs and other costs are relatively low, the eventual business result is well above the total retail trade's average.

In 1998, the Dutch bicycle sector's turnover amounted to over US$ 1 billion. Consumers spent 80% of that amount on purchasing new bicycles and 20% on parts, accessories and repairs. In recent years, there has been a sharp rise in consumer spending on bicycles, parts and repairs – for example, turnover increased by more than 30%[2] between 1993 and 1998.

The bicycle and bicycle sector in developing countries

In countries still at an early stage of economic development, there are big differences in levels of bicycle ownership. In these countries, it is the people with the lowest incomes who particularly need bicycles, because bicycles can increase their income a great deal. Bicycle use has dropped, however, due to higher costs, motorization and the risks caused to cyclists by motor vehicles. In turn, this has resulted in a drop in the production of bicycles and bicycle parts in various countries. For example, bicycles are still being assembled in South Africa, but all the parts come from Asia. Afribike, an organization that runs projects in South Africa to promote cycling, has developed a franchising package as part of its activities. This is a formula in which cooperation is arranged between bicycle sellers and bicycle makers, a production or assembly company and credit loan experts. This can grow to become the basis of new employment and can eventually stimulate renewed bicycle production.

During a mission to Senegal, Afribike defined the following factors as a barrier to bicycle ownership in that country:

- taxes and levies on the import and use of bicycles
- bad contact with the bicycle manufacturers in China and Taiwan
- the small scale of the import and assembly industry, which leads to relatively high costs
- lack of repair and maintenance facilities in the countryside.

Research in Kenya has shown that the bicycle has high price elasticity – in other words, a price increase will cause a sharp drop in the number of bicycles sold. On the other hand, a price reduction will cause a considerable increase in sales. For example, in Kenya a tax cut – from 80% to 20% – between 1986 and 1989 led to a 1500% increase in bicycle sales.[3]

Less car transport creates employment

In Germany, researchers have calculated the effect of a different means of transport, which is less harmful to the environment, on the number of jobs. In the scenario, which covers the period 1995-2010, the percentage journeys by car drops from 53% to 42%, while the percentage of walking, cycling and public transport increases. The number of bicycle kilometres per person doubles in the scenario, whereas bicycle use would only increase marginally if there were no specific policy. Total mobility is not restricted, but it is organized in a better way. Energy use by all motor vehicles is reduced. While there is a loss of 130,000 jobs, mainly in the car industry, 370,000 new jobs are created, mainly in public transport and the bicycle sector. This produces a credit balance, therefore, of over 200,000 jobs.[4]

Use of the bicycle at work

Besides increasing employment in the bicycle sector, the bicycle can also play an important role in the work sphere and can provide a cheap alternative for the transport of goods.

One example involves the collection of old paper in South Africa. In Midrand, cyclists who use goods bicycles to collect paper for recycling earn three times more than they used to. The cyclists do not compete with their colleagues who collect paper on foot, because they can cover more remote areas. This strengthens the economic base of the factory where the paper is recycled. Greater mobility therefore creates new employment opportunities.[5]

Examples of the bicycle at work in Western countries include bicycle couriers and newspaper rounds – for example, in the Netherlands newspapers are almost always delivered by bicycle. With the advent of the Internet economy, whereby small packages to be ordered through the Internet, the bicycle can play an important role in keeping down transport costs.

Source RAI: the Netherlands

Bicycle ownership and bicycle density in 24 countries in descending order of numbers of bicycles

Country	Ownership (x 1000)	Head of population per 1 bicycle	Country	Ownership (x 1000)	Head of population per 1 bicycle	Country	Ownership (x 1000)	Head of population per 1 bicycle
China	450,000	2.6	France	20,000	2.8	Belgium	5,200	1.9
America	100,000	2.6	Brazil	40,000	3.5	Romania	5,000	4.5
Japan	72,540	1.7	Netherlands	16,000	1.0	Denmark	4,500	1.1
Germany	62,000	1.3	Canada	10,150	2.7	Switzerland	3,800	1.8
India	30,800	24.4	Spain	6,950	5.7	Hungary	3,500	3.1
Indonesia	2,300	66.5	Sweden	6,000	1.4	Austria	3,300	2.3
Italy	23,000	2.5	South Korea	6,500	6.8	Finland	3,250	1.5
England	20,000	2.8	Mexico	6,000	13.2	Norway	3,000	1.4

1 De fiets in micro en macroeconomisch perspectief geplaatst (Cycling in a micro and macro economic context) . Studie verricht ten behoeve van het Ice project Kosten en Baten van Fietsverkeer, J. Fanoy, Goudappel Coffeng, 2000

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4 Hauptgewinn Zukunft ; Neue Arbeitsplatze durch unweltvertraglichen Verkehr, Cames et al., ÖkoInstitut, Freiburg, 1998

5 Making bikes work for South Africa. Paul S. White in Sustainable Transport, winter 1998, ITDP, New York.

Mondi Recycling on foot

Conclusions

In developing countries, it is clear that more bicycle ownership and use creates new employment. Strengthening the bicycle sector can make bicycles available to more people. If bicycle use is increased in economically developed countries at the expense of the car, this could have a negative effect on the total number of jobs. A German study shows, however, that when cycling policy is part of an integral traffic and transport policy in which public transport is also expanded considerably, the total number of jobs can actually increase. This refers specifically to Germany, of course, and the effects elsewhere may be entirely different. However, given the fact that bicycles are technically less complex than cars or buses, in a 'bicycle economy' the opportunities for local less skilled workers are greater than in a 'car economy'.

There are countless ways in which the bicycle can be used as a means of (goods) transport at work, resulting in increased earnings.

9. Travel costs and individual mobility

Lima, Peru

The economic importance of a cycling policy for society as a whole is described in the preceding chapters.

Needless to say, bicycle use also has a number of benefits for individual users. In fact, the chapters on the environment, health and traffic already mentioned the benefits in these areas without actually dealing with them specifically. This chapter describes the economic benefits for individual cyclists when they start using the bicycle.

Cheap and efficient mobility

For each travelled kilometre, travel costs for the bicycle are lower than any other means of transport, with the exception of walking. This means that people in both wealthy and poor countries can reduce their travel budgets considerably by cycling. And cycling is a lot faster than walking. In fact, on short journeys, cycling is often faster than public transport because it avoids transport to and from the railway station/bus stop and waiting times. And in congested areas, the bicycle can even travel faster than the car. The bicycle therefore not only saves on travel costs, but also on travelling time.

Savings on travel costs

In the developing countries, more than 1.3 billion people have to survive on less than 1 dollar a day. For this group, as well as for a large group of less poor people, transport is a very costly item, and a bus ticket is an enormous outlay that is often simply too expensive.

If such people are provided with a cheap means of transport like the bicycle, the reduction in travel costs has a number of positive effects:

- increased disposable income due to lower travel costs
- access to a larger labour market
- larger potential market
- better access to amenities such as health care
- more time for social, economic and recreational activities.[1]

The poorest groups can only purchase a bicycle if they receive direct financial support. In the Tanzanian city of Morogoro, 65% of all journeys are travelled on foot, and the bicycle would be a good alternative on many of those journeys. The fact that a quarter of bicycle journeys are made with a hired bicycle confirms that it is too expensive for many people to buy a bicycle. Yet, although people do not have the money to buy their own bicycle, the total amount they spend in one year on public transport is often higher than the price of a bicycle.

Moving South Africa[2], South Africa's strategic policy plan for transport, puts the proportion of the population without means of transport at 13%, while 19% are dependent on the cheapest form of public transport. For these groups of people, the bicycle can become an affordable and fast alternative to walking, which is slow, and to public transport, which is expensive.

The following overview of seven Asian cities demonstrates that the bicycle (or rickshaw) is the only affordable means of transport for large groups of people.

Purchase price and average annual cost of fuel and maintenance (operational costs) of vehicles in relation to income per capita in 1992 (in US$)[3]

		Bicycle		Rikckshaw		Motorbike		Car		Income
City	Country	Price	Oper.	Price	Oper.	Price	Oper.	Price	Oper.	per head
Phnom Penh	Cambodjia	40	3	60	5	1690	174	25100	600	200
Kanpur	India	53	15	128	85	1200	349	6400	1000	200
Surabaya	Indonesia	138	20	150	30	1480	183	24600	820	610
Manila	Philippines	176	16	255	31	1760	147	31300	1130	740
Chiang Mai	Thailand	178	16	790	32	1520	239	19800	1280	1580
George Town	Malaysia	180	20		42	2000	380	16000	2230	2490
Tokyo	Japan	160	23			1800	400	12000	2600	26920

This cost overview shows some remarkable differences. In most cities, the bicycle is ten times cheaper to buy than a motorbike, and in many cases 100 times cheaper than a car. The ratios for fuel consumption and maintenance are roughly the same. Given that fuel and maintenance costs alone are higher than the average income per head of population, it is obvious many people in the poorest countries cannot afford a car.

In Delhi, 28% of households earn too little income to buy a bicycle. If the same subsidy amounts now being paid to keep down the price of public transport in Delhi were spent on bicycles, every household under the poverty line (50% of all households) could have a free bicycle.[4]

Bicycle users in Western countries can also save considerably on their transport costs. This is certainly the case for people who decide to use the bicycle rather than buy a car, but also even for car owners. A Dutch employee living 7 kilometres from his work can save almost 250 US$ a year on petrol costs if he cycles to work every day.[5]

Shorter travelling time and increased mobility with the bicycle

On a bicycle, you can travel an average of four times further than walking in the same amount of time. Both when walking and cycling, you can cover a greater distance if the road surface is good quality.

Some African examples give an idea of the economic opportunities: In the city of Temeke in Tanzania it was calculated that a market attended mainly by people on foot is accessible to 115,000 people, but it is too far away for some people. Improving the route network for pedestrians would shorten the travelling time and make the market accessible to 190,000 people.[6]

In cities with a lot of congestion, the bicycle is not only faster than walking; it can also be faster than travelling by car or bus, particularly on short journeys. As described in Chapter 3, the average speed of car traffic during the rush hour is often no greater than 10 kilometres per hour. The average speed of a bus over a whole day is often lower than that of the bicycle anyway – for example, in Bogota this is just 9 kilometres per hour. Therefore, cyclists can save not only money, they can also save time.

Better facilities also increase the potential of the bicycle for transporting goods. A bicycle can transport up to 200 kilos of goods on a hard, flat road surface. This is less on an unpaved road surface.

In one of its reports, the World Bank describes a situation in Ghana.[7] In villages just outside the capital city of Accra, women sell oranges they have cultivated themselves at very low prices, because demand is limited in their immediate environment. They walk to markets in the village, carrying the oranges on their heads. Around 15 kilometres further away in the city of Accra, the supply of oranges is low and the prices are high. A distance like this can easily be covered by bicycle. If these women had bicycles, they could increase their income considerably. Furthermore, they would then have more time and energy to cultivate their land and then increase their production. The bicycle would increase both their sphere of activity and their transport capacity. A bicycle can transport approximately 50 kilos of goods at a speed of 8 to 10 kph. Walking, it is possible to transport around 25 kilos at a speed of 3 to 4 kph. The transport capacity of the bicycle is therefore around 5 times greater than on foot, apart from the energy saved.

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Scholars in Rustenburg, South Afrika, on the bikes they just got by an Afribike project

Conclusions

The bicycle is cheaper than all other means of transport. Particularly in developing countries, bicycle use has significant effects on the level of prosperity. Moreover, it considerably increases access to the labour market and the accessibility of markets, when people's only alternative is to walk. Amenities also become more accessible.

Summary

Particularly on short journeys, the bicycle is a good alternative to walking, the car or public transport. For long journeys, the bicycle is an important alternative to the car when travelling to the departure point for public transport.

A bicycle culture is stimulated by gearing facilities to the needs of cyclists, by involving cyclists in planning and policy development and by accompanying measures with information and education. When calculating the costs and benefits of cycling, it is assumed that high-quality bicycle facilities will be implemented. An increase in bicycle use largely depends on the quality of facilities.

Politically, investments in traffic facilities should be weighed up in the context of mobility, accessibility, quality of life and health. It is now possible to corroborate this economically.

The construction and maintenance of the bicycle infrastructure is somewhat cheaper than for the car infrastructure because a cycle path can process more traffic per metre width. It is only when bicycle use increases substantially that investments in new amenities for motor vehicles become redundant and substantial savings become evident. Bicycle parking facilities cost approximately 20 times less than car parking facilities. When bicycle facilities are good enough to enable investment in public transport to be reduced, savings can also increase significantly.
On short journeys, the bicycle can travel faster than the car and public transport, but that greatly depends on the local (traffic) situation. The bicycle also uses less space, particularly when bicycle parking is compared to car parking. On main thoroughfares, road capacity can benefit enormously from bicycle and public amenities that streamline the different means of transport.
Savings in time and use of space both have an important economic value.

The economies of city centres benefit when car use is replaced by bicycle use. City centres become more appealing and attract more activities and more people. This in turn leads to more spending. The cyclist is often underestimated as a consumer and the motorist is often overestimated. The bicycle can contribute to the quality of life of a city and thus stimulate more companies and individuals to move there.

Motorised transport uses more than half of all fossil fuels. In cities, it is responsible for over half of all CO2 emissions, 70% to 90% of all CO emissions and 30% to 50% of NOx emissions. For some Western European countries, the resulting health costs have been calculated at

almost 2% of GDP. Every time the bicycle replaces a journey made by motorised traffic, it causes a proportional reduction in energy consumption and air pollution. In cities, the benefits are even greater, because consumption and emissions per kilometre are much higher there, due to lower speeds, and the mixture of cars at a standstill, accelerating and braking. In addition, a significant proportion of the urban population considers the noise produced by motor vehicles to be an unacceptably harmful nuisance. Investment in the bicycle is a very cost-effective way of combating environmental pollution caused by motorised traffic.

Cycling for half an hour every day has a major effect on the prevention of a number of illnesses. In economically developed countries, most people exercise too little. Bicycle use is an effective way – and at the same time the most efficient way – of taking sufficient exercise. The positive effect of cycling on public health is much greater than the negative effect of road casualties. The Dutch business community could save more than US$700 million on absenteeism and medical treatment if employees took sufficient exercise.

An increase in bicycle mobility and bicycle safety go hand in hand. In Dutch cities, the substitution of bicycle kilometres for car kilometres results on balance in fewer traffic casualties. Good facilities for the bicycle are a precondition for this. In cities without special bicycle facilities, an increase in bicycle use actually results in a net increase in the number of accidents. The cost of road casualties worldwide amounts to an average of 2% of GDP.

In developing countries, bicycle use largely depends on the purchase price of bicycles and the presence of a local bicycle industry and repair facilities, which in turn provides an extra source of employment. Consolidation of the bicycle sector makes cycling accessible to more people. In economically developed countries, more cycling, together with more walking and public transport, can have a positive overall result for employment, as one study in Germany shows.

For individual users, the bicycle can significantly contribute to an increase in mobility and a reduction in travel costs. As a substitute to walking, the bicycle is much more efficient, both for transporting people and goods. As a substitute for public transport, the bicycle is much cheaper. In developing countries, this results in a significant improvement in the standard of living, not only because of lower transport costs, but also because of greater access to the labour market and to markets, as well as improved access to amenities such as health care. These advantages alone produce a very favourable cost-benefit ratio.

Colophon

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Contributions and advice:
- Saskia Hermans
- Rogier Marchand
- Berco Verhoek (Grontmij, Eindhoven)
- Jeroen Fanoy, Nicole Korsten and Tonhny Bosch (Goudappel Coffeng, Deventer)
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This publication has been compiled by:
- Jeroen Buis and Roelof Wittink (on behalf of Ice)

Information:
i-ce@cycling.nl

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