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Feasibility of Non-Motorized Transport Facilities in Addis Ababa City of Ethiopia: An Economic Analysis

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Abstract:

World Bank in recent years underlined the importance of promotion of Non-Motorized Transport (NMT) facilities in Sub-Saharan Africa. UN-Habitat is supporting the development of a sustainable, low carbon transport system in capital cities of many east African nations. According to Central Statistical Agency, Ethiopia (2010), Addis Ababa, the capital city is accounted for 32.3% of urban population of the country. In Addis Ababa, walking accounted for 60.5%. Thus, creation of a sustainable transport system for perspective economic growth requires a balanced approach towards creation of transport facilities with sufficient emphasis on non-motorised transport. To realize this, an economic analysis of providing non-motorized transport facilities in Addis Ababa has been carried out. The proposed NMT facilities are grouped into footpaths, cycle tracks and traffic calming measures. An economic analysis using benefit-cost technique is adopted as method of economic analysis. The costs of the proposed facilities were derived through engineering cost estimate. Creation of dedicated NMT infrastructure ensures benefit to NMT users. There are both short and long term benefits of provision of appropriate infrastructure. The quantification of long term benefits is more complex. Thus, we have confined to the short term benefits, accruing over a 5 year period. The quantum of benefits has been estimated in term of saving in productivity loss and time saving. The

construction is estimated for completion in one year. From 2nd year onwards benefits start accruing. The benefits and costs have been discounted at a rate of 12% to derive the NPV in the first year. For the conversion of financial costs into economic costs a factor of 0.85 has been adopted. The Benefit Cost (B/C) Ratio for provision of traffic calming measures is estimated to be 36.51, cycle tracks to be 4.52, footpaths to be 3.39. The overall B/C ratio has been estimated as 4.07. Overall the proposed investment programmes are economically viable.

Key words: Benefit-Cost Ratio, NPV, economic viability, non-motorized transport, traffic calming measures, footpaths, cycle tracks

1.0 Introduction:

The statistics of *Ethiopian Roads Authority* (ERA) revealed that there is on average a loss of 1700 lives in road accident and 7000 reported injuries in each year in Ethiopia. The actual casualty figure is double as these numbers speak only about those that are reported to the police. There is every probability of errors in data authenticity as the road accident data in Ethiopia are under reported. Among the measure causes, driver's error accounted for 81% of road accidents, 3% due to road factors. The data of *Urban Transport Study* (2005) revealed that in Addis walking accounted for 60.5% of all trips on average, ranging from 78.4% in the Keterna sub-city to 39.7% in the Bole sub-city. 42 % of all injuries in road accidents in Ethiopia happen in Addis Ababa and over 90% of these injuries involve pedestrians. Although road factor seems to be low as cause of road accidents in Ethiopia but for a city like Addis Ababa lack of appropriate road infrastructure is a measure cause of pedestrian accidents. The fatality and injuries in road accident hampers the productivity of person mostly males in prime age of their life. Female accounted one-fourth of killed and seriously injured (KSI) but suffers indirectly when accidents happens to their family members such as husband, son or father. WHO use fatality risk as major causes of death is

calculated as the number of deaths per 100,000 populations per annum. The report of the *National Road Safety Coordination Office* (NRSCO), Ethiopia records the high accident's fatality risk record of 136 deaths per 10,000 motor vehicles globally. There occurs an economy loss of 350-400 million birr per annum to the country exchequer due to road accidents (*Transport Research Laboratory*, 2001). Thus creation of adequate road infrastructures is desirable to reduce the numbers of fatality and injuries in road accidents. In Ethiopia road accidents causes a 0.8% loss to GNP although it is difficult to make a precise estimate of the cost of road accidents in Africa (*Ethiopian Roads Authority*). Realizing the large size of the city residents as pedestrian the Transport Policy for Addis Ababa (*Ministry of Transport*, *Federal Democratic Republic of Ethiopia-FDRE*), has given adequate attention to non-motorized transport in the preparation of the master plan and road plan of the city and its implementation. One of the components includes promotion of Non-Motorized Transport (NMT) modes to enable mobility of the people in the city. Thus, realising the importance of non-motorised transport for Addis Ababa, we have attempted to carry out an economic analysis of the feasibility of the provisions of non-motorised transport facilities.

Appreciation of the traffic and travel characteristics of the study town is important to plan for the transport facilities in general and NMT facilities in particular. Addis Ababa is one of the fastest growing capital cities in Africa. Its population, presently 3.56 million (2014), is envisaged to be nearly 5.5 million by 2020 (*UN –Habitat, Overview of GEF-Sustainable Transport Project*). Addis Ababa has a good road network of sound form and reasonable capacity. However, the high speed and high volume traffic is a major cause of congestion and road accidents. The availability of road capacity in Addis Ababa is reasonable but not sufficient. The city road length has increased approximately by 28%from 2,200 km to 2,814 km

during 2004 to 2008. Out of this road 45.5% (1,280 km) were asphalt roads and 54.5% (1,534 km) were gravels roads. In 2008, pedestrian walkways cover 12.76% (359 km) and drainage facilities in 47.57% (1,339 km) (*Addis Ababa Road Authority, 2010*). In Addis Ababa, walking dominates the modal split for daily trips. However, the provision for NMT is abysmally poor as there are no footpaths in 60% of city road networks (*Transport Research Laboratory Report, 2012*). There is no pedestrian priority as there are unsafe crossing points along the major urban highways and arterial road. Walking up to bus stop along the bus priority corridor is unsafe. The poor provision of NMT facilities is resulting increase accident at 12% per annum. The carriageway is generally of 2-lanes. Road reserves are good. The availability of footpath is negligible. Wherever footpaths are available the condition is not good. There is no exclusive cycle track. There are obstructions by parked vehicles and vendors. The objective of the local development plan of the city is to create a cost-effective movement systems and accessibility by increasing the cohesiveness between people, places and work. However, the provision for cyclist in the city is very poor. There exist no provision of cycle lane and cycle parking. The topography of the city do not encourage cycling in certain area in between its lowest point located at 7,631 feet above the sea level and area located over 9,800 feet. However, there remains cycling potential in east and south of the city centre. The figure provided by Urban Transport Study (UTS, 2005) observed that the pedestrian flows are very high at intersections with observed flows in between 23,000 to 79,000 in a 16 hours pedestrian volume count. High flows along the main roads were observed along with cross flows. The average trip per day per person is 1.08, while walk trip length is 1.5 km (UTS, 2005). Further, walk as only mode of transport was observed with 94.5%of 'walk trips' in the Akaki Kaliti district and 69.2% in Araba district. The traffic volumes on roads are high. Traffic

Management along the road network is poor. Most of the road lengths do not have signage. 63% of the road network studied in UTS, 2005 did not have footways. The footways along the main roads were operating at D, E, F level denoting A for best and F for poorest performance defined in *Addis Ababa City Road Administration* (AACRA) geometric design manual. 67% of pedestrian collision with traffic happened as they walk on the carriageway because of poor level of services along the main roads. NMT users were mostly males (60%); young (40% in age group 26-35 years); large number of students (15%); NMT trip lengths were short (less than 2 km); walk trips 40 minutes. NMT users considered pedestrian environment as 'bad'. Walk is resorted for want of public transport. Absence of footpaths and cycle tracks were considered as major problems. 'Continuity' of the facility was given top priority in the preference. A-grade crossing was preferred. The mobility of the people is low with a *per capita trip rate* (PCTR) of 1.08. Walk trips were very high (69.5%); 'Work' and Business' trips accounted for 75%; Average trip length of all trips was high (2.14 km). Average length of walks trips was 1.49 km. The average per capita income was observed to be ETB 6858 per month. The expenditure on 'Transport' was high (20%).

2.0 Literature Survey:

Addis Ababa with an area of 540 square kilometres is a fast growing African city. More than 70% of the registered vehicles in Ethiopia are found in this city. Realising the importance of transport sector, government is investing huge resources to build the road network. The *2002-2010 Master Plan of Addis Ababa* indicated the unattractive locations of passenger terminal and poor traffic management system. The city transport system face with a number of challenges with reference to NMT. These are lack of sufficient traffic signal, absence of bicycle lanes, lacks of adequate parking facilities,

poorly designed road junctions, separate bike-ways and etc. The inadequacy in enforcement of traffic legislation is one of the important reasons for pedestrian accident. The transport policy of Ethiopia underlines the need of non-motorised transport as a general policy objective for improvement of the urban transport mobility in Ethiopia (*Transport Policy of Addis Ababa*, August 2011). The report of the Sectoral Road Safety Study (*TRL & Ross Silcock, 2001*) indicated that in 1997-98 of the total road accidents, 42% (2297) of the road accidents in Ethiopia occurred in Addis Ababa. Out of these 22% were fatal and 28% were serious injuries accidents. there were all total A brief overview of the best practices in NMT policy, planning, design, finance and development approaches followed in several developed and developing countries. A holistic combination of all the above aspects is necessary for successful implementation of NMT programme. Some of the successful examples in NMT Policy and Planning measures have been described and include NMT network planning in Bogota-Columbia (Cervero et.al. 2009); *Dublin Public Bicycle Sharing Schemes* (Ghosh et.al. 2011), *National Bicycle Initiative in South Africa* (Gwala, 2007); *Legislation of National Bicycle Law in Japan* (ECMT, 2004); Integration of NMT planning in the overall Urban framework as successfully done in Netherlands (Fietsberaad, 2008), various successful promotional strategies as *Car Free Days in Bogota* (Cervero et.al. 2009) etc.

Some of the globally accepted design concepts in NMT facilities have also been described and suitably incorporated in the recommended designs. Once the NMT policy and plans are streamlined there is a need for a well-coordinated institutional and financing arrangement for successful implementation. Some of the institutional frameworks that have been successful in the areas of Urban Transport and NMT i.e. formation of Boards, Groups with representations from Ministry & Provincial Governments for implementing Bicycle Network Plan in Netherlands (Fietsberaad, 2008); legislation of cycling

laws as in Germany, Japan, Bogota (GTZ I-CE, 2009); formation of Unified Metropolitan Transport Authority (UMTA) (Gupta, 2013) in all cities with at least a million inhabitants as recommended in the Urban Transport Policy in India. Experiences world over show the major source of finance for NMT investment is indeed the central government which funds directly to NMT programmes or decentralizes budgets to municipal level. However, various other innovative financing mechanisms used in NMT funding (National Funds, PPP, Community funding, Levies & Charges) have also been described.

To carry out a successful NMT programme in Addis Ababa city of Ethiopia; require review of a number of policy/statues/acts, that impact the course of *Urban/Transport/NMT Planning and Development* (Pendakur, 2005) . The important documents reviewed in this regards are the *Transport Policy of Addis Ababa* (August, 2011), *Mid-Term Review of Road Sector Development Programme* (RSDP) II (Ethiopian Road Transport Authority, April 2005), *Provision for Non-Motorised Transport in Addis Ababa and Recommendation for Improvements* (Transport Research Laboratory, 2012), Addis Ababa City Government, *Urban Development Indicators* (Finance and Economic Development Bureau, 2008), *Urban Transport Study for Addis Ababa* (2005) and a host of other documents. Urban Transport and NMT in Ethiopia still continue to be affected by a number scattered and uncoordinated legislation and need reforms and restructuring to establish a sound policy and legal framework with clearly established roles and responsibilities at all levels of governance. The engineering interventions in Addis Ababa includes provision of footpaths and cycle tracks (along important roads; intense traffic calming measures; improvement of junctions; provision of bicycle stands; etc. Design of the engineering interventions identified need to be cost effective, user friendly and low in maintenance cost apart from other features. The

designs conform to international standards. For footpath, parking areas, bus bays etc., precast concrete blocks of 50-100 mm thick laid over 50-100 mm thick compacted granular base course is adopted. For the foot over bridge steel truss is selected. Modular design is adopted. Design of NMT facilities/infrastructure has been carried out. The pavement structure can be either of rigid type or flexible type. For catering the needs of non-motorized vehicles, the use of asphalt pavement (i.e. flexible pavement) has been preferred on the basis of *Transport Road Research Laboratory (TRRL) Road Note 29*, UK.

The Cost for NMT Project in the Addis Ababa was derived based on engineer's estimate, which in turn, were derived from the engineering drawings. The unit rates were established based on available resources such as prevalent market rates, data from recently awarded projects, quotations from vendors, etc.

3.0 Objective:

The objective of economic evaluation is to assess the viability of the proposed project in term of the benefits likely to accrue to the users. This will help decision makers to justify the cost of implementation of non-motorized transport interventions.

The predominant cost is the cost of construction, together with maintenance and operation costs. All costs and benefits are valued in monetary terms. The costs are expressed in economic prices to reflect the true resource cost to the economy. The economic feasibility of a project is established when the benefits are more than the cost.

Benefits to NMT users accrue when dedicated infrastructure is created for NMT. Provision of appropriate infrastructure for NMT has both short term and long term benefits. The most significant benefits in the short term are the reduction in fatal / serious injury accidents and time savings to

pedestrians and cyclists due to improvement in walking and cycle speeds.

The long term benefits are more complex and related to behavioural changes. These include increase in use of NMT, with persons shifting from motorized to non – motorized modes of transport, fuel savings and reduced emissions. The present analysis is confined to the short term benefits, accruing over a period of 5 years.

4.0 Approach

The NMT project aims at reducing the risks to pedestrians and cyclists by improving the quality of infrastructure for them. NMT interventions for Addis Ababa comprise:

- Traffic Calming Measures such as improvement of junctions, provision of speed tables / humps, entry/exit gates at the city limits;
- New NMT Facilities viz. footpaths, cycle tracks, bi-cycle stands and
- Other Facilities like pedestrian railing.

Economic analysis has been carried out for the four major NMT components for which quantification of benefits was possible, viz.

- Traffic Calming Measures,
- Footpaths, and
- Cycle tracks

Other components of NMT interventions have not been considered for economic analysis because of the complexity involved with quantification of benefits.

The approach for estimating the benefits of each is discussed below.

4.1.1 Component 1 : Traffic Calming Measures

Traffic Calming measures will reduce the speed of motorized traffic from 50/60 kmph to 20 kmph. While this in itself may not reduce the number of accidents, it will result in lesser force of impact and thereby reduce fatal (killed) as well as serious injury accidents (KSI). Studies worldwide, including Sub-Saharan African Transport Project in Africa (SSATP)[1], show that Traffic Calming Measures generally result in reducing KSI by 15% to 30%.

The monetary value or cost of a fatal accident is defined as the loss in productivity of the person killed. This has been calculated based on the average age of the victim, his per capita earnings, growing at 5% per annum over a total working life of 20 years. In the absence of any other data, the cost of a serious injury has been assumed as 20% of the cost of a fatal accident. Thus, the major benefit of Traffic Calming Measures is the reduction in KSI and the resultant saving in loss of productivity.

It is envisaged that total accidents will not increase with growth in population in the future. The dis-benefits to the motorists, in terms of reduction in motorized speed, have not been taken into consideration.

Normally Traffic Calming measures would reduce KSI of all categories. However, since in this analysis, footpaths (which would reduce KSI of pedestrians) and cycle tracks (which would reduce KSI of cyclists) are being analysed separately, we have taken the impact of TCM to be primarily on KSI of categories other than pedestrians and cyclists.

4.1.2 Component 2 : Footpaths

Footpaths proposed are segregated facilities. This facility will have two major benefits for pedestrians. The first is reduction

[1] Traffic calming measures has reduced the speed to 15% in Tanzania according to the report *Assessment of NMT Programme in Kenya and Tanzania*, SSATP, World Bank and Economic Commission for Africa, page no. 28. This is further confirmed by Safety Effects of Traffic Calming, UK

in KSI of pedestrians because of segregation from general traffic, and the second is improvement in walking speed because of better surface resulting in time savings. Benefits due to saving in KSI would be the same as that discussed in *Component 1*.

Time saving benefits has been estimated using average trip length for walk, walking speed –with and without improvement; per capita walk trip rate, trip purpose distribution and percentage of population being benefitted by improvement of footpaths.

The Value of Time (VOT) has been estimated for the population greater than 5 years of age, based on the average earnings per person in Ethiopia. The unit VOT for work is taken as the average earning per hour. The unit VOT of commuting trips (i.e. from home to work and back/home to school and back /other social and recreational purposes) has been taken as 30% of VOT of work/ business trips.

4.1.3 Component 3 : Cycle Tracks

Since bi-cycle tracks provided are also segregated facilities, these will have similar benefits viz. reduction in KSI of pedal cyclists and improvement in speed because of better surface resulting in time savings. Benefits due to saving in KSI have been discussed in *Component 1*. Time saving benefits has been discussed in *Component 2*.

5.0 Costs of NMT Interventions

The capital costs of NMT interventions have been ascertained on the basis of the engineering estimates. The operation and maintenance (O & M) cost is taken from the second year of operation @ 2% of capital cost. A standard conversion factor of 0.85 has been used to derive the economic cost of capital investment.

The financial and economic costs of different NMT interventions for Addis Ababa are presented in **Table 1.**

Table 1: Estimated Cost of Various NMT Interventions

Sl. No.	*NMT Interventions*	*Quantity No./ Length*	*Capital Cost in Million ETB (Financial)*	*Preliminary, General Supervision, Contingencies Cost in Million ETB*	*Total Cost in Million ETB (Financial)*	*Total Cost in Million ETB (Economic)*
A. Traffic Calming Measures (TCM)						
1	Improvement of Junctions	20 Nos.	3.85	0.87	4.72	4.01
2	Speed Tables / Humps	150 Nos.				
3	Entry / Exit Gates	2 Nos.	3.34	0.75	4.09	3.48
Sub –Total (A)			***7.19***	***1.62***	***8.81***	***7.49***
B. New NMT Facilities						
1	Pedestrian Walkway (Footpath)	359 Km.	361.43	81.51	442.94	376.50
2	Cycle Track	56.3 Km.	22.88	5.16	28.04	23.83
3	Cycle Parking	10 No.	4.23	0.95	5.18	4.40
Sub –Total (B)			***388.54***	***87.62***	***476.16***	***404.74***
C. Other Facilities						
1	Pedestrian Railing	10.0 Km.	27.9	6.28	34.18	29.05
Sub –Total (C)			***27.9***	***6.28***	***34.18***	***29.05***
Total Cost = Sub Total (A)+(B)+(C)					***519.15***	***441.28***

Source: Engineering Cost Estimate Calculation are based on December 2014 Price.

6.0 Cost Benefit Analysis

In this approach, the total cost of NMT interventions is compared with the monetary value of total benefits. Since the benefits are likely to accrue in the short term, the analysis has been done for a five years period. The Benefit - Cost Ratio (BCR) has been calculated by discounting the cost and benefit streams @ 12% rate of interest.

6.1.1 Component 1: Traffic Calming Measures

Costs: The economic cost for provision of different Traffic Calming Measures is presented in **Table 1**. The investment would be incurred in 2015. O&M would be incurred from the second year of operation, i.e. 2017.

Benefits: As mentioned earlier, the benefits of traffic calming measures will accrue primarily due to saving in productivity loss of KSI accidents of categories other than pedestrians and cyclists.

KSI Reduction: The reduction in the number of KSI accidents has been estimated based on the following data/assumptions/parameters:

- No of persons (excl. pedestrians and cyclists) killed in Addis Ababa = 85 per year[2]
- No of persons (excl. pedestrians and cyclists) seriously injured in Addis Ababa= 146 per year[3]
- Reduction in KSI Accidents due to TCM = 20%[4]
    - Reduction in killed = 20% of 85 = 17 per year
    - Reduction in Seriously Injured = 20% of 146 = 29 per year

The cost of a fatal accident or saving in future earnings of a person killed is estimated as below:

- Per capita earning of a person in Ethiopia = 6,858 ETB per month[5]
    - Average work life = 20 years

[2] Total number of accidents is 2297 in 2004-05 and 12.32 % are fatal accidents and 30% accidents are excluded as it involve pedestrians and cyclists.

[3] Total number of accidents is 2297 in 2004-05 and 21.20 % are seriously injured accidents and 30% accidents are excluded as it involve pedestrians and cyclists.

[4] Studies worldwide including Sub-Saharan African Transport Project in Africa (SSATP) show that provision of traffic calming measures generally result in reducing KSI by 15% to 30%. Here we have assumed that provision of traffic calming measures will reduce KSI by 20%.

[5] Addis Ababa Finance and Economic Development Bureau, 2008.

- Growth in earnings per year @ 5%
- Based on the above assumptions, future earnings saved due to saving of a fatal accident is estimated as 2,939,466 per person[6]
- Cost of a Serious Injury = 25% of cost of fatal accident i.e. 734,866 ETB
- Saving in productivity loss due to reduction in killed accidents =4,99,12,130 ETB[7]
- Saving in productivity loss due to reduction in serious accidents =2,14,72,798 ETB

The cost and benefit streams of Traffic Calming Measures for a 5- year period (2015-2020) is presented in **Table 2.**

Table 2: BCR of Component 1- Traffic Calming Measures

Year	*Economic Cost (in ETB)*			*Benefits (in ETB)*		
	Capital Cost	*O & M Cost*	*Total Cost*	*Saving in Productivity Loss – Fatal*	*Saving in Productivity Loss - Seriously Injured*	*Total Benefits*
2015(Y_0)	74,88,500		74,88,500			
2016(Y1)	-		-	4,99,12,130	2,14,72,798	7,13,84,927
2017(Y_2)		1,49,770	1,49,770	4,99,12,130	2,14,72,798	7,13,84,927
2018(Y_3)		1,49,770	1,49,770	4,99,12,130	2,14,72,798	7,13,84,927
2018(Y_4)		1,49,770	1,49,770	4,99,12,130	2,14,72,798	7,13,84,927
2020(Y_5)		1,49,770	1,49,770	4,99,12,130	2,14,72,798	7,13,84,927
NPV@12% in 2015			***70,48,807***			***25,73,26,688***
BCR in 2015-2020			***36.51***			
BCR in 2015-2016			***9.53***			

The BCR of Traffic calming measures in the first five years of operation is 36.51, and in the first year of operation are 9.53. Thus the provision of traffic calming measures is economically viable right from the first year of operation.

[6] Saving in future earnings due to fatal accidents =6858*12*(((1+0.05)^21)-1)/((1+0.05)-1) =2,939,466 ETB, (Formula: S = earnings per month (salary)*12*[(1+r)^ (n+1)-1/(1+r)-1], where S= saving in future earnings, r=rate of growth of earnings per annum and n= work life).

[7] Decimal values have been taken into consideration.

6.1.2 Component 2: Footpaths

Costs: The economic costs of construction and rehabilitation of footpaths is presented in **Table 1**. The investment would be incurred in 2015. O&M would be incurred from the second year of operation, i.e. 2017.

Benefits: Segregated footpaths will provide safety, speed and comfort to pedestrians during walk trips. These are expected to reduce pedestrian KSI, as well as bring about time savings. Benefits like comfort are difficult to quantify and hence not included in the analysis.

Pedestrian KSI Reduction: The reduction in the number of pedestrian KSI has been estimated based on the following data/assumptions/parameters:

- No of pedestrians killed in Addis Ababa= 195 per year[8]
- No of pedestrians seriously injured in accidents in Addis Ababa= 336 per year[9]
- Length of footpaths (359 km) provided in Addis Ababa comprise about 12.8% of city footpaths
- Reduction in pedestrian KSI Accidents due to footpaths = 25%[10]
- Hence, reduction in pedestrians killed = 25% of 12.8% i.e. 3% of total pedestrians killed
    - Reduction in killed accidents= 3% of 195 = 6 per year
    - Reduction in seriously injured accidents= 3% of 336 = 11 per year

[8] Total number of accidents is 2297 in 2004-05 and 69 % pedestrians suffered from injuries and 12.32% are fatal accident.
[9] Total number of accidents is 2297 in 2004-05 and 69 % pedestrians suffered from injuries and 21.20% are fatal accident.
[10] Studies worldwide including Sub-Saharan African Transport Project in Africa (SSATP) show that provision of footpaths generally results in reducing KSI by 20% to 35%. Here we have assumed that provision of footpaths will reduce KSI of pedestrians by 25%.

The costs of a fatal and seriously injured accident, described in *Component 1*, are ETB 29, 39,466 and ETB 7, 34,866 respectively. Hence, the total benefits due to reduction in pedestrian KSI worked out to ETB 2, 62, 69,653 per annum.[11]

Pedestrian Time Savings: Pedestrian time savings have been estimated based on the following:

- Average walk trip length of pedestrian in Addis Ababa town = 1.49 Km[12]
- Average walking speed[13]
    - Without project = 2.25 kmph
    - With segregated footpaths = 3.5 kmph
- Per Capita Trip Rate of pedestrian (PCTR-walk) in Addis Ababa town = 0.7[14]
- Total no. of pedestrians in 2015 in Addis Ababa= 22,32,580[15]
- Time saved per walk trip after improvement = 10 minutes
- Time saved per pedestrian in a year, taking 300 days a year[16] = 81 hours
- Percentage of Pedestrians benefitted by provision of footpaths = 12.8% = 2,84,877[17]

[11] Benefits due to reduction in pedestrian KSI = (6*29, 39,466) + (11*7, 34,866) = 2, 62, 69,653 ETB (Decimal values have been considered).
[12] Urban Transport Study, Addis Ababa, 2005.
[13] Available literature for Eldoret town in Kenya shows that with construction and rehabilitation of footpaths, the speed of a pedestrian will increase from 2.25 kmph. to 3.5 kmph. -Assessment of NMT Programme in Kenya and Tanzania, SSATP, World Bank and Economic Commission for Africa, page no. 38.
[14] Urban Transport in Developing World, pp-213.
[15] The population Addis is increasing at 3.8%.Of the total population 60.5% are pedestrians (36, 90,215*605% = 22,32, 580.
[16] Here 300 working days have been considered by excluding 52 Sundays and 13 holidays in a year.
[17] Footpath is provided in 359 Km (12.76% of total road length) out of 2814 km of total footpath (i.e. Footpath is approximately 12.76% of total footpath network)(Addis City Government _Urban Development Indicators_2007)

Value of Time (VOT): The unit VOT of a person in Ethiopia has been estimated based on the following:

- Average monthly earnings per person in Ethiopia = ETB 6,858[18]
- Hourly income, considering 8 work hours a day and 22 work days a month = ETB 39
- Wage Rate or VOT for business trip is taken as the hourly income = ETB 39 /hour
- VOT for Non-business trip @ 30% of VOT of business trip = Ksh. 19/hour
- Business trips are 25% and non-business trips are 75% of total trips
- Thus, Average VOT is estimated as ETB 19/hour[19]
- Benefits to pedestrians due to time saving have been estimated by taking into account increase in VOT @5% per annum and growth in population @ 3.8% per annum

The cost and benefit streams of Footpaths for a 5- year period (2015-2020) is presented in **Table 3.**

Table 3: BCR of Component 2-Footpaths

Year	Economic Cost (in ETB)			Benefits (in ETB)			
	Capital Cost	*O & M Cost*	*Total Cost*	*Saving in Productivity Loss – Fatal*	*Saving in Productivity Loss - Seriously Injured*	*Time Saving*	*Total Benefits*
2015(Y_0)	37,64,99,000		37,64,99,000				
2016(Y_1)	-		-	1,83,67,664	79,01,990	26,18,71,622	28,81,41,275
2017(Y_2)		75,29,980	75,29,980	1,83,67,664	79,01,990	28,54,13,881	31,16,83,534
2018(Y_3)		75,29,980	75,29,980	1,83,67,664	79,01,990	31,10,72,588	33,73,42,242
2019(Y_4)		75,29,980	75,29,980	1,83,67,664	79,01,990	33,90,38,014	36,53,07,667
2020(Y_5)		75,29,980	75,29,980	1,83,67,664	79,01,990	36,95,17,532	39,57,87,185
NPV@12% in 2015			***35,43,92,586***				***1,20,25,94,650***
BCR in 2015-2020			***3.39***				
BCR in 2015-2016			***0.77***				

Results: the Construction and rehabilitation of footpaths is economically viable as the BCR is 3.39 in the first five years

[18]Addis Ababa Finance and Economic Development Bureau, 2008.

(2015 to 2020) of operation. The BCR in the first year of provision of footpaths is 0.77.

6.1.3 Component 3 : Cycle Tracks

Costs: The economic cost of construction and rehabilitation of cycle tracks is presented in **Table 1**. The investment would be incurred in 2015. O&M would be incurred from the second year of operation, i.e. 2017.

Benefits: Segregated cycle tracks will provide safety, speed and comfort to pedal cyclists. These are expected to reduce cyclist KSI, as well as bring about time savings. Benefits like comfort are difficult to quantify and hence not included in the analysis.

Reduction in Cyclists KSI: The reduction in the number of cyclist KSI has been estimated based on the following data/assumptions/parameters:

- No of cyclists killed in accidents in Addis Ababa = 23[20] per year
- No of cyclists seriously injured in Addis Ababa= 46 [21]per year
- Length of cycle tracks (56.3 km) provided in Addis Ababa comprise about 1% of city network
- Reduction in cyclist KSI Accidents due to cycle tracks = 40%[22]

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[19] VOT assumed to increase @ 5% per annum.

[20] 1% cyclists are killed in Ethiopia every year (2297*1%=23) (Sectoral Road Safety Study (TRL & Ross Silcock, 2001 and How safe are Ethiopian roads? Paper prepared or Mid-term review of RSDP II, Planning and programming division, pp-14, April ,2005)

[21] 2% cyclists are seriously injured in Ethiopia every year (2297*2%=46) (Sectoral Road Safety Study (TRL & Ross Silcock, 2001 and How safe are Ethiopian roads? Paper prepared or Mid-term review of RSDP II, Planning and programming division, pp-14, April ,2005).

[22] Studies worldwide, including Sub-Saharan African Transport Project in Africa (SSATP), shows that cycle tracks generally result in reducing KSI by

- Reduction in cyclist KSI Accidents due to cycle tracks = 40%
- Hence, reduction in cyclists killed = 40% of total cyclists killed = 9
    - Saving in productivity loss due to reduction in killed in accidents = ETB 2,70,07,812
    - Saving in productivity loss due to reduction in Seriously Injured = ETB 8,10,234

The costs of a fatal and seriously injured accident, described in *Component 1*, are ETB 29, 39,466 and ETB 7, 34,866 respectively. Hence, the total benefits due to reduction in cyclist KSI worked out to Ksh. 2, 78, 18,046 per annum[23].

Cyclist's Time Savings: Cyclist time savings have been estimated based on the following:

- average length of cycle trip in Addis Ababa city = 2.5 Km[24]
- Average cycling speed[25]
    - Without project = 10 kmph
    - With segregated cycle tracks = 14 kmph
- Per Capita Trip Rate of cyclist (PCTR-cycle) in Addis Ababa city = 0.02[26]
- Time saved per cycle trip after improvement = 4.29 minutes
- Time saved per cyclist in a year, taking 300 days a year = 21.43 hours
- Percentage of cyclists benefitted by provision of cycle tracks = 1% = 738[27]

25% to 50%. Here we have assumed that provision of cycle track will reduce KSI of cyclists by 40%.

[23] (29,39,466*9.19+7,34,866*1.10)=2,78,18,046

[24] Urban transport Study, Addis Ababa,2005.

[25] Available literature for Eldoret town shows that with construction and rehabilitation of cycle tracks the speed of a cyclist will increase from 10 kmph. to 14 kmph-The significance of Non-Motorized Transport in Developing Countries, (SSATP Report Result World Bank and Economic Commission for Africa , Annex.11.8 and 11.10) page. 75,133 & 135).

[26] Urban Transport in Developing World, P.-213.

Value of Time (VOT): The VOT estimation has been discussed above. The average VOT of Ksh 23/hour has been adopted.

- Benefits to cyclists due to time saving have been estimated by taking into account increase in VOT @5% per annum and growth in population @ 3.8% per annum.

The cost and benefit streams of Cycle tracks for a 5- year period (2015-2020) is presented in **Table 4.**

Table 4: BCR of Component 3-Cycle Tracks

Year	Economic Cost (in ETB)			Benefits (in ETB)			
	Capital Cost	*O & M Cost*	*Total Cost*	*Saving in Productivity Loss – Fatal*	*Saving in Productivity Loss - Seriously Injured*	*Time Saving*	*Total Benefits*
2015(Y_0)	2,38,34,000		2,38,34,000				
2016(Y_1)		-	-	2,70,07,812	8,10,234	2,92,712	2,81,10,758
2017(Y_2)		4,76,680	4,76,680	2,70,07,812	8,10,234	3,19,027	2,81,37,073
2018(Y_3)		4,76,680	4,76,680	2,70,07,812	8,10,234	3,47,707	2,81,65,754
2019(Y_4)		4,76,680	4,76,680	2,70,07,812	8,10,234	3,78,966	2,81,97,013
2020(Y_5)		4,76,680	4,76,680	2,70,07,812	8,10,234	4,13,035	2,82,31,078
NPV@12% in 2015			***2,24,34,569***				***10,15,16, 206***
BCR in 2015-2020			***4.52***				
BCR in 2015-2016			***1.18***				

Results: The BCR for the construction of cycle tracks is 4.52 in the first five years (2015 to 2020) of operation. The BCR in the first year of provision of cycle tracks is 1.18. Thus, the provision of cycle tracks is not economically viable on its own.

6.1.4 Total NMT Project

The Benefit – Cost Ratio of the total NMT project, comprising of Components 1, 2, and 3 is presented in **Table 5.**

[27] The projected population of Addis Ababa for 2015 is 36, 90,215. Population growth rate is 3.8 % per annum. The total number of cyclists is estimated from the PCTR-cycle of 0.02. Improvement of 56.3 km cycle tracks constitutes

Table 5: Benefit - Cost Ratio of Total NMT Project

Year	Economic Cost (in ETB)			Benefits (in ETB)			
	Capital Cost	*O & M Cost*	*Total Cost*	*Saving in Productivity Loss – Fatal*	*Saving in Productivity Loss - Seriously Injured*	*Time Saving*	*Total Benefits*
2015(Y_0)	40,78,21,500		40,78,21,500				
2016(Y_1)	-		-	9,52,87,605	3,01,85,022	26,21,64,334	38,76,36,961
2017(Y_2)	-	81,56,430	81,56,430	9,52,87,605	3,01,85,022	28,57,32,907	41,12,05,535
2018(Y_3)	-	81,56,430	81,56,430	9,52,87,605	3,01,85,022	31,14,20,296	43,68,93,923
2019(Y_4)	-	81,56,430	81,56,430	9,52,87,605	3,01,85,022	33,94,16,980	46,48,89,608
2020(Y_5)	-	81,56,430	81,56,430	9,52,87,605	3,01,85,022	36,99,30,567	49,54,03,194
NPV@12% in 2015			***38,38,75,962***				***1,56,14,37,544***
BCR in 2015-2020			***4.07***				
BCR in 2015-2016			***0.95***				

7.0 *Conclusion:*

The overall provision comprising NMT facilities viz. traffic calming measures, footpaths and cycle tracks, is economically viable as the BCR is 4.07 in the first five years of operation. As provision of traffic calming measures generates the highest benefits, with a high BCR, it should be taken up first, followed by cycle tracks and footpaths.

REFERENCES:

Addis Ababa Atlas of Key Demographic and Socio Economic Indicators, 2010, Finance and Economic Development Bureau, Population Affairs Coordination Sub- Process, Addis Ababa, Ethiopia, 2010.

Addis Ababa City Road Administration (AACRA), *Geometric Design Manual*, Addis Ababa, Ethiopia, 2010.

approximately 1% of total road length in the city. Thus, 1% of cyclists will be using the improved cycle tracks.

Addis Ababa City Government, *Urban Development Indicators*, Finance and Economic Development Bureau, Addis Ababa, 2002 (EC), Ethiopia, 2010.

Cervero, Robert, Sarmiento, Olga L., Jacoby, Enrique, Gomez, Luis Fernando and Neiman, Andrea, *Influences of Built Environments on Walking and Cycling: Lessons from Bogotá*, International Journal of Sustainable Transportation, 2009, p.203 — 226.

Central Statistical Agency, (CSA), Ethiopia, Various Reports.

Chong, J., *Promoting Transport Solution for East African Cities*, United Nations Humans Settlements Programme, Yangzhou, December, 2013.

Ethiopian Roads Authority, *How Safe Are Ethiopian Roads,* Ministry of Infrastructure, FDR of Ethiopia, Paper Prepared for Mid-Term Review of Road Sector Development Programme II in Ethiopia, April, 2005.

European Conference of Minister of Transport (ECTM): *National Policies to Promote Cycling*, ECMT, ISBN 92-821-2325-1, 2004.

Fietsberaad, *Cycling in the Netherlands, Ministry of Transport*, Public Works and Water Management, The Netherlands, 2008.

Ghosh, McMorrow, Lawson: *Analysis of the Non-Motorized Commuter Journeys in Irish Cities*, Proceedings of the ITRN2011, University College Cork, 31st August – 1st September, 2011.

Gupta, S., *Urban Metropolitan Transport Authority of Different States in India*, Centre for Public Policy Research – Centre for Urban Studies, Working Paper Series, 2013.

GTZ, I-CE: *Cycling-Inclusive Policy Development: A Handbook,* GTZ: 2009.

Gwala, S., *Urban Non-Motorised Transport (NMT): A Critical Look at the Development of Urban NMT Policy and Planning Mechanisms in South Africa from 1996 - 2006*', Paper presented to the 26th Annual Southern African

Transport Conference, South Africa, 9 - 12 July 2007. 10p.

Master Plan of Addis Ababa, 2002-2010, Addis Ababa City Government, Addis Ababa, FDRE.

National Road Safety Coordination Office (NRSCO*), 2001 Safety Report*, Ethiopian Roads Authority, Ministry of Infrastructure, FDR of Ethiopia.

Pendakur, S, *Non-Motorized Transport in African Cities: Lessons from Experiences in Kenya and Tanzania,* 2005.

Provision for Non - Motorised Transport in Addis Ababa and Recommendations for Improvements, prepared for United Nations Humans Settlements Programme, Transport Research Laboratory, 2012.

Silcock, R., & TRL, *Sectoral Road Safety Study Report*, Transport Research Laboratory, *2001.*

Transport Policy of Addis Ababa, Ministry of Transport, Federal Democratic Republic of Ethiopia, August, 2011.

TRL Report: *Transport Research Laboratory (TRL) Road Note 29*, United Kingdom.

Walter Hook, *GTZ Sourcebook Module 3D (2003)*: *Preserving and Expanding the Role of Non-Motorized Transport*, GTZ: 2003.

UN –Habitat, Overview of GEF-Sustainable Transport Project

Urban Transport Study (UTS), Addis Ababa, World Bank, 2005.

World Bank and Economic Commission for Africa: *Assessment of NMT Programme in Kenya and Tanzania*, *SSATP*, page no. 28.