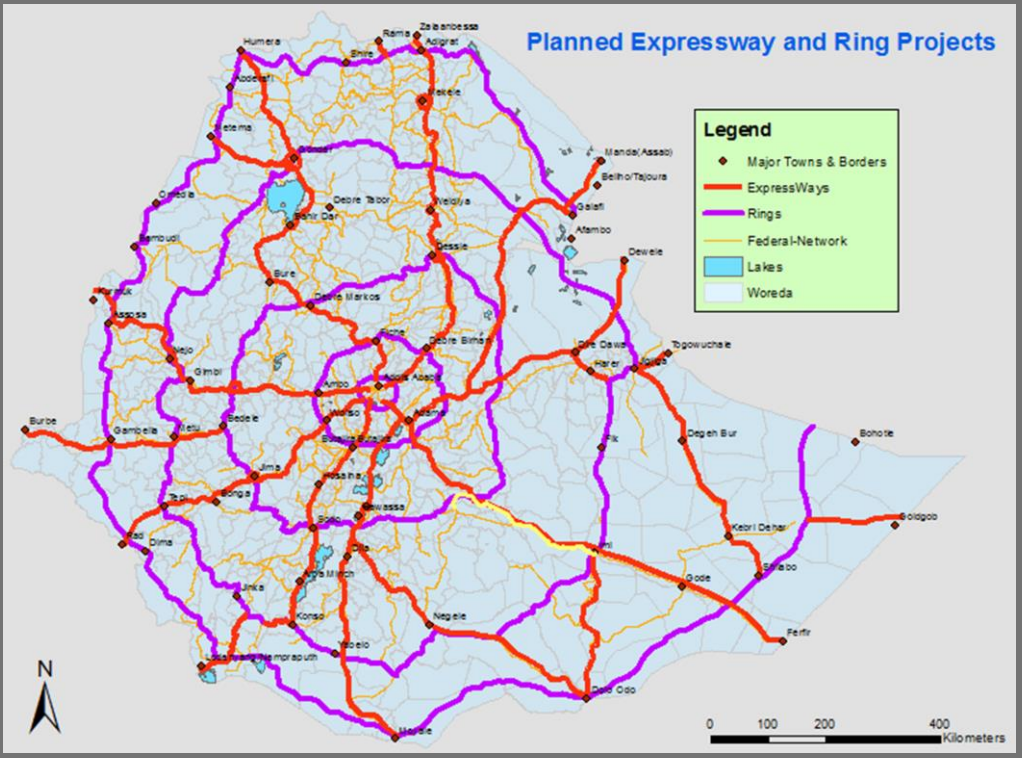
Ethiopia: The 5 and 10 Years Federal Road Master Plan

Federal Democratic Republic of Ethiopia
Ministry of Transport
Ethiopian Roads Authority (ERA)

CONSULTANCY SERVICES FOR PREPARATION OF 5 AND 10 YEARS FEDERAL ROAD NETWORK MASTER PLAN



Final Report

Voume I- Main Report

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Abbreviations and Acronyms

AADT	Annual Average Daily Traffic
ACCs	Agricultural Commercialization Centers
ACPZs	Agro Commodity Procurement Zones
ADB	Africa Development Bank
ADLI	Agriculture Development Led Industrialization
ADT	Average Daily Traffic
AFCAP	African Community Access Program
ARD	Agriculture and Rural Development
ATA	Agriculture Transformation Agency
BCR	Benefit Cost Ratio
BOFED	Bureau of Finance and Economic Development
BPR	Business Process Re-engineering
CBA	Cost Benefit Analysis
CSA	Central Statistical Agency
DC1-5	Design Class1-5
DFID	Department for International Development
DS1-10	Design Standard 1-10
EIAIP	Ethiopia Integrated Agro-Industrial Parks
ECA	Economic Commission for Africa
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
EPE	Environmental Policy of Ethiopia
EPLAUA	Environmental Protection, Land Administration and Use Authority
ERA	Ethiopian Roads Authority
ESDP	Education Sector Development Program
ETP	Education and Training Policy
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Product
GER	Gross Enrolment Ratio

GIS	Geographic Information System
GTP	Growth and Transformation Plan
HDM	Highway Development /Maintenance and Management
HEC	Highway Engineers and Consultants
HEP	Health Extension program
HSDP	Health Sector Development Program
HEWP	Health Extension Worker Program
HIV/AIDS	Human Immune Virus/Acquired Immune Deficiency Syndrome
HSDP	Health Sector Development Program
IAIPs	Integrated Agro Industrial Parks
IDCA	Italian Development Corporation Agency
IPDC	Industrial Parks Development Corporation
IRR	Internal Rate of Return
IT	Information Technology
KM	Kilometer
Masl	Mean above Sea Level
MCA	Multi-criteria Analysis
MDG	Millennium Development Goal
MIRR	Modified Internal Rate of Return
MLIN	Middle Level Income Nations
MoFED	Ministry of Finance and Economic Development
MoLAR	Ministry of Agriculture and Livestock Resources
MS SQL	Micro Soft Sequential Query Language
NP	National Parks
NPV	Net Present Value
OCC	Opporunity cost of capital
ORF	Office of Road Fund
ORN	Overseas Road Notes
PA	Peasant/Pastoral Association
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
RED	Roads Economic Decision
RGDP	Regional Gross Domestic Product
RNMS	Road Network Management Support

RR10	Rural Road 10vehicle/day
RR30	Rural Road 30vehicle/day
RR50	Rural Road 50vehicle/day
RSDP	Road Sector Development Program
RSDP I	Road Sector Development Program I
RSDP II	Road Sector Development Program II
RSDP III	Road Sector Development Program III
RSDP IV	Road Sector Development Program IV
RTC	Rural Transformation Center
SCF	Standard Conversion /Seasonal Correction Factor
SDPRP	Sustainable Development and Poverty Reduction Program
SNBP	Safety Net Beneficiary Program
SPM	Strategic Planning and Management
SPSS	Statistical Package for Social Science
SSATP	Sub-Saharan Africa Transport Policy Program
TRL	Transport Research Laboratory
TVET	Technical Vocational Education and Training
UN	United Nations
UNIDO	United Nations Industrial Development Organization
URRAP	Universal Rural Roads Access Program
Vs.	Versus

EXCUTIVE SUMMARY

1 EXCUTIVE SUMMARY

This 10 years federal Road Network Master Plan which has been initiated by the Ethiopian Roads Authority is undertaken by SEYOUNG Engineering Co. Ltd and KYONGDONG Engineering Co. Ltd from South Korea and their local associates of Afri Geoinformation Engineering Plc. and ALERT Engineering Plc. In doing so, the Consultants assessed and analyzed the overall socio-economic profile of the country, previous performance of road programs, existing mobility and accessibility condition, extent of regional integration and international experience.

The Plan is directional but not directive. It places infrastructure in the context of Ethiopia's broader economic goals. It sets a clear course for the future so that infrastructure providers (ERA, RRAs and Woredas) have a common understanding of national level expectations and policy settings. This is a strategic document rather than a strict plan of what to build, when and why. It sets out investment principles and identifies what the government wants to achieve in the next 10 years and beyond. The Plan does not seek to resolve all the issues that might exist in a sector, any region, or part of the economy. However, it does seek to identify the biggest areas of concern, and suggest the way forward. Given the long lead times for infrastructure and the long asset life, many of these challenges will take a number of years to resolve.

This study has been undertaken between August 2019 and August 2020. The master plan has identified a number of roads to be upgraded, rehabilitated, and constructed, which are essential and desirable to improve mobility, efficiency, connectivity, and accessibility. It has also estimated the desirable federal road network required to bring the nation to the middle-level economic status.

Steps followed in determining the required total length of the nation's road network is summarized hereunder:

(i) The first step was to determine the total length of the network by reviewing and comparing Ethiopia's land area, population and income with average of middle-income countries under similar status and condition with Ethiopia 20-25 years ago. Comparison was made using total road length and road density in terms of land area and population;

(ii) From the calculated average road density (205 km/1,000 sq. km) of selected Middle Income countries, Ethiopia's estimated network size has subsequently been determined using the total land area of the country (Ethiopia's Land area is 1,147,831 sq km). Accordingly, the total optimum network was estimated at 234,995.4km for the whole of Ethiopia;

(iii) Taking 144,027 km of existing network, it requires an additional road network of 90,968 km at country level to reach to 205km/1000 sq km road density;

(iv) The total required 90,968 km is distributed to regions proportionally based on land area of the region to the total land area of the country.

Table 1-1:- Optimum Network proposed for Regions

No	Region Name	Area Sq. Km (A)	All existing Roads Including Woreda and Urban Roads in Km (B)	*Additional network required in Km (C)	Proposed Optimum Network (in Km) B+C
1	AMHARA REGION	158316.97	26593	12547	39140
2	DIRE DAWA	1529.76	866	121	987
3	GAMBELLA REGION	25803.39	2795	2045	4840
4	HARARI	399.45	752	32	784
5	SOMALI REGION	323,290.52	6306	25622	31928
6	SOUTHERN REGION	117742.81	28388	9331	37719
7	TIGRAY REGION	57023.38	7651	4519	12170
8	BENISHANGUL-GUMUZ	50921.02	2345	4036	6381
9	OROMIA REGION	317,541.28	61239	25166	86405
10	AFAR REGION	94728.33	3394	7507	10901
11	Addis Ababa	534.1	3699	42	3741
	Sum	1,147,831.0	144,027	90,968	234,995

Note: * Additional network required is estimated based on land area i.e (Region Area/Total Country Area multiplied by 90,968 km.)

(v) Out of the additionally required 90,968 km of new roads, 16% (14,555 km) was estimated to be implemented by ERA while all the Regional governments and Woredas will construct the remaining 84% (76,413 km) of the network.

In identifying the missing links, the consultant collected various socio-economic data, identified and mapped major economic growth poles and potentials in all regions and areas of the country. The Consultant has then made intensive effort and identified about 16,022.5 km of missing links, 9043 km of Expressways, 392 km of outer rings on selected towns and 10,458 km of external Rings connecting the proposed expressways and major towns are identified. The five external rings are proposed in a certain interval distance from the capital Addis Ababa outwards to major towns, regional capitals and borders. The alignments are best chosen using

route selection tools in GIS to get a more realistic length and minimized cost of construction. The Consultant has performed multi criteria analysis using socio economic and network connectivity criterion to set priority considering various scenarios.

Methods/Tools applied

With regard to identification of upgrading and rehabilitation projects, the Consultant has utilized HDM 4 Model. The 2017 traffic count data from ERA and new counts by the Consultant have been used in conjunction with condition data of the roads from the 10 years maintenance plan prepared by two local consultants in 2017. Considering the GDP size and economic growth, the Consultant forecasted the future traffic growth rates by vehicle type.

The experience from South Korea is acquired and adopted to propose new expressway and ring network structures. Existing Traffic Count and Traffic Generating areas were used to propose missing links, identify potential for upgrading to better standard roads, four-lanes or expressways and other roads for rehabilitation.

The Consultant allotted points to different attributes mainly to: population and number of towns, surplus and cash crop production criterion, road density (remoteness), improve connectivity by linking to better standard roads and other equity criteria were aggregated and then investment priority was determined. Consequently, the Consultant established the investment priority of 193 routes.

The study has emphasized the need and benefits of providing alternative express highways. Benefits of expressways are envisaged to provide the road users with cheaper, more efficient, faster and safer travel conditions. It is clear that the new expressways will significantly reduce vehicle-operating costs and create favorable conditions for the import and export activities. The Consultant also assessed the benefits of construction of additional lanes along the existing routes and rehabilitation of existing lanes or construction of separate expressways. Based on different discussions with stakeholders, it was found rational and better to construct alternative expressways due to the following reasons:

- New alternative expressway will avoid demolishing existing infrastructures such as sewerage systems, telephone and electric network and water pipes.
- Right off way costs will be minimized providing sufficient space to construct roads with the desired standard and allocate spaces for future expansion and addition of lanes.
- Reduce construction time in solving the right of way issues, etc.

The Consultant established a new network for the overall territory, enhancing the connectivity among regions and supporting international open-door strategies as the foundation of national development and inter-regional unification. In addition, a number of external ring networks are proposed to provide detour for selected major towns of high population and high network connectivity. This helps vehicles to maintain design speed and avoid congestion which will be created from traffic entering to the towns from different directions.

The new proposed Expressway and Ring networks are stated as below.

Table 1-2:- Proposed Expressway and ring Network

Newly Proposed Link	Link Name	Length_Km	Status
Expressway 1: Addis Ababa ~ Awash arba-Mile-Dobi-Djibouti border	Expressway 1-1: Addis Ababa-Adama	80	Completed
	Expressway 1-2: Adama-Metehara-Awash Arba	132	(Under Procurment/Ongoing
	Expressway 1-3: Awash arba-Mile-Dobi-Djibouti border	437	Newly Proposed
Expressway 2: Awash Sebat killo - Meiso - Diredawa - Dawale	Expressway 2-1: Awash Sebat killo - Meiso - Diredawa	215	Newly Proposed
	Expressway 2-2:Diredawa - Dawale	213	Completed
Expressway 2A: Diredawa-Harer-Fik - Jijiga - Togo Wuchale	Expressway 2A:Diredawa-Harer-Fik -Jijiga - Togo Wuchale	150	Newly Proposed
Expressway 3: Addis Ababa ~ Kombolecha ~ Mekele ~Zalanbesa	Expressway 3-1: Addis Ababa-Dessie	293	Newly Proposed
	Expressway 3-2: Dessie-Mekele	320	Newly Proposed
	Expressway 3-3: Mekele-Adigrat	115	Newly Proposed
	Expressway 3-4: Adigrat-Zalaanbessa	40	Newly Proposed
Expressway 3A: Adigrat-Adwa-Rama	Expressway 3-5: Adigrat-Adwa-Rama	35	Newly Proposed
Expressway 4: Addis Ababa ~ Bahirdar-Gondar-Metema	Expressway 4-1: Addis Ababa-Debremarkos	270	Newly Proposed
	Expressway 4-2: Debremarkos-Bahirdar	250	Newly Proposed
	Expressway 4-3: Bahirdar-Gondar-Metema	340	Newly Proposed
Expressway 4A: Gondar-Humera	Expressway 4A: Gondar-Humera	230	Newly Proposed

Newly Proposed Link	Link Name	Length_Km	Status
Expressway 5: Addis Ababa ~ Nekemte-Asossa-Kumuruk	Expressway 5-1: Addis Ababa ~ Nekemte	300	Newly Proposed
	Expressway 5-2:Nekemte -Assosa-Kurmuk	350	Newly Proposed
Expressway 6: Addis Ababa ~ Jima-Bedele-Metu-Gambella-Burbe	Expressway 6-1: Addis Ababa ~ Jima	320	Newly Proposed
	Expressway 6-2: Jima-Bedele-Metu	257	Newly Proposed
	Expressway 6-3: Metu-Gambella-Burbe	266	Newly Proposed
Expressway 6A: Jima-Bonga-Tepi-Rad	Expressway 6A-1: Jima-Bonga-Tepi	200	Newly Proposed
	Expressway 6A-2: Tepi-Rad	105	Newly Proposed
Expressway 7: Addis Ababa-Butajira-Hossaina-Sodo - Arbaminch-Konso-Woieto-Naparputh	Expressway 7-1: Addis Ababa-Butajira-Hossaina-Sodo	315	Newly Proposed
	Expressway 7-2: Sodo - Arbaminch- Konso	213	Newly Proposed
	Expressway 7-3: Konso-Weito-Naparputh	250	Newly Proposed
Expressway 8: Mojo - Hawassa - Moyale	Expressway 8-1:Mojo - Hawassa	260	Ongoing
	Expressway 8-2: Hawassa - Hagremariam	202	Newly Proposed
	Expressway 8-3:Hageremariam-Moyale	310	Newly Proposed
Expressway 8A: Aposto-Negele-Borena-Dolo odo	Expressway 8A-1:Aposto-Negele Borena	275	Newly Proposed
	Expressway 8A-2: Negele Borena- Dolo odo	340	Newly Proposed
Expressway 9: Adama-Assela-Dodolla-Robe-Ginir-Imi-Gode-Ferfer	Expressway 9-1: Adama-Assela- Robe	310	Newly Proposed
	Expressway 9-2: Robe-Ginir-Imi	330	Newly Proposed
	Expressway 9-3: Imi-Gode-Ferfer	405	Newly Proposed
Expressway 10: Jijiga-Degabour-Kebridehar-Shilabo	Expressway 10-1:Jijiga - Degehabur	170	Newly Proposed
	Expressway 10-2: Degehabur - Kebridahar - Shilabo	315	Newly Proposed
Expressway 11:	Warder - Goldgob	171	Newly Proposed

Table 1-3:- Proposed Outer Rings on Selected Towns

Newly Proposed Link	Link Name	Length_Km	Status	Type
Outer ring 1:Diredawa Outer ring	Outerring 1-1: Diredawa Outer ring	25.93	Newly Proposed	Missing Link
Outer ring 2:Kombolecha Outer ring	Outerring 2-1: Kombolecha Outer ring	48.11	Newly Proposed	Missing Link
Outer ring 3:Mekele Outer Ring	Outerring 3-1: Mekele Outer ring	68.91	Newly Proposed	Missing Link
Outer ring 4:Gondar Outer ring	Outerring 4-1: Gondar Outer ring	88.67	Newly Proposed	Missing Link
Outer ring 5:Nekmete Outer Ring	Outerring 5-1: Nekemte Outer ring	58.42	Newly Proposed	Missing Link
Outer ring 6:Jima Outer ring	Outerring 6-1: Jima Outer ring	50.56	Newly Proposed	Missing Link
Outer ring 7:Sodo Outer ring	Outerring 7-1: Sodo Outer ring	26.57	Newly Proposed	Missing Link
Outer ring 8:Shashemene Outer Ring	Outerring 8-1: Shashemene Outer ring	25.42	Newly Proposed	Missing Link

The total length of Expressways and Town Ring network on selected towns would amount to 8784 km and 392 km respectively and envisaged to be implemented in phases.

In addition, a number of External Ring roads proposed to connecting expressways and close the loop with the total length of 10,458 km are shown as follows:

Table 1-4:- Proposed External Rings Connecting Expressways and Major Towns

Rings	Project	Length_Km	Status
Ring 1:, Sendafa-Sululeta-Holeta-Sebeta-Bishoftu-Sendafa (Addis Ababa outer ring road)	Ring 1-1:Sendafa - Sululta	73.93	Missing Link
	Ring 1-2:Sululta Holeta	42.00	Missing Link
	Ring 1-3:Holeta - Sebeta	74.00	Holeta - Sebeta is Upgrading
	Ring 1-4:Sebeta-Bishoftu	50.99	Missing Link
	Ring 1-5:Bishoftu - Sendafa	48.71	Upgrading
Ring 2:Deberbirhan-Fiche-Ambo-Weliso-Butajira-Kela-Meki-Dera-Metehara-Deberbirhan	Ring 2-1: Deberbirhan-Fiche	178.03	Upgrading
	Ring 2-2: Fiche - Ambo	145.07	Missing Link
	Ring 2-3: Ambo-Weliso	60.24	Upgrading
	Ring 2-4: Weliso-Butajira	74.00	Butajira-Weliso is upgrading

Rings	Project	Length_Km	Status
	Ring 2-5: Butajira-Kela-Meki	45.00	Missing Link
	Ring 2-6: Meki - Dera	60.00	Missing Link
	Ring 2-7: Dera-Metehara	100.00	Upgrading
	Ring 2-8: Metehara-Debirbirhan	60.24	Upgrading
Ring 3:Kombolecha-Akesta-Mekenselam-Debrework-Bure-Nekemte-Bedele-Jima-Tercha-Sodo-Hawassa (Leku)-Kofle-Robe-Gasera-Jara-Shekhussien-Gelemso-Assebot-Gewena-Kombolecha	Ring 3-1: Kombolecha-Akesta-Mekanselam-Debrework	332.49	Upgrading
	Ring 3-2: Debrework-Bure	442.17	Upgarding
	Ring 3-3: Bure-Nekemte	222.76	Upgrading
	Ring 3-4: Nekemte-Bedele	96.00	Upgrading
	Ring 3-5: Bedele-Jima	140.00	Upgrading
	Ring 3-6: Jima-Tercha-Sodo	162.48	Upgrading
	Ring 3-7: Sodo-Hawassa(Leku)	88.00	Upgrading
	Ring 3-8: Hawassa(Leku)-Kofle	55.00	Missing Link
	Ring 3-9: Kofle-Robe-Gasera	167.00	Upgrading
	Ring 3-10: Gasera-Jara-Shekuhussien	219.75	Upgrading
	Ring 3-11: Shekuhussien-Gelemiso-Asebot	162.10	Upgrading
	Ring 3-12: Asebot-Gewane	316.85	Missing Link
	Ring 3-13: Gewane Kombolecha	147.48	Upgrading
Ring 4: Korem-Sekota-Gondar-Koladiba-Shuwura-Gelgilbelese-Wombera-Nejo-Gore-Masha-Tepi-Mizan-Jinka-Konso-Yabelo-Negeleborena-Filtu-Imi-Fik-Jijiga-Adigala-Dubti-Semera-Korem	Ring 4-1:Korem-Sekota-Gondar	229.70	Missing Link
	Ring 4-2:Gonder - Kola Diba - Shawura	116.76	Upgrading
	Ring 4-3:Shawura - Gilgel Beles	117.54	Missing Link
	Ring 4-4:Gilgel Beles - Wonbera	86.12	Missing Link
	Ring 4-5:Wonbera - Nejo - Gore	424.77	Missing Link
	Ring 4-6:Gore-Masha-Tepi- Mizan	167.71	Upgrading
	Ring 4-7:Mizan - Jinka - Konso	372.40	Missing Link
	Ring 4-8:Konso -Yabelo	104.33	Upgrading
	Ring 4-9:Yabelo - Negele Borena	243.35	Upgrading

Rings	Project	Length_Km	Status
	Ring 4-10:Negele Borena - Filtu - Imi	348.99	Missing Link
	Ring 4-11:Imi - Fik -Jigjiga	381.82	Upgrading
	Ring 4-12:Jijiga - Adigala - Dubti - Semera	370.13	Missing Link
	Ring 4-13:Semera-Korem	270.85	Upgrading (most section)
Ring 5: Galafi-Berehale-Adigrat-Adwa-Shire-Humera-Abederafi-Metema-Great Ren Dam-Kumurk-Begi-Gambela-Abobo-Dima-Omorate-Dilo-Moyale-Doloodo-Kelafo-Shilabo-Warder-Dhoqoshay (Somali Border	Ring 5-1:Adigrat- Berhale - Galafi	449.16	Missing Link
	Ring 5-2:Humera - Shire - Adowa - Adigrat	386.74	Upgrading
	Ring 5-3:Metema - Abderafi - Humera	176.65	Upgrading
	Ring 5-4:Kurmuk - Abay Dam - Bambudi - Metema	387.80	Missing Link
	Ring 5-5:Gambela - Begi - Kurmuk	299.37	Missing Link
	Ring 5-6:Gambella- Abobo - Dima	261.68	Missing Link
	Ring 5-7:Dimma - Omorate	255.51	Missing Link
	Ring 5-8:Omorate - Dilo	201.38	Missing Link
	Ring 5-9:Moyale - Dilo	171.19	Missing Link
	Ring 5-10:Moyale - Dolo Odo	376.85	Missing Link
	Ring 5-11:Warder - Shilabo - Kelafo - Dolo Odo	523.54	Missing Link
	Ring 5-12:Warder - Dhoqoshay (Berbera)	169.66	Missing Link

The priority of upgrading, rehabilitation and expressways was based on the HDM 4 results of Net Present Values (NPVs) and Economic Internal Rate of Returns (EIRRs) using the existing network data as inputs. Expressways were ranked in order of priority to be constructed in the next 10 years. The remaining proposed Expressways and Ring Roads were planned for phase-wise implementation in the next 20 to 30 years based on envisaged demand and budget availability.

An estimated amount of Birr 1,428.37 Billion is required to implement the identified and selected projects within the 10 years Master Plan.This estimate is only for the federal road network and excludes budget required for maintenance, other studies and training etc.

Side by side, the consultant has identified a number of chllenges that have been affecting the performance and efficiency of the sector. The Consultant believes that if not addressed, the scale of constraints and challenges currently affecting the construction/road sector threaten the realization of the strategies set out in the Government's ambition and realization of the Master Plan. However, the Consultant also believes that ERA with support and direction of the Ministry of Transport can tackle and reverse the situation and confident that the same commitment that contributed to the successful implementation of the predecessor strategies will continue in ensuring the effective implementation of this road development framework.

Finally, this Road Master Plan study, which is designed to implement the road sector strategy over the coming 10 years period (2020-2030), is prepared in two Volumes: **Main Report and Appendices**. The Main report consists of ten chapters and structured as follows:

Chapter 1 presents a summary of the whole essence of the Master Plan study as **Executive Summary** including the process, contents and outcomes and concludes with the Consultants' conviction that the Government represented by ERA/MOT will continue in ensuring the effective implementation of the road development framework. The last section explains how the Master Plan study is structured.

Chapter 2 is about the **Background of the Study** highlighting the socio-economic-transport setting in which the sector is based; the Master Plan is formulated. Objectives of the study and contract information are also provided.

Achievements, challenges, and opportunities are discussed in Chapter 3. The performance of the last five phases of the RSDP and emerged challenges are outlined. Opportunities are basically associated with the recently issued transformation agenda: the Home Grown Economic Reform Agenda---A Pathway to Prosperity.

Chapter 4 is about the **Road Sector Policy**: the development of a set of constructs and propositions that are formulated to achieve the Master Plan and the functioning and performance of the road transport system.

Chapter 5, the ten years **Road Master Plan**, starts with the review of previous studies, review of the 10 Years Maintenance Master Plan and the implementation of the past five phases of RSDP (1997-2019) before the optimum road length is determined.

Chapter 6 is about **Project Identification.** It starts with approach and criteria and proceeds to identification and prioritization of missing links. **Project Analysis** through HDM 4 is provided in Chapter 7.

Chapter 8 deals with **Implementation and Financing Plan** for the year 2020 and 2030.

Implementation framework including modality, involvement of stakeholders, monitoring and follow-up of the Master Plan is provided in Chapter 9.The Main Report concludes with **Expected Impact** of the Master Plan in Chapter 10.

Part II provides supporting documents as Appendices. It includes

Annex 11.1: Ways to improve ROW Clearance;

Annex 11.2 Cost Estimation;

Annex 11.3 Traffic Generating Areas

Annex 11.4: Output of HDM-4 Analysis;

Annex 11.5 Proposed Missing Links with New Functional Classification;

Annex 11.6 Implementation Plan

Annex 11.7: List of Urban Centers more than 10,000 Population and their Accessibility;

Annex 11.8 Travel Time gained per Trip for Selected Towns

Annex 11.9 Response on Comments on the Draft Final Report

Logical Framework Matrix of the 10 Years Road Master Plan (Draft to be finalized by the Client)

Overall Goal	To sustain a rapid and inclusive economic growth by implementing a series of homegrown economic reforms throughout the nation	GDP & Per capita Income growth	Regular reports of MOFEC and Planning Commission	Overall political stability is maintained
Development objective	Connect different economic and social centers with improved road network to Prosperous Ethiopia.	Road network level compared to optimum size	Performance Monitoring System by Consultants	Government reforms under home grown reform agenda are in place
Results/Outputs	Implement the 10 Years Federal and Regional Road Network Master Plans	% of roads in acceptable condition length of roads constructed/improved	Performance Monitoring System by Consultants Progress reports by ERA and RRAs Different Surveys	Challenges in implementing the 10 years Road Master Plan are properly identified and met
Activities	Allocate average annual budget of …, Increase allocation for asset management works, Put in place … contractors and consultants to undertake physical works and systems, and Monitor performance.	ERA finalises procurement activities in time Delivery of contractors and consultants Rate of success in achieving construction within budget and time from planned targets	Progress reports by ERA and RRAs Supervision consultants' reports	Construction of … km of roads Rehabilitation of … km of roads Upgrading of … km of roads Undertaking asset management works including establishment of Road Asset Management System Improving ERA's and RRA's capacity through a series of measures Implementing sector reforms in areas of …

BACKGROUND OF THE STUDY

2 BACKGROUND OF THE STUDY

The link of improved transport system with an array of socio-economic opportunities is discussed; relevant information of the services is outlined

2.1 Ethiopia and the Transport System

Movements of people, goods and information have always been fundamental components of human societies. Contemporary economic processes have been accompanied by a significant increase in mobility and higher levels of accessibility. Although this trend can be traced back to the industrial revolution, it significantly accelerated in the second half of the 20th century as trade was liberalized, economic blocs emerged and the comparative advantages of global labor and resources were used more efficiently. However, these conditions are interdependent with the capacity to manage, support and expand movements of passengers and freight as well as their underlying information flows. Societies have become increasingly dependent on their transport systems to support a wide variety of activities ranging, among others, from commuting, supplying energy needs, to distributing parts between factories. Developing transport systems has always been a continuous challenge to satisfy mobility needs, to support economic development and to participate in the global economy.

The goal of transportation is thus to transform the geographical attributes of freight, people or information, from an origin to a destination, conferring them an added value in the process. The convenience at which this can be done - transportability - varies considerably. Transportability refers to the ease of movement of passengers, freight or information. It is related to transport costs as well as to the attributes of what is being transported (fragility, perishable, price). Political factors can also influence transportability such as laws, regulations, borders and tariffs. When transportability is high, activities are less constrained by distance.

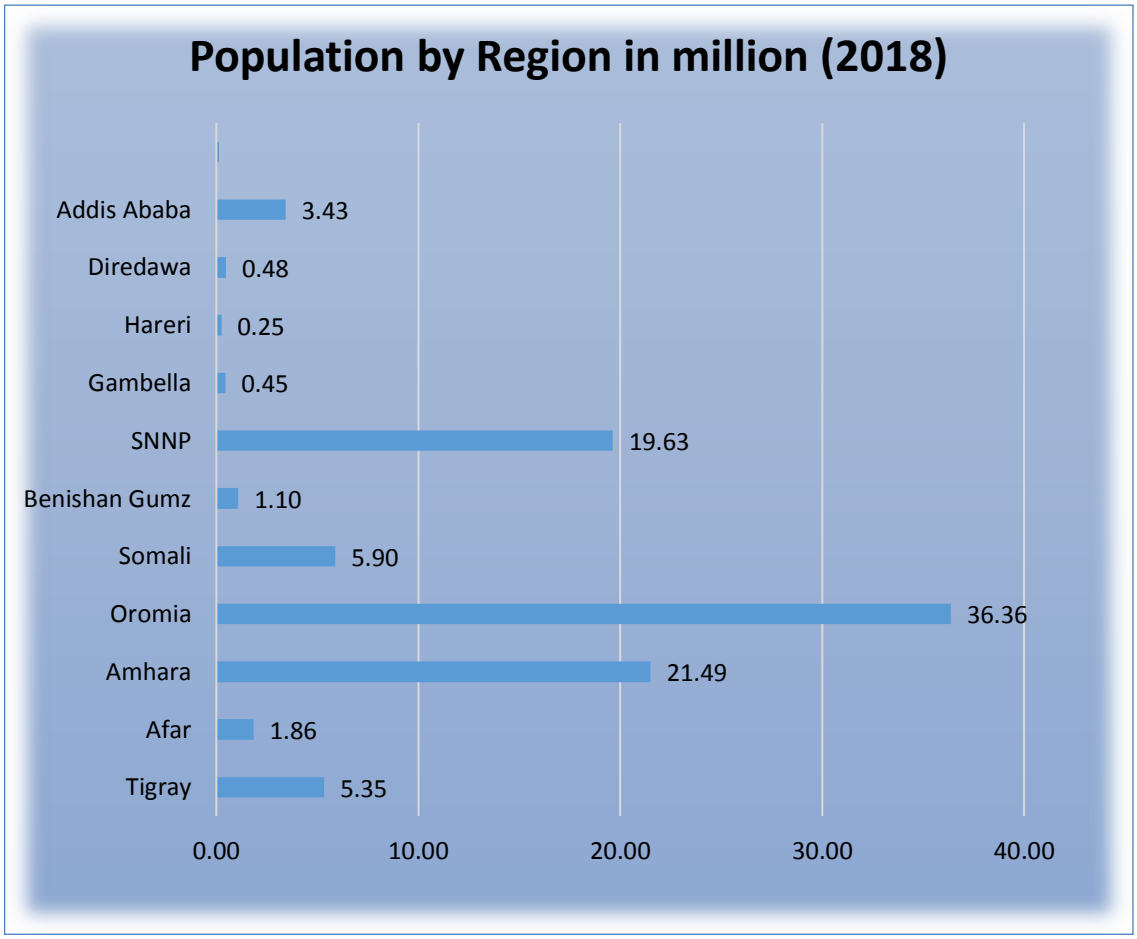
Ethiopia is a large, landlocked, and diverse country. It is located in the Horn of Africa with an area of 1.147,831 sq km. Ethiopia, a growing economy with a population of over 100 million with average annual growth rate of 2.4% located in the conflict affected Horn of Africa region, is experiencing an unprecedented political and economic change. At this rate, Ethiopia's population is expected to reach 130 million by 2025, and the United Nations projects that it will become the tenth most populous country in the world by 2050. According to the World Bank Group estimation in 2015, only about 20 percent of the population lives in urban centers.

Table 2-1:- No of Woredas and Population by Region

Regions	No of Woreda	Population Density as per 2017/18 Pop		
		Area Sq. Km	Population in million	Population Density (person per sq. km)
Tigray	57	57023.38	5.346	93.75
Afar	36	94728.33	1.875	19.79
Amhara	185	158316.97	21.491	135.75
Oromia	291	317,541.28	36.364	114.52
Benshangul-Gumuz	21	50921.02	1.096	21.52
Somali	57	323,290.52	5.899	18.25
Gambella	13	25803.39	0.449	17.40
SNNPR	184	117742.81	19.626	166.69
Dire Dawa	1	1529.76	0.479	313.12
Harari	1	399.45	0.252	630.87
Addis Ababa	117	534.1	3.433	6427.64
Total	**967**	**1,147,831**	**96.4**	

Source: Central Statistical Agency and from respective Regions

Figure 2-1:- Population by Region



Source: Central Statistics Projection and consultant calculation

What is the implication for road transport system? Ethiopia's location, topography and geopolitics present a particular transport challenge. Landlocked, mountainous and situated in the strategically important and unstable Horn of Africa, its international links are vulnerable. The specific purpose of transportation is to fulfill a demand for mobility and or accessibility, since transportation can only exists if it moves people, freight and information around. Well-developed and efficient transportation systems offer high levels of accessibility while less-developed ones have lower levels of accessibility. Thus, accessibility is linked with an array of economic and social opportunities.

The transport system of Ethiopia consists of about 144,027 km of all-weather roads, of which over 25 percent are federal roads (with only about 13 percent bitumen-surfaced), low expressway network, about 800,000 operational motor vehicles, two international airports, about thirteen domestic airports, several gravel-surfaced runways, as well as a newly completed standard gauge railway line, from Addis Ababa to Djibouti (about 743 km), and a

second railway line (Combolcha to Mekelle) under construction, and commercial maritime fleet operated by a public enterprise.

2.2 Review of the Ethiopian Economic Profile

Ethiopia has sustained double-digit growth rate over the past fifteen years, roughly double than the Sub-Saharan African average with significant improvements in food security and human development indicators and declining poverty. Growth has been largely broad-based. Since 2000, households have experienced considerable advances in well-being. The incidence of poverty had declined to a level of 29.6 per cent in 2011. Agricultural growth drove reductions in poverty, supported by pro-poor spending on basic services, effective rural safety nets and essential infrastructure. In spite of rapid economic growth, inflation was a major threat to macroeconomic stability during the first two years of GTPII implementation (2015/16 and 2017/18). The Government has instituted various measures to keep inflation within single digit. Stabilization measures taken included tight fiscal and monetary policies, financing of the budget deficit from non-inflationary sources, adoption of new business registration and licensing codes with the aim of establishing a transparent and competitive domestic trading system, and implementation of a price stabilization programme by supplying the urban population with basic food items (including wheat, sugar and edible oil) at subsidized prices. Because of these measures, prices eventually stabilized, with inflation decreasing to 22 per cent in 2017/2018 from 38.1 per cent in 2010. Still inflation has been observed until 2018. Table below shows sectorial contributions to GDP in the last 10 years.

Table 2-2:- Sectoral Contributions to GDP in (Billions of Birr)

Sector	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Agriculture	181.2	195.0	212.5	222.9	238.8	251.8	267.8	544.1	580.4	600.9
Industry	38.8	43.0	49.8	58.3	73.9	86.5	103.7	343.9	413.8	464.4
Services	163.2	184.7	207.2	229.1	259.0	292.0	325.0	575.9	619.3	673.9
Total	381.7	421.8	469.4	510.3	571.7	630.3	696.5	1,463.9	1,613.5	1,739.2

Source: National Bank of Ethiopia, 2018

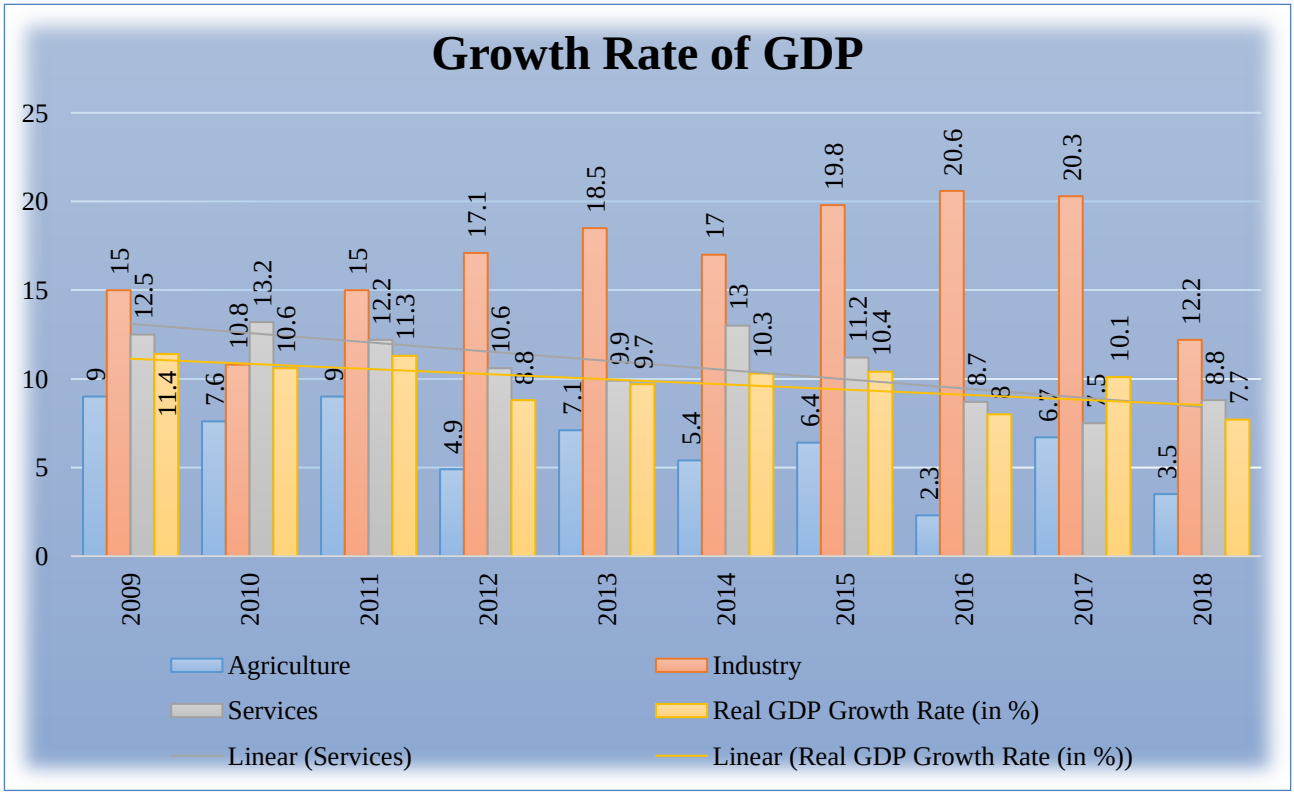
The average growth rate in Ethiopia's Gross Domestic Product (GDP) during the last 10 years (From 2008/09 to 2017/18) is shown on Table 2-3 below which was about 9.8 percent. In terms of sectorial distributions, the contribution of industrial sector was growing at increasing rate during the period except in the years 2009/10 and 2017/18. While the pace of contribution of the agricultural sector to the GDP is mixed. Similar to agricultural sector, the contribution of the service sector to GDP was not constant (sometimes increasing at increasing rate and decreasing in other time). During 2008/09-2017/18, a stable and moderately high growth rates, ranging between 7.7 and 11.4 per cent of GDP were registered in the country. Further, the GDP grew remarkably in 2010/11, by registering an average growth rate of 11.3%. See the detail of the growth rates of the GDP from the table below. Subsequently, Figure below illustrates the growth rates of the GDP by major sectorial classification.

Table 2-3:- Growth Rates of GDP of Ethiopia by Major Sectorial Classification

Sector	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Agriculture	9.0	7.6	9.0	4.9	7.1	5.4	6.4	2.3	6.7	3.5
Industry	15.0	10.8	15.0	17.1	18.5	17.0	19.8	20.6	20.3	12.2
Services	12.5	13.2	12.2	10.6	9.9	13.0	11.2	8.7	7.5	8.8
Real GDP Growth Rate (%)	11.4	10.6	11.3	8.8	9.7	10.3	10.4	8.0	10.1	7.7

Source: National Bank of Ethiopia, 2018

Figure 2-2:- GDP growth rate by major sector



The Ethiopian economy is highly dependent on agriculture, which accounts for almost between 47.5% and 45.3 share of GDP during the first three years (from 2008/09-2010/11). Starting from 2011/12, the share of the agricultural sector to GDP was decreasing and the contribution of the service sector to GDP began increasing more than both the agricultural and industrial sectors. From 2012/13 to 2014/15, significant share of service sector from the total GDP is observed and the share of the service sector from the total GDP during the time was 45, 46 and 47 per cent respectively. In the last three years, the share of the industrial sector of the total GDP has been increasing, even though the share of the industrial sector is still below the

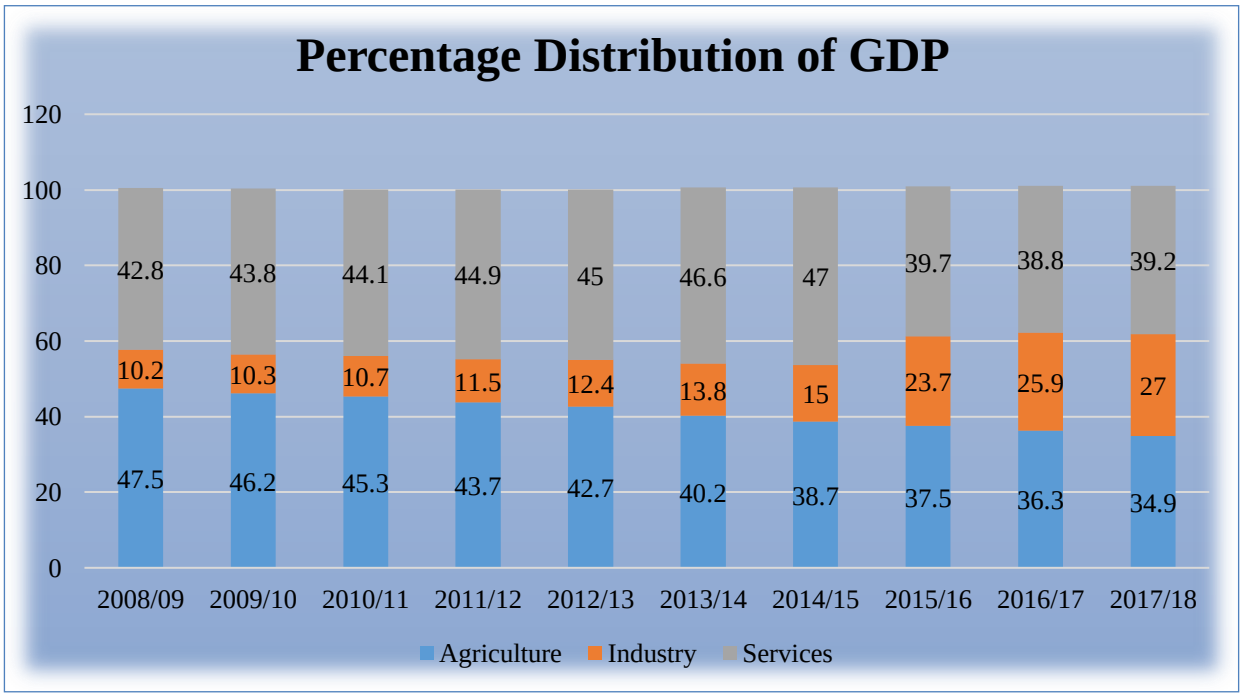
share of agricultural and service sector. The share of service, agriculture and industry of the total GDP was 39.2, 34.9 and 27 per cent respectively in 2017/18. See the detail of percentage distribution of GDP by major sector in Table below. Figure below shows the percentage contribution of GDP by sector.

Table 2-4:- Percentage Contribution of GDP by Sector

Sector	2008 /09	2009/ 10	2010/ 11	2011/ 12	2012/ 13	2013/ 14	2014/ 15	2015/ 16	2016/ 17	2017/ 18
Agriculture	47.5	46.2	45.3	43.7	42.7	40.2	38.7	37.5	36.3	34.9
Industry	10.2	10.3	10.7	11.5	12.4	13.8	15.0	23.7	25.9	27.0
Services	42.8	43.8	44.1	44.9	45.0	46.6	47.0	39.7	38.8	39.2
Total	**100.5**	**100.3**	**100.1**	**100.1**	**100.1**	**100.6**	**100.7**	**100.9**	**101**	**101.1**

Source: National Bank of Ethiopia, 2018

Figure 2-3:- Percentage Distribution of GDP by Major Sector



2.3 The Ethiopian Road Network and Previous Master Plans

Road transport is the most important means of motorized transport in Ethiopia. It accounts for more than 95% of the country's total domestic passenger and cargo traffic. The country has limited road network, small transport vehicle fleet and a low coverage of road transport services. The majority of the rural population is dependent on traditional means of transport.

The Government of Ethiopia has well recognized that limited road network coverage and poor condition of the existing road network has been an impediment to economic recovery and growth. Therefore, to address the transport problems in the road sector; the Government has launched the Road Sector Development Program (RSDP) in 1997. Since then, five phases of RSDP were implemented over the period of 1997 – 2020.

Since RSDP has been launched the Ethiopian Roads Authority (ERA) have had carried out comprehensive Federal Road Network Master Plan Study in 2002 by Sheladia INC. and KDEC-KOTI in JV with CWCE in 2014 which had served as major source for identifying the road projects to be included in successive plans and programs. The two master plans identified a number of road upgrading, road rehabilitation, and new road construction projects, which are essential and desirable to improve the efficiency and connectivity of the road network and improve access in the country. At the same time, different Regional Road Authorities have attempted to develop their own Master Plans. This is in addition to the Ethiopian Rural Travel Transport Program/ERTTP and its follow-on Universal Rural Roads Access Program/URRAP; frameworks formulated and implemented with the objective of contributing to the efforts addressing the challenges to rural access and transport in the broader context of stimulating socio-economic development and reducing poverty. All these plans have served their purpose in guiding the implementation of the road sector over the years.

The national economy has been expanding at accelerated rate in recent years. This accelerated economic growth is expected to continue in order to achieve the country's vision of becoming a middle-income country and other associated objectives. In line with this vision, modernizing the road network and improving the efficiency of its connectivity is essential. Accordingly, a new and revised Federal Road Network Master plan, which serves as an indicative plan for future development of the network, is required.

2.4 Objectives and Scope of the Study

The objective of this study is to define a medium to long-term road program or plan for the country based on the current condition and distribution of the road network based on social and economic evaluations. This plan will enable the Government to decide on future development and financing of the sector, facilitate the development of a well- integrated transport network and promote investment on the road sector.

In general, with the aim of defining the medium to long-term road development plan, this study has the following major objectives:

- Identify medium to long-term road development plan; and
- Forecast and evaluate future financial implications on the transport plan.

2.5 Contract Information and Milestones

The detail contract information and milestones of the project is presented below (Table 2.5).

Table 2-5:- Project Contractual Information

Project:	Supplementary Agreement for Consultancy service for preparation of Road functional Classification for federal and Regional Roads [(Preparation of Five (5) Year and Ten (10) Year Federal Road Network Master plan of Ethiopia).
Client:	Ethiopian Roads Authority
Consultant:	Seoyoung Engineering Co., Ltd in JV with Kyong Dong Engineering Co., Ltd in Sub-Consultancy with AFRI Geoinformation Engineering Plc. and Alert Engineering Plc.
Financer:	Government of Ethiopia/GoE.
Contract Signing Date:	July 31, 2019.
Effective Date: (ERA's letter of instruction issue date for commencement of the service)	August 15, 2019.
Commencement of service: (the period that the consultant confirmation of staff to start the service)	Within 15 days after effective date
Contract expiration date:	8 months after the commencement of the service.

DIAGNOSIS OF THE SECTOR: ACHIEVEMENTS, CHALLENGES AND OPPORTUNITIES

3 DIAGNOSIS OF THE SECTOR: ACHIEVEMENTS, CHALLENGES AND OPPORTUNITIES

The 22 years RSDP performance is 85%; but still marred by many challenges. Shortcomings in areas of functional classification system and data management, weakness in asset management and funding, delay in obstructions clearance, mixed performance of the domestic construction industry, etc. A Home Grown Economic Reform Agenda is considered as an opportunity to implement the Road Master Plan.

3.1 Achievements

The Ethiopia Road Network Master Plan is studied based on an assessment of the past and future development of the economy and of the transport sector (including geopolitical aspects). A review of road transport sector achievements and challenges are manifold, as outlined briefly in this chapter.

The Road Sector Development Program (RSDP) has been running now for over twenty-two years that had as its initial aim the restoration of the even country's limited road network that had been allowed to deteriorate badly to such an extent that less than 20% of the road network was at an acceptable level in 1997; when the program was launched. The implication of which was that transport users in general were facing high transport costs and rural community participation in the wider economy was severely limited by poor transport access as well as high transport costs.

In 1997, the Government through the Ethiopian Roads Authority set out an ambitious program of infrastructure investment to reduce the accumulated backlog of maintenance, improve road access within and between regions and reduce travel distance through improvement in road connectivity. Over the 22 years that the program has been running (1997-2019) approximately Birr 373.1 billion has been expended on activities covering some 153,000 km of roads including maintenance which requires repetitive intervention on the same roads. Much have been achieved during this period and it is with this achievement in mind that it has been considered important to look back at the past performance of RSDP and the agency tasked with the responsibility to carry out in order to determine to what extent RSDP has met the Government's policy and economic development objectives. And subsequently, this review would determine what lessons can be learned for the formulation of future programs to support the Government's development and poverty reduction objectives.

Table 3-1:- RSDP: Physical and Financial Performance

Program	Physical Plan Vs. Accomplishment (km)			Financial Plan Vs. Disbursement (in million ETB)		
	Plan	Actual	% age	Budget	Disb.	% age
RSDP I	8,908	8,709	98	9812.9	7,284.6	74
RSDP II	8,252	11,589	140	15985.9	18,112.8	113
RSDP III	14,686	12,395	84	34643.9	34,957.9	101
RSDP IV	97,517	85,860	88	125409.1	158,333.3	126
RSDP V (4 years)	93,122	34,460.1	37	251336.5	154,384.99	61
Total RSDP (22 yrs)	**222,485.4**	**153,013.1**	**69**	**437,188.3**	**373,073.59**	**85**

It is important to shed light here that the RSDP set out a clear strategic direction for the restoration and expansion of Ethiopia's road network. Looking back, RSDP-IV built on the gains made through earlier phases of the RSDP. RSDP-IV formed a strategic pillar of Government's Growth and Transformation Plan and, in terms of its physical and financial plans and corresponding achievements, it is the largest ever program undertaken in the sector. RSDP-IV which was developed within the framework of country's overarching plan, the Growth and Transformation Plan, have contributed much in transforming the road sector by boosting the size and quality of the road network enhancing institutional capacity and improving overall efficiency. Moreover, unlike earlier phases of the RSDP, RSDP IV places a high emphasis on improved access, specifically the construction of link roads and engineered low volume roads. *The performance of RSDP V is mixed and marred with many challenges as the country is passing through turbulences, change of government and ERA management*.

In the past few years, efforts were made to make inventory and condition survey of all roads and to develop a system, which register and manage the Geo-database of all networks under Federal and Regional jurisdiction. These studies produced different maps for the planning and effective management of network in each region. According to data collected from Regions and ERA's Road Asset Management and Planning in 2018, the total volume of Federal and Regional roads network and distribution is shown in the Table 3.2 below.

Table 3-2:- Road Network Volume by Region

No	Region Name	Area Sq. Km	Length of Federal Roads (in Km)	Length of Regional Roads (in Km)	Woreda/ URRAP Roads (in Km)	All Roads Including Woreda and Urban Roads (in Km)
1	Tigray	57023.38	2588	1490	2302	7651
2	Afar	94728.33	1916	1124		3394
3	Amhara	158316.97	6502	4786	11000	26593
4	Oromia	317,541.28	9081	10655.67	35460	61239

No	Region Name	Area Sq. Km	Length of Federal Roads (in Km)	Length of Regional Roads (in Km)	Woreda/ URRAP Roads (in Km)	All Roads Including Woreda and Urban Roads (in Km)
5	Benshangul Gumuz	50921.02	735	936	519	2345
6	Somali	323,290.52	2586	3305		6306
7	Gambella	25803.39	602	2027	33	2795
8	SNNPR *	117742.81	4592	10866	6070	28388
9	Dire Dawa	1529.76	45	161	280	866
10	Harari	399.45	52	455.3	144	752
11	Addis Ababa	534.1				3699
	Sum	**1,147831.0**	**28,699**	**35,806.4**	**55,808**	**144,027**

Source: ERA Road Asset Management and Planning. Road Network data as of 2018/19 and Verification Survey of the Consultant in the region;

*SNNPR, 5,838 km are competed and 4130 km are under construction and has no shape file as per the verification survey in the Region by team of the Consultant and SNNPR senior Staff.

Overall, there were positive outcomes under the successive Road Programs. The objectives of improving access and condition has met through the building and upgrading of both the Federal and Regional networks. Accomplishments in the areas of institution and capacity building of the sector were encouraging. It laid foundations on overall capacity of the sector in physical works, policy and institutional capacity building.

In conclusion, good results have been achieved in the expansion and rehabilitation of the Ethiopian road network. Success can be attributed to many factors but the institutional arrangement of making ERA the lead implementing body with full policy support and authority from the Government provided the firm institutional base on which to focus resources, build the necessary capacity and rapidly mobilise the program.

However, the implementation of the plan was marred by many challenges. Needless to say, emergence can only happen through continuous build up, taking stock of the achievement and conducive macroeconomic and socio-politics atmosphere. Neither does it happen by fiat. It should be a result of “standing on shoulder effect” by consolidating and building on capabilities the country has already built.

3.2 Challenges

Overall, certainly the implementation of huge road projects and a series of policy and capacity building projects have positively contributed to the initial RSDP goals. ERA,RRAs, the donor

community and the government represented by different institutions can congratulate themselves on a job well done. Nevertheless, while massive projects can potentially generate large benefits there are considerable risks. Cost overruns, poor implementation quality, inadequate operational and maintenance capacity, and negative social or environmental impacts can severely undercut a project's anticipated social and economic returns. Moreover, unless these are resolved, future projects, which are designed to be developed under PPP,can affect on debt dynamics and in some cases macroeconomic stability.

Based on the foregoing analysis and discussion with various stakeholders, the Consultant seeks to forward its views that the following need to receive attention during the implementation of the Master Plan. Problems noted were the following:

Out-dated Functional Classification System: There is no standard and up to date functional classification system of the road network. Road sections are indicated by towns or other points, which are missing from many maps. Evidently, each section is defined by the organization doing the work without reference to a standard classification. In many cases, there is no agreement on beginning and ends of each section, and the kilometres of length vary widely, as can be seen from comparing the previous tables.

Comprehensive Data/Information System: A data bank on the characteristics and condition of the road network does not exist. For instance, data received from the Maintenance Districts is incomplete and provide no data useful for HDM work. For this reason, it was necessary to use the last network data available. Moreover, there is no library or filing system for project related data including elements of feasibility and design studies, in either electronic or hard copies. There is no adequate system based on GPS for locating projects and road sections and road characteristics, not to mention structures. Further, traffic data is available and better organized. However, it is difficult to locate the count stations relative to road sections and network data compiled by different implementers.

Cost Data for Maintenance Planning: Data used presently for the evaluation of the network are based on a limited sample of roads from the Maintenance Districts, each with its own criteria, and not on a network wide database. Cost data for different construction interventions such as rehabilitation and upgrading are based on completed projects. If there is no recently completed project sharing the characteristics of the project to be assessed, then using those costs can lead to incorrect estimates. Each Maintenance District calculates costs for maintenance force account. These show considerable differences with respect to different line items, making network- wide costs difficult to estimate.

The Need for Improved Feasibility Study: Although the feasibility studies have been started to be undertaken over several years ago, the same process for project evaluation and prioritization is used today. The result is a piecemeal project analysis instead of a network approach. All feasibility studies done by consultants are somewhat to acceptable standard but vary considerably on the assumptions used and therefore are difficult to compare with each other. So, just because a project has a higher ERR does not mean it is really a better option.

Project Implementation: Quick assessment of the information on the status of the projects draws attention to the huge delay in completion of the projects. The average contract period has been nearly 3 years. However, majority of them are delayed from a few months to nearly 2 years more in the case of some projects at peripheral areas. If the sample projects are a fair indication, delay seems to be endemic. The reasons for this could not be ascertained in the time available, and in any case would require a profound look into the circumstances of each project.

Project Identification and Equitability: A comprehensive database and demand forecasts should be regularly updated based on actual traffic and socio-economic data, including origin—destination surveys. Planning cannot be substantiated and well accepted by society without such information.

Improved Asset Management: To date, there has been limited preventive periodic maintenance. As a result, roads have deteriorated, requiring expensive reconstruction. Existing road maintenance procedures require larger resources over the long term than with periodic maintenance in place. A shift from reconstruction to periodic maintenance will provide the Government with an important opportunity to use its limited financial resources more efficiently. In order to realize the opportunities, asset management and life-cycle analysis should be developed by ERA. There is the need to adopt and implement immediately a road management system that establishes the capability to prioritise and approve annual maintenance and funding programmes based on need.

The short-run emphasis should be on stabilizing network condition and avoiding further deterioration. There is ample scope to improve the performance of maintenance operations. In addition, road standards should be revised and low cost technical solutions applied on low volume roads. Stable and secure funding is required, including application of the “user pays” principle through the introduction of a flexible road fund.

Road Fund Administration: The Ethiopian Road Fund Administration Office has been created and mandated to ‘finance the maintenance of roads and roads safety measures’. The Office which is supported by the Board appears to fulfill its functions adequately. The Road Fund proclamation provides no guidance on priorities within the broad definition of ‘maintenance’ and ‘road safety’ and therefore, in the absence of guidelines, relies on the discretion of the Board members to assess the validity of annual programs proposed by the road authorities. However, the striking point is what will happen in future when: (i) the network expands; (ii) the periodic maintenance cycle needs implementing on the rehabilitated federal roads; and (iii) there is a greater requirement for maintenance of regional, town and rural roads.The principles of ‘road pricing’ and ‘user charges’ have not been applied. There is the need to adopt mechanisms that review road fund revenues and make recommendations to Government for increases.

Domestic Construction Industry: While encouraging, the rise of the construction sector raises questions about sustainability of recent achievements on growth and structural change.

The construction sector is, in its very nature, a sector highly dependent on the business cycle. The sector is booming now with a mixed result, but this boom will not last forever, and could in a worst-case scenario turn into a bust, as seen elsewhere. Over the past three years, about a fifth of GDP growth is attributed to the construction sector. This is substantial, as the sector has limited value added owing to high input costs. Construction activity is driven by a combination of public and private investment which led to a rise in employment more than 2.0 million workers, many migrating from rural areas and working as daily laborer. Construction has led to recent growth, jobs and contributed to structural change. At some point, this impetus will fade as the business cycle turns, even as the country continues to pursue an infrastructure-led growth strategy.

Capacity of ERA: Whilst extensive training has been provided to ERA personnel, retention of key professionals remains as big a problem for ERA now as it was at the outset of RSDP. In fact, some opinions suggest that quality of ERA's especially middle-level administration is diminishing with the continued loss of key experts. Despite extensive training of ERA personnel capacity is still a problem due to inability to retain professionals once qualified. This is a phenomenon experienced by public institutions everywhere. Paradoxically, ERA remains the primary provider of policy advice and management on road infrastructure to Government.

The volume of projects to be managed by ERA increased from 17 in 1998 to 97 in 2008 to more than 300 today with this number expected to increase under future Road Programs. This is excluding maintenance operations and other complex and time-consuming service projects. However, the Authority's current project management capabilities are placing constraints on what it should theoretically be able to effectively and efficiently manage. The implication being that 'other things being equal' the authority can only improve its project management efficiency by (i) either reducing the number of projects currently being managed, (ii) it could significantly ramp up its capacity to address its current limitations, or (iii) it could by outsourcing many of the day-to-day activities to a private sector management consultant. Whichever strategy is adopted, the organization would benefit from a series of targeted reforms in service delivery as it has been undertaking currently and transform itself as an efficient organization, one that can act as a model to other sectors.

Right-of-Way Clearance: Highway right-of-way acquisition and utilities accommodation in Ethiopia has become significantly more complex and literally stopping project implementation especially in the last few years. At the same time, right-of-way and utilities personnel are under increasing pressure to provide cleared right-of-way more quickly. Included in this Master Plan are options that would be explored and be used as appropriate in right-of-way acquisition, relocation of affected residences and businesses, and relocation and accommodation of utilities with minimal disruption to communities (Annex 11-1).

3.3 Opportunities

In Ethiopia, in spite of progress made in economic growth, poverty and unemployment remain high. As a result, the 2018 witnessed a time of political shock and of extreme financial and

economic turbulence throughout the country, which have seen a new phase of challenges related to democratization and popular participation in the overall governance of the country. This has necessitated an era of change and transformation: i) to cope with the challenges; ii) to create renewed optimism among citizens; and iii) working towards a prosperous Ethiopia over the coming several years.

The new administration has quickly embarked on a transformational journey in reversing the situation. The government has subsequently made clear its transformation agenda in September 2019: A Home Grown Economic Reform Agenda---A Pathway to Prosperity. To attain this goal, Ethiopia needs to sustain the high growth episodes that have been observed over the last decade by deepening structural change in its economy. The authorities have initiated reforms in key strategic sectors, opening telecommunications, energy, aviation and logistics to foreign participation and marking a major shift in Ethiopia's economic transformation. The implementation of these reforms supported by the proposed operation stands to transform the economy by strengthening the role of the private sector, contributing to export expansion and moving towards a sustainable financing model for Ethiopia's growth and development. The government's objective is to sustain the growth momentum of the past decade needed to create jobs for its young and growing population with approximately 2 million new entrants joining the labor market each year.

The demand for road infrastructure is expected to grow driven by a myriad of factors such as economic growth, urbanization, the need for bringing society closer to each other, the federal system that requires improved access to connect and empower different parts of communities— putting greater and greater pressure on infrastructure services that are already severely stretched. Moreover, dependence on one or two outlets to the sea poses the risk of becoming a "captives hipper". Alternative routes need to be maintained to: (i) reduce the risk of dependence on infrastructure of transit countries; (ii) reduce fees, direct costs and delays due to transit and customs charges in transit countries; and (iii) reduce vulnerability to disruption in transit countries.

The demand for infrastructure is not static but evolves with country conditions. This is a notable feature of the relationship between infrastructure and economic growth. The relationship is not unidirectional as infrastructure investments create and perpetuate growth, which in turn changes the type of infrastructure demanded as society becomes more prosperous and the economic structure changes.

The current government is even more committed to moving forward with infrastructure projects, investments in which could help strengthen the overall economy. In addition to the huge investment it is making on regular basis, it is likely that there will be a greater focus on the reforms needed to enhance private sector investment, as it is clear that this has become more important than ever. Where possible, the Government will encourage public-private partnership (PPP) projects, and they may provide interesting investment opportunities.

The Road Sector Development Program, which is planned to be implemented in the coming 10 years, required to have a revised master plan considering the past performance and future economic development plan. Therefore, the overall aim of the road transport master plan study is to identify a short & long-term Federal road network development master plan over the next 10 years, to decide future development and financing of the road sector infrastructure based on medium to long term projections of regional and domestic transport demand and to develop suitable institutional arrangements in order to support the Government's national agenda.

ROAD PLANNING AND POLICIES

4 ROAD PLANNING AND POLICIES

Policy objectives and statements which are sets of constructs and propositions that are established to implement the Road Programs are summarized.

4.1 Planning vs. Policy

Allocation of substantial resources for investment in roads is a major step towards overcoming the serious infrastructural constraints currently threatening to undermine the sustainability of Ethiopia's medium and long-term economic growth. Even this current year allocation and the envisaged commitment can contribute significantly to improving the size and quality of road infrastructure; but planning, policy, regulatory reform and tackling the challenges identified under previous section requires urgent consideration.

Road planning or the Master Plan deals with the preparation and implementation of actions designed to address specific problems. Whereas road policy is the development of a set of constructs and propositions that are established to achieve particular objectives relating to socio-economic development, and the functioning and performance of the transport system. A major distinction between the planning and policy is that the latter has a much stronger relation with legislation. Policies are frequently, though not exclusively, incorporated into laws and other legal instruments that serve as a framework for developing planning interventions. Planning does not necessarily involve legislative action, and is more focused on the means of achieving a particular goal.

Thus, transport policy can be concomitantly a public and private endeavor, but governments are often the most involved in the policy process since they either own or manage many components of the transport system. Governments also often perceive that it is their role to manage transport systems due to the important public service they provide.

The eventual success of a policy depends upon establishing clear goals. If there are multiple objectives, they must be consistent. They must be flexible enough to change over time as the circumstances evolve. In simple terms, the objectives must:

- Identify the present conditions and situation.
- Indicate the goals to be achieved.
- Identify the barriers to achieving the goals.
- Identify what is needed from other agencies and the private sector.
- Determine how success will be judged and measured.
- Identify what steps are required to achieve success.

4.2 Ethiopian Road Sector Policy

The Road Master Plan lays out the government's vision for Ethiopia's road infrastructure for the next 10 years. It seeks to guide infrastructure users, providers and regulators in a common direction over the next 10 years and to support the decisions these groups make about the use, provision and regulation of infrastructure.W.T Consult Plc has assumed the role of drafting the Ethiopian Road Sector Policy in October 2019 through the same has not been approved.

A. Vision

The vision of the Road Master Plan is to promote long-term prosperity through the development of efficient, cost effective, and environmentally and socially sustainable transport infrastructure and services, serving the whole nation.

B. Mission

Preserve and improve Ethiopia's road network to contribute to prosperity of the nation.

C. Theme of the 10 Years Plan

Working towards closing the road infrastructure gap and accelerating Prosperity of the Nation.

D. Guiding Principles of Road Policies

A reliable and efficient road network is critical to further enhance the economic growth and improve the livelihood of the population in a sustainable manner. In general, the following policy principles guide the pursuit of objectives:

- **i)** Greater focus on customer (user need), and relatedly efficiency outcome;
- **ii)** Re-alignment of governance and institutional arrangements, and assignment of responsibilities to long-term vision and objectives; and performance-based management and incentive structure (in a businesslike manner), and enhancement of capacity (management, professional and skilled labor, systems and technology that are relevant) not only to the present situation, but to the future as well.
- **iii)** Applying minimum criteria for economic and financial return, while considering equity as a social objective to meet basic infrastructure needs;
- **iv)** A strategic orientation from the technical aspects of maintenance to asset management;
- **v)** Developing medium-and long-term plans, taking account of hierarchical and functional classification of roads, balancing resource use and establishing link between the road development plans and multi-year financing plans;
- **vi)** Integrating road safety in planning, design, and comprehensive asset management;

vii) Streamlining environmental and social impact mitigation, and climate change response;

viii) Facilitating Public-Private Partnership as s source of finance, and promoting cost recovery a means of economically efficient system for the preservation of road assets; to reduce the burden on budgetary allocations and external borrowing.

Table 4-1:- Policy Objectives and Statements

Strategic Thrust	Policy Objective	Policy Statements
1. Economic and Financial Sustainability	Provide customer-focused, efficiency-outcome oriented and integrated road network to promote sustainable road transport towards accelerated socio-economic development	Paradigm shift in road sector management, priorities in road development, road asset management, road and bridge design standards, road sector financing, domestic construction industry and consulting firms, vehicle weight and axle load limits, quality assurance and control, new technology in road sector management, etc.
2. Environmental Sustainability &Climate Change Response		
2a. Environmental Sustainability	Ensure that all road projects are environmentally sustainable, and explicitly and adequately incorporated in planning, design, contracting, and that ecological values are protected	Integrating environmental elements at the stages of formulation, EIA, compliance to environmental clauses of road works contracts, improving road safety, etc.
2b. Climate Change Response	Develop, establish and update climate resilient standards for road development	Establish a framework for climate change response, construction of resiliency of vulnerable road projects to climate change, GIS application in assessing climate-resilient road access, contractual provisions related to climate change, etc.

Strategic Thrust	Policy Objective	Policy Statements
3. Social Sustainability	Ensure that road project induced adverse social impacts are minimized, appropriate safeguards introduced, and mitigation measures implemented, as part of long-term commitment to enhance sustainability.	Mainstream a sustainable and comprehensive approach to SIA, minimize resettlement, ROW management and responsibilities, labor-based methods, HIV/AIDS at work sites, needs of women, safety of workers, rights of labor and labor relations, etc.
4. Research and Development	Strengthen and sustain road and transport research and development, in collaboration with appropriate academic and other relevant institutions, and streamline the dissemination and adoption of innovative practices.	Research guide and program, financial self-sufficiency to sustain research, research outcomes dissemination, etc.
5. Organizational Competence &Accountability	Enhance road sector organizational competence and accountability	Technical capacity of road agencies, introduction of modern systems and procedures, service delivery, domestic construction industry, training, technology transfer, etc.

THE ROAD SECTOR PLAN

5 THE ROAD SECTOR PLAN

This is the third comprehensive Road Master Plan since 2000. Optimum size of road network that supports the nation to join the middle-income country status is determined as 235,000 km.

5.1 Contemporary Road Master Plan

The underlying philosophy of the Master Plan is to continue creating infrastructure development. It presents a policy framework that articulates issues related to both economic growth and social development. The Plan is meant to serve as a comprehensive reference document for policy makers in Government, donors, the international community, and co-operating partners on the country's socio-economic development priorities. It, therefore, represents a consensus on how Ethiopia can further accelerate the attainment of its development objectives.

This report sets out the Road Sector Master Plan (2020-2030) for the Federal Democratic Republic of Ethiopia. It is based on: (i) a detailed assessment of the economy and the transport sector, including achievements, challenges, and opportunities; (ii) extensive consultations with relevant agencies and stakeholders; (iii) a detailed Road Functional Classification System; and (iv) a well prepared and discussed Road Sector Policy and Strategy.

There is a growing realization that perhaps planning has failed and that the wrong questions have been asked. Rather than estimate traffic increases and then provide capacity to meet the expected growth, it is now accepted that what is required is better management of the road transport system through new approaches to planning. Just as urban planning requires the inputs of many specialists, so transport planning is beginning to utilize multi-disciplinary teams in order to broaden the scope of the planning process. The preparation of the road master plan has followed a modified approach and a multi-step process accommodating the interest of policy makers, society and professionals.

We see three major levers that would improve performance in the road sector. These measures are not about inventing a completely new approach to infrastructure—what is proposed is simply rolling out proven best practice on a global scale. These are:

(i) Improving project selection and optimizing infrastructure portfolios; selecting the right combination of projects;

(ii) Streamlining project delivery which includes proactive contract management, improving towards efficient domestic construction industry, speeding up approval and land acquisition processes, investing heavily in early-stage project planning and design, which can prevent changes and delays later on in the process when they become ever more expensive;

(iii) Making the most of existing infrastructure assets before investing in costly new projects, the government can address some infrastructure needs by getting more out of existing capacity.

ERA has currently working on various frontiers including preparation of the road map to enhance development, and institutional setup to improve its efficiency. This document is believed to consolidate all efforts and lead the country's direction on development of the road sector for the next ten years.

5.2 Review of Previous Studies

5.2.1 Previous Road Master Plans

ERA has commissioned or undertaken a number of strategic studies as part of the on-going RSDP and special studies to respond to government's direction which have been adopted in various times. The review includes the two Road Master Plans prepared earlier, the successive Road Programs, Growth and Transformation Plan, Ongoing and Planned Projects under these programs, Maintenance Action Plan, etc.

The two earlier federal road network master plan studies have focused on the major policy issues of the road network infrastructure and entered on three main pillars: namely increasing efficiency of the road network; increasing accessibility to potential areas and the rural community; and increasing the implementation capacity of ERA. Both have:

- Estimated/calculated the required size of road network that reduces transportation cost to the economy and support sustainable growth and poverty reduction; and

- Identified missing links that could improve the size and quality of the Ethiopian road network in line with the country's vision of becoming middle-income country. A comprehensive network analysis was carried out for the whole of Ethiopia by consultants. The studies proposed not only upgrading of existing roads, but also the construction of many new links to open up fertile, improve access of remote and distant areas, and give greater network connectivity over the whole country.

Ranges of scenarios applying different assumptions and methodologies for achieving various goals have been considered. Different assumptions which lead to different estimated needs were taken into account. Massive data collection from various angles was launched to explore the needs of the sector. The gap was calculated as the difference between the estimated requirements and the actual level of investments. There are various methodologies used in the literature to estimate infrastructure investment requirements; they can be broadly classified in two categories: "top-down" and "bottom-up". As the data of macroeconomic variables are

relatively more comprehensive compared with the data of individual infrastructure projects, both studies have adopted the “top-down” approach to conduct the empirical analysis.

In general, both studies had implemented two methods or approaches to determine the optimum road network of the country. These are:

1. Reviewing and comparing Ethiopia’s land area, road density, population and income with other middle-income countries; and

2. Using internationally accepted scientific models/tools.

They had evaluated typical criteria to be considered for the national road network size, the size of the country, geographical condition, traffic demand, and volume of internal and external resources that could be channeled to the sector, urbanization, population, economic activities, and some other criteria.

5.2.2 Review of the 10 Years Maintenance Master Plan

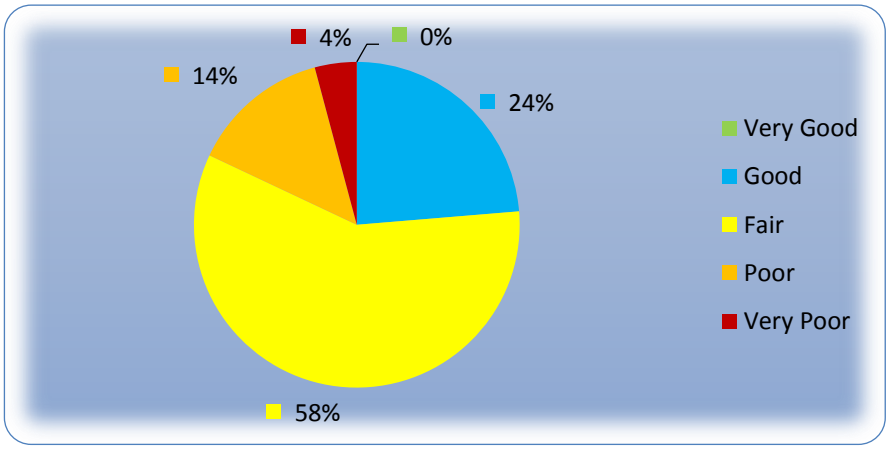
The consultant has reviewed the Ten Years Maintenance Master Plan for using the road condition data in the HDM 4 Model. The two consultants (HITCON Engineering Plc. and DANA and Associates Engineering Consultant Plc.) hired by ERA had performed detail condition survey of federal roads in the country.

5.2.2.1 Road Condition Survey Lot-1

From the road condition data collected by HITCON Engineering under Lot 1, a total of 5,713 km of paved, 4,255 km of unpaved roads were surveyed, and their conditions were analyzed. The condition data in conjunction with the other consultant data was used to understand the country’s general road condition and baseline to establish target for the future. The road condition data covers roads under Debre Markos, Kombolcha, Adigrat, and Gonder (Lot-1). Figure 5-1 and Table 5.1 below show paved and unpaved road conditions data of these districts.

From the analysis of paved road condition survey of Lot-1, about 24%, 58%, 14 % and 4% are in Good, Fair, Poor and Very Poor condition respectively.

Figure 5-1: Overall rating of the Lot I paved roads of the five districts



The Unpaved or Gravel Roads Condition data for five districts collected under Lot-1 shows that 54% of the road networks are in fair condition while 36% and 6% are in poor and very poor condition respectively.

Table 5-1:- Summarized Unpaved condition data for five districts

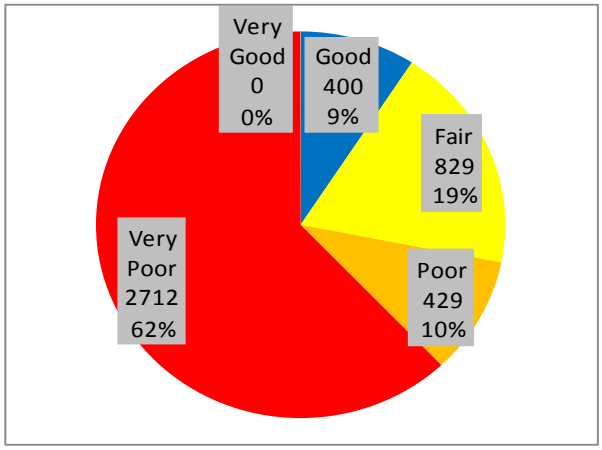
		Very Good		Good		Fair		Poor		Very Poor		Lot - 1/ Directorate Average	
		85%+		71-85%		51-70%		36-50%		0-35%			
Section	Network Length	Length (km)	CI (%)	Length (km)	CI (%)	Length (km)	CI (%)	Length (km)	CI (%)	Length (km)	CI (%)	Index	Category
Alemgena	1,540.7	-	-	57.3	74.9	598.4	54.7	736.4	41.6	148.6	25.8	46.2	Poor
Kombolcha	702.2	0.4	100.0	5.8	73.7	368.2	54.6	297.3	40.7	42.1	28.3	47.7	Poor
Adigrat	432.1	-	-	36.9	74.5	285.5	56.4	103.1	43.3	6.5	32.3	54.5	Fair
Gonder	634.0	0.0	-	47.6	73.7	375.2	56.4	186.1	43.3	25.0	30.2	53.0	Fair
Debre Markos	837.9	-	-	5.0	75.9	631.3	53.4	166.7	43.4	34.9	27.4	51.5	Fair
	4,146.9	0.4	100	152.6	74.4	2,258.7	54.8	1,484.1	42.0	257.2	27.0	49.4	Poor

Source: Road Network Management Support-Lot1

5.2.2.2 Road Condition Survey Lot-2

DANA and Associates Engineering Consultants PLC present the results of the pavement condition and strength surveys conducted on paved roads under the jurisdiction of Nekempte, Jima, Sodo, Shashamene and Diredawa Road Network Management Directorates. The performance of the surveyed roads according to the calculated condition indexes as presented in Table 5-2indicate that 9%, 19%, 10%, and 62% fall under the category of Good, Fair, Poor and Very Poor condition. This shows that the majority of the road in the network i.e. 72% is in Poor to Very Poor condition with average CI of 31. A table and a chart in Figure 5-2 below show road lengths in km and conditions in percentages.

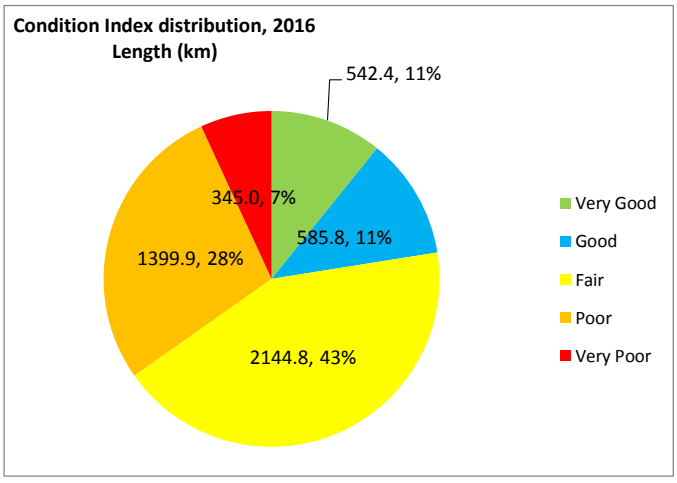
Figure 5-2:- Summarized Condition data for paved roads



Regarding unpaved roads conditions under Lot-2, the information gathered show that 43% of the total gravel roads are in fair and 28% are in poor condition. Only 11% of the network is in very good condition. See Figure 5-2 below for the details.

Figure 5-3:-- Summarized Condition data for unpaved roads by DANA and Its Associates

Condition Index Category	Length (km)	Length (%)
Very Good	542.4	11%
Good	585.8	12%
Fair	2144.8	43%
Poor	1399.9	28%
Very Poor	345.0	7%



Regarding road condition, the summary of condition assessment of 10 Years Maintenance Master Plan by HITCON and DANA Associates (done in 2016/2017) is presented in Table 5-3 below.

Table 5-2:- Summary of Condition Survey Assessment

	Road Condition (%)		
	Good	**Fair**	**Poor**
Company	Asphalt		
Lot-1	26	54	18
Lot-2	10	19	72
Average	18	36.5	45
	Gravel		
Lot-1	4	54	42
Lot-2	22	43	35
Average	13	48.5	38.5

Source: Consultant summary from 10 Years maintenance Master Plan

5.3 Rationale of the Proposed Master Plan

The purpose of the Master Plan is, while introducing characteristic features of spatial planning, to promote and guide equitable regional road network development that is consistent with maximization of national economic potential, utilization of scarce resources and support the government's ambition in creating prosperous Ethiopia. It is also a big step in achieving high degree of coordination among different layers of government and create consensus on the way road development is proceeding for the coming few years.

The consultant has considered visions to be achieved in the long-term plan (in 2050) and targets set in the short-term period (in 2030). The short-term plan is designed taking into considerations the long-term targets set for the master plan. The main points and rationale of the proposed plan are:

i. Connect any two regional capitals, major towns (population with 50,000 or more) within one-day trip in 2050. So considerable time saving will be gained and transport efficiency and mobility will be highly improved. Even though the master plan target period is 2030, it considers the long-term vision for 2050i.e. considering the long term target of connecting all regional capitals and towns (population with 50,000 or more) within a one-day trip. The Master Plan identified new links which are designated as new expressways and ring networks. The ring network shall connect

the new expressways and designed to be located in a certain interval distance from the capital and access major towns, regional capitals and borders. The implementation of expressways and rings will continue starting from 2020/21;

ii. Access all Regional capitals, Industrial Parks, Major Towns, Logistics points, and Potential areas within a one-day trip to Border entries in 2050. The new masterplan is targeted to achieve an average of one day trip from all regional capitals to border points in 2050. The identification of missing links and the implementation plan shall consider this long term target of achieving this vision in every course of the master plan study;

iii. Provide paved roads access to all Woreda capitals. From the past 5 years' experience, New Woredas have been continuously emerging so the plan may not provide asphalt road access to all Woreda capitals. In that case, it is proposed to provide paved road access within an average of 15km distance of the Woreda capital. So the identification of missing links and upgrading of gravel roads to Asphalt shall consider providing paved road access to all Woreda capitals;

iv. One of the main targets of the master plan is to expand high standard roads like expressways in all potential and economic centers. So the master plan shall consider and exercise the expansion of expressways and highways in potential areas;

v. Implementation of massive rehabilitation projects to improve transport operating efficiency and reduce transport costs for both freights and passengers and encourage production and distribution; and

vi. Create coherence and integration on existing network for better accessibility and mobility for the entire transport system in the Country.

5.4 Basic Project Selection Principles

Considering the above rationale, the consultant has set basic principles used for project prioritization and selection. These are:

i. Provide high priority for Expressways and Ring Projects, which facilitate the import and export trade and improve mobility between regional capitals and border entries. The same applies for rings;

ii. Provide high priority for new projects crossing high potential agricultural and productive areas;

iii. Provide high priority to projects crossing Industrial areas and new centers;

iv. Provide priority for projects which create linkage between towns and urban centers with the existing network;

v. Provide priority for projects accessing tourist attraction areas and provide better access;

vi. Provide priority for projects which access high mining and natural resource potentials;

vii. Provide high priority for projects, which targeted to provide access to large-scale potential farming areas in low lands of Ethiopia. The projects shall facilitate the import and export of agricultural inputs and products;

viii. Provide high priority for upgrading and rehabilitation projects which give access to Woreda Capitals, high economic centers and potentials; and

ix. Provide high priority for projects which crosses major transport corridors, import and export routes, borders and customs posts and alternative routes

5.5 Determination of Optimum Size of Road Network

The development plan for this particular study is prepared for the next 10 years i.e. up to 2030. In the course of preparation of this plan, the Consultant set long term vision-targeting 2050 and has considered the 5 and 10 years plan as an integral part of this long term vision.

Road density approaches in conjunction with random model is used to determine the optimum network size and accessibility targets of the country and regions. Selected middle income countries with similar land area, Population and GDP per capita are considered to set the target density for Ethiopia. After selecting reference countries, their average density is used to set Ethiopia's target density. This density and the total land area of Ethiopia leads to calculate the optimum road network of the country as a whole. After determining the optimum network for Ethiopia, the total additional required network to meet the middle income target is calculated and analyzed based on land area and population of each region. Then the random model is considered to determine how areas are accessible or connected or linked with the network system. A robust Geographic Information System (GIS) and data collected during socio economic survey were used as supporting tools.

A step-by-step analysis and approach is shown in the following section. The table below shows the list of countries with different Land Area, Population and GDP per capita for benchmarking.

Table 5-3:- List of Selected High, middle and low income countries with Land Area, Population and GDP

Country Name	Data as of 2018				Road Length (km)		Road Density Km/1000 sq. km	Road Density Km/1000 people
	Land Area	Population	Pop. Density	GDP per Capita	Roads (in Km)	Expressways (in Km)		
Low Income (GDP Per capita up to 1000 USD)								
Niger	1,267,000	22,442,948	17.71	412	18,949		14.96	0.84
Madagascar	587,295	26,262,368	44.72	461	21,269	714	36.22	0.81

Country Name	Data as of 2018				Road Length (km)		Road Density Km/1000 sq. km	Road Density Km/1000 people
	Land Area	Population	Pop. Density	GDP per Capita	Roads (in Km)	Expressways (in Km)		
Mozambique	786,380	29,495,962	37.51	490	32,059		40.77	1.09
Central African Republic	622,980	4,666,377	7.49	510	20,278		32.55	4.35
Congo, Dem. Rep.	2,344,860	84,068,091	35.85	562	153,497		65.46	1.83
Uganda	241,550	42,723,139	176.87	643	129,469		535.99	3.03
Liberia	111,370	4,818,977	43.27	674	10,600		95.18	2.20
Chad	1,284,000	15,477,751	12.05	730	40,231		31.33	2.60
Burkina Faso	274,220	19,751,535	72.03	731	15,272		55.69	0.77
Ethiopia	1,104,300	96,400,000	87.29	772	115,430	85	104.53	1.06
Mali	1,240,190	19,077,690	15.38	901	22,474		18.12	1.18
Benin	114,760	11,485,048	100.08	902	16,000		139.42	1.39
Yemen, Rep.	527,970	28,498,687	53.98	944	72,440		137.20	2.54
Average							100.57	
Middle Income (GDP Per capita 1000 up to 5000 USD)								
Morocco	446,550	36,029,138	80.68	3,238	57,334	1,588	128.39	1.59
Kenya	580,370	51,393,010	88.55	1,711	161,415		278.12	3.14
Cote d'Ivoire	322,460	25,069,229	77.74	1,716	81,996		254.28	3.27
Nigeria	923,770	195,874,740	212.04	2,028	193,200		209.14	0.99
Egypt, Arab Rep.	1,001,450	98,423,595	98.28	2,549	180,030	988	179.77	1.83

Country Name	Data as of 2018				Road Length (km)		Road Density Km/1000 sq. km	Road Density Km/1000 people
	Land Area	Population	Pop. Density	GDP per Capita	Roads (in Km)	Expressways (in Km)		
Average							209.94	
High Income (GDP Per capita 5000 up to 10,000 USD)								
Iraq	435,052	38,433,600	88.34	5,878	58,592		134.68	1.52
Namibia	824,290	2,448,255	2.97	5,931	44,138		53.55	18.03
Ecuador	256,370	17,084,357	66.64	6,345	42,150		164.41	2.47
South Africa	1,219,090	57,779,622	47.40	6,374	750,014	1,400	615.22	12.98
Colombia	1,141,749	49,648,685	43.48	6,651	140,672		123.21	2.83
Peru	1,285,220	31,989,256	24.89	6,947	139,295	2,758	108.38	4.35
Serbia	88,360	6,982,084	79.02	7,234	45,419	962	514.02	6.51
Libya	1,759,540	6,678,567	3.80	7,235	100,024		56.85	14.98
Thailand	513,120	69,428,524	135.31	7,274	701,847	521	1367.80	10.11
Gabon	267,670	2,119,275	7.92	8,030	9,170		34.26	4.33
Botswana	581,730	2,254,126	3.87	8,259	17,916		30.80	7.95
Brazil	8,515,770	209,469,333	24.60	8,921	1,751,868	11,000	205.72	8.36
Turkey	785,350	82,319,724	104.82	9,311	426,906	2,289	543.59	5.19
Mexico	1,964,375	126,190,788	64.24	9,698	393,473	6,144	200.30	3.12
China	9,562,910	1,392,730,000	145.64	9,771	4,846,500	142,500	506.80	3.48
Average							310.64	

Country Name	Data as of 2018				Road Length (km)		Road Density Km/1000 sq. km	Road Density Km/1000 people
	Land Area	Population	Pop. Density	GDP per Capita	Roads (in Km)	Expressways (in Km)		
Very High Income (GDP Per capita above 10,000 USD)								
Equatorial Guinea	28,050	1,308,974	46.67	10,174	2,880		102.67	2.20
Malaysia	330,345	31,528,585	95.44	11,239	144,403	1,821	437.13	4.58
Russian Federation	17,098,250	144,478,050	8.45	11,289	1,529,373	2,064	89.45	10.59
Argentina	2,780,400	44,494,502	16.00	11,653	231,374	734	83.22	5.20
Costa Rica	51,100	4,999,441	97.84	12,027	39,018	77	763.56	7.80
Romania	238,400	19,473,936	81.69	12,301	86,494	829	362.81	4.44
Uruguay	176,220	3,449,299	19.57	17,278	30,331		172.12	8.79
Czech Republic	78,870	10,625,695	134.72	23,079	130,671	1,213	1656.79	12.30
Portugal	92,226	10,281,762	111.48	23,146	82,900	2,992	898.88	8.06
Saudi Arabia	2,149,690	33,699,947	15.68	23,219	221,372	3,891	102.98	6.57
Spain	505,935	46,723,749	92.35	30,524	683,175	17,109	1350.32	14.62
Korea, Rep.	100,339	51,635,256	514.61	31,363	110,714	4,767	1103.40	2.14
Italy	301,340	60,431,283	200.54	34,318	487,700	6,758	1618.44	8.07
Japan	377,970	126,529,100	334.76	39,287	1,215,000	8,050	3214.54	9.60
France	549,087	66,987,244	122.00	41,464	965,446	11,882	1758.28	14.41
United Kingdom	243,610	66,488,991	272.93	42,491	397,039	3,701	1629.81	5.97
United Arab Emirates	83,600	9,630,959	115.20	43,005	4,080	1,392	48.80	0.42

Country Name	Data as of 2018				Road Length (km)		Road Density Km/1000 sq. km	Road Density Km/1000 people
	Land Area	Population	Pop. Density	GDP per Capita	Roads (in Km)	Expressways (in Km)		
Canada	9,984,670	37,058,856	3.71	46,211	1,042,300	16,900	104.39	28.13
Belgium	30,530	11,422,068	374.13	46,556	154,012	1,756	5044.61	13.48
Germany	357,580	82,927,922	231.91	48,196	644,480	13,009	1802.34	7.77
Hong Kong SAR, China	1,110	7,451,000	6,712.61	48,717	2,090	232	1882.88	0.28
Finland	338,450	5,518,050	16.30	49,648	454,000	926	1341.41	82.28
Austria	83,879	8,847,037	105.47	51,513	124,508	1,719	1484.38	14.07
Netherlands	41,540	17,231,017	414.81	53,024	141,374	2,808	3403.32	8.20
Sweden	447,430	10,183,175	22.76	54,112	579,564	2,050	1295.32	56.91
Australia	7,741,220	24,992,369	3.23	57,305	920,217	3,132	118.87	36.82
Denmark	42,920	5,797,446	135.08	60,726	77,732	1,254	1811.09	13.41
United States	9,831,510	327,167,434	33.28	62,641	6,853,024	108,394	697.05	20.95
Singapore	719	5,638,676	7,842.39	64,582	3,440	163	4784.42	0.61
Average							1350.46	

Source: The World Bank National account data, 2018.

From the above list of countries, the following are chosen for benchmarking Ethiopia's target road density.

Table 5-4:- List of Selected middle income countries with similar land Area and Population with Ethiopia

Country Name	Data as of 2018				Road Length (km)		Road Density Km/1000 sq. km	Road Density Km/1000 people
	Land Area	Population	Pop. Density	GDP per Capita	Roads (in Km)	Expressways (in Km)		
Middle Income (GDP Per capita 1000 up to 5000 USD)								
Morocco	446,550	36,029,138	80.68	3,238	57,334	1,588	128.39	1.59
Kenya	580,370	51,393,010	88.55	1,711	161,415		278.12	3.14
Cote d'Ivoire	322,460	25,069,229	77.74	1,716	81,996		254.28	3.27
Nigeria	923,770	195,874,740	212.04	2,028	193,200		209.14	0.99
Egypt, Arab Rep.	1,001,450	98,423,595	98.28	2,549	180,030	988	179.77	1.83
Average							209.94	

As seen from the above table, countries with similar or proportional land area against population and GDP with Ethiopia are considered and reference is made to assume average of 205km/1,000 sq. km road density for Ethiopia. Then analysis is made to determine the optimum network for Ethiopia considering Ethiopia's Land area of 1,147,831 sqkm. The optimum network for Ethiopia is estimated as 234,995 km. The existing all-weather roads network is 144,027 km. Then an additional 90,968 km is required to meet 205km per 1000 sq km road density for the whole land area.

Various assumptions should be made in distributing the required additional network in each region; two options are exercised. These are consideration of distributing the additional network proportionally based on population or area of the respective region as follow.

The formula to determine the additional required network and the optimum network for each region based on land area is:

Additional Required Network of Region "A" = (Area of Region "A" /Country Area)*90,968 km. The optimum network of Region "A"= Existing Network Volume of Region "A"+ Additional Required Network of Region "A".

The formula to determine the additional required network and optimum network for each region based on population is

Additional Required Network of Region “A” = (Population of Region “A”/Total Population of Ethiopia)*90,968 km. The optimum network of Region “A”= Existing Network Volume of Region “A”+ Additional Required Network of Region “A”.

The calculated result is shown below (Table 5.5).

Table 5-5:- Estimated Road Network based on Area and Population of Regions

Region	Area Sq. Km (A)	Pop (in million) (B)	Existing Network (C)	Existing Road Density (D)	Additional required network (in km) estimated proportional to Area of region (E)	Optimum Network C+E (F)	Road Density (B+D)/A*1000 (G)	Additional network distributed proportional to Population of region (H)	Optimum Network C+H (I)	Road Density (C+H)/A*1000 (J)
AMHARA	158316.97	21.491	26593	168	12547	39140	247	20299	32412.2	296
DIRE DAWA	1529.76	0.479	866	566	121	987	645	452	313.2	862
GAMBELLA	25803.39	0.449	2795	108	2045	4840	188	424	5282.7	125
HARARI	399.45	0.252	752	1883	32	784	1963	238	81.8	2479
SOMALI	323,290.52	5.899	6306	20	25622	31928	99	5572	66187.3	37
SOUTHERN	117742.81	19.626	28388	241	9331	37719	320	18538	24105.5	399
TIGRAY	57023.38	5.346	7651	134	4519	12170	213	5050	11674.4	223
BENISHANGUL-GUMUZ	50921.02	1.096	2345	46	4036	6381	125	1035	10425.1	66
OROMIA	317,541.28	36.364	61239	193	25166	86405	272	34347	65010.2	301
AFAR	94728.33	1.875	3394	36	7507	10901	115	1771	19393.7	55
Addis Ababa	534.1	3.433	3699	6925	42	3741	7005	3243	109.3	12996
Sum	**1147831.0**	**96.310**	**144027**	**125**	**90,968**	**234,995**	**205**	**90,968**	**234995.4**	**205**

From the above table, one can observe that the density obtained using regional land area (Column G) estimation brings or improves the imbalance between regions especially those regions which currently has less network like Somali, Afar, Benshangul Gumuz and Gambella. If we consider population to proportionally distribute the required additional network (Column H), the areal density imbalance between regions remains higher. Also length of the network per population (km/1000 pop) is important parameter to consider. Fairness or equity of Roads among regions are also measured by the length of the road per population. In the following table, existing and future road density is calculated and compared as follows.

Table 5-6:- Road Density per 1000 population for optimum network of the two options

Region Name	Area Sq. Km	Pop (in million) In 2018/19 (B)	Pop (in million) In 2030/31	All Existing Road Including	Existing Road Density (km/1000 Pop)	Optimum Network	Road Density (km/1000 Pop)	Optimum Network proportion to	Road Density (km/1000 Pop)
AMHARA	158316.97	21.491	25.482	26593	1.24	39140	1.54	46892	1.84
DIRE DAWA	1529.76	0.479	0.660	866	1.81	987	1.50	1318	2.00
GAMBELLA	25803.39	0.449	0.637	2795	6.22	4840	7.60	3219	5.05
HARARI	399.45	0.252	0.328	752	2.99	784	2.39	990	3.02
SOMALI	323,290.52	5.899	7.697	6306	1.07	31928	4.15	11878	1.54
SOUTHERN	117742.81	19.626	25.318	28388	1.45	37719	1.49	46926	1.85
TIGRAY	57023.38	5.346	6.519	7651	1.43	12170	1.87	12701	1.95
BENISHANGUL-GUMUZ	50921.02	1.096	1.477	2345	2.14	6381	4.32	3380	2.29
OROMIA	317,541.28	36.364	47.139	61239	1.68	86405	1.83	95586	2.03
AFAR	94728.33	1.875	2.371	3394	1.81	10901	4.60	5165	2.18
ADDIS ABABA	534.1	3.433	4.530	3699	1.08	3741	0.83	6941	1.53
SUM or AVE.	1147831.0	96.310	122.317	144027	1.50	234995	1.92	234995	1.92

From the above table (Column G), one can observe that the road density (km of road per 1000 population) for those regions like Somali, Afar, Benshangul Gumuz and Gambella are higher than the others when optimum network distribution using land area is considered. So their low road density (Km per 1000 sqkm) will still be higher when distributed for their less number of population. Therefore, the consultant prefers or sticks to use the optimum network estimation and readjustment (Column F) based on land area of regions as it minimizes the imbalance network volume among regions.

Random Model Approach

After the estimation of optimum network, Random model approach which is a scientific method to measure level of accessibility is used to determine accessibility. In Random model analysis, accessibility is measured in terms of the distance to the nearest section of the road network for any population. The Random Model assumes that roads can be represented by a set of infinitely long straight lines, distributed at random on a plane. For a random road network, the mean distance to the nearest road is:

Mean distance (m) = (Area/Road length) x ½ where Area=Area Considered in the model in this case area of each regions, Road length=the total length of All-weather Roads in the region.

For a random road network model, the proportion of the area farther than a given distance (d) to the network is given by: $e^{-d/m}$

Where m is the calculated mean distance to the network as shown above, d=Average distance from any point to the network and e=2.73

The accessibility estimates (the mean access distance and percentage of population farther than a given distance say 5km and 2km of the road) with an estimated inhabitable land area and a different proposed length of roads is calculated. To determine the inhabitable land area, the consultant has calculated and assumed inhabitable land area as areas where 10 person or more people per 1000 sqkm is living. Table below shows the average mean distance to all-weather road (including Woreda roads) % of area farther than 2-km and 5km using Random Model.

Table below shows the average travel distance to all-weather road (including Woreda roads), percentage of area farther than 3-km and 5km using Random Model.

Table 5-7:- Average travel distance to all weather roads and % of area farther than 2km and 5km

No	Region Name	Proposed Optimum network including Woreda and Urban Roads	Mean Distance to all weather roads (km)	% of area farther than 5km	% of area farther than 2-km
1	Amhara	39140	2.02	8%	37%
2	Dire Dawa	987	0.78	-	8%
3	Gambella	4840	2.67	15%	47%
4	Harari	784	0.25	0%	0%
5	Somali	31928	5.06	37%	67%
6	Southern	37719	1.56	4%	28%
7	Tigray	12170	2.34	12%	43%
8	Benishangul-Gumuz	6381	3.99	29%	61%
9	Oromia	86405	1.84	7%	34%
10	Afar	10901	4.34	32%	63%
11	Addis Ababa	3741		-	-
		234,995	2.49	14.4%	39%

The above analysis is undertakenconsidering the next 10 years analysis period as the main target period. Considering 205 km/1000 sq. km density, the consultant has proposed the following as target to be achieved in the year 2025 and 2030. Table below shows proposed target for the new master plan.

Table 5-8:- Proposed target for the new master plan

Sector/Indicator	Baseline 2019/20 (Including Woreda roads)	Plan Target 2024/25 (Including Woreda roads)	Plan Target 2029/30 (Including Woreda roads)
Length of All Weather Roads (in Km) including Woreda and Urban Roads	144,027	220,000.00	234,995
Road density (km/1000 km2)	125.00	161.00	205.00
Road density (km/1000 population)	1.19.0	1.50	1.78
Roads in acceptable condition (%)	55.0*	77.50	85.00
Average Time taken to all-weather road (hours)	1.7	1.50	0.85
Proportion of Area farther than 5 km from all-weather roads (%)	28.8	19.00	14.4

Note: Roads in acceptable condition were estimated based on summary of condition data from 10 Years maintenance master plan study

PROJECTS IDENTIFICATION APPROACH

6 PROJECTS IDENTIFICATION APPROACH

Road projects for different intervention types are identified and categorized systematically in Corridors: Central-Eastern Corridor (2605.4 km), Southern Corridor (5222 km), Central Western Corridor (1994.3 km), North-Western Corridor (1955 km), North-Eastern Corridor (1644.6 km), and an additional of 2605.4 km that transcends in more than one Corridor. Overall, the Consultant has identified 193 links with a total road network of 16022.5 km.

6.1 Approach

The consultant has implemented the following approach for the identification of missing links.

1. Assess and Identify current and future economic growth poles and centers
    - Identify urban centers with different population size and major growth poles such as large and medium scale industries, Surplus and Cash Crop producing areas, Potential mining areas, touristic sites etc.
    - Map all the identified growth poles and economic centers together with the existing road network
2. Identify major growth poles and economic centers which has no road access;
3. Identify missing links that are required to efficiently connect these growth poles and economic centers; and
4. Perform route selection to draw best routes on the map.

The detail methodology for the identification of missing links is explained below.

6.2 Identification of Potential Centers and Corridors

One of the critical steps in the identification of missing links is the identification of growth poles and potentials, which create a significant transport demand, but has no access to the existing network. These areas require access and connection to the nearby network. In this section, the Consultant has discussed the methodology implemented for identification of corridors and missing links within and between corridors. The selected criteria to identify missing links are:

i. Urbanization Centers: The consultant has identified and considered towns with population more than 10,000;
ii. Location of large and medium scale Industries;
iii. Areas of Industrial Parks, Agro Industrial Parks and Agro Centers;
iv. Surplus Production and Cash Crop areas of more than 10,000 Tons;
v. High Livestock potential areas;
vi. Potential areas of Large scale faming in Low Land areas;
vii. Existing and Potential Mining areas;
viii. Major touristic sites which has no road access; and
ix. Transport and logistics hubs such as Dry Ports and Customs Location, Border entries and Ethiopian Commodity Exchange Warehouses.

All these socio economic data are the bases for Traffic Generating Areas formation and the maps of each of the above data have been used as background information in the identification of missing links. The details of each are explained below.

6.2.1 Urban Centers

The development of urbanization has great role in the creation of transport demand for a given area. On the other hand, the development of modern road network system will have high influence on converting rural area to urbanization. As a result, rural–urban linkages play a crucial role in the generation of income, employment and wealth. However, infrastructure problems, institutional constraints and trade barriers tend to discourage linkages between rural and urban regions and thus prevent a process of rural empowerment and economic development. In this regard, it may be necessary to simultaneously consider rural and urban areas into regional planning units to create enabling environment for extended trade networks and knowledge exchange between metropolitan areas and countryside. Accordingly, enhanced rural–urban linkages in Ethiopia could play a crucial role in poverty reduction.

According to World Population Review (http://worldpopulationreview.com/countries/ethiopia-population/cities/Ethiopia), Ethiopia is the world's 31st largest country and the 14th most populous country in the world. Addis Ababa, the capital city, has more than three million people. This is the only city in the country that hit this milestone. There are, however, many other cities of similar to this country's large population; there are nine cities that each has a population of at least 100,000.

Hence, the Consultant will give due attention to urban areas during the identification new missing links. Accordingly, the Consultant has considered about 390 urban centers located in all regions of the country with population size of each more than 10,000. Based on this information, the Consultant performed the identification of missing links. Table 6-1 below shows categories of the urban centers with corresponding populations.

On the other hand, the situations and types of problems in cities and towns differ due to various reasons. (The problem in one urban area needs its own specific solution). For this reason, looking into urban entities seems appropriate and important to have a better picture of the problems at different urban levels and to design relevant strategies and standards. In light of this, the manual prepared by the Ministry of Urban Development and Construction adopts the classification of Ethiopian urban centers under five levels:

Table 6-1:- Category of Towns

No.	Towns Category	Population Range
1	Small Towns	2001 - 20,000
2	Medium Towns	20,001 - 50,000
3	Large Towns	50,001 - 100,000
4	Cities	100,001 - 1,000,000
5	Metropolitans	More than 1,000,000

Source: Ministry of Urban Development and Construction

The following are the characteristics of the town categories:

i. Small Towns
   - No Asphalt road (unless it is located along asphalt road);
   - No or little unpaved collector and access roads;
   - Small drainage facilities;
   - No electric power source whatsoever; and
   - No or outdated telephone service.

ii. Medium and large towns
   - Asphalt road which is part of the highway network; and
   - Mostly provided with hydroelectric power and telephone services.

iii. Cities and Metropolitans
   - Apart from the main road, most of the collector and some access roads are asphalt;
   - Drainage is better served;
   - Power is better served; and
   - Telephone is at the highest technology level.

Based on the above-mentioned classification and by taking into consideration the projected population data of 2018, the Consultant has considered towns, which have more than 10,000 populations as focus areas for identification of the missing links. The following sections describe towns that have more than 10,000 populations in different regions, zones and Woredas. There are 389 towns of more than 10,000 populations. Out of 389 towns, Federal Road does not connect 53 towns.

Urban Centers in Afar Region

There are ten towns in Afar Region with each having more than 10,000 populations. The populations of these towns range from 11,181 to 61,521. The smallest populated town is Gewane with 11,181 while the biggest populated town is Dubti with 61,521. The average

population of the selected ten towns of the Region is 27,917. Out of the 10 towns, one is not connected to the Federal road and that is Sabure. See the details in the Annex-11-7.

Urban Centers in Amhara Region

The towns with more than 10,000 populations are found in Amhara Region and they are 91. The minimum populated town is Wuchale, which with 10,251 population and Gondar is the largest town with 360,000 populations. Hence, the average number of populations of the selected 91 (ninety-one) towns of the Region is 37,884.Out of the 91 towns, 10 towns have no Federal access roads. See the details in Annex-11-7.

Urban Centers in Benishangul Region

There are nine (nine) towns in Benishangul Gumuz Region with populations of more than 10,000. The populations range from 11,891 to 52,575. The minimum populated town is Wenbera, which is 11,891, and the highest populated town is Asossa with 52,575. The average population of the selected nine towns of the Region is 20,416. All towns have Federal access roads. See the details in Annex-11-7.

Urban Centers in Gambella Region

There are five towns in Gambella Region that have populations of more than 10,000.The minimum populated town is Pegnudo that has population of 10,674 while the biggest town in the region is Gambella that has a population of 74,102. The average population of the selected five towns of the Region is 24,418. There is one town, which has no access. The details are presented in Annex-11-7.

Urban Centers in Oromia Region

Towns, which have more than 10,000 population in Oromia Region, are 132. Their populations range from the minimum 10,093 of Ticho Town in Arsi Zone to 355,475 of Adama Town in East Shewa Zone. The average population of the selected 132 (one hundred thirty-two) towns of the Region is 34,804 population. Out of 132 towns, 15 towns have no Federal Access roads. See the details in Annex-11-7.

Urban Centers in Southern Nations and Nationalities Region (SNNPR)

The numbers of towns with more than 10,000 populations in SNNPR are 82. Their populations range from 10,006 to 355,475. The minimum population is 10,006 of Kemba town and the maximum population is 335,508 of Hawassa, The average population of the selected 82 towns of the Region is 35,296. Out of 82 towns, 14 towns have no Federal access roads. See the details in Annex-11-7.

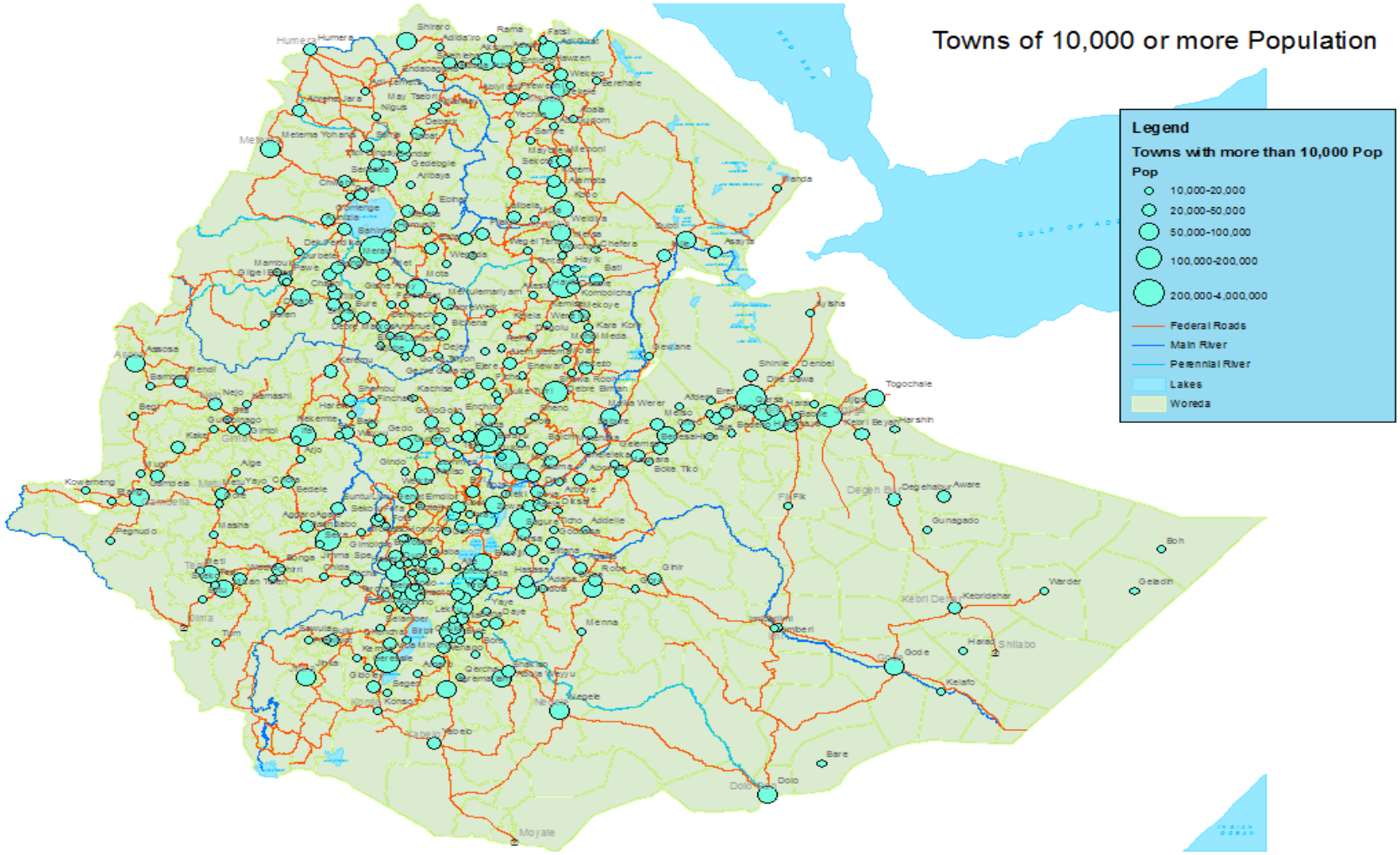
Urban Centers in Somali Region

The total number of towns with more than 10,000 population in Somali region is 24. The populations range from 10,624 to 169,390 with the minimum as 10,624 of Imi town and the maximum as 169,390 of Jigjiga town. These are among the selected twenty-four towns of the Region. The average population of the 24 (twenty-four) towns of the Region is 28,870. Out of 24 towns, 11 towns have no Federal access roads. The details are shown in Annex-11-7.

Urban centers in Tigray Region

The numbers of urban centers with more than 10,000 populations in Tigray Region are 34. The population ranges from the minimum 10,547 of Shiraro town to 358,528 population of Mekelle town. The average population of the selected 34 towns of the Region is 39,057. One town has no Federal access road. The details are shown in Annex-11-7. Moreover, the Consultant has considered Dire Dawa and Harar towns with total populations 466,000 and 246,000 respectively, as main focus area related to urbanization center. Figure below shows towns in Ethiopia with more than 10,000 Population.

Figure 6-1:- -Map showing Towns of 10,000 or more Population



Source: Consultants Analysis

Large and Medium Scale Industries

The development of industry in the country has great potential in the creation of transport demand for moving the production of industrial products from the industrial areas to international and local markets. Hence, the Consultant has considered industrial areas by giving due attention during the identification of new missing links. Accordingly, the Consultant has identified a number of large and medium size industries that are located in all regions of the country. Based on this information, the Consultant has performed the identification of missing links. Table below shows the detail distribution of operational large and medium scale industries in all regions.

Table 6-2:- -Distribution of Operational Large & Medium Scale Industries in all Regions

Regional States and Urban Centers	No. of Estab.	No. of Persons Engaged	Wages and Salaries (Birr)	Gross Value of Production (Birr)	Value Added in National Account Concept (Basic Price)	1 Fixed Assets (Birr)	2 New Capital Expenditure (Birr)
Tigray	254	33,873	1,023,044	10,653,927	4,102,134	4,507,213	1,142,827
Afar	16	6,435	127,573	2,125,946	876,180	347,980	70,509
Amhara	489	23,133	846,853	11,569,068	4,176,533	7,715,498	2,050,584
Oromiya	942	79,716	4,563,265	71,642,743	37,687,347	98,216,468	12,576,835
Somalie	26	1,003	41,422	2,401,725	1,893,211	43,635	1,112
SNNPR	297	22,562	392,842	7,911,442	2,552,576	3,438,151	884,389
Gambella	1	26	841	5,868	1,252	2,608	-
Harari	30	1,047	11,800	700,220	597,117	28,611	3,882
Dire Dawa	127	7,231	278,323	5,489,874	1,607,224	2,582,865	129,016

Source: Central Statistics Authority (CSA)

Note: The no. of persons engaged includes both permanent and contract employees. Unless the compensation is not clearly identified, it may significantly vary the wages and salaries and the same applies for Gross Value of Production per wage. The Consultant used the no. of establishment and distribution among regions and this was further identified by Woreda level and is included in the socioeconomic database.

6.2.2 Industrial Parks and Agro Processing Zones

Industrial parks are newly or recently developed economic activities in Ethiopia. If fully materialized, the newly emerged industrial parks will have high demand on road transport system of the country. Since, the capital formation, number of labors involved in the industry and the estimated amount of production of the industrial parks are very large and so the economic impact would be profound. These industrial parks accommodate information such as large amount of the capital formation, number of laborers involved in the industry, estimated amount production, etc. Thus, the Consultant will take into consideration the availability of the industrial parks project during identification of missing links. Based on this, the Consultant has identified 11 and 4 (four) new constructed and planned industrial parks, respectively. The name industrial parks, location and area covered by the industrial parks are indicated in Table below.

Table 6-3:- Industrial Parks under Implementation

No	Industrial Park Name	Location	Distance from Djibouti or Port Sudan (km)		No of Shades	Total Area (Ha)
			By Road	By Rail		
1	Bole Lemi 1	Addis Ababa	860	756	10	172
2	Bole Lemi 2	Addis Ababa	860	756	-	181
3	Kilinto	Addis Ababa	860	756	-	279
4	Adama	Adama	678	700	6	365
5	Debre Birhan	Debre Birhan	990	886	8	100
6	Kombolcha	Kombolcha	480	757	9	75
7	Mekelle	Mekelle	680	675	15	238
8	Bahirdar	Bahirdar	576	-	8	150
9	Jima	Jima	346 + 860	346 + 756	9	150
10	Hawassa	Hawassa	998	-	52	300
11	Diredawa	Diredawa	318		15	388

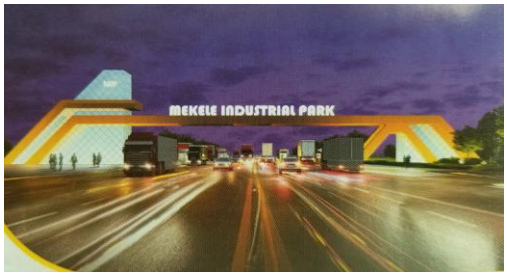
Source: Industrial Parks Development Corporation.

Note: -The no of shades for some of the Industrial Parks is not given as they are under final implementation stage. They are located in Addis Ababa and do not significantly affect the identification of missing links.

Figure 6-2:- - Front view of few Industrial Parks

Adama Industrial Park

Bahirdar Industrial Park



Mekelle Industrial Park

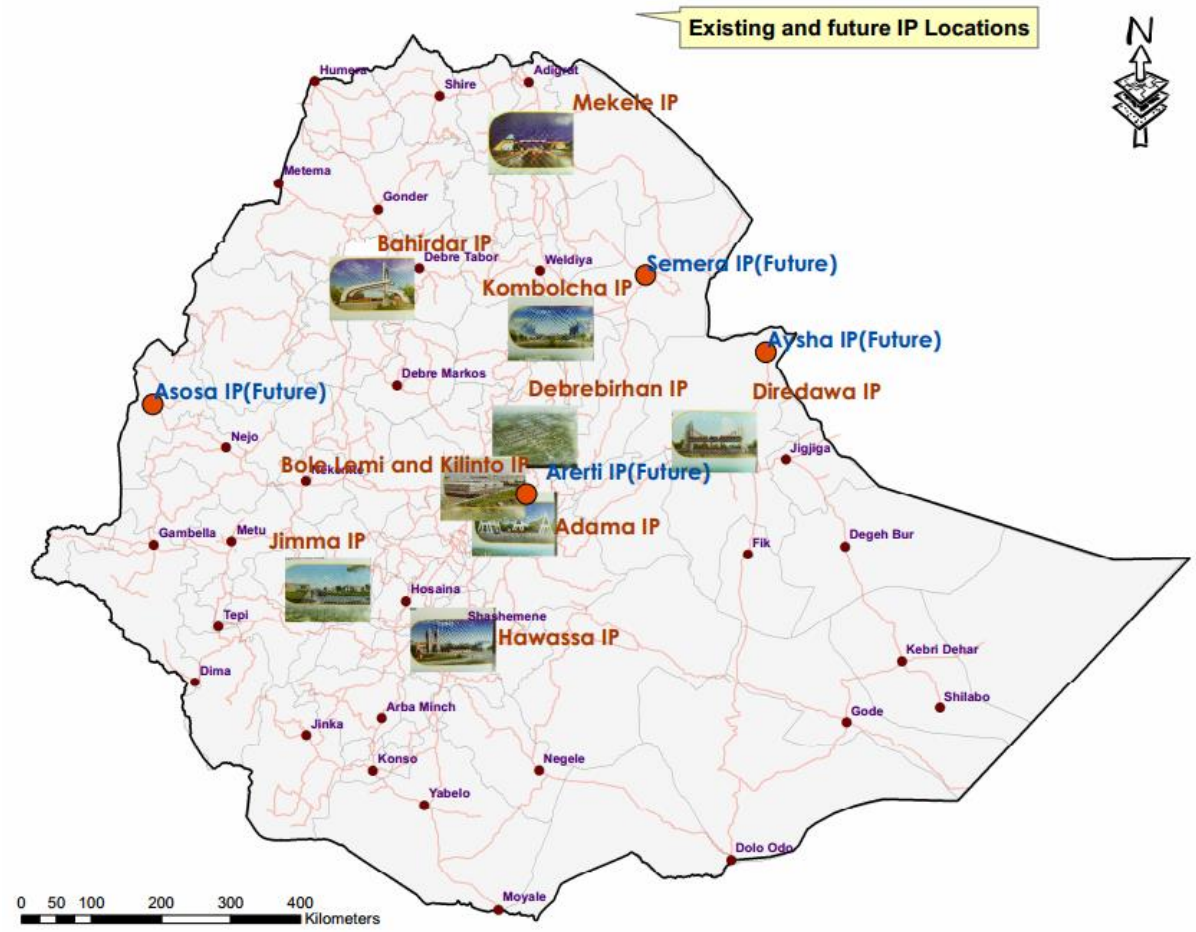
Hawassa Industrial Park

In Addition to the 11 industrial parks, four other parks are planned and currently under preparation for construction. The detail information of the future planned industrial park projects is presented in the following table. Table below shows the future planned Industrial Parks and Figure below shows the location of existing and future Industrial Parks.

Table 6-4:- Future Planned Industrial Parks

No.	Industrial Park Name	Location	Distance from Djibouti (km) or Port Sudan	
			By Road	By Rail
1	Arerti	Near Modjo	698	720
2	Ayesha	Somali on Diredawa Dewele road	250	200
3	Semera	Afar		
4	Assosa	Benshangul Gumuz	150	

Figure 6-3:-- The Location of Existing & Future Industrial Parks



6.2.3 Agro Processing Zones

The Government of Ethiopia (GOE) has identified key priority intervention areas to increase productivity of smallholder farms and expand large-scale commercial farms. Likewise, the GOE has given emphasis to develop the agricultural sector and ensure food security. Among the top priorities identified by the GOE include: small and large-scale irrigations development; agricultural inputs supply financing; increasing productivity of crops and livestock; improving agricultural production methods using mechanization, post-harvest loss reduction, developing research-based food security system; and natural resources management. As part of the second Growth and Transformation Plan (GTP II), the government is looking to the agro-processing sector as one engine to outgrowth future economic growth. In an effort to accelerate the country's agricultural development, the government has established the Agricultural Transformation Agency (ATA) to address systemic bottlenecks in the agricultural sector by supporting and enhancing the capability of the Ministry of Agriculture and Livestock Resources (MoALR) and other public, private, and non-governmental implementing partners.

In order to promote commercial-scale farming, the MoALR created the Ethiopian Agricultural Land and Investment Administration Agency dedicated to overseeing any new large-scale commercial farm deals. The goal is to increase productivity, employment, technology transfer, and foreign exchange reserves by attracting investors with incentives and favorable land lease terms.

Under GTP II, Ethiopia's future economic growth in part depends on the development of the agro-processing sector (e.g. processed food, beverages, and livestock products – meat, milk, and eggs), as well as the textile/apparel and leather industries and the latter are targeted for export markets in order to generate foreign exchange. In addition, the GOE continues to invest heavily in the expansion of the sugar industry, which is subject to planned privatization, with the aim to become one of the top ten sugar producers in the world over the next decade. In the future, the GOE intends to work with the private sector to develop capacity to process some of these commodities, like fruits and vegetables, in order to add value and capture higher export prices.

To meet its agro-processing objectives, the GOE is building Integrated Agro-Industrial Parks (IAIP). The pilot areas selected for establishment of the Agro-Industrial Parks are mainly based on the potential of existing agricultural resources and allied sectors, infrastructure, and facilities.

The African Development Bank (ADB) proposed to finance a project called Ethiopia Integrated Agro-Industrial Parks (EIAIP) Support Project. According to ADB (2018), the development of Integrated Agro Industrial Parks (IAIPs) and accompanying Rural Transformation Centers (RTCs) in Ethiopia forms part of the government-run Industrial Parks Development Corporations (IPDC) strategy to make the country's agricultural sector globally competitive. The complete approach is to develop an integrated Agro Commodity Procurement Zones (ACPZs) and IAIPs with state of-the-art infrastructure through backward and forward linkages based on all-inclusive and sustainable industrial development model. The concept of IAIPs is to integrate various value-chain components via the constellation approach. Associated RTCs are to be collection points for fresh farm feed and agricultural produce to be hauled to the IAIPs where the processing, management, and distributing (including export) activities are to take place.

The purpose of IAIPs is to attract the private sector to establish food processing plants in areas of high agricultural production and in so doing add value to agricultural produce. In addition, IAIPs is envisaged to link farmers to processing plants, reduce post-harvest losses, create jobs, drive rural economic growth, and ultimately create fortune for farmers in Ethiopia. According to ADB (2018), a network of Rural Transformation Centers (RTCs) which provides linkages between processors in IAIPs to producers and raw material supply will serve each IAIP.

RTCs are intermediate infrastructure placed closer to farming communities to provide services to the IAIPs and to the farmers. The RTC will provide integrated services to rural communities within a 100-kilometer radius of the proposed IAIP site. Farmers and farmer groups deliver their produce and receive agricultural inputs. At the RTCs, agricultural produce would be collected, sorted, stored and undergo primary processing before transported to an IAIP. Within the sphere of each RTCs are Agricultural Commercialization Centers (ACCs) located at the Kebeles to serve as bulking and sales points to famer Cooperatives and Unions.

Regarding Agro Processing zones, there are about 17 selected locations and 4 pilot zones. The GoE is developing, concurrently, four IAIPs namely: Baeker (Western Tigray Region), Bulbula (Central Eastern Oromia Region), Bure (Southwest Amhara region) and Yirgalem (Eastern SNNP Region). These are to be supported by the Italian Development Cooperation Agency (IDCA), the United Nations Industrial Development Organization (UNIDO) and the Food and Agriculture Organization (FAO).

Figures 6.4 and 6.5 below show the locations of selected Agro Industry Zones and four piloted areas.

Figure 6-4:- Identified Agro-Processing Zones in the Country

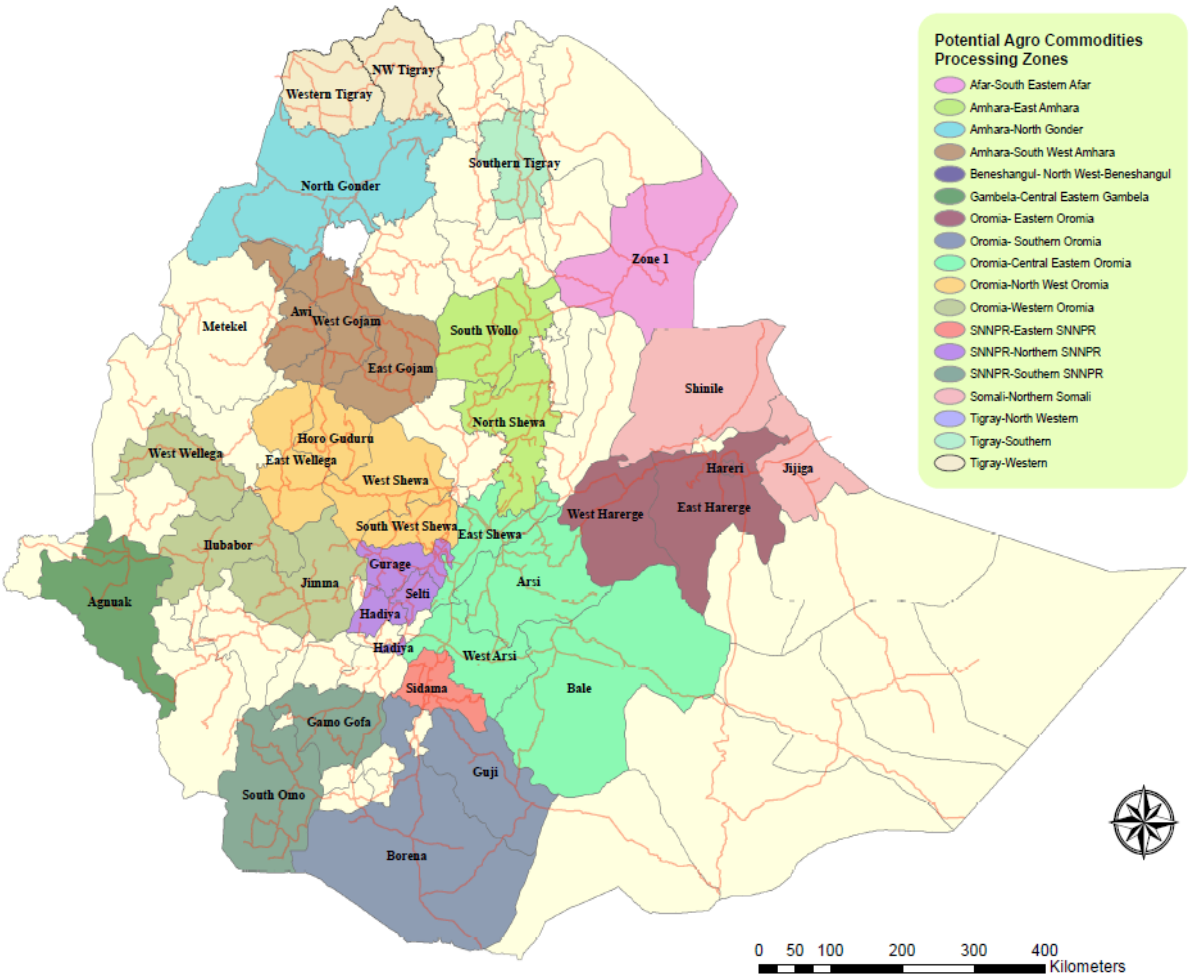
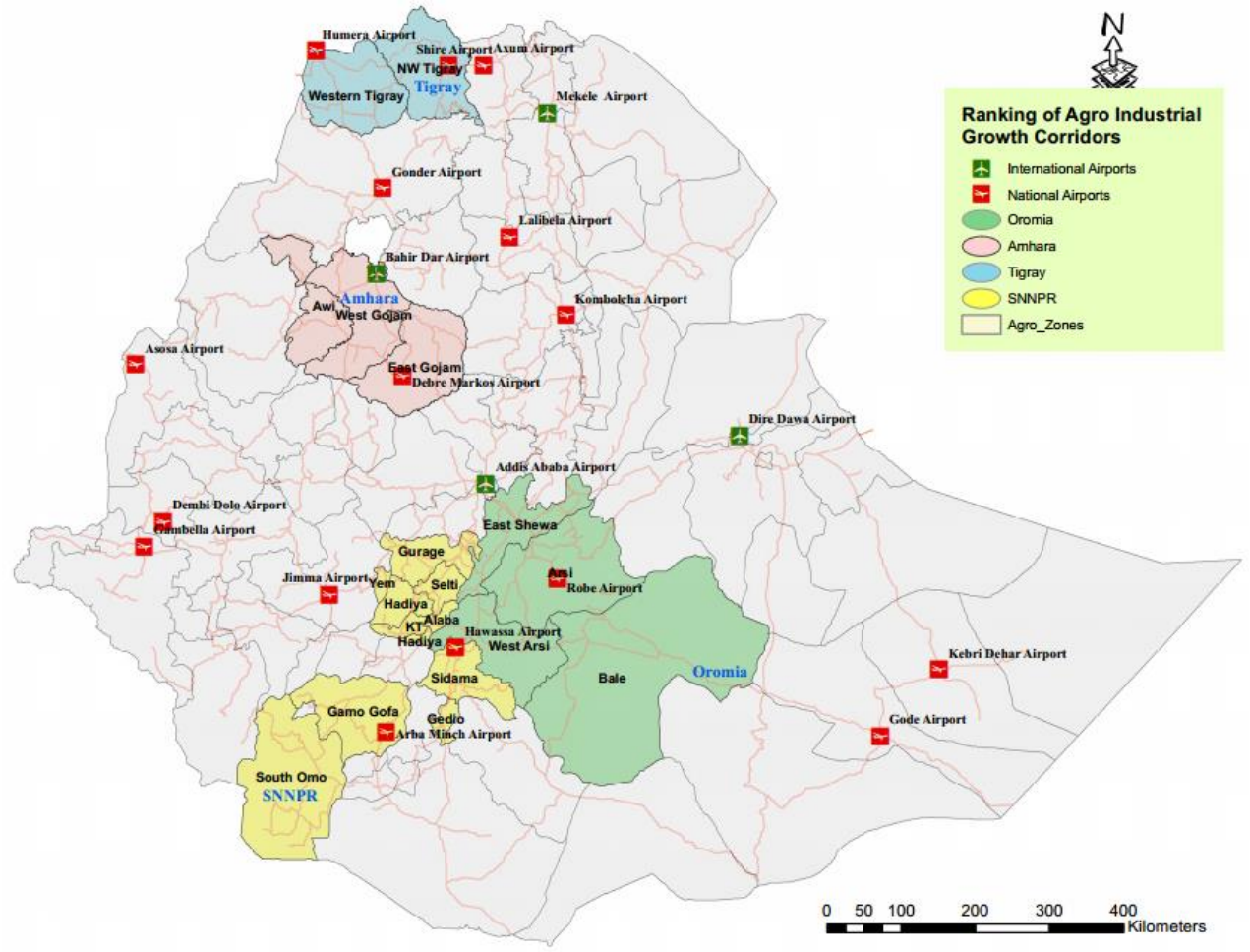


Figure 6-5:- - Pilot Agro Processing zones under implementation



6.2.4 Agro Processing Centers

There are 23 identified Agro Centers in different parts of the country. These identified agro centers are the potential locations of agro industries and sources of raw materials for major Industries and industrial parks. They are considered in the identification of Missing Links. They are shown in Table below.

Table 6-5:- Location of Agro-processing centers

No	Region	Location of Agro Centers
1	Oromia	Gebre Guracha
2	Oromia	Ambo
3	Oromia	Goba
4	SNNP	Sawla
5	Oromia	Ziway
6	Amhara	Gonder
7	SNNP	Konso
8	Tigray	Humera
9	Tigray	Shire
10	SNNP	Turmi
11	SNNP	Dila
12	Oromia	Bedele
13	Tigray	Maychew
14	Oromia	Dodola
15	SNNP	Hosaina
16	Amhara	Chagni
17	Oromia	Gimbi
18	Amhara	Debre Markos
19	Tigray	Wukro
20	Amhara	Gashena
21	Amhara	Debre Tabor
22	SNNP	Jinka
23	Harer	Harar

6.2.5 Surplus Production and Cash Crop Area

The Consultant has identified Woredas with high Surplus productions and cash crop areas. The Agricultural data collected during Socio economic Survey of the Road Functional Classification shows that there are about **553** Woredas which produce more than 10,000 quintals surplus productions which possibly create high transportation needs and demands. These Woredas are identified and used for the identification of missing links of different functions. The total surplus crop production in the country is **116, 355,936.86 quintals**. Table 6-6 below shows the number of Woredas and corresponding surplus crop productions in quintals in the Country with respective regions which produce more than 10,000 quintals crop surplus per year.

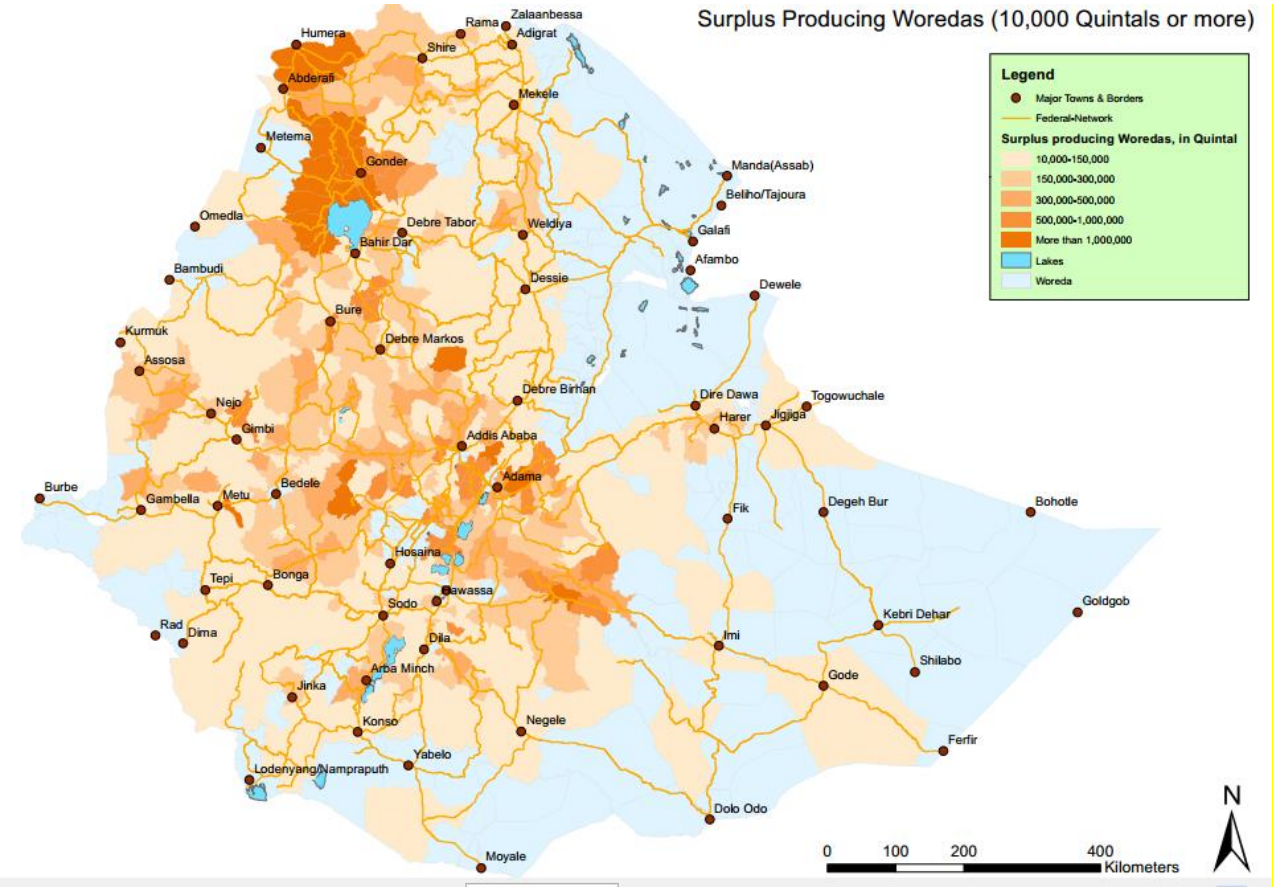
Table 6-6:- Summary of Surplus Crop Producing Woredas by Region

No	Region	Number of Woredas	Surplus Crop Production (Tons)
1	Afar	2	43,242.85
2	Amhara	127	33,359,358.26
3	Benishangul Gumuz	19	2,275,596.10
4	Gambella	3	83,347.63
5	Oromia	239	63,506,269.16
6	SNNP	113	10,988,516.06
7	Dire Dawa	1	13,959.73
8	Harari	1	12,992.82
9	Somali	14	334,924.26
10	Tigray	34	5,737,729.99
	Total	**553**	**116,355,936.86**

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

The Distribution of Surplus Producing Woredas is shown in Figure below.

Figure 6-6:- Surplus Producing Woredas of 10,000 Quintals or more



Surplus Crop production in Amhara Region

There are 127 Woredas in the Amhara Region that produce more than 10,000 quintals per year surplus crops. The total surplus crop Production of the Region was 33,359,358.26 quintals. The largest surplus crop producing zones in the Region are: North Gonder, West Gojjam and East Gojjam with respective production of 19,117,439.52, 5,694,344.67and 2,594,321.46 quintals.The numbers of Woredas with surplus crop production of the largest producer zones are 20, 14 and 17, respectively. The smallest surplus crop producer zones in the Region are Wag himra, Bahir dar Liyu and Oromia and their respective total surplus were 28,035.02, 87,124.60 and 216,904.63 quintals.

Table 6-7:- Summary of Surplus Crop Production (more than 10,000 quintals) in Amhara Region

No.	Zone	No of Woredas	Surplus Crop Production (quintal)
1	Awi	7	1,000,044.89
2	Bahir Dar Liyu	1	87,124.60
3	East Gojjam	17	2,594,321.46
4	North Gondar	20	19,117,439.52
5	North Shewa	22	1,327,357.11
6	North Wollo	9	910,661.35
7	Oromiya	6	216,904.63
8	South Gonder	9	1,398,579.14
9	South Wolo	20	984,545.86
	Wag Himra	2	28,035.02
10	West Gojjam	14	5,694,344.67
	Total	**127**	**33,359,358.26**

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in Benishangul Gumuz Region

There are 19 Woredas in Benishangul-Gumuz Region that have surplus crop production of more than 10,000 quintals per year. Most of the Woredas with more than 10,000 quintals crop surplus per year are in Asossa Zones. In this regard, the maximum surplus crop is produced in Kamashi zone, with the total surplus crop production of 1,076,014.27 quintals. It is even produced half of all the other surplus of the remaining zones. The smallest volume of surplus crop production was 41,665.30 quintals in Mao komo special woreda of the region. The total surplus crop production of the Region was 2,275,596.10 quintals. Table below shows the details of surplus crop production of the Region.

Table 6-8:- Woredas with Crop Surplus Production of More than 10,000 quintals per year in Benishangul Gumuz Region

No.	Zone	Number of Woreda	Surplus Crop (quintals)
1	Assosa	7	921,623.79
2	Kamashi	5	1,076,014.27
3	Mao Komo Special	1	41,665.30
4	Metekel	5	223,409.36

No.	Zone	Number of Woreda	Surplus Crop (quintals)
5	Pawe Special	1	49,262.91
	Total	19	2,275,596.10

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in Oromia Region

The total number of Woredas which produce surplus crops of more than 10,000 quintals per year in Oromia Region are **239**. The total surplus crop production of the region was 63,506,269.16 quintals.The largest surplus crop producer zones in the Region are: West Shewa, East Shewa and Arsi with the total productions of 10,709,036.09, 9,199,952.48 and 6,324,017.96, quintals respectively in 2017/18. The numbers of Woredas in the above largest surplus crop producer zones are 16, 13 and 24, respectively. The smallest surplus crop producer zones in the region are: Borena, West Guji and West Hararge and with respective total surplus crop production of 10,171.17, 360,856.99 and 448,594.18 quintals. The numbers of Woredas with surplus crop production in the smallest producer zones are 1, 5 and 11, respectively. Table below shows the details of surplus crop production woredas and by zone in Oromia Region.

Table 6-9:- Summary of Surplus Crop Production (more than 10,000 Quintal) of Oromia Region

No.	Region	Zone	No. of Woredas	Surplus Crop Production (quintals)
1	Oromia	Arsi	24	6,324,017.96
2	Oromia	Bale	14	5,569,932.56
3	Oromia	Beddellee	8	1,627,280.74
4	Oromia	Borena	1	10,171.17
5	Oromia	East Hararghe	15	1,899,425.19
6	Oromia	East Shoa	12	9,199,952.48
7	Oromia	East Wollega	16	3,120,122.71
8	Oromia	Finfinne Zuriya	5	1,943,864.91
9	Oromia	Guji	9	1,164,808.34
10	Oromia	Horo Guduru Wollega	9	1,402,534.43
	Oromia	Ilu Abba Bora	13	2,679,767.35
11	Oromia	Jimma	17	5,336,399.21
12	Oromia	Kellem Wollega	9	1,319,190.90
13	Oromia	North Shoa	14	5,006,923.22

No.	Region	Zone	No. of Woredas	Surplus Crop Production (quintals)
14	Oromia	South West Shoa	11	2,509,644.98
15	Oromia	West Arsi	10	1,004,106.79
16	Oromia	West Gujii	5	360,856.99
17	Oromia	West Hararghe	11	448,594.18
18	Oromia	West Shoa	17	10,709,036.09
19	Oromia	West Wollega	19	1,869,638.95
		Total	**239**	**63,506,269.16**

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in SNNP Region

There are 113 Woredas with surplus crop production of more than 10,000 quintals per year in SNNP Region. The total surplus crop production of the Region was 11,174,109.86 quintals. The largest surplus crop producer zones in the Region are Sidama, Gamo Gofa and Gurage with production in quintals of 2,661,479.86, 1,835,593.76 and 1,738,294.83 quintals, respectively. The numbers of Woredas with surplus crop production in the zones are 11, 13 and 5, respectively. The smallest surplus crop producer zones in the region are Sheka, Gedeo and Special Woredas with respective volumes of production 81,925.02, 204,547.32 and 251,096.52 quintals. The numbers of Woredas with the smallest surplus crop production of the zones are 1, 6 and 6. Table below shows the details of surplus crop production in SNNP Region in 2017/18.

Table 6-10:- Summary of Surplus Crop Production (more than 10,000 quintals) of SNNP Region

No.	Zone	No. of Woredas	Surplus Crop Production (quintals)
1	Bench Maji	10	435,318.44
2	Dawuro	5	465,453.97
3	Gamo Gofa	10	1,835,593.76
4	Gedeo	6	204,547.32
5	Gurage	8	1,738,294.83
6	Hadiya	7	691,659.77
7	Kefa	10	257,186.98

No.	Zone	No. of Woredas	Surplus Crop Production (quintals)
8	Kembata Timbaro	7	338,870.73
9	Segen Hizboch	4	329,032.39
10	Sheka	3	81,925.02
11	Sidama	18	2,069,255.59
12	Siliti	1	592,224.27
13	South Omo	6	323,901.30
14	Wolayita	13	1,374,155.17
15	Special Woredas	5	251,096.52
	Total	113	10,988,516.06

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in Somali Region

The total numbers of Woredas in Somali Region which produce surplus crop of more than 10,000 quintals in the year are 14 woredas. The total surplus crop production was 334,924.26 quintals. The largest surplus crop producing zone is Afder and the amount of production of surplus crop production during the year is 138,320.30 quintals. On the other hand, the smallest surplus quantity was produced in Jigjiga Zone with 95,203.80 quintals. Table below shows the details of surplus crop production in Somali Region.

Table 6-11:- Woredas with Produced Crop Surplus (more than 10,000 quintals) in Somali Region

No.	Zone	Number of Woreda	Surplus Crop (quintals)
1	Afder	6	138,320.30
2	Gode	4	101,400.17
3	Jijiga	4	95,203.80
	Total	**14**	**334,924.26**

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in Tigray Region

In Tigray, there are 41 Woredas that produce more than 10,000 quintals of surplus crops. In 2017/18, the total amount of surplus crops produced in Tigray region was 5,737,729.99 quintals. The largest surplus crop producer zone is Western zone and the quantity of surplus production during the year was 1,679,306.14 quintals. While the smallest surplus crop producer zone is Eastern zone and the amount of production during the year was 406,460.73 quintals. Table below shows the details.

Table 6-12:- Surplus Crop (more than 10,000 quintals) in Tigray Region

No	Zone	Number of Woreda	Surplus Crop (quintals)
1	Central Zone	9	970,991.69
2	Eastern Zone	6	406,460.73
3	North Western Zone	6	1,237,188.52
4	South Eastern Zone	4	522,800.14
5	Southern Zone	5	903,015.67
6	Western Zone	3	1,679,306.14
7	Mekele Especial Zone	1	17,967.11
	Total	**34**	**5,737,729.99**

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in Gambella Region

There are 3 Woredas with crop surplus production in Gambella Region. The largest surplus crop producer woreda during the year was Gambella Zuria woreda and the amount of production of the woreda was 54,417.79 quintals. Whereas, the smallest surplus crop producer woreda is Goge and the amount of production during the year is 11,198.64 quintals. Table below shows the details.

Table 6-13:- Produced Surplus Crop (more than 10,000 quintals) in Gambella Region

No.	Zone	Woreda	Surplus Crop (quintals)
1	Agnuwak	Gambella Zuria	54,417.79
2	Agnuwak	Abobo	17,731.21
3	Agnuwak	Goge	11,198.64
		Total	**83,347.63**

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in Hareri Region

There is one Woreda, Hunde, in Hareri Region which produces surplus crops of more than 10,000 quintals per year. In 2017/18, Hunde Woreda produced 12,992.82 quintals of surplus crops. Table below shows the detail of surplus crop production in Hareri Region.

Table 6-14:- Produced Surplus Crops (more than 10,000 quintals) in Hareri Region

No.	Zone	Woreda	Surplus Crop (quintals)
1	Hareri	Hunde	12,992.82
			12,992.82

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in Dire Dawa

There is one Woreda, Gorgora, in Dire Dawa which produces surplus crops of more than 10,000 quintals per year. In 2017/18, Gorgora Woreda produced 12,992.82 quintals of surplus crops. Table below shows the detail of surplus crop production in Dire Dawa.

Table 6-15:- Produced Surplus Crops (more than 10,000 quintals) in Dire Dawa

No.	Zone	Woreda	Surplus Crop (quintals)
1	Gorgora	Gorgora	13,959.73
			13,959.73

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

Surplus Crop production in Afar Region

There are 2 Woredas with crop surplus production in Afar Region. The largest surplus crop producer woreda during the year was Teru woreda and the amount of production of the woreda was 31,912 quintals. Whereas, the smallest surplus crop producer woreda is Erebti and the amount of production during the year is 11,330 quintals. Table below shows the details.

Table 6-16:- Produced Surplus Crop (more than 10,000 quintals) in Afar Region

No.	Zone	Woreda	Surplus Crop (quintals)
1	Zone-2	Erebti	11,330
2	Zone-4	Teru	31,912
		Total	43,242

Source: Central Statistics Agency (CSA), 2017/18 and Computed by the Consultant

- Areas of Livestock Potential

Livestock is one of the contributor for traffic generation. The consultant has identified all livestock Potential Woredas in all regions in order to analyze their accessibility to the existing network. The number of livestock population and their distribution is visualized with the existing network to have information on the demand of new links. The following table shows the livestock population by region.

Table 6-17:- Livestock Potential by Region

Region	Ox & Cow	Mule	Horse	Donkey	Camel	Goat	Sheep
Afar	2187895	906	73	189356	872777	6869412	1578111
Amhara	14766099	205343	355941	2173102	83467	5456117	8448100
Benishangul Gumuz	910590	8252	44409	95717	859	595940	264218
Dire Dawa	52716	137		19772	5740	202707	75419
Gambella	282650	76	747	1737	0	99013	44298
Harari	54680			9875		50263	5929
Oromia	42639519	635383	2274177	4503080	1492188	17327491	16322657
SNNP	25203655	490064	979189	1290784	3789	9479299	9891327
Somali	4486276	677	14257	330587	4043808	10902408	11018389
Tigray	5135540	6772	4125	828683	6800	4721630	2180423
Grand Total	95719620	1347610	3672918	9442693.445	6509428	55704280.57	49828871

Source: Consultant data collection from Regions and Zones

6.2.6 Surplus Crops Producing Woredas without Federal Access Roads

The Consultant has identified Surplus Producing Woredas which have no federal access roads. This helps to easily identify Surplus Producing Woredas which require roads to be linked with the Federal Network. Using GIS, the Consultant has identified and analyzed 104 Woredas without Federal access roads which produce more than 22 million quintals. Table below shows the details.

Table 6-18:- Surplus production (more than 10,000 Quintals) Woredas without Federal Roads

No	Region	Zone	Woreda	Surplus Prod. In Quintal
1	Amhara	Awi	Ankasha Guagusa	138406.0
2	Amhara	East Gojjam	Baso Liben	215773.1
3	Amhara	East Gojjam	Shebel Berenta	119106.7
4	Amhara	North Gondar	Merab Belesa	512797.0
5	Amhara	North Shewa	Antsokiya Gemza	19635.4
6	Amhara	North Shewa	Gishe	20410.7
7	Amhara	North Shewa	Menz Lalo Meder	33615.9
8	Amhara	North Wollo	Dawunt	31737.8
9	Amhara	Oromiya	Dewe Harewa	14515.9
10	Amhara	South Gonder	Tach Gayint	53175.8
11	Amhara	South Wolo	Alibuko	21307.5
12	Amhara	South Wolo	Mehal Sayit	31728.7
13	Amhara	South Wolo	Mekdela	77084.8
14	Amhara	South Wolo	Sayinit	75299.9
15	Amhara	Wag Himra	Dehena	12126.1
16	Amhara	West Gojjam	Sekela	37006.9
17	Amhara	West Gojjam	Wenberma	155138.4
18	Benishangul Gumuz	Kamashi	Agalometi	25867.8
19	Gambella	Agnuwak	Abobo	17731.2
20	Gambella	Agnuwak	Goge	11198.6
21	Oromia	Arsi	Enkelo Wabe	309372.4
22	Oromia	Arsi	Sude	247127.5
23	Oromia	Arsi	Tena	245328.5

No	Region	Zone	Woreda	Surplus Prod. In Quintal
24	Oromia	Arsi	Zeway Dugda	286298.8
25	Oromia	Bale	Berbere	195786.5
26	Oromia	Bale	Legehida	10988.7
27	Oromia	Bale	Gura Damole	48844.7
28	Oromia	East Hararge	Bedeno	126624.0
29	Oromia	East Hararge	Fedis	16875.8
30	Oromia	East Hararge	Gole Oda	58037.2
31	Oromia	East Hararge	Melka Belo	103870.0
32	Oromia	East Shewa	Gimbichu	1031394.8
33	Oromia	East Wellega	Boneya Bushe	28445.5
34	Oromia	East Wellega	Ebantu	151583.5
35	Oromia	East Wellega	Limu	198785.1
36	Oromia	East Wellega	Nunu Qumba	59841.7
37	Oromia	East Wellega	Wama Hagelo	123455.2
38	Oromia	Guji	Dima	71496.0
39	Oromia	Guji	Hambela Wamena	93075.8
40	Oromia	Guji	Qercha	45722.9
41	Oromia	Guji	Uraga	155705.0
42	Oromia	Horo Gudru Wellega	Hababo Guduru	141253.7
43	Oromia	Ilu Aba Bora	Becho	37973.1
44	Oromia	Ilu Aba Bora	Boricha	198481.9
45	Oromia	Ilu Aba Bora	Chewaqa	439643.8
46	Oromia	Ilu Aba Bora	Darimu	401886.7
47	Oromia	Ilu Aba Bora	Diga	88436.0
48	Oromia	Ilu Aba Bora	Doreni	23445.5
49	Oromia	Ilu Aba Bora	Meko	130479.2
50	Oromia	Ilu Aba Bora	Nono Sele	13141.3
51	Oromia	Jimma	Setema	250219.4
52	Oromia	Jimma	Sigmo	162596.5
53	Oromia	Jimma	Tiro Afeta	266458.3
54	Oromia	North Shewa	Dera	1691591.6

No	Region	Zone	Woreda	Surplus Prod. In Quintal
55	Oromia	North Shewa	Hidabu Abote	366637.4
56	Oromia	North Shewa	Jido	61158.2
57	Oromia	North Shewa	Mulo	183580.5
58	Oromia	North Shewa	Yaya Gulele	400923.2
59	Oromia	Qeleme Wellega	Gawo Qebe	53273.1
60	Oromia	Qeleme Wellega	Jimma Horo	89707.8
61	Oromia	Qeleme Wellega	Yemalogi Welel	80530.7
62	Oromia	South West Shewa	Ameya	521848.7
63	Oromia	South West Shewa	Tole	199327.4
64	Oromia	West Arsi	Kokosa	46293.0
65	Oromia	West Arsi	Kore	38717.8
66	Oromia	West Arsi	Siraro	50020.8
67	Oromia	West Hararge	Boke	26312.5
68	Oromia	West Hararge	Guba Qoricha	31000.4
69	Oromia	West Hararge	Mesela	24981.2
70	Oromia	West Shewa	Dano	7299748.9
71	Oromia	West Shewa	Elifata	25115.3
72	Oromia	West Shewa	Jibat	96889.3
73	Oromia	West Shewa	Metarobi	62683.6
74	Oromia	West Shewa	Midakegni	164152.0
75	Oromia	West Shewa	Tikur Enchini	95643.7
76	Oromia	West Wellega	Boji Cheqorsa	57945.4
77	Oromia	West Wellega	Genji	63150.5
78	Oromia	West Wellega	Haru	109572.7
79	Oromia	West Wellega	Homa	21579.5
80	Oromia	West Wellega	Nole Kaba	23461.2
81	Oromia	West Wellega	Seyo Nole	67443.7
82	SNNP	Bench Maji	Bero	64800.2
83	SNNP	Bench Maji	Surima	15382.8
84	SNNP	Dawuro	Esira	25635.3
85	SNNP	Dawuro	Gena Bosa	45553.9

No	Region	Zone	Woreda	Surplus Prod. In Quintal
86	SNNP	Gamo Gofa	Boreda	299334.9
87	SNNP	Gedeo	Bule	41563.8
88	SNNP	Hadiya	Duna	148514.4
89	SNNP	Kefa	Cheta	16665.6
90	SNNP	Kefa	Sayilem	20094.4
91	SNNP	Kembata Timbaro	Anigacha	61133.9
92	SNNP	Kembata Timbaro	Daniboya	108362.6
93	SNNP	Sidama	Arbegona	612872.1
94	SNNP	Sidama	Awasa Zuriya	199957.5
95	SNNP	Sidama	Gorche	35544.1
96	SNNP	Sidama	Loko Abaya	15234.0
97	SNNP	Sidama	Malga	265279.6
98	SNNP	Sidama	Wensho	54362.1
99	SNNP	Siliti	Lanifaro	592224.3
100	SNNP	South Omo	Gelila	11584.8
101	SNNP	Wolayita	Bolossa Bonibe	70185.1
102	Somali	Afder	Kersa Dula	29973.2
103	Somali	Fik	Selehad	27576.9
104	Somali	Jijiga	Harshin	15405.6

6.2.7 Government's future Plan on Low Land Farming in different parts of the Country

The Ethiopian Government has a plan to expand and develop the country's agriculture towards low land areas using mechanized framings. A number of irrigation projects has been underway or completed along the major rivers in different parts of the country. The Megech and RIBB projects are among the few large-scale irrigation projects that have been developed with financial support by the World Bank with an approved loan of about US $100 million.

The Consultant has acquired few of the major perennial rivers, which have potentials for large-scale irrigation development projects. Table below shows the major rivers with corresponding lengths (km) in Ethiopia.

Table 6-19:- Major Rivers and their Length in Ethiopia

No.	River	Length (km)		
		In Ethiopia	Outside Ethiopia	Total
1	Abay	800	650	1,450
2	Wabi Shebele	1,000	130	1,130
3	Genale	480	378	858
4	Awash	1,200	0	1,200
5	Omo	760	0	760
6	Tekeze	608	0	608
7	Mereb	440	0	440
8	Baro	277	0	277
9	Angereb	220	0	220
10	Weyib	256	-	256

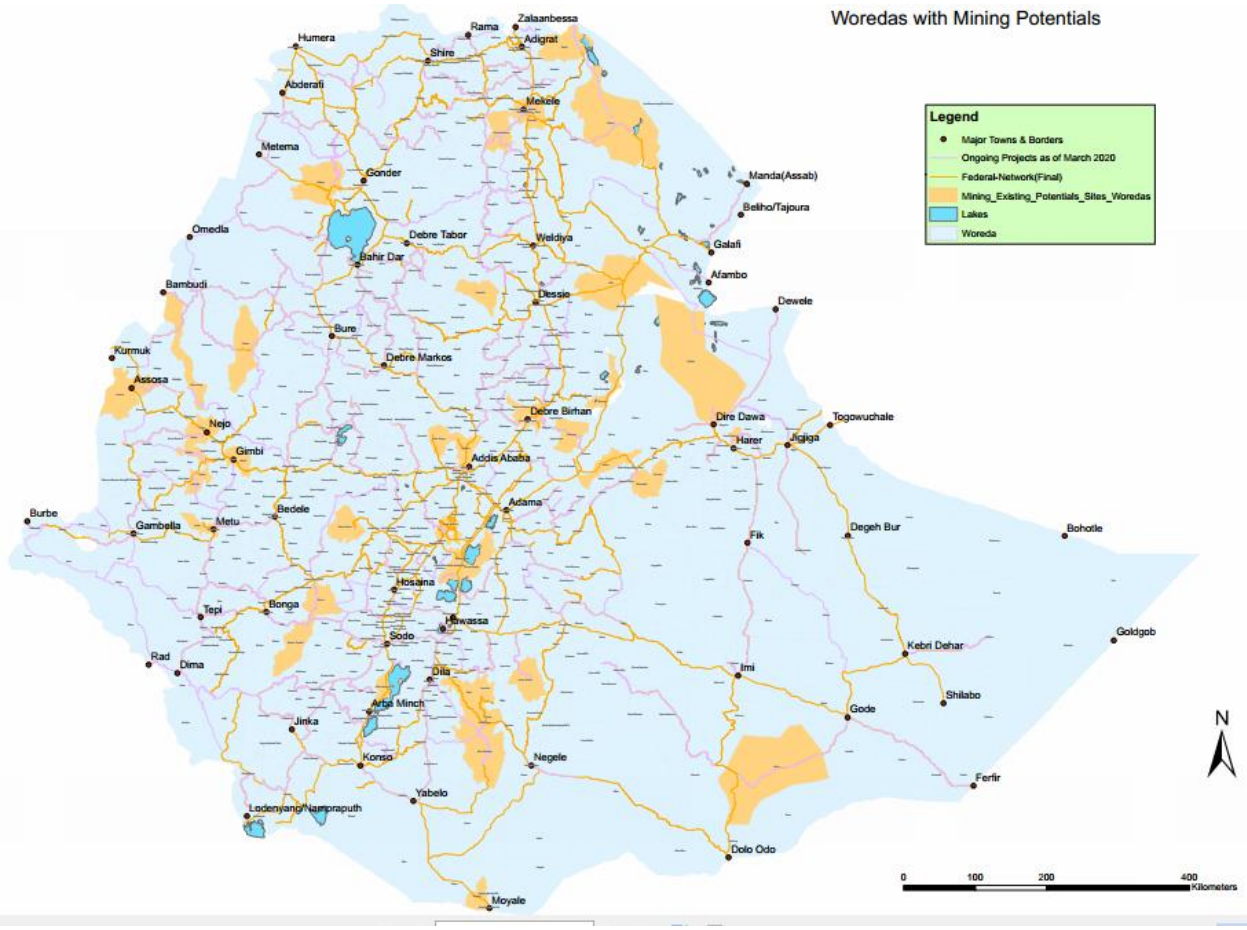
Source: Consultant Analysis

Among the few major rivers in the South Eastern Oromia, Southern Somali, Afar and Gambella regions, Wabishebele, Weyib, Genale, Awash and Baro Rivers and their tributaries are identified and an average of 20-km buffers on both side of the rivers which has mostly flat and rolling terrain are assumed as possible potentials for large scale farming. These areas require road infrastructures that facilitate the import and export of agriculture products and inputs in the future.

6.2.8 Existing and Future Mining Potentials

The Consultant has collected data on the existing and future mining potentials and mapped them to have sufficient information on the distribution and availability of road infrastructure. Figure below shows the location, type and size of mineral potentials in Ethiopia.

Figure 6-7:- Map of Woredas with Mining Potentials



6.2.9 Identification of Tourist site attractions

Facilitating tourist site attractions with all the necessary infrastructures is one of the government direction in order to get the desired income from the sector. Tourism is one of the pillar of government income generation and future focus. The consultant has identified all tourist site attractions and analyzed their accessibility with the existing network. Also the type and quality of pavement is also studied in order to visualize their access to the existing network. The following table shows the no of major tourist site attraction by region.

Table 6-20 :- No of major Tourist Site attraction

Region	No of Major Tourist Attraction Sites
Afar	14
Amhara	38
Benishangul Gumuz	3
Dire Dawa	1
Gambella Region	3
Harari	3
Oromia	56
SNNP	24
Somali	14
Tigray	21
Grand Total	177

Source: Consultant data collection and Analysis

6.2.10 Transport and Logistics Hubs

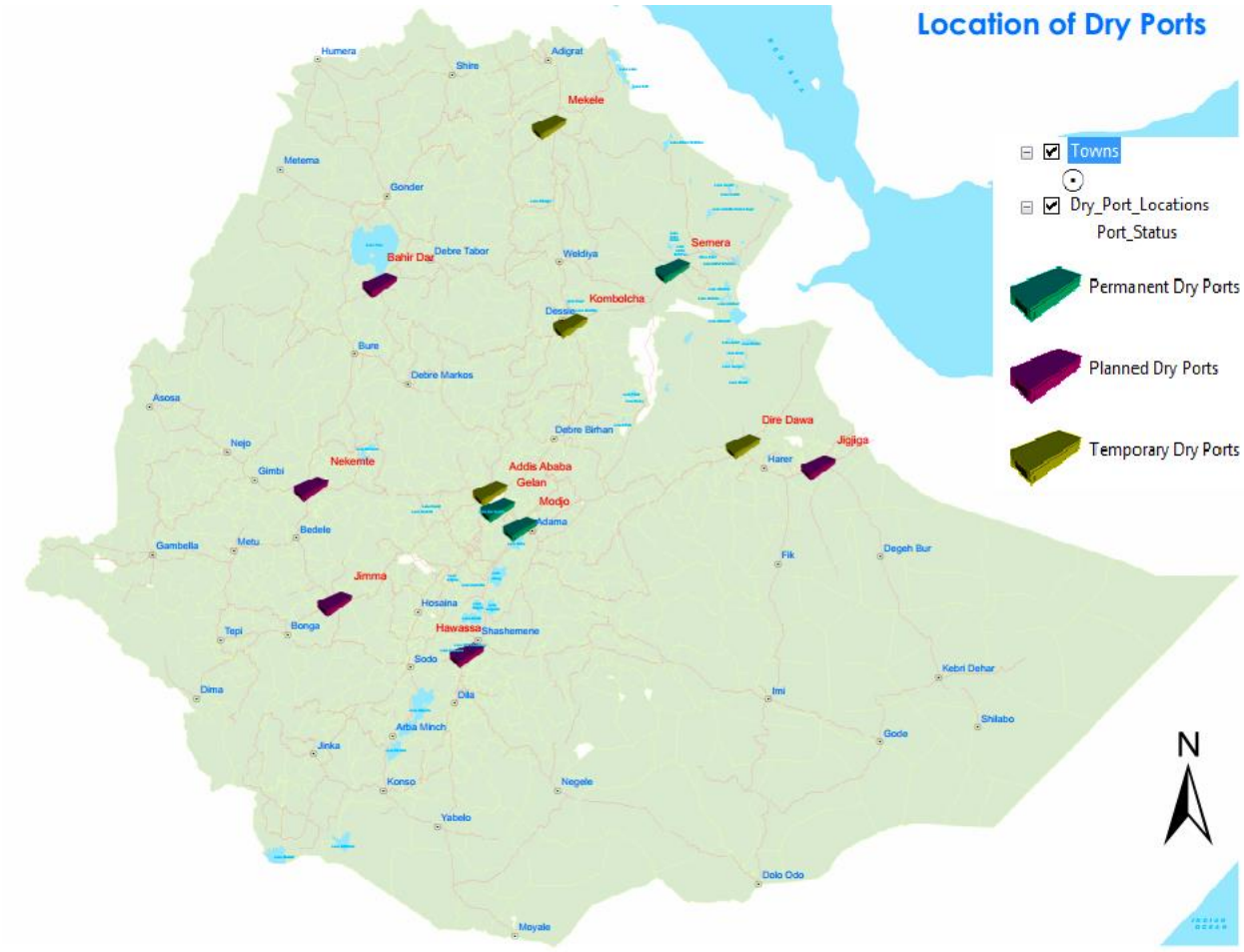
- **Dry Ports**

Locations of Dry Ports in the Country are among the criterion to identify missing links. The Ethiopian Shipping Lines Service Enterprise (ESLSE) has built and is building dry ports in different parts of the country. Currently, there are seven dry ports, which are located at Kaliti, Gelan, Modjo, Semera and Dire Dawa, all located along the Addis Ababa – Djibouti corridor. The remaining two are located at Kombolcha, 400 kilometers north of Addis Ababa and Mekelle, about 370 kilometers further north of Kombolcha and about 770 km north of Addis Ababa. The Dry Port at Modjo handles about 80% of the Country's import-export markets along the Ethiopia-Djibouti trade corridor. The ESLSE is also to build two Dry Ports, the first one at Hawassa, about 280 kilometers south of Addis Ababa and the second one at Wereta, about 625 kilometers north-west of Addis Ababa, about 60 km north of Bahar Dar town.

The Ethiopian Shipping Lines has also a plan to construct dry ports in Mekelle, Bahirdar, Jima, and Nekemet. By the end of the first Growth and Transformation Plan (GTPI) that is

2014/15, the total number of dry ports was planned to be 35, according to ESLSE. These sites were planned to be distributed across the six of the nine regions in the country, excluding Afar, Benishangul and Harari regions. Figure below shows locations of Dry Ports.

Figure 6-8:- Location of Dry Ports

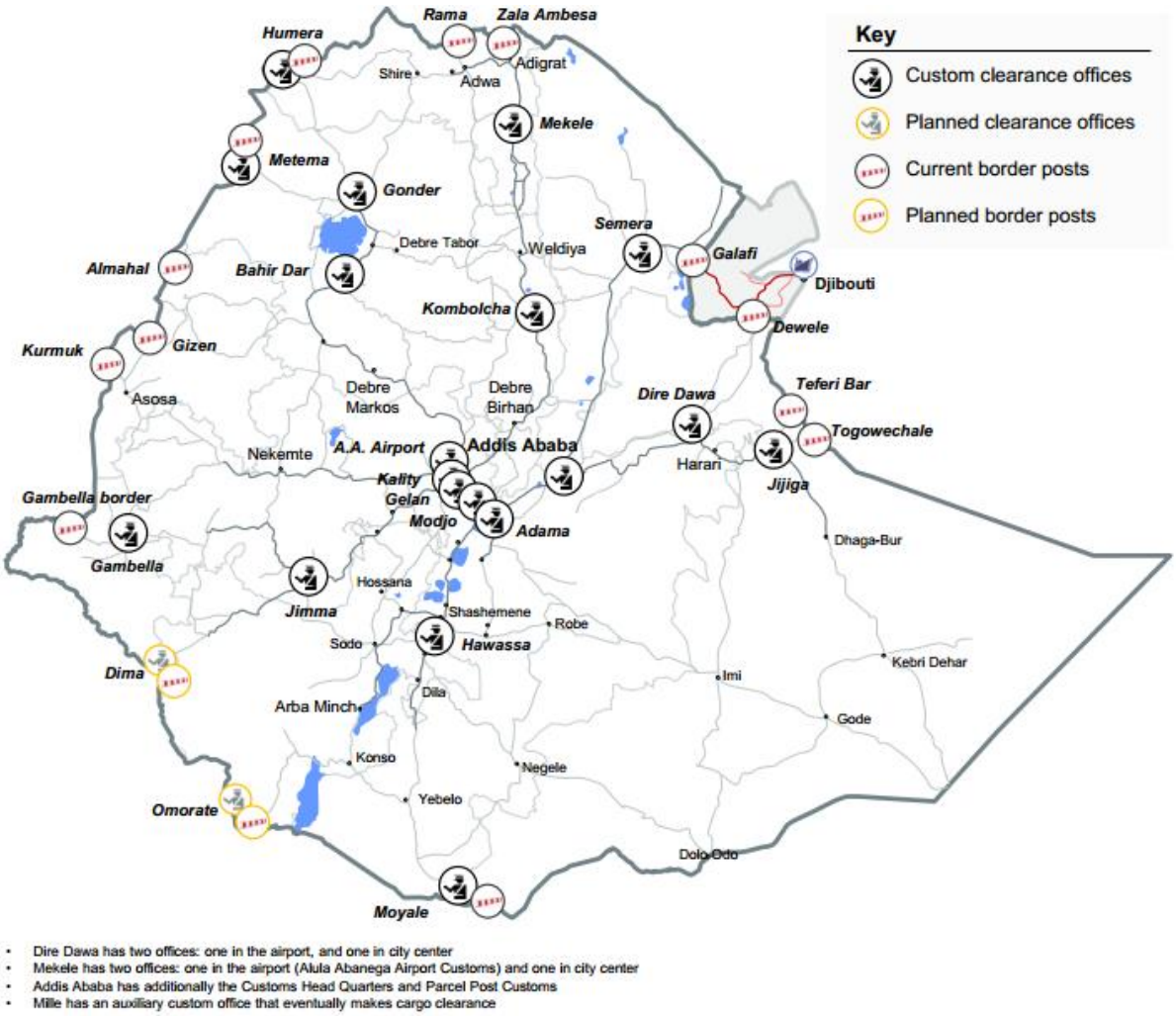


- **Customs and Border entries**

The Consultant has also considered the location of customs offices for identification of missing links. Customs offices have been strategically established in different parts of the Country to collect income taxes and revenues. The numbers have been expanding by years. By 2017/18, 12 Customs offices were functioning located at Head Office in Addis Ababa, Addis Ababa Airport, Modjo, Adama, Bahirdar, Diredawa, Kombolcha, Mekelle, Jigjiga, Moyale, Mille, and Galafi. During this time, a total of Birr 9,859.90 billion was

planned and Birr 5,554.57 billion (56.3%) was collected. The maximum of the entire total was collected at Kality office (about 42%) followed by Modjo office (20.2%) and third at Adama office (20.3%) where the three offices collected more than 80% of the customs duty. Figure below shows the locations of Customs Offices in the Country.

Figure 6-9:- Locations of Customs Offices and Border entries



Source: Analytical Work on Transport Sector in Ethiopia, Growth, Competitiveness and Regional Integration, African Development Bank, Jose Enrique Perez, December 2014)

Regarding border entries, for more than twenty years in the past, more than 90% of the country's imports and exports have been handled through Djibouti Port. There are some commodities handled through Port of Sudan. However, there are more than five potential

ports to handle Ethiopia's imports and exports and these are: Djibouti Port in the Republic of Djibouti; Massawa and Asab ports in Eritrea; Hargessa port in Somaliland; Port Sudan in the Sudan; and Mombasa in Kenya. There are more potential ports along the Red Sea.

Massawa and Assab ports in Eritrea are to resume rendering port services for Ethiopia. The Massawa port is ideal to facilitate the imports and exports of the northern Ethiopia regions of Tigray and Amhara whereas; Assab and Djibouti ports can facilitate imports and exports of Oromiya Region, Amhara Region and the northern part of the Southern Nations and Nationalities Peoples Region (SNNPR). Similarly, the Hargessa Port in Somaliland can serve the imports and exports of Eastern Ethiopia; Port Sudan can facilitate imports and exports of Western Tigray and Northwestern Amhara regions; lastly, Mombasa Port in Kenya can render services for the imports and exports of the southern and southeastern parts of SNNPR. Therefore, it is up to Ethiopia to optimize its import-export operations through proper utilization of rational ports based on reliability, security and proximity.

6.2.11 Ethiopia Commodity Exchange (ECX) Warehouses

The Ethiopia Commodity Exchange (ECX) is a new initiative for Ethiopia and the first of its kind in Africa established in April 2008. The ECX is a unique partnership of market actors that is, the Members of the Exchange and its main promoter, the Government of Ethiopia. ECX represents the future of Ethiopia, bringing integrity, security, and efficiency to the market. ECX creates opportunities for unparalleled growth in the commodity sector and linked industries, such as transport and logistics, banking and financial services, and others. The ECX commenced trading operations in April 2008 that has invited membership of the agricultural and trade industry. The ECX was started to benefit and modernize the way Ethiopia was trading its most valuable assets, its commodities. Ethiopia needed a change from the traditional means of trading to better support the needs of all those involved in the trading and production.

ECX creates trust and transparency through aggressive market data dissemination to all market actors, through clearly defined rules of trading, warehousing, payments and delivery and business conduct, and through an internal dispute settlement mechanism. ECX provides market integrity at three important levels: the integrity of the product itself, the integrity of the transaction, and the integrity of the market actors.

ECX is developing a new method of exchange and a safer one for all who trade on it. A marketing system that coordinates better, that links faster, and that protects the interests of both sides of the trade. It is time for a marketing system that is transparent, efficient, and

innovative. The ECX is a marketplace, where buyers and sellers come together to trade, assured of quality, delivery and payment. The vision of ECX is to transform the Ethiopian economy by becoming a global commodity market of choice. ECX's mission is to connect all buyers and sellers in an efficient, reliable, and transparent market by harnessing innovation and technology, and based on continuous learning, fairness, and commitment to excellence.

ECX promotes and enables the following market services:

- **Market integrity** by guaranteeing the product grade and quantity and operating a system of daily clearing and settling of contracts;
- **Market efficiency** by operating a trading system where buyers and sellers can coordinate in a seamless way on the basis of standardized contracts;
- **Market transparency** by disseminating market information in real time to all market players; and.
- **Risk management** by offering contracts for future delivery, providing sellers and buyers a way to hedge against price risk.

The Ethiopian Commodity Exchange (ECX) as one of the pillars of the export trade in the country, it is continuously expanding its territories and its number of warehouses has reached 17, including the new warehouse in Metu town. Table below shows the locations of warehouses and the types of commodities that have been traded. Subsequently, Figure below shows map of the distribution of the ECX warehouses in the Country.

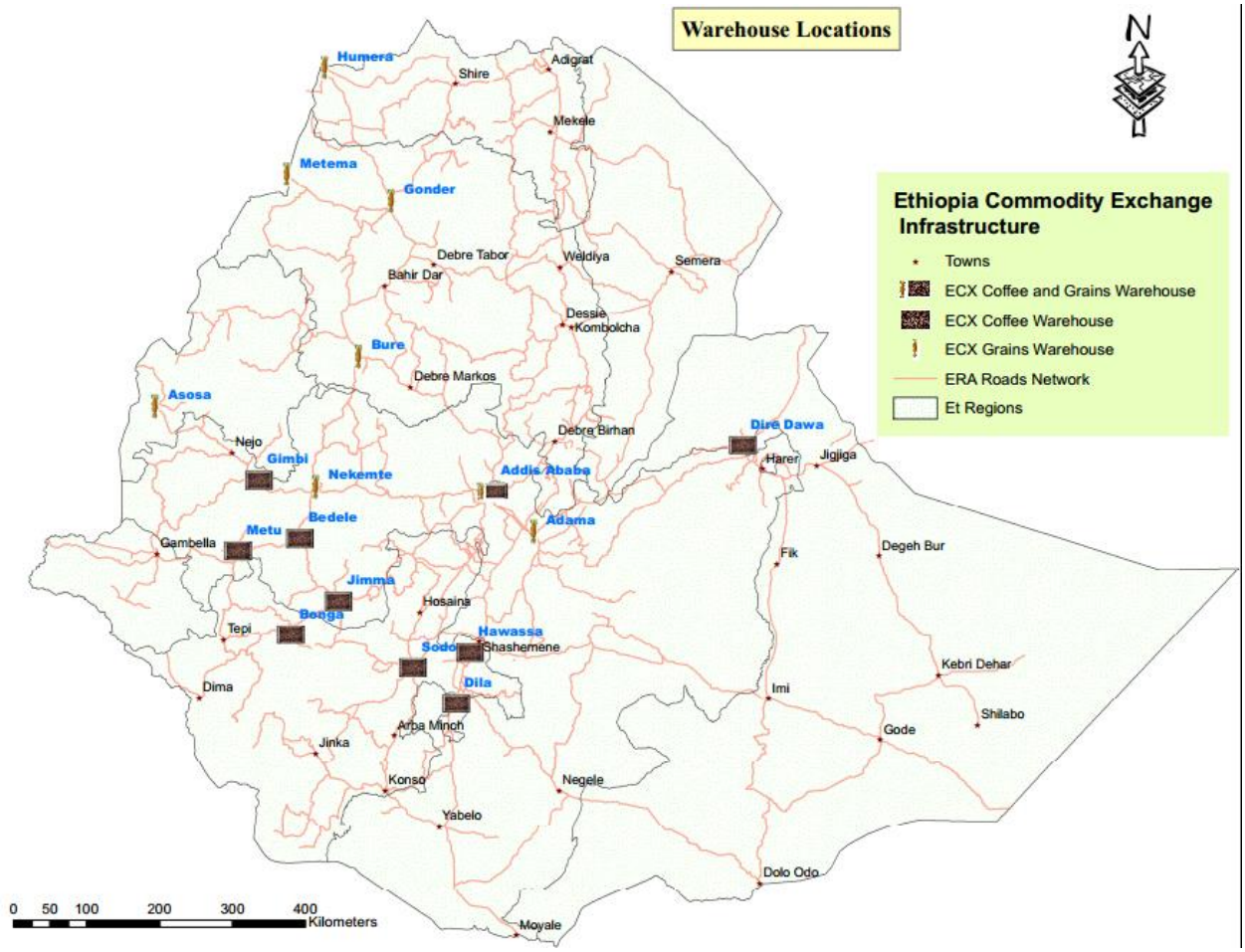
Table 6-21: Locations of ECX Warehouses in Ethiopia

ID	*Location*	*Main Focus*
1	Assosa	Grains Warehouse
2	Hawassa	Coffee Warehouse
3	Addis Ababa	Coffee and Grains Warehouse
4	Dire Dawa	Coffee Warehouse
5	Jimma	Coffee Warehouse
6	Adama	Grains Warehouse
7	Gonder	Grains Warehouse
8	Nekemte	Grains Warehouse

ID	Location	Main Focus
9	Humera	Grains Warehouse
10	Metema	Grains Warehouse
11	Sodo	Coffee Warehouse
12	Bedele	Coffee Warehouse
13	Bure	Grains Warehouse
14	Gimbi	Coffee Warehouse
15	Bonga	Coffee Warehouse
16	Dila	Coffee Warehouse
17	Metu	Coffee Warehouse

Source: Ethiopian's Commodity Exchange

Figure 6-10:- Map shows the distribution of ECX warehouses



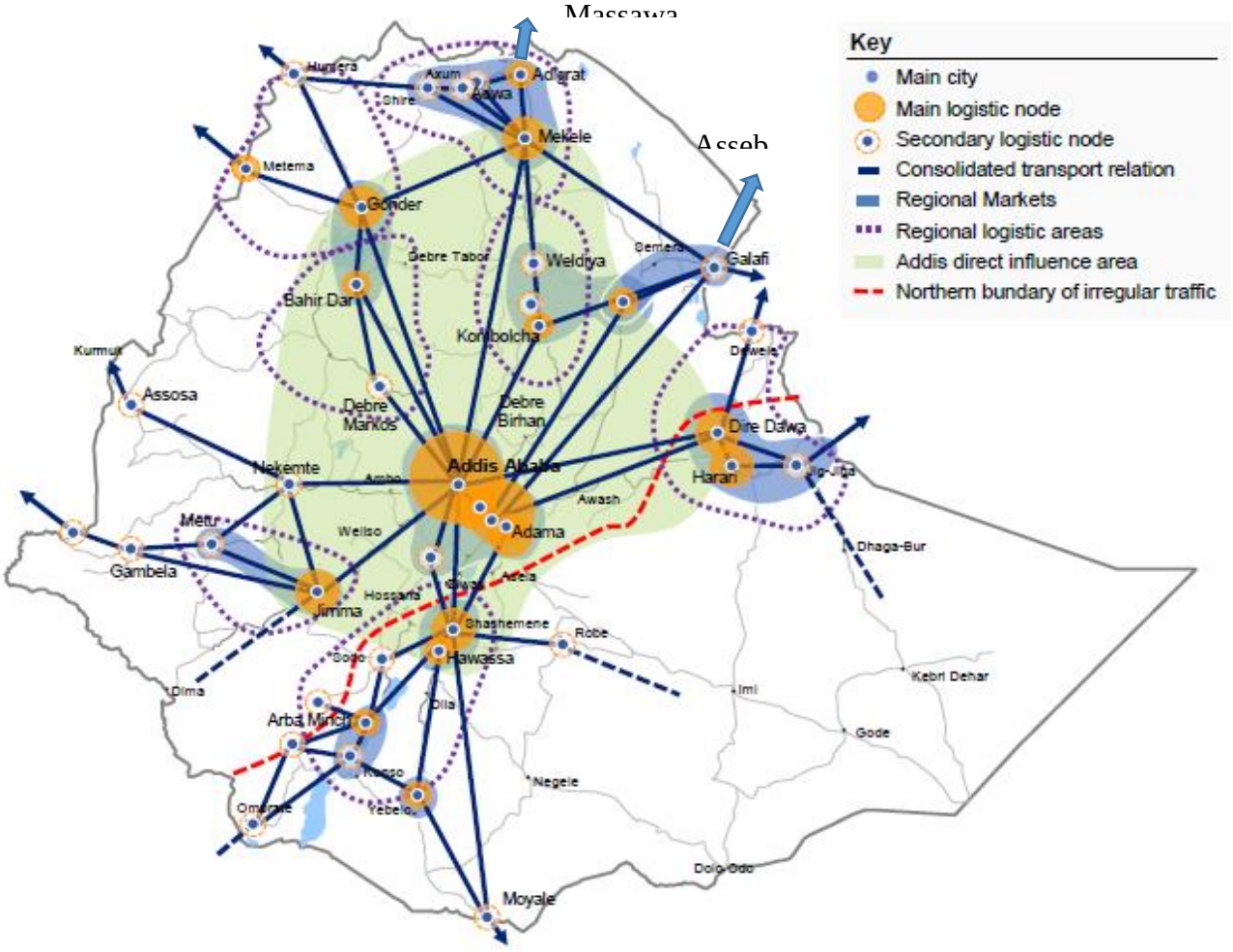
6.2.12 Regional Integration and Identification of Corridors

According to the Study sponsored by the African Development Bank (Perez, Enrique), 5 major corridors and 18 regional logistic nodes were identified in different parts of the country.

After the review and analysis of the socio-economy situation, the transport system status, the policy and strategy, the Study synthesized and defined the main transport corridors and regional transport markets based on economic growth poles. Based on the analyses of the updated socio-economic situation, logistics and transport services and infrastructure; the major transport and logistics corridors were identified from the development of transport

and logistics activity, Figure below shows the main logistic nodes and Regional Markets that were identified by the study.

Figure 6-11:- Regional logistic areas



(Source: Analytical Work on Transport Sector in Ethiopia, Growth, Competitiveness and Regional Integration, African Development Bank, Jose Enrique Perez, December 2014)

Agenda 2063 (Africa Union)

AGENDA 2063 is Africa's blueprint and master plan for transforming Africa into the global powerhouse of the future. The continent's strategic framework aims to deliver on its goal for inclusive and sustainable development and is a concrete manifestation of the pan-

African drive for unity, self-determination, freedom, progress and collective prosperity pursued under Pan-Africanism and African Renaissance.

AGENDA 2063 encapsulates not only Africa's Aspirations for the Future but also identifies key Flagship Programs that can boost Africa's economic growth and development and lead to the rapid transformation of the continent.

AGENDA 2063 also identifies key activities to be undertaken in its 10 year Implementation Plans which will ensure that Agenda 2063 delivers both quantitative and qualitative Transformational Outcomes for Africa's people (Agenda 2063 of African Union).

Among the flagship projects planned by Agenda 2063 programs, the. INTEGRATED HIGH SPEED TRAIN NETWORK is one of the major one is aimed to connect all African capitals and commercial centers through an African High Speed Train Network thereby facilitating the movement of goods, factor services and people. The increased connectivity by rail also aims to reduce transport costs and relieve congestion of current and future systems

Trans-African Highway (TAH)

The other major Infrastructure Network Program is the Trans -Africa Highway Network Routes that is aimed to connect all African Countries. Ten routes have been identified for the Trans-African Highways Network. The numbers begin with "TAH" which stands for "Trans-African Highway". This is followed by digits 1 to 10. The following table shows Trans-African Highway Network Routes. Table below shows the Trans-African Highway (TAH) Network.

Table 6-22:- Trans-African Highway (TAH) Network

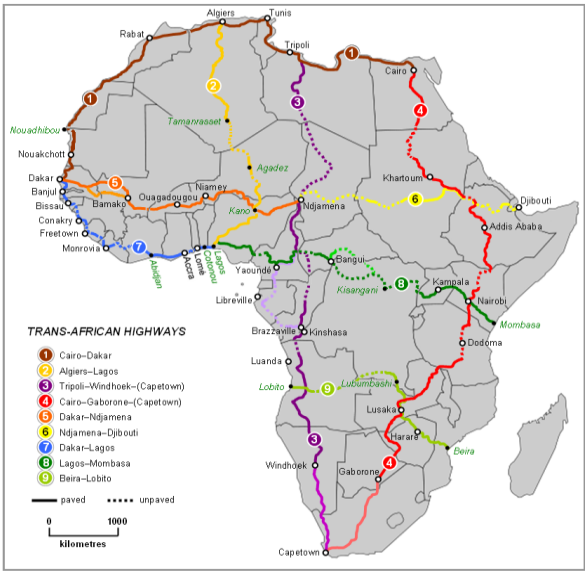
Route Number	Route Name	Length (Km)
TAH 1	Cairo – Dakar	8,636
TAH 2	Algiers – Lagos	4,504
TAH 3	Tripoli – Windhoek – Cape Town	9,610
TAH 4	Cairo – Gaborone – Cape Town	8,860
TAH 5	Dakar – N'Djamena	4,500
TAH 6	N'Djamena – Djibouti	4,220
TAH 7	Dakar – Lagos	4,760

TAH 8	Lagos – Mombasa	6,260
TAH 9	Beira – Lobito	3,520
TAH 10	Djibouti – Libreville - Bata	7,000

Source: Trans-African Highways Network Study

Among the TAH Network, the routes that cross Ethiopia are the following**.**

- TAH 6: Ndjamena-Djibouti Highway, 4219 km
  - **Ethiopian Part of TAH6:-** Metema - Azèzo – Bahir Dar - Debre Markos – Dejen - Goha Tsiyon - Addis Ababa – Mojo – Hawasa – Dila - Agere Maryam – Mega – Moyale
- TAH 4: Cairo–Gaborone–(Pretoria/Cape Town) Highway, 8860 Km
  - **Ethiopian Side TAH 4:** Metema - Azèzo – Werota – Weldiya – Dese – Kembolcha – Bati – Mille – Dobi – Galafi
- TAH 10: Djibouti (Sea Port) – Ethiopian Border– Modjo - Moyale (Kenya Border)
  - **Ethiopian Side TAH 10:** Galafi – Dobi – Mile – Awash – Mojo – Hawasa - Dila - Agere Maryam – Mega – Moyale



Implementation of the Tripartite Transport and Transit Facilitation Programme Eastern and Southern Africa (TTTFP)

The overall strategic objective of TTTFP is to facilitate the development of a more competitive integrated and liberalized regional road transport market in the EA-SA region. Its main purpouse is to develop and implement harmonized road transport policies, laws, regulations and standards for efficient cross-border road transport and transit networks, transport and logistics services, systems and procedures in the EA-SA region. Table 6-23 below shows the number of development corridors under TTTFP.

Table 6-23:- No of Development Corridors under TTTFP

Country	No. Of Development Corridors
Somalia	4
Eritrea	3
Djibouti	3
Kenya	3

Source: Tripartite Transport and Transit Facilitation Programme Eastern and Southern Africa (TTTFP)

Ethiopian side road corridors and projects from TTTFP initiatives are stated below.

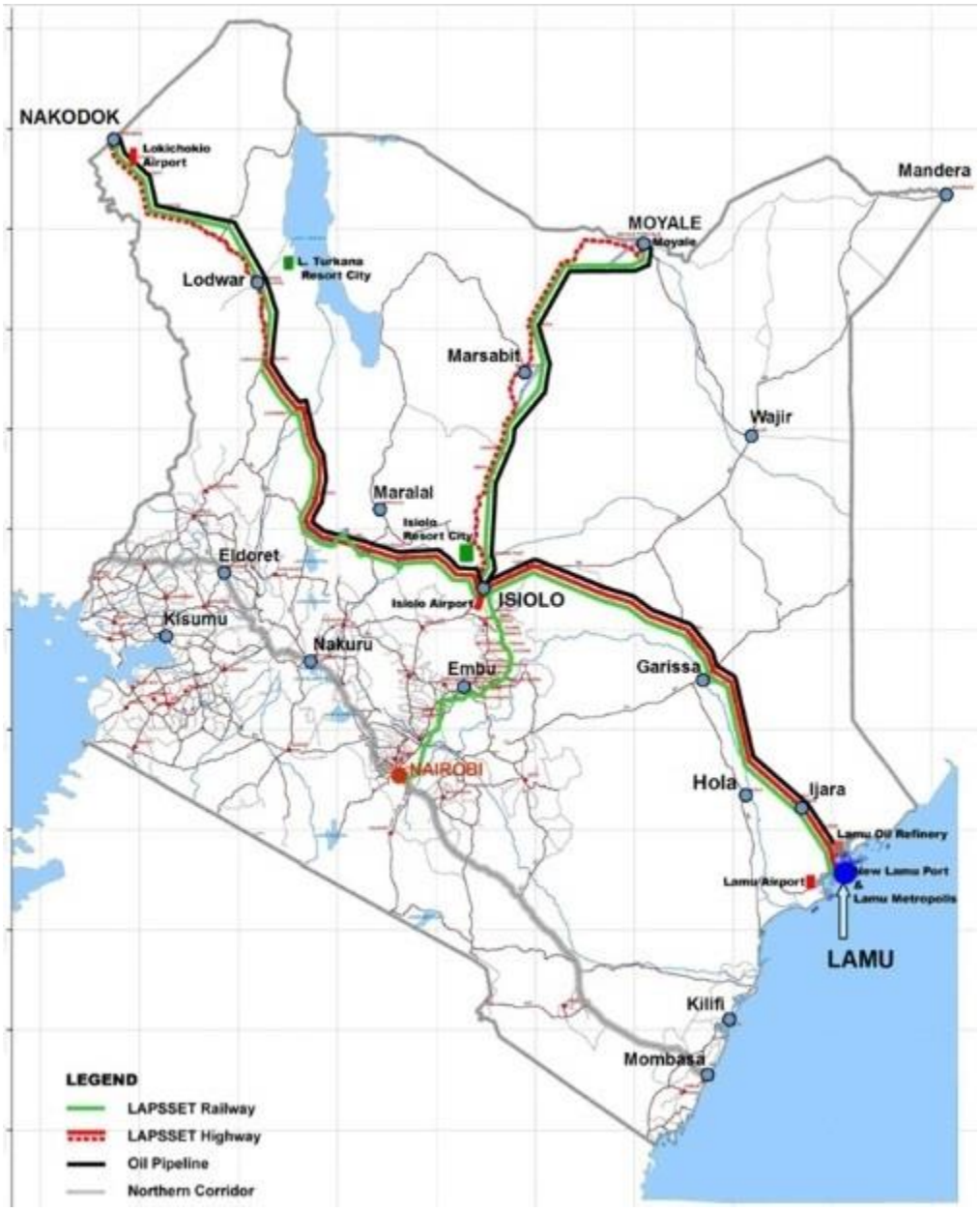
- Adama-Awash-Mieso-Diredawa-Dewle-Djibouti;
- Awash-Mile-Manda-Bure-Assab;
- Harer-Jigjiga-Togocahle—Berbera on Somali-Berbera Corridor;
- South Eastern, Ginir-Gode-Kelafo-Musthir-Firfer-Mokadisho Corridor;
- Negele Borena-Filtu-Delo-Siftu-Mekuadish, Bossasao-Puntland Corridor; and
- Southern, Development of Sugar Cane projects –Turmi, Namraputh::, Lodengia-Kenya border

Lamu Port Development

Lamu Port development is one of the biggest port development projects by the Kenyan Government**.** It contains the following major components.

- A port at Manda Bay, Lamu;
- Standard gauge (1,435 mm (4 ft. 8 ½ in)) railway line to the Southern Sudan capital of Juba and to Addis Ababa, the Ethiopian capital;
- Road network;
- Oil pipelines (South Sudan and Ethiopia);
- Oil refinery at Bargoni;
- Three airports; and
- Three resort cities (Lamu, Isiolo and Lake Turkana shores.)

Figure 6-12:- Lamu Port Development Project

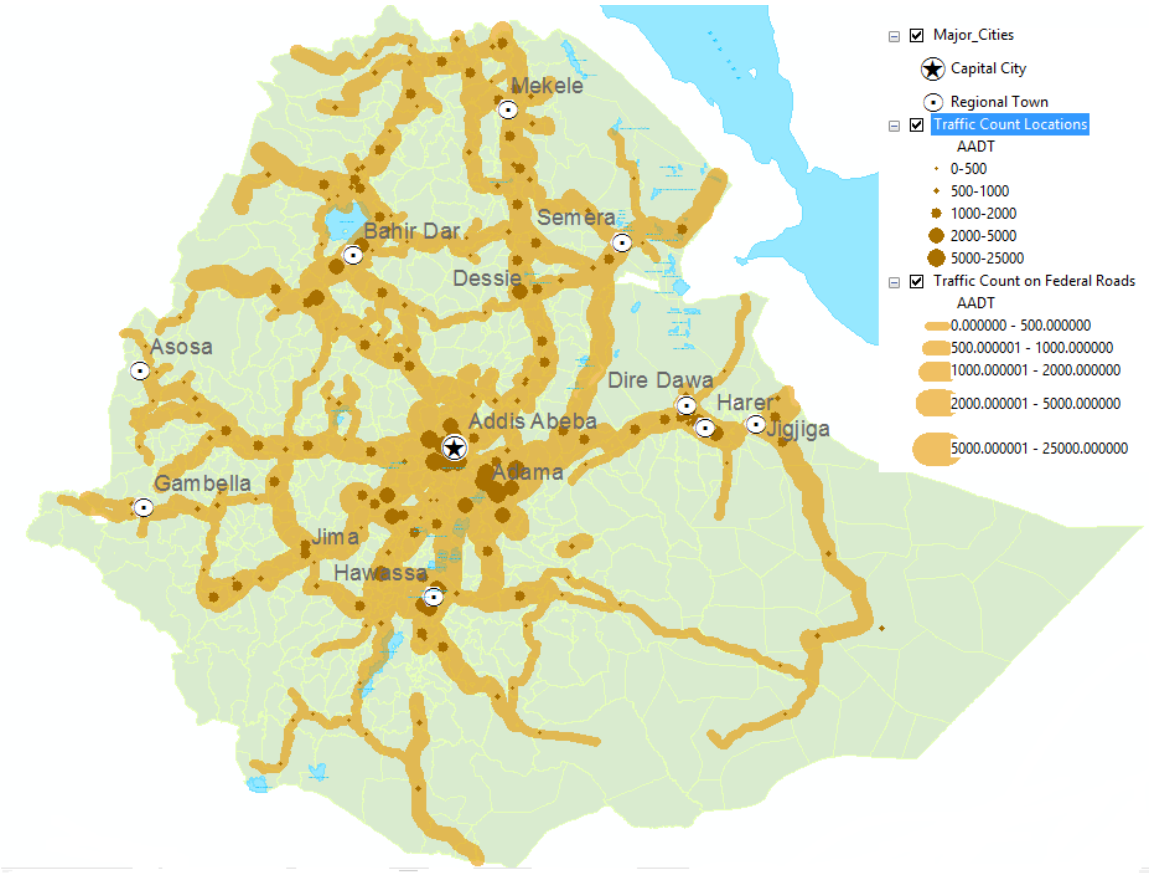


The Highway Network Component of Lamu Project contains:

- Lamu – Garissa (D568) - 250 km;
- Garissa – Isiolo (C81,D586,B9) - 423 km ;
- Isiolo – Moyale (A2) - 505 km; and
- Isiolo–Nadapal – 721Km.

Identified major transport and logistics corridors: The road transport system was analyzed and the grouping of the main national and international logistic corridors was performed. The major corridors were identified using existing traffic count on major trunk roads from ERA traffic count survey records as shown in Figure 6.13below. Subsequently Figure below shows major Transport Corridor with corresponding traffic volume.

Figure 6-13:- Traffic Flow on Federal Roads



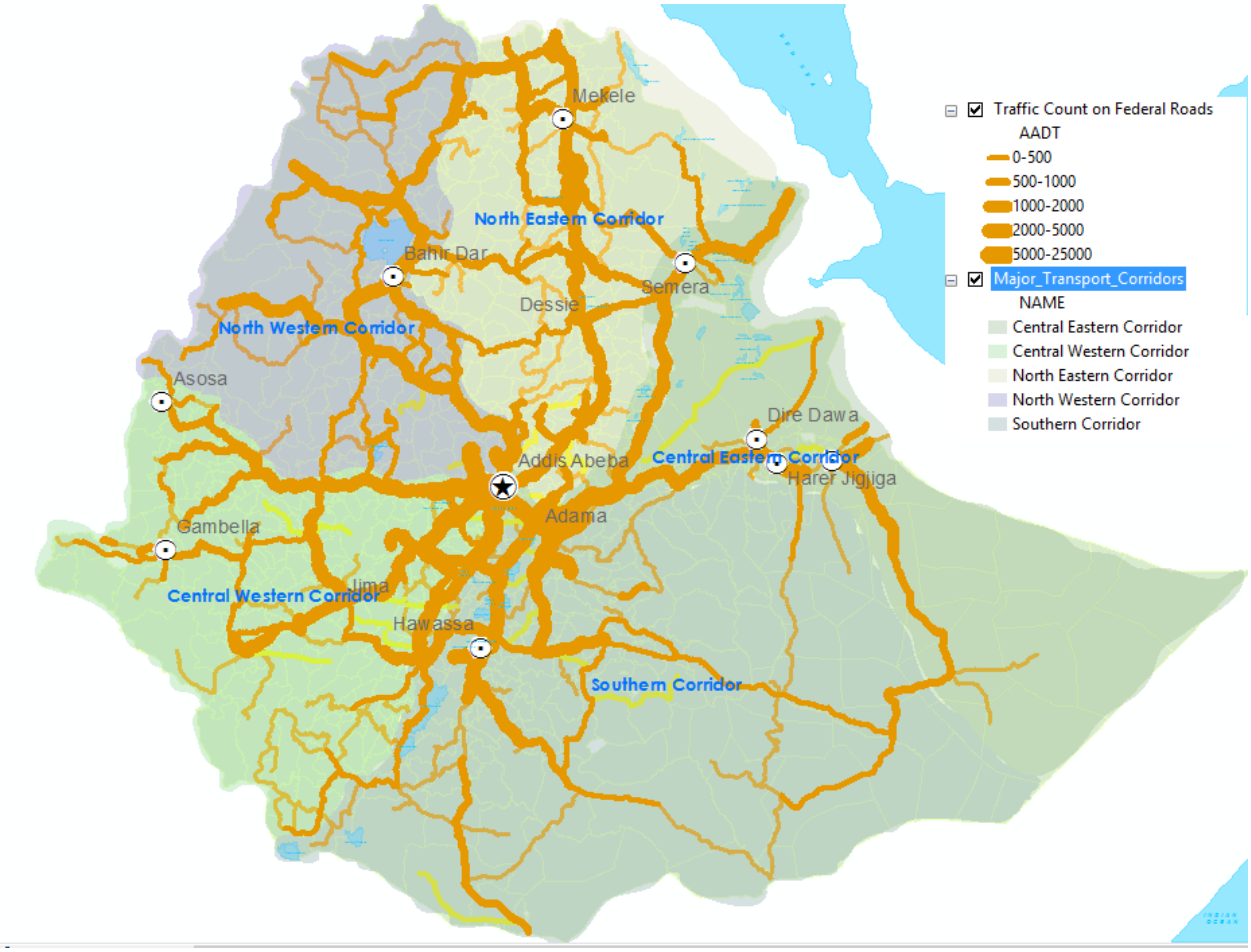
- Central - Eastern Corridor:
  - Addis Ababa - Adama - Awash - Mille → } Galafi - Djibouti Corridor.
  - Addis Ababa - Adama - Awash - Mille → } Banda - Eritrea Border (towards Assab);
  - Addis Ababa - Adama - Awash - Dengego → Dire Dawa - Djibouti Border;
  - Addis Ababa - Adama - Awash - Dengego → Harar-Jigjiga-(Berbera Corridor).

- Southern Corridor:
  - Addis Ababa - Adama - Asela - Dodola → Robe-Ginir-Imi-Gode (Somali Border)
  - Addis Ababa - Mojo - Shashamene - Dodola → Hawassa - Moyale (Kenya Border)
  - Addis Ababa - Mojo - Shashamene → Wolaita Sodo-Arbaminch-Konso-Turmi-Namraputz (Kenya Border)
- Northwestern Corridor
  - Addis Ababa - Bahir Dar - Azezo → Gondar - Humera (Eritrea Border)
  - Addis Ababa - Bahir Dar - Azezo → Gondar-Shire-Adwa-Rama(Eritrea border) → Metema (Sudan Border)

  Addis Ababa - Bahir Dar – Azezo
- Northeastern Corridor
  - Addis Ababa - Kombolcha - Dessie - Mekele - Adigrat (Eritrea Border)
  - Kombolcha - Mile - Galafi (Djibouti Border)
  - Mekele - Galafi (Djibouti Border)
  - Mekele - Shire - Shiraro - Humera (Eritrea Border)
- Central Western Corridor
  - Addis Ababa - Nekemte - Mekenajo → Assosa - Kurmuk (Sudan Border)
  - Addis Ababa - Nekemte - Mekenajo → Dembedilo-Gambela-Jikao (Sudan Border)
  - Addis Ababa - Jima → Bedele - Metu- Gambela - Jikao (Sudan Border)
  - Addis Ababa - Jima → Mizan Teferi - Guraferda (South Sudan Border)

Source: Consultant Findings

Figure 6-14:- Major Transport Corridor with traffic volume



Source: Consultant Findings

The potential for utilization of Massawa and Asab ports in Eritrea for Ethiopia's exports and imports is significant and imminent. The Port of Massawa is ideal to provide maritime services to northern and northwestern Ethiopia mainly to Tigray and Amhara regions; while the Port of Assab is most likely to provide maritime services mainly to central, western and southwestern Ethiopia. The opening of the two ports, in addition to the Port of Djibouti, will significantly facilitate the movements of Ethiopia's imports and exports. Recently, the Head of the Massawa Port Administration, Mr. Layne Asfahaley has confirmed that the Port is ready to serve Ethiopia's import and export commodities.

6.3 Traffic Survey and Analysis

6.3.1 Traffic Survey

Traffic Count is one of the major tasks of this assignment. The Consultant organized and deployed traffic count teams to conduct traffic count surveys on selected gravel and asphalt roads which have no traffic count data by ERA's annually scheduled traffic surveys. ERA has rich experience of traffic count surveys on selected roads which the result is very important to get information of the transport activities and mobility characteristics of the roads.

ERA's practice on traffic count survey is performing three seasons, seven days traffic count every year which some of them is full day 24 hours count. The most common practice for most consultants is to perform two days with preferably at least one 24 hours count on a weekday and one during a weekend. On the other days, 16- Hour counts would be sufficient. These should be extrapolated to 24-hour volume in the same proportion as the 16-hour/24-hour split on those days when full 24-hour counts have been undertaken.

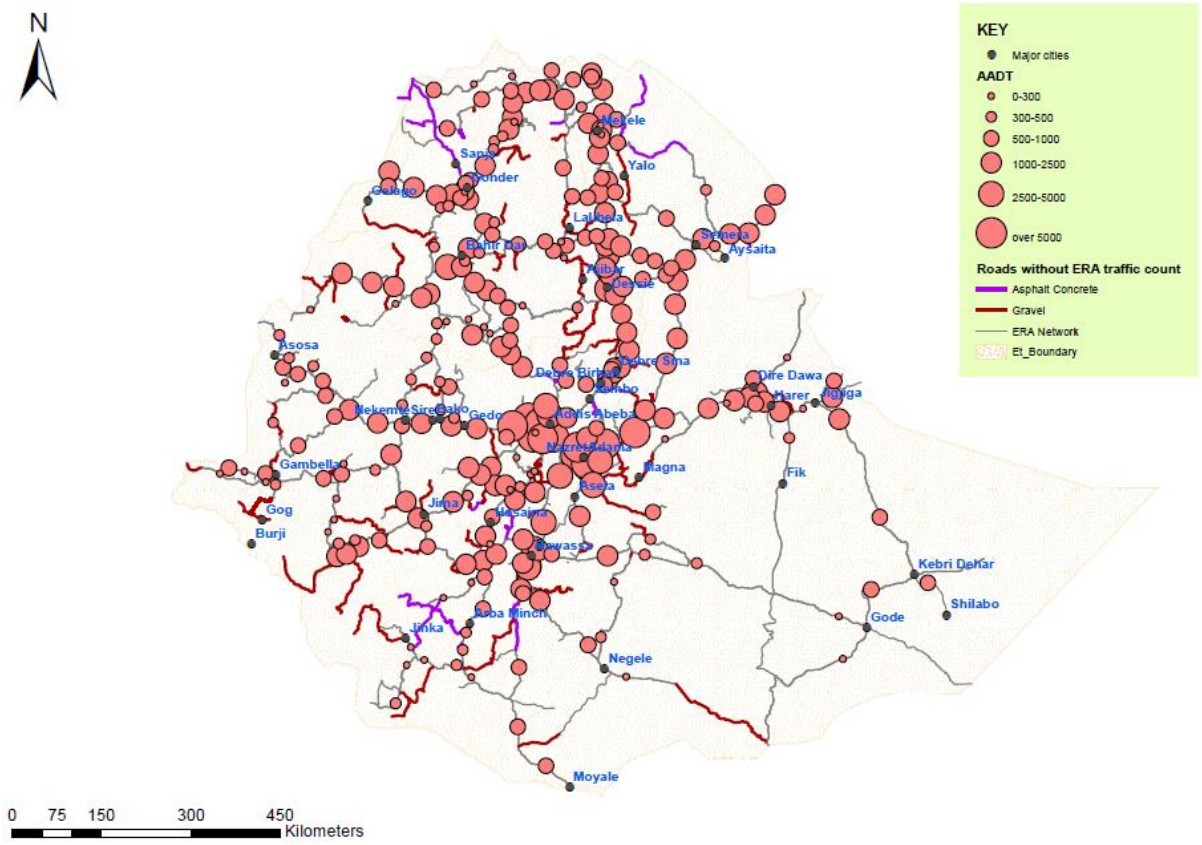
Counts are avoided at times when travel activity is abnormal for long or short periods due to the roads under construction, payment of wages and salaries, public holidays, etc. If abnormal traffic flows persist for extended periods, for example during harvest times, additional counts need to be made to ensure this traffic is properly included.

If possible, the seven-day counts should be repeated several times throughout the year. Countrywide traffic data should preferably be collected on a systematic basis to enable seasonal trends in traffic volumes to be quantified.

6.3.2 Traffic Count Data on Existing Roads

The Consultant has received traffic count data from ERA. The traffic count data shows Classified Traffic Count, Annual Average Daily Traffic (AADT) and time series Growth of traffic for more than 20,000 km of Roads. The Consultant used the 2017 data for selected roads, which were considered for HDM-4 Analysis. Figure below shows distribution of Traffic Count Locations throughout the Country during the 2017 Survey.

Figure 6-15:- Existing Traffic Location

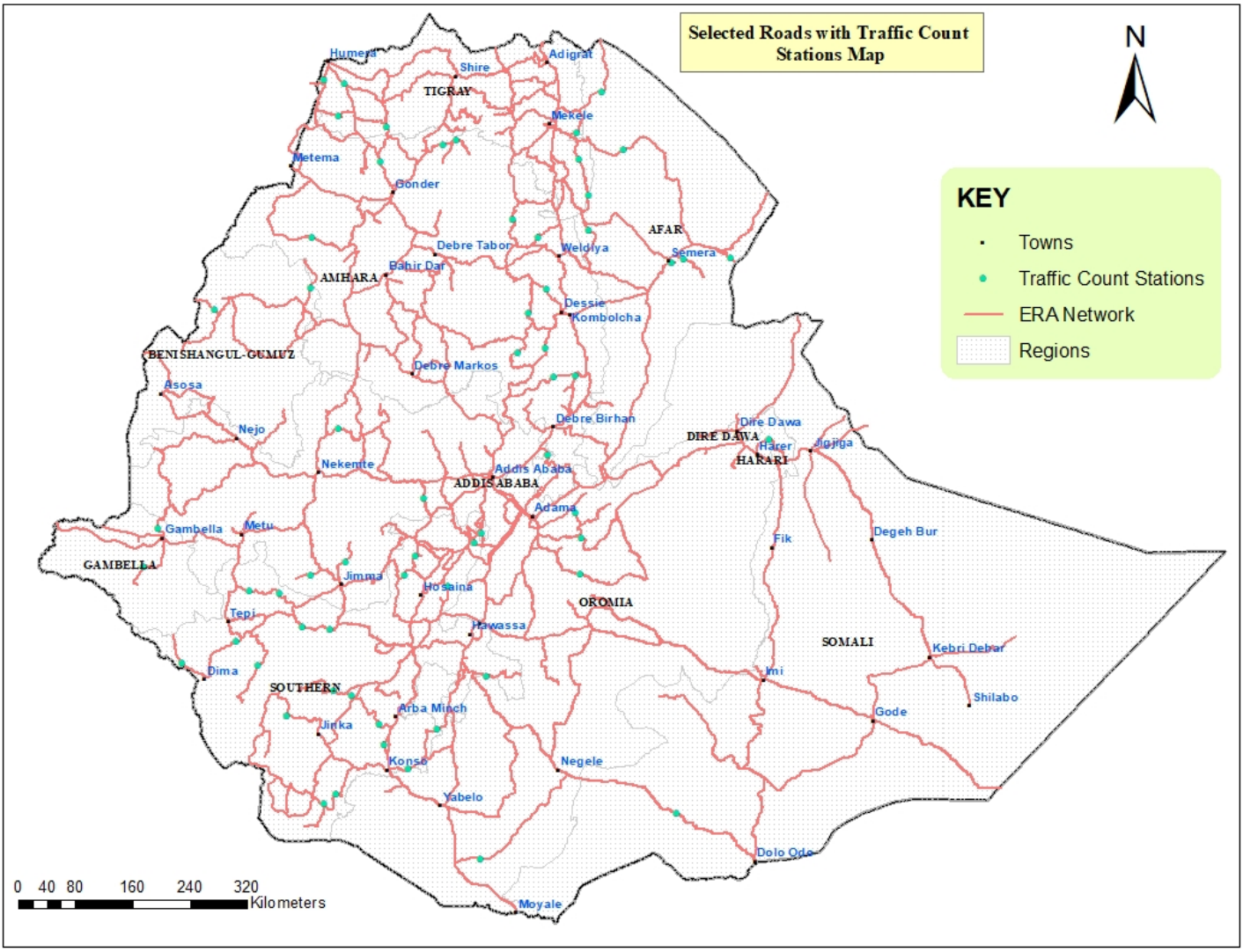


6.3.2.1 Selection of Roads and their Locations for Traffic Count

The Consultant used the 2017 traffic data for HDM 4 analysis. However, as discussed above, the total coverage of ERA traffic count in 2017 was only 75 % and the acquired data were not sufficient to perform analysis. Accordingly, the Consultant could not find full AADT data neither for all roads, which are ongoing projects nor under heavy maintenance program. Therefore, the Consultant selected 62 roads with total lengths of 4547.43 (km). The Consultant prepared the selected roads for the traffic survey. The roads included 16 asphalt roads and 46 gravel roads.

Locations of traffic count surveys on the 62 roads were identified carefully based on ERA Traffic Survey Manual. The main criteria used to select traffic count locations was by considering 5 Km distance from starting or ending of the road. The detail locations of the roads selected for traffic count survey are shown in Figure below.

Figure 6-16:- Selected roads and location for traffic count conducted by the Consultant



6.3.2.2 Team Organization and Planning for Traffic Survey

Team organization and planning for field survey is very important to achieve the main objective of the traffic count study. Preparation of data collection forms was one of the basic tasks of the Consultant before undertaking the field survey. Appropriate and workable formats should be prepared. Accordingly, the Consultant prepared formats for traffic counts through the participation of all experts.

Eight teams were organized for the 62 roads each team consisting of one team leader and one assistant. Table below shows road names, road length (km), road surface type, location, team organization and duration of the survey.

Table 6-24:- Team Organization and Selected Roads for Traffic Count

No	Road name	Road Length (Km)	Surface type	Region	TEAM	Duration of the Survey
1	Abala-Shauigubi Junction	56.73	AC	Afar	Team one	One Month
2	Berhale-Dalol	81.01	AC	Afar		
3	Dobi – Galafi	14.73	AC	Afar		
4	Dubti- Asayita	62.11	Earth	Afar		
5	Erebti -Afdera	120.76	AC	Afar		
6	Hida- Yalo	64.98	Gravel	Afar		
7	Nahile- Abala	58.17	Gravel	Afar		
8	Semera- Dubti	10.65	Earth	Afar		
9	Yalo- Nahile	68.44	Gravel	Afar		
10	Buahit- Delyebza	71.84	Gravel	Amhara	Team Two	One Month
11	Dansha -Humera	102.56	AC	Tigray		
12	Dansha Junc-Ketema Negus	22.11	AC	Amhara		
13	Debark-Janamora	95.46	Gravel	Amhara		
14	Division-Abuderafe	59.18	AC	Tigray		
15	Muse bamb-Bebew river	42.19	AC	Amhara		
16	Raweyna-Myckadra	49.92	AC	Tigray		
17	Shahura-Gelago	159.95	Gravel	Amhara		
18	Ambamariam-Akesta Junc	34.2	Gravel	Amhara	Team Three	One Month
19	Betto river (Jama)-Akesta junc	113.43	Gravel	Amhara		
20	Bilbila- Usketema	54.06	Gravel	Amhara		
21	Gobesa showla Gebeya-Senbo	50.43	AC	Amhara		
22	Gugufetu-Jama	72.64	Gravel	Amhara		

No	Road name	Road Length (Km)	Surface type	Region	TEAM	Duration of the Survey
23	Kobo-Lalibela	104.06	Gravel	Amhara		
24	Kutaber-Wagaletena	67.79	Gravel	Amhara		
25	Mehalmeda-Abus Alem ketema	100.55	Gravel	Amhara		
26	Meleya-Mehalmeda	40.69	Gravel	Amhara		
27	Abobo-Goge	58.31	Gravel	Gambella	Team Four	One Month
28	Dima-Goge	96.65	Gravel	Gambella		
29	Gambella-Shebele	43.56	Gravel	Gambella		
30	Guba-Bambudi	80.85	Gravel	Benshangul Gumuz		
31	Guten-Nekemte	44.48	Gravel	Oromia		
32	Jawi-Junction-Fendka Ayma	94.11	Gravel	Benshangul Gumuz		
33	Agaro- Gera agri.Devt	47.55	Gravel	Oromia	Team Five	One Month
34	Bonga-Felege selam	52.33	Gravel	SNNP		
35	Chitu -Haro -Wenchi	62.31	Gravel	Oromia		
36	Gimbo-Gojeb river2	93.18	Gravel	SNNP		
37	Gojeb river2-Diri Junction	50.95	Gravel	SNNP		
38	Kayntari-Limu	78.21	Gravel	Oromia		
39	Mizan Teferi-bebeka	30.01	Gravel	SNNP		
40	Wacha-Maji	173.3	Gravel	SNNP		
41	Arbaminch-Belta	85.54	AC	SNNP	Team Six	One Month
42	Belta-Sawla Laska	67.14	AC	SNNP		
43	Chida-Felegeselam	47.27	Gravel	SNNP		
44	Erbore-Menterara	38.67	Gravel	SNNP		
45	Jinka-Hana-Omo factory3	186.91	Gravel	SNNP		
46	Laska- Laha-Salayesh	108.07	AC	SNNP		
47	Menterara-Turmi	38.68	Gravel	SNNP		

No	Road name	Road Length (Km)	Surface type	Region	TEAM	Duration of the Survey
48	Aleta wondo-Bensa daye	48.91	Gravel	SNNP	Team seven	One Month
49	F/genet-Burji	113.12	Gravel	SNNP		
50	Filtu-Dolo	213.88	Gravel	Somali		
51	Konso-Burji(Soyama)	75.68	Gravel	SNNP		
52	Mega-Wachile	107.76	Gravel	Oromia		
53	Wezeka-Gidole Gato	29.2	AC	SNNP		
54	Alaba Alemgebeya-Wulberg	58.26	AC	SNNP	Team Eight	One Month
55	Atat Junction-Kose	47.67	Gravel	SNNP		
56	Bui-Midrekebd-Meki	58.36	Gravel	SNNP		
57	Bulala-Adele	86.39	Gravel	Oromia		
58	Harar-Jarso-Bombas	86.06	Gravel	Oromia		
59	Kella-Dugda	23.65	Gravel	SNNP		
60	Kose-Gilgel Gibe II	35.66	AC	SNNP		
61	Koshim-Negele	116.51	Gravel	Oromia		
62	Metehara-Chole	89.59	Gravel	Oromia		

- Traffic Count Format

The format for traffic count consists of: name of the road project, direction of driving, location name, enumerators, date, day of the week, time breakdown in hours, weather condition, supervisor and vehicle type. Table 6.21 below shows traffic count data collection form.

Table 6-25:- Traffic Count Data Collection Form.

Traffic Count Data Collection Form

Project_____ Day: -_____

Location: _____ Direction_____ Date _____

Enumerator: _____ Supervisor_____ Weather Condition____

Hourly interval	Car	Land Rover and Minibus	Small Bus (< 27 seats)	Large Bus >27 Seats	Small Truck 3.5 Tone	Medium Truck (7.5 Tone)	Heavy Truck (7.5-12) Tone	Truck and Trailer (12 Tone)	Total
6:00AM-7:00AM									
7:00AM-8:00AM									
8:00AM-9:00AM									
9:00AM-10:00AM									
10:00AM-11:00AM									
11:00AM-12:00AM									
12:00AM-1:00 PM									
1:00PM-2:00PM									
2:00PM-3:00PM									
3:00PM-4:00PM									
4:00PM-5:00PM									
5:00PM-6:00PM									
6:00PM-7:00PM									
7:00PM-8:00PM									
8:00PM-9:00PM									
9:00PM-10:00PM									
Total									

6.3.2.3 Training of Field Survey Team

Following the preparation of survey formats, the effort was further strengthened through training of civil engineers/senior surveyors before conducting field surveys. The training was conducted for one day in a classroom using PowerPoint presentation and exercise using selected road network.

The training focused on the following areas:

- Objectives of the traffic count;
- Identification of selected roads on the ground using maps;
- Selection of appropriate traffic count locations;
- How to identify vehicle type; and
- How to conduct traffic count using tally and fill traffic count forms.

The above points were addressed during the field survey team training. Therefore, the Consultant successfully completed the field survey as planned with the desired quality.

6.3.2.4 Traffic Count Survey Results

The surveys were conducted on selected 62 federal roads. The Consultant carried out the surveys using eight teams along the subject roads at different sites on opposite directions. The surveys took a month (from November 7 to December 6 in 2019). The traffic counts along each road were carried out for two days per week (i.e. one market day and one normal day) for 16 hours per day.

There are two types of traffic counting methods namely; manual and automatic. There is no significant difference between the two methods. However, the economic use or selection of an appropriate method of traffic counting is a function of the level of traffic flow and the required data quality. As discussed above, most of the selected roads were gravel and asphalt surfaced and were not major trunk or link roads. Therefore, the levels of traffic flows on the selected roads were relatively lower than on urban area. Hence, the Consultant undertook manual traffic count. Traffic counts were carried out on hourly basis on both directions for each vehicle category.

The traffic counts were encoded and were made ready for model analysis. Two encoders were trained and they inserted data into excel under the supervision of the transport economist and the highway management engineer. The data entered for each road were checked and verified before conducting the analysis

The average value of daytime traffic of market day and normal day gives average daily time traffic for the two days. Based on the previous ERA counts on the road sections, the Consultant developed the average annual daily traffic (AADT) of each road by utilizing Seasonal Conversion Factor (SCF) and Night Factor (NF) of the related road. These identify traffic volume and vehicles composition on the road. All traffic survey data were organized and AADT for each road is developed for the model analysis. Table below shows the AADT on 62 selected roads.

One Season Average daily Traffic =Average day traffic of Normal Day and Market Day*NF

AADT= One Season Average daily Traffic *SCF

Table 6-26:- AADT of Selected Roads (2019)

No	ID	Road Name	Length (KM)	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	TOTAL AADT
1	UNAD-21	Abala - Shaigubi Junction	56.73	0	304	2	0	34	8	22	0	371
2	UNAD-20	Berahele – Dalol	81.01	0	343	14	0	73	1	50	0	481
3	A1a	Dobi – Galafi	14.73	0	11	0	0	1	0	0	43	55
4	UNCO-47	Dubti – Aysaita	62.11	0	235	1	0	14	32	24	0	306
5	UNCO-39	Erbti – Afdera	120.76	0	85	2	8	12	7	24	506	644
6	UNCO-35	Hida – Yalo	64.98	0	44	17	0	71	8	2	0	142
7	UNCO-40	Nahile – Abhala	58.17	0	64	2	0	39	0	17	0	122
8	UNCO-50	Semera – Dubiti	10.65	19	790	29	8	35	3	69	2	954
9	UNCO-38	Yalo – Nahile	68.44	0	36	34	0	102	4	2	0	178
10	UNGO-60	Buahit – Delybeza	71.84	0	15	8	10	20	14	17	0	84
11	C35e	Dansha – Humera	102.56	2	206	1	4	25	20	20	14	292
12	UNGO-65	Dansha Junc - Ketma Neguse	22.11	0	75	0	0	18	7	6	0	104
13	UNGO-59	Debark-Janamora	95.46	0	72	15	8	30	23	35	0	184
14	E35-6	Division - Abuderafe	59.18	2	153	0	0	9	7	5	2	178
15	C35b	Muse Bamb - Bebew River	42.19	7	222	12	3	50	45	25	25	388
16	E34	Rawyna - Myckadra	49.92	6	512	6	4	94	33	26	10	691

No	ID	Road Name	Length (KM)	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	TOTAL AADT
17	UNGO-64	Shahura – Gelego	159.95	2	22	20	33	28	27	17	3	152
18	UNCO-44	Ambamariam-Akesta Junc	34.2	0	28	8	4	8	6	10	0	65
19	UNCO-42	Betto River (Jamma) - Akesta Junction	113.43	0	40	8	6	0	5	21	0	80
20	D31-4b	Bilbila – Usketema	54.06	0	27	8	0	10	3	28	0	76
21	UNAL-2	Gobesa_Showla Gebeya - Senbo	50.43	12	470	36	0	66	14	10	0	608
22	UNCO-32	Gugufetu – Jama	72.64	0	40	25	18	1	5	30	0	118
23	UNCO-36	Kobo – Lalibela	104.06	0	61	24	1	3	1	12	0	102
24	UNCO-30	Kutaber-Wagaletena	67.79	0	114	50	6	22	5	18	0	214
25	UNAL-14	Mehalmeda - Abus - Alemketema	100.55	1	197	48	17	22	0	5	0	289
26	D21b	Meleya - Mehalmeda	40.69	5	57	16	7	14	2	14	1	115
27	UNJI-89	Abobo – Goge	58.31	0	42	7	12	27	14	21	2	125
28	D63	Dima – Goge	96.65	0	18	9	0	17	1	18	0	63
29	C44-4	Gambella - Shebele	43.56	1	52	7	2	36	20	20	0	137
30	C33-4	Guba – Bambudi	80.85	0	35	0	0	14	29	21	31	130
31	B32-1	Guten – Nekmte	44.48	1	109	61	19	20	35	45	19	308
32	UNDM-53	Jawi Junction - Fendka-Ayma	94.11	6	486	43	15	117	84	72	2	825

No	ID	Road Name	Length (KM)	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	TOTAL AADT
33	E57-1	Agaro - Gera agri. Devt	47.55	3	190	41	1	93	25	23	2	379
34	E61a	Bonga - Felege Selam	52.33	1	115	21	0	29	3	1	0	170
35	B41-1	Chitu-Haro Wenchi	62.31	9	61	156	2	83	8	17	0	336
36	E62b	Gimbo - Gojeb river2	93.18	2	77	33	4	45	15	9	3	188
37	E62a	Gojeb river2-Diri junction	50.95	2	69	32	3	50	16	9	4	185
38	C54-1	Kayntari-Limu	78.21	2	280	35	4	42	11	17	2	393
39	D61	Mizan Teferi - Bebeka	30.01	1	531	125	19	194	38	48	5	961
40	D53	Wacha – Maji	173.3	1	49	95	11	64	16	16	3	253
41	UNSO-88	Arbaminch-Belta	85.54	0	336	19	0	186	4	6	0	550
42	UNSO-89	Belta-Sawla Laska	67.14	0	110	4	0	62	1	1	0	178
43	E61b	Chida - Felegeselam	47.27	0	101	25	0	67	2	2	10	207
44	C70-3b	Erbore - Menterara	38.67	0	14	0	0	10	0	10	0	34
45	UNSO-95	Jinka-Hana-Omo-Factory3	186.91	0	109	27	0	17	3	38	10	204
46	UNJI-86	Laska - Laha - Salayesh	108.07	0	31	6	0	38	3	3	0	80
47	C70-3	Menterara – Turmi	38.68	0	229	0	0	38	0	10	0	276
48	UNSH-68	Aleta Wondo - Bensa Daye	48.91	6	518	16	2	94	11	16	4	667
49	E72-1	F/Genet - Burji	113.12	0	54	16	1	32	1	10	1	114

No	ID	Road Name	Length (KM)	Car	Land Rover	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck Trailer	TOTAL AADT
50	D82-2	Filtu – Dolo	213.88	0	12	3	0	8	1	1	1	26
51	UNSO-90	Konso - Burji (Soyama)	75.68	1	18	25	3	26	2	1	0	76
52	C82-1	Mega-Wachile	107.76	0	30	2	1	17	15	1	1	66
53	C70-1c	Wezeka - Gidole Gato	29.2	0	7	6	0	7	0	0	0	20
54	A7-3b	Alaba Alemgebeya - Wulberg	58.26	48	607	43	45	60	26	142	7	978
55	E52	Atat Junction - Kose	47.67	0	8	10	0	8	0	6	0	33
56	E5b	Bui - Midirekebd – Meki	58.36	0	22	25	0	16	0	0	0	62
57	C92-1	Bulala-Adele	86.39	0	73	97	0	117	25	32	2	345
58	D10-2	Harar - Jarso - Bombas	86.06	2	306	62	3	41	6	60	2	483
59	UNAL-17	Kella – Dugda	23.65	1	27	54	0	93	0	11	0	185
60	E52-1	Kose - Gilgel Gibe II	35.66	0	38	2	0	7	1	0	0	49
61	B91-2	Koshim- Nagele	116.51	0	75	114	0	210	10	8	1	417
62	B101-1	Metehara – Chole	89.59	6	488	0	0	112	14	157	5	782

6.4 Identification of Missing Links

Consideration of Major Nodes and Economic Growth Poles

Considering the above identified Urban Centers, Industrial Parks and Agro Processing Zones, Identified Agro Centers, ECX warehouses and Surplus production Woredas of a certain volume of tons, dry ports and custom location and large potential low land agricultures in each corridor, missing links within corridors and between corridors are identified. All the above considerations of socioeconomic data are the bases for the formation of Traffic Generating Areas (TGAs). In the exercise of identification of missing links, socioeconomic data which forms TGAs were taken as background maps and also so many maps having different spatial & socioeconomic data with different scenarios have been prepared & used for the purpouse of identification. Some of the maps which are prepared for the purpose of identification of missing links are

1) Map of Woredas with Population density and distribution with existing road network
2) Map for surplus producing Woredas and agriculture potentials with existing road network
3) Map of large and medium scale industries
4) Map for Tourist site attractions
5) Maps for Mining Potentials
6) Map of government's plan for large scale farming
7) Maps of identified missing links, expressway and rings with all socio economic facilities
8) etc

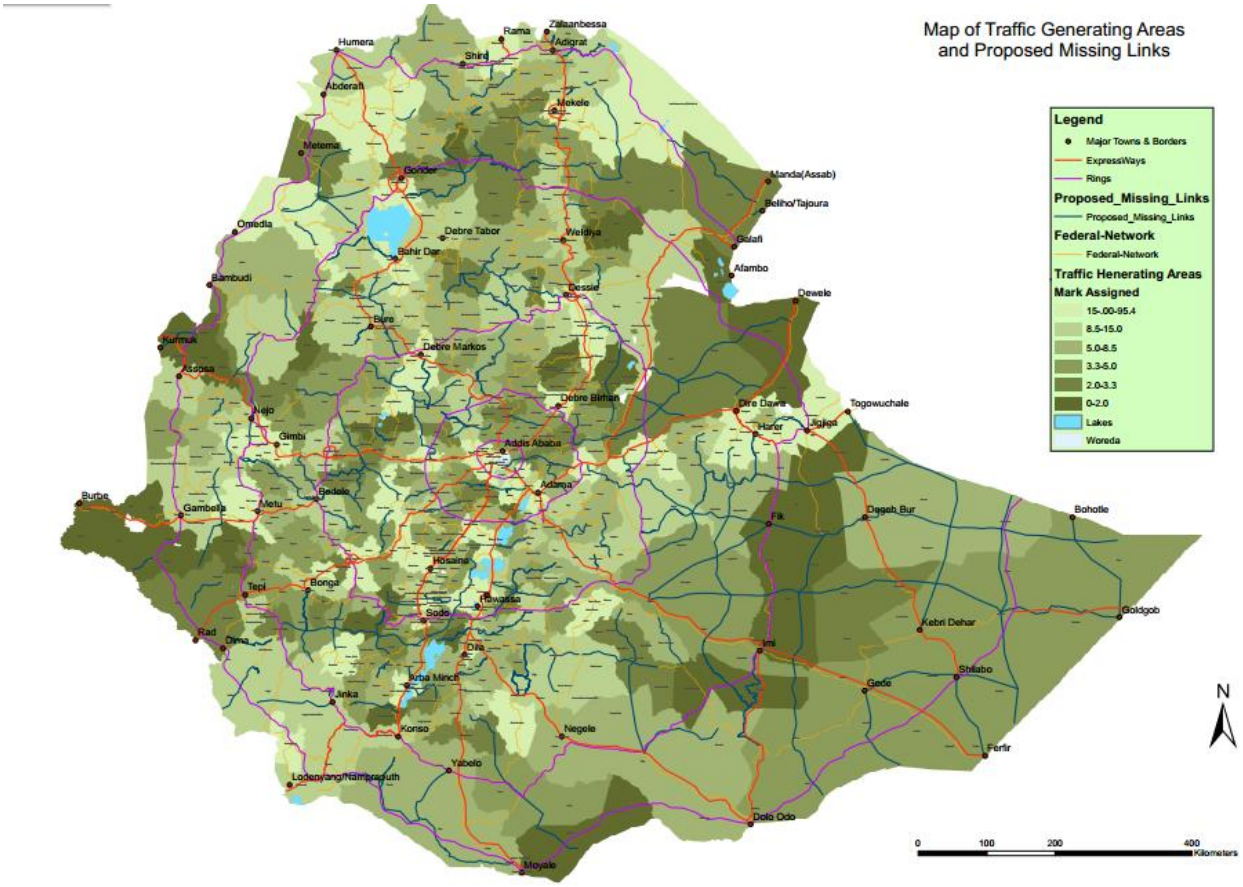
The process of identification of missing links was very iterative and continuous process and done with joint effort and assistant of ERA's taskforce team. A step by step identification and discussion on the result and identified links map with ERA's management has been done for long period of time.

Traffic Generating Areas for Identification of Missing Links

The Consultant used TGAs for the purpose of identification of missing links. In the road functional classification project, the consultant established 312 traffic generating zones using socio economic data collected at Woreda level. Based on Socio economic characteristics, Woredas were merged into 312 zones that serve as the main center for traffic generations. After the creation of TGAs, multi criteria analysis was exercised by allocating weights for the different criterion and then TGAs were ranked based on their values. Based on the above, six functional classes were established. The TGAs and respective classes are attachedin Annex-11-5. The detail of TGA formation, weighting and Ranking is included in the TGA Classes report on the Road Functional Classification Project.

The Consultant has made the TGAs as background and overlay with the above identified growth poles and logistic corridor in order to identify the missing links. Figure below shows the TGAs and the proposed missing links.

Figure 6-17:- Map of Traffic Generating Areas and proposed Missing Links



Identification of Missing Links within Corridors

- Missing Link in Central - Eastern Corridor:
  - Addis Ababa - Adama - Awash - Mille → } Galafi - Djibouti Corridor.
  - Addis Ababa - Adama - Awash - Mille → } Banda - Eritrea Border (towards Assab);
  - Addis Ababa - Adama - Awash - Dengego } → Dire Dawa - Djibouti Border;
  - Addis Ababa - Adama - Awash - Dengego } → Harar-Jigjiga-(Berber Corridor).

Number of nodes / vertices considered

There are about 99 urban centers with population each above 10,000 along the Central and Eastern corridors. Diredawa, Harar and Jigjiga are regional capitals of each with over 150,000 populations while Bishoftu and Adama are major towns along the corridor. There are already developed Adama and Diredawa Industrial parks; the future Planned Semera, Ayesha, Modjo and Arerti Industrial parks are located this corridor. Tuludimtu Pilot Agro Industry Zone is also located in this corridor. Diredawa is also the center of one of the ECX Coffee warehouses while Adama is one of the ECX Grain Warehouse centers. Hararis identified as Agro Centers in the Eastern part of the country. Similarly, Southern Afar, Northern Somali and Eastern Oromia are among the identified Agro Processing Zones along the corridor.

Under this corridor a total of number of 24 missing links with length of 2601 km are identified. The following table shows the list of identified missing links in the Central Eastern Corridor including the purpose used for identification of the links.

Table 6-27:- List of Missing Links in Central Eastern Corridor

No	Link name	Length (Km)	Near Access Road	Purpose
1	Adulala Jun- Yerer Mountain	12.05	Access to Addis Ababa-Adama-Mile	More than 10,000 Population and Surplus Crop Production
2	Aware-Misrak Gashamo	136.27	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population
5	Awash-Fenatle-Dewele Ju Km 249-349	94.32	Access to Mile-Galafi Corridor	More than 10,000 Population
3	Awash-Fenatle-Dewele Ju-Km 0-Km 149	149.64	Access to Mile-Galafi Corridor	More than 10,000 Population and Tourist Attraction site
4	Awash – Fenatle - Dewele Ju-Km149-Km249	100.00	Access to Mile-Galafi Corridor	More than 10,000 Population
6	Bohotle-Goldgob	177.72	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population
7	Deghabur-Awabre	78.79	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population
8	Dobi-Elidar-Beliho	18.19	Access to Mile-Galafi Corridor	More than 10,000 Population
9	Duruksi – Warder - Dabre Wein, Lot1 Km0-Km126	176.91	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Turist Attraction site
10	Duruksi - Warder - Dabre Wein, Lot2 Km126-Km343	166.39	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population

No	Link name	Length (Km)	Near Access Road	Purpose
11	FugnaBira-Ejersa-Chinhaksen-Jigjiga	68.13	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Tourist Attraction site
14	Gewane Jun-Bike	83.14	Access to Mile-Galafi Corridor	More than 10,000 Population
12	Gewane-Afdem-Harmukale, Lot1, km0-Km103	103.06	Access to Dire Dawa - Djibouti Border and Mile-Galafi Corridor	More than 10,000 Population
13	Gewane-Afdem-Harmukale,, Lot2, km103-Km201	92.76	Access to Dire Dawa - Djibouti Border and Mile-Galafi Corridor	More than 10,000 Population
15	Ginir-Dihun-Shekosh-Wareder Lot 3,Km368-Km Km 540	165.10	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
16	Gode - Shilabo-Biyo Ado, Lot2, Km 143-Km 235	93.31	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
17	Harshin – Haskul – Aroresa - K.Dehar Lot1-Km 0-Km193	193.19	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Surplus Crop Production
18	Harshin - Haskul – Aroresa - K.Dehar, Lot2 Km193-Km368	174.96	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population
19	Midega-Obole-Mareg Dugheleh Lot 3 Km 152-Km 237	84.00	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Tourist Attraction site
20	Misrak Geshamo-Boh	171.00	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population
21	Shinle-Harewe	18.73	Access to Dire Dawa - Djibouti Border and Mile-Galafi Corridor	More than 10,000 Population and Tourist attraction site
22	Togowuchale-Harshin	55.23	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Surplus Crop Production
23	Warder - Agere Weyin - Goldgob, lot1,Km0-km90	89.70	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
24	Warder - Agere Weyin - Goldgob, lot1,Km90-Km188	98.53	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population

- Missing Links in Southern Corridor

Addis Ababa - Adama - Assela - Dodola → Robe-Ginir-Imi-Gode (Somali Border)

- Addis Ababa - Mojo - Shashamene - Dodola
- Addis Ababa - Mojo - Shashamene → Hawassa - Moyale (Kenya Border)
- Addis Ababa - Mojo - Shashamene → Wolaita Sodo-Arbaminch-Konso-Turmi - Namraputh (Kenya Border)

Number of nodes/vertices considered

There are about 95 urban centers with population above 10,000 in this corridor. Ziway, Shahamene, Bale Robe, Assela, Hawassa, Dilla, Sodo, Arbaminch are among the large towns in the corridor with each over 50,000 populations. The already developed Hawassa Industrial park is found in this corridor. SNNPR North, Central and Southern zones as well as Oromia Central are among the identified Agro Processing Zones. Hawassa, Dilla and Sodo are also centers of the ECX Coffee warehouses while Ziway, Doddola, Goba, Gebreguracha, Dilla and Hossaina, Konso and Turmi are identified Agro Centers in the Southern part of the Country.

In Southern Corridor, a total of number of 57 missing links with length of 5222 km are identified. The following table shows the list of identified missing links including the parameters used for identification of the links

Table 6-28:- List of Missing Links in Southern Corridor

No	Link name	Length (Km)	Near Access Road	Purpose
1	Adami Tulu- Assela	55.1	Access to Addis Ababa-Adama-Asela - Dodola Corridor Hawassa - Moyale (Kenya Border) Corridor	Surplus crop Production, more than 10,000 Population and Tourist Attraction Site
2	Adola-Melkadesta-Harnfema	72.4	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than 10,000 Population, Surplus Crop Production area
3	Aje-Alage-Koshe-Mito Road	54.7	Access to Shashamane- Woliyita Sodo-Arabmich Corridor	More than 10,000 Population, Surplus Crop Producion area and Tourist Attraction Site
4	Aje-Loke-Shasha-Tebela,Lot1-Km54	54.3	Access to Shashamane- Woliyita Sodo-Arabmich Corridor	More than 10,000 Population, Surplus Crop Producion area and Tourist Attraction Site
5	Aje-Loke-Shasha-Tebela,Lot2-Km107	53.1	Access to Shashamane- Woliyita Sodo-Arabmich Corridor	More than 10,000 Population, Surplus Crop Producion area and High Traffic Volume

No	Link name	Length (Km)	Near Access Road	Purpose
6	Angetu-Bedere	74.0	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than 10,000 Population and Surplus Crop Production
7	Angetu-Mena	25.3	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Production and Tourist Attraction Site
8	Arbaminch -Nechsar park -Kele	83.5	Access to Hawassa Wolayita Sodo-Arbamich Corridor	More than 10,000 Population and Tourist Attraction site
9	Arbegona-Yirgalem	52.7	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than 10,000 Population and Surplus Crop Production
10	ARSI NEGELE-KORE-MERARO	67.5	Access to Addis Ababa-Adama-Asela-Dodola and Shashemene-Hawassa Corridor	More than 10,000 Population, Surplus Crop Producion area and Tourist Attraction Site
11	Assasa-Agarfa	79.5	Access to Addis Ababa-Adama-Asela-Dodola Corridor	More than 10,000 Population, Surplus Crop Producion area
12	Bele Arsi - Siba	26.8	Access to Addis Ababa-Adama-Asela-Dodola Corridor	More than 10,000 Population, Surplus Crop Producion area
13	Bule Hora-Aflala-Meta Gefersa	128.3	Access to Hawassa - Moyale (Kenya Border) Corridor	More than 10,000 Population,Surplus Crop Producion and Tourist Attraction Site
14	Chencha-Chano	16.3	Access to Hawassa Wolayita Sodo-Arbamich Corridor	More than 10,000 Population and Tourist Attraction Site
15	Chire- Adola	111.1	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than 10,000 Population, Surplus Crop Producion area
16	Dama(Anfele)-Bore	24.8	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than 10,000 Population and Surplus Crop Production
17	Delo Mena-Kundi	120.5	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
18	Diksis-Kulla-Derba-Halila-Chole	68.0	Access to Addis Ababa-Adama-Asela-Dodola Corridor	More than 10,000 Population, Surplus Crop Producion area and High Traffic volume
19	Dodola-Bensaware	71.0	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than 10,000 Population, Agrocenter and Surplus Crop Production
20	Dogo-Kofele-Repi--DedoYirgachefe	37.7	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than 10,000 Population and Surplus Crop Production
21	Filtu - Al Abdile - Manguada	138.1	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population

No	Link name	Length (Km)	Near Access Road	Purpose
22	Ginir-Dihun-Shekosh-Wareder Lot 1, Km 0-Km 182	182.7	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
23	Ginir-Fiq, Lot1, Km0-Km115	114.5	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
24	Ginir-Fiq, lot2, Km115-Km213	98.6	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
25	Girawa - Husse-Waldiya-Meyu	109.8	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population,Surplus Crop Producion area
26	Gobesa -Bekoji-Kersa	73.2	Access to Addis Ababa-Adama-Asela-Dodola Corridor	More than 10,000 Population, Surplus Crop Producion area
27	Gode-Beredele-Bug Bere	135.9	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
28	Hargele - Imi Km0-Km115	116.0	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
29	Hargele - Imi Km115-Km231	115.4	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
30	Imi Jun- El Bahid-Bur Huso, lot1, Km0-Km98	98.3	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
31	Imi Jun- El Bahid-Bur Huso, lot2, Km98-Km213	115.5	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
32	Kersa-Shire	38.1	Access to Addis Ababa-Adama-Asela-Dodola Corridor	More than10,000 Population and Tourist Attraction site
33	Kofele-Arbegona-Daye	23.1	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than10,000 Population
34	Kofle-Qore-Shire	30.3	Access to Addis Ababa-Adama-Asela-Dodola Corridor	More than10,000 Population
35	Magna-Semare-Seru	75.6	Access to Addis Ababa-Adama-Asela-Dodola Corridor	More than 10,000 Population, Surplus Crop Producion area and High Traffic volume
36	Mechara -Fik-Deghamedo-Degehabur km 256-km 411	154.1	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
37	Mechara -Fik-Deghamedo-Degehabur km-0-Km146	146.3	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area

No	Link name	Length (Km)	Near Access Road	Purpose
38	Mechara-Fik-Deghamedo-Degehabur Km146-Km 256 (Fik)	110.1	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
39	Meki-Iteya	47.6	Access to Addis Ababa-Adama-Asela - Dodola Corridor Hawassa - Moyale (Kenya Border) Corridor	Surplus crop Production, morethan 10,000 Population and High traffic volume
40	MeliyuBele-Filtu, Lot1,Km0-km149 (Genale)	147.9	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
41	MeliyuBele-Filtu, Lot2,Km149-km234	86.4	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
43	Metagefersa-Wachile-Dakwta-Erer	165.4	Access to Hawassa-Moyale Corridor	Surplus Crop Producion area
42	Meyu-Goda-Ritu, Lot1, Km0-Km110	110.8	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
44	Meyu-Goda-Ritu, lot-2, km110-Km207	96.9	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
45	Midega-Obole-Mareg Dugheleh Lot 1, Km 0-Km 78.5	78.5	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Tourist Attraction site
46	Moyale-Jenya	181.9	Access to Hawassa-Moyale Corridor	Surplus Crop Producion area
47	Nonsebo-Angetu	46.4	Access to Hawassa-Adola-Negele- Dolo Odo Corridor	More than 10,000 Population and Surplus Crop Production
48	Raitu-Shakisa-Elkere	140.1	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
49	Remti- Burka	182.6	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
50	Segeg-Ali-Dihun-Imi JCT, Lot1, km0-Km102	102.8	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
51	Segeg-Ali-Dihun-Imi JCT,Lot2, km102-km200	98.6	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
52	Shekuhussien-Beltu-Ramsi	111.2	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population and Surplus Crop Producion area
53	Sofomr-Mio-Gorobebeksa	86.0	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population,Surplus Crop Producion area and Tourist Attraction Site
54	Teltele-Meramaro-Abot	52.0	Access to Hawassa-Moyale Corridor	More than 10,000 Population and Tourist Attraction Site

No	Link name	Length (Km)	Near Access Road	Purpose
55	Toltawond-Abot-Jenya	171.7	Access to Hawassa-Moyale Corridor	More than 10,000 Population and Tourist Attraction Site
56	Tula-Hantate-Shigasha-Tebela	70.4	Access to Wolaita Sodo-Arbaminch-Konso-Turmi and Hawassa - Moyale (Kenya Border) Corridor	Surplus crop Production and morethan 10,000 Population
57	Yabelo-Jenya	92.6	Access to Hawassa-Moyale Corridor	Surplus Crop Producion area

- Missing Links in Central - Western Corridor
  - Addis Ababa - Nekemte - Mekenajo } → Asosa - Kurmuk (Sudan Border)
  - Addis Ababa - Nekemte - Mekenajo } → Dembedilo-Gambela-Jikao (Sudan Border)
  - Addis Ababa - Jima → Bedele - Metu- Gambela - Jikao (Sudan Border)
  - Addis Ababa - Jima → Mizan Teferi - Guraferda (South Sudan Border)

Number of nodes/vertices considered

There are about 83 urban centers with population each above 10,000 in this corridor. Jima, Nekemte, Metu and Assosa are among the biggest towns in this corridor with each over 50,000 population. The already developed Jima Industrial park and the planned future Assosa Industrial Park are located in this corridor. Assosa, Jima, Nekemte, Gimbi, Bedele, Bonga and Metu are also centers of the ECX Coffee and Grain warehouses while Ambo, Sawula, Bedele, Gimbi and Jinka are the identified Agro Centers in the Central - Western Corridor.

The total of number of missing links in this corridor is 27 with length of 1994.3 km. The following table shows the list of identified missing links including the purpouse used for identification of the links.

Table 6-29:- List of Missing Links in Central Western Corridor

No	Linkname	Length (Km)	Near Access Road	Purpose
1	Ameya-Koisha-Salayesh-Laha	77.4	Addis Ababa - Jima-Mizan Teferi - Guraferda (South Sudan Border)	More than 10,000 Population and Surplus Crop Producion area
2	Atanago-Koma-Mote	74.2	Access to Addis ababa-Nekemte -Nejo Corridor	Surplus Crop Producion area
3	Bachuma-Oudadishi-Selamber-Tebela Lot 1,Km 0-Km 81	81.3	Addis Ababa - Jima-Mizan Teferi - Guraferda (South Sudan Border)	More than 10,000 Population

No	Linkname	Length (Km)	Near Access Road	Purpose
4	Bedele-Bube	159.5	Access to Addis Ababa Jimma Corridor	More than 10,000 Population, Surplus Crop Production, ECX Warehouse and Agro Center
5	Bedelle -Koma	74.0	Access to Addis Ababa-Jimma-Bedele-Gambella Corridor	More than 10,000 Population, Surplus Crop Production and ECX Warehouse
6	Bonga-Duba Yaneba-Dime/Laska	141.9	Access to Wolaita Sodo-Arbaminch-Konso-Turmi-Nemreputh (Kenya Border)	More than 10,000 Population and ECX Warehouse
7	Bure-Girar	91.0	Access to Addis Ababa -Jimma-Bedele-Gambella	More than 10,000 Population and Surplus Crop Producion area
8	Chitu-Gindo-Darge	54.8	Access to Addis Ababa-Jimma Corridor	More than 10,000 Population, Surplus Crop Producion area and High Traffic Volume
9	Deramalo-otolo	43.1	Access to Hawassa Wolayita Sodo-Arbamich Corridor	More than 10,000 Population
10	Dipa-Ciam	34.0	Access to Addis Ababa -Jimma-Bedele-Gambella	More than 10,000 Population
11	Gilgelgibe-Tirokeneni-Tole Jima	84.2	Access to Addis Ababa -Jima Corridor	More than 10,000 Population and Surplus Crop Producion area
12	Guliso-Nejo	39.6	Access to Addis ababa-Nekemte -Nejo Corridor	More than 10,000 Population and Surplus Crop Producion area
13	Harbuchulele-Inge-Welkite	62.0	Access to Addis Ababa-Jimma Corridor	More than 10,000 Population, Surplus Crop Producion area and High Traffic Volume
14	Harosebu-Gna-Kara-Melkaebitcha-Babo	70.6	Access to Addis Ababa-Nekemte -Nejo Corridor	More than 10,000 Population and Surplus Crop Producion area
15	Jemu - Barda-Kitie	77.6	Addis Ababa - Jima-Mizan Teferi - Guraferda (South Sudan Border)	More than 10,000 Population and Surplus Crop Producion area
16	Jinka-Washawuha-Washmeda	115.9	Access to Wolaita Sodo-Arbaminch-Konso-Turmi-Nemreputh (Kenya Border)	More than 10,000 Population,Surplus Crop Production and Agro Center

No	Linkname	Length (Km)	Near Access Road	Purpose
17	Maji-Tum-Tulgit	39.7	Access to Wolaita Sodo-Arbaminch-Konso-Turmi-Nemreputh (Kenya Border)	More than 10,000 Population and Surplus Crop Production
18	Mechara-Tulema-Bure	73.7	Access to Addis Ababa -Jimma-Bedele-Gambella and Addis Ababa-Nekmete-Nejo Corridor	More than 10,000 Population and Surplus Crop Producion area
19	Mendi-Wama-Shemeltoke	35.2	Access to Addis Ababa-Nekemte -Nejo Corridor	More than 10,000 Population and Surplus Crop Producion area
20	Mengshi-Dima	66.9	Access to Addis Ababa -Jimma- Mizen Teferi- Guraferda	Morethan 10,000 Population
21	Sebasebat-Chewaka-Ephrem	67.5	Access to Addis Ababa- Nekemte -Nejo and Jimma -Bedele-Gambella Corridor	More than 10,000 Population, Surplus Crop Production area, ECX Warehouse
22	Sentu-Yanfa-Gechi	80.0	Access to Addis Ababa-Jimma-Bedele-Gambella Corridor	More than 10,000 Population, Surplus Crop Producion area, Agro Center, high Traffic volume and ECX Warehouse
23	Shirishir-Wubhamer spur road	11.6	Access to Wolaita Sodo-Arbaminch-Konso-Turmi-Nemreputh (Kenya Border)	More than 10,000 Population and Surplus Crop Production
24	Silkamaba-Benja-Mote	76.7	Access to Addis Ababa -Jimma	Surplus Crop Producion area
25	Sire(Moto)-Mote-Nunu-Arjo	112.0	Access to Addis ababa-Nekemte -Nejo Corridor	Surplus Crop Producion area
26	Tulgit-Tirmatid-South Sudan Border	62.1	Access to Wolaita Sodo-Arbaminch-Konso-Turmi-Nemreputh (Kenya Border)	More than 10,000 Population
27	Waka- Morka	87.8	Access to Hawassa Wolayita Sodo-Arbamich Corridor	More than 10,000 Population

- North - Western Corridor
  - Addis Ababa - Bahir Dar - Azezo → Gonder - Humera (Eritrea Border)
  - Addis Ababa - Bahir Dar - Azezo →Gonder-Shire-Adwa-Rama(Eritrea border)
  - Addis Ababa - Bahir Dar – Azezo → Metema (Sudan Border)

Number of nodes/vertices considered

There are about 82 urban centers with population each above 10,000 in this corridor. Debremarkos, Bahirdar and Gondar are among the biggest towns in the corridor with each over 150,000 populations. The already developed Bahirdar Industrial park and the Humera Pilot Agro Industry Zone are in this corridor. Bure, Metema and Humera are also centers of ECX Grain warehouses while Chagni, Gashena, Debretabor and Gondar are the identified Agro Centers in the North - Western part of the country.

The total of number of missing links in this corridor is 28 with length of 1955 km. The following table shows the list of identified missing links including the parameters used for identification of the links.

Table 6-30:- List of Missing Links in North Western Corridor

No	Linkname	Length	Near Access Road	Purpose
1	Adet-Fagita-Addiskidame-Pawe	138.67	Access to Addis Ababa-Bahirdar Corridor	Surplus Crop Producion area
2	Adigosh-Birkutan-Sittona	36.65	Access to Mekele-Shire-Shiraro-Hummera	More than10,000 Population and Tourist Attraction Site
3	AGAMSA-ABAY RIVER-ROBE GEBEYA Lot 1, Km 0-Km 80	80.00	Access to Addis Ababa-Bahirdar Corridor	More than 10,000 Population and Surplus Crop Producion area
4	AGAMSA-ABAY RIVER-ROBE GEBEYA Lot 2, Km 80- Km 140	59.63	Access to Addis Ababa-Bahirdar Corridor	More than 10,000 Population and Surplus Crop Producion area
5	Ayema - Kunzila-Gelago Junc	49.80	Access to Addis Ababa-Bahirdar-Gonder Corridor	More than 10,000 Population and Surplus Crop Production
6	Bahirdar-Kunzila	56.55	Access to Addis Ababa - Bahirdar -Gonder-Humera and Azezo-Metema Corridor	More than 10,000 Population and Surplus Crop Production
7	Behir-Shigili-Maykadera	35.97	Access to Addis Ababa - Bahirdar -Gonder-Humera	More than 10,000 Population
8	Bullen - Gublak	70.37	Access to Addis Ababa-Nekemete -Nejo-Asossa	More than 10,000 Population
9	Bure - Gomer	41.90	Access to Addis Ababa-Bahirdar Corridor	Surplus Crop Producion area
10	Chulute-Debre Markos	93.87	Access to Addis Ababa-Bahirdar Corridor	More than 10,000 Population, Surplus Crop Production and ECX Warehouse
11	Debre Eliyas jun-Finoteselam-G/Abay-Fagita-Merawi	158.98	Access to Addis Ababa-Bahirdar Corridor	Surplus Crop Producion area
12	Derba-Inchni-Gojo	73.95	Access to Addis Ababa-Nekemte-Nejo Corridor	More than 10,000 Population and High Traffic volume
13	Gida-Yaso	68.74	Access to Addis ababa-Nekemte -Nejo Corridor	More than 10,000 Population,Surplus Crop Producion area and Tourist Attraction Site
14	Goha Tsion-Kachise	65.70	Access to Addis Ababa-Bahirdar Corridor	More than 10,000 Population and Surplus Crop Producion area
15	Hateto-Wayu	44.14	Access to Addis ababa-Nekemte -Nejo Corridor	More than 10,000 Population, Surplus Crop Producion area and Tourist Attraction Site

16	Hoja- Dure-Goro Kelate	67.32	Access to Addis Ababa-Nekemte-Nejo Corridor	More than 10,000 Population
17	Jawi-Kunzla	82.61	Access to Addis Ababa - Bahirdar -Gonder-Humera and Azezo-Metema Corridor	More than 10,000 Population and Surplus Crop Production
18	Lemlem Bereha-Elias Jun	38.53	Access to Addis Ababa-Bahirdar Corridor	Surplus Crop Producion area
20	Maganana-Mahbireselassie-Serba Delgi	119.14	Access to Addis Ababa - Bahirdar -Gonder-Humera and Azezo-Metema Corridor	Surplus crop Production, morethan 10,000 Population and High traffic volume
19	Maganan-Maserodenb-Aberahajira Road	54.89	Access to Addis Ababa - Bahirdar -Gonder-Humera and Azezo-Metema Corridor	Surplus crop Production, morethan 10,000 Population and High traffic volume
21	Maksegnit-Arbaya Belessa	80.71	Access to Addis Ababa-Bahirdar-Gonder Corridor	More than 10,000 Population,Tourist Attraction site and Surplus Crop Producion
22	Maytemen-Ketema Nigus	35.05	Access to Addis Ababa - Bahirdar -Gonder-Humera	More than 10,000 Population
23	Maytsebri-Mayhanse-Dedebit Jun	76.17	Access to Mekele-Shire-Shiraro-Hummera	More than10,000 Population
24	Muger-Gibre Guracha	46.43	Access to Addis Ababa-Nekemte-Nejo Corridor	More than 10,000 Population and Agrocenter
25	Nejo-Yaso-Gelasa-Dibate jun	37.79	Access to Addis ababa-Nekemte -Nejo Corridor	More than 10,000 Population
26	Sherkole-Kurmuk	64.92	Access to Addis Ababa-Nekemete -Nejo-Asossa	More than 10,000 Population
27	Shiraro-Lama	37.18	Access to Mekele-Shire-Shiraro-Hummera	More than10,000 Population
28	Tewedros Ketema-M Siliase-Aykel	139.38	Access to Addis Ababa - Bahirdar -Gonder-Humera and Azezo-Metema Corridor	Surplus crop Production, morethan 10,000 Population and High traffic volume

.North - Eastern Corridor

- Addis Ababa - Kombolcha - Dessie - Mekelle - Adigrat (Eritrea Border)
- Kombolcha - Mile - Galafi (Djibouti Border)
- Mekele - Galafi (Djibouti Border)
- Mekele - Shire - Shiraro - Humera (Eritrea Border)

Numberof nodes/vertices considered

There are about 70 urban centers with population each above 10,000 in this corridor. Debrebirhan, Kombolcha, Dessie, Woldiya, Mekele, Adigart, Adwa and Axum are the largest towns in the corridor with each over 50,000 population. The already developed Mekelle and Kombolcha Industrial parks are located in this corridor. There are a number of Agro Processing zones in this corridor.

Under this corridor a total of number of 27 missing links with length of 1644.6 km are identified. The following table shows the list of identified missing links in the Central Eastern Corridor including the paramters used for identification of the links.

Table 6-31: List of Missing Links in North Eastern Corridor

No	Linkname	Length	Near Access Road	Purpose
1	Adi Mella-Debre Genet-Filafil	87.9	Access to Mekele-Shire-Shiraro-Hummera	More than10,000 Population and Tourist Attraction Site
2	Adigudom - Gijet - Saba Tegu	71.3	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population and Tourist Attraction Site
3	Ajbar-Yeberet-Shola-Kon	97.5	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population,Surplus Crop Production and Tourist Attraction Site
4	Amba Gyiorgis-ArbaTseguar-Abi Adi Jun. Km0-Km118	118.7	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population
5	Ambamariam-Yeberet	60.2	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population,Surplus Crop Production and Tourist Attraction Site
6	Atsbi - Konaba-Berhale	20.5	Access to Mekele-Shire-Shiraro-Hummera	More than 10,000 Population and High Traffic Volume

No	Linkname	Length	Near Access Road	Purpose
7	Awash Arba-MlWerer-Bora Lot1, Km 0-km 62	61.9	Access to Mile-Galafi Corridor	More than 10,000 Population
8	Awash Arba-MlWerer-Bora, Lot2, Km 62-Km 180	118.0	Access to Mile-Galafi Corridor	More than 10,000 Population
9	Axum - Adet	29.8	Access to Mekele-Shire-Shiraro-Hummera	More than10,000 Population
10	Bati - Chifra	45.0	Access to Mile-Galafi Corridor	More than 10,000 Population and Surplus Crop Production
11	Birki - Haikemesehal-Atsbi Jun	19.9	Access to Mekele-Shire-Shiraro-Hummera	More than 10,000 Population, Tourist Attraction Site and High Traffic Volume
12	Chila - Wukero Maray	21.8	Access to Mekele-Shire-Shiraro-Hummera	More than10,000 Population
13	Dessie Jun-Ambamariam	43.6	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population,Surplus Crop Production and Tourist Attraction Site
14	Dig Degu - Hamaye Kem - Kunaba Lot 1, Km 0- Km 54	54.0	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population
15	Dig Degu - Hamaye Kem - Kunaba Lot 2, Km 54-Km144	89.5	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population
16	Dilybza-Arba Tseguar	39.0	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population and Turist Attraction site
17	Edaga Hamus--Sawni-Adewuka-Beda	94.6	Access to Mekele-Shire-Shiraro-Hummera	More than 10,000 Population, Tourist Attraction Site and High Traffic Volume
18	Filakit-Arbgebaya-Simada	93.8	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	Surplus Crop Producion area
19	Kerseber - Sobiyan	20.1	Access to Mekele-Shire-Shiraro-Hummera	More than 10,000 Population and Tourist Attraction Site

No	Linkname	Length	Near Access Road	Purpose
20	Mayichew-Bora-Sekota	68.5	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population Agro center and Surplus Crop Production area
21	Mehoney-Yalo-Degadigu	93.3	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population
22	Simada-Saynet-Busso	136.3	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population,Surplus Crop Production and Tourist Attraction Site
23	Sirtuager-Alemgebeya-Ankober	46.7	Access to Mile-Galafi Corridor	More than 10,000 Population
24	Tenta - Mekdela Amba	13.5	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population,Surplus Crop Production and Tourist Attraction Site
25	Tulusa - Dejach Meda	28.7	Access to Mekele-Shire-Shiraro-Hummera	More than 10,000 Population
26	Waja-Yalo	37.6	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	More than 10,000 Population
27	Yeberet-Arb Gebeya	32.8	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	Surplus Crop Producion area

In addition, there are 30 missing links with length of 2605.4 km found in more than one corridor. The following table shows list of missing links crosses more than one corridor.

Table 6-32:- List of Missing Links in crossing more than one corridor

No	Linkname	Length	Corridor	Near Access Road	Purpose
1	Afdera Jun-Mengaga-Endhura-Elidar	179.4	North Eastern and Central Eastern Corridor	Access to Mile-Galafi Corridor	More than 10,000 Population and Tourist Attraction Site
2	Amba Gyiorgis-Arba Tseguar-Abi Adi Jun. k118-km231	112.4	North Western and North Eastern Corridor	Access to Addis Ababa-Bahirdar-Gonder Corridor	More than 10,000 Population,Tourist Attraction site and Surplus Crop Producion

No	Linkname	Length	Corridor	Near Access Road	Purpose
3	AMBO-LEMLEM BERHA	117.6	North Western and Central Western Corridor	Access to Addis Ababa-Nekemte -Nejo Corridor	More than 10,000 Population, Surplus Crop Producion area and High Traffic volume, Agro Center
4	Arerti-Melka Jilo-Metehara Jun	38.2	Central Eastern and North Eastern Corridor	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Surplus Crop Production
5	Arerti-Welenchiti	38.5	Central Eastern and North Eastern Corridor	Access to Addis Ababa-Adama-Mile	More than 10,000 Population and Surplus Crop Production
6	Bachuma-Oudadishi-Selamber-Tebela Lot2,Km81-Km245	154.5	Central Western and Southern Corridor	Addis Ababa - Jima-Mizan Teferi - Guraferda (South Sudan Border)	More than 10,000 Population and Tourist Attraction Site
7	Belesa-Arba Tseguar jun	50.1	North Western and North Eastern Corridor	Access to Addis Ababa-Bahirdar-Gonder Corridor	More than 10,000 Population,Tourist Attraction site and Surplus Crop Producion
8	Bordede - Gelemeso	44.7	Central Eastern and Southern Corridor	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population
9	Burka-Midaga-Tolla-Harar Road Project	184.1	Central Eastern and Southern Corridor	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Tourist Attraction site
10	Daleti-Knocho-Wembera	93.4	Central Western and North Western Corridor	Access to Addis Ababa-Nekemete -Nejo-Asossa	More than 10,000 Population
11	Deder-Tirtira	76.2	Central Eastern and Southern Corridor	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population, High Traffic Volume Surplus Crop Producion area and
12	Gidole - Beneta-Kako	84.2	Central Western and Southern Corridor	Access to Hawassa - Moyale Corridor	More than 10,000 Population and Surplus Crop Production
13	Ginir-Dihun-Shekosh-Wareder Lot 2, Km 182-Km 367	185.4	Central Eastern and Southern Corridor	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
14	Gode - Shilabo-Biyo Ado, Lot1, Km 0-Km 143	142.6	Central Eastern and Southern Corridor	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population

No	Linkname	Length	Corridor	Near Access Road	Purpose
15	Hambiso-G/Meskel-Weleka-Wegedi-Key Mebrat	176.0	North Eastern and North Western Corridor	Access to Addis Ababa-Bahirdar Corridor	More than 10,000 Population, Surplus Crop Production and ECX Warehouse
16	Mekanbirahan-Arbatsiguar JCT	60.0	North Eastern and North Western Corridor	Access to Addis Ababa-Bahirdar-Gonder Corridor	More than 10,000 Population,Tourist Attraction site and Surplus Crop Producion
17	Metehara - Mechara	64.4	Central Eastern and Southern Corridor	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Tourist Attraction Site
18	Midega-Obole-Mareg Dugheleh Lot 2, Km 78.5-Km 152	74.6	Central Eastern and Southern Corridor	Access to Addis Ababa-Adama-Awash-Dengego-Jigjiga Corridor	More than 10,000 Population and Tourist Attraction site
19	Muti - Adaadi Mariam	12.5	Central Western and Southern Corridor	Links Addis Ababa - Adama-Awash and Addis Ababa-Jimma Corridors	More than 10,000 Population, Surplus Crop Production and Tourist Attraction Site
20	Sembo-Muketure	59.0	North Eastern and North Western Corridor	Access to Addis Ababa-Bahirdar-Gonder	More than 10,000 Population,Surplus Crop Production and Tourist Attraction site
21	Shilabo-Ferfer	126.9	Central Eastern and Southern Corridor	Access to Robe-Ginir-Imi Corridor	More than 10,000 Population
22	Shinshicho-Shone - Hawassa	53.4	Central Western and Southern Corridor	Access to Shashamane-Woliyita Sodo-Arabmich Corridor	More than 10,000 Population, Surplus Crop Producion area
23	Sire-Adugna-Bakojima-Gutin	74.5	Central Western and North Western Corridor	Access to Addis ababa-Nekemte -Nejo Corridor	More than 10,000 Population, Surplus Crop Producion area and ECX Warehouse
24	Sirtuager-Awasharba	60.1	Central Eastern and North Eastern Corridor	Access to Mile-Galafi Corridor	More than 10,000 Population and Tourist Attraction site
25	Smada-Gundeweyn	71.7	North Eastern and North Western Corridor	Access to Addis Ababa-Kombolcha-Dessie-Mekele Corridor	Surplus Crop Producion area
26	Tulema-Areka	61.8	Central Western and Southern Corridor	Access to Shashamane-Woliyita Sodo-Arabmich Corridor	More than 10,000 Population, Surplus Crop Producion area

No	Linkname	Length	Corridor	Near Access Road	Purpose
27	TuluBollo-Mojo (Lot 1, Km 0-Km 46)	45.7	Central Western and Southern Corridor	Links Addis Ababa - Adama-Awash and Addis Ababa-Jimma Corridors	More than 10,000 Population, High Traffic volume and Surplus Crop Production and Tourist Attraction site
28	TuluBollo-Mojo(Lot 2, Km 46-Km 103)	57.8	Central Eastern and Southern Corridor	Links Addis Ababa - Adama-Awash and Addis Ababa-Jimma Corridors	More than 10,000 Population, High Traffic volume and Surplus Crop Production and Tourist Attraction site
29	Tuludimtu-chefedonsa-shenkora-Arerti	81.6	Central Eastern and North Eastern Corridor	Access to Addis Ababa-Adama-Mile	Surplus Crop Production area, Morethan 10,000 Population and High Traffic Volume
30	Welenchiti -Sodere Road Junction	24.3	Central Eastern and Southern Corridor	Access to Addis Ababa-Adama-Mile	More than 10,000 Population and Surplus Crop Production

The Consultant has identified 193 links with a total of 16,022.5 km.

6.5 Prioritizationof Missing Links

The Consultant has proposed and analyzed the criteria to set priority for missing links. The multi criteria were discussed among consultant professional team and accordingly a weight was assigned to all criterion. The basic principles used by the Consultant to set criteria are as follows.

Basic principles adopted for selection of criteria are:

- Contribution for traffic generation, such as population size, number of urban centers;
- Contribution to GDP and roles to economic growth, such as amount of surplus production, cash crops, livestock, number of industries etc;

- Priority to develop untouched areas and low lands;
- Contribution to Tourism development;
- Contribution for connectivity and Regional integration within the Country and with Neighboring Countries;

- Priorities for regions which have poor federal access roads; and
- Priorities for roads which provide access to borders and ports

The details are explained below.

As this study is focused on road master plan for short term (5 years) and long term (10 years), it is envisaged to deal with upgrading and rehabilitation of existing roads and identification of missing link roads. In all cases, the identified roads had to be evaluated and prioritized for future implementation based on the availability of budgets.

Accordingly, a number of existing roads for upgrading and rehabilitation and missing link roads for new construction were identified. The prioritization of existing roads was performed using the Highway Development and Management (HDM 4) Tool that was developed by the World Bank and have been underutilization for more than twenty years. In this respect, the required data were acquired from pertinent organizations and sources. These data included road construction and maintenance costs as well as vehicle related costs. The data were analyzed using HDM 4 and the presumed parameters were generated and then the projects were prioritized. The main criteria of prioritization were net present value (NPV), benefit-cost ratio (B-CR) and internal rate of return (IRR).

In the case of missing links however, the benefits are more of qualitative and there are no readily available tangible data for processing. In this case, the most common methodology of project evaluation is multi criteria analysis (MCA). The MCA approach considers parameters such as social, economic, environmental and pavement condition as the main criterion and some sub-criteria to find the best suitable parameters and their corresponding weights.

A key feature of MCA is its emphasis on the judgement of the decision making team in establishing objectives and criteria, estimating relative importance weights and, to some extent, in judging the contribution of each option to each performance criterion. The subjectivity that intervenes this can be a matter of concern. Its foundation in principle is the decision makers' own choices of objectives, criteria, weights and assessments of achieving the objectives.

In view of the foregoing, the Consultant has considered MCA by itself and through discussions with the ERA Steering Committee. Accordingly, in utilizing MCA in the case of the missing links, the following were dealt with Main Criteria (MC), Sub Criteria, Criteria Range, and marks (points) with respect to specifics and overall. Overall, there were eight (8) main criteria, eleven (11) sub criteria, and thirty (30) criteria ranges. These are succinctly described below:

MC 1: Population and Urban Center

This main criterion comprises of two sub criteria which are: populations served by road crossing Woredas with criteria ranges from least population per kilometer to highest population per km. In allocating points for roads, the roads get marks based on proportion of their population to the maximum population of road crossing Woredas. A road which crosses

highest population per km gets 10 points. Therefore, the maximum point/mark allocated in this case is 10. On the other hand, the maximum point/mark allocated in the case of urban centers is 6. To make uniform comparison, the number of urban center per 50km is considered. Therefore, if the maximum number of towns crossed by 50km of road is 4, then the road will get maximum mark which is 6. Then based on the number of towns, proportional mark is assigned.

MC 2: Surplus Crops Production

In this case, there are two sub criteria that are surplus crops for domestic consumption, surplus crops for export.

MC 2.1: Surplus Crops for Domestic Market

Similar with population the allocation of the mark used in the case of roads crossing surplus producing Woredas is the size of surplus production. The maximum mark is determined by the maximum total surplus producing Woredas crossed by the proposed roads. And the maximum mark in the case of surplus crop production is 10 mark. Therefore, a road which crosses largest surplus crop producing Woredas has got the maximum mark and for the remaining roads, the mark is allocated proportionately with respect to the maximum of surplus amount of road.

MC 2.2: Surplus Crops for Export (Cash crops)

Under this multi criteria the consultant has followed the same procedure with the above multi criteria for surplus production. The maximum point allocated is 8 and the remaining roads get proportionally with the total.

MC 2.3: Arable land

Arable land is land which is capable of being ploughed and used to grow crops but not currently cultivated. Under this multi criteria, measured size of arable land found in the Woredas crossed by newly identified missing links is used for comparison. The maximum mark/point assigned for road crossing high size of arable land is 7 mark. Based on the size of arable land crossed by the roads, the mark is distributed proportionally in accordance with the size of arable land found in the Woredas.

MC 3: Livestock

Livestock in Ethiopia are domesticated animals commonly raised to produce labor and commodities such as meat, eggs, milk, leather, and wool. Under this criteria, the total number of livestock (in Tropical Livestock Unit) is the measurement of comparisons between roads crossing livestock potential areas. The total marks/points allocated for road having high livestock population is 10 mark. Therefore, the remaining roads have assigned marks proportionally to the total livestock population multiplied by 10.

MC 4: Mining

There are two sub criteria under mining and these are metallic and placer gold; and industrial mineral. The total allocated mark/points for mining is 8 mark/points.

MC4.1: Metallic and Gold

Under this multi criteria the consultant has evaluated the volume of metallic and placer gold crossed by the identified missing links. The total mark/point allocated for metallic and gold is 5 mark. Therefore, the maximum mark/point is assigned road crossing largest metallic mineral and placer gold Woredas. The remaining roads get marks proportionally according to the amount of production.

MC 4.2: Industrial Mineral

Under this multi criteria the consultant has evaluated the volume of industrial mineral crossed by the identified missing links. The total mark/point allocated for industrial mineral is 3 mark. Therefore, the maximum mark/point is assigned for road crossing largest industrial mineral Woredas. The remaining roads get marks proportionally according to the amount or potential of industrial mineral.

MC 5: Industries

This multi criteria is evaluated with the number of Medium scale, large scale and agro-industries found in the Woredas crossed by newly identified missing links. The maximum mark/point allocated for road crossing high industrial Woredas is 10 mark. For the remaining roads, the mark is allocated proportionally to the maximum number of Industries crossing road multiplied by 10.

MC 6: Tourism

Under this multi criteria, the total number of major tourist attraction sites crossed by the future missing link is considered. The total mark allocated for road crosses high number of tourist attraction Woredas is 6 mark. For the remaining roads, the mark is assigned proportionally to maximum no of tourist site attraction multiplied by 6.

MC 7: Federal Road Density

The Federal Road Density is measured in km per 1,000 sq. km. The maximum mark is allocated for road crossing very low federal road density Woredas which is 6km per 1000 sq km. This is to privilege future missing links crossing less federal road density Woredas. Roads crossing very low density Woredas which is 6 km per 1000 sq km or less get 10 mark. Roads crossing high density Woredas get less mark. The remaining roads get proportionally by dividing 6 to the density of the Woredas crossed by the roads multiplied by 10.

MC 8: Network Connectivity

There are two sub criteria in this case and these are: Transport Corridor and Regional Integration.

MC 8.1: Transport Corridor

There are four criteria ranges under the Transport Corridor. The first one is corridor road that connect feeder or unclassified road; the second one is corridor road that connect collector roads; the third one is corridor road that connect main access roads; and lastly, corridor road that connect trunk or link roads. Correspondingly, the allocated points/marks are 1.25; 2.50, 3.75 and 5 respectively.

MC 8.2: Regional Integration

Under this sub criterion, there are four criteria ranges and these are: roads connecting Woredas within one zone; roads connecting two zones within one region; roads connecting two regions; and lastly roads connecting two Borders and Posts. The corresponding allocated points/marks are: 2.5, 5.0, 7.5 and 10.0.

It can be concluded that, the identified missing links have been evaluated for prioritization purposes using the above criteria, sub criteria and criteria ranges after thorough professional exercise and sufficient discussions with the clients and other stakeholders. The Consultant feels that the exercise was iterative and can be revised at point of time.

Table 6-33:- Criterion and Weight used for Priority of Missing Links considering Socio economic characteristics of crossing Woredas

No	Main Criteria	Sub Criteria	Mark allocation	Weight	Marking From Total (100%)
1	Population and Urban Center				16
1.1		Total Population of Crossing Woredas			10
			T.Pop/km	Proportionally to the maximum population/km	(Pop/km of road / Maximum pop of crossing Road)*10
			T.Pop/km	Max Tot pop / km gets 10 points	10
1.2		Urban Center			6
			No of Urban Center/50km	Proportionally to the maximum no of	(No of Urban Center /4)* 6

No	Main Criteria	Sub Criteria	Mark allocation	Weight	Marking From Total (100%)
				Urban Center / 50km	
			Maximum No of Urban Center/ 50km is 4	The maximum No of Urban Center observed is 4	6
2	Surplus crop Production and cash crop				18
2.1		Surplus Crop Production			10
			Surplus Production of Woredas crossed by the road	Proportionally to the maximum Surplus production	(Surplus Production / Maximum Surplus Production)*10
			Maximum Surplus Production of Woredas crossed by the road	Maximum Surplus productionget 10 mark	10
2.2		Cash Crop			8
			Cash Crop Production of Woredas crossed by the road	Proportionally to the maximum cash crop production	(Cash crop Production / Maximum Cash Crop Production) * 8
			Maximum Cash Crop Production of Woredas crossed by the road	Maximum Cash Crop production get 8 mark	8
2.3		Arable land			7
			Total Size of Arable Land crossed by the roads	Proportionally to the maximum size of Arable Land	Size of Arable land / Maximum Size of Arable Land)*7
			Maximum size of Arable land crossed by the Road	Maximum Size of Arable land get 7 mark	7.0
3	Livestock	Livestock Pop			10
			No of Livestock pop of Woredas crossed by the road	Proportionally to the maximum Livestock pop	No of Livestock Pop / Maximum No of Livestock Pop) * 10

No	Main Criteria	Sub Criteria	Mark allocation	Weight	Marking From Total (100%)
			Maximum No of Livestock Pop of Woredas crossed by the road	Maximum Livestock Pop get 10 mark	10
4	Mining	Mining			8
	Metallic and Gold				5.0
			Quantity of Metallic and Gold (MTon)	Proportionally to the maximum Quantity of Metallic mineral	Quantity of Metallic mineral of crossing Woreda / Maximum Metallic Mineral) * 5
			Maximum Quantity Metallic and Gold (MTon) is	Roads with Highest Quantity of Metallic mineral in ton gets 5 mark	5.0
	Industrial Mineral				3
			Quantity of Industrial Mineral (MTon)	Proportionally to the maximum Quantity of Industrial mineral	(Quantity of Industrial mineral / maximum Quantity of Industrial mineral) * 3
			Maximum Quantity of Industrial Mineral (MTon) is 290	Road with Maximum Quantity of Industrial mineral gets 3 mark	3.0
5	Industries	Industries			10
			No of Medium or Large Scale Industrial or Agro industries of crossing Woredas	Proportional to the Maximum No of Medium or Large Scale Industrial or Agro industries of crossing Woredas	No of Medium or Large Scale Industrial or Agro industries of crossing Woredas / Maximum No of Medium or Large Scale Industrial or Agro industries of crossing Woredas * 10
			Maximum No of Medium or Large Scale Industrial or Agro industries of crossing Woredas	Maximum No of Medium or Large Scale Industrial or Agro industries of crossing Woredas gets 10 mark	10.0

No	Main Criteria	Sub Criteria	Mark allocation	Weight	Marking From Total (100%)
6	Tourism	Tourism			6
			No of Major Tourist sites of crossing Woredas	Proportional to the Maximum No of Major tourist sits of crossing Woredas	No of Tourist site/ Maximum No of Tourist site * 6
			Maximum No of Major Tourist attraction sites crossed by the Road	Maximum No of Major Tourist attraction sites crossed by the Road gets 6 mark	6
7	Federal Road Density	Federal Road Density (km /1000 Sq Km)			10
			Federal Road Density > 6	Proportional to the Minimum road density of crossing Woredas	6 / (Federal Road Density) * 10
			Federal Road Density <=6	Road crossing very low federal road density (which is 6 or less) gets 10 mark	10
8	Network Connectivity				15
8.1		Connect (Transport Corridors)			5
			Connect Feeder Road or Unclassified	Feeder or Unclassified	1.25
			Connect Collector Road	Collector	2.50
			Connect Main Access Road	Main Access	3.75
			Connect Trunk/Link Road	Trunk or Link	5.00
8.1	Network Connectivity	Regional Integration			10.0

No	Main Criteria	Sub Criteria	Mark allocation	Weight	Marking From Total (100%)
			Roads Connecting Woredas with in one Zone	Woredas within One Zone	2.5
			Roads Connecting two zones with in a Region	Woredas within Two Zones	5.0
			Roads Connecting two Regions	Woredas in Two Regions	7.5
			Roads Connecting to Borders and Posts	Access to Borders	10.0

After analyzing all the missing links based on the criterion above, priority is set using the final score or mark obtained by the links. When missing links appears very long, it is divided into two or three lots of reasonable length for ease of contract management. In such cases, priority of the highest rank missing link is assigned for the other lots to finish the construction of all lots at once and achieve the target objectives.

Table 6-34:- List of Missing Links and their priority

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Gida-Yaso	68.7	Benishangul Gumuz	Oromia	Gida Keremu	Yaso	Ongoing
Adola-Melkadesta-Harnfema	72.4	Oromia	SNNP	Adola	Girja	Ongoing
Maksegnit-Arbaya Belessa	80.7	Amhara	Amhara	Gondar Zuriya	Misrak Belesa	Ongoing
Adigudom - Gijet - Saba Tegu	71.3	Tigray	Tigray	Enderta	Tanqua Abergele	Ongoing
Hoja- Dure-Goro Kelate	67.3	Oromia	Oromia	Abuna Gindeberet	Metarobi	Ongoing
Simada-Saynet-Busso	136.3	Amhara	Amhara	Legambo	Simada	Ongoing
Bure - Gomer	41.9	Amhara	Amhara	Bure	Wenberma	Ongoing
Chencha-Chano	16.3	SNNP	SNNP	Ariba Minichi Zuriya	Chencha	Ongoing
Shirishir-Wubhamer spur road	11.6	SNNP	SNNP	South Ari	South Ari	Ongoing
Kofle-Qore-Shire	30.3	Oromia	Oromia	Kofele	Kore	Ongoing

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Birki - Haikemesehal- Atsbi Jun	19.9	Tigray	Tigray	Atsbi Wonberta	Klite Awlalo	Ongoing
Dobi-Elidar-Beliho	18.2	Afar	Afar	Elidar	Elidar	Ongoing
Raitu-Shakisa-Elkere	140.1	Oromia	Somali	El Kere	Raitu	Design Completed
Sire(Moto)-Mote-Nunu-Arjo	112.0	Oromia	Oromia	Boneya Bushe	Wama Hagelo	Under Design
Dama(Anfele)-Bore	24.8	Oromia	Oromia	Bore	Dima	Under Design
Dogo-Kofele-Repi--DedoYirgachefe	37.7	Oromia	SNNP	Bule	Yirgachefe	Design Initiated / Completed
Chulute-Debre Markos	93.9	Amhara	Oromia	Aneded	Ginde Beret	Design Initiated / Completed
Tuludimtu-chefedonsa-shenkora-Arerti	81.6	Oromia	Amhara	Akaki	Minjar Shenkora	Design Initiated / Completed
Kerseber - Sobiyan	20.1	Tigray	Tigray	Gulo Meheda	Gulo Meheda	Design Initiated / Completed
Deramalo-otolo	43.1	SNNP	SNNP	Deramalo	Kemba	Design Initiated / Completed
Shilabo-Ferfer	126.9	Somali	Somali	Ferfer	Shilabo	Special Case
Adulala Jun- Yerer Mountain	12.1	Oromia	Oromia	Adea	Bishoftu Town	Tourism Project
Muti - Adaadi Mariam	12.5	Oromia	Oromia	Kersana Malima	Kersana Malima	Tourism Project
Tenta - Mekdela Amba	13.5	Amhara	Amhara	Tenta	Tenta	Tourism Project
Silkamaba-Benja-Mote	76.7	Oromia	Oromia	Boneya Bushe	Nono	1
TuluBollo-Mojo(Lot 2, Km 46-Km 103)	57.8	Oromia	Oromia	Adea	Lomme	2
TuluBollo-Mojo (Lot 1, Km 0-Km 46)	45.7	Oromia	Oromia	Becho	Tole	3

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Burka-Midaga-Tolla-Harar Road Project	184.1	Harari	Oromia	Fedis	Midega Tole	4
Shinshicho-Shone -Hawassa	53.4	Oromia	SNNP	Kacha Bira	Siraro	5
Bahirdar-Kunzila	56.5	Amhara	Amhara	Bahir Dar Liyu	North Achefer	6
Toltawond-Abot-Jenya	171.7	Oromia	SNNP	Dire	Teltele	7
Harshin- Haskul-Aroresa-K.Dehar,Lot2 Km193-Km368	175.0	Somali	Somali	Aware	Kebridehar	8
Harshin- Haskul-Aroresa-K.Dehar Lot1-Km 0-Km193	193.2	Somali	Somali	Aware	Kebri Beyah	9
Metagefersa-Wachile-Dakwta-Erer	165.4	Oromia	Somali	Arero	Udet	10
Ginir-Fiq, lot2, Km115-Km213	98.6	Oromia	Somali	Fik	Legehida	11
Ginir-Fiq, Lot1, Km0-Km115	114.5	Oromia	Oromia	Ginir	Seweyna	12
Duruksi-Warder-Dabre Wein, Lot2 Km126-Km343	166.4	Somali	Somali	Shilabo	Warder	13
Duruksi-Warder-Dabre Wein, Lot1 Km0-Km126	176.9	Somali	Somali	Danot	Warder	14
Bachuma-Oudadishi-Selamber-Tebela Lot2,Km81-Km245	154.5	SNNP	SNNP	Boreda	Loma	15
Bachuma-Oudadishi-Selamber-Tebela Lot 1,Km 0-Km 81	81.3	SNNP	SNNP	Cheta	Meant Goldiya	16
Bule Hora-Aflala-Meta Gefersa	128.3	Oromia	Oromia	Arero	Qercha	17
Aje-Alage-Koshe-Mito Road	54.7	Oromia	SNNP	Adami Tulu Jido	Shala	18
Kersa-Shire	38.1	Oromia	Oromia	Kore	Munesa	19
Gilgelgibe-Tirokeneni-Tole Jima	84.2	Oromia	Oromia	Chora Boter	Tiro Afeta	20
Midega-Obole-Mareg Dugheleh Lot 3 Km 152-Km 237	84.0	Somali	Somali	Aware	Harshin	21
Midega-Obole-Mareg Dugheleh Lot 1, Km 0-Km 78.5	78.5	Oromia	Somali	Babile	Midega Tole	22

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Midega-Obole-Mareg Dugheleh Lot 2, Km 78.5-Km 152	74.6	Somali	Somali	Degehabur	Fik	23
Debre Eliyas jun-Finoteselam-G/Abay-Fagita-Merawi	159.0	Amhara	Amhara	Debere Elias	Sekela	24
Adami Tulu- Assela	55.1	Oromia	Oromia	Adami Tulu Jido	Zeway Dugda	25
Angetu-Mena	25.3	Oromia	Oromia	Arena Buluq	Delo Mena	26
Gode - Shilabo-Biyo Ado, Lot1, Km 0-Km 143	142.6	Somali	Somali	Debewoin	Shilabo	27
Gode - Shilabo-Biyo Ado, Lot2, Km 143-Km 235	93.3	Somali	Somali	Shilabo	Shilabo	28
Warder - Agere Weyin - Goldgob, lot1,Km0-km90	89.7	Somali	Somali	Geladin	Warder	29
Warder - Agere Weyin - Goldgob, lot1,Km90-Km188	98.5	Somali	Somali	Geladin	Geladin	30
Assasa-Agarfa	79.5	Oromia	Oromia	Adaba	Limuna Bilbilo	31
Chire- Adola	111.1	Oromia	SNNP	Adola	Nensebo	32
Remti- Burka	182.6	Oromia	Oromia	Boke	Gole Oda	33
Awash-Fenatle-Dewele Ju-Km149-Km249	100.0	Somali	Somali	Ayisha	Shinile	34
Awash-Fenatle-Dewele Ju-Km 0-Km 149	149.6	Afar	Somali	Afdem	Mieso	35
Awash-Fenatle-Dewele Ju Km 249-349	94.3	Somali	Somali	Ayisha	Ayisha	36
Deder-Tirtira	76.2	Oromia	Oromia	Deder	Melka Belo	37
Adet-Fagita-Addiskidame-Pawe	138.7	Amhara	Benishangul Gumuz	Dengila	Yilmana Densa	38
Jinka-Washawuha-Washmeda	115.9	SNNP	SNNP	Mago National Park	South Ari	39
Goha Tsion-Kachise	65.7	Oromia	Oromia	Abuna Gindeberet	Were Jarso	40
Arbegona-Yirgalem	52.7	SNNP	SNNP	Arbegona	Wensho	41
Mechara-Fik-Deghamedo-Degehabur Km146-Km 256 (Fik)	110.1	Oromia	Somali	Boke	Meyu Muluke	42

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Mechara -Fik-Deghamedo-Degehabur km 256-km 411	154.1	Somali	Somali	Degehabur	Fik	43
Mechara -Fik-Deghamedo-Degehabur km-0-Km146	146.3	Oromia	Oromia	Boke	Habro	44
Meki-Iteya	47.6	Oromia	Oromia	Bora	Zeway Dugda	45
Aje-Loke-Shasha-Tebela,Lot1-Km54	54.3	Oromia	SNNP	Boricha	Siraro	46
Aje-Loke-Shasha-Tebela,Lot2-Km107	53.1	SNNP	SNNP	Boricha	Humbo	47
Tula-Hantate-Shigasha-Tebela	70.4	SNNP	SNNP	Dale	Loko Abaya	48
Delo Mena-Kundi	120.5	Oromia	Somali	Delo Mena	Gura Damole	49
Nonsebo-Angetu	46.4	Oromia	SNNP	Arena Buluq	Nensebo	50
Meyu-Goda-Ritu, lot-2, km110-Km207	96.9	Oromia	Somali	Gole Oda	Seweyna	51
Meyu-Goda-Ritu, Lot1, Km0-Km110	110.8	Oromia	Somali	Raitu	Seweyna	52
Tulema-Areka	61.8	SNNP	SNNP	Bolossa Bonibe	Gena Bosa	53
Kofele-Arbegona-Daye	23.1	Oromia	SNNP	Kofele	Malga	54
Segeg-Ali-Dihun-Imi JCT,Lot2, km102-km200	98.6	Somali	Somali	Degehamedo	Segeg	55
Segeg-Ali-Dihun-Imi JCT, Lot1, km0-Km102	102.8	Somali	Somali	Dihun	Imiberi	56
Bohotle-Goldgob	177.7	Somali	Somali	Boh	Geladin	57
Sentu-Yanfa-Gechi	80.0	Oromia	Oromia	Boricha	Limu Seka	58
Bedele-Bube	159.5	Oromia	Oromia	Bedele Town	Yubdo	59
Gobesa -Bekoji-Kersa	73.2	Oromia	Oromia	Limuna Bilbilo	Shirka	60
Hambiso-G/Meskel-Weleka-Wegedi-Key Mebrat	176.0	Oromia	Amhara	Degem	Wogidi	61
Misrak Geshamo-Boh	171.0	Somali	Somali	Boh	Gashamo	62
Shekuhussien-Beltu-Ramsi	111.2	Oromia	Oromia	Boke	Legehida	63

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Togowuchale-Harshin	55.2	Somali	Somali	Awubere	Kebri Beyah	64
Afdera Jun-Mengaga-Endhura-Elidar	179.4	Afar	Afar	Afdera	Elidar	65
Sofomr-Mio-Gorobebeksa	86.0	Oromia	Somali	Dawe Qachen	Goro Bekeksa	66
AMBO-LEMLEM BERHA	117.6	Oromia	Oromia	Ambo	Jeldu	67
Shinle-Harewe	18.7	Somali	Somali	Shinile	Shinile	68
Derba-Inchni-Gojo	73.9	Oromia	Oromia	Adea Berga	Sululta	69
Arerti-Melka Jilo-Metehara Jun	38.2	Amhara	Oromia	Fentale	Minjar Shenkora	70
Ginir-Dihun-Shekosh-Wareder Lot 3,Km368-Km Km 540	165.1	Somali	Somali	Kebridehar	Warder	71
Ginir-Dihun-Shekosh-Wareder Lot 1, Km 0-Km 182	182.7	Oromia	Somali	Dihun	Seweyna	72
Ginir-Dihun-Shekosh-Wareder Lot 2, Km 182-Km 367	185.4	Somali	Somali	Dihun	Shekosh	73
Girawa - Husse-Waldiya-Meyu	109.8	Oromia	Somali	Girawa	Meyu Muluke	74
FugnaBira-Ejersa-Chinhaksen-Jigjiga	68.1	Oromia	Somali	Chinakesen	Jijiga	75
Aware-Misrak Gashamo	136.3	Somali	Somali	Aware	Gashamo	76
Nejo-Yaso-Gelasa-Dibate jun	37.8	Benishangul Gumuz	Oromia	Agalometi	Nejo	77
MeliyuBele-Filtu, Lot1,Km0-km149 (Genale)	147.9	Oromia	Oromia	Berbere	Gura Damole	78
MeliyuBele-Filtu, Lot2,Km149-km234	86.4	Somali	Somali	Filtu	Kersa Dula	79
Tewedros Ketema-M Siliase-Aykel	139.4	Amhara	Amhara	Chilga	Takusa	80
Yabelo-Jenya	92.6	Oromia	Oromia	Dire	Yabelo	81
Harbuchulele-Inge-Welkite	62.0	Oromia	SNNP	Kebena	Welkite Town	82
Agamsa-abay river-robe gebeya lot 1, km 0-km 80	80.0	Oromia	Oromia	Abay Chomen	Jarte Jardga	83

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Agamsa-abay river-robe gebeya lot 2, km 80- km 140	59.6	Oromia	Oromia	Amuru	Jarte Jardga	84
Guliso-Nejo	39.6	Oromia	Oromia	Boji Cheqorsa	Nejo	85
Bedelle -Koma	74.0	Oromia	Oromia	Bedele Town	Nunu Qumba	86
Bati - Chifra	45.0	Amhara	Afar	Bati	Werebabo	87
Metehara - Mechara	64.4	Oromia	Oromia	Anchar	Fentale	88
Atanago-Koma-Mote	74.2	Oromia	Oromia	Limu Seka	Wama Hagelo	89
Maji-Tum-Tulgit	39.7	SNNP	SNNP	Maji	Surima	90
Moyale-Jenya	181.9	Oromia	Oromia	Dire	Moyale	91
Chila - Wukero Maray	21.8	Tigray	Tigray	Tahitay Maychew	Tahitay Maychew	92
Gewane-Afdem-Harmukale, Lot1, km0-Km103	103.1	Somali	Somali	Denbel	Shinile	93
Gewane-Afdem-Harmukale,, Lot2, km103-Km201	92.8	Afar	Somali		Gewane	94
Welenchiti -Sodere Road Junction	24.3	Oromia	Oromia	Boset	Jeju	95
Arerti-Welenchiti	38.5	Amhara	Oromia	Boset	Minjar Shenkora	96
Teltele-Meramaro-Abot	52.0	Oromia	Oromia	Teltele	Teltele	97
Awash Arba-MlWerer-Bora, Lot2, Km 62-Km 180	118.0	Afar	Amhara	Dalifagi	Semurobina Gelalo	98
Awash Arba-MlWerer-Bora Lot1, Km 0-km 62	61.9	Afar	Afar	Amibara	Semurobina Gelalo	99
Axum - Adet	29.8	Tigray	Tigray	Lailay Mayichewu	Tahitay Maychew	100
Mengshi-Dima	66.9	Gambella Region	Gambella Region	Dima	Mengesh	101
Sire-Adugna-Bakojima-Gutin	74.5	Oromia	Oromia	Abe Dengoro	Sibu Sire	102
Maganan-Maserodenb-Aberahajira Road	54.9	Amhara	Amhara	Metema	Tach Armacho	103
Muger-Gibre Guracha	46.4	Oromia	Oromia	Adea Berga	Metarobi	104

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Arbaminch -Nechsar park - Kele	83.5	Oromia	SNNP	Amaro Special Wereda	Nech Sar National Park	105
Edaga Hamus--Sawni-Adewuka-Beda	94.6	Afar	Tigray	Dalol	Saesi Tsadamba	106
Waka- Morka	87.8	SNNP	SNNP	Denibu Gofa	Loma	107
Filtu - Al Abdile - Manguada	138.1	Somali	Somali	Cherati	Filtu	108
Yeberet-Arb Gebeya	32.8	Amhara	Amhara	Mekdela	Tach Gayint	109
Chitu-Gindo-Darge	54.8	Oromia	Oromia	Ameya	Wonchi	110
Magna-Semare-Seru	75.6	Oromia	Oromia	Amigna	Seru	111
Maganana –Mahbireselassie - Serba Delgi	119.1	Amhara	Amhara	Alefa	Takusa	112
Gewane Jun-Bike	83.1	Afar	Somali	Afdem	Mieso	113
Hargele - Imi Km0-Km115	116.0	Somali	Somali	Afker	El Kere	114
Hargele - Imi Km115-Km231	115.4	Somali	Somali	El Kere	Mirab Imi	115
Angetu-Bedere	74.0	Oromia	Oromia	Arena Buluq	Meda Welabu	116
Jemu - Barda-Kitie	77.6	Gambella Region	SNNP	Dima	Minit Shasha	117
Bordede - Gelemeso	44.7	Oromia	Oromia	Guba Qoricha	Meiso	118
Jawi-Kunzla	82.6	Amhara	Amhara	Alefa	North Achefer	119
Adigosh-Birkutan-Sittona	36.7	Tigray	Tigray	Qafta Humera	Tahitay Adiyabo	120
Adi Mella-Debre Genet-Filafil	87.9	Tigray	Tigray	Lailay Mayichewu	Wereilehi	121
Amba Gyiorgis-Arba Tseguar-Abi Adi Jun. k118-km231	112.4	Amhara	Amhara	Misrak Belesa	Wegera	122
Amba Gyiorgis-ArbaTseguar-Abi Adi Jun. Km0-Km118	118.7	Amhara	Amhara	Sehale Seyemt	Zikwala	123
Arsi negele-kore-meraro	67.5	Oromia	Oromia	Arsi Negele	Kore	124
Tulgit-Tirmatid-South Sudan Border	62.1	SNNP	SNNP	Surima	Surima	125

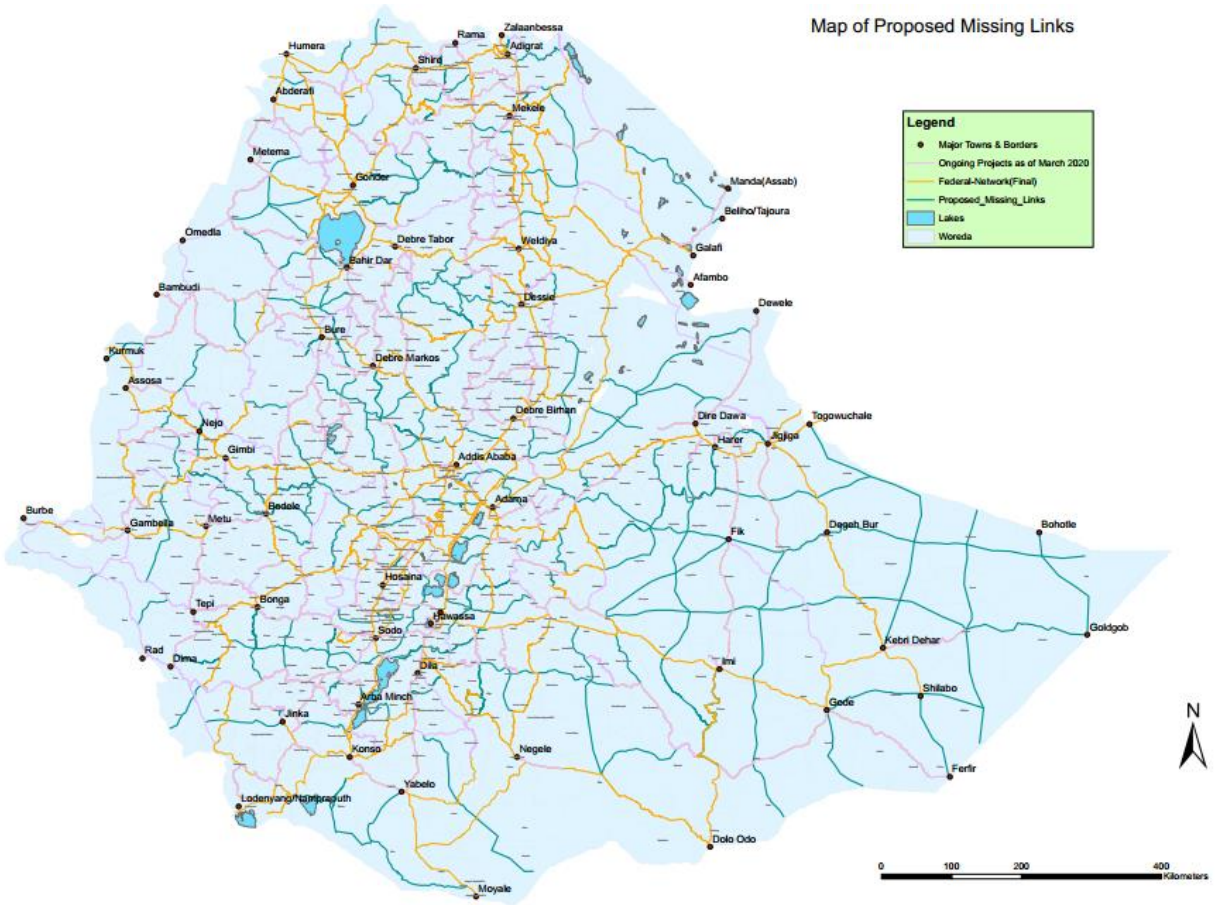
Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Bonga-Duba Yaneba-Dime/Laska	141.9	SNNP	SNNP	Bonga Town	Selamago	126
Mechara-Tulema-Bure	73.7	Oromia	Oromia	Bure	Yemalogi Welel	127
Mayichew-Bora-Sekota	68.5	Amhara	Tigray	Abergele	Sekota	128
Behir-Shigili-Maykadera	36.0	Tigray	Tigray	Qafta Humera	Qafta Humera	129
Gidole - Beneta-Kako	84.2	SNNP	SNNP	Bonke	Male	130
Dessie Jun-Ambamariam	43.6	Amhara	Amhara	Dese Zuriya	Tenta	131
Sirtuager-Alemgebeya-Ankober	46.7	Amhara	Amhara	Ankober	Berehet	132
Sherkole-Kurmuk	64.9	Benishangul Gumuz	Benishangul Gumuz	Kurmuk	Sherkole	133
Diksis-Kulla-Derba-Halila-Chole	68.0	Oromia	Oromia	Chole	Sude	134
Lemlem Bereha-Elias Jun	38.5	Amhara	Oromia	Debere Elias	Jarte Jardga	135
Daleti-Knocho-Wembera	93.4	Benishangul Gumuz	Benishangul Gumuz	Bilidigilu (oda godera)	Wenbera	136
Sebasebat-Chewaka-Ephrem	67.5	Oromia	Oromia	Chewaqa	Diga	137
Imi Jun- El Bahid-Bur Huso, lot1, Km0-Km98	98.3	Somali	Somali	Afker	Mirab Imi	138
Imi Jun- El Bahid-Bur Huso, lot2, Km98-Km213	115.5	Somali	Somali	Afker	Bare	139
Dipa-Ciam	34.0	Gambella Region	Gambella Region	Goge	Jore	140
Bullen - Gublak	70.4	Benishangul Gumuz	Benishangul Gumuz	Bulen	Dangur	141
Smada-Gundeweyn	71.7	Amhara	Amhara	Gonchasiso Enese	Simada	142
Ajbar-Yeberet-Shola-Kon	97.5	Amhara	Amhara	Dawunt	Sayinit	143
Harosebu-Gna-Kara-Melkaebitcha-Babo	70.6	Oromia	Oromia	Ayira	Jarso	144
Mehoney-Yalo-Degadigu	93.3	Afar	Tigray	Megale	Teru	145
Bure-Girar	91.0	Gambella Region	Oromia	Abobo	Nono Sele	146

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Sembo-Muketure	59.0	Oromia	Oromia	Jida	Wuchale	147
Belesa-Arba Tseguar jun	50.1	Amhara	Amhara	Misrak Belesa	Misrak Belesa	148
Deghabur-Awabre	78.8	Somali	Somali	Aware	Degehabur	149
Dilybza-Arba Tseguar	39.0	Amhara	Amhara	Beyeda	Sehale Seyemt	150
Sirtuager-Awasharba	60.1	Afar	Amhara	Amibara	Berehet	151
Shiraro-Lama	37.2	Tigray	Tigray	Shiraro Town	Tahitay Adiyabo	152
Bele Arsi - Siba	26.8	Oromia	Oromia	Bale Gasera	Robe	153
Ameya-Koisha-Salayesh-Laha	77.4	SNNP	SNNP	Konta Special	Melekoza	154
Dodola-Bensaware	71.0	Oromia	Oromia	Dodola	Kokosa	155
Ayema - Kunzila-Gelago Junc	49.8	Amhara	Amhara	Jawi	Quara	156
Waja-Yalo	37.6	Afar	Amhara	Golina	Yalo	157
Filakit-Arbgebaya-Simada	93.8	Amhara	Amhara	Dawunt	Tach Gayint	158
Gode-Beredele-Bug Bere	135.9	Somali	Somali	Adadilo	Kelafo	159
Ambamariam-Yeberet	60.2	Amhara	Amhara	Mekdela	Tenta	160
Hateto-Wayu	44.1	Oromia	Oromia	Jima Geneti	Jima Rare	161
Dig Degu - Hamaye Kem - Kunaba Lot 1, Km 0- Km 54	54.0	Afar	Afar	Erebti	Teru	162
Dig Degu - Hamaye Kem - Kunaba Lot 2, Km 54- Km144	89.5	Afar	Afar	Afdera	Erebti	163
Mendi-Wama-Shemeltoke	35.2	Oromia	Oromia	Mene Sibu	Mene Sibu	164
Mekanbirahan-Arbatsiguar JCT	60.0	Amhara	Amhara	Jan Amora	Misrak Belesa	165
Maytemen-Ketema Nigus	35.0	Tigray	Tigray	Tsegede	Tsegede	166
Tulusa - Dejach Meda	28.7	Amhara	Amhara	Tselemet	Tselemet	167

Link_Name	Length Km	Start_Region	End_Region	Start_Woreda	End_Woreda	Final Rank
Atsbi - Konaba-Berhale	20.5	Afar	Afar	Berehale	Konaba	168
Maytsebri-Mayhanse-Dedebit Jun	76.2	Tigray	Tigray	Asegede Tsimbila	Tselemt	169

The total length of identified (Newly Proposed) missing links is about 16,022.5 km. The following Figure shows map of missing links

Figure 6-18:- Map of New Proposed Missing Links



6.6 Identification of Links between Corridors

The missing links between corridors were identified based on the integration and traffic flows of two or more adjacent corridors and identification of major cities or growth poles. The traffic flow between two corridors should be coherent. The basic principles considered were:

- Identification of major cities or growth poles in adjacent corridors;
- Analysis and evaluation of traffic flows on the existing network; and

- Checking the network connectivity between corridors and identify missing links.

6.6.1 Identification of Cities or future Growth Centers

The Consultant analyzed the urbanization and socio economic conditions of major cities in Ethiopia. As Addis Ababa is Ethiopia's capital and the center of high population, industries, and core features of the central government as well as the private sector, major socio economic development and radical urbanization has been continuously registered. It is important to facilitate the growth of other cities by linking them with high standard roads and bring them to developed and alternative cities. The new industrial parks and agro centers development strategy of the government and the rapid growth of population demanded the development of high standard highways and expressways. Considering major towns and metropolitan cities as categorized in Table below and the existing and projected population are shown below.

Table 6-35:- The Population range for Cities and Metropolitans category

No	Towns Category	Population Range	Remarks
1	Small Towns	2001-20,000	
2	Medium Towns	20,001-50,000	
3	Large Towns	50,001-100,000	
4	Cities	100,001-1,000,000	Considered for the analysis
5	Metropolitans	More than 1,000,000	Considered for the analysis

Source: Ministry of Urban Development

Towns with a population of 200,000 and above

These towns are eight; namely Addis Ababa, Dire Dawa, Adama, Mekele, Gondar, Dessie, Bahirdar, and Hawassa. Their 2017/18 populations including locations of these towns are shown in Table below.

Table 6-36:- Towns residing a population of 200,000 and above

No.	Town's name	2017/18 Population	Region	Zone
1	Addis Ababa	3,363,654	Addis Ababa	
2	Dire Dawa	293,000	Dire Dawa	
3	Adama	355,475	Oromia	East Shoa
4	Makele	358,528	Tigray	S. Eastern
5	Gondar	360,600	Amhara	North Gondar
6	Dessie	209226	Amhara	North Wello

7	Bahirdar	313997	Amhara	East Gojjam
8	Hawassa	335508	SNNP	Sidama

Source: Consultant Analysis from CSA Population data

Towns with populations 100,000 to 199,999

There are thirteen towns in this category and most of them are regional and zonal capitals. These are Jigjiga, Jimma, Kombolcha, Shashamene, Harar, Bishoftu, Nekemete, Arbaminch, Sodo, Hossaina, Debrebirhan and Debremarkos. The 2017/18 population of these towns is shown in Table below.

Table 6-33: Towns residing a population of 100,000 to 199,999

No.	Town's Name	2017/18 Population	Region	Zone	Remarks
1	Jijjiga	169,390	Somali	Jijjiga	Regional Capital
2	Jimma	195,228	Oromia	Jimma	Zonal Capital
3	Kombolcha	102,244	Amhara	South Wello	Zonal Capital
4	Shashamene	161,354	Oromia	West Arsi	Zonal Capital
5	Bishoftu	162,127	Oromia	East Shoa	Woreda Capital
6	Harar	137,000	Harari	Region Capital	Regional Capital
7	Nekemte	121,385	Oromia	Zonal Capital	Zonal Capital
8	Arbaminch	159,019	SNNP	Zonal Capital	Zonal Capital
9	Sodo	161,450	SNNP	Zonal Capital	Zonal Capital
10	Dilla	125,599	SNNP	Zonal Capital	Zonal Capital
11	Hossaina	148,847	SNNP	Zonal Capital	Zonal Capital
12	Debremarkos	108,882	Amhara	Zonal Capital	Zonal Capital
13	Debrebirhan	113,693	Amhara	Zonal Capital	Zonal Capital

Source: Consultant Analysis from CSA Population data

6.6.2 Evaluate and analyze the traffic flow on the existing network

Considering the traffic movements on major trunk roads and around cities, the Consultant has identified links with major congestions and high traffic volumes. The traffic flows on these links have been continuously increasing in volumes and types. Table below shows road links with corresponding lengths (km) and average annual daily traffic (AADT) for years 2007, 2012 and 2017. Subsequently, Figure below shows AADT on selected trunk roads, 2007, 2012 and 2017.

Table 6-37: Selected Trunk Roads and Corresponding AADTs for years 2007, 2012, and 2017

LINKID	LINKNAME		AADT		
		Length (km)	2007	2012	2017
A1-1	Addis-Modjo	71.34	14051	23134	12041*
A1-2	Modjo – Nazarth	18.5	10696	17496	21311
A1-3	Nazarth –Metehara	83.96	2442	4529	6110
A1-4	Metehara-Awash Junc.	45.57	2442	4529	6110
A1-5	Awash – Gewane	142.83	1203	1503	1886
A1-6	Gewane – Mille	154.36	1203	1503	1886
A1-7	Mille- Semera	33.21	1073	1066	1333
A1-8	Semera – Serdo	42.8	1073	1066	1333
A1-9	Serdo – Hanef	54.87	1073	1066	1333
A1-10	Dobi - Eritrea Border (Burrei)	98.69	1073	1066	1333
A10-1	Awash Jun-Areberekete	103.39	996	924	1372
A10-2	Arbareketi –Kobo	98.51	679	830	1570
A10-3	Kobo – Kulubi	27.28	782	887	1686
A10-4	Kulubi –Dengego	30.32	1048	1900	1988
A10-5	Dengego-Harar	29.45	1574	1818	2207
A10-6	Harar-Bombas	51.16	524	1717	2049
A10-7	Bombas – Jijiga	47.44	524	1717	2049
A10-8	Jijiga - Degehabour(U construct)	160.84	881	790	1097
A10-a	Dengego - Dire Dawa	23.58	1395	1688	4160
A2-1	Addis-Debrebirhan	108.91	1237	1679	1974
A2-10	Maichewe – Mekele	101.58	495	924	1077
A2-11	Mekele – Adigrat	107.91	579	996	1974
A2-12	Adigrat – Adiabun	92.12	379	712	724
A2-13	Adiabun – Axum	22.09	438	780	1418
A2-1a	Addis Ababa-Legetafo	17.11	1237	1679	1974
A2-2	Debreberhan – Debresina	49.81	800	1376	1753
A2-3	Debresina - Efeson/Atye	87.3	800	1376	1753

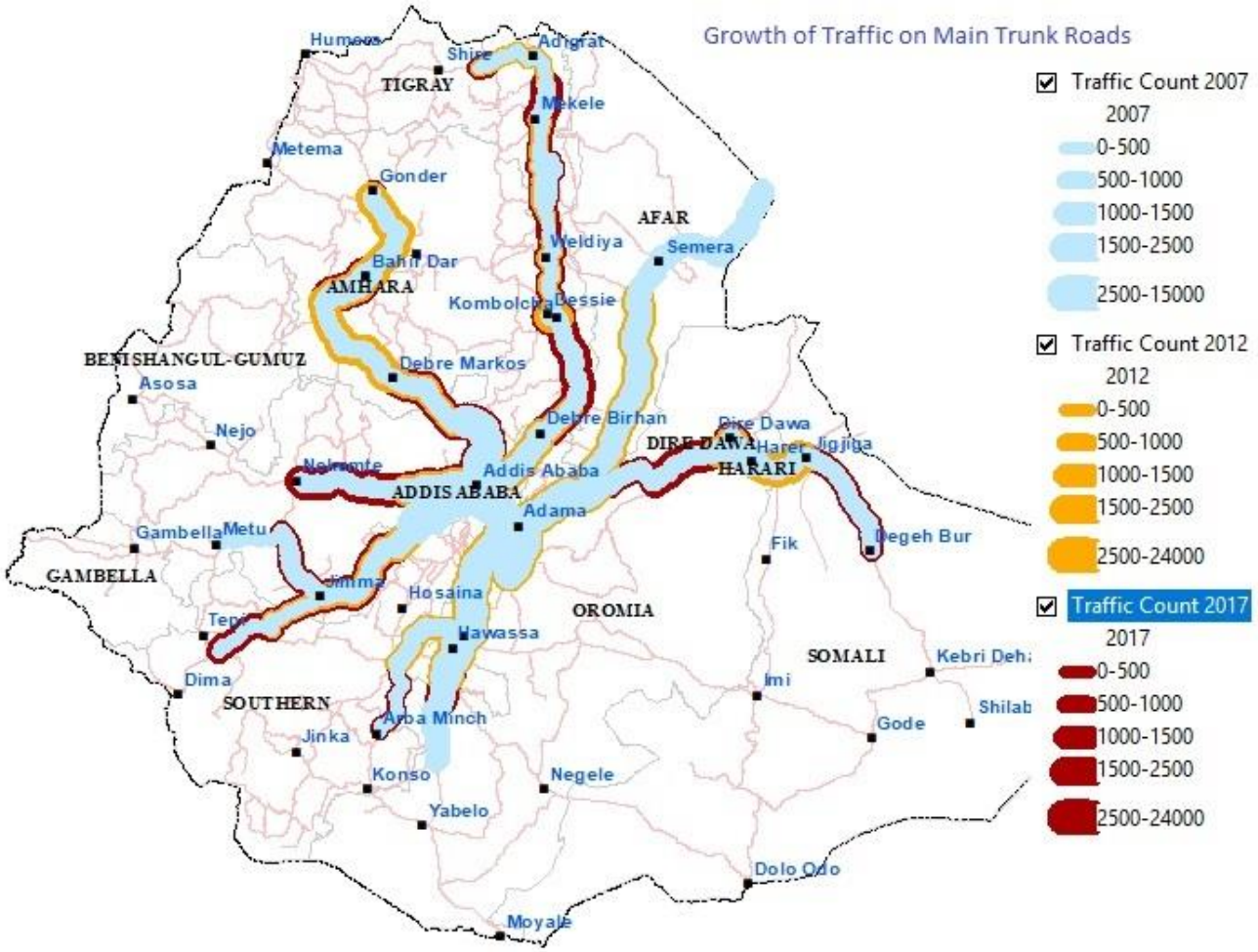
LINKID	LINKNAME		AADT		
		Length (km)	2007	2012	2017
A2-4	Efeson (Ataye) - Kemisse – Kombolch	106.09	540	959	1596
A2-5	Kombolcha – Dessie	23.06	881	1622	2681
A2-6	Dessie – Wuchalie	59.31	455	940	1379
A2-7	Wuchalie – Woldiya	59.03	455	940	1379
A2-8	Woldiya– Waja	65.51	373	784	1237
A2-8b	Moheny – Hewane	66.09	474	324	1393
A2-9	Waja – Maichewe	63.53	373	784	1237
A3-1	Addis-Chancho-Commando	102.88	1639	1917	3827
A3-10	Azezo Airport – Gondar	12.03	414	537	1100
A3-2	Commando-Gerbe Guracha-Abay River	84.89	840	1372	1917
A3-4	Dejen - Debre Markos	67.63	770	1135	1654
A3-5	D/Markos - Bure Junc.	104.18	784	1717	1814
A3-6	Bure – Dangla	68.06	764	1804	2077
A3-7	Dangla - Bahir Dar	82.44	1232	1860	4018
A3-8	Bahirdar-Woreta	56.2	722	1663	2275
A3-9	Woreta - Azezo Airport	104.76	854	1521	1642
A4-1	Addis-Holeta	37.82	1365	1847	8471
A4-1a	Tatek-Kolfe	17.45	1365	1365	8471
A4-1b	Holeta-Burayu-Old Route	10.72	1365	1365	8471
A4-2	Holeta-Ambo	80.55	1365	1847	8471
A4-3	Ambo-Gedo	66.99	785	888	1720
A4-4	Gedo-Bako	58.95	785	888	1720
A4-5	Bako-Nekemte	80.29	848	592	1542
A5-1	Addis Ababa-Weliso	108.41	2658	2943	8587
A5-2	Welkite-Woliso	41.95	1182	1998	2402
A5-3	Welkite-Gibe River	29.98	920	1293	1674
A5-4	Gibe River – Saja	52.23	920	1293	1674
A5-5	Saja-Asendabo-Jimma	112.72	920	1293	1674

LINKID	LINKNAME		AADT		
		Length (km)	2007	2012	2017
A5-6	Jima-Agaro-Bedelle	132.97	709	981	1259
A5-7	Metu-Bedele	117.15	423	455	460
A6-1	Jima-Belet Chake-Bonga	100.16	342	523	1105
A6-2	Bonga - Mizane Teferi	96.08	230	456	1112
A7-1	Modjo-Ziway	89.65	2243	3534	3854
A7-2	Ziway-Shashemene	88.96	2243	3534	3854
A7-3	Shashemene-Alaba	59.22	842	1006	1251
A7-4	Alaba – Sodo	58.92	842	1006	1251
A7-5	Sodo – Arbaminch	123.65	436	402	742
A8-1	Shashemene – Awassa	17.52	2210	3077	3825
A8-2	Awassa – Aposto	43.67	1869	3115	3056
A8-3	Aposto-Dilla	45.35	1146	1263	1729
A8-3a	Aposto – Yirgalem	7.75	1146	1263	1729
A8-4	Dila-Agremariam	109.65	1113	1069	847
A9-1	Adama – Melkasa	17.25	2231	3344	6450
A9-2	Melkasa – Iteya	33.79	1454	2736	6878
A9-3	Iteya – Asella	24.67	1454	2736	6878

Note: * Traffic is diverted to the new expressway of Addis – Adama

The attached map shows the traffic growth on selected major trunk roads for 3 consecutive 5 years interval, 2007, 2012 and 2017.

Figure 6-19:- Traffic Growth on Selected Trunk Roads, 2007, 2012 and 2017



Check the Network Connectivity between Corridors and identify Missing Links between Corridors

6.6.3 Selection of Cities for New External Ring Network

Considering the future urbanization and traffic growth trend of the major trunk roads and cities, the Consultant has identified few roads and cities of high traffic, which demand high standard roads such as Expressways/National highways, which help them diffuse traffic entering and exiting from different directions. The proposed external ring networks in the selected cities also help to maintain smooth flow and get access. The additions of major Expressways/Highways could aggravate the development of the cities to make them alternative investment areas and major growth hubs. Likewise, balanced development between cities will be established. The selected cities for proposal of new external ring network are shown in Table below.

Table 6-38:- Selected cities for proposal of new external ring network

No.	Town's name	2017 Population	Region	Zone	Main features and purpose
1	Addis Ababa	3,363,654	Addis Ababa		High population, industrial cities and the proposed road helps to diffuse the traffic from the radial network originating and exiting from the city.
2	Dire Dawa	293,000	Dire Dawa		High Population, Industrial city and new industrial park, major railway station, ECX warehouses, etc.
3	Mekelle	358,528	Tigray	S. Eastern	High Population, Industrial city and new industrial park.
4	Gondar	360,600	Amhara	North Gondar	High Population, Industrial city and new industrial and tourist city.
5	Kombolcha	209,226	Amhara	North Wello	High Population, Industrial city and new industrial park, future railway station and import/export hub.
6	Shashamene	335,508	SNNP	Sidama	High Population, Industrial city and new industrial park, ECX warehouses, etc.
7	Jimma	195,228	Oromia	Jimma	High Population, Industrial city and new industrial park, ECX warehouses, etc.
8	Nekemte	121,385	Oromia	Zonal Capital	High Population and high network connectivity with roads in different corridors.
9	Wolaita Sodo	161,450	SNNP	Zonal Capital	High Population and high network connectivity with roads in different corridors.

6.6.4 Expressway and Ring Network experience of South Korea

The consultant has taken lesson from South Korea, a country in Asian content which has a total area of 100,295 sq km and almost one tenth of the land area of Ethiopia. To have good understanding of the Road Network Development of South Korea, it is better to know the socio economic profile of the country as below.

- Land Area : 100,307 km2
- - 400 km from Seoul to Busan (length from two corners)
- Population : 51.79 million
- No. of Vehicle : 23.44 million(2019)
- GDP Per Capita : 33,346 (2018)
- Urbanization Rate : 91.8%
- - 35.8% (1960) ➔ 81.9% (1990) ➔ 88.3 %(2000)
- - 25.5 million in Seoul National Capital Area (high population concentrates on seoul area)
- Length of Public Roads : 110,091 km(2017)
    - 92.8% is paved

  - Occupy 3,144km2 (3.1% of Land)
  - Extra 58,899km of Agricultural & Fishery Road

- Total Length of Expressways : 4,717km

After the independence from colonization of Japan in 1945, South Korea had confronted a war with North Korea between 1950 and 1953 that Ethiopia showed her alliance and stranded on the side of South Korean by sending her military force to fight North Korea.

Immediately after the end of the war, South Korea had shifted their struggle for the reconstruction of demolished buildings, roads and other infrastructures. At that time, the total length of roads was 26,032 km of which only 2.6% were paved.

In 1968, South Korea commenced the implementation of Seven Series of “Five-Year Economic Development Plan” from 1962 to 1996 with 9.3% annual growth of GNP through 1990s.The country had brought innovative road policies and a new era of the road development was started. In 1969, the first major Expressway road from Seoul to Bussan was opened which has a total length of 428-km and was completed within 2.5 years with a cost of USD 42.9 million. It connects five of the seven top cities of South Korea. As the country has rectangular shape of 340 km by 240 km, a plan of 7 x 9-grid structure expressway network was planned and started for implementation phase by phase based on the economic viability and cost benefit advantage of each segment. Figure below shows the South Korean Expressway Grid Network.

Figure 6-20:- South Korean Expressway Grid Network

The average distance between two expressways is about 40-km. An aggressive road construction and financing has been implemented and a huge road construction projects are underway.

6.6.5 Adaptation of South Korean Experience to Ethiopia

From the experience and knowledge gained from South Korea, the Consultant adopted and implement a radial expressway and ring structures to the Ethiopia's Triangular shape Land

area. The Expressways and Rings are presumed to radiate from the Capital Addis Ababa and expand to all directions throughout the Country.

The basic principles and assumptions followed in the proposal of Expressway and Rings are

1. Set Long Term Plan (in 2050 and beyond) and lay the foundation today to attain a full radial Expressway and Ring Network serving the entire land area of Ethiopia;
2. Starting from 40-km of radial distance from the capital City (1st Ring), propose a ring network which connect the expressway (existing main trunk corridors to ports, regional capitals and borders), major cities and growth poles. The average distance between rings shall be 250-km;
3. At any place in Ethiopia, target an Expressway or a Ring Network access with an average distance of 100-km;
4. The identification and route location of the Expressway and Rings shall be targeted to gain the maximum benefits by connecting cities, major towns and growth poles within the desired route corridor;
5. A phase-by-phase implementation after detail feasibility study of each segment. South Korea gave priority to balance economic viability and equity in the construction of the expressways; and
6. Adopt and design Special Road Financing Scheme, which enables to collect money for Construction of Expressways and Rings. Special Road Tax and revenue collecting scheme should be implemented).

Figure below shows a schematic representation of the Proposed Expressway and Ring structures to be adopted for Ethiopia.

Figure 6-21:- Proposed Expressway and Ring Network

Adaptation and Proposal of Expressways along the existing Trunk Roads and Proposal of New Rings

Expressway Connecting Regional capitals, major towns, borders and ports

The identification of high standard roads (expressways) follows the major traffic corridors and existing trunk roads that connect major cities, ports and borders. In addition to connecting the cities as alternative routes, the proposed Expressways will reduce vehicle-operating cost and facilitates urbanization in the route corridors.

The basic criteria that the Consultant used in the identification of alternative expressways are the following:

i. High transport demand on the existing main trunk roads connecting the selected cities, borders and ports; and
ii. Major corridors, which can bring huge economic benefits.

As indicated in previous sections, the Consultant also made a study on the following important aspects along the existing highways:

- Terrain and Agro-ecological conditions;
- Demographic and settlement patterns in Woredas and Urban centers along the roads; and
- Other Socio-economic conditions along the road corridors.

Based on the traffic demand and other socio-economic analysis as mentioned above, the Consultant has analyzed the need and benefits of providing alternative express highways on the existing trunk roads. The economic and other benefits of expressways are to provide the road users cheaper, more efficient, quicker and safer travel. It is clear that the new expressways will reduce the continuously increasing vehicle operating costs significantly and create favorable condition for the import-export activities.

The Consultant has assessed the benefits of construction of new separate expressways over expanding or construction of additional lanes along the existing routes. The main reasons are explained below

i. Construction of parallel expressways far from the existing routes avoids demolishing of existing infrastructures like water utilities, telephone and electric lines;
ii. Right off way cost to expand the existing routes is much more expensive than new routes;
iii. The time to demolish and clear the right of way obstacles and issues is by far longer than the new routes;
iv. The new route will provide more space for future expansion (like reserving the middle space to expand and add additional lanes when the need arises in the future); and
v. It will shorten over all construction period.

The details will be dealt with during feasibility study and actual implementation of each project.

New Rings Connecting Expressways and major growth poles and development centers

The new proposed rings have to be designed to connect the proposed expressways, cities and major towns at certain interval (distance). The interval ranges from 40-km around Addis Ababa to 250 km around towns and areas 800-km and 1,000-km away from Addis Ababa. The rings will facilitate mobility and shorten the travel distance between regional capitals and major towns. The proposed rings may pass by the existing link roads or follow new routes. Wherever the rings follow the exiting link roads, the Client evaluate an option to expand the existing route or propose new routes based on the results of cost-benefit analysis of the two options.

The Proposed Expressways and Rings are detailed below

The Consultant team has introduced and proposed the new expressway and ring system concept for the whole Country to enhance connectivity among regions and supporting international open-door strategies as the foundation of national development and inter-regional unification.

The Revised Expressways and Rings networks are the following:

Table 6-39:- List of Existing and New Proposed Expressways with Corresponding Length

Newly Proposed Link	Link Name	Length _ Km	Status	Type
Expressway 1: Addis Ababa ~ Awash arba-Mile-Dobi-Djibouti border	Expressway 1-1: Addis Ababa-Adama	80	Completed	Existing
	Expressway 1-2: Adama-Metehara-Awash Arba	132	(Under Procurment / Ongoing	Upgrading
	Expressway 1-3: Awash arba-Mile-Dobi-Djibouti border	437	Newly Proposed	Upgrading
Expressway 2: Awash Sebat killo - Meiso - Diredawa - Dawale	Expressway 2-1: Awash Sebat killo - Meiso - Diredawa	215	Newly Proposed	Upgrading
	Expressway 2-2:Diredawa - Dawale	213	Completed	Existing
Expressway 2A: Diredawa-Harer-Fik - Jijiga - Togo Wuchale	Expressway 2A:Diredawa-Harer-Fik -Jijiga - Togo Wuchale	150	Newly Proposed	Upgrading
Expressway 3: Addis Ababa ~ Kombolecha ~ Mekele ~Zalanbesa	Expressway 3-1: Addis Ababa-Dessie	293	Newly Proposed	Upgrading
	Expressway 3-2: Dessie-Mekele	320	Newly Proposed	Upgrading
	Expressway 3-3: Mekele-Adigrat	115	Newly Proposed	Upgrading
	Expressway 3-4: Adigrat-Zalaanbessa	40	Newly Proposed	Upgrading
Expressway 3A: Adigrat-Adwa-Rama	Expressway 3-5: Adigrat-Adwa-Rama	35	Newly Proposed	Upgrading
Expressway 4: Addis Ababa ~ Bahirdar-Gondar-Humera	Expressway 4-1: Addis Ababa-Debremarkos	270	Newly Proposed	Upgrading
	Expressway 4-2: Debremarkos-Bahirdar	250	Newly Proposed	Upgrading
	Expressway 4-3: Bahirdar-Gondar-Metema	340	Newly Proposed	Upgrading
Expressway 4A: Gondar-Humera	Expressway 4A: Gondar-Humera	230	Newly Proposed	Upgrading
Expressway 5: Addis Ababa ~ Nekemte-Asossa-Kumuruk	Expressway 5-1: Addis Ababa ~ Nekemte	300	Newly Proposed	Upgrading
	Expressway 5-2:Nekemte -Assosa-Kurmuk	350	Newly Proposed	Upgrading
Expressway 6: Addis Ababa ~ Jima-Bedele-Metu-Gambella-Burbe	Expressway 6-1: Addis Ababa ~ Jima	320	Newly Proposed	Upgrading
	Expressway 6-2: Jima-Bedele-Metu	257	Newly Proposed	Upgrading
	Expressway 6-3: Metu-Gambella-Burbe	266	Newly Proposed	Upgrading
Expressway 6A: Jima-Bonga-Tepi-Rad	Expressway 6A-1: Jima-Bonga-Tepi	200	Newly Proposed	Upgrading
	Expressway 6A-2: Tepi-Rad	105	Newly Proposed	Missing Link
Expressway 7: Addis Ababa-Butajira-Hossaina-Sodo - Arbaminch-Konso-Woieto-Naparputh	Expressway 7-1: Addis Ababa-Butajira-Hossaina-Sodo	315	Newly Proposed	Upgrading
	Expressway 7-2: Sodo - Arbaminch- Konso	213	Newly Proposed	Upgrading
	Expressway 7-3: Konso-Weito-Naparputh	250	Newly Proposed	Upgrading

Expressway 8: Mojo - Hawassa - Moyale	Expressway 8-1:Mojo - Hawassa	260	Ongoing	Upgrading/Ongoing
	Expressway 8-2: Hawassa - Hagremariam	202	Newly Proposed	Upgrading
	Expressway 8-3:Hageremariam-Moyale	310	Newly Proposed	Missing Link
Expressway 8A: Aposto-Negele-Borena-Dolo odo	Expressway 8A-1:Aposto-Negele Borena	275	Newly Proposed	Upgrading
	Expressway 8A-2: Negele Borena- Dolo odo	340	Newly Proposed	Upgrading
Expressway 9: Adama-Assela-Dodolla-Robe-Ginir-Imi-Gode-Ferfer	Expressway 9-1: Adama-Assela- Robe	310	Newly Proposed	Upgrading
	Expressway 9-2: Robe-Ginir-Imi	330	Newly Proposed	Upgrading
	Expressway 9-3: Imi-Gode-Ferfer	405	Newly Proposed	Upgrading
Expressway 10: Jijiga-Degabour-Kebridehar-Shilabo	Expressway 10-1:Jijiga - Degehabur	170	Newly Proposed	Upgrading
	Expressway 10-2: Degehabur - Kebridahar - Shilabo	315	Newly Proposed	Upgrading
Expressway 11:	Warder - Goldgob	171	Newly Proposed	Missing Link

Table 6-40:- Rings on Selected Towns

Newly Proposed Link	Link Name	Length_Km	Status	Type
Outering 1:Diredawa Outer ring	Outerring 1-1: Diredawa Outer ring	25.93	Newly Proposed	Missing Link
Outering 2:Kombolecha Outer Ring	Outerring 2-1: Kombolecha Outer ring	48.11	Newly Proposed	Missing Link
Outering 3:Mekele Outer Ring	Outerring 3-1: Mekele Outer ring	68.91	Newly Proposed	Missing Link
Outering 4:Gondar Outer ring	Outerring 4-1: Gondar Outer ring	88.67	Newly Proposed	Missing Link
Outering 5:Nekmete Outer Ring	Outerring 5-1: Nekemte Outer ring	58.42	Newly Proposed	Missing Link
Outering 6:Jima Outer Ring	Outerring 6-1: Jima Outer ring	50.56	Newly Proposed	Missing Link
Outering 7:Sodo Outer ring	Outerring 7-1: Sodo Outer ring	26.57	Newly Proposed	Missing Link
Outering 8:Shashemene Outer Ring	Outerring 8-1: Shashemene Outer ring	25.42	Newly Proposed	Missing Link

The total length is 9043km Expressways and 392 Town Ring network are envisaged to be implemented in phases. The priorities are discussed in the issuing sections. Table below shows the lists of Proposed Rings to Connect Expressways, major towns and close loops with corresponding lengths.

Table 6-41:- List of Proposed Rings and Corresponding Lengths (km)

Rings	Project	Length_Km	Status
Ring 1:, Sendafa-Sululeta-Holeta-Sebeta-Bishoftu-Sendafa (Addis Ababa outer ring road)	Ring 1-1:Sendafa - Sululta	73.93	Missing Link
	Ring 1-2:Sululta Holeta	42.00	Missing Link
	Ring 1-3:Holeta - Sebeta	74.00	Holeta - Sebeta is Upgrading
	Ring 1-4:Sebeta-Bishoftu	50.99	Missing Link
	Ring 1-5:Bishoftu - Sendafa	48.71	Upgrading
Ring 2:Deberbirhan-Fiche-Ambo-Weliso-Butajira-Kela-Meki-Dera-Metehara-Deberbirhan	Ring 2-1: Deberbirhan-Fiche	178.03	Upgrading
	Ring 2-2: Fiche - Ambo	145.07	Missing Link
	Ring 2-3: Ambo-Weliso	60.24	Upgrading
	Ring 2-4: Weliso-Butajira	74.00	Butajira-Weliso is upgrading
	Ring 2-5: Butajira-Kela-Meki	45.00	Missing Link
	Ring 2-6: Meki - Dera	60.00	Missing Link
	Ring 2-7: Dera-Metehara	100.00	Upgrading
	Ring 2-8: Metehara-Debirbirhan	60.24	Upgrading
Ring 3:Kombolecha-Akesta-Mekenselam-Debrework-Bure-Nekemte-Bedele-Jima-Tercha-Sodo-Hawassa (Leku)-Kofle-Robe-Gasera-Jara-Shekhussien-Gelemso-Assebot-Gewena-Kombolecha	Ring 3-1: Kombolecha-Akesta-Mekanselam-Debrework	332.49	Upgrading
	Ring 3-2: Debrework-Bure	442.17	Upgarding
	Ring 3-3: Bure-Nekemte	222.76	Upgrading
	Ring 3-4: Nekemte-Bedele	96.00	Upgrading
	Ring 3-5: Bedele-Jima	140.00	Upgrading
	Ring 3-6: Jima-Tercha-Sodo	162.48	Upgrading
	Ring 3-7: Sodo-Hawassa(Leku)	88.00	Upgrading
	Ring 3-8: Hawassa(Leku)-Kofle	55.00	Missing Link

Rings	Project	Length_Km	Status
	Ring 3-9: Kofle-Robe-Gasera	167.00	Upgrading
	Ring 3-10: Gasera-Jara-Shekuhussien	219.75	Upgrading
	Ring 3-11: Shekuhussien-Gelemiso-Asebot	162.10	Upgrading
	Ring 3-12: Asebot-Gewane	316.85	Missing Link
	Ring 3-13: Gewane Kombolecha	147.48	Upgrading
Ring 4: Korem-Sekota-Gondar-Koladiba-Shuwura-Gelgilbelese-Wombera-Nejo-Gore-Masha-Tepi-Mizan-Jinka-Konso-Yabelo-Negeleborena-Filtu-Imi-Fik-Jijiga-Adigala-Dubti-Semera-Korem	Ring 4-1:Korem-Sekota-Gondar	229.70	Missing Link
	Ring 4-2:Gonder - Kola Diba - Shawura	116.76	Upgrading
	Ring 4-3:Shawura - Gilgel Beles	117.54	Missing Link
	Ring 4-4:Gilgel Beles - Wonbera	86.12	Missing Link
	Ring 4-5:Wonbera - Nejo - Gore	424.77	Missing Link
	Ring 4-6:Gore-Masha-Tepi- Mizan	167.71	Upgrading
	Ring 4-7:Mizan - Jinka - Konso	372.40	Missing Link
	Ring 4-8:Konso -Yabelo	104.33	Upgrading
	Ring 4-9:Yabelo - Negele Borena	243.35	Upgrading
	Ring 4-10:Negele Borena - Filtu - Imi	348.99	Missing Link
	Ring 4-11:Imi - Fik -Jigjiga	381.82	Upgrading
	Ring 4-12:Jijiga - Adigala - Dubti - Semera	370.13	Missing Link
	Ring 4-13:Semera-Korem	270.85	Upgrading (most section)
Ring 5: Galafi-Berehale-Adigrat-Adwa-Shire-Humera-Abederafi-Metema-Great Ren Dam-	Ring 5-1:Adigrat- Berhale - Galafi	449.16	Missing Link
	Ring 5-2:Humera - Shire - Adowa - Adigrat	386.74	Upgrading
	Ring 5-3:Metema - Abderafi - Humera	176.65	Upgrading

Rings	Project	Length_Km	Status
Kumurk-Begi-Gambela-Abobo-Dima-Omorate-Dilo-Moyale-Doloodo-Kelafo-Shilabo-Warder-Dhoqoshay (Somali Border	Ring 5-4:Kurmuk - Abay Dam - Bambudi - Metema	387.80	Missing Link
	Ring 5-5:Gambela - Begi - Kurmuk	299.37	Missing Link
	Ring 5-6:Gambella- Abobo - Dima	261.68	Missing Link
	Ring 5-7:Dimma - Omorate	255.51	Missing Link
	Ring 5-8:Omorate - Dilo	201.38	Missing Link
	Ring 5-9:Moyale - Dilo	171.19	Missing Link
	Ring 5-10:Moyale - Dolo Odo	376.85	Missing Link
	Ring 5-11:Warder - Shilabo - Kelafo - Dolo Odo	523.54	Missing Link
	Ring 5-12:Warder - Dhoqoshay (Berbera)	169.66	Missing Link

The total length is 10,045 km and expected to be implemented in phased manner.

6.7 Identification of existing gravel roads to upgrade to Asphalt

The Consultant has considered all existing federal network which are owned and administered by the Ethiopian Roads Authority (ERA) for the identification of gravel roads to be upgraded to asphalt standard. The process of selection focused on identification of those roads which are not included in the ERA Plan of 2012 EFY under different intervention which are currently under construction. Table below shows the summary of the existing status of the roads under asset management

Table 6-42:- Preparation Status of Gravel Roads

Total Length of	Existing Status	Remark
554.5	Under Tendering	
3,272.0	Under Design	In the process of Design for Upgrading
5,296.0	Upgraded	Roads already Upgraded or in the final completion stage
3,043	To be Upgraded	To be Considered in the HDM4 analysis
731.0	Rehabilitation	DBST surfaced to be Asphalt Concrete

Table below shows the list of gravel roads which are identified for further analysis. The Consultant has selected 81 gravel roads with total lengths of about 4,762 km. These are 24 road projects with length 1, 719 km from design and 57 roads with length 3043 km from existing gravel roads that are not included in any intervention or plan of ERA.

Table 6-43:- List of Gravel Roads to be Analyzed for Upgrading to Asphalt

No	Road Name	Length(KM)	Region
1	Isak R.Bridge - Guba	70	Benishangul Gumuz
2	Mechara - Dire shak husen	126	Oromia
3	Robe - Goro	60	Oromia
4	Goro -Ginir	70	Oromia
5	Ginchi - Busa-Tulubolo	48	Oromia
6	Chida - Waka	80	South
7	Seraba - Delgi - Shahura	100	Amhara
8	Woito - Erbore	39	South
9	Mazoria - Bojobar	10	South
10	Sherkole - Blue Nile	80	Benishangul Gumuz
11	Negele - Bulbul	43	Oromia
12	Holeta - Sebeta	29	Oromia
13	Debre Markos-Waber	60	Amhara
14	Waber - Aratie	60	Amhara
15	Metu - Alge	50	Oromia
16	Erbore - Mentrara	39	South
17	Imi - Hargele	285	Somali
18	Hargele - Dolobay	60	Somali
19	Mega - Wachile	109	Oromia
20	Wachile - Bulbul	84	Oromia
21	Filtu - Triangula	104	Somali
22	Triangula - Bogol Manyo	30	Somali
23	Bogol Manyo -Sarole	28	Somali
24	Sarole -Dollo	55	Somali
25	Semara-Didigsala-Yallo	168	Afar

No	Road Name	Length(KM)	Region
26	Hida-Yallo	71	Afar
27	Yabello-Metagefersa-Obolo	105	Oromia
28	Tolay Juction-Tolay	63.19	Oromia
29	Yallo-Chercher-Mehoni	65	Afar and Tigray
30	Kerseber-Debredamo	52.46	Tigray
31	Dilb-Kulmesk	25	Amhara
32	Ejere-Balchi-Shenkora Yohannis	20.94	Oromia and Amhara
33	Jigjiga-Teferi Ber	72.65	Somali
34	Tongo-Gidame	69	Oromia and BG
35	Indeto-Gasera	56.97	Oromia
36	Mendi-Dalati	37.75	Oromia and BG
37	Brindad-Teltele	34.23	Oromia
38	Terma Ber- Saladengay	20.71	Amhara
39	Dibate Junction-Dibate	43.38	Benishangul Gumuz
40	Ebenat-Belesa	39.96	Amhara
41	Kobo-Dadar	12.31	Oromia
42	Delgi-Chuhawit	27.77	Amhara
43	Saja-Fofa	27.24	SNNP
44	Kebado Jun-Dilla	6	SNNP
45	Dera-Sire	23.63	Oromia
46	Tere-Amoute	19	SNNP
47	Aletawendojun-Chuko	9	SNNP
48	Alelitu-Etisa	12	Oromia
49	Mitak Jun-Mitak	13	Amhara
50	Sire-Chole	65.05	Oromia
51	Metu-Sor Hydro Electric Power	22.68	Oromia
52	Beke-Zemute	21.96	SNNP
53	Fofa-Gilgel Gibe II	30.15	SNNP
54	Kella-Dugda	23.89	Oromia and SNNP

No	Road Name	Length(KM)	Region
55	Tiya-Gerenso-Amoute	58	SNNP
56	Eliya-Adura	71	Gambella
57	Fejeji Junction-Fejeji	60.56	SNNP
58	Nifasm-Bichena	42.84	Amhara
59	Hailwuha-Factory2-Factory1-Hana	78	SNNP
60	Bui Aymelel-Rob Gebiya	38.38	SNNP
61	Nahile-Abhala	59.73	Afar
62	Robit-Awash	64.5	Amhara and Afar
63	Bui-Medre kebdi-Meki	58.99	SNNP
64	Wacha-Maji	174.25	SNNP
65	Konso-Burji(Soyoma)	76.02	SNNP
66	Keyafer-Turmi	80.08	SNNP
67	Seru - Shekhusen	65	Oromia
68	Yalo - Nahile	68	Afar
69	Gidame - Mugi	91	Oromia
70	Shebelle - Imi	29	Somali
71	Magna - Mechara	140	Oromia
72	Adura - Akobo and Adura - Burbe	125	Gambella
73	Sugar F3 - Sugar F4	50	SNNP
74	Tiya - Amote	12	SNNP
75	Gidole - Konso	23	SNNP
76	H/Mariam - Burji	61	Oromia and SNNP
77	Awragodana - Bole (Bole - Bojober)	24	SNNP
78	Begondi - Wenbera	48	Benishangul Gumuz
79	Gilgelbeles - Dibate	58	Benishangul Gumuz
80	Blue Nile - Dibate jun	57	Benishangul Gumuz
81	Kamashi - Yaso	72	Benishangul Gumuz
	Total	**4762**	

6.8 Proposed existing asphalt roads to be analyzed for rehabilitation/upgrading

The Consultant also considered all Federal asphalt roads that are owned and administered by ERA for the identification of asphalt roads to be rehabilitated or upgraded to better standard. Those roads under the 2012 EFY plan for different interventions and the projects under construction by ERA were excluded. Hence, the Consultant considered all the excluded roads (i.e. planned and under construction) of the Authority during the preparation of the implementation plan of for projects. The detailed list of planned roads and roads under construction are annexed to this report. The total number of these roads are 150 with the total corresponding lengths of 9,428-km. Table below shows the list of identified asphalt roads for rehabilitation and upgrading.

Table 6-44:- List of Asphalt Roads to be analyzed for Rehabilitation and Upgrading

No	Road Name	Length (KM)	Region / Location
1	Abay River Bridge-Dejen	20	Amhara
2	Abay River Bridge-Gundewoin	83	Amhara
3	Adet-Bahirdar	41.5	Amhara
4	Adiarkay-Buya	26.17	Amhara
5	Alawha-Chifra	63.77	Amhara
6	Ambagiorgis-Debark	64.2	Amhara
7	Ataye-Robit	48	Amhara
8	Azezo Junction-Buhena	35.45	Amhara
9	Bahirdar-Wereta	59.21	Amhara
10	Bichena-Debre work	23.87	Amhara
11	Buhena-Negade Bahir	64	Amhara
12	Bure-Dangla	39	Amhara
13	Chefarrobit-Ataya	32.46	Amhara
14	Debre Tabour-Debre Zebit	99.5	Amhara
15	Dangla-Bahirdar	66.74	Amhara
16	Debre Sina-Guda Beret	26.38	Amhara
17	Debremarkos-Bure	49.61	Amhara
18	Debrework-Gundeweyn	46.09	Amhara
19	Degusit-Unzo River	34.49	Amhara
20	Dejen-Debre Markos	69.07	Amhara

No	Road Name	Length (KM)	Region / Location
21	Dessie-Kombolcha	20.33	Amhara
22	Dessie-Haik	29.69	Amhara
23	Gindowoin-Mota	35.26	Amhara
24	Godobert-Debre Birhan	34.09	Amhara
25	Gonder-Ambagiorgis	33.29	Amhara
26	Gonder Junction-Muse Bamb	41.32	Amhara
27	Haik-Wuchale	31.79	Amhara
28	Harbu-Chefarobit	53.95	Amhara
29	Kombolcha-Harbu	22.09	Amhara
30	Kossober-Chagni	61.04	Amhara
31	Meksegnet-Azezo Airport	29.25	Amhara
32	Mersa-Woldia	29.21	Amhara
33	Mota-Zema River Bridge	30	Amhara
34	Negade bahir-Shehede	56.17	Amhara
35	Robit-Debre Sina	32	Amhara
36	Robit-Waja	33.4	Amhara
37	Shehede-Metema	33.23	Amhara
38	Tik-Bichena	29.59	Amhara
39	Unzo River-Adiarkay	19.76	Amhara
40	Wereta-Debre Tabour	39.7	Amhara
41	Wereta-Maksegnet	76.01	Amhara
42	Woldia-Robit	33.52	Amhara
43	Wuchale-Mersa	30.84	Amhara
44	Addis Debre Birhan	112.62	Oromia
45	Addis Ababa-Commando	115	Oromia
46	Addis-Holeta	37.29	Oromia
47	Assela-Bokoji-Dodola	121.29	Oromia
48	Chancho-Derba	22.27	Oromia
49	Commando-Abay River	71.09	Oromia

No	Road Name	Length (KM)	Region / Location
50	Dengego(Dire Dawa)-Harar	23.13	Oromia
51	Dodola-Robe	110.13	Oromia
52	Gibe River-Saja	56.87	Oromia
53	Woliso-Welkite	40.84	Oromia
54	Gore-Gambella	145.21	Oromia
55	Hageremariam-Yabello	100.7	Oromia
56	Holeta-Muger	56.91	Oromia
57	Holeta-Ambo	81.91	Oromia
58	Dedesa River Bidge-Bedele	71.0	Oromia
59	Jimma-Bonga	111.47	Oromia
60	Kebremengist-Negele	120.12	Oromia
61	Mendi-Bambasi	46.39	Oromia
62	Metehara-Awash Junction	38.18	Oromia
63	Metu-Gore	23.04	Oromia
64	Mojo-Ejere-Arerti-Kosom(Gobessa)	84.2	Oromia
65	Mojo-Adama	20.43	Oromia
66	Adama-Assela	76.82	Oromia
67	Nejo-Mendi	75.51	Oromia
68	Nekemte-Mekenejo	113	Oromia
69	Shashamane-Dodola	75.56	Oromia
70	Shashamene-Wondogenet	18.04	Oromia
71	Welkite-Gibe River	28.25	Oromia
72	Yabello-Mega	100.14	Oromia
73	Robe-Goba	13.71	Oromia
74	Saja-Jimma	105.63	Oromia
75	Addis Ababa-Mojo	68.47	Oromia
76	Alemgena-Butajira	117.28	Oromia
77	Arberakete-Kobo	99.66	Oromia
78	Awash Junction-Arberakete	106.54	Oromia

No	Road Name	Length (KM)	Region / Location
79	Bako-Nekemte	76.1	Oromia
80	Gedo-Bako	58.94	Oromia
81	Kobo-Kulubi	26.48	Oromia
82	Kulubi-Dengego	31.85	Oromia
83	Meke Nejo-Nejo	58.33	Oromia
84	Mojo-Ziway	88.16	Oromia
85	Adama-Metehara	93.74	Oromia
86	Shashamane-Hawassa	17.94	Oromia
87	Alemgena-Waliso	111.48	Oromia
88	Ziway-Shashamane	91.15	Oromia
89	Degehabour-Kebri dehar	211.97	Somali
90	Jigjiga-Togochale	95.68	Somali
91	Kebridar-Gode	173.22	Somali
92	Jigjiga-Degehabour	170.27	Somali
93	Alaba-Sodo	65.28	SNNP
94	Aposto-Adola	154.32	SNNP
95	Areka-Sodo	28.33	SNNP
96	Bojeber-Butajira	27.42	SNNP
97	Bonga-Shishende	49.55	SNNP
98	Butajira-Hossana	99.79	SNNP
99	Butajira-Ziway	51.38	SNNP
100	Gubre Juction-Bojeber	54.8	SNNP
101	Hossana-Areka	68.05	SNNP
102	Mazoria-Hossana	64.94	SNNP
103	Mirab Abaya-Arbaminch	84.13	SNNP
104	Sodo-Mirab Abaya	38.46	SNNP
105	Welkite-Mazoira	59.98	SNNP
106	Wezeka-Konso	50.02	SNNP
107	Alaba-Alem Gebeya-Wulberg	58.79	SNNP

No	Road Name	Length (KM)	Region / Location
108	Gemeto Mazoria-Wondo Genet	18.22	SNNP
109	Kose-Gilgel-Gibe River II	36	SNNP
110	Arbaminch-Wezeka	41.26	SNNP
111	Keyafer-Jinka	39.4	SNNP
112	Konso-Woito	70.98	SNNP
113	Abi Adi-Adwa	92.7	Tigray
114	Adi abun-Axum	24.16	Tigray
115	Adigoshu-Humera	92.21	Tigray
116	Adigrat-Zalanbesa	39.85	Tigray
117	Alamata-Moheny-Hiwane	119.02	Tigray
118	Axum-Salakelaka	27.04	Tigray
119	Bizet-Adiabun	76.98	Tigray
120	Bizet-Adigrat	34.28	Tigray
121	Dedebit-Adirement	77.66	Tigray
122	Indasilase-Dedebit	71.21	Tigray
123	Mekele-Abi Adi	92.91	Tigray
124	Mekele-Negash	61.29	Tigray
125	Negash-Adigrat	53.66	Tigray
126	Salkelaka-Shire	34.82	Tigray
127	Dansha-Humera	105.63	Tigray
128	Rawyna-Myckadra	51.42	Tigray
129	Shire-Adigoshu	178.92	Tigray
130	Adigudom-Mekele	44.89	Tigray
131	Maychew-Adigudom	86.2	Tigray
132	Waja-Maychew	78.31	Tigray
133	Assosa-Kurmuk	98.17	Benishangul Gumuz
134	Bambasi-Assosa	51.84	Benishangul Gumuz
135	Chagni-Mambuk	54.55	Benishangul Gumuz
136	Adaitu-Mille	30.39	Afar

No	Road Name	Length (KM)	Region / Location
137	Awash Junction-Gedamitu	92.58	Afar
138	Dobi-Galafi	15.03	Afar
139	Gedamitu-Gewane	56.41	Afar
140	Gewane-Hundufo	48.69	Afar
141	Hundufu-Adayitu	71.21	Afar
142	Mille-Semera	73.97	Afar
143	Mille-Wark River	35.4	Afar
144	Samera-Serdo	37.46	Afar
145	Serdo-Afdera	190.15	Afar
146	Serdo-Hanef	56.77	Afar
147	Wanba River-Chifera	34.68	Afar
148	Wark River-Wanba River	34	Afar
149	Gambella-Itang	46.52	Gambella
150	Itang Junction-Lare-Old Jikawo	54.81	Gambella
	Total	9428	

PROJECT ANALYSIS IDENTIFICATION APPROACH

7 PROJECT ANALYSIS IDENTIFICATION APPROACH

HDM-4 Model applied for the economic analysis of exsiting roads with key parameters. Roads that exhibited positive NPV and BCR; and with EIRR greater than opportunity cost of capital are included in 10 years Master Plan for intervention.

As was stated in the Inception Report, the Consultant has presented two options as methodology for analysis of roads for upgrading and rehabilitation. Considering the time constraints and urgency of the assignment, the Consultant chose HDM-4 for the economic analysis of the existing roads that are selected for improvement to better standard. Maximum effort was exerted during the collection and organization of data for use in HDM 4.

Accordingly, the required data were collected, entered to the Model, analyzed and the required results or outputs were generated. Strategic development periods of short-term (1-5 years) and long-term (10 years and beyond) were considered. Strategic analyses were performed by considering the following three options:

i. Upgrading of the existing gravel roads to Asphalt concrete;
ii. Rehabilitation of existing Asphalt roads; and
iii. Upgrading existing asphalt roads to better standard.

Further, economic parameters of net present values (NPVs), economic internal rate of returns (EIRRs) and benefit-cost ratios (B-CR) were generated and used as criteria to test the for viability of the subject networks. The basic data utilized in HDM-4 are stated as follows:

- Physical road data:
  - Definition:
    - ✓ Section name,
    - ✓ Speed flow type,
    - ✓ Traffic flow pattern,
    - ✓ Climate zone,
    - ✓ Road class,
    - ✓ Surface class,
    - ✓ Pavement type,
    - ✓ Road length (km),
    - ✓ Carriageway width (m),
    - ✓ Shoulder width,
    - ✓ Number of lanes,
    - ✓ AADT and base year.
  - Geometry:
    - ✓ Rise and fall (m/km),
    - ✓ Average horizontal curvature (deg./km),

- ✓ Speed limit (km/hr.),
- ✓ Altitude (m), and
- ✓ Drain type
- ✓ Mean rut dep (mm),
- ✓ Texture depth (mm),
- ✓ Skid resistance (km/hr.), and
- ✓ Drainage condition.

➢ Pavement:

- ✓ Material type,
- ✓ Surfacing thickness (mm),
- ✓ Last or new construction, and
- ✓ Structural number.

➢ Condition:

- ✓ International roughness index (m/km),
- ✓ Total area of cracking (%),
- ✓ Ravelled area (%),
- ✓ Number of potholes (no./km),
- ✓ Edge break area (m^2/km),
- ✓ Mean rut depth (mm),
- ✓ Texture depth (mm),
- ✓ Skid resistance (km/hr.), and
- ✓ Drainage condition.

- Vehicle data by type of vehicles:
  - ➢ Vehicle operating cost savings;
    - ✓ New Vehicle Price (financial and economic);
    - ✓ Fuel costs (petrol and diesel),
    - ✓ Lubricant cost,
    - ✓ New tire costs
    - ✓ Maintenance labour costs
    - ✓ Crew costs,
    - ✓ Overhead costs, and
    - ✓ Interest Rate.

Working and non-working time of passengers in the case of passenger vehicles.

- Utilization and loading
  - ➢ Kilometres driven per year (km),

- Hours driven per Year (hr.),
- Service Life (years),
- Per cent of time for private use (%),
- Gross vehicle weight (GVW),
- Equivalent Standard Axle Loads (ESALs), and
- Passenger Car Equivalents (PCEs).

- Work standards:
  - Improvement costs (upgrading, reconstruction, lane addition, etc.), and
  - Maintenance costs by surface type.

7.1 Traffic data as an input in HDM-4

Regarding, traffic data, the Consultant used the ERA data of 2017 for the selected roads. As observed, the traffic growth of some roads for 2017 looked exaggerated than the previous years and thus adjustment is made. In addition, the Consultant conducted traffic count surveys on some gravel roads, which did not have traffic data. Hence, the Consultant has used this traffic data in HDM-4. The traffic growth rates used for the analysis were determined based on national GDP and population growth rates. Traffic growth rates were assigned for each vehicle classification for the period 2020-2030. The average annual daily traffic (AADT) and traffic composition were used as input in HDM 4. The details of the traffic growth rates are presented in Table 7-1 below.

Table 7-1:- Established Traffic Growth rates of Subject Vehicles

Period (Years)	Vehicle category and traffic growth rates (%)							
	Car	Pickup / Jeeps	Small bus	Large bus	Small truck	Medium truck	Heavy truck	Truck –trailer
2020-2030	7.7	7.7	8.3	8.3	7.7	8.3	9.5	9.4

7.2 Unit costs as input in HDM-4 for economic analysis

1. The Consultant has revised and used the unit costs. The unit costs were considered into two main categories i.e. “base case” which is “without project case” and “with project case”. Under “project case”, there are four types of unit costs and under the “base case”; there are three types of unit costs. The values of unit costs under the “with project case” were categorized as follows: Construction of Express way/Motorway (minimum six lanes and access controlled);

2. Construction of National Highway (minimum four lanes and access controlled);

3. Pavement Reconstruction (improving the existing pavement structure); and
4. Upgrading of Gravel roads to asphalt surfacing.

Table below shows economic and financial costs for use in HDM 4.

Table 7-2:- Economic and Financial Costs (Birr/per km) under Project Case Scenario

No	Type of the Intervention	Economic Unit cost	Financial Unit Cost
1	Construction of Expressway/Motorway (Six Lane)	124,3000,000	143,000,000
2	Construction of National Highway (Four Lane)	65,200,000	75,000,000
3	Pavement Reconstruction (improving the existing pavement structure)	20,000,000	23,000,000
4	Upgrading of Gravel roads to asphalt Concrete	24,000,000	27,600,000

The types of maintenance activities considered under the "base case" are as follows:

i. Maintenance of existing Asphalt concrete (Overlay);
ii. Maintenance of Existing Asphalt road (Surface restoration); and
iii. Maintenance of existing gravel roads.

Table 7-3:- Economic and Financial Unit Costs (Birr/km) under Base Case Scenario

No	Type of the Intervention	Economic Unit Cost	Financial Unit Cost
1	Maintenance of existing Asphalt concrete (Overlay)	4,800,000	5,520,000
2	Maintenance of Existing Asphalt road (Surface restoration)	229,000	263,350
3	Maintenance of existing gravel roads	177,000	203,550

Note: The economic unit costs of maintenance activities were adopted from the document prepared by HITCON Engineering Plc. during the preparation of 10 years Maintenance Plan.

7.3 Road conditions as inputs in HDM 4

The Consultant has reviewed the ten years maintenance plan for using the road condition data in HDM 4. The ten years maintenance plan under two lots had performed detailed condition survey of federal asphalt and gravel roads in the country and has prepared 10 years Maintenance plan as shown in the above review section. The condition data for the analysis is derived from this study.

7.4 Other important inputs for use in HDM-4

In addition to the above traffic data, the Consultant has considered the following: road condition; physical characteristics of vehicles; new vehicle price and price of tyre; fuel and lubricants prices; maintenance labor costs, etc. The Consultant through GIS determined the terrain types of all subject roads.

The details of physical characteristics of vehicle, new vehicle price and the price of tyre and other service items were collected from WT Consult. The consultant compiled the data by modifying and substituting latest data from other sources. The detail of these data is explained in the next sections. Table below shows other important inputs of HDM 4.

Table 7-4:- Other Important Inputs Data

Characteristics	Vehicle Type							
	Car	Utilities	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck & Trailer
Physical characteristics								
Gross vehicle weight (ton)	1.2	1.7	5.2	15	5.5	9	30	50
Axles per vehicle	2	2	2	2	2	2	3	6
Tyres per vehicle	4	4	4	6	4	6	10	22
Passenger occupancy (no.)	3	4	20	45	-	-	-	-
Equivalent Standard Axles-ESA (VDF)	-	-	0.3	1.5	1	3.5	5.5	8
Utilization								
Annual km run (km)	20,000	40,000	50,000	45,500	50,000	60,000	65,000	65,000
Annual hours (hrs.)	600	900	1,200	2,000	1,600	1,400	2,300	2,500
Average Service Life (yrs.)	10	12	15	15	12	14	15	15
Unit Costs (Economic)								
New vehicle price (ETB)	592,333	1,303,666	1,026,056	1,874,111	886,011	1,063,746	2,314,391	4,217,391
Unit Costs (Financial)								
New Vehicle Price (ETB)	1,777,000	3,911,000	2,074,000	2,650,000	1,860,000	3,650,000	3,750,000	4,952,124
Unit Costs (Economic)								
Tyre price (ETB)	2,368	6,075	8822.60	13,314	8822.60	13,314	13,314	13,314
Unit Costs (Financial)								
Tyre price (ETB)	2,724	6,986	10,146	15,311	10,146	15,311	15,311	15,311
Economic Unit Costs								

Characteristics	Vehicle Type							
	Car	Utilities	Small Bus	Large Bus	Small Truck	Medium Truck	Heavy Truck	Truck & Trailer
Fuel & Lubricants								
Fuel (ETB/lit)	18.77	17.90	17.90	17.90	17.90	17.90	17.90	17.90
Lubricant (ETB/lit)	56.40	56.40	56.40	56.40	56.40	56.40	56.40	56.40
Maintenance Labor cost (ETB/hr)	20.78	20.78	20.78	20.78	20.78	20.78	20.78	20.78
Crew cost (ETB/hr)	-	-	17.02	48.01	18.63	25.08	35.83	46.58
Annual Overhead (ETB)	5,553.93	10,032.91	12,236.56	19,474.59	13,186.11	64,181.93	101,262.48	141,041.16
Passenger time cost (ETB/hr)	19.8	19.8	8.28	8.28				
Annual Interest rate (%)	10	10	10	10	10	10	10	10

7.5 The outputs or results of the HDM-4 road economic analysis

At the beginning, the Consultant specified three strategies to run the HDM-4. The types of roads improvements included: upgrading of gravel to asphalt concrete, pavement reconstruction of asphalt roads and upgrading of asphalt roads to better standard asphalt surfacing (i.e. adding two lanes on the existing two-lane and makes it 4 lanes). The details are shown in Table below.

Table 7-5:- Strategies by the Consultant to Perform the Analysis

Strategy	Strategy type	Interventions	Base Case Scenario	With Project Scenario
1	Upgrading of Gravel Roads	Upgrading of 2-lane Gravel roads to 2 lane and 2 layers Asphalt Concrete	Maintenance of Existing Gravel as 2020	Upgrading to 2-lane Asphalt Road as of 2020 and maintenance of Asphalt (Surface Restoration) as of 2024
2	Pavement Reconstruction	Pavement reconstruction of 2-lane Asphalt Concrete (and 2 layers) without major geometry change	Maintenance of Existing Asphalt (surface restoration) as 2020	Pavement Reconstruction as of 2020 and maintenance of Asphalt (Surface Restoration) as of 2024
3	Upgrading of Asphalt Roads to better Standard	Upgrading existing 2-lane Asphalt roads to 4 lanes (and 2 layers)	Maintenance of Existing Asphalt (surface restoration) as of 2020	Upgrading to 4 lanes as of 2020 and maintenance of Asphalt (Surface Restoration) as of 2024

The Consultant has classified the economic results of the HDM-4 analysis into three main categories based on the above-mentioned strategies. The basic economic parameters generated by HDM 4 and used for project comparisons are: Net Present Value (NPV), Economic Internal Rate Return (EIRR) and Benefit Cost Ratio (B-CR). The Consultant has selected the roads with positive NPVs and B-CRs and roads with greater than the opportunity

cost of capital (OCC) which is 10.23%. The outputs and the evaluation results are shown in Table below.

Outputs of the first strategy analysis (upgrading of asphalt roads to better standard)

Under this strategy, the Consultant has proposed 154 existing asphalt roads with the total length of 9,534 km for economic analysis by HDM-4. The results justified the selection of about 21 roads with total length of 1,138.93 km for future intervention. These roads resulted in positive NPVs and B-CRs and EIRRs greater than 10.23%, the OCC. Hence, these roads (i.e. roads which have positive NPV and B-CR and greater than 10.23 EIRR) have been included in the next 10 years implementation plan of ERA. The economic analysis results of HDM-4 with asphalt roads proposed for upgrading are presented in Table below.

Table 7-6:- Analysis of Asphalt Roads Proposed for Upgrading to Better Standard

No	Road Name	Length (km)	NPV (million Birr)	EIRR (%)	B-CR	Selected or Not
1	Holeta-Muger	56.91	16,417.29	48.0	5.191	YES
2	Mojo-Adama	20.43	12,493.71	156.6	11.005	YES
3	Holeta-Ambo	81.91	12,314.68	54.1	2.706	YES
4	Addis Ababa-Mojo	68.47	11,825.26	98.0	3.096	YES
5	Addis Ababa-Commando	115.00	10,215.00	57.3	5.39	YES
6	Alemgena-Waliso	111.48	9,600.83	38.9	1.550	YES
7	Adama-Metehara	93.74	5,524.75	32.6	1.061	YES
8	Adama-Assela	76.82	3,390.58	25.1	0.794	YES
9	Alemgena-Butajira	117.28	3,204.78	23.7	0.492	YES
10	Metehara-Awash Junction	38.18	2,250.20	32.6	1.061	YES
11	Ziway-Shashamane	91.15	1,697.51	16.2	0.335	YES
12	Mojo-Ejere-Arerti-Kesem	35.25	793.61	20.6	0.405	YES
13	Chancho-Derba	22.27	415.03	16.1	0.335	YES
14	Dengego(Dire Dawa)-Harar	23.13	253.70	14.4	0.197	YES
15	Samera-Serdo	37.46	201.44	11.4	0.091	YES
16	Adaitu-Mille	30.39	201.12	11.7	0.119	YES
17	Addis-Holeta	37.29	91.62	38.6	1.649	YES
18	Dobi-Galafi	15.03	75.53	11.4	0.091	YES
19	Dangla-Bahirdar	66.74	17.29	10.3	0.005	YES

No	Road Name	Length (km)	NPV (million Birr)	EIRR (%)	B-CR	Selected or Not
20	Shashamane-Hawassa	17.94	16.29	11.2	0.004	YES
21	Mojo-Ziway	88.16	15.20	10.4	0.030	YES

Output of the second strategy analysis (pavement reconstruction)

Under this strategy, 133 existing asphalt roads with the total length of 8424 km were proposed for economic analysis by HDM-4. The results of the analysis showed that 70 roads with the total length of 4092 km are justified for selection for future intervention. These roads resulted in positive NPVs and B-CRs and in EIRRs greater than 10.23%. Hence, the Consultant has included these roads in the next 10 years implementation plan of ERA. The result of HDM-4 are attached in Annex-11-4. The list of Roads with Positive NPV and their priority order is shown below

Table 7-7:- List of Roads with Positive NPV for Rehabilitation/Pavement Reconstruction

The NPV, EIRR and Benefit-Cost Ratio of Asphalt Roads proposed for Pavement Reconstruction					
Road Name	Length (KM)	NPV	IRR	B-CR	Selected /Not
Butajira-Hossana	99.79	4,446.85	39.4	2.706	YES
Commando-Abay River	71.09	4,105.44	47.7	3.507	YES
Hossana-Areka	68.05	3,579.38	44.1	3.194	YES
Arberakete-Kobo	99.66	2,826.71	26.9	1.722	YES
Awash Junction-Arberakete	106.54	2,758.06	25.3	1.572	YES
Jimma-Bedele	141.14	2,554.08	23.0	1.099	YES
Saja-Jimma	105.63	2,454.69	24.0	1.411	YES
Jigjiga-Degehabour	170.27	2,387.43	19.3	0.851	YES
Bahirdar-Wereta	59.21	2,343.34	31.2	2.403	YES
Alamata-Moheny-Hiwane	119.02	2,256.68	21.8	1.151	YES
Butajira-Ziway	51.38	1,893.91	31.1	2.238	YES
Dejen-Debre Markos	69.07	1,845.82	25.6	1.623	YES
Wereta-Maksegnet	76.01	1,582.53	22.6	1.264	YES
Mekele-Negash	61.29	1,531.44	24.9	1.517	YES
Bure-Dangla	39.00	1,490.46	30.7	2.314	YES
Debremarkos-Bure	49.61	1,456.32	26.5	1.783	YES
Woliso-Welkite	40.84	1,452.13	29.8	2.159	YES
Negash-Adigrat	53.66	1,340.79	24.9	1.517	YES
Gibe River-Saja	56.87	1,279.00	23.9	1.366	YES
Kulubi-Dengego	31.85	1,247.36	32.7	2.378	YES

The NPV, EIRR and Benefit-Cost Ratio of Asphalt Roads proposed for Pavement Reconstruction					
Road Name	Length (KM)	NPV	IRR	B-CR	Selected /Not
Meke Nejo-Nejo	58.33	1,245.85	23.6	1.297	YES
Ataye-Robit	48.00	1,194.52	25.0	1.512	YES
Welkite-Gibe River	28.25	1,187.37	38.4	2.552	YES
Addis Debre Birhan	112.62	1,149.09	16.0	0.620	YES
Welkite-Mazoira	59.98	1,053.92	19.8	1.067	YES
Harbu-Chefarobit	53.95	1,006.10	21.3	1.132	YES
Areka-Sodo	28.33	980.89	29.6	2.103	YES
Dessie-Kombolcha	20.33	957.92	34.8	2.861	YES
Assela-Bokoji-Dodola	121.29	902.83	14.5	0.452	YES
Waja-Maychew	78.31	889.76	18.0	0.690	YES
Godobert-Debre Birhan	34.09	867.68	25.0	1.546	YES
Gedamitu-Gewane	56.41	862.64	18.6	0.929	YES
Quiha-Maymekeden	16.73	841.74	43.9	3.055	YES
Mekele-Abi Adi	92.91	827.93	18.0	0.820	YES
Debre Tabour-Debre Zebit	99.50	826.64	16.1	0.505	YES
Robit-Debre Sina	32.00	795.70	25.0	1.510	YES
Meksegnet-Azezo Airport	29.25	781.48	26.0	1.622	YES
Kobo-Kulubi	26.48	736.83	26.4	1.690	YES
Nekemte-Mekenejo	113.00	718.68	14.6	0.386	YES
Mille-Wark River	35.40	714.01	21.7	1.225	YES
Abi Adi-Adwa	92.70	709.20	15.6	0.465	YES
Wark River-Wanba River	34.00	673.10	21.4	1.202	YES
Debre Sina-Guda Beret	26.38	655.95	25.0	1.510	YES
Salkelaka-Shire	34.82	637.61	21.8	1.112	YES
Kossober-Chagni	61.04	573.72	16.7	0.571	YES
Robit-Waja	33.40	508.04	19.8	0.924	YES
Woldia-Robit	33.52	503.99	19.8	0.913	YES
Axum-Salakelaka	27.04	497.62	21.7	1.118	YES
Alaba-Alem Gebeya-Wulberg	58.79	448.37	14.9	0.463	YES
Wuchale-Mersa	30.84	439.73	19.2	0.866	YES
Dodola-Robe	11.13	424.47	12.9	0.232	YES
Mersa-Woldia	29.21	416.49	19.2	0.866	YES
Maychew-Adigudom	86.20	405.96	13.6	0.286	YES
Gedo-Bako	58.94	396.28	14.2	0.408	YES
Kombolcha-Harbu	22.09	395.32	21.1	1.087	YES
Adiabun-Axum	24.16	373.96	19.8	0.938	YES
Haik-Wuchale	31.79	369.61	17.7	0.706	YES
Dessie-Haik	29.69	345.20	17.7	0.706	YES
Wereta-Debre Tabour	39.70	340.41	16.2	0.521	YES

The NPV, EIRR and Benefit-Cost Ratio of Asphalt Roads proposed for Pavement Reconstruction					
Road Name	Length (KM)	NPV	IRR	B-CR	Selected /Not
Adigudom-Mekele	44.89	299.24	14.9	0.405	YES
Abay River Bridge-Dejen	20.00	234.52	17.2	0.739	YES
Adigrat-Zalanbesa	39.85	213.24	14.1	0.325	YES
Chefarabet-Ataya	32.46	184.93	13.8	0.346	YES
Robe-Goba	13.71	153.31	11.1	0.082	YES
Gubre Juction-Bojeber	54.80	140.65	12.2	0.156	YES
Bako-Nekemte	76.10	65.21	10.8	0.052	YES
Ambagiorgis-Debark	64.20	45.27	10.7	0.043	YES
Alawha-Chifra	63.77	32.35	10.6	0.031	YES
Itang Junction-Lare-Old Jikawo	54.81	30.58	10.8	0.034	YES
Gambella-Itang	46.52	25.95	10.8	0.034	YES

Outputs of the third strategy analysis (upgrading of existing gravel roads to asphalt concrete)

Under this strategy, initially 81 existing gravel roads with the total length of 4,762km were proposed for economic analysis using HDM-4 Model. However, the consultant has excluded 15 roads with total length of 922km, which are gravel roads under construction and/or under professional acceptance (recently completed) from the HDM-4 analysis. The consultant has made priority of above road projects based on the value of NPVs for implementation plan. In spite of excluding 15 road projects from HDM-4 analysis, the consultant has considered them in the 5 and 10 years implementation plan with low priority since they are under construction and/or recently completed. Therefore, ERA will achieve the target of upgrading all existing gravel roads to asphalt concrete in the 5 and 10 years implementation plan.

On the other hand, there are existing gravel road projects that are currently under design or design completed, these projects have given higher priority before newly identified roads regardless of their NPV values. The result of HDM-4 analysis is attached in Annex-11-4. The result of HDM-4 analysis of Roads is shown below.

Table 7-8:- Output of existing gravel roads with NPV to be upgraded to Asphalt Concrete

No	Road Name	Length(KM)	Net Present Value (NPV)	Priority	Region
1	Isak R.Bridge – Guba	70	4,213.7	1	Benishangul Gumuz
2	Mechara - Dire shak husen	126	3,285.0	2	Oromia
3	Robe - Goro	60	1,586.0	3	Oromia
4	Goro -Ginir	70	1,586.0	4	Oromia

No	Road Name	Length(KM)	Net Present Value (NPV)	Priority	Region
5	Ginchi - Busa-Tulubolo	48	1,534.3	5	Oromia
6	Chida - Waka	80	1,423.0	6	South
7	Seraba - Delgi - Shahura	100	738.6	7	Amhara
8	Woito - Erbore	39	411.9	8	South
9	Mazoria - Bojobar	10	379.0	9	South
10	Sherkole - Blue Nile	80	202.2	10	Benishangul Gumuz
11	Negele - Bulbul	43	135.0	11	Oromia
12	Holeta - Sebeta	29	33.5	12	Oromia
13	Debre Markos-Waber	60	-7.4	13	Amhara
14	Waber - Aratie	60	-7.4	14	Amhara
15	Metu - Alge	50	-613.5	15	Oromia
16	Erbore - Mentrara	39	-726.8	16	South
17	Imi - Hargele	285	-1,127.0	17	Somali
18	Hargele - Dolobay	60	-1,622.5	18	Somali
19	Mega - Wachile	109	-1,856.0	19	Oromia
20	Wachile - Bulbul	84	-1,856.0	20	Oromia
21	Filtu - Triangula	104	-2,474.6	21	Somali
22	Triangula - Bogol Manyo	30	-2,474.6	22	Somali
23	Bogol Manyo -Sarole	28	-2,474.6	23	Somali
24	Sarole -Dollo	55	-2,474.6	24	Somali
25	Semara-Didigsala-Yallo	168	9,248.0	25	Afar
26	Hida-Yallo	71	3,932.6	26	Afar
27	Yabello-Metagefersa-Obolo	105	3,142.0	27	Oromia
28	Tolay Juction-Tolay	63.19	3,131.4	28	Oromia
29	Yallo-Chercher-Mehoni	65	2,719.0	29	Afar and Tigray
30	Kerseber-Debredamo	52.46	2,559.7	30	Tigray
31	Dilb-Kulmesk	25	2,559.0	31	Amhara
32	Ejere-Balchi-Shenkora Yohannis	20.94	2,353.2	32	Oromia and Amhara

No	Road Name	Length(KM)	Net Present Value (NPV)	Priority	Region
33	Jigjiga-Teferi Ber	72.65	1,998.4	33	Somali
34	Tongo-Gidame	69	1,974.4	34	Oromia and BG
35	Indeto-Gasera	56.97	1,073.4	35	Oromia
36	Mendi-Dalati	37.75	465.3	36	Oromia and BG
37	Brindad-Teltele	34.23	294.9	37	Oromia
38	Terma Ber- Saladengay	20.71	294.0	38	Amhara
39	Dibate Junction-Dibate	43.38	287.5	39	Benishangul Gumuz
40	Ebenat-Belesa	39.96	276.0	40	Amhara
41	Kobo-Dadar	12.31	213.5	41	Oromia
42	Delgi-Chuhawit	27.77	72.1	42	Amhara
43	Saja-Fofa	27.24	6.1	43	SNNP
44	Kebado Jun-Dilla	6	-46.0	44	SNNP
45	Dera-Sire	23.63	-56.1	45	Oromia
46	Tere-Amoute	19	-71.0	46	SNNP
47	Aletawendojun-Chuko	9	-76.0	47	SNNP
48	Alelitu-Etisa	12	-102.5	48	Oromia
49	Mitak Jun-Mitak	13	-109.1	49	Amhara
50	Sire-Chole	65.05	-128.1	50	Oromia
51	Metu-Sor Hydro Electric Power	22.68	-174.1	51	Oromia
52	Beke-Zemute	21.96	-234.0	52	SNNP
53	Fofa-Gilgel Gibe II	30.15	-261.9	53	SNNP
54	Kella-Dugda	23.89	-288.9	54	Oromia and SNNP
55	Tiya-Gerenso-Amoute	58	-305.9	55	SNNP
56	Eliya-Adura	71	-440.8	56	Gambella
57	Fejeji Junction-Fejeji	60.56	-471.8	57	SNNP
58	Nifasm-Bichena	42.84	-637.4	58	Amhara
59	Hailwuha-Factory2-Factory1-Hana	78	-648.0	59	SNNP
60	Bui Aymelel-Rob Gebiya	38.38	-714.4	60	SNNP

No	Road Name	Length(KM)	Net Present Value (NPV)	Priority	Region
61	Nahile-Abhala	59.73	-831.6	61	Afar
62	Robit-Awash	64.5	-920.9	62	Amhara and Afar
63	Bui-Medre Kebdi-Meki	58.99	-1,034.0	63	SNNP
64	Wacha-Maji	174.25	-1,133.8	64	SNNP
65	Konso-Burji(Soyoma)	76.02	-1,262.0	65	SNNP
66	Keyafer-Turmi	80.08	-1,335.5	66	SNNP
67	Seru - Shekhusen	65	Under construction	67	Oromia
68	Yalo - Nahile	68	Recently Completed	68	Afar
69	Gidame - Mugi	91	Recently Completed	69	Oromia
70	Shebelle - Imi	29	Under construction	70	Somali
71	Magna - Mechara	140	Recently Completed	71	Oromia
72	Adura - Akobo and Adura - Burbe	125	Under Construction	72	Gambella
73	Sugar F3 - Sugar F4	50		73	SNNP
74	Tiya - Amote	12		74	SNNP
75	Gidole - Konso	23	it part of Arbaminich-Konso Road	75	SNNP
76	H/Mariam - Burji	61	Under construction	76	Oromia and SNNP
77	Awragodana - Bole (Bole - Bojober)	24		77	SNNP
78	Begondi - Wenbera	48	Under construction	78	Benishangul Gumuz
79	Gilgelbeles - Dibate	58	Recently Completed	79	Benishangul Gumuz
80	Blue Nile - Dibate jun	57	Under construction	80	Benishangul Gumuz
81	Kamashi - Yaso	72	Recently Completed	81	Benishangul Gumuz

IMPLEMENTATION & FINANCING PLAN

8 IMPLEMENTATION & FINANCING PLAN

A summarized implementation plan with corresponding disbursement basing the pace of the last few years intervention is prepared and shown in Tables and geographically.

8.1 Proposed Physical Yearly Plan for the next 10 Years

The Consultant has analyzed and determined the future expected performance growth rate under each type of intervention through the lifetime analysis of 21 years; specifically, from the last 4 years implementation capacity of ERA. 15%, 12.5%, 7.5%, and 5% increments were proposed for Construction link roads; Rehabilitation of Trunk roads, Upgrading of link roads and Construction of Expressways respectively. Table below shows the details.

Table 8-1:- Yearly accomplishment and proposed growth of performance

No	Type of Intervention	ERA last 4 years Maximum	Expected an proposed performance increment (%)	Proposed yearly implementation Plan
1	Rehabilitation of Trunk Roads	205	12.5	500
2	Construction of Expressway Roads/ Upgrading of Trunk Roads	230	5	241.5
3	Upgrading Link Roads	540	7.5	880.0
4	Construction of Link Roads	950	15.0	1330.0

Considering the growth performances in Table above, the total lengths of roads under each intervention were proposed to be implemented. Table below shows the proposed 10-Year Plan.

Table 8-2:- 10-Year Proposed plan by intervention type

Implementation Plan Year	Rehabilitation (Km)	Construction of Expressway (Km)	Upgrading of Link roads (Km)	Construction of New Link (Km)	Total Proposed Yearly Plan (Km)
2020/21	500.0	241.5	880.0	1330.0	2951.5
2021/22	575.0	253.58	946.00	1529.5	3304.1
2022/23	661.3	266.25	1016.95	1758.9	3703.4
2023/24	760.4	279.57	1093.22	2022.8	4156.0
2024/25	874.5	293.54	1175.21	2326.2	4669.4
2025/26	1005.7	308.22	1263.35	2675.1	5252.4
2026/27	1156.5	323.63	1358.11	3076.4	5914.6
2027/28	1330.0	339.81	1459.96	3537.8	6667.6
2028/29	1529.5	356.81	1569.46	4068.5	7524.3
2029/30	1758.9	374.65	1687.17	4678.8	8499.5
Total from 2020/21 - 2029/30	10,151.86	3,037.56	12,449.44	27,003.95	52,642.80

8.2 Proposed Financial Plan for the next 10 Years

Last 9 years Financial Accomplishment and Estimated Budget for the next 10 Years

Regarding ERA's growth of allocated budget for road projects Table below shows the yearly growth of approved capital budget for the last 9 years from the Government of Ethiopia (GoE) and Development Partners. .

Table 8-3:- 9-Years Capital Budget for ERA

ERA Capital Budget					
No.	**Year (EFY)**	**GoE**	**Loan**	**Grant**	**Total Approved**
1	2003	12,172,451,202	2,292,366,000	106,100,000	14,570,917,202
2	2004	16,723,313,000	3,560,210,000	118,423,000	20,401,946,000
3	2005	17,139,199,000	4,368,237,000	328,500,000	21,835,936,000
4	2006	23,170,000,000	8,000,005,200	764,881,000	31,934,886,200
5	2007	23,000,000,000	7,982,427,000	907,198,000	31,889,625,000
6	2008	24,000,000,000	9,000,034,000	177,093,000	33,177,127,000
7	2009	35,000,000,000	11,000,000,000	158,974,000	46,158,974,000
8	2010	35,000,000,000	10,378,622,000	153,562,000	45,532,184,000
9	2011	27,900,000,000	10,687,307,000		38,587,307,000

Source: The Ethiopian Roads Authority

Based on the above allocation and growth of capital budget, the consultant has proposed the following cost estimate for the next 10 years master plan. Table below shows the proposed financial budget allocation for the next 10 Years (in million birr).

Table 8-4:- Proposed financial budget allocation for the next 10 Years (in million birr)

Implementation Plan Year	Rehabilitation	Construction of Expressway	Upgrading of Link	Construction of Link	Total Plan
2020/21	10,000.00	15,697.50	21,120.00	35,910.00	82,727.50
2021/22	11,500.00	16,482.38	22,704.00	41,296.50	91,982.88
2022/23	13,225.00	17,306.49	24,406.80	47,490.98	102,429.27
2023/24	15,208.75	18,171.82	26,237.31	54,614.62	114,232.50
2024/25	17,490.06	19,080.41	28,205.11	62,806.81	127,582.39
202526	20,113.57	20,034.43	30,320.49	72,227.84	142,696.33
2026/27	23,130.61	21,036.15	32,594.53	83,062.01	159,823.30
2027/28	26,600.20	22,087.96	35,039.12	95,521.31	179,248.59
2028/29	30,590.23	23,192.36	37,667.05	109,849.51	201,299.15
2029/30	35,178.76	24,351.97	40,492.08	126,326.94	226,349.76
2020/21-2029/30	203,037.18	197,441.47	298,786.49	729,106.52	1,428,371.66

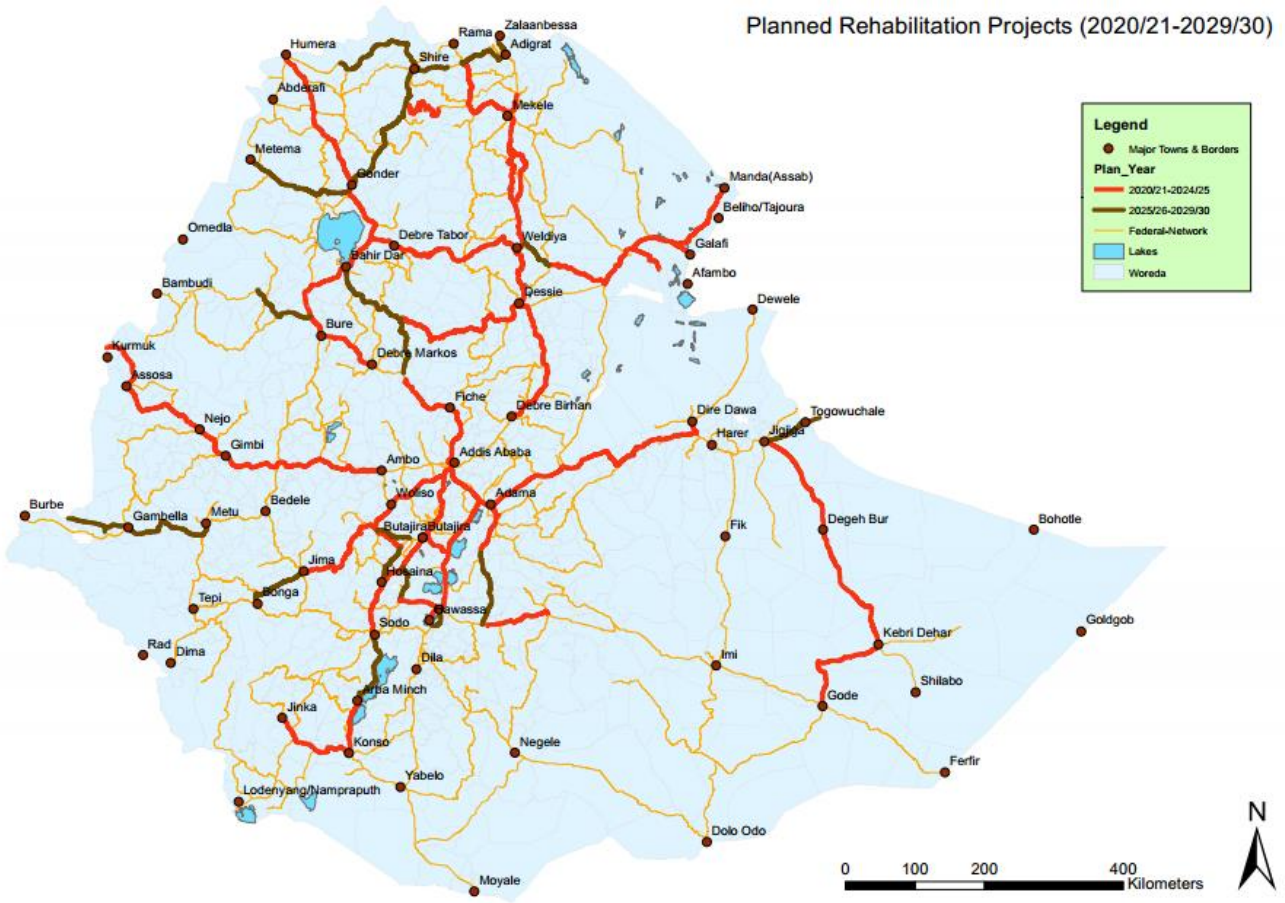
8.3 Detailed Implementation Plan

Considering the output of HDM-4 model and the condition of the roads, the consultant has prepared detail priority and implementation plan for all projects as follow. For New missing links the implementation plan is done based on the final priority of the projects as per the criterion, weights and marking given in the above chapter.

8.3.1 Rehabilitation Projects

Based on the above analysis on the yearly estimated physical plan and budget, the Consultant has prepared implementation plan for the next 10 years Master Plan. The Plan includes ongoing and 2013 E C Projects with a total length 4715 km and cost of ETB 93.37 billion. The total numbers of newly identified rehabilitation projects to be implemented after 2013 E.C are 42 with a total length of 3981 km and with a total cost of ETB 79.62 billion. The list of Projects with corresponding costs and year of Implementation is attached in Annex-11-6. Figure below shows the proposed projects for rehabilitation with implementation year.

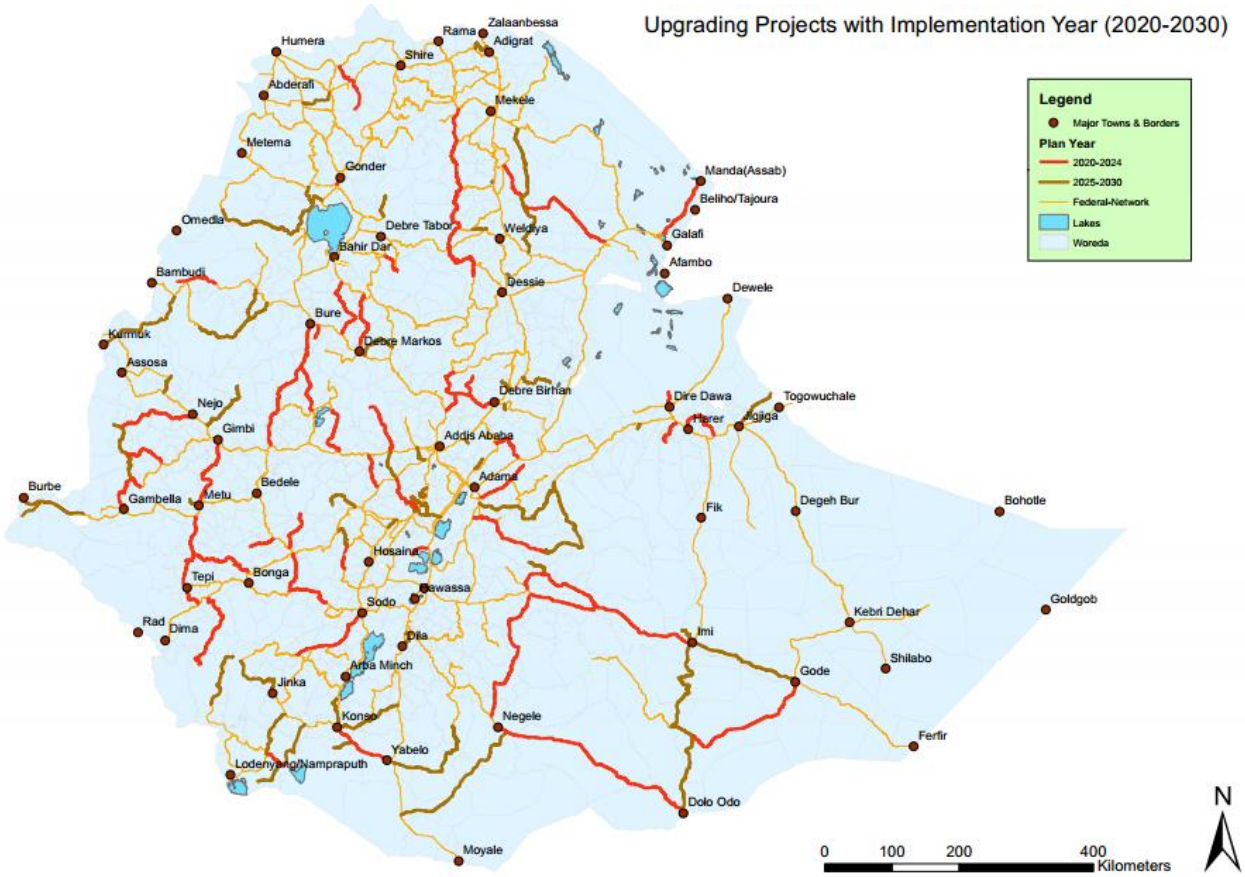
Figure 8-1:- Map shows Proposed Rehabilitation projects with Implementation Year



8.3.2 Upgrading Gravel to Asphalt

The Consultant has prepared implementation plan for the identified Upgrading Projects. The total number ongoing projects are 67 with lengths of 5,579-km. Among these, there are considerable numbers of projects that are design completed and under procurement for implementation in 2013 E.C. The total costs of ongoing and design completed projects were estimated at ETB 117.14billion. The newly identified projects are 72 with a total length of 3,993-km. The estimated budget for their implementation is about ETB 95.84 billion. The details are presented in Annex-11-6. Figure below shows the proposed projects for upgrading with implementation year.

Figure 8-2:- Map showing Proposed Upgrading projects with Implementation Year



8.3.3 Construction of Expressways

There are 7 ongoing Expressway projects with total lengths of about 339 km. In this study, 24 Expressways and Ring projects with a total length of 2,960-km for implementation in the next 5 and 10 years plan period have been proposed. The total costs of the projects were estimated at ETB 187.56 Billion. The implementation plans for the identified Expressway Projects are shown in Table below. The Figures below respectively show; Expressways to be implemented during 2020/21 - 2024/25; Expressways to be implemented between 2020/21 and 2029/30 and Expressways to be implemented after 2030 and Expected in 2050.

Table 8-5:- Planned Projects for Construction of Expressway (cost in million birr)

No.	Road Name	Length (KM)	Type	Per km Costs	Total cost (Million)	Plan Year
1	Awash-Meiso	71	Expressway	65.3	4244.5	2021/22
2	Meiso-Dengego-Diredawa	214	Expressway	65.3	8619.6	2021/22
3	Addis Ababa - Holeta-Ambo	118	Expressway	65.3	7705.4	2021/22

No.	Road Name	Length (KM)	Type	Per km Costs	Total cost (Million)	Plan Year
4	Addis Ababa-Commando	110	Expressway	65.3	7183	2022/23
5	Addis Ababa - Alemgena-Woliso	110	Expressway	65.3	7183	2022/23
6	Addis Ababa-Debrebirhan	129	Expressway	65.3	8423.7	2022/23
7	Addis Ababa Outer Ring Road (Sebeta-Holeta, Lot1=32, Sebeta-Gelan-Lot 2=50)	82	Expressway	65.3	5354.6	2022/23
8	Alemgena-Butajira	117.28	Expressway	65.3	7658.38	2023/24
9	Dire Dawa-Dengego-Harar	50	Expressway	65.3	3265	2023/24
10	Awash Junction-Adaitu	270	Expressway	65.3	17631	2023/24
11	Adaitu-Mille-Semera	105	Expressway	65.3	6856.5	2023/24
12	Semera-Serdo	37.46	Expressway	65.3	2446.14	2024/25
13	Serdo-Dobi-Galafi	71	Expressway	65.3	4636.3	2024/25
14	Woliso-Jima	241	Expressway	65.3	15737.3	2025/26
15	Commando-Debremarkos	181	Expressway	65.3	11819.3	2025/26
16	Ambo-Nekemte	202	Expressway	65.3	13190.6	2025/26
17	Debrebirhan-Kombolecha	269	Expressway	65.3	17565.7	2025/26
18	Shashemen Outer ring	25.6	Expressway	65.3	1671.68	2025/26
19	Debrebirhan-Fiche	178	Rings (Expressway/Tr	65.3	11623.4	2027/28
20	Weliso-Butajira	74	Rings (Expressway/Tr	65.3	4832.2	2027/28
21	Fiche-Ambo	145	Rings (Expressway/Tr	65.3	9468.5	2027/28
22	Jima Outer ring	51	Expressway	65.3	3330.3	2029/30
23	Kombolecha Outer Ring	50	Expressway	65.3	3265	2029/30
24	Nekemte Outer Ring	59	Expressway	65.3	3852.7	2029/30

Figure 8-3:- Expressway projects to be implemented during 2020/21 - 2024/25

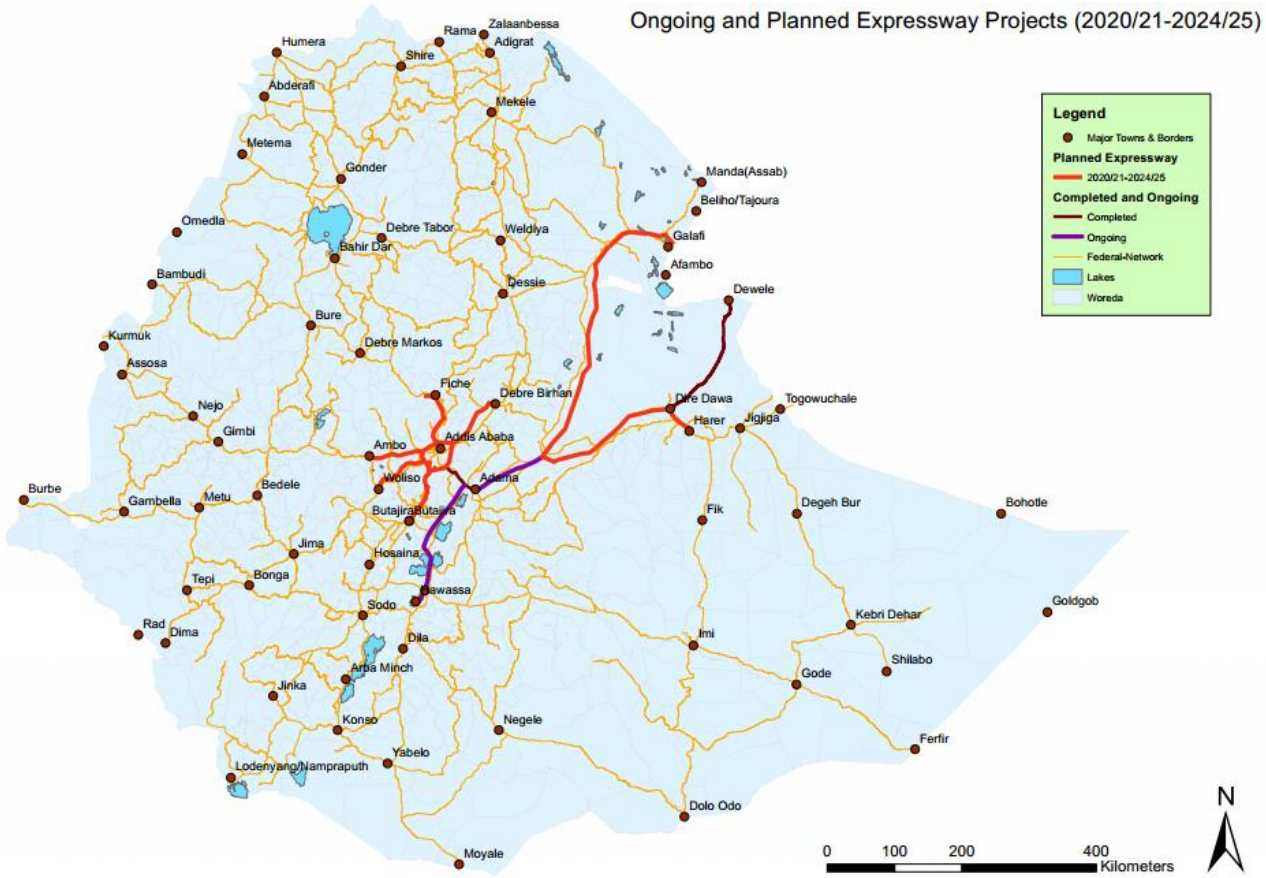


Figure 8-4:- Expressway projects to be implemented during 2020/21 - 2029/30

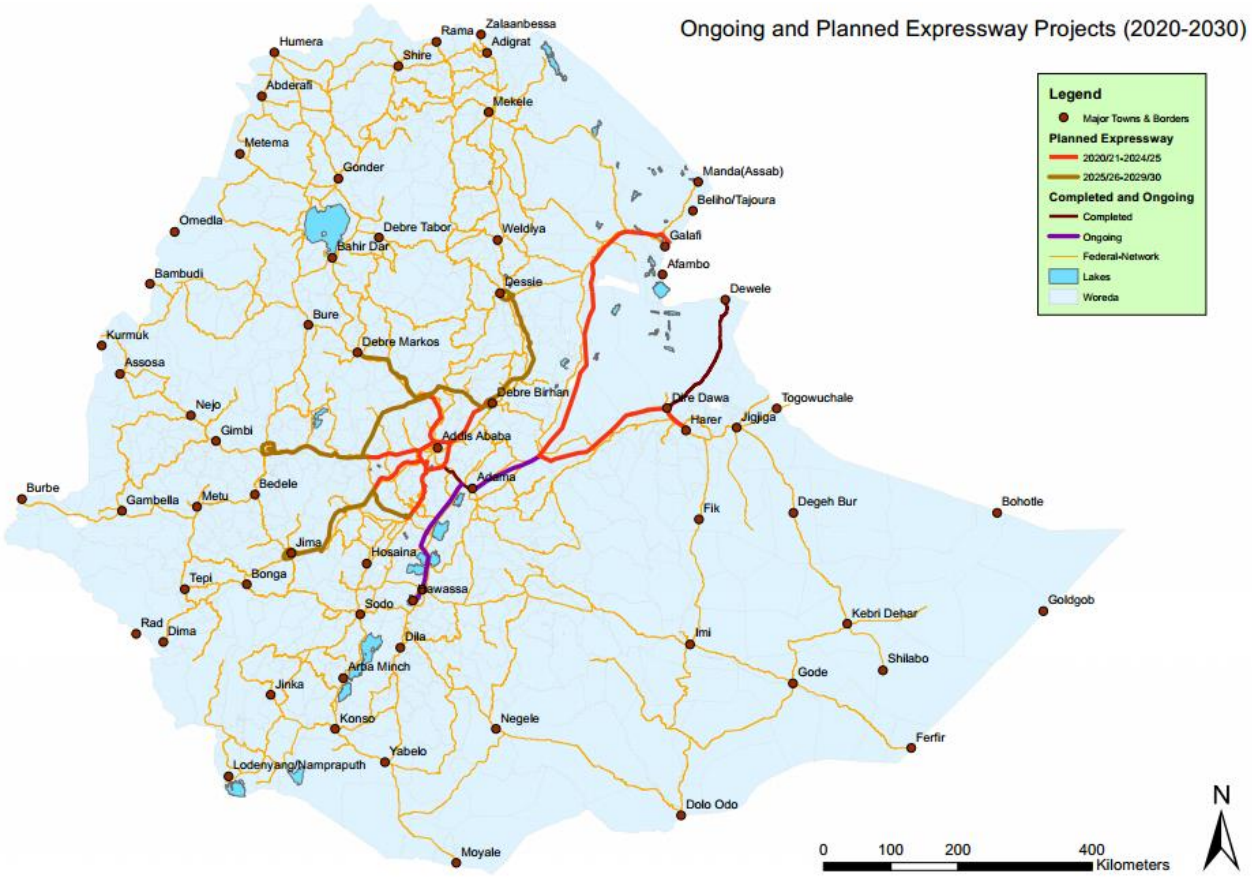
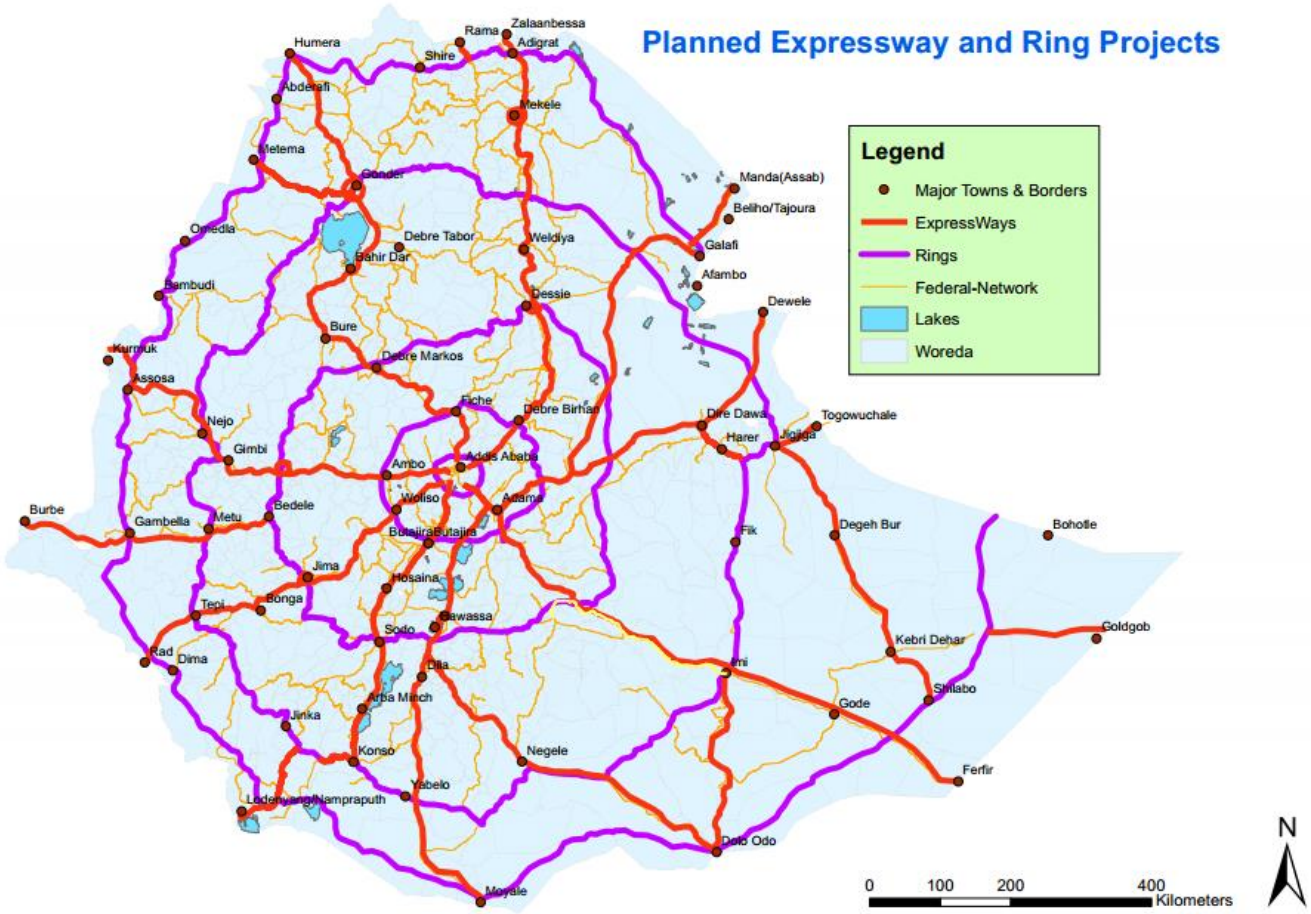


Figure 8-5:- Expressway Projects to be planned in 2050



8.3.4 Construction of New Link Roads

The Consultant has prepared an implementation plan considering large number of ongoing projects and other projects remained from GTP II. The newly identified missing links are 193 with the total lengths of 16,022.5-km. The estimated budget for their implementation is about ETB 478.37 Billion. The details are shown in Annex-11-6. Figure below shows the Newly Proposed Missing Links with Implementation Year.

Figure 8-6:- Newly Proposed Missing Links with Implementation Year

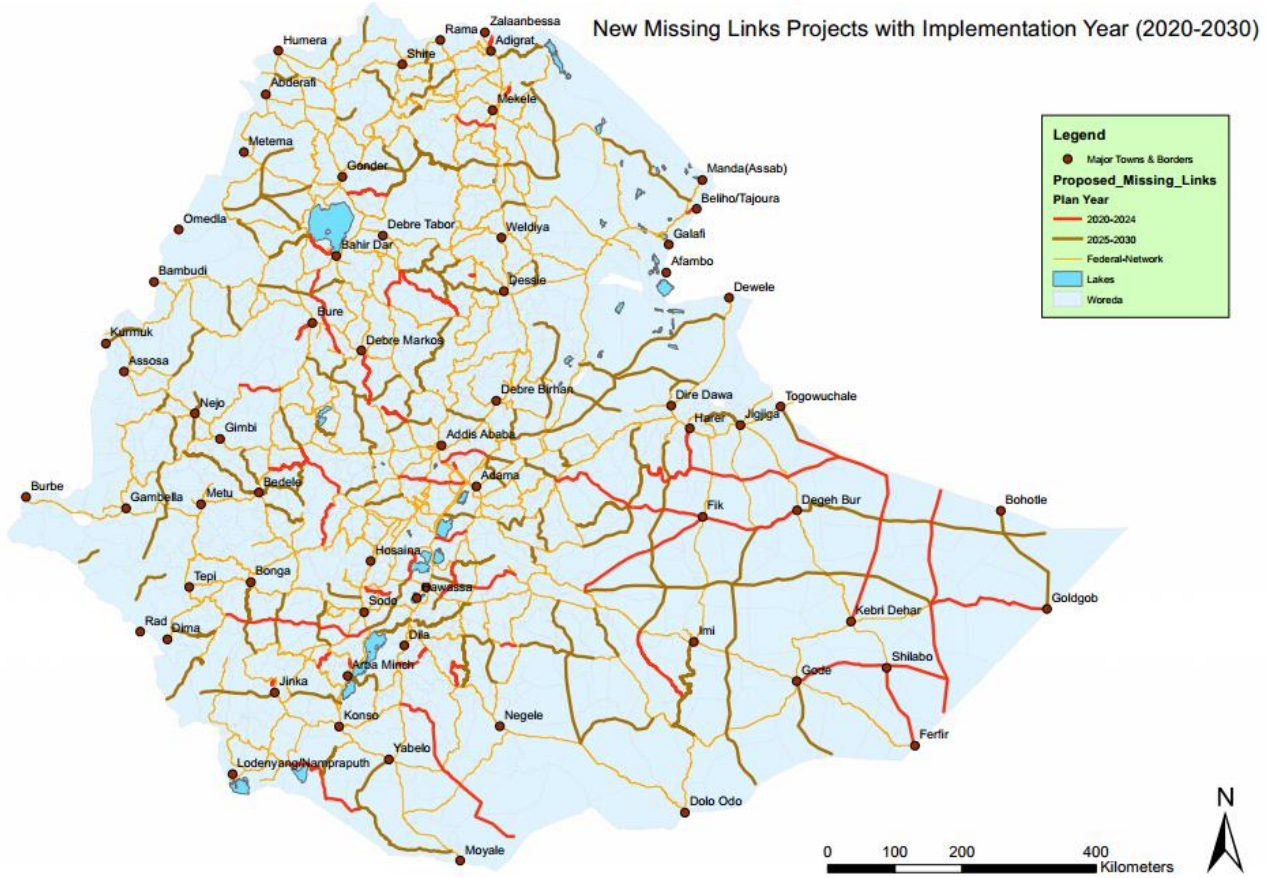
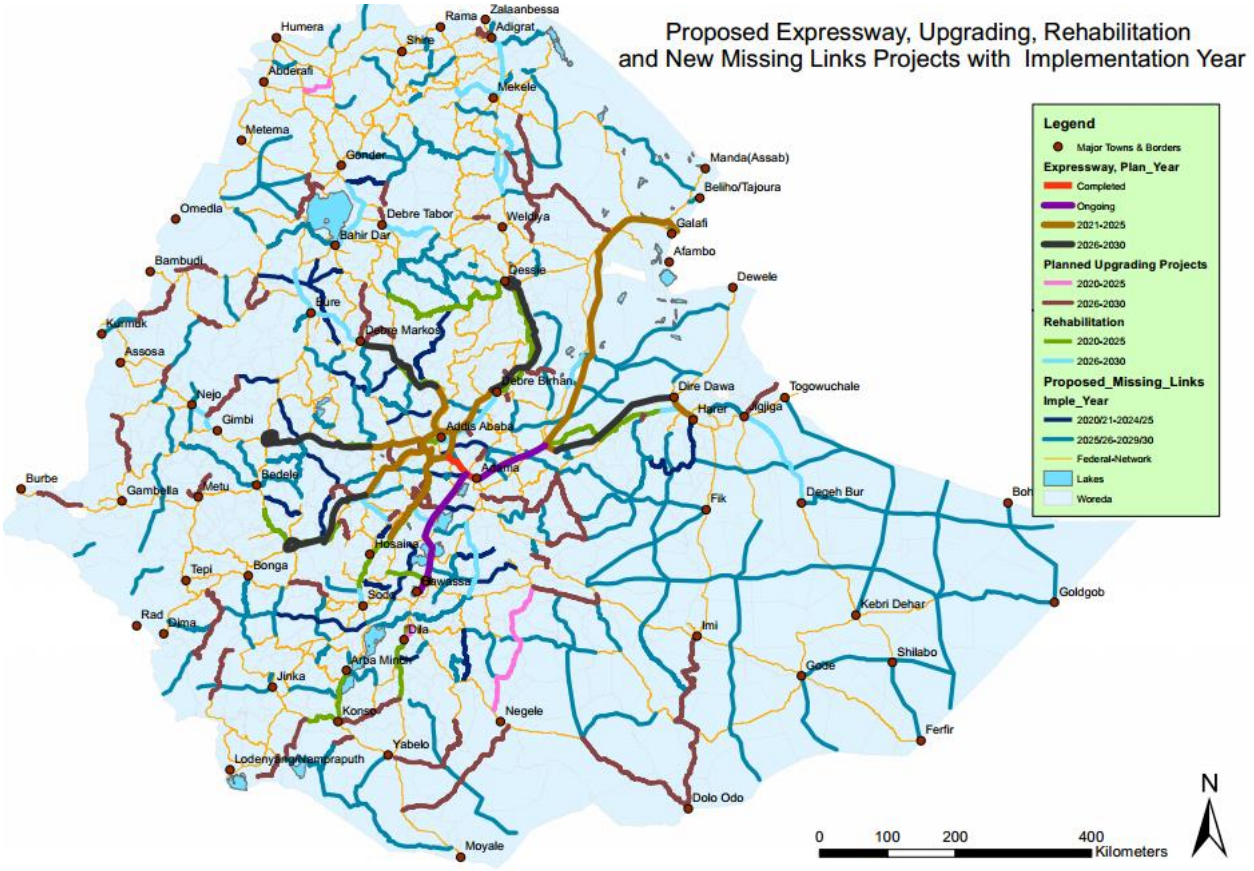


Figure 8-7:- Proposed Expressway, Upgrading, Rehabilitation and Newly Proposed Missing Links



8.3.5 Summary of Proposed Roads by Functional Classification

The Consultant has performed the functional classification of the new proposed missing links based on the new functional class. Accordingly, all the 193 links have been classified and the list is attached in Annex-11-3. The summary of proposed Expressway and missing links by region and Road Class are shown below.

Table 8-6:- Length of Planned Projects by Functional Class

Road Class	Length (Km)
Expressway and Rings	2960.3
Trunk	725.2
Link	6949.8
Main Access	6784.8
Collector	1437.5
Feeder	141.9
Grand Total	**18999.5**

Excluding Collector and Feeder Roads which are expected to be administrated by regions, the total length of proposed plan by function is shown in the following table.

Table 8-7:- Length of Federal Planned Projects by Functional Class

Road Class	Length (Km)
Expressway and Rings	2960.3
Trunk	725.2
Link	6949.8
Main Access	6784.8
Grand Total	**17420.1**

Comparing Proposed Plan by Regions and Class, the following tables gives an idea on the no and Length of Proposed Roads.

Table 8-8:- No of Federal Planned Projects by Region and Functional Class

Region	Trunk	Link	Main Access	Grand Total
Afar	2	4		6
Amhara	1	4	15	20
Benishangul Gumuz		1	1	2
Gambella Region			2	2
Oromia	3	20	28	51
SNNP		8	6	14
Somali	2	12	14	28
Tigray		2	9	11
Crossing Two Regions		19	20	39
Grand Total	**8**	**70**	**95**	**173**

The Length of Planned Missing Links by Region and Class is shown below.

Table 8-9:- Length of Federal Planned Projects by Region and Functional Class

Region	Trunk (Km)	Link (km)	Main Access (Km)	Grand Total
Afar	197.55	313.75		511.30
Amhara	49.80	487.57	1092.27	1629.64
Benishangul Gumuz		93.39	70.37	163.76
Gambella Region			100.95	100.95
Oromia	246.47	1694.31	1786.19	3726.97

Region	Trunk (Km)	Link (km)	Main Access (Km)	Grand Total
SNNP		655.78	294.33	950.11
Somali	231.38	1718.09	1503.13	3452.60
Tigray		117.70	354.14	471.84
Crossing Two Regions		1869.19	1583.43	3452.62
Grand Total	**725.19**	**6949.79**	**6784.81**	**14459.79**

Regarding Expressways, the number of planned Expressway projects by region is shown below.

Table 8-10:- Length of Expressway Projects by Region

Regions	No of Roads	Length_Km
Afar	4	483.46
Afar/Somali	1	71
Amhara	3	497
Diredawa/Oromia/Hareri	1	50
Oromia	10	1107.6
Oromia/Amhara	3	420
Oromia/SNNPR	1	117.28
Oromia/Somali/Diredawa	1	214
Grand Total	24	2960.34

IMPLEMENTATION FRAMEWORK & FOLLOW-UP

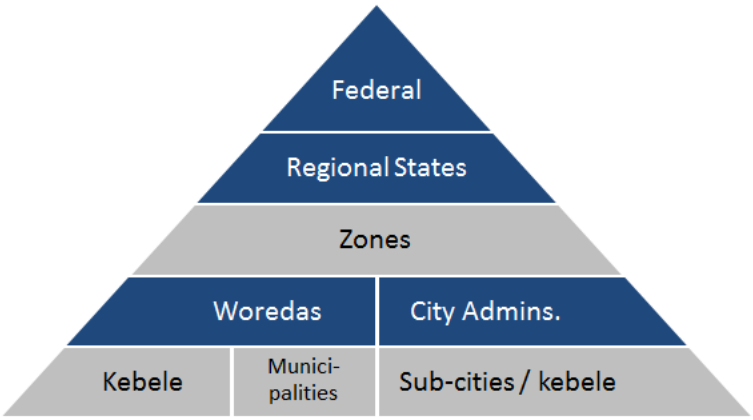
9 IMPLEMENTATION FRAMEWORK & FOLLOW-UP

Existing organizational set-up of ERA will assume coordination and implementation of the Master Plan. RRAs are as usual entrusted to their part. In addition, a National Implementation Follow-up Group chaired by the Minister of Transport will be in place to oversee implementation of the Master Plan. ERA serves as a secretariat of the Group.

9.1 Implementation Modality

Ethiopia has three main government levels: Federal, regional, and local government. Regional states have their own constitutions and are typically subdivided into administrative zones. Local governments, as the third tier, are established under regions according to their own constitutions and governance structures. City administrations/urban local governments and woredas (or rural local governments) are semi-autonomous local government entities, with legal status as corporate bodies with their own political leadership (council).

The Master Plan has been developed to allow all stakeholders to participate in the development of the country's road network. Its implementation will, therefore, involve all stakeholders, including the three levels of Government: the Federal, Regional down to Woreda, private sector and the general public. ERA will assume the implementation process of the federal road network and overall road network coordination; while the Regions assume the role of implementation of regional and local roads involving the Woredas administration.



To be effective, however, the implementation of this Strategy will require the collaboration of federal, regional, territorial and critical infrastructure sector partners and the establishment of mechanisms to facilitate this collaboration.

ERA would have overall responsibility for coordination and implementation of the Master Plan. It will report to the Ministry of Transport. The follow-up will be delegated to the Office of the Director General lead by Deputy Director General in charge of Planning. The Office will build up on the already established system and improve the identification, planning and monitoring

of projects and the evaluation of their development impact, particularly with respect to RSDP objectives, institutional requirements and implementation risks mitigation. The office will be supported by intermittent staff and consultants, which are entrusted to work on performance monitoring and evaluation, and others. In addition, preparatory works and actual execution of projects are undertaken by ERA's main departments; Construction Projects Management, Asset Management, Project Development, and Corporate Services.

- Effective construction project management, which involves the pre-award and post-award activities, processes and practices, the critical success factors for good contract management, can make or break organization's vision, strategy and its reputation;

- Efficient and effective road network asset management in an optimal manner including placing of a modern Road Asset Management System and significant private sector participation in maintaining and managing road network is a central task at the moment and to this Master Plan;

- Delivery of sound design and undertaking proven procurement strategies that maximize values are the major steps in ensuring the effective implementation of projects. This may be a significant task as the projects are broken down into many components that involve preparatory studies, many form of project development and procuring contractors and consultants in traditional and currently emerging methods;

Towards this end, the Corporate Services Department is expected to plan and develop a series of institutional capacity building projects considering Authority's tangible and non-tangible factors. The top management's recent efforts in working with hard capabilities including office and supplies, structures and systems, legal frameworks and polices, etc. is commendable. However, the intangibles which are normally difficult to quantify and have to do with experience, expertise, confidence, creativity, motivation, institutional culture, social skills need to be given a focus. This may be done in a more dedicated and designed mechanism in developing individual professionals and departments through formal training, on-the-job-training, precision training, provision of tools and equipment, and carrier development. Along with this, it is useful to note here that there is a close relationship between capability, efficiency and good governance. However, if capacity building effort is to serve as a useful instrument to improve confidence and good governance, the Authority need to put much stronger emphasis on intangible factors in their future development efforts.

9.2 Monitoring and Follow-up

Effective monitoring and evaluation of the activities of the Master Plan are critical for realization of set goals and outcomes. First, the process provides essential data and insights for drawing lessons, priority setting and informed review of implementation processes. Second, the process offers the assurance that resources are used for agreed purposes. Good quality monitoring is critical to the effective implementation of projects and to accountability in the use of resources.

During the implementation of MP, the M & E function of ERA need to be strengthened through technical support and exposure training. The monitoring system incorporates a system to monitor inputs, outcomes and impacts so that resources can be strategically managed and progress tracked. This process helps to distinguish the MP monitoring from traditional project monitoring. The monitoring system will feed information back into the processes of governing and decision-making, making it a vital public management tool. To enable regular and quality reporting, key performance indicators that have been identified and developed over the years will further be refined to reflect the level of development and type of challenges the sector has been experiencing. These indicators will help to focus efforts and resources for evaluating sector performance and guide the Implementation Follow-up Group (Section 9.3) to entrust its responsibility.

To strengthen the monitoring system, outcome and output indicators have to clearly been separated to track every level of progress in the implementation process by the top management. Implementing the Action Plan requires: (i) incorporating objectives into annual work programs, with departments “buying in” to the long term objectives; (ii) consistent project evaluation and planning; (iii) prioritization of programs in accordance with available resources; and (iv) regular updating and monitoring against benchmarks.

A three-stage process is proposed to be developed by top management of ERA to monitor implementation of the Program. The first monitoring stage, the initial stage, involves measuring the potential achievements of the projects and whether these achievements match to certain targets set forth by the Strategy. The second stage, the Program-related stage, consists of a group of projects with their related metrics aiming principally at management of timelines for implementation and budget adherence. The third stage, the Strategy-related stage, aims to measure the goals of the overall Plan/Program/sector in the context of the aggregate projects that make up the Strategy implementation. The monitoring processes may be developed in a format shown in Table below.

Table 9-1:- Monitoring Format of Master Plan

Monitoring Level	Indicators	Responsibility	Remarks
Project Level			Monthly progress report and /or project supervision consultant's report.
Program Level			Semi-annual and annual Road Program assessment report.
Strategic Level			The third level of monitoring is in relation to the achievement of the goals and objectives identified under the MP or government reform agenda.

Monitoring is of value only if it results in appropriate remedial action. It is, therefore, necessary to develop systems and procedures for such actions as part of the monitoring process, as and when performance indicators are identified. Monitoring benchmarks need to be agreed between the Ministry of Transport and ERA, on a rolling basis - reviewed every month, or when circumstances change. They should reflect the resources allocated and be realistic, achievable targets, initially as guidance, but later, as the monitoring system becomes entrenched, a basis for reward or penalty. Inappropriate targets (either too demanding or not sufficiently demanding) will distort resource use and allocation. Table below provides a type of format that may be considered in monitoring and follow-up.

Table 9-2:- Summary Reporting Format

Category	Target	Achievement	Responsibility	Remarks

With regard to indicators of the RSDP Monitoring System that has been used for the last two decades, having the new MP in place, it is now pertinent time to quickly review and modify the system to better suit the changing needs. It may be needed to review and adopt a revised system of performance monitoring indicators divided into two:

(i) that includes few indicators that are easy and quick to collect only serve assess the performance and the capacity and the capability of the road authorities to manage the Plan; and

(ii) Similar to the existing comprehensive system to continue measure the impact and outcome of road sector investment on road users and the economy alike. The first

assessment should be conducted in less than two months at the end of each year and be ready for Implementation Follow-up Group's discussion in conjunction with ERA's and regular progress report. The second comprehensive assessment report needs to be ready for annual Road Conference involving various stakeholders including international community.

9.3 Coordination and Oversight

The Road Master Plan is a necessarily 'strategic' document. To implement the strategy, the government will work with many parties, including improving the workings of government agencies. The National Implementation Follow-up Group chaired by the Minister of Transport consists of Heads of ERA and RRAs, General Manager/owner of participating contractors and consultants, others as required need to be established to advice and act as a conduit between road infrastructures stakeholders and the government. The Group may meet twice a year and review and monitor the progress, identify challenges, resolve interagency coordination issues, recognize best performing projects, and facilitate benchmarking of good practices. ERA serves as secretariat of the Group.

The Group need to work closely with Regional Governments, House of Peoples representatives, professional associations, and other key stakeholders to help achieve the objectives of the 10 year Master Plan and to ensure that the sector meaningfully contribute to the development of the nation. This Group will also work towards the development of partnerships that respect jurisdictions and build upon existing mandates and responsibilities. ERA will produce an "Annual State of Road Infrastructure" report that updates the progress being made against the action plan from which a separate, concise, and independent report prepared and presented at the Group's Meeting.

9.4 Stakeholder Participation and Consultations

The implementation of the past Road Programs made clear on the necessity to listen more to stakeholders concern and feedback, engage with stakeholders and adhere to the open-office principles. The development, implementation, and stakeholder involvement of the Road Master Plan process is outlined below:

Step 1: Project Development

Project development will be systematic. This is a two-stage process: (i) developing projects in accordance with strategic objectives and evaluating and modifying them in a consistent format to suit the need of the time; and (ii) ensuring that project definition is optimal by considering alternative ways of achieving the objective.

Step 2: Prioritization

The projects included in the Action Plan should be subject to strict due diligence, including economic (and financial) feasibility covering economic (and financial) rates of returns and sensitivity tests to ensure the robustness of the feasibility of projects, taking into consideration potential future negative changes in costs and benefits; and environmental and social assessment. Projects with the highest economic returns will be given high priority, followed by lower return projects as middle and low priority. ERA then defines priorities, both between Regions and within Regions. This is a complex task requiring an effective planning structure to be in place, evaluating alternatives within a common analysis framework.

Step 3: Annual Programs and Buying-In

RRAs will need to structure their annual work programs in support of the federal road action plans and to adopt longer planning time horizons. A sort of flexible annual planning cycle which allows sufficient discussion and consultation among different stakeholders need to be adopted before the projects are submitted to Ministry of Finance and Economic Cooperation for budget request.

Step 4: Implementation and Monitoring

The projects included in the Action Plan will be implemented through annual budgets and plans and there needs to be: (i) consistency between annual plans and the Strategy; (ii) prioritization in accordance with long-term objectives; and (iii) benchmarking and monitoring of implementation.

EXPECTED IMPACT OF THE MASTER PLAN

10 EXPECTED IMPACT OF THE MASTER PLAN

The Consultant has assessed the expected impacts of the master plan after implementation of the identified road projects. The impacts are analyzed and presented using different indicators and parameters.

10.1 Increase in Road Network Volume and Density

The Consultant has estimated the increase in the overall road network and road density after implementation of the projects. Considering 17,419.8 km of Expressway, Trunk, Link and Main Access roads to be constructed in the planned year, the total network and planned density is presented below.

Table 10-1:- Improved in Road Network (km) and Density (km/km$^{2)}$

Indicator	2019/20	2029/30
All weather road Network (km)	144,027	234,995
Total Federal Road Network (km)	28,699	46,118.8
Length of Asphalt Roads (km)	15,338	46,118.8
All weather Road Density (km/ 1,000km$^{2)}$	126.3	205
Federal Road Network Density (km/ 1,000km^2)	25.17	40.17

Source: Consultant Analysis

10.2 Improvements in Mean Distance and Travel Time from all-weather roads

The Consultant has analyzed the improvements in the mean distance and travel time to all weather roads and percentage of area farther than 2-km and 5-km before and after the implementation of the master plan. It was estimated using Random Model Approach with the support of GIS. The analysis considers all areas are inhabitable and results are presented in table below.

Table 10-2:- Improvements in Mean Distance and Travel Time

Indicator	2019/20	2029/30
Mean distance to all weather road (km)	7.8	2.49
Mean Travel Time (hr.) to all weather road	2.6	0.86

Indicator	2019/20	2029/30
% of areas farther than 5km	35	14.4
% of areas farther than 2km	49	39

10.3 Improved weighted travel time to all Weather roads and from Major towns

The Consultant has analyzed the gained weighted travel time to all-weather roads for a trip between selected major towns before and after the Implementation of projects in the Master Plan and all Expressway and ring projects in 2050. The results of the analysis shows that in one single trip between the selected 100 towns, 1062 hrs or 44 days will be gained if the expressway and rings are constructed. The selected towns and travel times is attached in Annex-11-8. Table below shows improvement in weighted travel time per trip.

Table 10-3:- Improved in Weighted Travel Time per Trip

Indicator	Before Expressway	After Expressway	Weighted Travel Time Gain
Travel time Gain per Trip on selected sample Towns and Borders	1945 (hr)	883.6 (hr.)	1062 hrs. or 44 days