नेपाल सरकार

शहरी विकास मन्त्रालय

सिंहदरबार,
काठमाडौं, नेपाल ।

पत्र संख्या:- २०८०/८१-३१
चलानी नं.:- ५८७

मितिः-२०८०/०७/१९

श्री भौतिक पूर्वाधार विकास मन्त्रालय,
मधेश प्रदेश,जनकपुरधाम ।
श्री भौतिक पूर्वाधार तथा शहरी विकास मन्त्रालय,
कर्णाली प्रदेश,सुर्खेत।
श्री भौतिक पूर्वाधार विकास मन्त्रालय,
सुदुरपश्चिम प्रदेश,धनगढी।

विषयः- नमूना PTMP Guidelines पठाइएको सम्बन्धमा ।

उपरोक्त विषयमा स्थानीय पूर्वाधार विभागबाट प्रादेशिक तथा स्थानीय सडक सुधार कार्यक्रम कार्यान्वयनका लागि पेश भई आएको Provincial Transport Master Plan (PTMP) Guideline सम्बन्धी नमूना दस्तावेज (Reference documents) मन्त्रालयको मिति २०८०/०७/१७ को (सचिवस्तरीय) निर्णय अनुसार यसै पत्रसाथ संलग्न गरी पठाइएको व्यहोरा अनुरोध छ।

बोधार्थः-

१. श्री स्थानीय पूर्वाधार विभाग,श्रीमहल, पुल्चोक ललितपुर ।
२. श्री प्रादेशिक तथा स्थानीय सडक सुधार कार्यक्रम श्रीमहल, पुल्चोक ललितपुर ।

.....
निरुपम मिश्र
सि.डि.ई

फोन नं.: ४२११८८३, ४२११६७३ , फायक्स: ९७७-१-४२११८७३, ९७७-१-४२००२४६
इमेल: info@moud.gov.np, वेवसाइट: www.moud.gov.np

Government of Nepal
Ministry of Urban Development
Department of Local Infrastructure (DoLI)
Provincial and Local Roads Improvement Program (PLRIP)
Central Program Coordination Unit (CPCU)
Shreemahal, Lalitpur

Provincial Transport Master Plan (PTMP) Guidelines

June, 2023

CONTENTS

List of Appendices

Abbreviations

AADT	:	Average Annual Daily Traffic
DTMP	:	District Transport Master Plan
FG	:	Federal Government
GIS	:	Geographical Information System
IRI	:	International Roughness Index
IZOI	:	Immediate Zone of Influence
LG	:	Local Government
LRBP	:	Local Roads Bridge Program
MCA	:	Multi Criteria Analysis
MTMP	:	Municipal Transport Master Plan
NH	:	National Highway
NRS	:	Nepal Road Standard
PCU	:	Passenger Car Unit
PG	:	Provincial Government
PH	:	Provincial Highway
PL	:	Planned
PR	:	Provincial Road
PRN	:	Provincial Road Network
PTMP	:	Provincial Transport Master Plan
RMG	:	Road Maintenance Group
SDI	:	Surface Distress Index
UC	:	Under Construction
WA	:	Wider Area
WGS	:	World Geodetic System

1 INTRODUCTION

1.1 Background

In 2015, the new constitution of Nepal was promulgated, introducing a new administrative structure for the country. The responsibility for the road network is now to be shared between the federal, the provincial and the local (palika) governments. This change in administrative structure has introduced a need for new guidelines to support the preparation of Provincial Transport Master Plans (PTMPs) and Municipal Transport Master Plans (MTMPs).

The present PTMP guidelines follows the approaches adopted in the DoLI's Approach Manual for DTMP (1998), Interim Guideline for DTMP (2010), DTMP Guideline (2012).

1.2 Purpose of PTMP Guidelines

During 2019, a draft guideline for the PTMP preparation was prepared which provided a systematic approach to road classification, data preparation and preparation of 5-year road sector development investment plan

Present version of the guidelines attempts to elaborate and update the previous procedures by introducing approach to accessibility analysis, population coverage and prioritization of the road network with multi criteria analysis (MCA).

2 ROAD CLASSIFICATIONS

2.1 Administrative Road Classification

Based on present administrative division of Nepal, following classification of roads are in practice:

a) *National Highways*: Road Network managed by Federal Government and has defined 80 highways

b) *Provincial Roads*: Road network under the jurisdiction of Province Governments includes the provincial highways and provincial roads.

c) *Municipal Roads*: Road network under the jurisdiction of Municipalities which includes urban and rural roads within a municipality.

2.2 Functional Road Classification

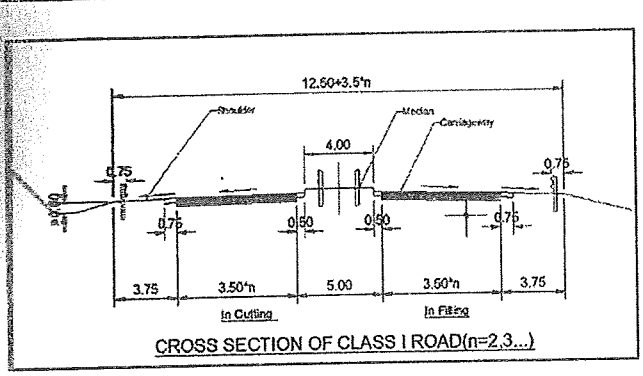
Roads are also classified based on the functional requirements. The NRS 2070 has specified following classes of roads.

a) *Class I Road*: These are expressways and highways standard with capacity more than 20,000 PCU, with divided lanes with minimum of 4 lanes with shoulders and median.

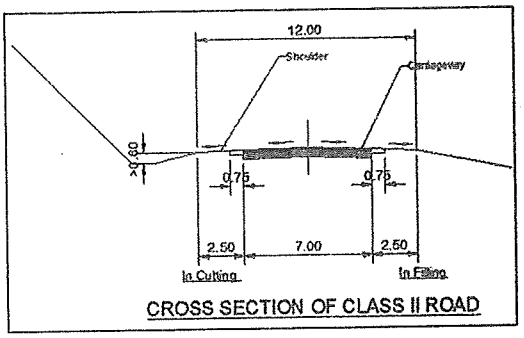
b) *Class II Road*: These are roads with capacity 5,000- 20,000 PCU, with minimum of 2 lanes with shoulders.

c) *Class III Road*: These are roads with capacity 2,000- 5,000 PCU, with 2 lanes with shoulders.

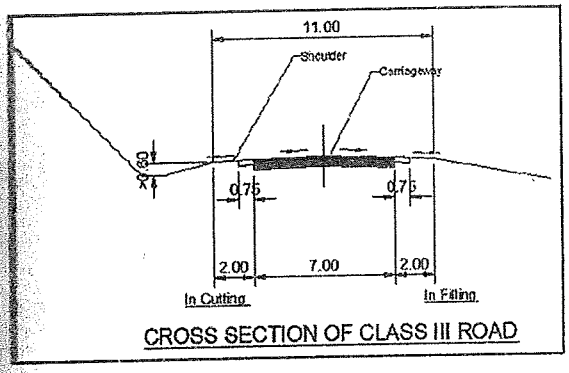
d) *Class IV Road*: These are roads with capacity less than 2,000 PCU, with single or intermediate lanes with shoulders



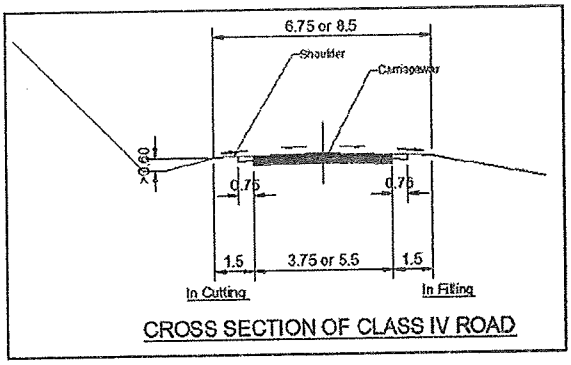
CROSS SECTION OF CLASS I ROAD(n=2,3...)



CROSS SECTION OF CLASS II ROAD



CROSS SECTION OF CLASS III ROAD



CROSS SECTION OF CLASS IV ROAD

2.3 Provincial Road Network

"Provincial Road Networks (PRNs)" are the road network of province highways and province roads within province which are not included in Federal Road Networks (FRNs) and Local Road Networks (LRNs. The ownership of the network of these roads rests with the respective provincial governments and responsibility for planning, design, construction, maintenance and operation and management of provincial road networks lies with the provincial governments where they are located. The province government should follow the standards as approved by the Government of Nepal related to service area, Right of way, Traffic volume.

The provincial road can be categorized in two sub-categories;

a) Province Highway

"Province Highway" is a main road that links district headquarters, important market areas, tourist destinations or other important locations with the province capital or NH within the province. Moreover, provincial highway can be a road linking two or more national highways (NHs); or a road linking two or more local government headquarters or the road designated by province as province highway and not included in the FRN.

b) Province Road

"Province Road" is a road that links local level headquarter with district headquarter or Province Highway or National Highway; or the road, not included in FRN and Province Highway, that links foreign border checkpoints; and the road designated by province as province roads.

2.4 Road Coding and Sectioning

2.4.1 Province Road Coding

A simplified approach is proposed for road coding;

a) Province Highways are coded with PH-XX-YYY. The "PH" denotes the provincial highway, "XX" denotes the province abbreviation and "YYY" is a serial number for each provincial highway in a province

The province two letter abbreviation shall be

Koshi Province: KH

Madhesh Province: MH

Bagmati Province: BG

Gandaki Province: GA

Lumbini Province: LU

Karnali Province: KA

Sudurpaschim Province: SU

e.g., PH-MH-001 represents the province highway in Madhesh Province for serial no 001

b) Province Roads are coded with PR-XX-YYY which is similar to the Provincial highways.

2.4.2 Road Nodes

Road nodes are the destination or important locations which is used for road section (link) definition. Each of the nodes will have node code (N-XX-YYYY), node names and geographical coordinates e.g. (N-MH-0001) is a node in Madhesh Province with a serial number of 0001. A road may have many nodes to define the road sections.

2.4.3 Road Sections (Links)

Road sections are required to break the road into links based on administrative boundaries e.g., districts, Palika centers, major rivers etc. and is defined using from and to nodes. The road sections should be automatically created using nodes using dynamic segmentation technique. This methos is suitable when more nodes are introduced at later stages.

The road section can be denoted using a suffix e.g PH-XX-YYY-ZZ where "ZZ" is the section serial and starts with 01 and can go up to 99. The sequence of the road sections along with the nodes defines the road connectivity and can be used for tracing back road connections.

3 PREPARING PTMP

3.1 GIS Data Collection

Preparation of the PTMP will involve collection of all the network data of a province;

a) National Highways (NH) is available in digital formats.

b) Previous DTMP roads. A compiled version as of 2016 is available in GIS format. This also includes some village roads

c) Others roads are available in the Openstreet maps in GIS format

d) Additional roads can be digitized from the freely available satellite imagery (google earth, Bing images etc.)

All the road network should be brought to a common projection system (e.g., WGS 84) and should include in one system so that it can be used in selection of PTMP Roads.

3.2 PTMP Road Identification

With the road data collected above, major task is to identify the road that will be included in the PTMP excluding the National Highways. This should be based on the criteria defined for the Provincial Highway and Provincial Road. It will be based mostly on consultation with the Provincial and Local Government and concerned stakeholders.

3.3 Preparing GIS Data of PTMP

All the identified roads for the PTMP shall be prepared in GIS;

a) Cleaning of the road geometry as required with reference to the background satellite imagery. Since most of the compiled road may not be correct and may have changed during the construction.

b) The planned road section also needs to be reviewed based on the terrain and satellite imagery.

c) Creation of road nodes with names and locations. If there are settlement near the nodes, the node name can be referred to the settlement name. If not, the node can be referred to as junction of roads.

d) Road codes and other data should be provided in the GIS.

3.4 Inventory

Inventory of all the roads in PRN should be undertaken which shall include the pavement types, last resurface years, road width, road condition, cross-drainage structures and condition. These can be taken using mobile application and GIS data should be prepared. A status map shall be prepared for the PRN.

3.5 Traffic Survey

A yearly traffic count is required for each of the existing roads. A classified count along with PCU computation is required for existing roads. In case of new construction traffic volume shall be estimated based on the nodes that the perspective road will connect e.g. administrative service centers, settlements, markets etc.

3.5.1 Computation of AADT

A classified link count for duration of minimum 72 hours is required at sections representing the average traffic for the road. The location of the count station should be chosen far away from the junctions and markets. The 72 hours count should be converted to AADT based on the seasonal factor published by the DoR. The classified traffic count can be converted to PCU based on the NRS 2070 guidelines as detailed below;

Table 3-1: Vehicle types, Equivalency Factors

S. No	Vehicle Type	Equivalency Factor
1	Bicycle, Motorcycle	0.5
2	Car, Auto Rickshaw, SUV, Light Van and Pick Up	1.0
3	Light (Mini) Truck, Tractor, Rickshaw	1.5
4	Truck, Bus, Minibus, Tractor with trailer	3.0
5	Non-motorized carts	6.1

3.5.2 Assessment of Capacity of Road

The decision for upgrading to higher standard of road is guided by the traffic volume. Following table from NRS 2070 provides the guidelines for assessing road classes based on traffic volume.

Table 3-2: Capacity of Roads, PCU/day

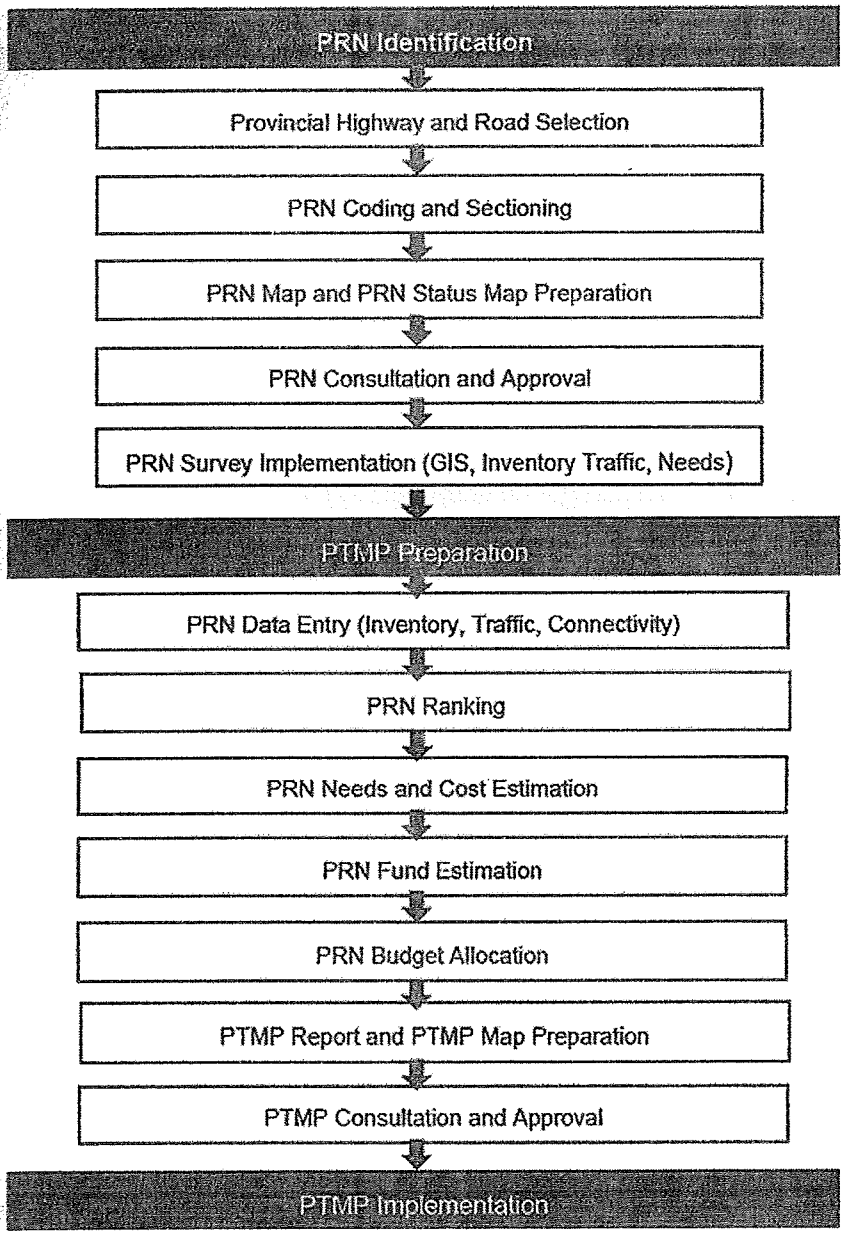
S. No.	Category	Plain		Rolling		Mountainous and steep	
		Low curvature (0-50 deg/km)	High curvature (>50 deg/km)	Low curvature(0-100 deg/km)	High curvature(>100 deg/km)	Low curvature(0-200 deg/km)	High curvature(>200 deg/km)
1	Single Lane Road(3.75 m) with good quality shoulders at least 1.0m wide	2000	1900	1800	1700	1600	1400
2	Intermediate lane Road(5.5m) with good quality shoulders at least 1.0m wide	6000	5800	5700	5600	5200	4500
3	Double lane Road(7.0m) with good quality shoulders at least 1.0m wide	15000	12500	11000	10000	7000	5000
4	Four lane road with a minimum 3.m wide median	40000	35000	32500	30000	25000	20000

3.6 Road Standards

The Nepal road standard 2070 shall be adopted in preparing the standards for the all the provincial roads.

3.7 PRN Consultation and Approval

Once the PRN have been identified, these need to be presented to and consulted with the Provincial Government and with other relevant stakeholders to ensure that there is a general agreement regarding the identification and classification of the Provincial highways and provincial roads. The consultation process is important to ensure that there is sufficient acceptance of the PRN. After completing the consultation process and incorporating any adjustments to the PRN, the final PRN needs to be formally approved by the Provincial Government. The entire process is summarized below.



PRIORITIZATION

Basic Approach

Prioritization of the provincial roads are essential for preparing investment planning. Road ranking should be based on multi criteria with various weightage applicable to a province and the prioritization should be separated for different types of works i.e., upgrading and rehabilitation and new construction. Ranking shall be done separately for Provincial Highways and Provincial Roads.

Prioritization of New Construction Works

The prioritization criteria for the new construction can be defined with following criteria and ranges of scores. The new construction portion of the proposed road should be analyzed separately and multicriteria applied to rank the roads.

S.	Criteria	Weightage
1	Municipality centers still not connected to Road Networks	20
2	Population served per Km of proposed Road within 4 Hrs & 2 Hrs travel time in Hills and Terai Respectively	20
3	Population beyond 4 Hrs travel time within Zone of Influence (ZOI) of roads (unconnected populations)	20
4	Social Criteria (settlements, schools, hospitals/health center, religious sites)	20
5	Agricultural, Tourism, Industrial Potential, market centers	10
6	High priority roads of Government based on their periodic plan or other related planning document	10
	Total	**100**

1) *Municipality centers still not connected to Road Networks*: These are count of unconnected municipal centers within the ZOI of the prospective Road.
2) *Population served per Km of proposed Road within 4 Hrs & 2 Hrs travel time in Hills and Terai Respectively:* The total population served by the proposed new construction portion of the road can be calculated using Accessibility Approach as described in Appendix E. The approach is based on the population density overlaid on the zone of influence area based on walk time grid.
3) *Population beyond 4 Hrs travel time within ZOI of roads (unconnected populations):* This refers to population beyond 4 hrs travel time within the Zone of Influence which is computed using approach described in Appendix B.
4) *Social Criteria (settlements, schools, hospitals/health center/ religious sites):* These are counted from GIS map within the ZOI of the road.
5) *Agricultural, Tourism, Industrial Potential, market centers:* These numbers can be counted from the GIS map within the ZOI of the road. Secondary information on agricultural and industrial potential can be used.
6) *High priority roads of Government based on their periodic plan or other related planning document:* This refers to the priority set by the Federal, Provincial and Local Government.

4.3 Prioritization of Upgrading and Rehabilitation

The prioritization criteria for upgrading or rehabilitation is mostly governed by the economic analysis and traffic category which includes the benefit and cost of the works. Following criteria are suggested for this type of works.

S.N.	Criteria	Weightage
1	Municipality centers yet to be connected by paved road	20
2	Population served per Km of Road	20
3	Social Criteria (settlements, markets, schools, hospitals/health center, religious sites)	15
4	Traffic Category	20
5	Density of existing National Highways and Provincial Roads in a district (Km/sqkm)	10
6	High priority roads of Government based on their periodic plan or other related planning document	15
	Total	**100**

1) *Municipality centers yet to be connected by paved road*: These are count of Municipalities centers not connected by paved road within the ZOI of the road.
2) *Population served per Km of Road:* The total population served by the road suing Accessibility Approach as described in Appendix B.
3) *Social Criteria (settlements, schools, hospitals/health center/ religious sites):* These are counted from GIS map within the ZOI of the road.
4) *Traffic Category:* The Annual Average Daily Traffic (AADT) which is based on the traffic count with adjustment to seasonal variation.
5) *Density of existing National Highways and Provincial roads in a district:* It provides priority to the districts having less density of National Highways and Provincial roads. If a road passes through many districts, lowest density should be considered.
6) *High priority roads of Government based on their periodic plan or other related planning document:* This refers to the priority set by the Federal, Provincial and Local Government.

4.4 Approach to Scoring

In order to make the criteria comparable their results have to be transformed to dimensionless indices using the zero-to-one method. The following formula is applied to each criterion of the area of investigation

High Value Ranking (Increasing order)

D = (X-MIN)/(MAX-MIN) * WEIGHTAGE

Low Value Ranking (decreasing order)

D = (MAX-X)/(MAX-MIN) * WEIGHTAGE

D= Transformed score
X= Original criteria value
MAX = maximum original value
MIN = minimum original value
WEIGHTAGE= Weightage of each criterion

For each area of investigation, the road link with the highest value D' results in '1' multiplied by the highest weightage under the relevant criteria. In case of Zero score, it is transformed by relating it to the value of second lowest score using pro-rata distribution method. An example is provided below for population criteria.

S.N.	Road Code	Length (Km)	Population in ZOI	Popualtion / Km	Max Weigthage	Standard Score	Formula	Transformed Score
1	PH-MA-001	2.5	2000	800	20	7.56	(800-375)/(1500-375) x 20	7.56
2	PH-MA-002	4	1500	375	20	0.00	(1500-375)/(1500-375) x 20	3.54
3	PH-MA-003	6	6000	1000	20	11.11	(1000-375/(1500-375) x 20	11.11
4	PH-MA-004	3	4500	1500	20	20.00	(1500-375)/(1500-375) x 20	20.00
5	PH-MA-005	1.5	1200	800	20	7.56	(800-375)/(1500-375) x 20	7.56
			MAX	1500				
			MIN	375				

Tranformed Score for Road 2	
Own Value	375
Next Lowest Value	800
Factor	0.469 (375/800)
Score of Next Lowest Value	7.56
Tranformed Score	3.54 (7.56 x 0.468)

4.5 Prioritization of Maintenance Works

In general, all the maintenance works should be undertaken but in case of budget constraints, prioritization may be used. The prioritization criteria used in the upgrading and rehabilitation can be adopted in this case.

5 PREPARING INVESTMENT PLAN

5.1 Basic Assumptions

Investment plan shall be prepared for 5 years and this shall include the new construction, upgrading and maintenance works based on ranking and planning shall be prepared for each road in PRN.

5.2 Approach

The approach to preparation of the plan will include;

a) Plan for new construction and upgrading spread over the period of 5 years for each road requiring new construction. The construction planning should be based on the available funds and should indicate the section length (from to) including bridges.

b) The plan for maintenance works shall be prepared for each road and for each year. The subsequent year will be changed based on introduction of new roads

c) A total estimate for each year and each road should be prepared.

5.3 Funding Gap Analysis

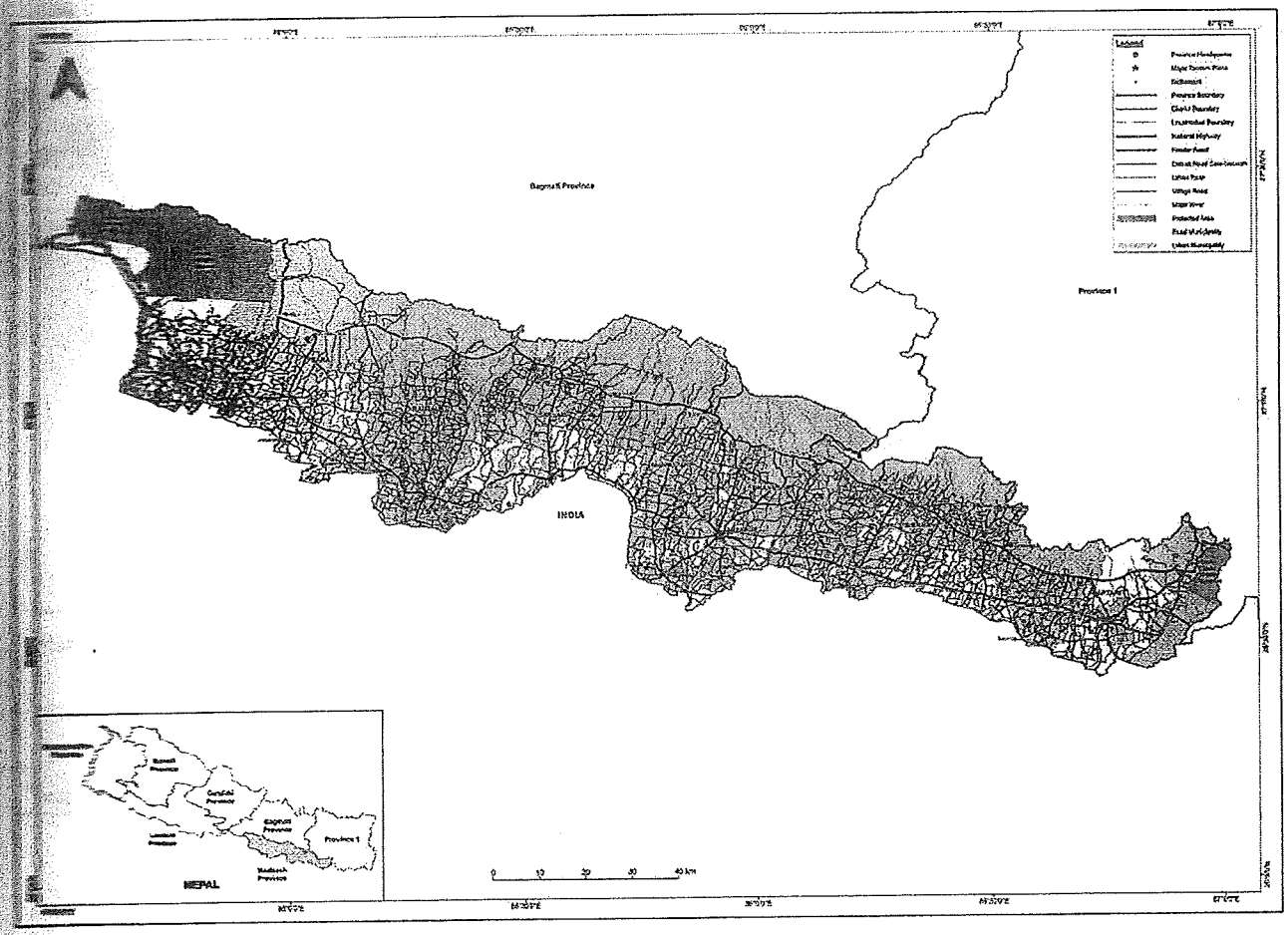
The funding sources including donor assisted projects and province internal resources should be assessed for each year. Based on this funding gap should be analyzed for each year.

Appendix A

Sample PTMP Maps

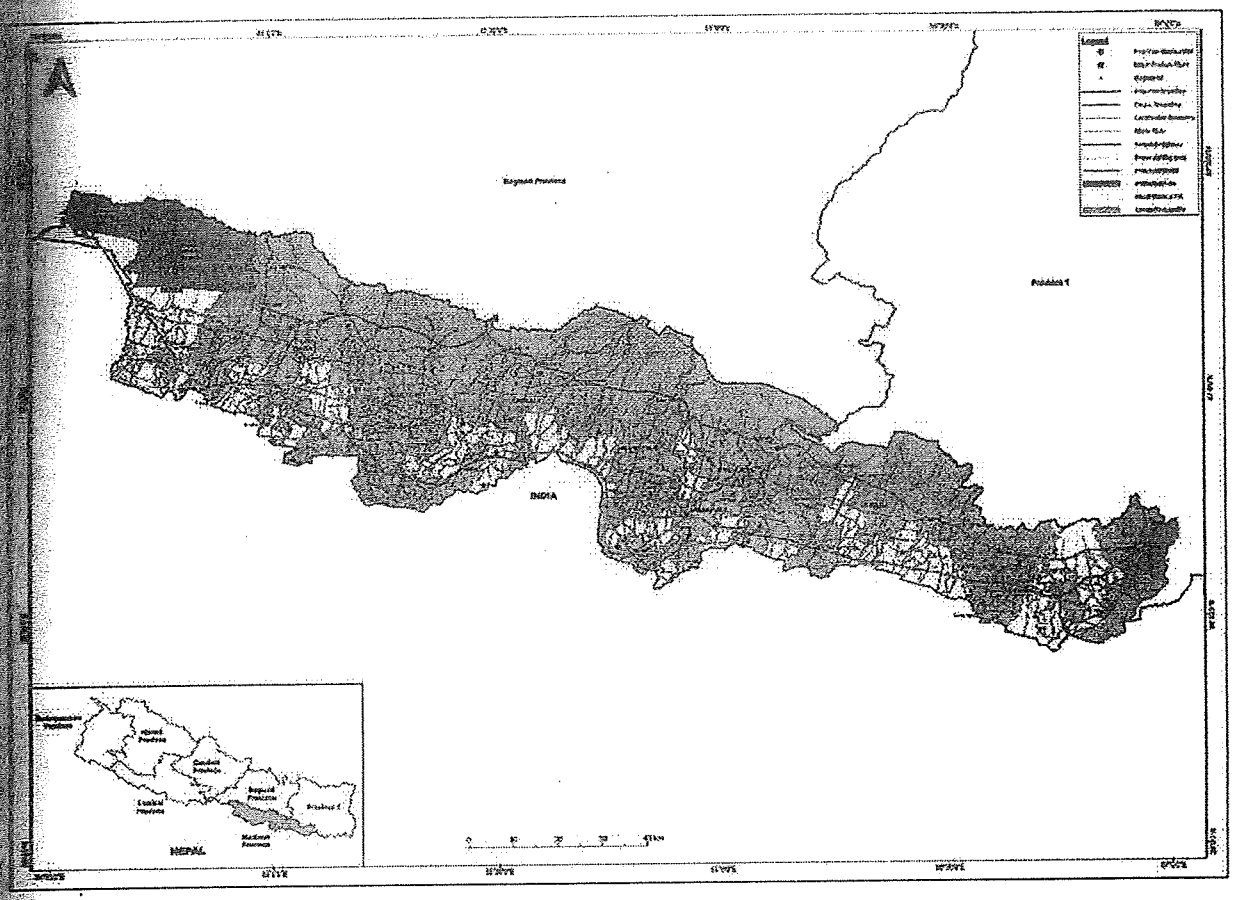
PRN Map

The PRN maps is used for identification of potential provincial roads. It includes all the roads from various sources (e.g. NH, LRN, OSM and digitized roads).



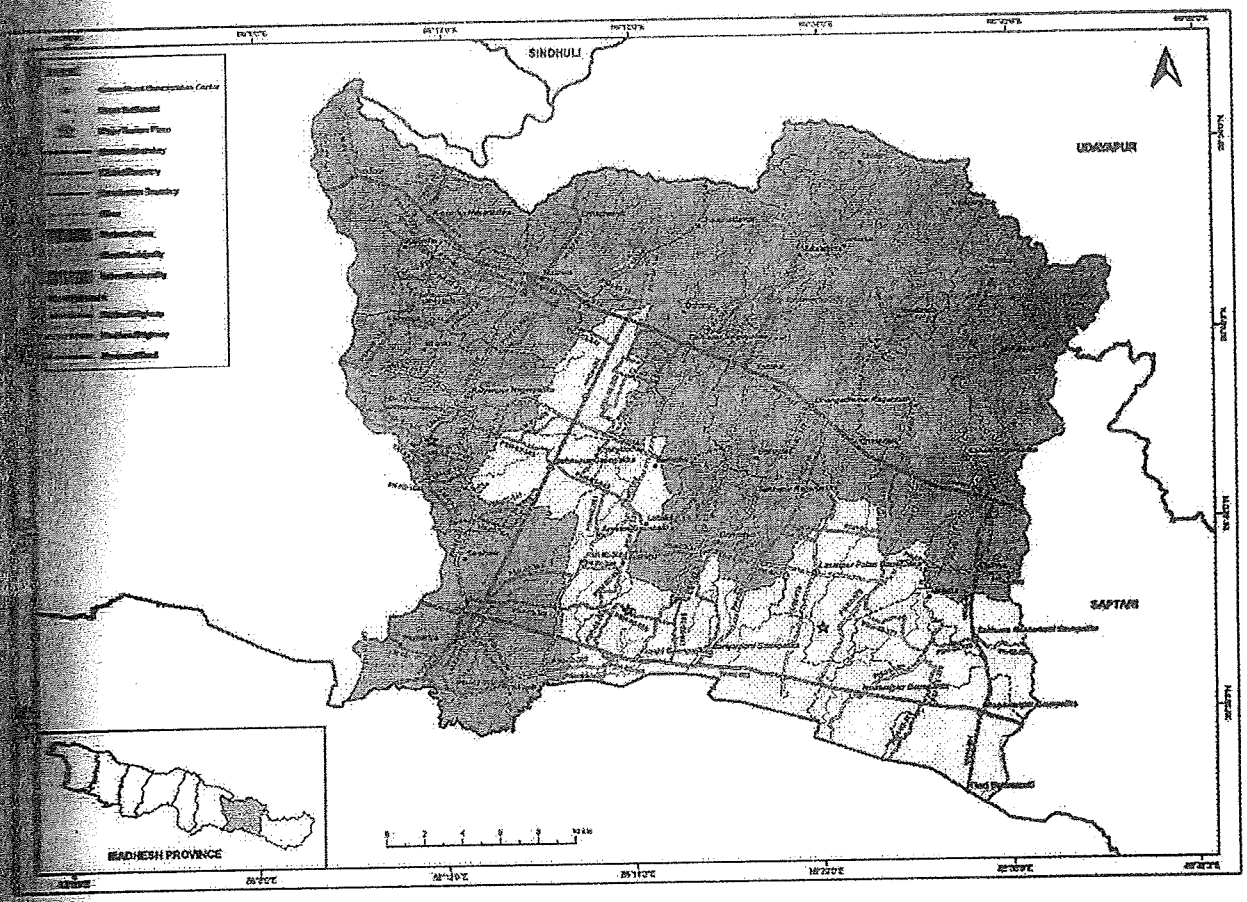
PTMP Map

The PTMP Map includes the national highways, provincial highways and provincial roads.



District Level Maps

Prepare the PTMP map at district level. Maps of all districts are prepared by clipping the PTMP map with the district boundaries.



नेपाल सरकार
सहरी विकास मन्त्रालय
सिंहदरबार, काठमाडौं

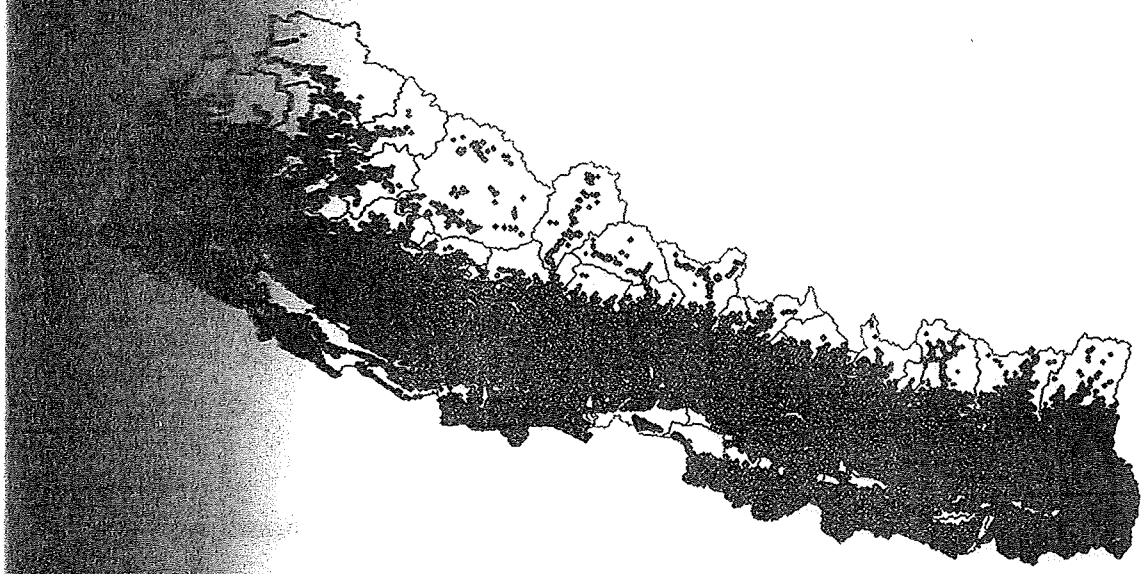
Appendix B

Notes on GIS Based Accessibility Analysis

Population Density

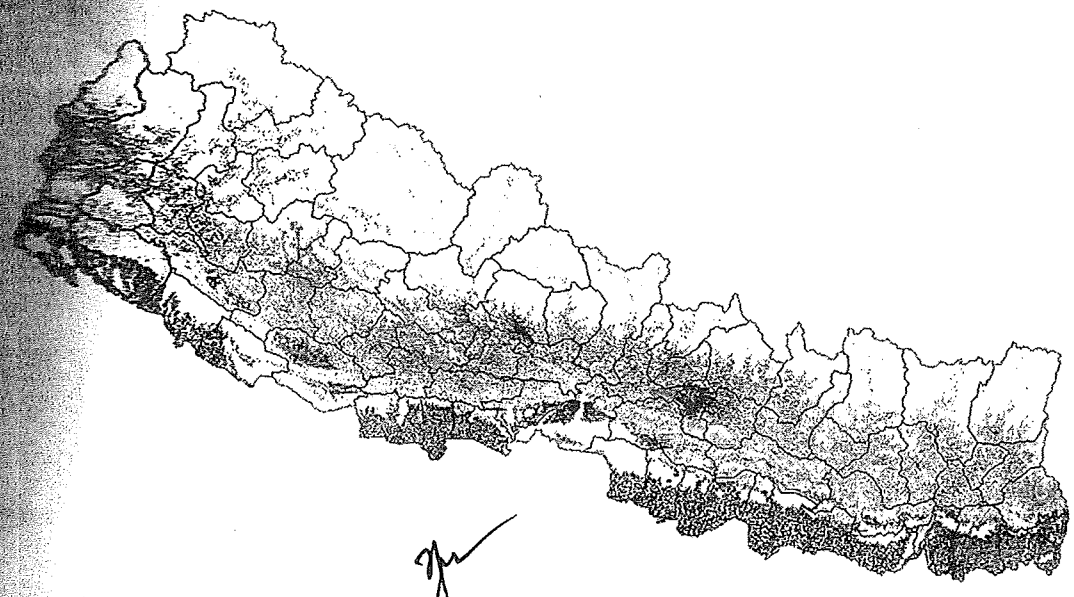
Population density is one of the requirements for accessibility analysis and used to estimate population within the influence area of road and population within various time zones from the road. Following approach is used to determine grided population density map

Digitization of house/building points from satellite imagery. Google satellite was used as base layer and detectable house/building were manually digitized. It is manual process and takes many man-hours. A total of 6.78 million points were digitized.



Each house points are assigned population based on municipal population of 2021 census. This is used to updated once the ward-wise population is obtained.

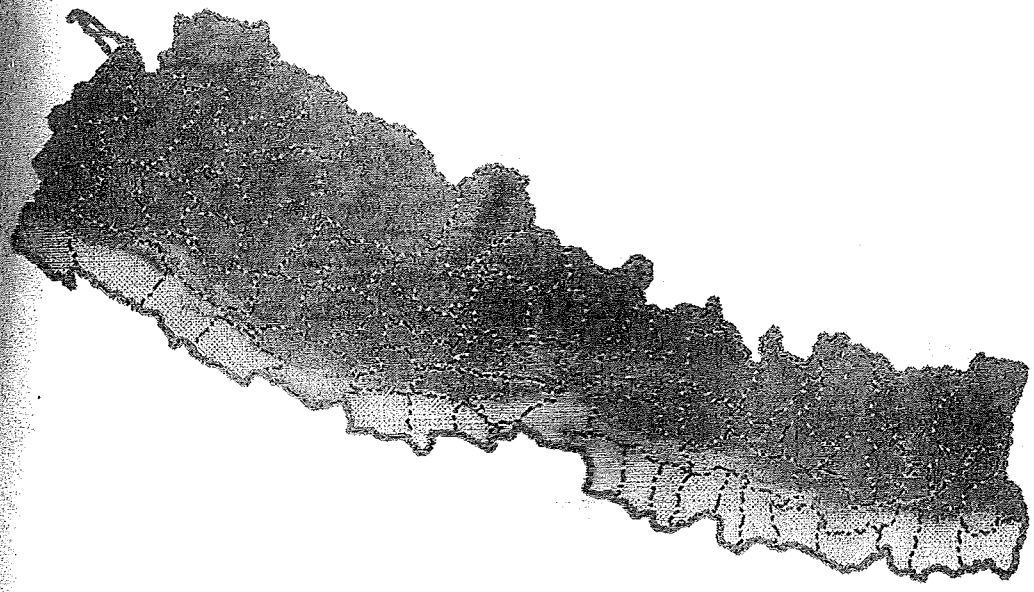
A 900 x 900m grid is overlaid to the point data and total population count is assigned to each grid. This provided the population in 900 x 900 grid and is converted to density per sqkm. Population count for 90x90 m grid is computed from the 900 x 900m grid.



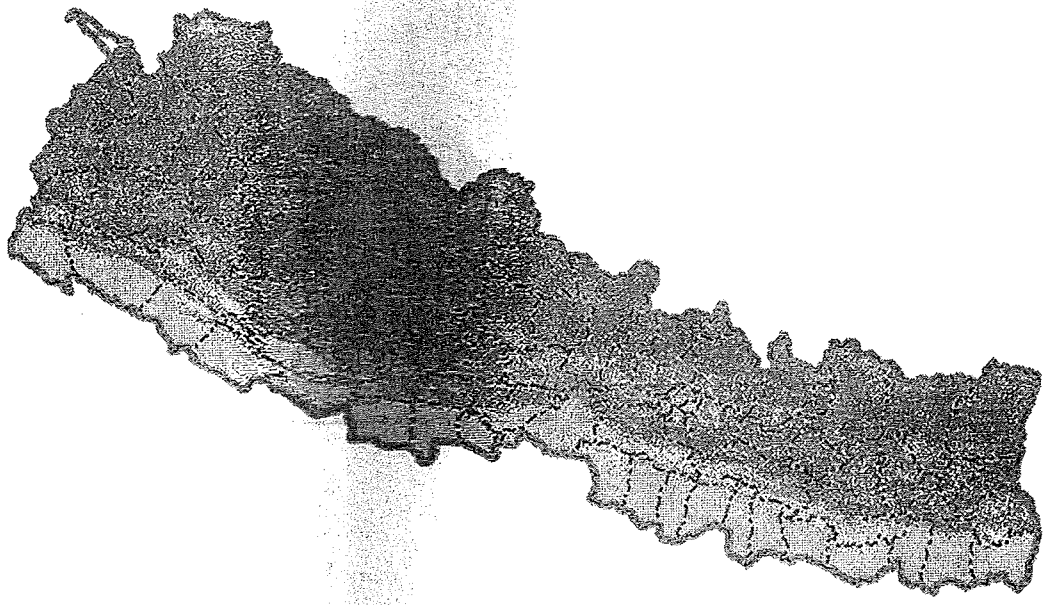
Accessibility Modeling

Accessibility modeling is based on terrain slope which is used to determine the shortest path to the road. Following approach is used;

a) The SRTM (Shuttle Radar Topographic Mission) elevation data at 90m resolution is clipe to Nepal boundary.



b) From elevation data, slope is determined.



c) From slope a travel speed for each 90m grid is determined using Tobler's hiking function.

A time required to travel this grid is also computed from the travel speed.

$$W = 6e^{-3.5\left|\frac{dh}{dx} + 0.05\right|}$$

$$\frac{dh}{dx} = S = \tan\theta$$

where

W = walking velocity [km/h][2]

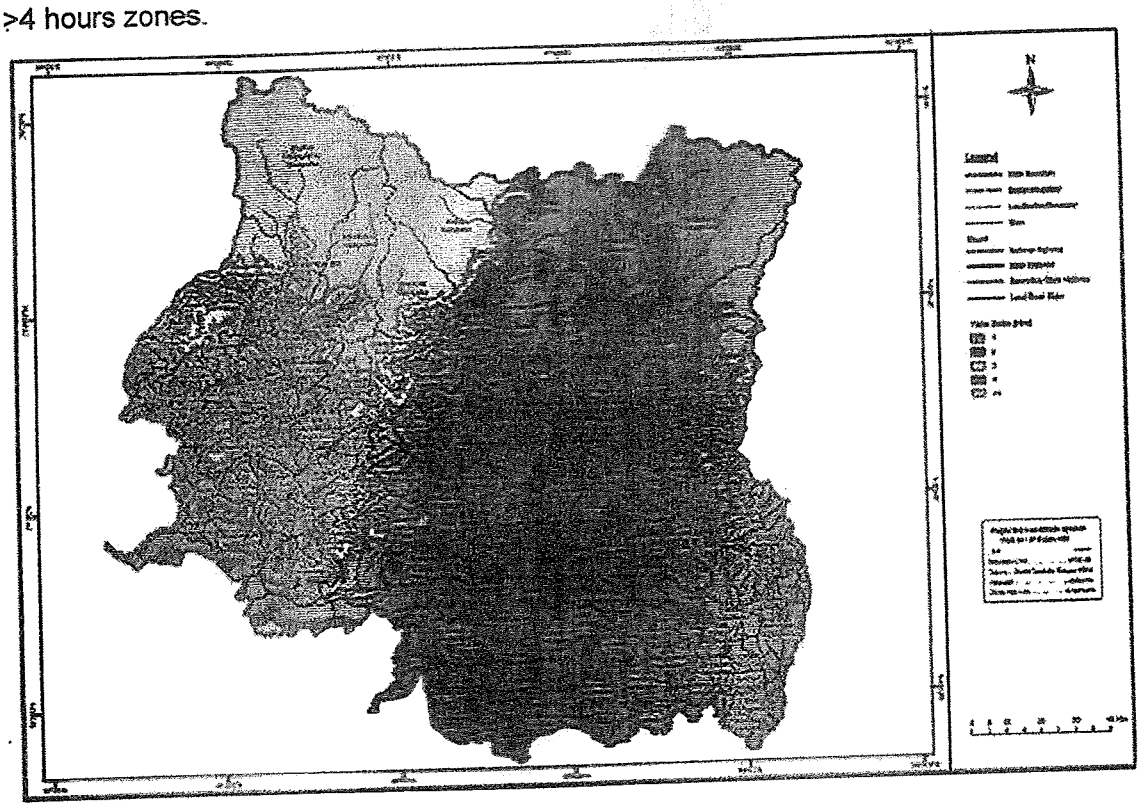
dh = elevation difference,

dx = distance,

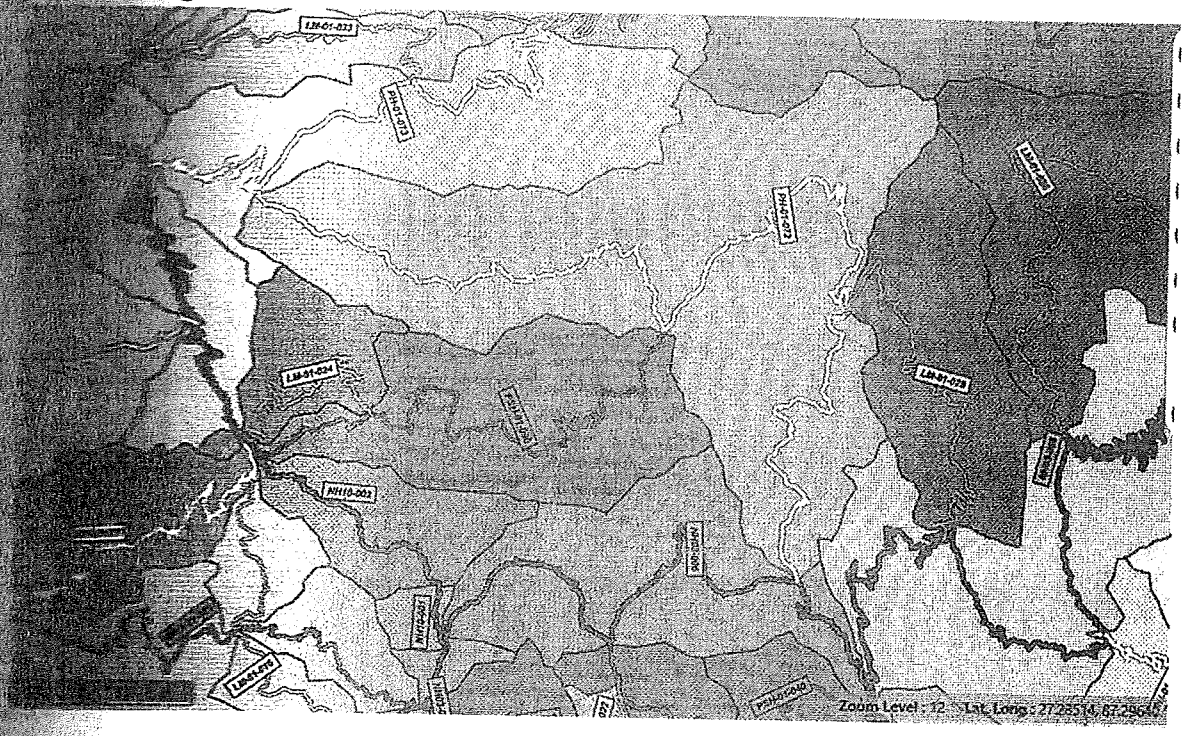
S = slope,

θ = angle of slope (inclination).

d) Based on travel speed grid, a cost distance algorithm is used determine the required time to travel to road. The travel time grid is computed and classified into 1, 2, 3, 4 and >4 hours zones.



- Based on travel time grids, influence area of each road is also computed using cost allocation algorithm.



- Population grid is overlaid over the travel time zones or road influence area to count the population.