



Analysis of Unpaved Road Speed Condition Using a GIS-Based Desktop Application: AR-Speed Condition

SUB-THEME: Technology and Modern Engineering Practices to Drive Efficiency

Eng. Chisomo Dan Kauma
(MURP, BSCE, Cert. Irrig.)

Road Data Management Engineer



Background

Roads are among the most important public assets in many countries.

Poor road quality contributes to time delays, vehicle operating costs increase, and accident costs (Johansson,2004)

Road users are willing to pay more to ride on better roads (Olsson, 2003). The risk of being delayed, in particular, is viewed negatively.

Road improvements bring benefits to road users through improved access to hospitals, schools, and markets; improved comfort, speed, and safety; and lower vehicle operating costs.

Objectives of the Study

The study Objectives

1. Assess selected unpaved road speed condition using AR-speed condition software

2. Demonstrate the use of AR-speed condition software

Justification of the Study

The study supports

SUB-THEME: Technology and Modern Engineering Practices to Drive Efficiency

SDG 9, Target 9.1, and Indicator 9.1.1 by advocating for the Rural Access Index (RAI) which % of rural population who lives within 2km of an all-season road (Rastogi, 2006)..

Malawi Vision 2063 Visions for the Transport Systems.

National Transport Masterplan focus on development of an integrated multi-modal transport sector

National Transport Policy measures to reduce transportation costs, improve road safety



Theoretical Framework



This study was informed by

(a) Transportation Planning Theory which relies on the equilibration theory of Manheim (Manheim *et al.*, 2016).

Theory states that transportation system will influence or change the socioeconomic system, and vice versa; the socioeconomic system will demand changes in the transportation system.

The socio-economic & transportation systems are interrelated (Zuidgeest, 2000)..

(b) Habermas' Theory of Communicative Action developed by Habermas, (1987): focuses on truth of facts, the correctness of norms, and the sincerity of expressions

Materials and Methodology

Study Area

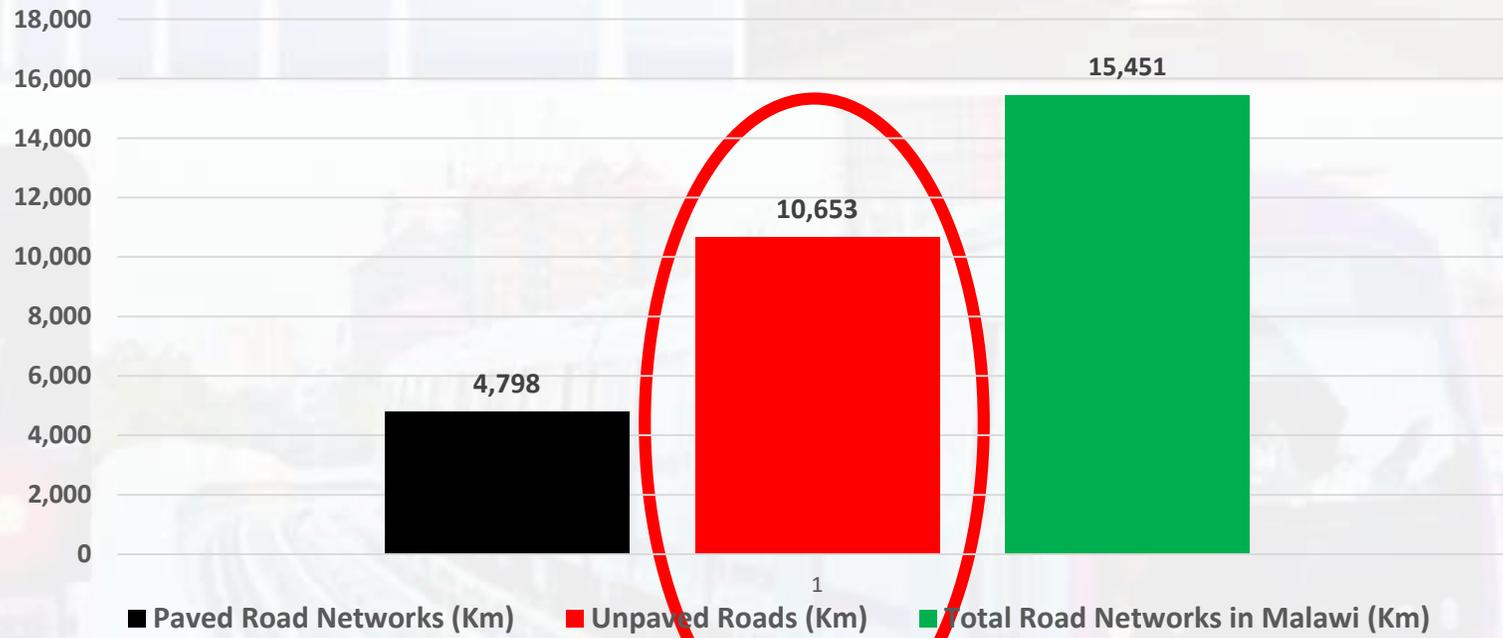
Residential areas in the Central Region of Malawi, Lilongwe City: Area 8 (Nchesi), Area 7 (Kawale) and Area 21 (Chilinde).



Road Network Status in Malawi

Paved Road Networks (Km)	Unpaved Roads (Km)	Total Road Networks in Malawi (Km)	% Paved Roads	% Unpaved Roads
4,798	10,653	15,451	31%	69%

Malawi Classified Road Network



Source: Roads Authority
2021

Road Condition Data Collection Methods

Visual Condition.

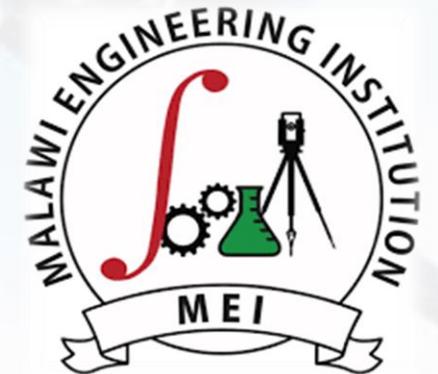
Road Surface Speed Condition.

Video Survey-Distress Surveys with Surface Distress Condition.

ROMDAS-Roughness-Laser/Bump Integrator(Ride Quality).

Structural Capacity-Falling Weight deflectometer(FWD)/LWD.

Drone Survey and Smart-Phone.



Road Condition-Road Speed Condition

- ❑ Condition surveys have main aspects
 - Data Collection,
 - Condition Rating
 - Quality Management.

Why Conduct Vehicle Speed Survey?

To acquire data on the general condition of the road network under the responsibility of the maintenance.

To provide baseline speeds to determine vehicle operating costs and passenger time savings.

Road Speed Condition-Data Collection



Driver

Observer

**Maintenance
Engineer**

- **Driver**-A well trained driver with particular medium-sized vehicle with an independent suspension system. Driver should be driving at speeds as close to the boundary between comfortable and uncomfortable up to 50 km/h. Above 50 km/h it is recommended that the driver aims for a target speed of 55 km/h so that the accuracy of the GPS does not decrease

Observer- movements observed by the inspector when driving at a given speed over the road.

Maintenance Engineer- Overview the whole road speed survey in technical perspective.

AR-Road Speed Condition

- AR-Road Speed Condition is a desktop software for viewing road tracks from GPS in gpx file format for analysis of road speed condition with a threshold set by a user.
- The software is particularly aimed towards assessing conditions of road during the initial planning stage of road rehabilitation program. With the aid of this software, such assessment can be performed in relatively inexpensive manner that too within very short duration compared to traditional survey methods.
- The software reads the geospatial data stored for each point of each segment of every road section stored in the gpx file. It calculates average speed of the whole road track and compares it with standard threshold and gives the assessment of road condition in the form of ***poor, fair*** and ***good***.

WHAT TO DO,
WHERE ?
WHEN TO DO IT!
Are things getting better or worse?

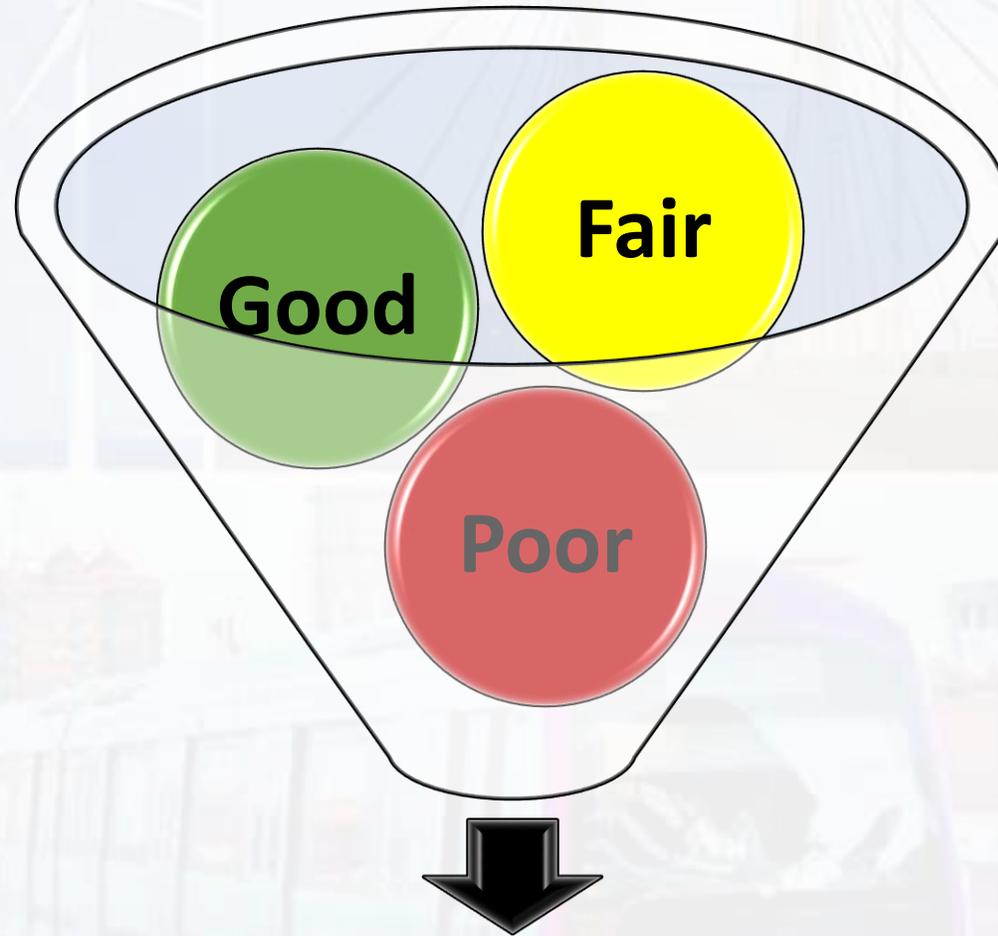
AR-Road Speed Condition Section

AR-Road Speed Condition

Road Section



AR-Road Speed Condition Rating

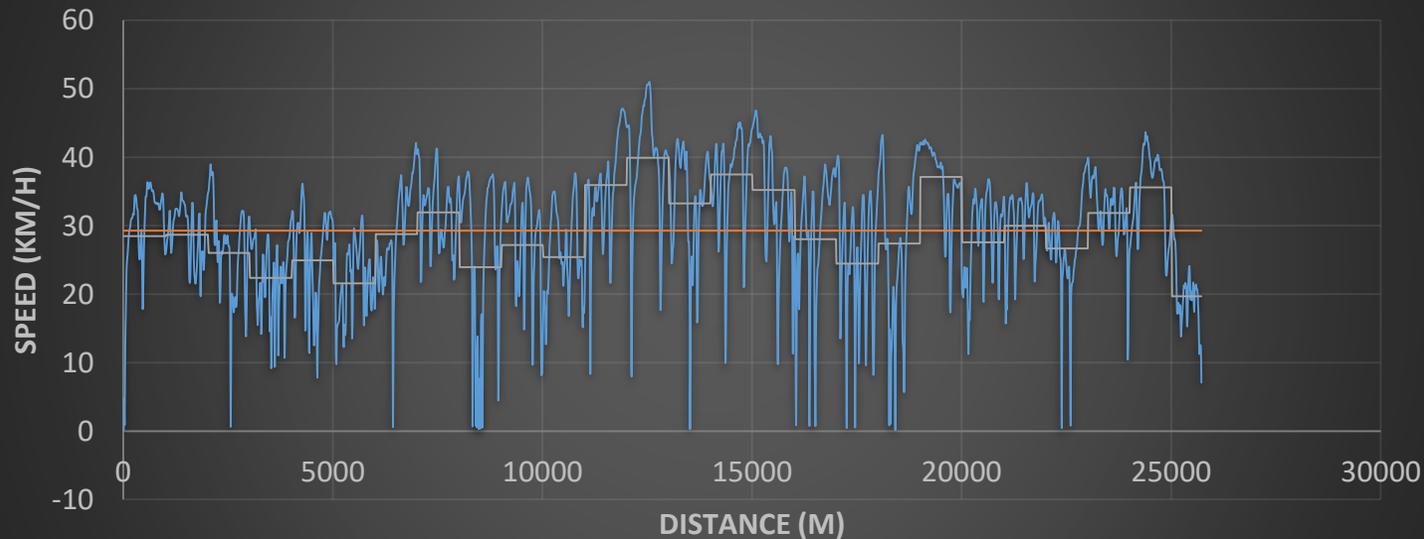


AR-Road Speed Condition Rating

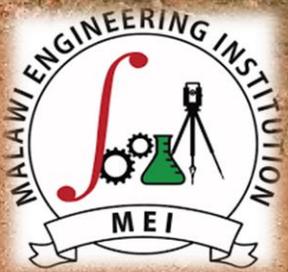
AR-Road Speed Condition

AR-Road Speed Condition, A GIS Desktop app, Analyzing the road surface speed condition data collected from GPS with a user assigning bands of rating(Good, Fair and Poor) in graph analysis, Map display and an option to export to Excel.

AR-Road Speed Condition Profile



— Speed — Average Speed — Km Average Eng. Chisomo Dan Kauma



Developed by

Eng. Arnold M. Kilaini (GIS & Mobile Software Developer)-Tanzania
&
Eng. Ram G. Kachhepati (Mobile Software Developer)-Nepal

Eng. C. Dan Kauma (GIS Expert)-Malawi

Chisomo.kauma@gmail.com (Mobile no: +265 881465071)

AR-Road Speed Condition- Software Overview

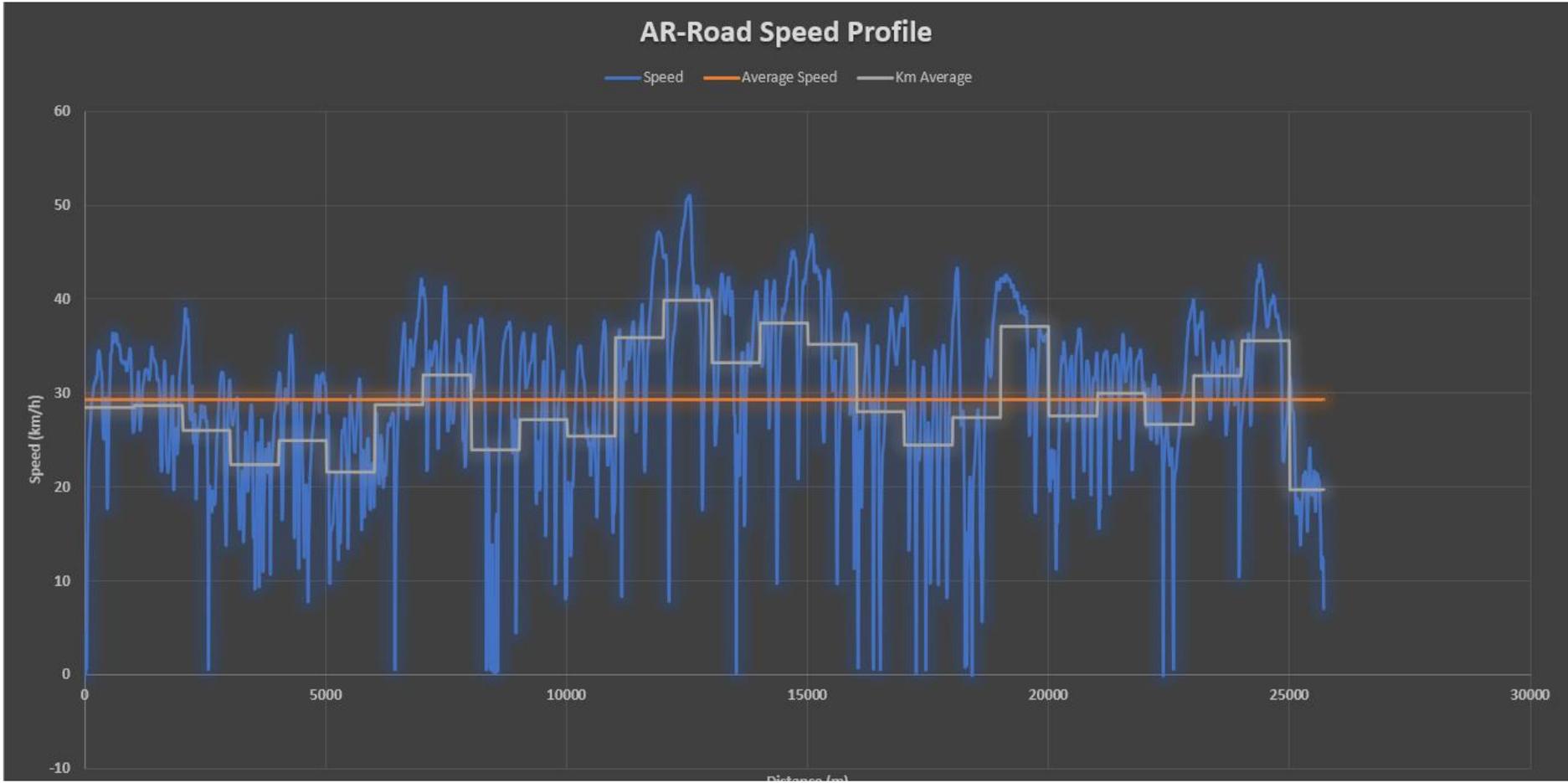


The screenshot displays the software interface for 'AR-Road Speed Condition 1.0.2'. On the left, a vertical menu contains buttons for 'FILE OPEN', 'SHOW PROFILE', 'SHOW MAP', 'ABOUT', and 'MANUAL'. The main area is a large white space with a 'Track Name:' label at the top left. On the right, there are two panels: 'CONDITION LIMIT' with input fields for 'Poor Max: 0' and 'Fair Max: 0', and 'SUMMARY' with labels for 'Total Points:', 'Total Length:', 'Elapsed Time:', and 'Average Speed:'. At the bottom right, a 'CONDITION' panel is partially visible. At the bottom left, there is an 'Export to Excel' button. The bottom center of the interface shows the name 'Eng. Chisomo Dan Kauma'.

A vertical navigation bar on the right side of the slide, containing five buttons: 'FILE OPEN', 'SHOW PROFILE', 'SHOW MAP', 'ABOUT', and 'MANUAL'. The buttons are arranged vertically and are highlighted with a yellow border.

AR-Road Speed Condition app- Condition Limit

FILE OPEN	CONDITION LIMIT	CONDITION
SHOW PROFILE	Poor Max: <input type="text" value="20"/>	
ABOUT	Fair Max: <input type="text" value="30"/>	FAIR
MANUAL	SUMMARY	
	Total Points: 1763 Total Length: 25.72 km Elapsed Time: 1.42 hrs Avg Speed: 29.258 km/hr	



Criteria		km	%	
Good	> 30	Good	13.86	54%
Fair	20 - 30	Fair	8.64	34%
Poor	< 20	Poor	3.21	12%
Condition		TOTAL	25.71	100%
FAIR				



AR-Road Speed Condition Profile

Excel Report from AR- Road Speed Condition

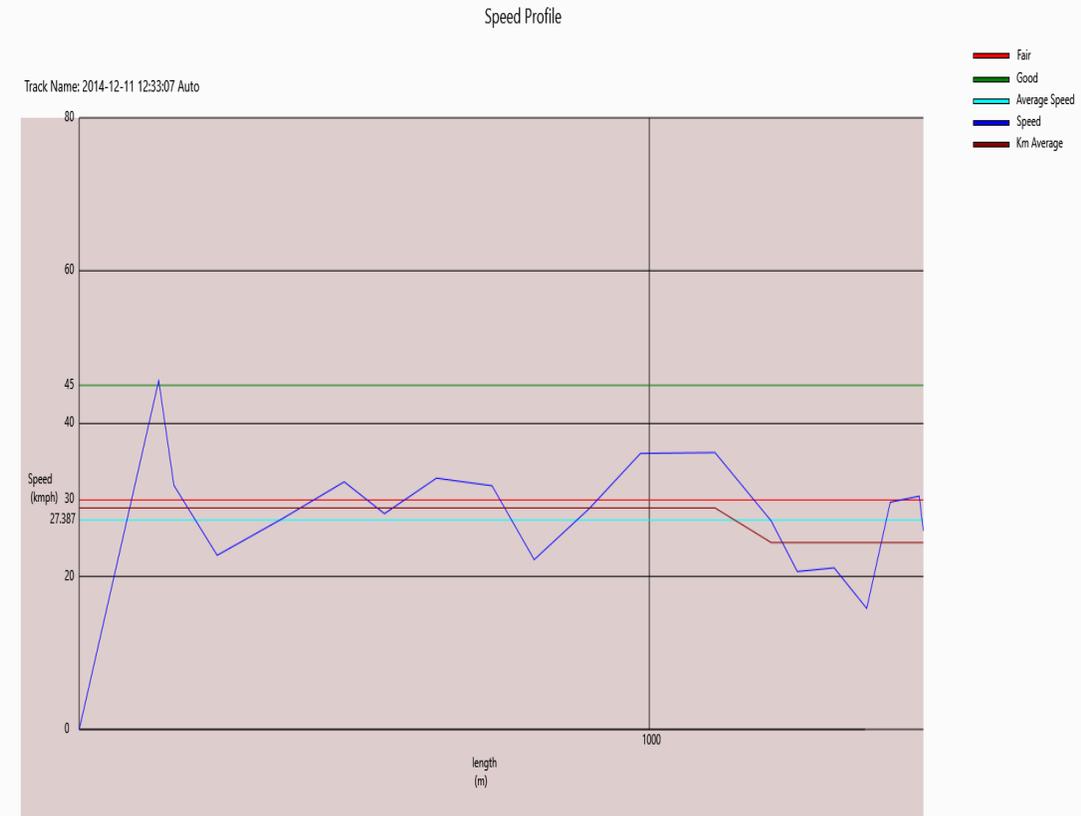


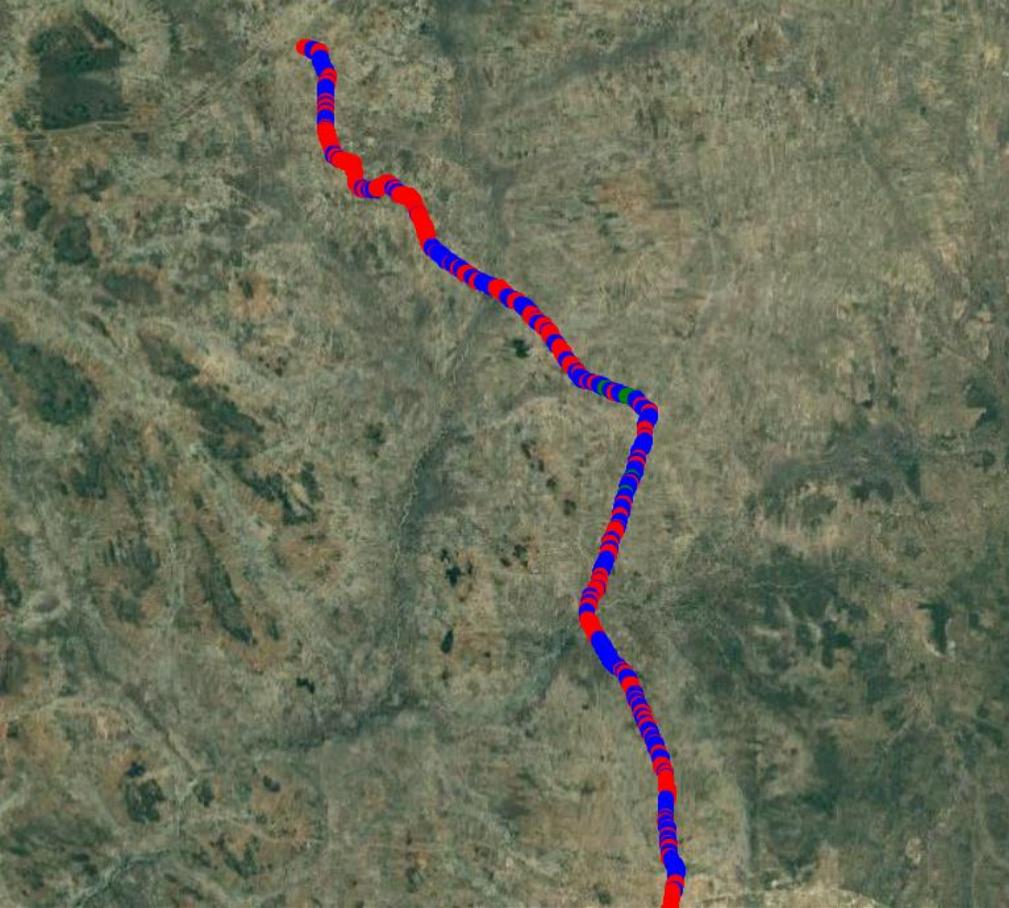
Grid	Lat/Lon hddd°mm.mmm'	Criterial		Condition		Good	km	%
Datum	WGS 84	Good	> 45	POOR		Fair	0.14	9%
		Fair	30 - 45			Poor	0.6	40%
		Poor	< 30			TOTAL	0.75	50%
							1.49	100%

Header	Name	Start Time	Elapsed Time	Length	Average Speed	Total Points
tp	2014-12-11 12:33:07 Auto	12/11/2014 10:33	0.05 hrs	1.481 km	27.387 km/hr	20

Header	Position	Time	Altitude	Length (m)	Interval	Distance (m)	Speed (km/h)	Average (km/h)	km average (km/h)
tp0	-6.7745014094 38.1138848327	12/11/2014 10:33	239.02	0	0:00:00	0	0	27.387	28.97
tp1	-6.77377671 38.1149155553	12/11/2014 10:33	237.1	139.451	0:00:11	139.451	45.63847	27.387	28.97
tp2	-6.773641929 38.1151146255	12/11/2014 10:33	235.66	26.604	0:00:03	166.055	31.9249	27.387	28.97
tp3	-6.7732838541 38.1157000177	12/11/2014 10:33	237.58	75.917	0:00:12	241.972	22.77519	27.387	28.97
tp4	-6.7726946063 38.1165553909	12/11/2014 10:33	237.1	114.951	0:00:15	356.923	27.58824	27.387	28.97
tp5	-6.772182053 38.1173857022	12/11/2014 10:34	237.1	107.953	0:00:12	464.876	32.38592	27.387	28.97
tp6	-6.7718092259 38.1179027818	12/11/2014 10:34	236.14	70.559	0:00:09	535.435	28.22349	27.387	28.97
tp7	-6.7712944932 38.1185470149	12/11/2014 10:34	236.62	91.303	0:00:10	626.738	32.86903	27.387	28.97
tp8	-6.7706510145 38.1191453151	12/11/2014 10:34	236.14	97.386	0:00:11	724.124	31.87185	27.387	28.97
tp9	-6.7701579072 38.1195955072	12/11/2014 10:34	235.66	74.01	0:00:12	798.134	22.20309	27.387	28.97
tp10	-6.76951929 38.1201829948	12/11/2014 10:34	237.1	96.181	0:00:12	894.315	28.85417	27.387	28.97
tp11	-6.7688721232 38.1206763536	12/11/2014 10:35	239.02	90.256	0:00:09	984.571	36.10247	27.387	28.97
tp12	-6.7677030992 38.1208051834	12/11/2014 10:35	242.87	130.766	0:00:13	1115.337	36.21201	27.387	28.97
tp13	-6.7668196466 38.1208718196	12/11/2014 10:35	242.87	98.511	0:00:13	1213.847	27.27987	27.387	24.44
tp14	-6.7664107773 38.120927643	12/11/2014 10:35	241.91	45.88	0:00:08	1259.728	20.64607	27.387	24.44
tp15	-6.7659472581 38.1212801021	12/11/2014 10:35	238.54	64.584	0:00:11	1324.312	21.1367	27.387	24.44
tp16	-6.7656216212 38.1216805056	12/11/2014 10:36	235.18	57.148	0:00:13	1381.46	15.82555	27.387	24.44
tp17	-6.7653538194 38.1219393387	12/11/2014 10:36	232.3	41.275	0:00:05	1422.734	29.71766	27.387	24.44
tp18	-6.7650506459 38.1222841702	12/11/2014 10:36	228.93	50.855	0:00:06	1473.59	30.51328	27.387	24.44
tp19	-6.7650110833 38.1223359704	12/11/2014 10:36	228.93	7.216	0:00:01	1480.806	25.97717	27.387	24.44

Excel Report from AR-Road Speed Condition





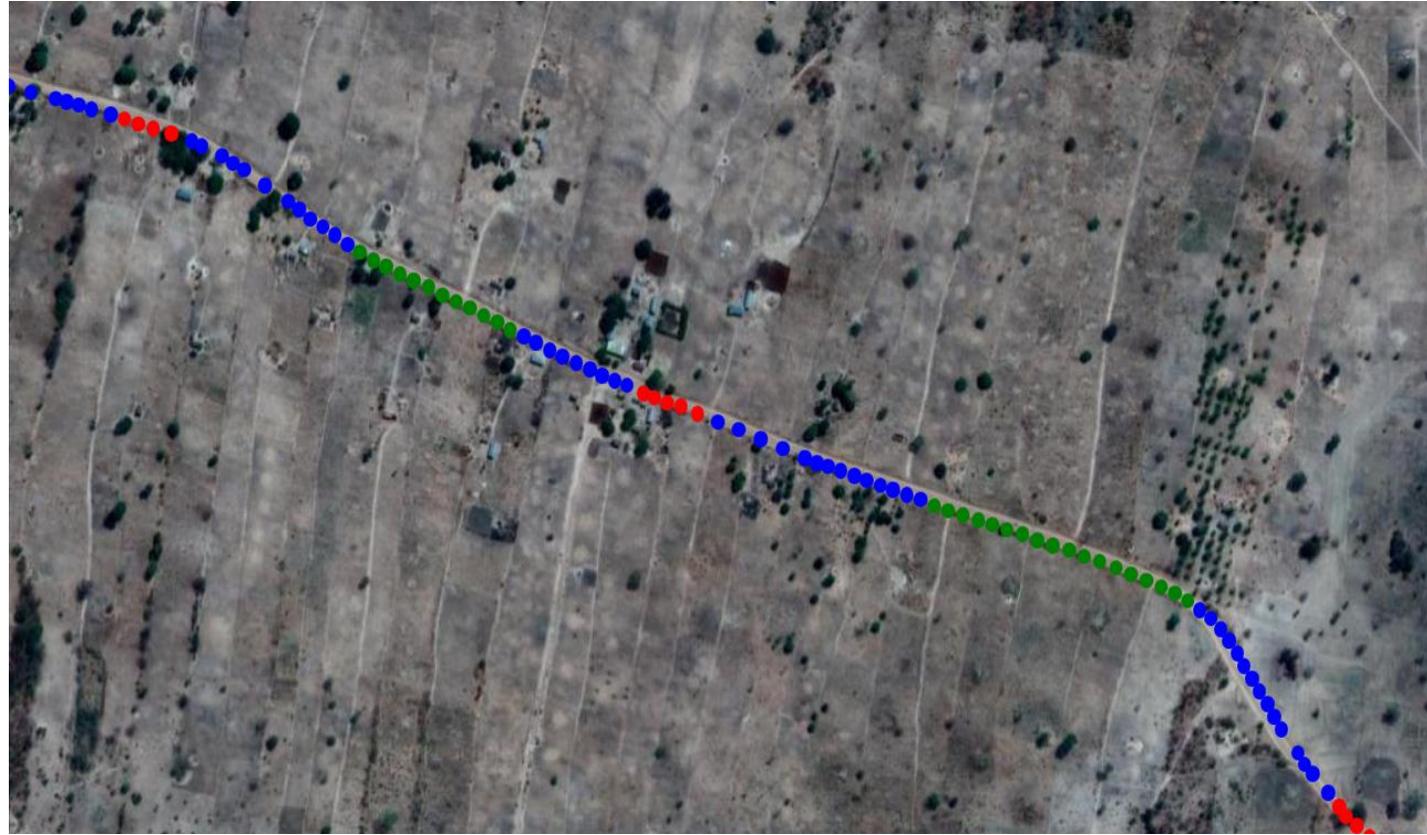
SHOW MAP

Map-shows map display as per road condition

Eng. Chisomo Dan Kauma



Map-with Good, Fair and Poor Road Sections



-  Poor
-  Fair
-  Good



Results of the Study



NCHESI RESIDENTIAL STREETS

Header	Name	Start Time	Elapsed Time	Length	Average Speed
Track	Nchesi Residential Streets	9/6/2022 1:21:16 PM	0.27 hrs	4.312 km	15.84 kmph

NCHESI RESIDENTIAL STREETS

	km	%
Good	0	0%
Fair	0	0%
Poor	4.312	100%
TOTAL	4.31	100%

CHILINDE RESIDENTIAL STREETS

Header	Name	Start Time	Elapsed Time	Length	Average Speed
Track	Chilinde Residential Streets	9/6/2022 12:46:33 PM	0.23 hrs	3.690 km	16.01 kmph

CHILINDE RESIDENTIAL STREETS

	km	%
Good	0	0%
Fair	0.207	6%
Poor	3.483	94%
TOTAL	3.69	100%

KAWALE RESIDENTIAL STREETS

Header	Name	Start Time	Elapsed Time	Length	Average Speed
Track	Kawale Residential Streets	9/6/2022 6:09:35 AM	0.46 hrs	7.815 km	17.05 kmph

KAWALE 1 RESIDENTIAL STREETS

	km	%
Good	0	0%
Fair	0.293	4%
Poor	7.521	96%
TOTAL	7.81	100%

Setbacks of the Road Speed Condition

Factors affecting the speed are shown below.

- Traffic
- Pedestrians
- Animals
- Villages
- Police Stop Points
- Weather Conditions
- Diversion

Way Forward

- Upgrade AR-Road Speed Condition app in a web/server based application.
- Working and Developing PCI(Pavement Condition Index) Desktop Application.

Developers Contacts

Contact

Ram Gopal Kachhepati
kakshyapati@gmail.com

+977 9803045243
Nepal

Arnold M. Kilaini
kilaini1@gmail.com
+255 712304741
Tanzania

Chisomo Dan Kauma
Chisomo.kauma@gmail.com
+265999626161
Malawi





Thank You For Listening

