

# How to save money on road maintenance?

A multi-criteria approach for Machakos District, Kenya

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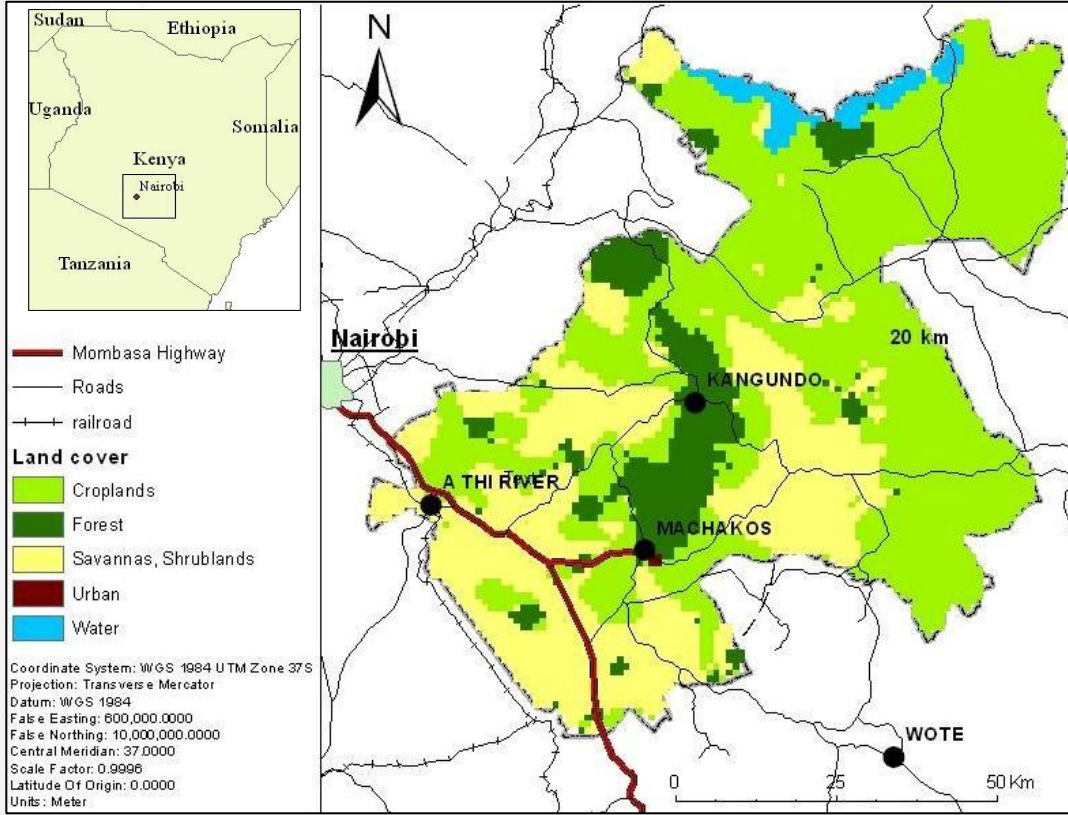


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## Introduction

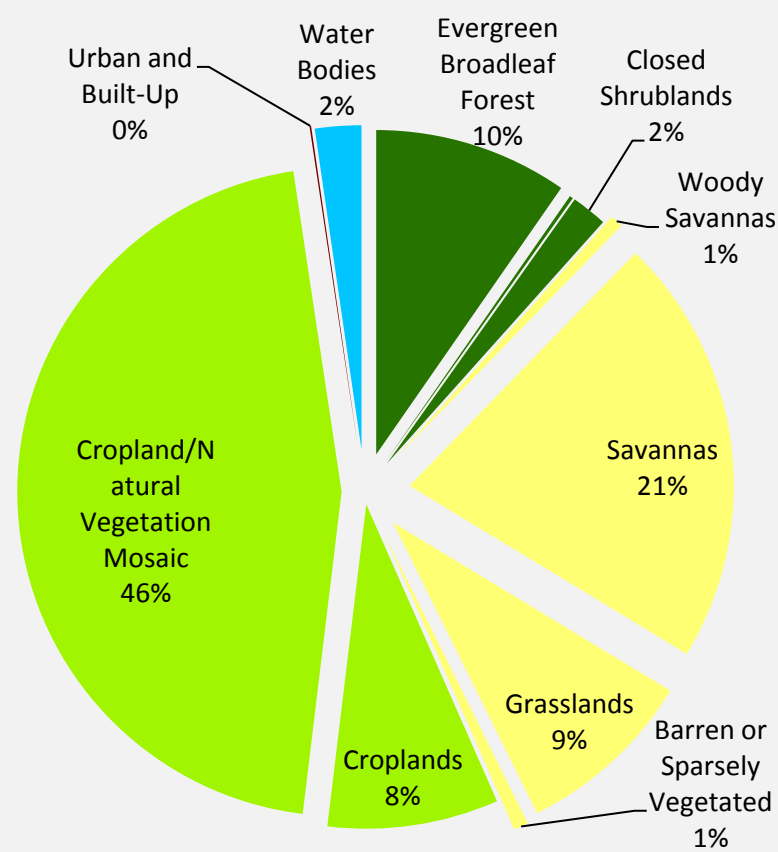
The **Republic of Kenya** is located in East Africa. After gaining its independence from Britain, the country was left in devastated economic state. It remains a developing country according to Human Development Index statistics. Efforts, such as Vision 2030, are being made to improve the economy by focusing on the important agricultural sector which includes production of tea, coffee, fresh fruits, vegetables and garden flowers. This sector employs 75% of the labor force.

**Machakos** district is a fundamental contributor to the Kenyan economy due to its closeness to the capital city, location between the international airport of Nairobi and Mombasa port, availability of massive arable land, and sufficient labor force. However, it has poor infrastructure and high poverty level among the population.



	Machakos	Kenya
Area km <sup>2</sup>	6 216.17 (1.1%)	591 219.6
Population	1 098 584 (2.8%)	38 610 097
Population density/km <sup>2</sup>	177	65
Road length (km)	523 (1.4%)	37287
Primary roads (asphalt, km)	76 (3.6%)	2091
Secondary roads (dirt, km)	447 (1.3%)	35196
Road density (km/100km)	8.4	6.3
Road per capita (km per 1000 people)	0.48	0.97
Average Poverty level per county (%)	59.6	45.9
Urbanization by county (%)	52	32.3

Table 1. General information for Machakos District and the Republic of Kenya



## Aim and objectives

Implementing a multi-criteria plan for detecting roads of ideal importance to improve Machakos' road network, in support of Kenya's vision of future economic development.

## Methodology

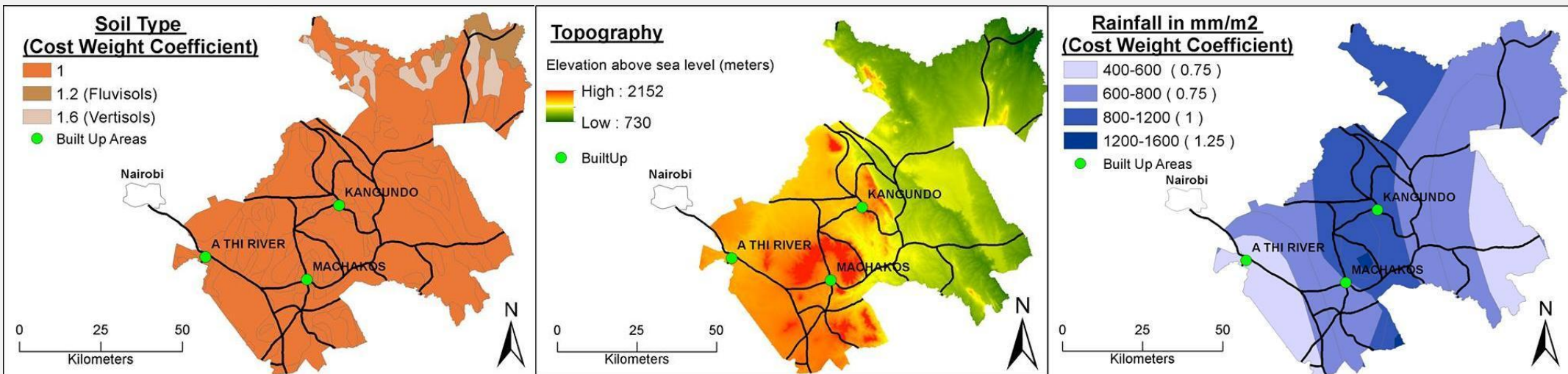
The cost of road maintenance depends on factors – soil type, slope, precipitation proximity to towns. They are categorized and assigned weighted values according to their relative importance. Each road segment's cost is calculated taking into account the cumulative effect using the following formula:

$$\text{COST} = \text{SOIL} * \text{SLOPE} * \text{PRECIP} * \text{PROXI} * \text{KM} * 2000,$$

In which 2000 is base cost needed for maintenance of 1 km of road network. Furthermore, proximity to capital Nairobi detects the roads with importance for the economic development.

## Results and discussion

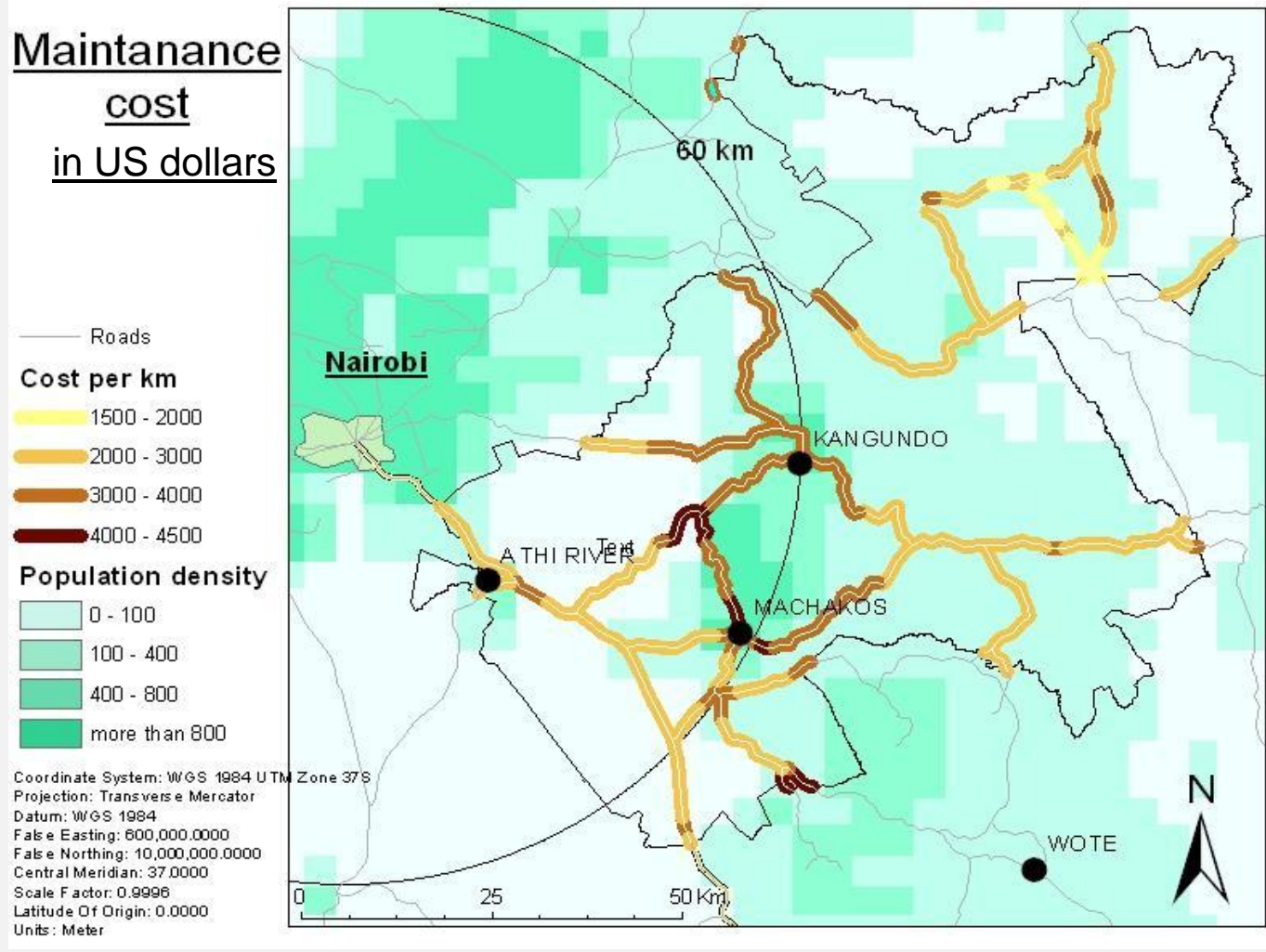
Examining the importance of different cost factors and defining the biggest contributor to the cost.



Soil Type			Topography			Precipitation			Proximity to town		
Criteria	Weight	Road length	Criteria	Weight	Road length	Criteria	Weight	Road length	Criteria	Weight	Road length
Fluvisols	1.2	6	0-4 %	1	452	<800	0.75	373	<40 km	1.5	486
Vertisols	1.6	10	4-10%	1.5	71	800-1200	1	150	>40 km	1	37
Other soil types	1	508	>10%	2	0	>1200	1.25				

Table 2. Road length distribution according to cost weight criteria used for GIS analysis

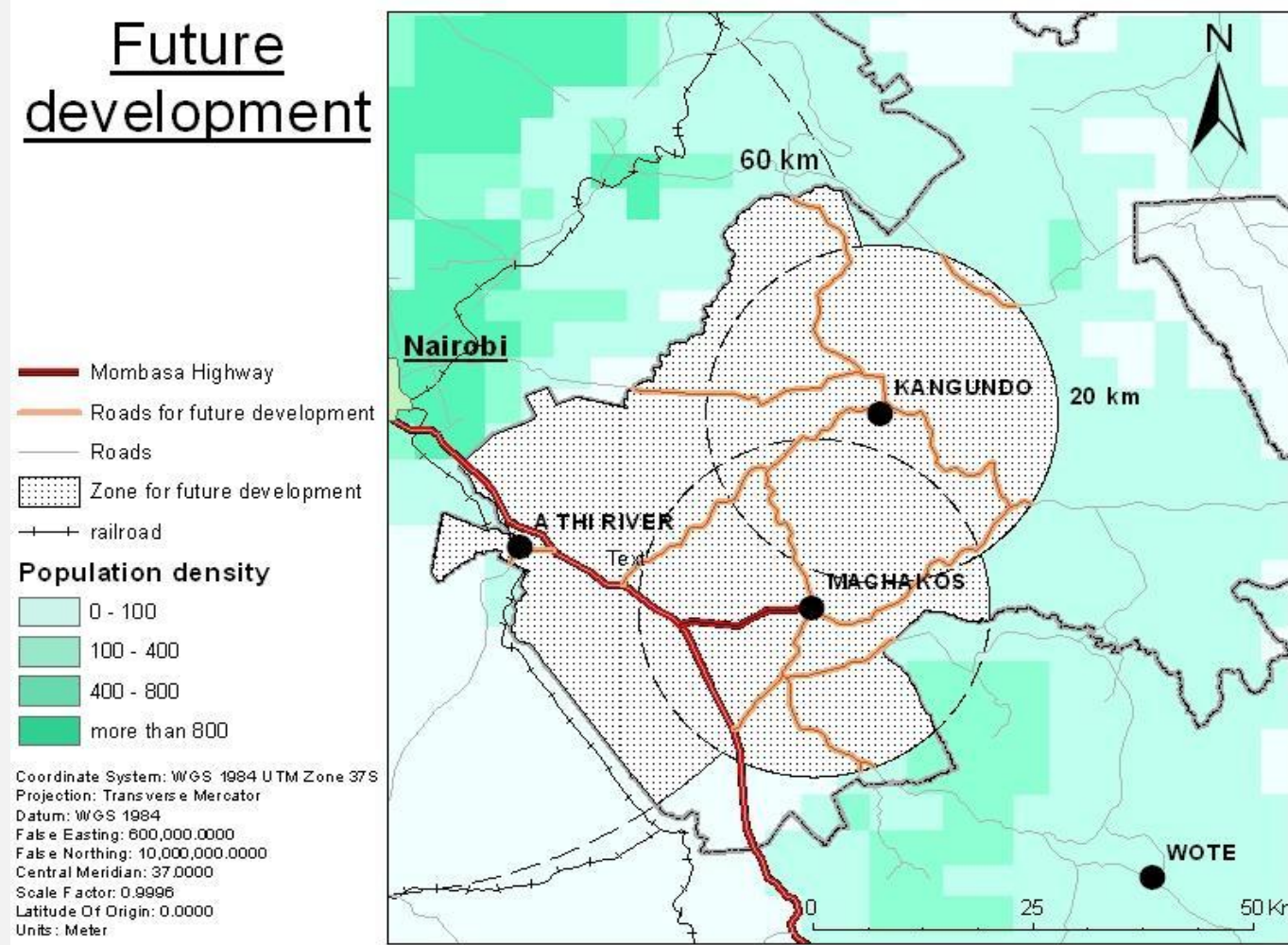
## Maintenance cost in US dollars



	Machakos	Kenya
Road/water intersections	43 (1.8%)	2448
Cost per intersection	10 000	10 000
Road maintenance cost	1 366 611 (1.5%)	91 834 101
Average cost per km	2 611 (+6%)	2463
Total cost	1 796 611	116 314 101
Cost per capita(USD)	1.64	3.01

Table 3. Roads maintenance cost for Machakos District compared in average with the total road maintenance cost for Republic of Kenya

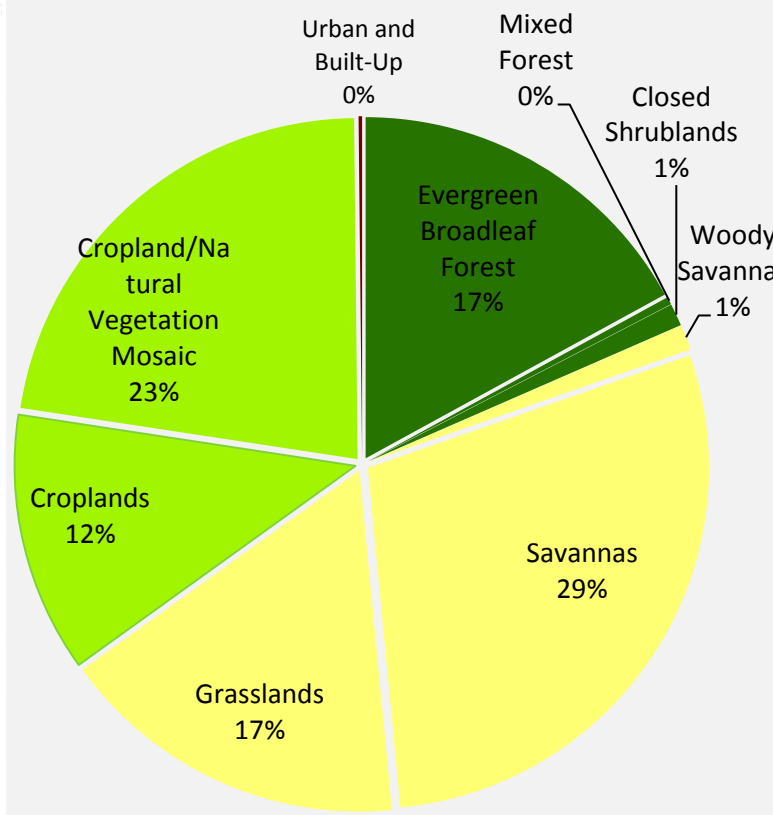
## Future development



	Machakos
Length Total (km)	447
Length asphalted future roads(km)	246
Proportion of population benefiting (%)	67
Decrease in cost (%)	17.36

Table 4. Future development of the zones around the most populated areas in Machakos District (Machakos and Kangundo)

Defining a zone for future development using proximity to capital and Machakos-Kangundo agglomeration as main criteria and estimated decrease in maintenance cost if roads are asphalted.



Land use proportion (for reference Introduction map)

## Conclusion and suggestions

- Urban proximity is the biggest contributor to the cost for maintenance
- South west Machakos is highly populated and includes the political and economic capitals of two major urban areas
- Asphalting the roads can help lower the long term maintenance cost by preventing the high damage to these busy urban and suburban roads
- Improvement of road network will contribute to the future economic development defined in the government strategy plan for the Republic of Kenya

## References and Contact information

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