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Soil Loss Atlas of Malawi

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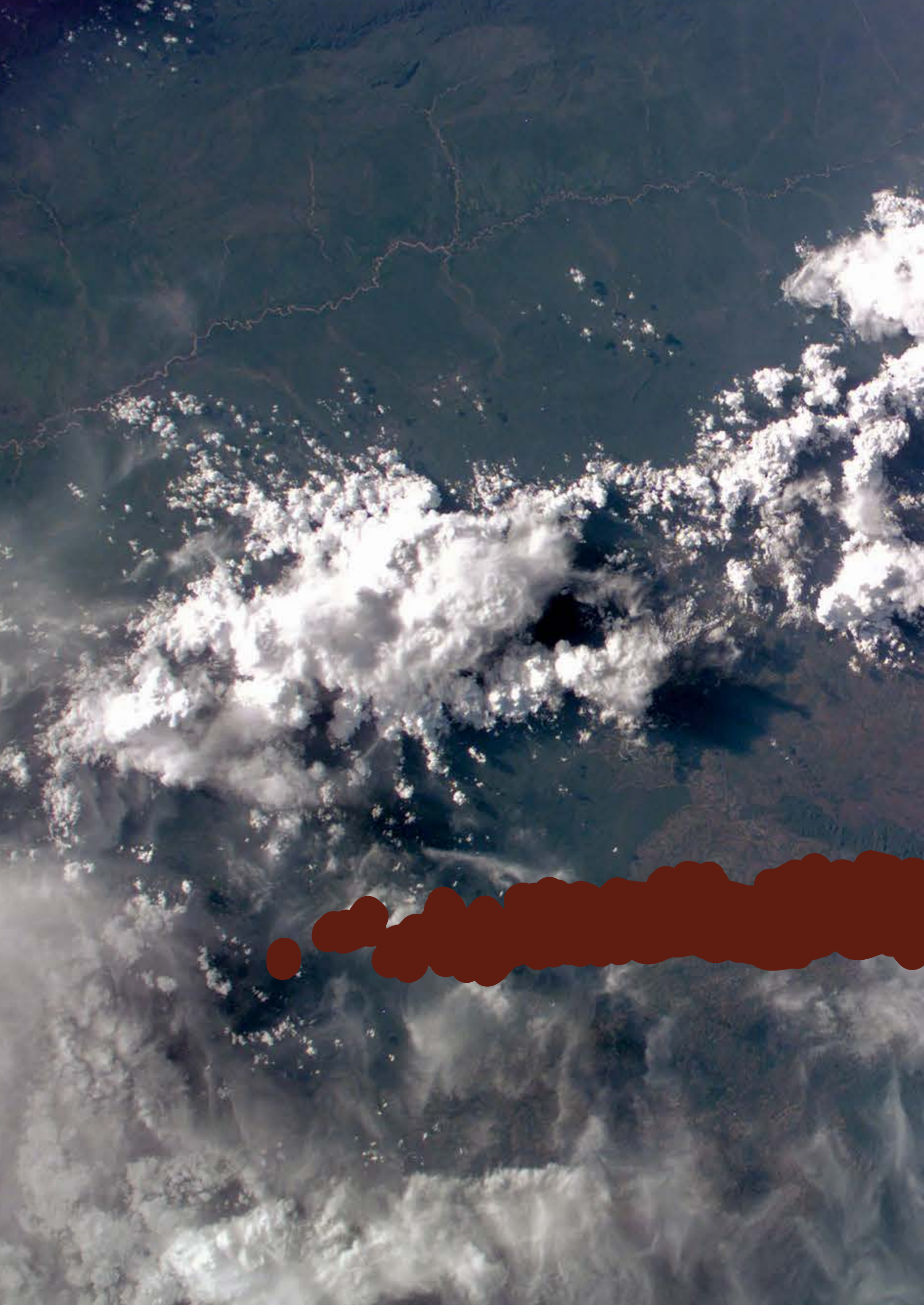

Soil Loss Atlas of Malawi

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Contents

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Executive summary

With over three-quarters of the country's soils at risk, soil loss in Malawi represents a major threat to food security and nutrition, agricultural growth, the provision of ecosystem services and the achievement of the Sustainable Development Goals (SDGs). Since the Malawian economy is highly dependent on agriculture, soil loss is a significant hindrance to the overall economic development of the country. The Soil Loss Atlas of Malawi is part of an effort of the Government of Malawi (GoM) and its development partners to determine the major contributing factors to soil loss in Malawi and the most effective approaches to control it.

This publication addresses the urgent need for updated data and information on soil loss rates in Malawi, which have not been reviewed since 1992. Furthermore, since soil loss is one of the monitoring indicators in the Agricultural Sector Wide Approach program (ASWAp) adopted by the GoM and its development partners, there is also a need to develop a baseline soil loss rate to help with program indicator monitoring.

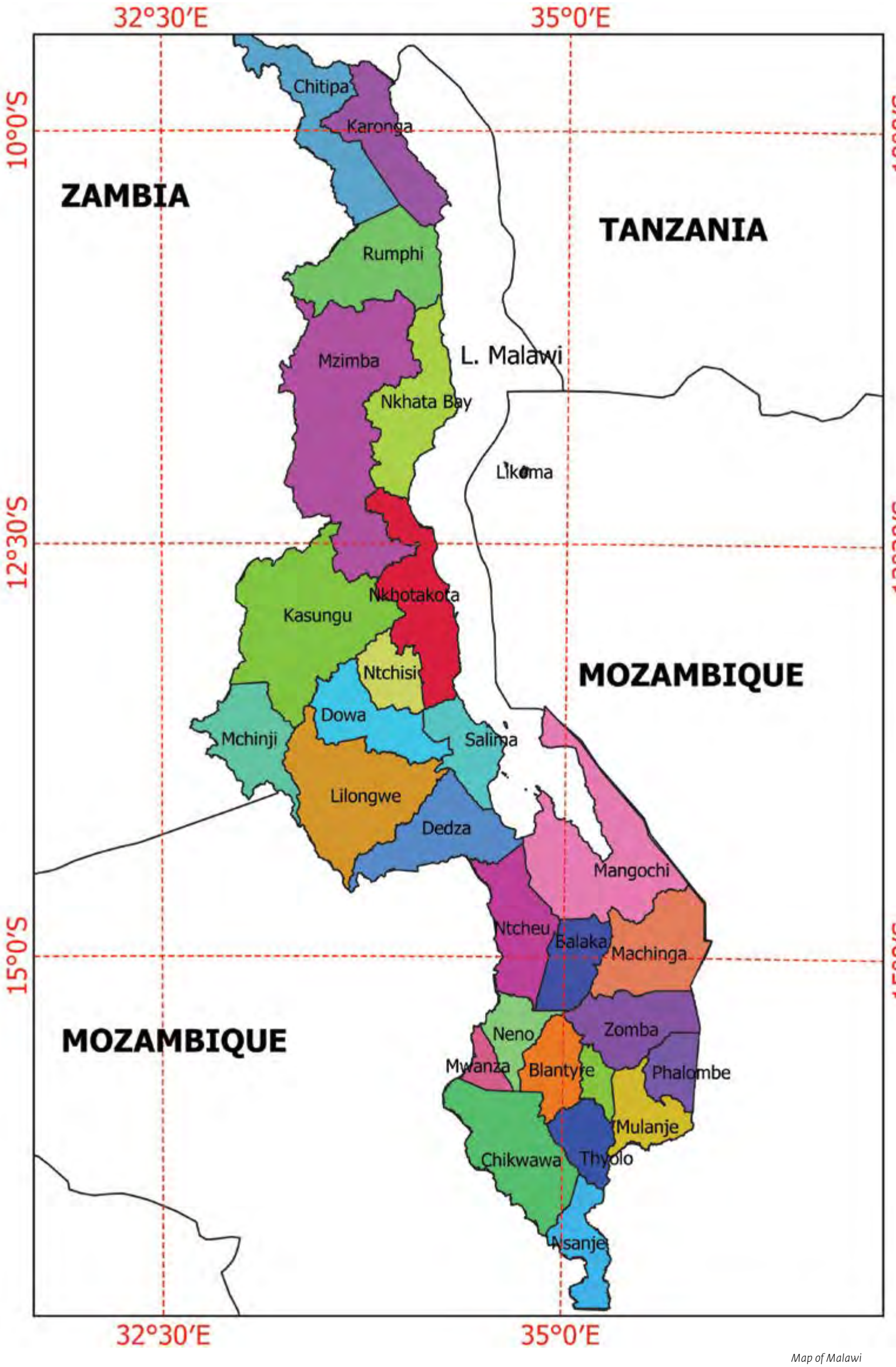
Soil erosion is a natural or human-driven process where the top layers of soil are removed from their original location. In the context of agriculture, soil loss occurs when natural soil erosion is accelerated so that the soil is blown or washed away by agents such as water, wind and tillage. Soil loss is fuelled by agents of erosion (such as wind, runoff, gravity, etc.) and further influenced by factors such as unsustainable soil management, land use/cover management, topography, and soil type. Some of these factors are often modified by human activities in ways that can increase or slow down the rate of soil loss process.

The Soil Loss Atlas of Malawi builds a comprehensive picture of soils in the country by examining different types of soil loss and their drivers across the 27 districts of Malawi. The publication captures information on soil types, land cover and land use types, topography, mean annual rainfall, soil loss rates and soil nutrient loss rates. All of this data is mapped by district through photographic evidence, graphs and maps which effectively illustrate the scale and range of soil loss across the country. The Atlas also provides an overview of the topsoil loss trends between 2000 and 2014.

The overall approach used for the development of this Atlas was the combination of modelling using the Soil Loss Estimation Model for Southern Africa (SLEMSA) and validation by field measurements. The model provides a dynamic approach for estimating national topsoil loss using secondary data, development of a footprint history of topsoil loss rates in the past ten years, identification of potential drivers of soil loss in the country and capacity development of local staff to implement future soil loss assessment activities.

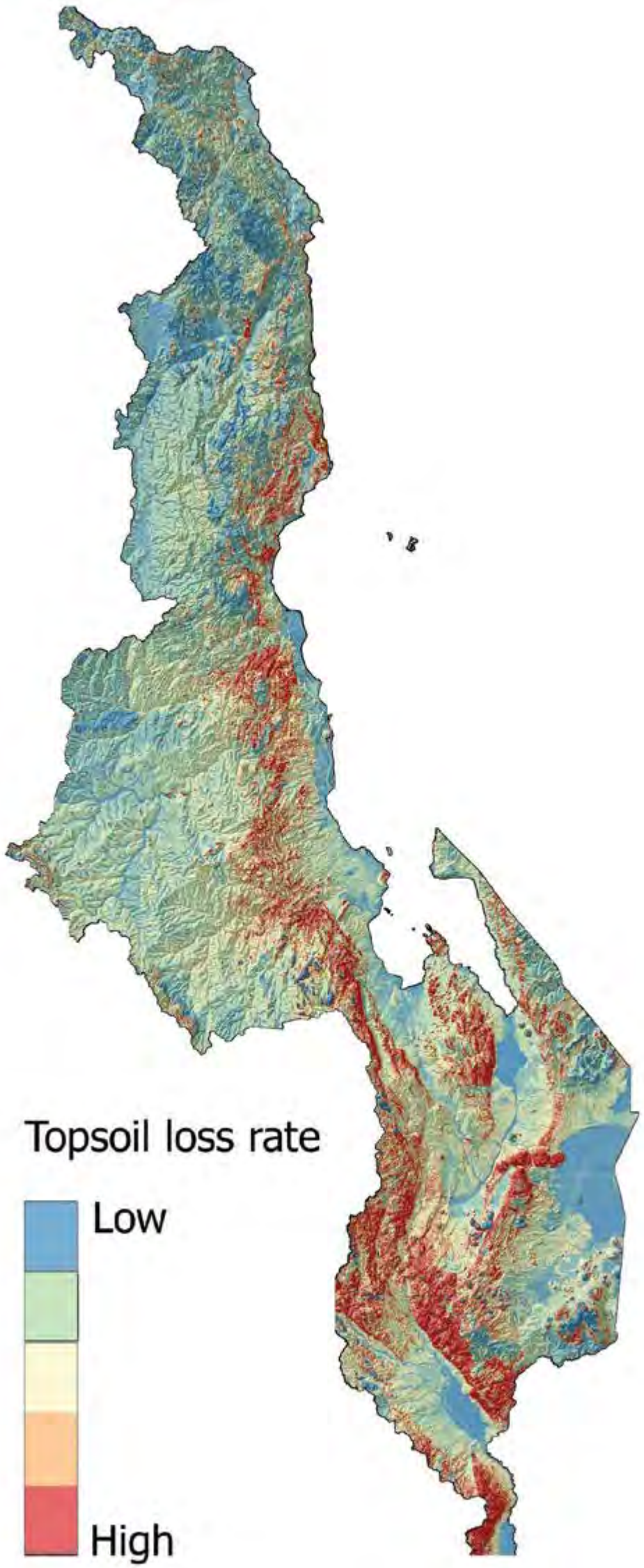
The Soil Loss Atlas of Malawi is a useful resource for a variety of stakeholders including researchers, scientists, decision-makers, land managers, students and the general public. The publication provides a baseline for future monitoring of soil loss rates and trends in the country. It delivers key data and evidence which can inform targeted decision-making to tackle the issue of soil loss in Malawi.

Map of Malawi



Source of base map: Government of Malawi

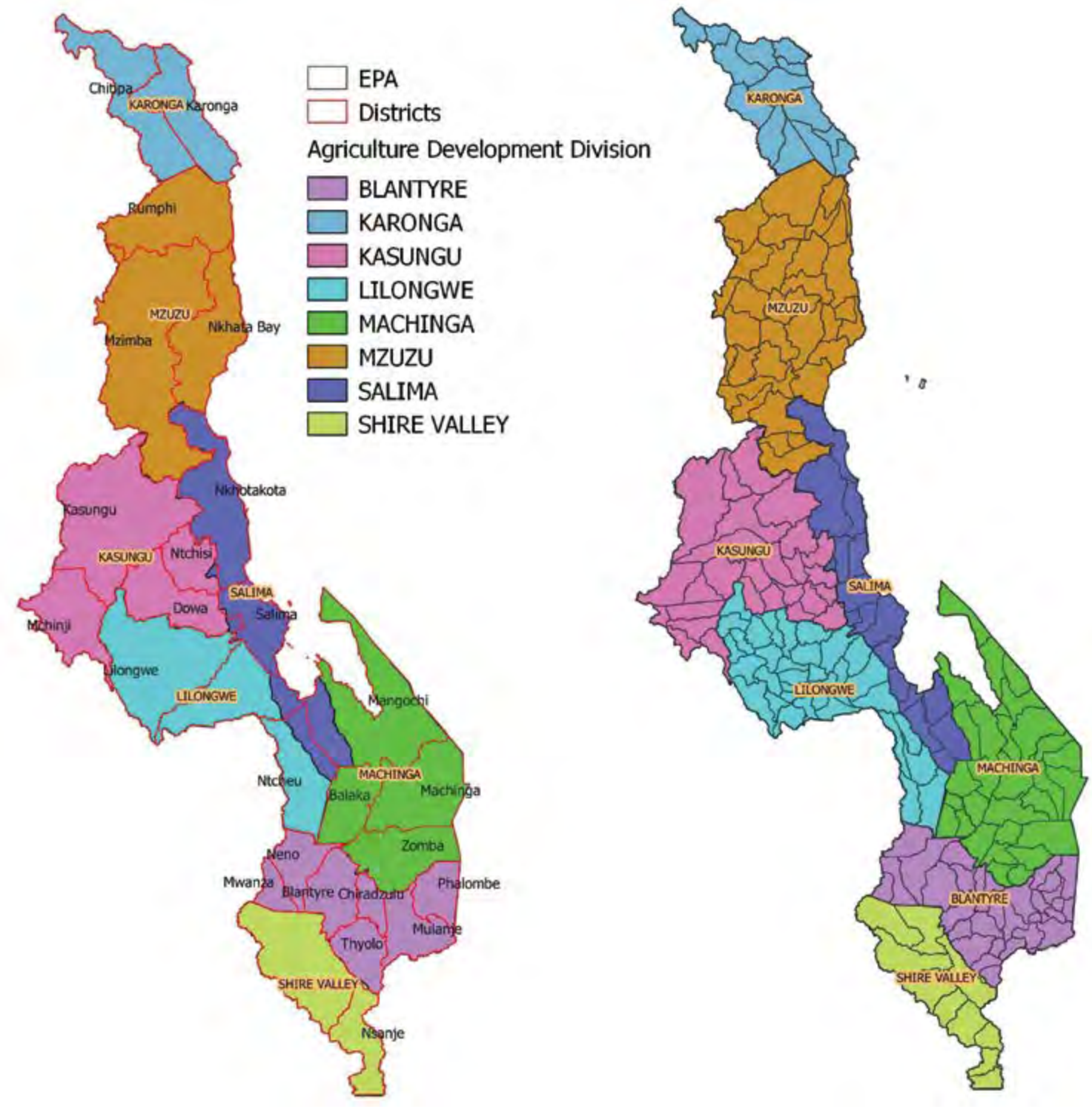
Topsoil loss rate



Source of base map: Government of Malawi

Agriculture services

The government extension services in Malawi are structured along agricultural development divisions (ADDs), which are further subdivided into district agricultural offices and extension planning areas (EPAs). There are eight ADDs: three in the Southern Region (Shire Valley ADD, Blantyre ADD and Machinga ADD), three in the Central Region (Lilongwe ADD, Salima ADD and Kasungu ADD) and two in the Northern Region (Mzuzu ADD and Karonga ADD).



Source of base map: Government of Malawi

1 Introduction to soil loss in Malawi

Soil erosion is defined as the accelerated removal of topsoil from the land surface through water, wind and tillage. Soil erosion occurs naturally under all climatic conditions and on all continents. However, this phenomenon has been accelerated by human activities (up to 1,000 times) through intensive agriculture, deforestation and introduction of land-uses that are not well matched to the land-use capability. Soil loss is fuelled by agents of erosion (such as wind, runoff, gravity, etc.) and further influenced by factors such as soil management, land use/cover management, topography, and soil type. Some of these factors are often modified by human activities in ways that can increase or slow down the rate of soil loss process. During soil loss, the soil particles are first detached then transported before being deposited some distance away from the initial position.

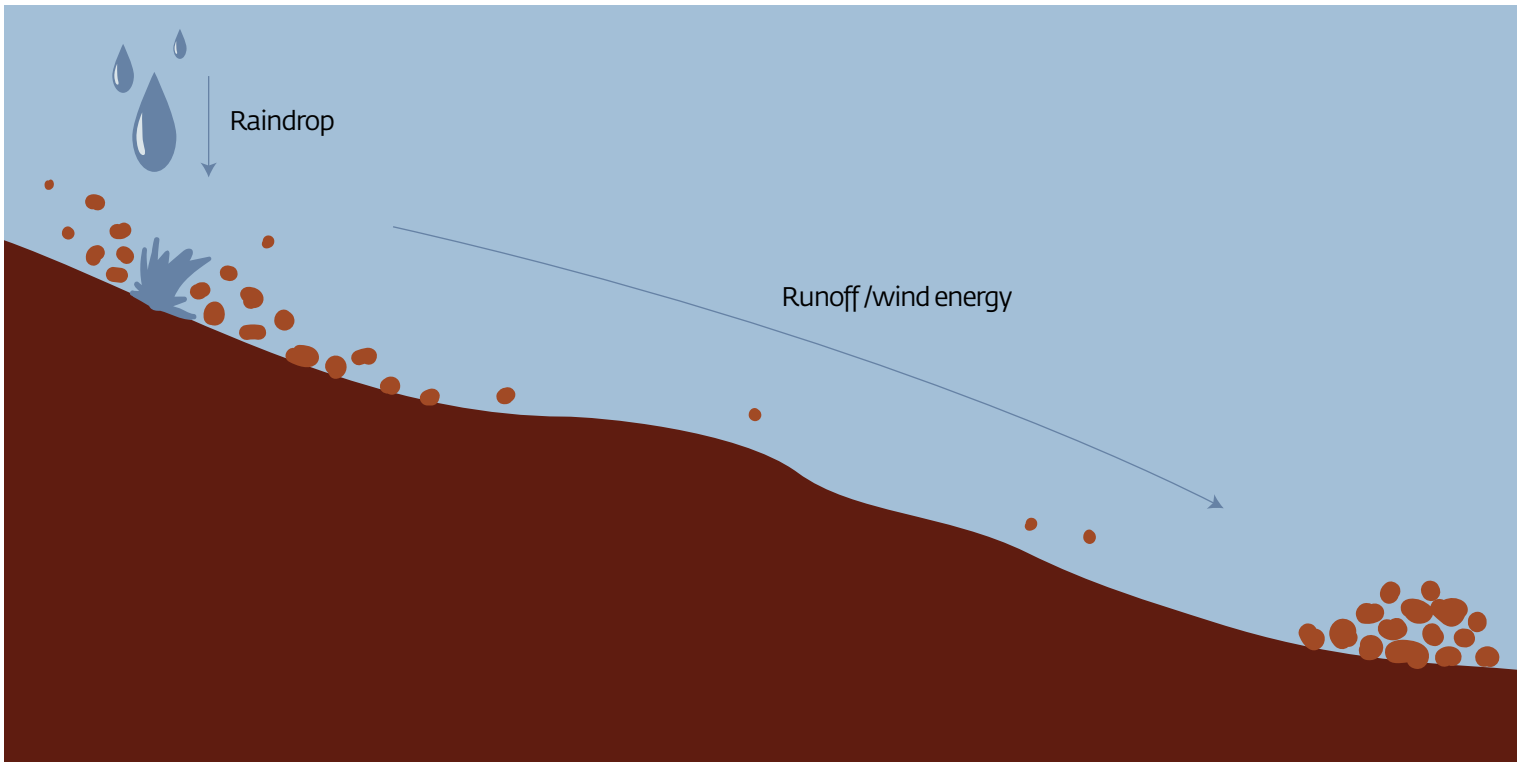


Figure 1.1: Simple conceptual illustration of the process of soil loss

Particle detachment occurs when the individual soil particles are separated off from the soil mass due to shearing force (e.g. from tillage equipment, hooves of animals, surface runoff, etc.) or due to impact force (e.g. from raindrops) on the soil (Figure 1.1). The detachment forces are effective where the soil is vulnerable (easily detachable). Soil vulnerability is brought about by its inherent soil properties (the status of the chemical and physical soil properties), continuous poor soil management, and prolonged exposure to weathering actions (Morgan, 1986). These forces cause the most damage if there is minimal restrictive soil cover (such as a lack of vegetation cover, mulches, crop-residues, etc.).

2 Types of soil loss and their drivers in Malawi

Figure 2: Types of soil erosion

The rate of soil loss is the amount of soil removed per unit area in a given time frame and is often expressed in ton/ha/year. The eroded soil that leaves a specified area is then deposited in another area, which can include another field or a watershed. The description of soil loss often focuses on the area where the soil has been removed. The detached soil particles may be deposited a few centimeters away or even meters or kilometers away. The fate of the detached soil is not always in the ocean/lakes.

The major contributing factors to soil loss are:

1. "Vulnerable soils": Soils with weak structure, shallow depth, and medium to fine texture
2. Detachment or transport energy: Also known as agents of erosion and comes in the form of rainfall, runoff, or wind energy. They initiate the erosion process and transport the detached particles
3. Land use/cover: It represents human intervention/acceleration in/of the erosion process as well as the vegetative cover to protect the soil against agents of erosion.
4. Topographic factors: They include slope and slope length. They provide the gradient for translating the detached soil.

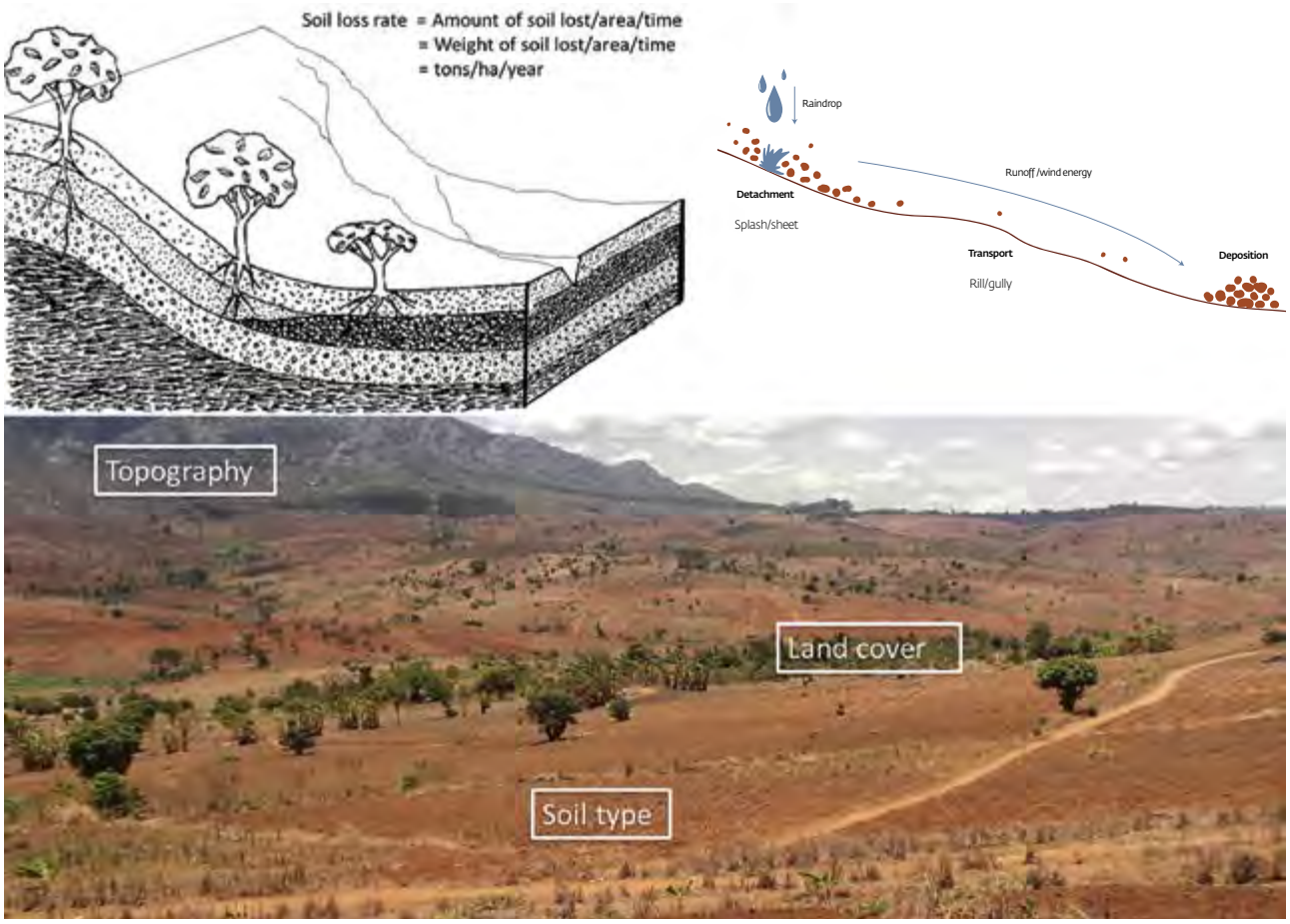
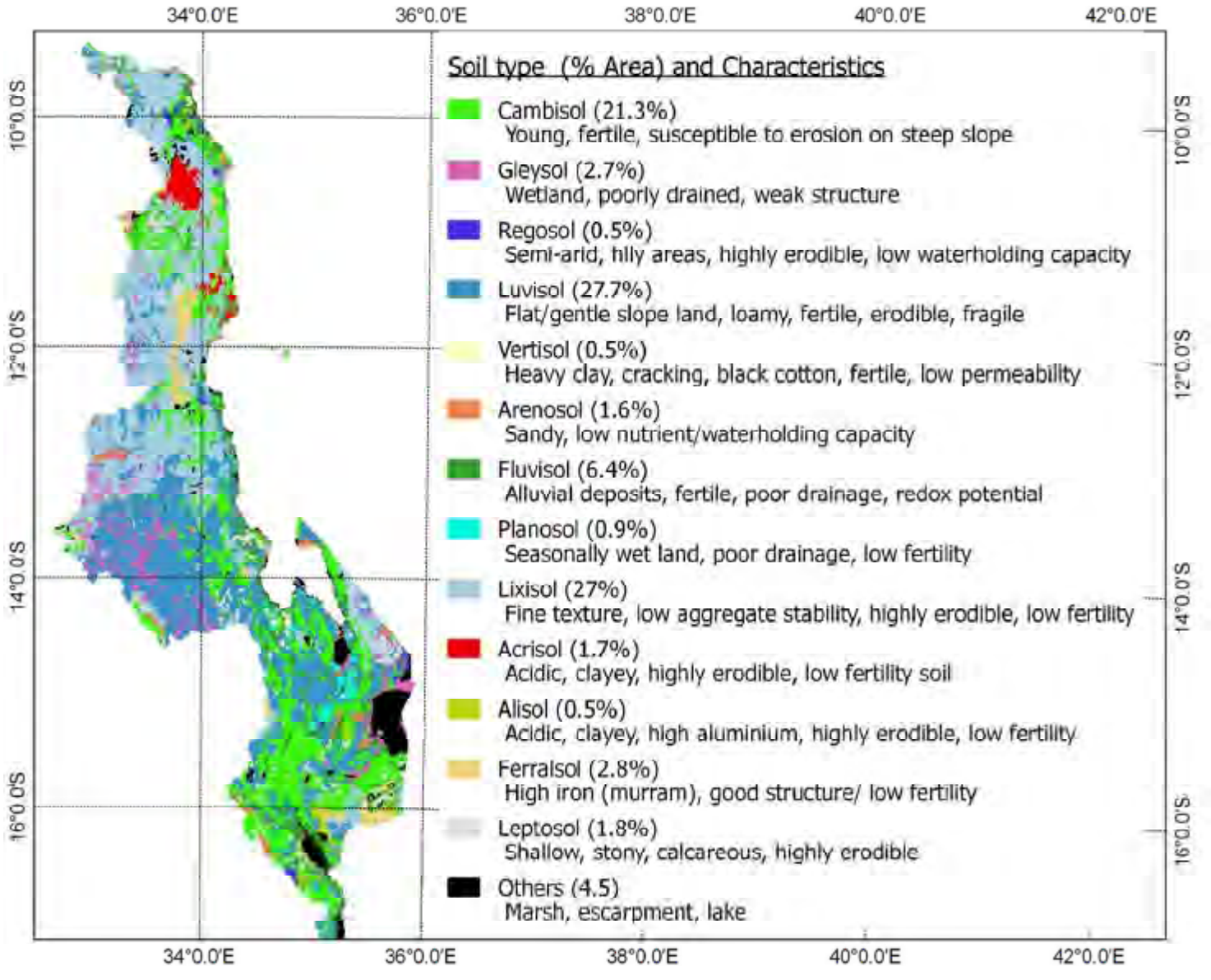


Figure 3: Soil loss and category of contributing factors

2.1 Major soil types in Malawi

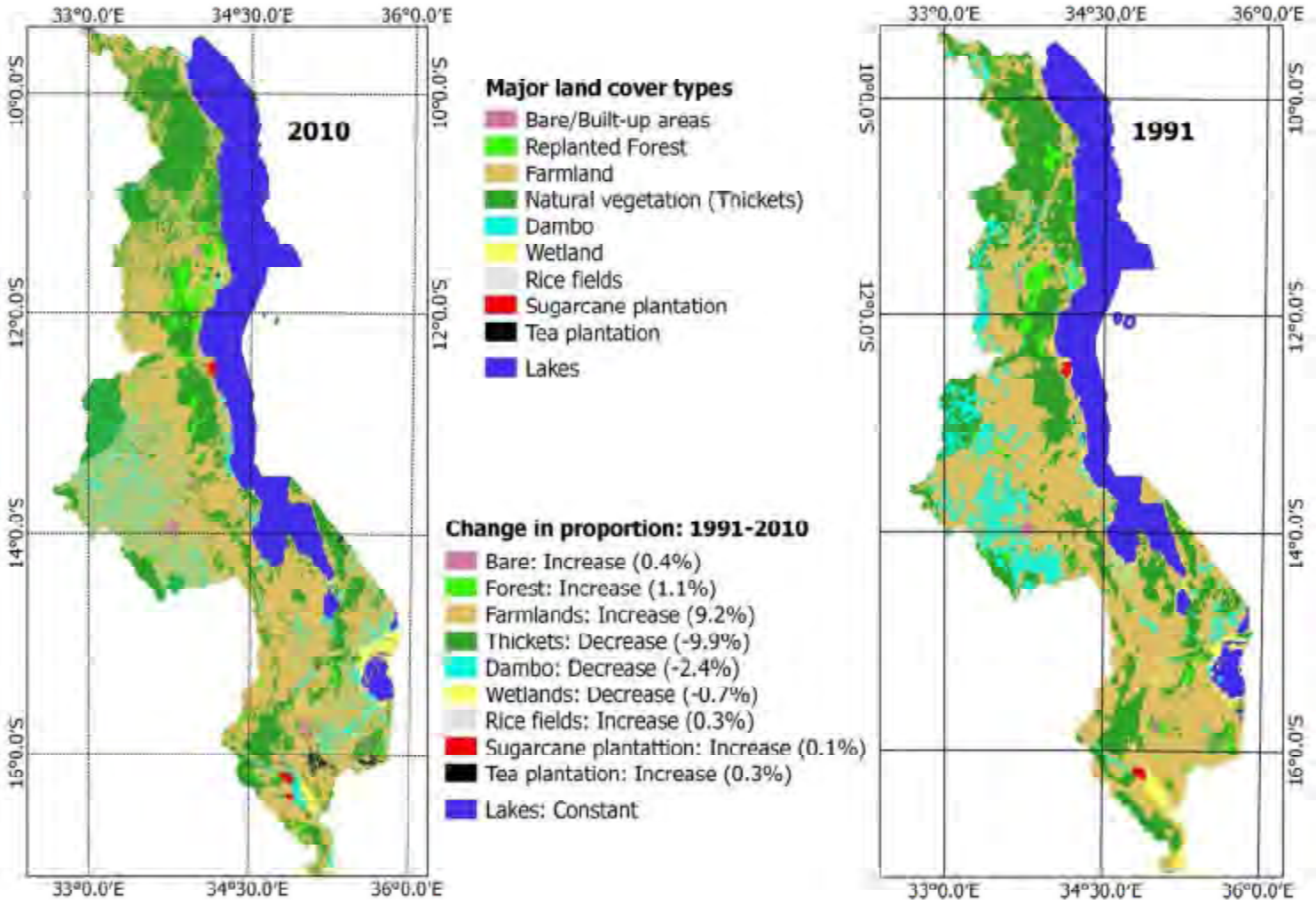
The major soil types in Malawi are Luvisols, Lixisols, and Cambisols. Lixisols are dominant in the northern region, Luvisols in the central region, and Cambisols along the Rift Valley and most importantly in the southern regions. Cambisols and Luvisols are naturally endowed with good soil nutrients for agricultural purposes. Lixisols have relatively higher silt and organic matter content. However, they need judicious fertilizer use and management in order to safeguard agricultural productivity and minimize the negative impacts on the environment, as well as on human and animal health. Soils in the region may take a long time to regenerate if continuously tilled and subjected to soil erosion, without any nutrient and organic matter input.



Source of base map: Government of Malawi

2.2 Major land cover/use types in Malawi

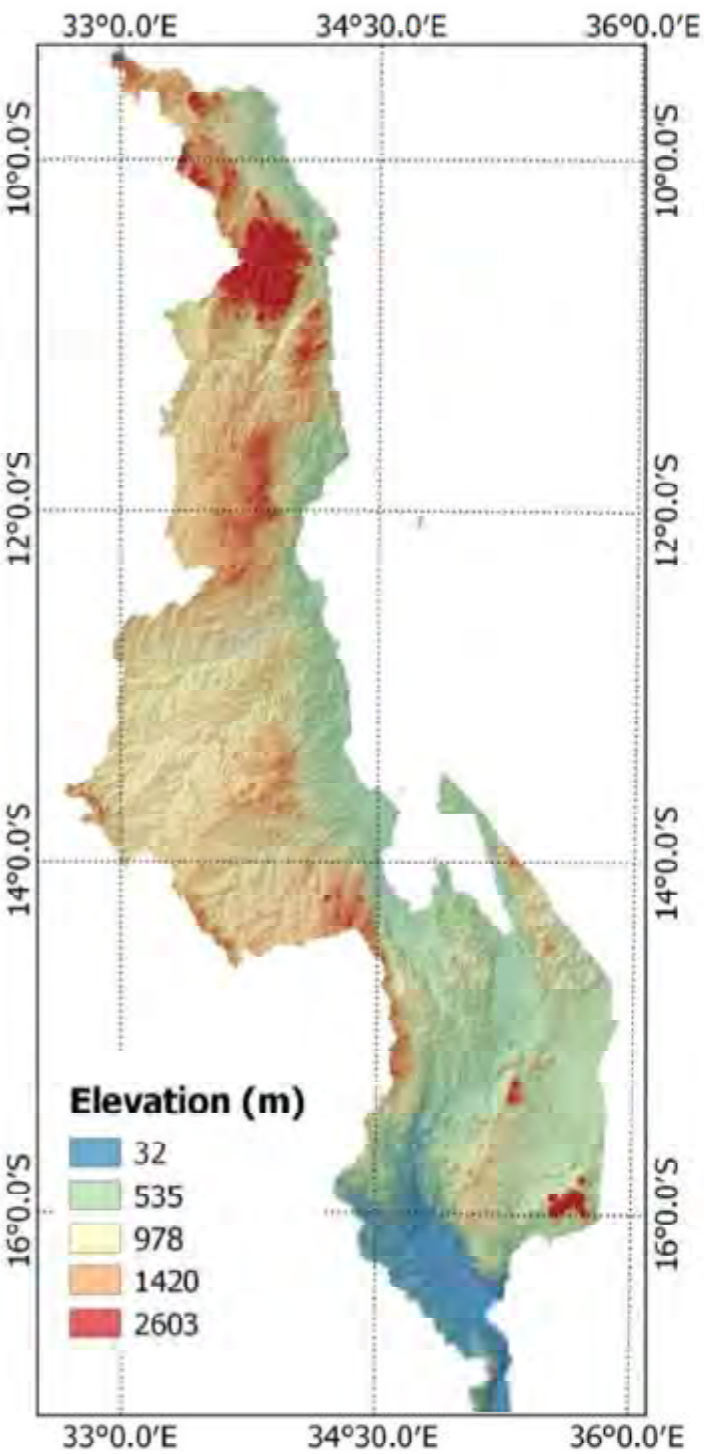
The main land use/cover types in Malawi are farmlands, natural forests, forest plantation, wetlands, built-up areas, and lakes. Farmlands occupy the largest areas, with an increased coverage of 9% between 1991 and 2010. The majority of the farmlands have seasonal ground/vegetative cover owing to the seasonal types of crop grown in them. The produce provided by these farmlands is mostly used at the local level. The natural forest is dominantly used as game parks or forest reserves. They provide the country with tourist attraction benefits, fuelwood, medicinal plants, timbre, food, water catchment areas, above-ground carbon stocks, and the ground cover that protects the soil from agents of erosion. Some parts of these forested lands have been replanted with tree species such as pines, rubber, etc. All together, the forests occur mainly in the north of Malawi and in the upper parts of the central region.

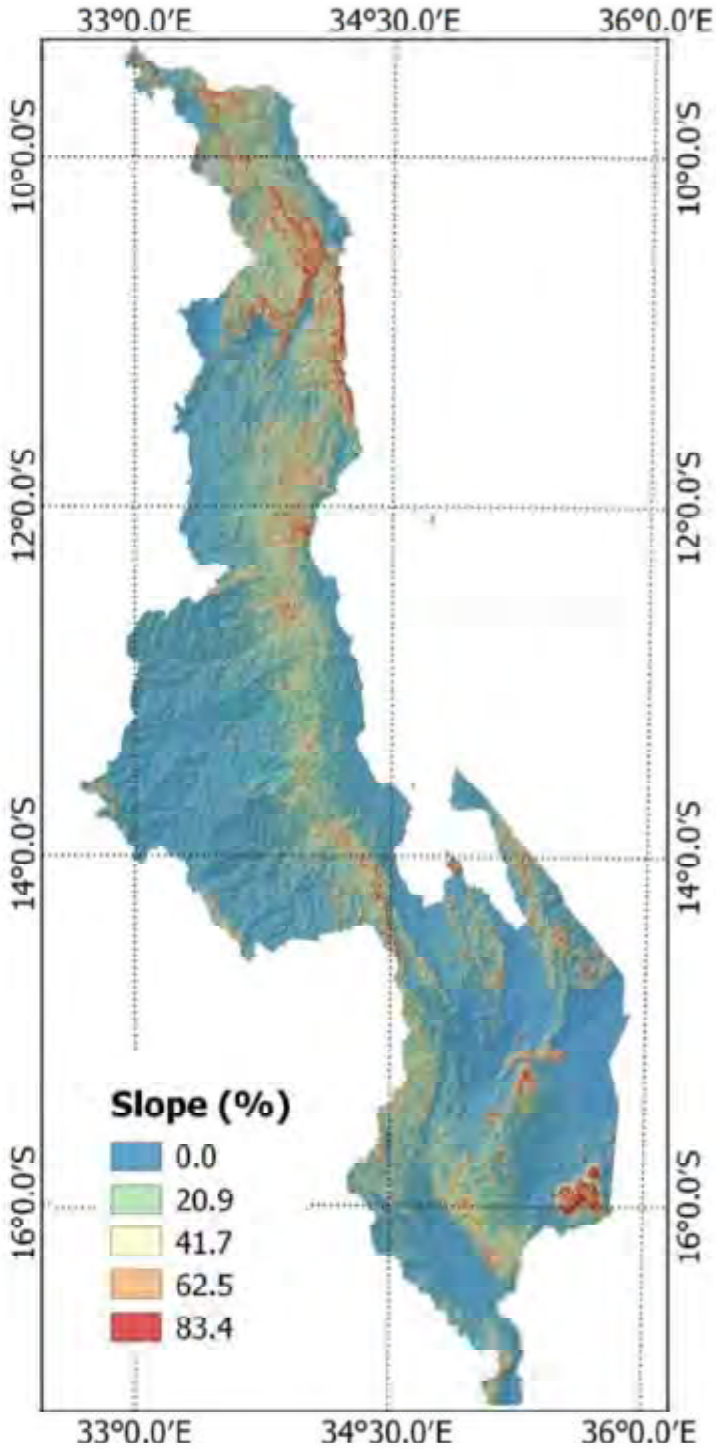


Source of base map: Government of Malawi

2.3 Topography

Malawi lies between the Longitudes 32° 40' 17.8" E and 35° 55' 6.2" E and between the Latitudes 17° 7' 34.7" S and 9° 21' 49.2" S and covers about 118,484 km^2. The altitude generally drops from a high of 2603 m above sea level in the northern part of the country and in Mulanje, in the south, to 32 m above sea level. The topography of the country can be generally categorized into four major types: the hilly and undulating terrain in the north and some parts in the south; mid-altitude flat/gently sloping plateaus in the centre; steep slopes of the Rift Valley region; and flat/gently sloping plains in the south and lakeshore regions. Apart from the Rift Valley, the other three relief characteristics form three discernable major drainage basins: the north, central, and south drainage basins.

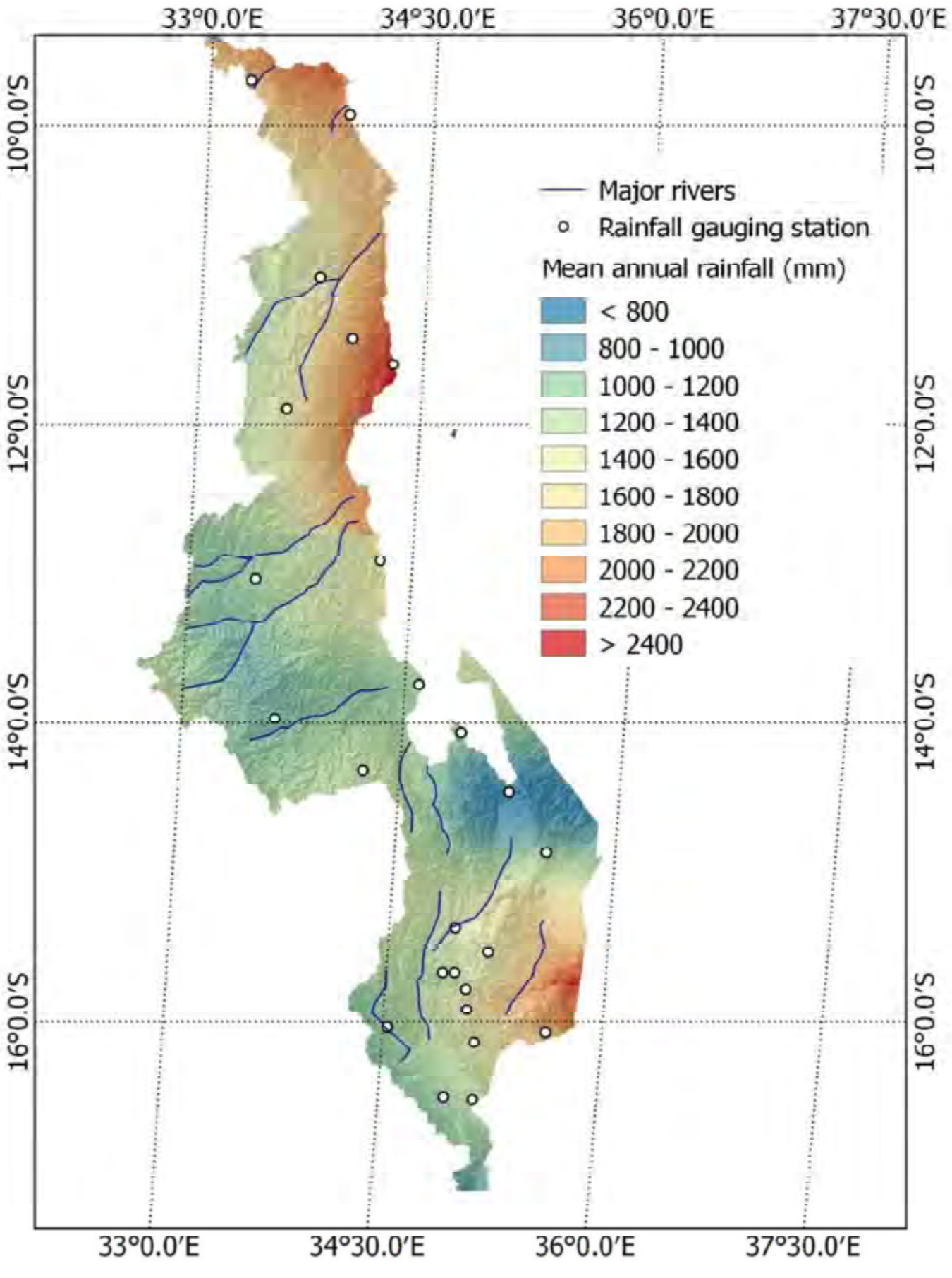




Source of base map: Government of Malawi

2.4 Mean annual rainfall

Mean annual rainfall in Malawi ranges from 725 mm to 2500 mm. This rainfall occurs during two seasons that are separated by a small window of a little less than three weeks. About 95% of this rainfall falls between November and April. The majority of this rain falls in the north and southern regions (in Mulanje and Phalombe). The rainfall "energy" is directly related to the total annual precipitation; implying that the areas with high rainfall regimes also have high rainfall energy for initiating soil loss.



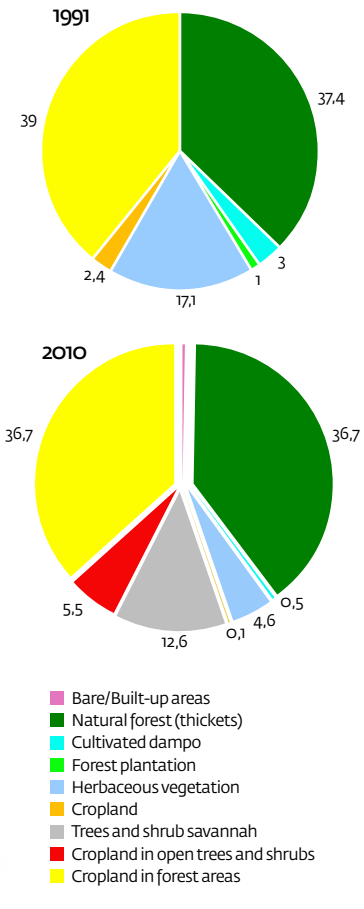
Source of base map: Government of Malawi

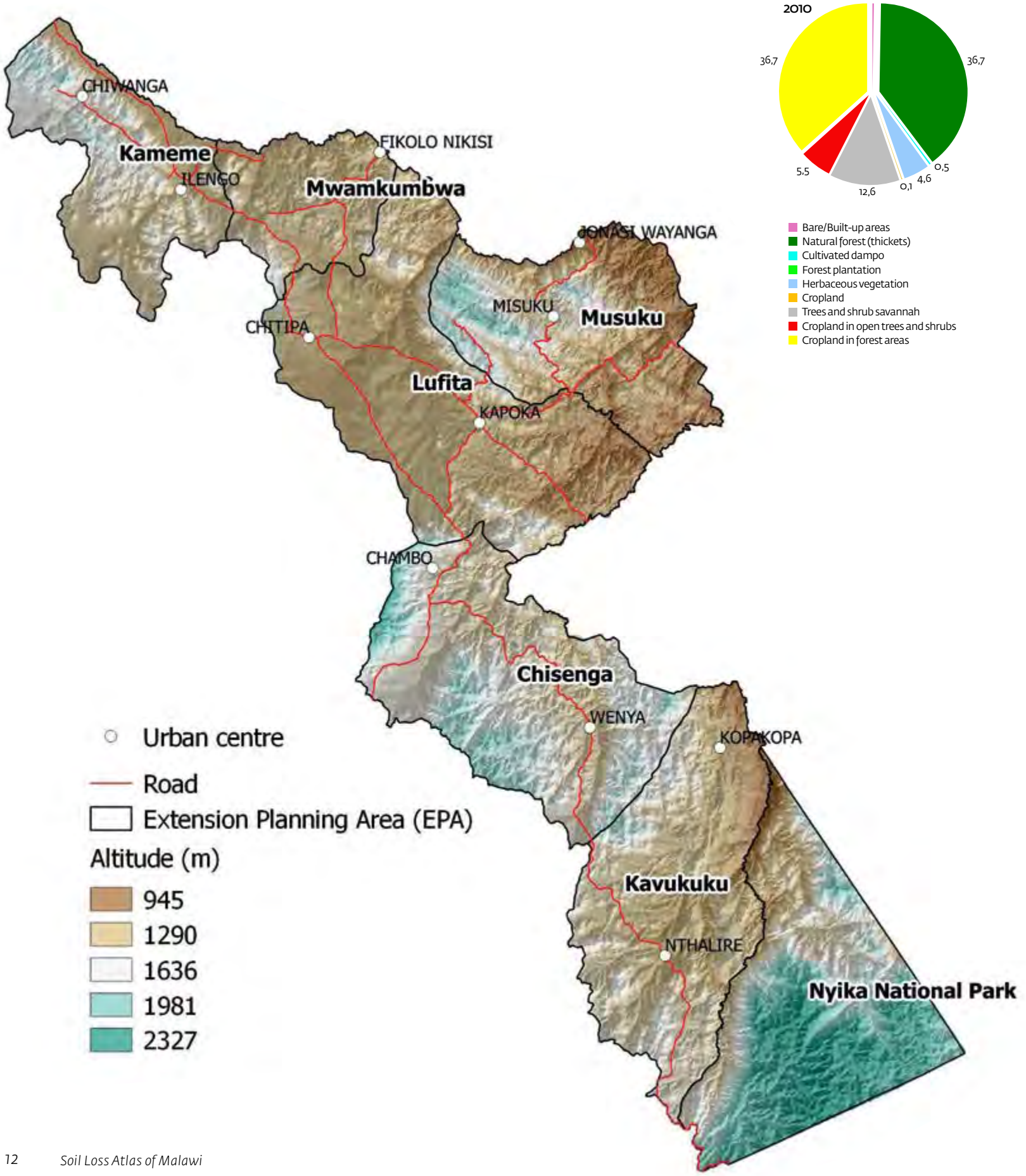
3 Topsoil loss by districts

Drivers of soil loss
1. Vegetation cover change:

The main land use/cover types are croplands, forest, and urban settlements. Significant changes in proportion of these land use types have been observed between 1991 and 2010. The most noticeable change was the increase in both open areas with trees, shrubs and cropland areas. There was also a corresponding decline in natural vegetation especially in areas with high rainfall and steep slopes.

Proportion (%) of land use/cover





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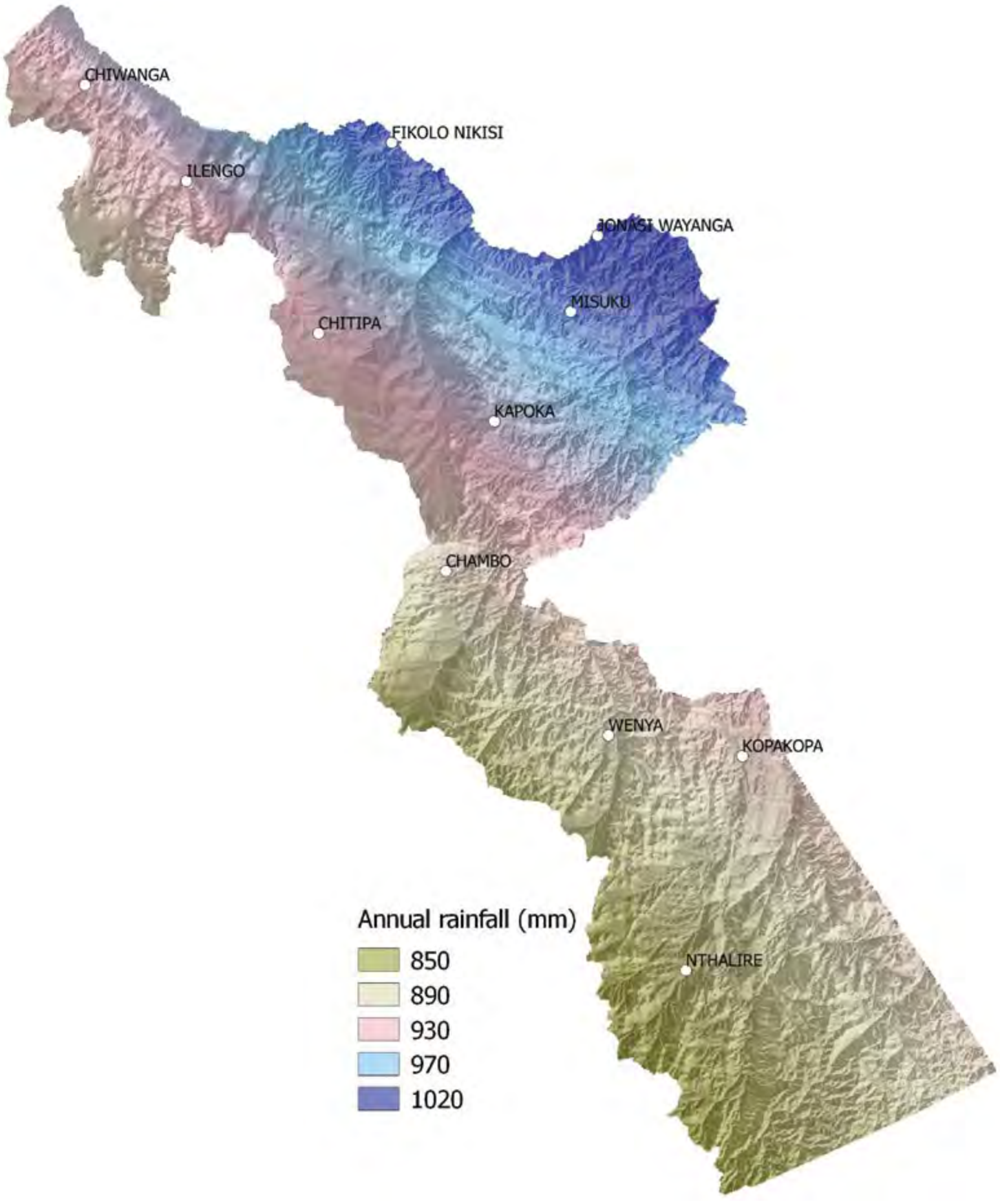

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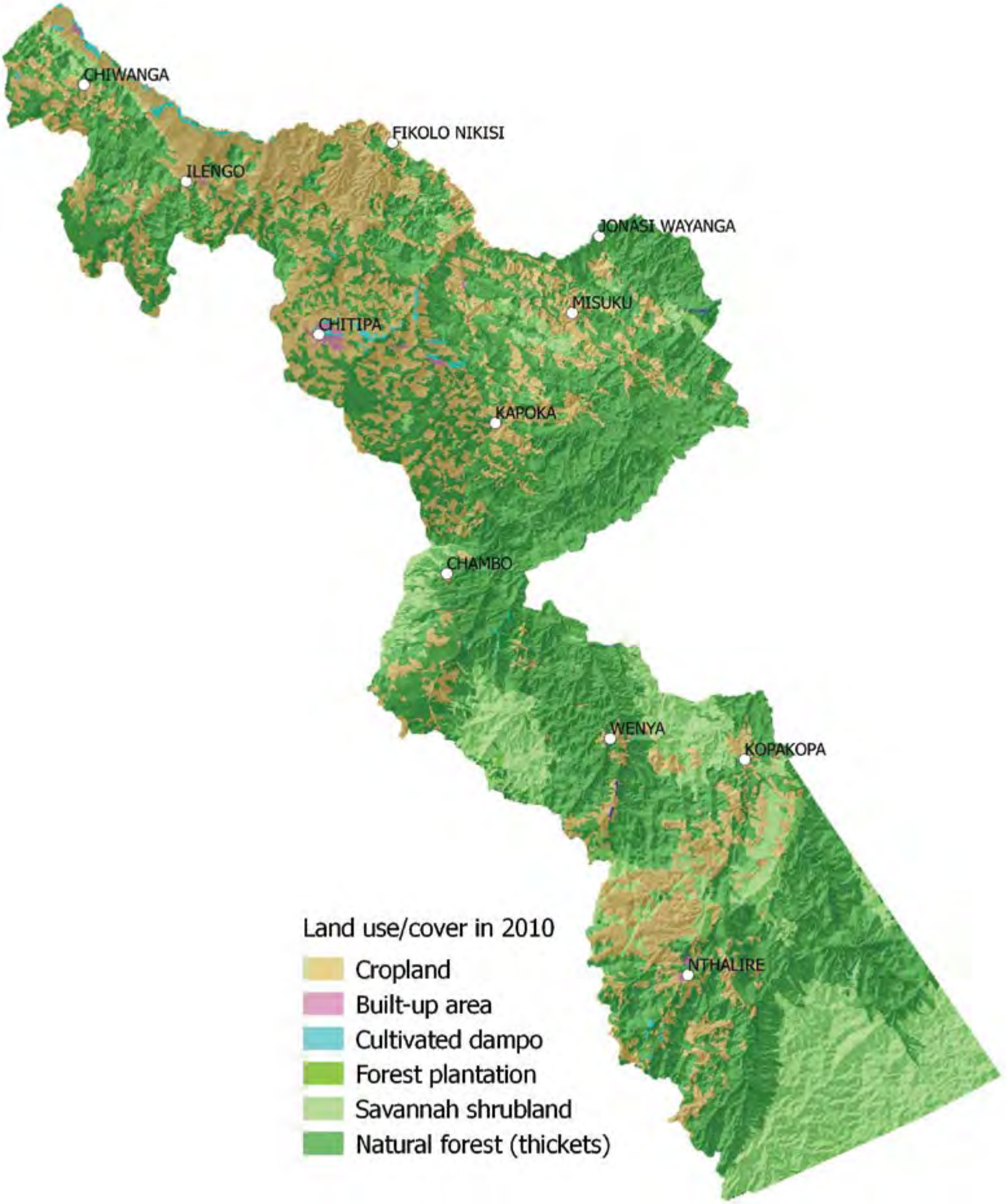

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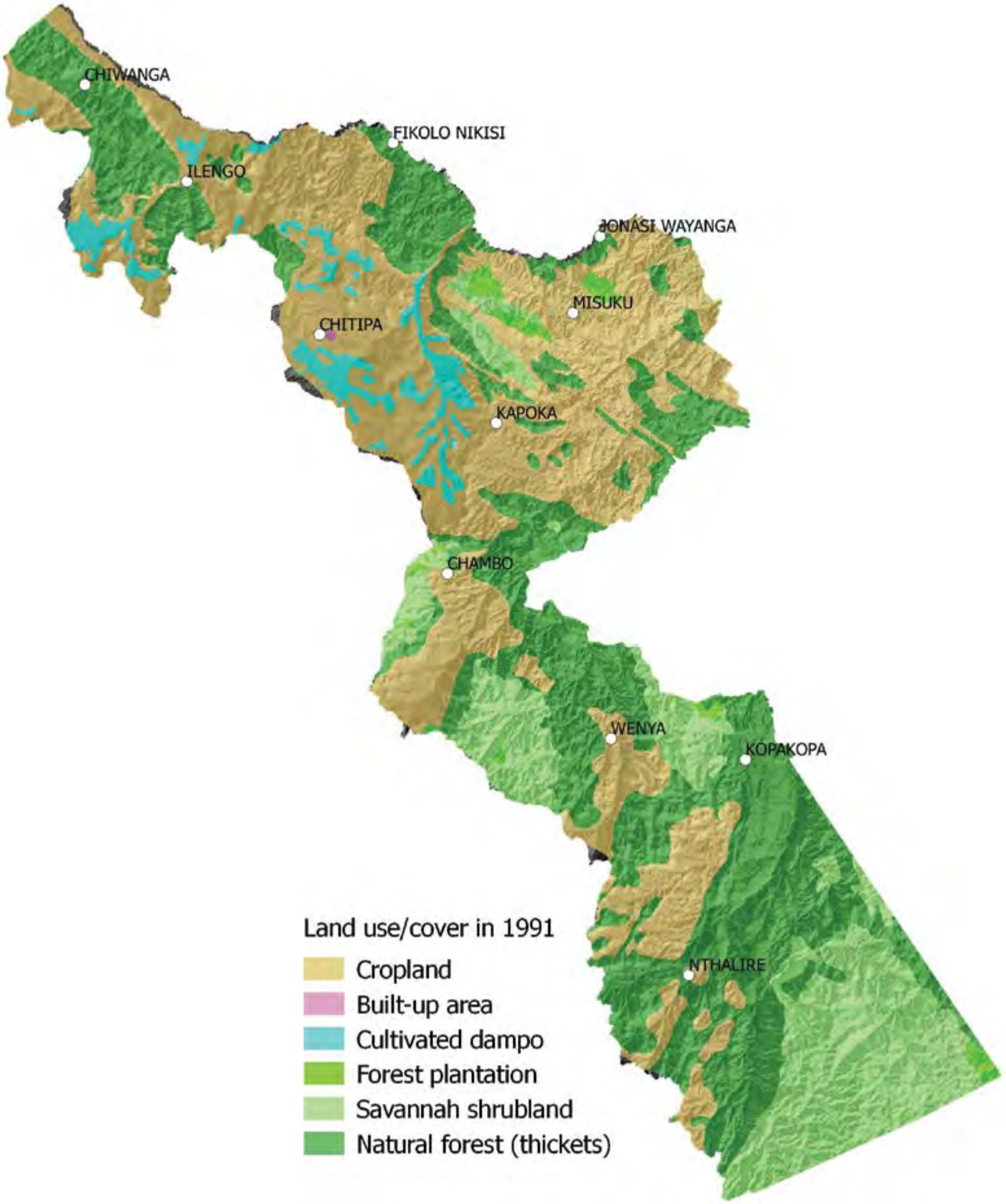


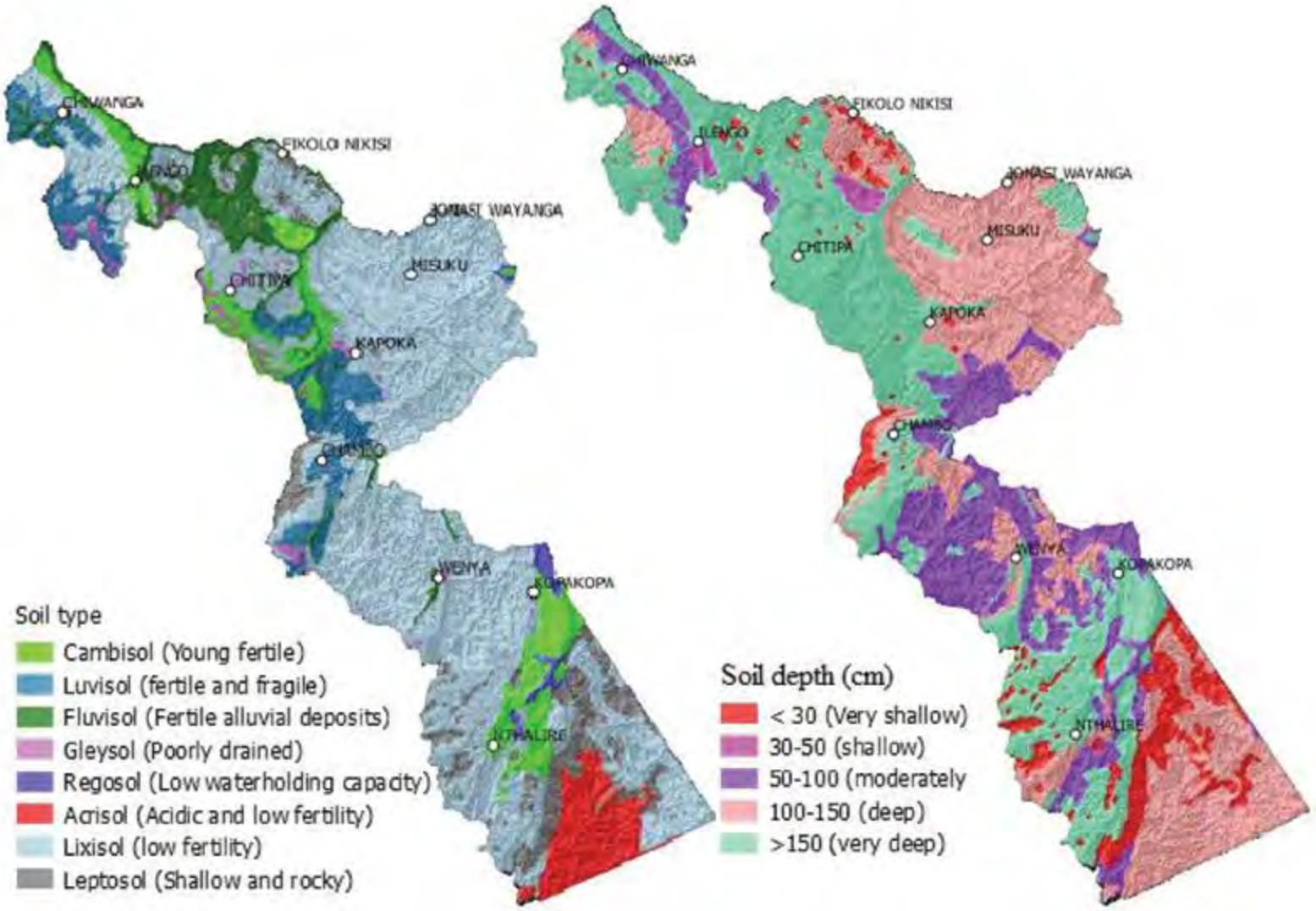
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors:

Some parts of the district, especially along the border with Tanzania, experience rainfall erosion. Steep slopes with shallow and structurally unstable soils are also common (e.g. in Misuku and Nyika National Park EPAs).

Sleep slopes and shallow soils at Msukwa

Ragged terrain, steep slopes, and shallow soil at Muoma Soil loss risk factors



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Natural vegetation cover change between 1991	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Kameme	Large decline	12.6	92.1	931	894-964	Risk
Mwamkumbwa	Large decline	8.3	73.2	973	936-1020	High risk
Lufita	Small increase	10.7	99.7	949	905-1015	Risk
Musuku	Small decline	24.3	82.1	1000	965-1045	High risk
Chisenga	Small decline	16.7	96.1	891	860-924	High risk
Kavukuku	Large decline	13.5	91	878	842-928	High risk
Nyika National Park	No change	22.4	99.1	885	845-917	High risk

Gully erosion at Tchewa, Nthalire

Measuring sheet erosion at Mughogho, Kampsongo

Gully at Kabaghe, Sanga

Sheet erosion at Sanga Topsoil loss rate

Topsoil loss rate

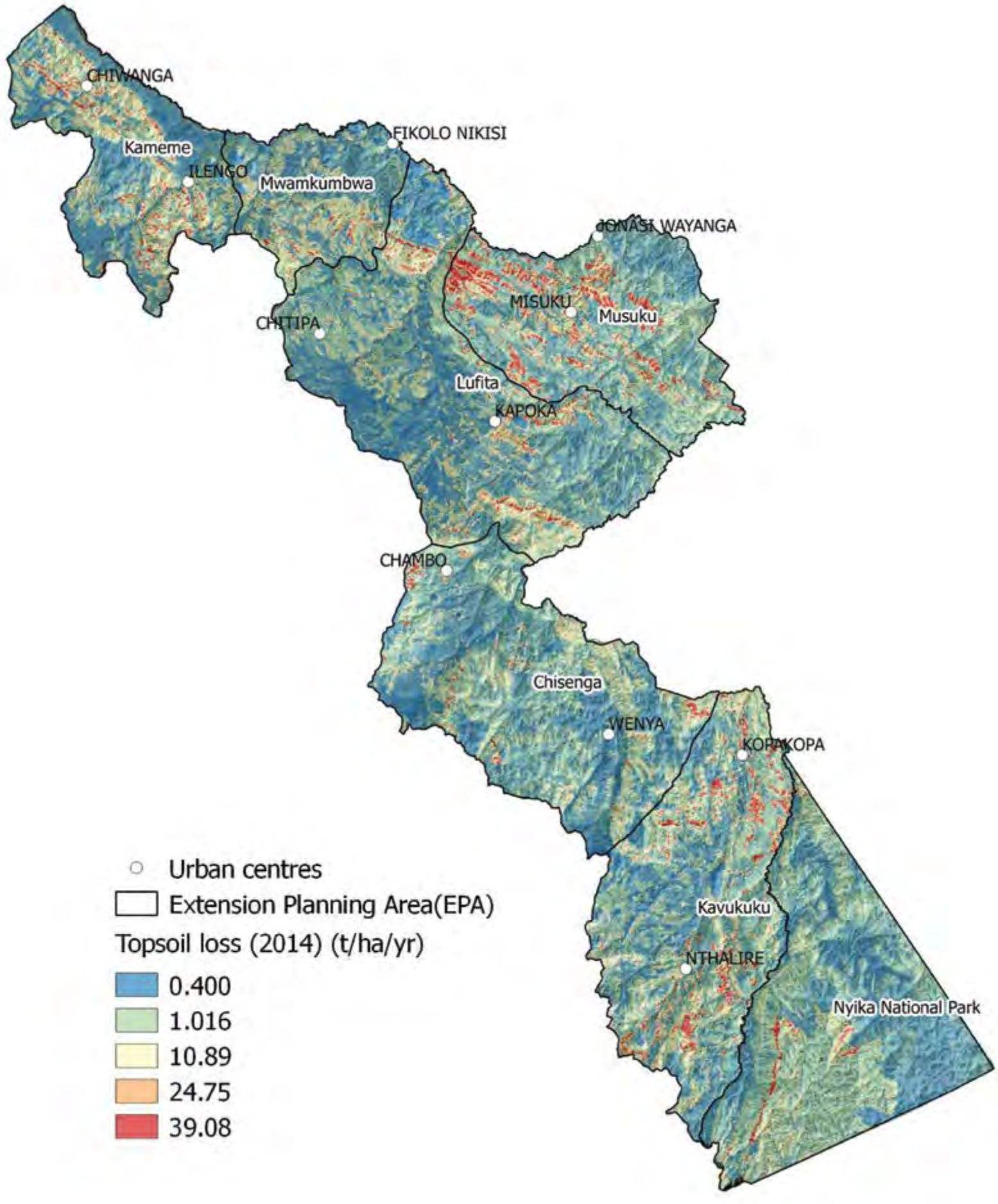
The mean topsoil loss rate for the districts in 2014 was 15.22 t/ha/yr. Misuku EPA had indications of the highest soil loss rates. Kameme and Kavukuku EPAs also had indications of considerably high soil loss rates. The main contributing factors for high soil loss rates in these areas are: vulnerable soils on very steep slopes erosion rainfall, and decline of protective vegetative cover. The protected Nyika National Park, while having steep slopes and vulnerable soil, seems to experience the lowest soil loss rates.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Kameme	18.53	0.47	39.08
Mwamkumbwa	12.71	0.41	26.18
Lufita	12.65	0.40	27.70
Musuku	19.29	0.83	31.22
Chisenga	14.42	0.54	26.12
Kavukuku	18.77	0.43	38.51
Nyika National Park	10.14	0.48	23.22

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA pH OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
-%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chisenga 5.41 1.490	0.735	0.075	8.321	0.537	0.525	3.254	1.228	0.708	2.123	12.739	11.678
Kameme 5.20 0.994	0.490	0.050	26.522	0.272	0.506	3.628	1.495	1.746	2.690	22.550	27.316
Kameme (Ipenza) 5.21 0.739	0.364	0.037	9.273	0.591	0.796	4.864	2.603	1.382	1.529	20.258	17.453
Kavukuvuku 5.47 1.349	0.666	0.066	12.179	0.659	0.506	3.496	1.260	0.979	2.936	17.614	16.146
Lufita 5.45 0.978	0.483	0.050	12.788	0.506	0.603	2.815	1.177	0.860	2.109	24.732	15.410
Misuku 4.84 1.831	0.906	0.095	10.881	0.475	0.682	7.712	1.489	1.106	2.936	17.375	15.595
Mwamkumbwa 5.17 1.347	0.664	0.067	14.667	0.584	0.827	5.710	4.359	1.449	0.906	27.914	19.567



Source of base map: Government of Malawi

Typical state of croplands in July-August period in 2017

Cropland at Adam 1, Kameme EPA

Cropland at Mweneluungu, Kavukuku EPA

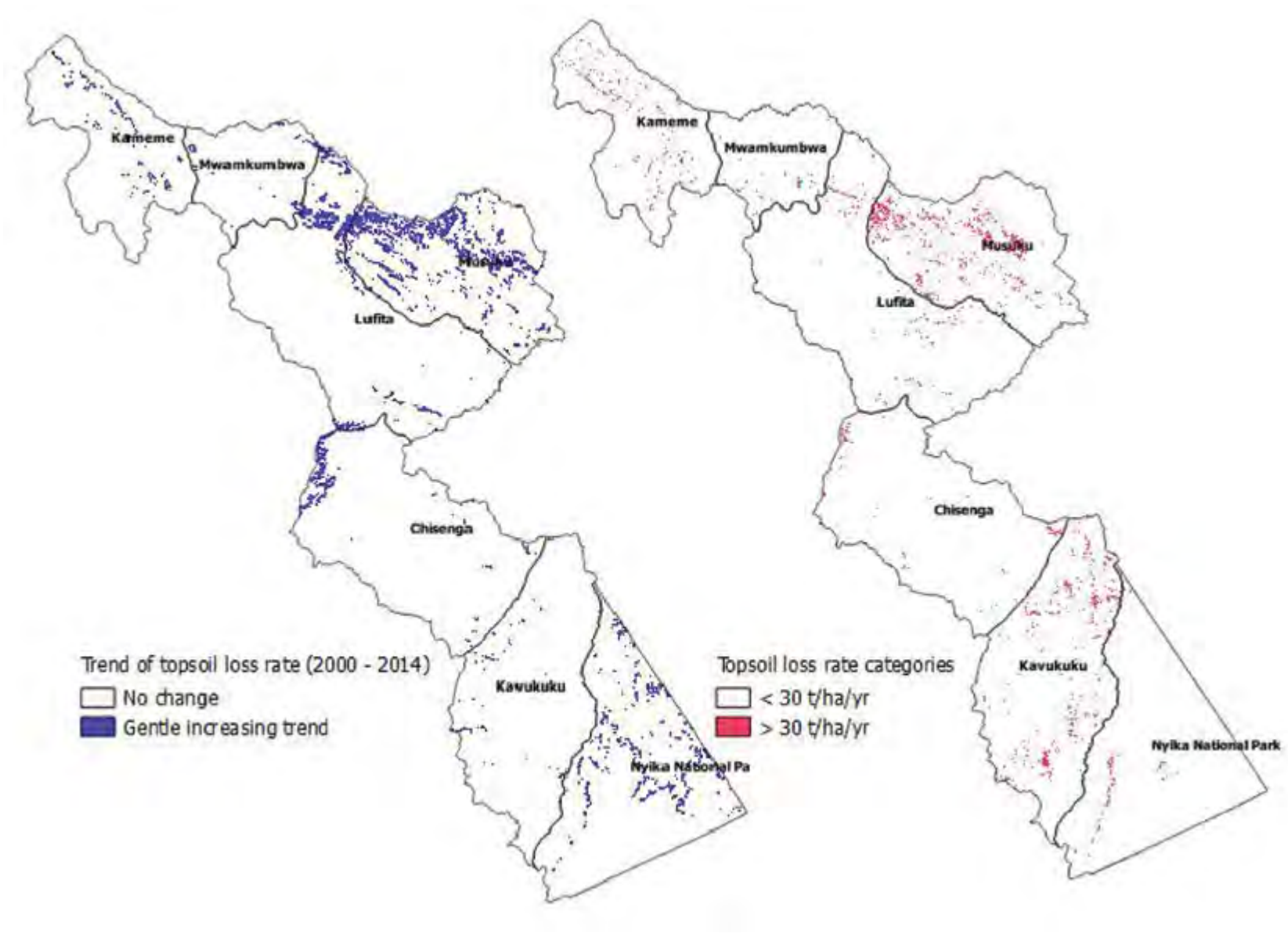
Cropland at Chinkhutupa, Chisenga EPA

Cropland at Ilondo, Lufita EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Kameme	0.0892	0.0162	0.2828	0.3883
Mwamkumbwa	0.1024	0.0267	0.3197	0.4488
Lufita	0.0796	0.0071	0.2316	0.3182
Musuku	0.0790	0.0124	0.2364	0.3278
Chisenga	0.0958	0.0147	0.2265	0.3370
Kavukuku	0.1006	0.0239	0.2776	0.4021
Nyika National Park	0.0784	0.0066	0.2862	0.3712

Topsoil loss trend between 2000 and 2014



Source of base map: Government of Malawi

The majority of the areas with a high rate of topsoil loss are the ones which have previously experienced an increasing trend of topsoil loss rate between 2000 and 2014. Kameme, Kavukuku and Musuku EPAs experienced the most topsoil loss. They need more soil conservation efforts to ease the growing trend of topsoil loss rates. Nyika National Park also experienced increasing trends of soil loss rates. While this area is protected and has usually had low soil loss rates, there are now signs of soil loss and associated issues, especially near the border with the Keronga District.

Land, soil and water conservation measures

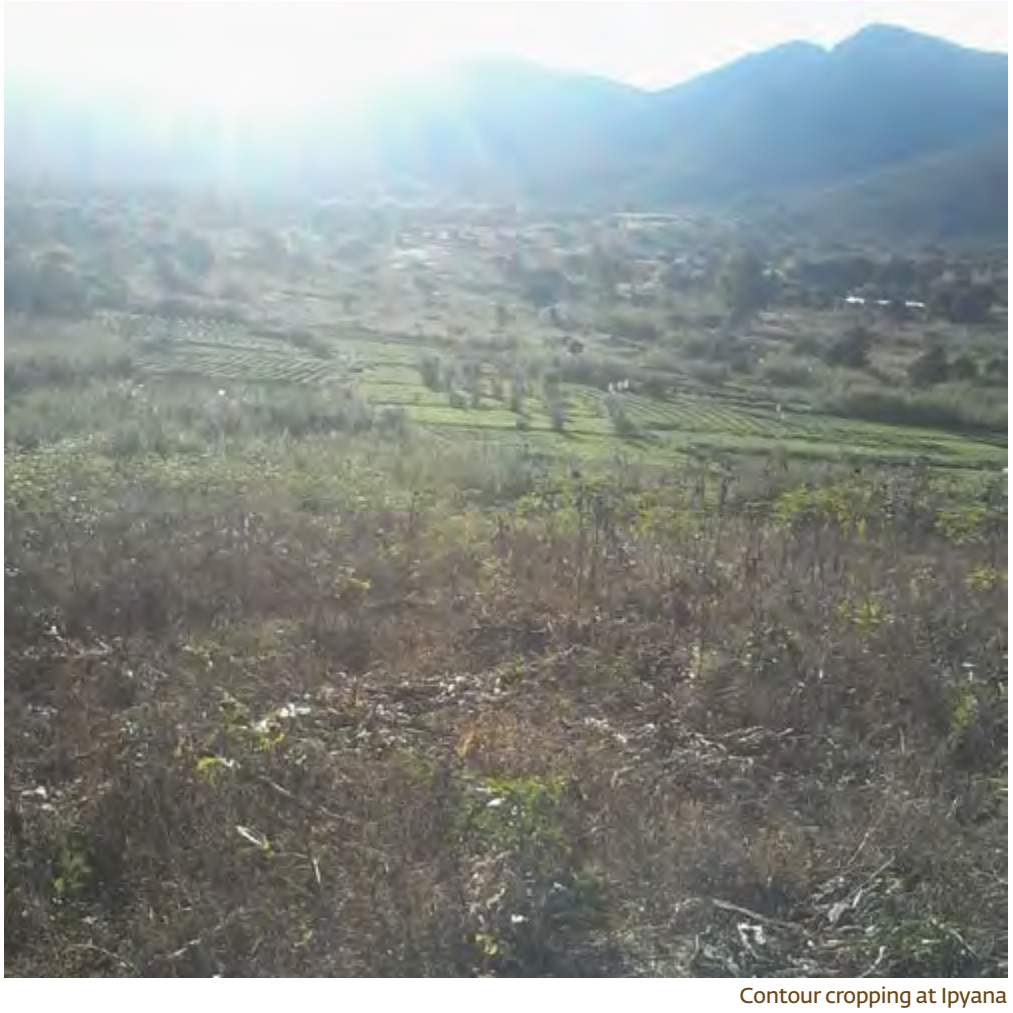
Contour ridging at Msukwa Chapota

Vetivar grass strips and tree-crops at Zyangamlima , Mwanyanja

Land, soil and water conservation measures

Protection of natural forest at Kavukuku

Natural and planted forest at Misuku



Contour cropping at Ipyana

Drivers of soil loss
1. Vegetation cover change:

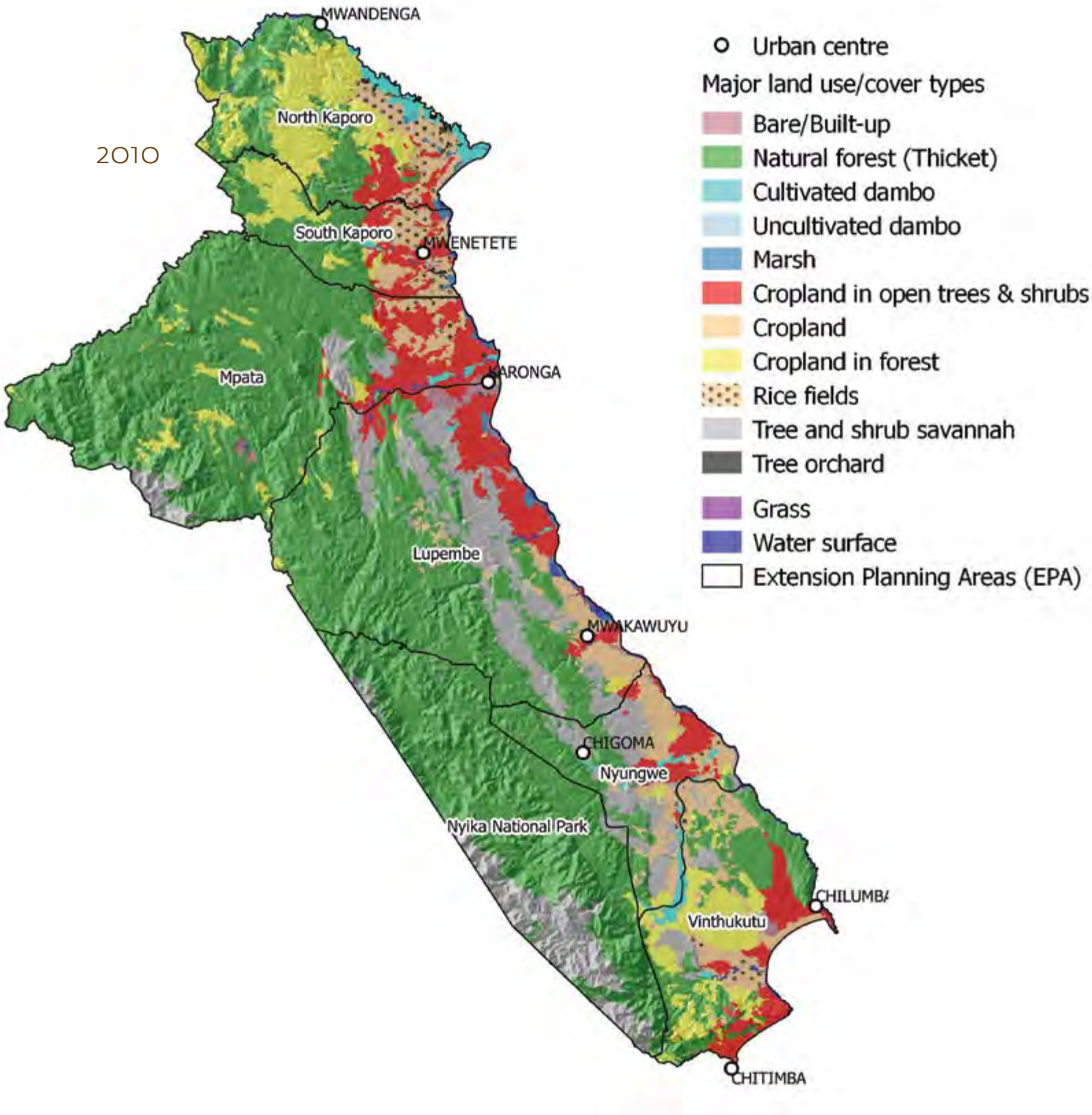
The main land use/cover types are smallholder croplands, natural forests, and urban/settlements. There were no significant changes in the proportion of these land use types between 1991 and 2010, except for the intensification and diversification of agriculture within the cropland areas. The main threat to soil loss is the intensification and diversification of agriculture within the croplands especially in steep slopes and in shallow and vulnerable soils.

Major land cover/use types in 2010 and 1991

1991

Source of base map: Government of Malawi

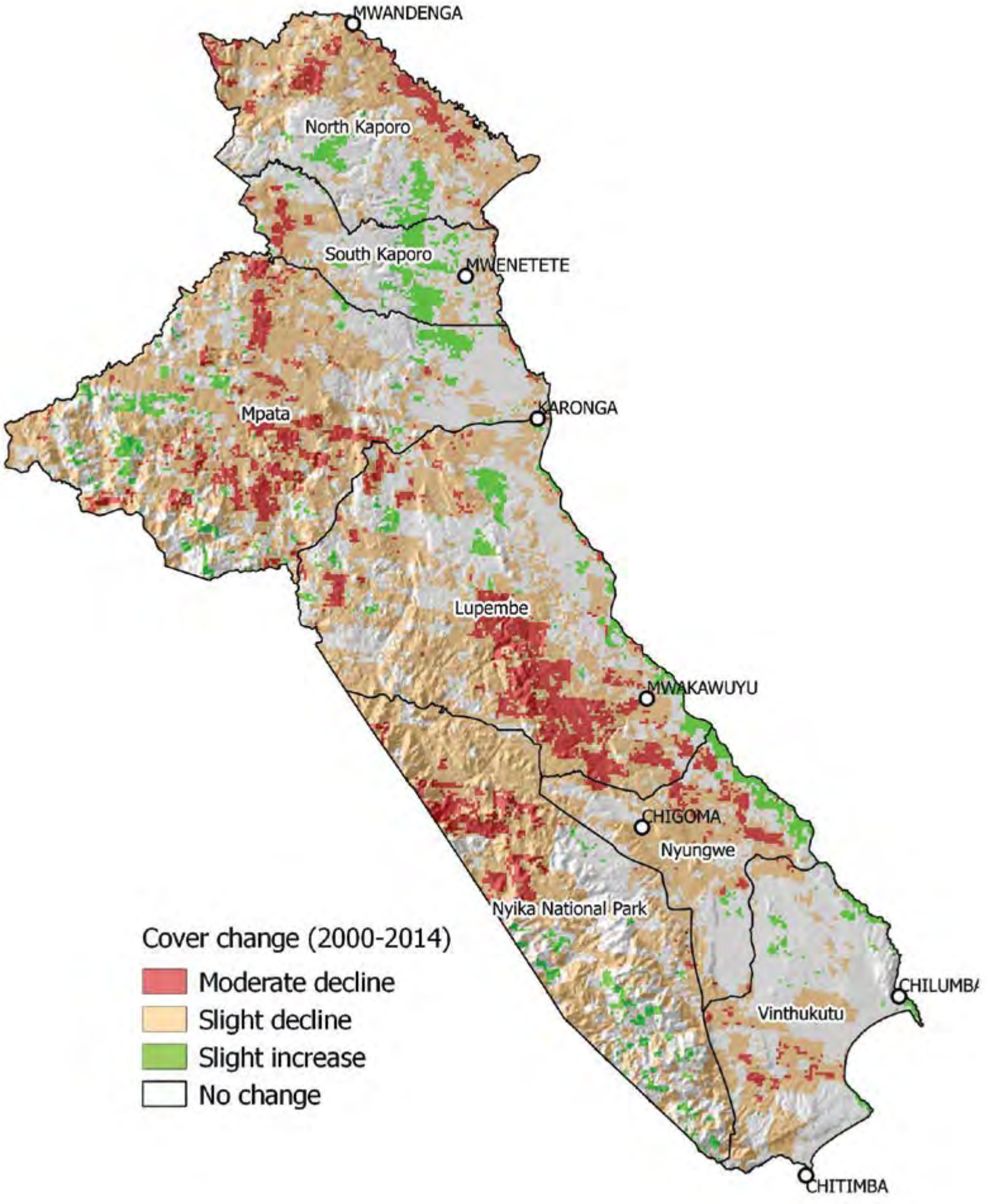
2010



Source of base map: Government of Malawi

Example of land cover type at Wiriro and at Kayerekera

Vegetation cover change



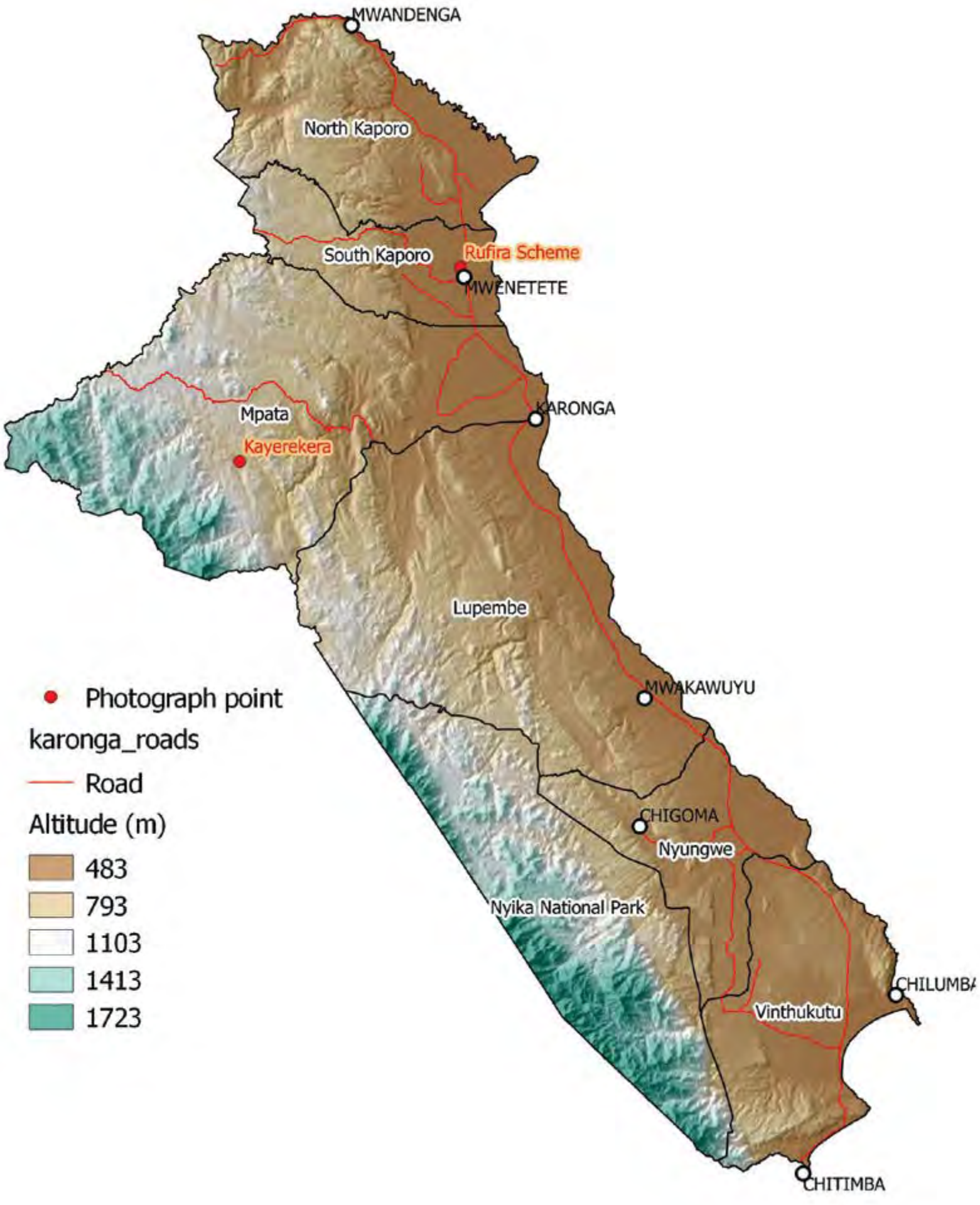
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors:

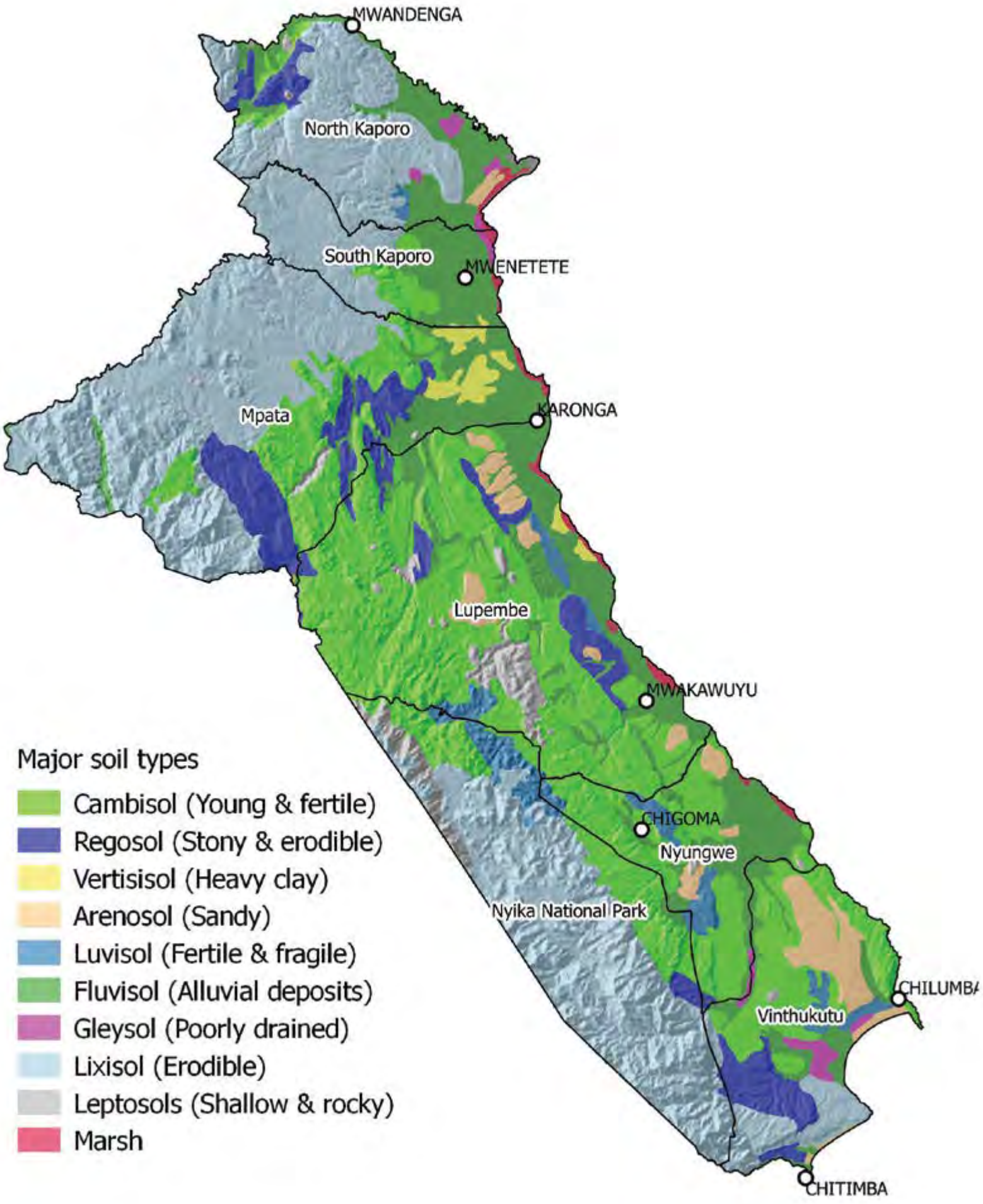
Karonga's axis from the north to south has a lot of escarpments, being in the Rift Valley. The escarpments have steep slopes and shallow soil. These soils are more vulnerable to soil erosion especially where there is agricultural intensification and low vegetation cover. The south-western side has rather flat terrain with deep soil.

Deep soil at Kayerekera Irrigation farm

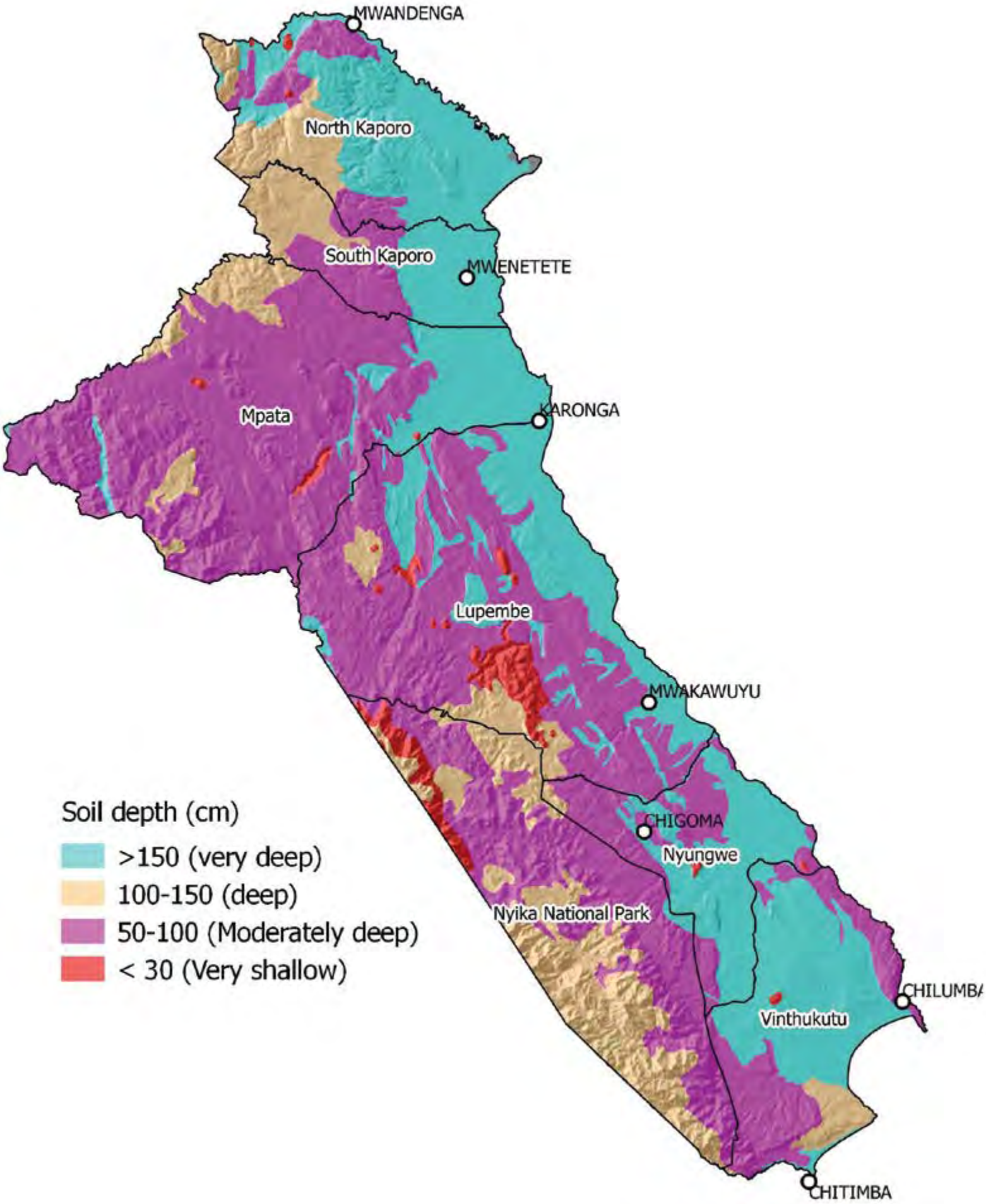
Deep soil at Rufira rice scheme



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

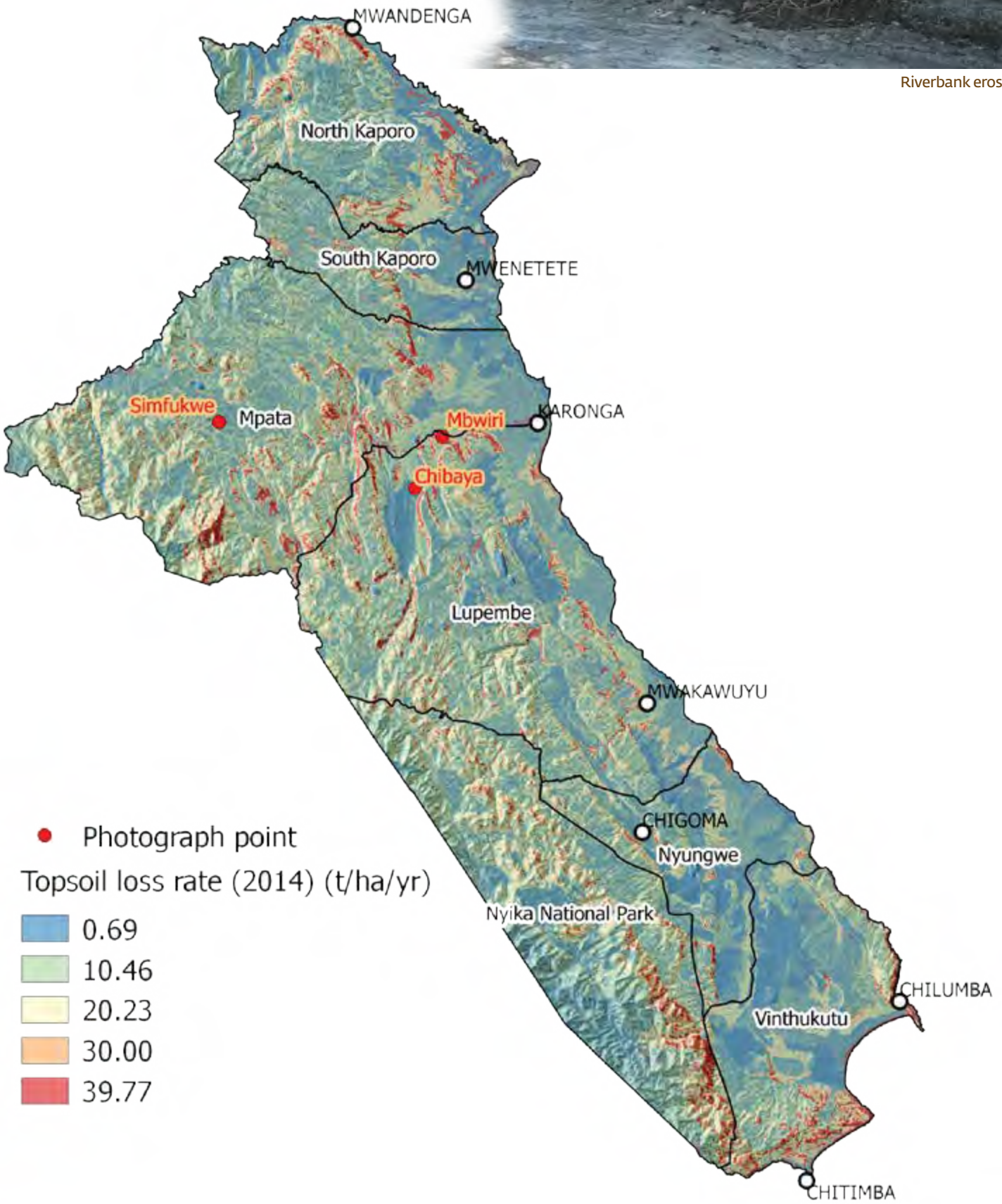
Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
North Kaporo	Moderate	11.6	91.3	1035	1007-1066	Moderate risk
South Kaporo	Slight	7.2	66.9	1004	990-1020	Moderate risk
Mpata	Moderate	15.6	99.8	955	909-996	Moderate risk
Lupembe	Moderate	11.0	78.5	941	914-978	Moderate risk
Nyika National Park	Slight	27.0	99.8	917	905-929	Moderate risk
Nyungwe	Moderate	6.7	65.5	931	921-940	Moderate risk
Vinthukutu	Moderate	7.9	98.2	937	925-948	Moderate risk

Features of soil erosion

Gully erosion measurement at Mbwiri

Rill erosion measurement at Simfukwe

Riverbank erosion at Chibaya



Source of base map: Government of Malawi

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 5.37 t/ha/yr. Thumbwe EPA had indications of the lowest soil loss rates. The main contributing factors for the soil loss rates in these areas include the presence of vulnerable soils and agricultural intensification, especially in steep slopes.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
North Kaporo	12.30	0.71	33.31
South Kaporo	9.10	0.75	31.82
Mpata	22.30	0.69	39.74
Lupembe	18.17	0.74	33.35
Nyika National Park	13.57	0.84	39.67
Nyungwe	9.01	0.88	36.14
Vinthukutu	11.29	0.79	37.24

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Kapolo North	5.29	1.440	0.709	0.072	10.726	0.873	0.512	6.340	1.673	3.341	2.160	39.338	17.509
Kapolo South	5.12	1.734	0.854	0.087	27.797	0.560	0.593	4.725	1.788	0.949	0.753	23.085	8.071
Lupembe	7.13	1.903	0.940	0.095	48.241	0.961	0.749	9.660	2.788	2.341	0.856	25.813	4.455
Mpata	6.05	1.804	0.888	0.090	8.694	0.439	0.523	3.073	1.155	0.554	0.522	31.713	13.300
Nyungwe	7.43	2.685	1.323	0.134	40.894	0.549	0.543	4.270	1.444	2.368	0.662	35.768	15.616
Vinthukutu	5.79	1.405	0.692	0.070	63.741	0.436	0.524	3.127	1.237	1.021	0.715	29.098	20.370
Nyika National Park	4.60	2.002	0.926	0.112	29.536	0.554	0.672	4.341	1.606	1.63	0.985	21.267	15.697

Typical croplands in July-August period in 2017

Cropland at Mwenengolongo, Kaporo North EPA

Cropland at Mwanyesha, Lupembe EPA

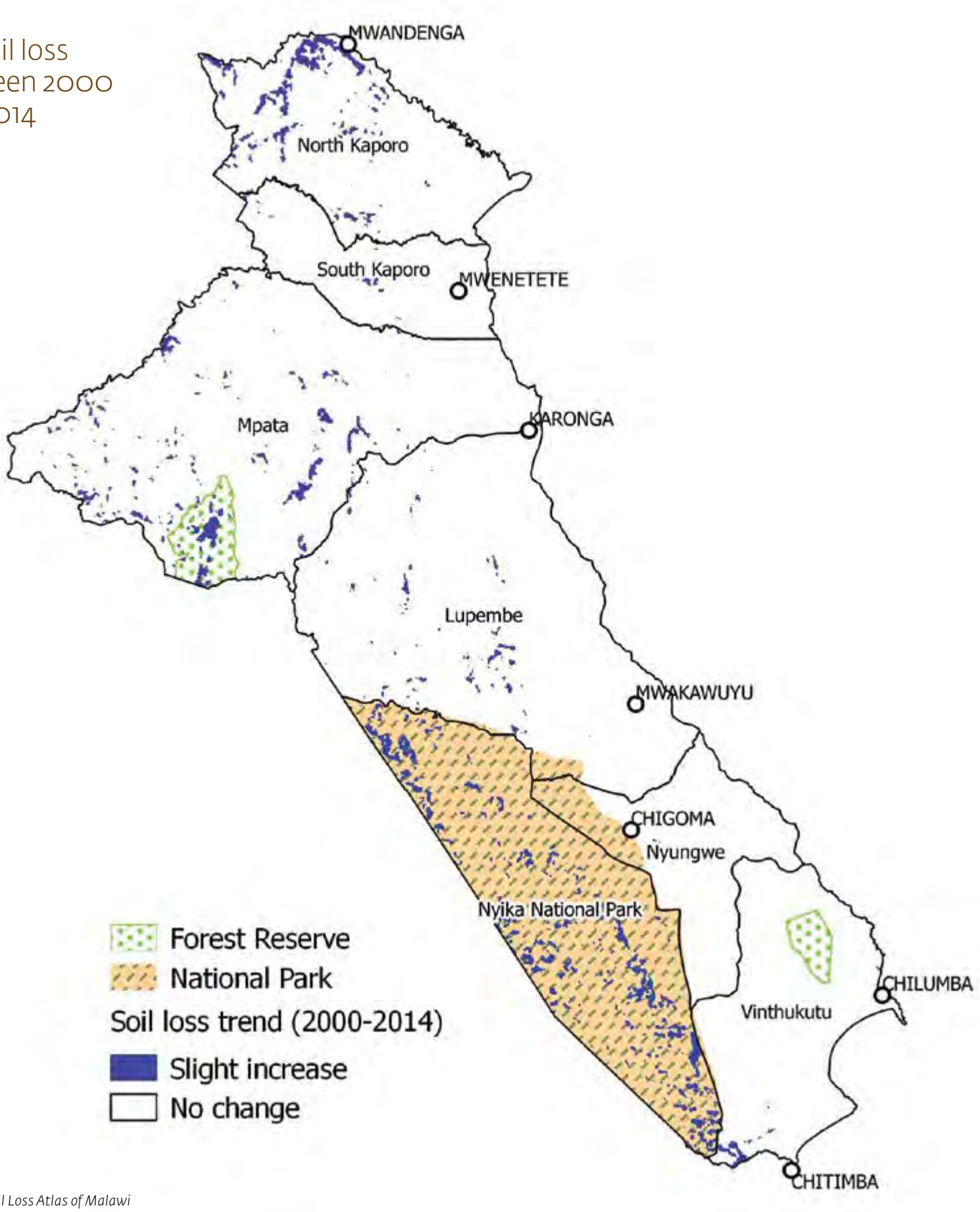
Cropland at Mchekacheka in Nyungwe EPA

Cropland at Sopera, in Vinthukutu EPA

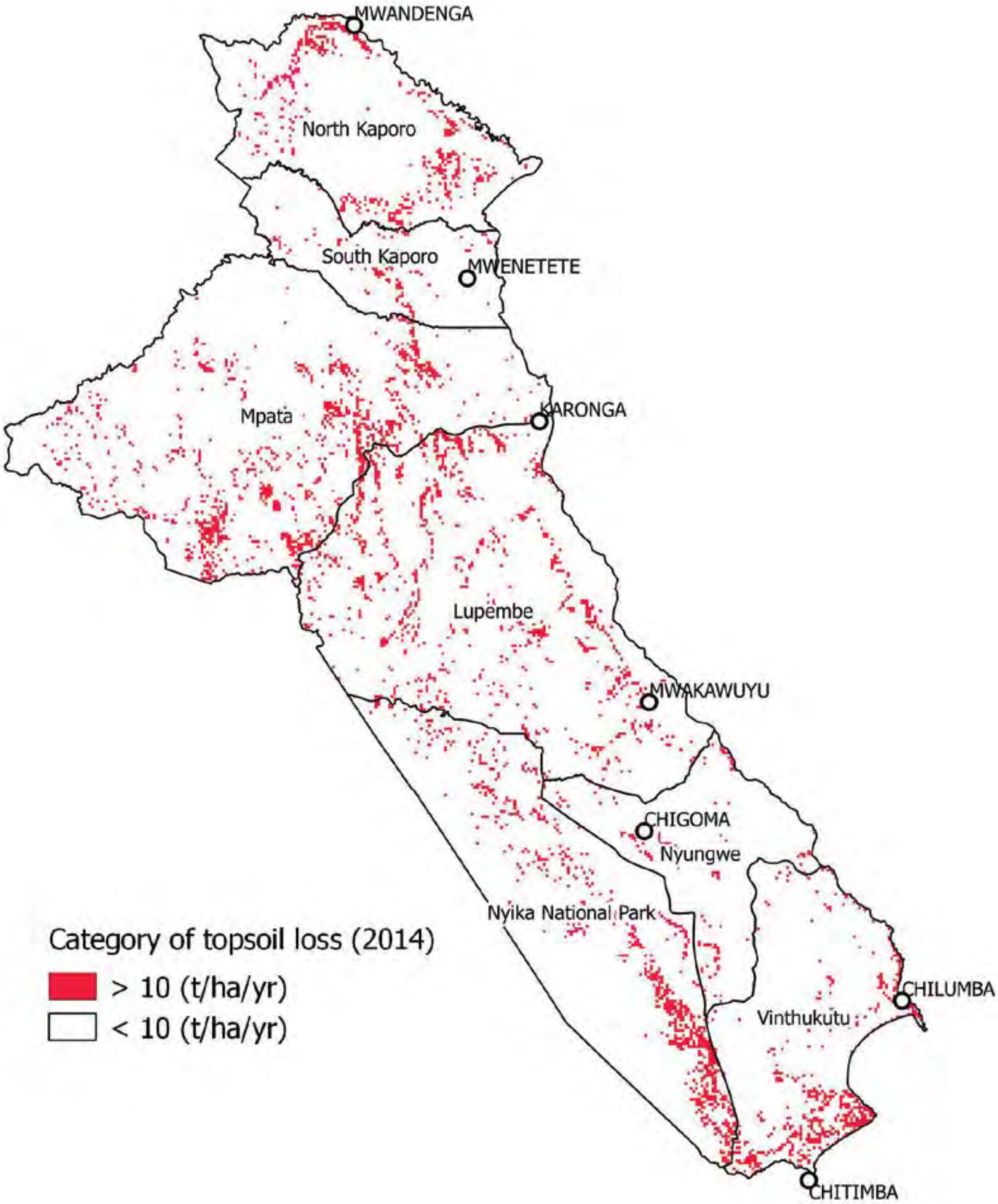
Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss Mean	Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
North Kaporo	0.102	0.028	0.270	0.399
South Kaporo	0.096	0.017	0.239	0.351
Mpata	0.105	0.014	0.244	0.364
Lupembe	0.124	0.021	0.289	0.434
Nyika National Park	0.070	0.006	0.180	0.256
Nyungwe	0.099	0.023	0.196	0.318
Vinthukutu	0.089	0.027	0.215	0.332

Topsoil loss between 2000 and 2014



Source of base map: Government of Malawi



Source of base map: Government of Malawi

The trend of topsoil loss rates in the District seem to have been declining in the northern parts and increasing in the southern parts between 2000 and 2014. Notably, in Mbulumbuzi, the areas with high soil loss rates in 2014 seem to have been having declining soil loss rates. Chiradzulu Forest Reserve seem to have contributed to the declining soil loss rates in its jurisdiction. However, In Ntonda (north of Blantyre City), the declining rates of topsoil loss occur in the Ndirange Forest Reserve. However, Malabvi Forest Reserve does not seem to have had any impact in reducing soil loss rate.

Some of the soil and water conservation measures

Maintaining natural vegetative cover at Mpata

Some of the soil and water conservation measures

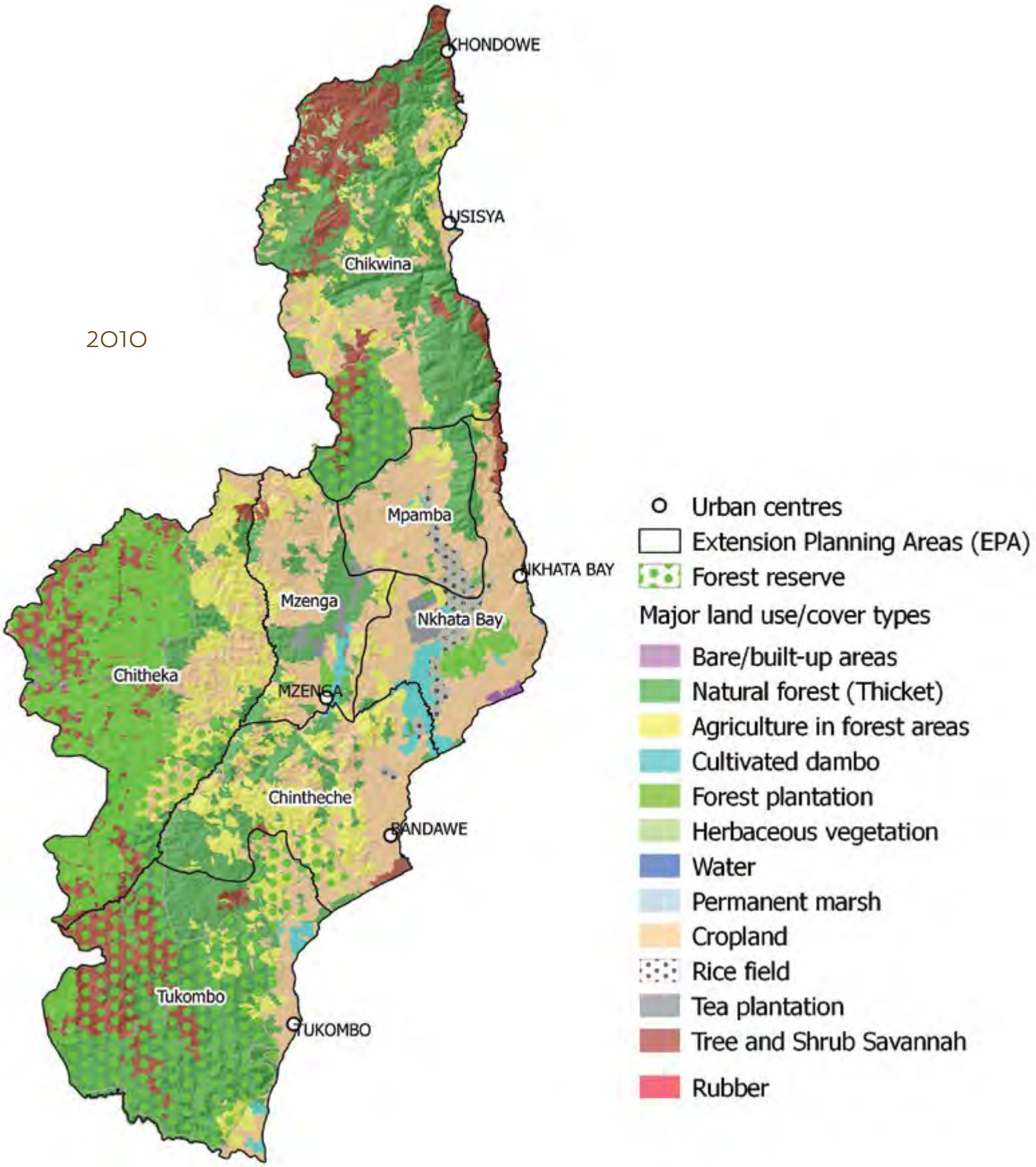
Use of perennial cover crop at Mulinda in Kaporo South EPA

Cut-off drain at Sopera in Vinthukutu EPA

Drivers of soil loss
1. Vegetation cover change:

The main land use/cover types are smallholder croplands, forest reserves, and natural forests. The district experienced a significant decline in vegetative cover proportions between 1991 and 2010. The main threat to soil loss is therefore loss of protective vegetation cover.

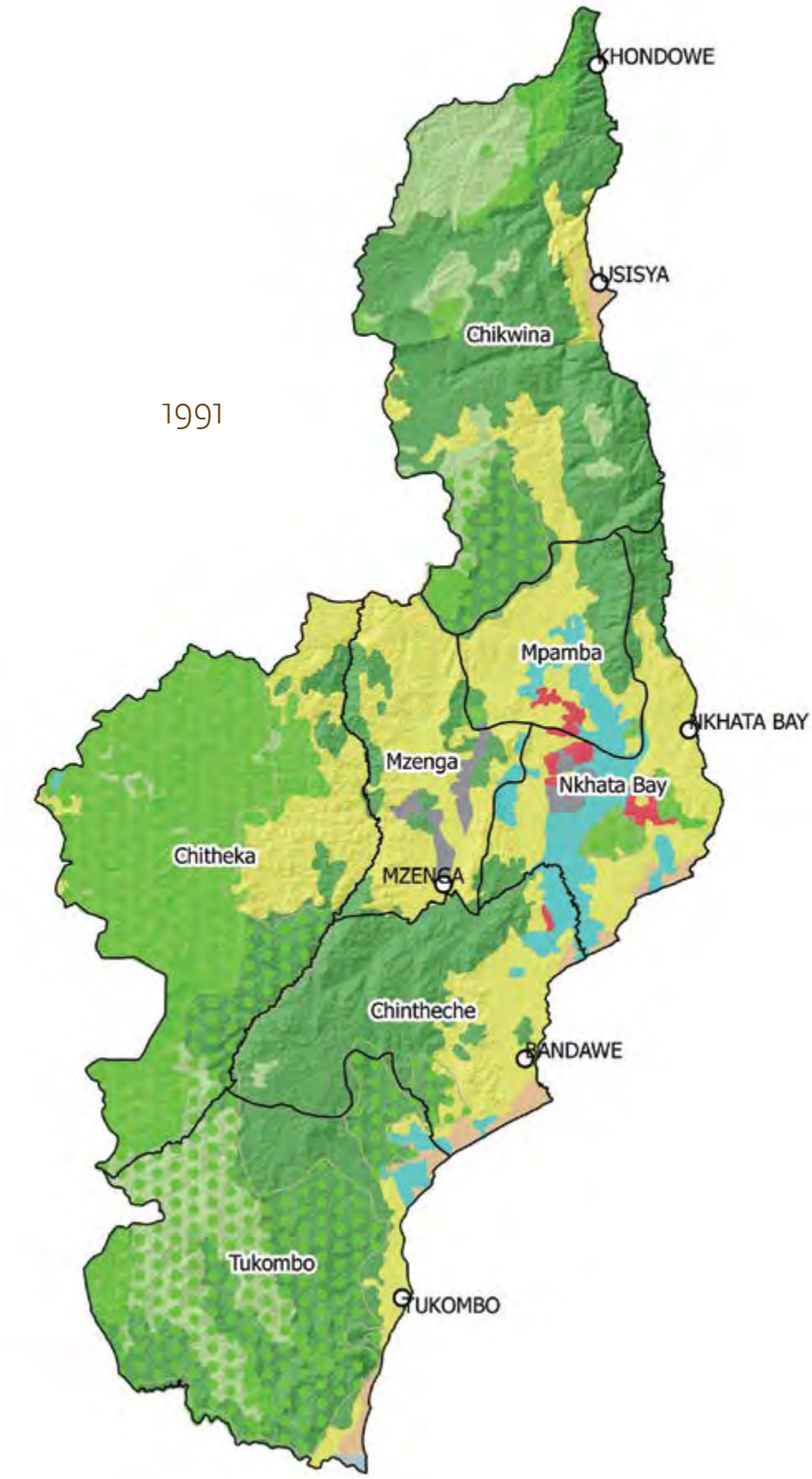
Major land cover/use types in 2010 and 1991



2010

Source of base map: Government of Malawi

1991

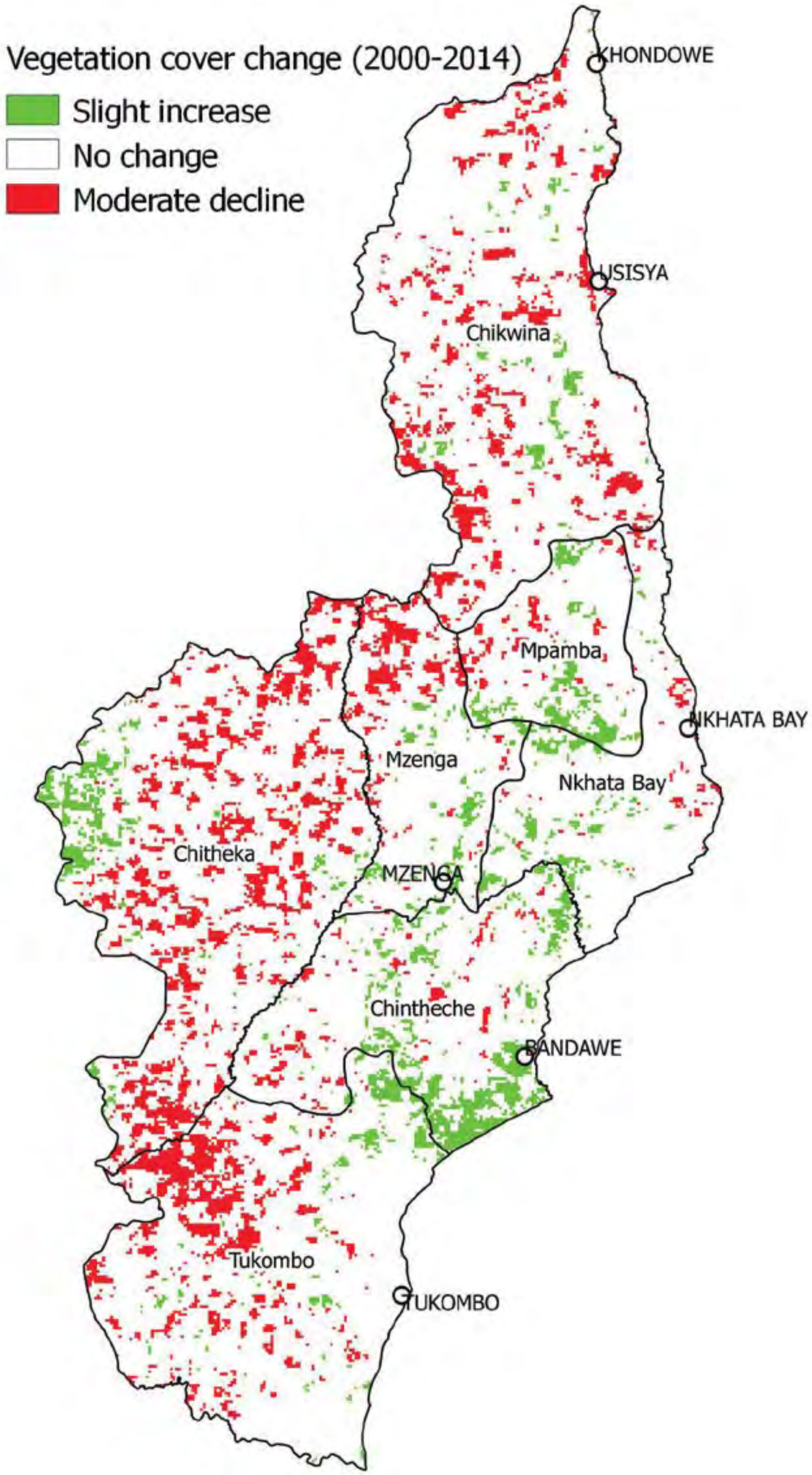


Source of base map: Government of Malawi

Natural forest at Luanatonga

Example of land cover at Limphasa Rice scheme

Vegetation cover change



Source of base map: Government of Malawi

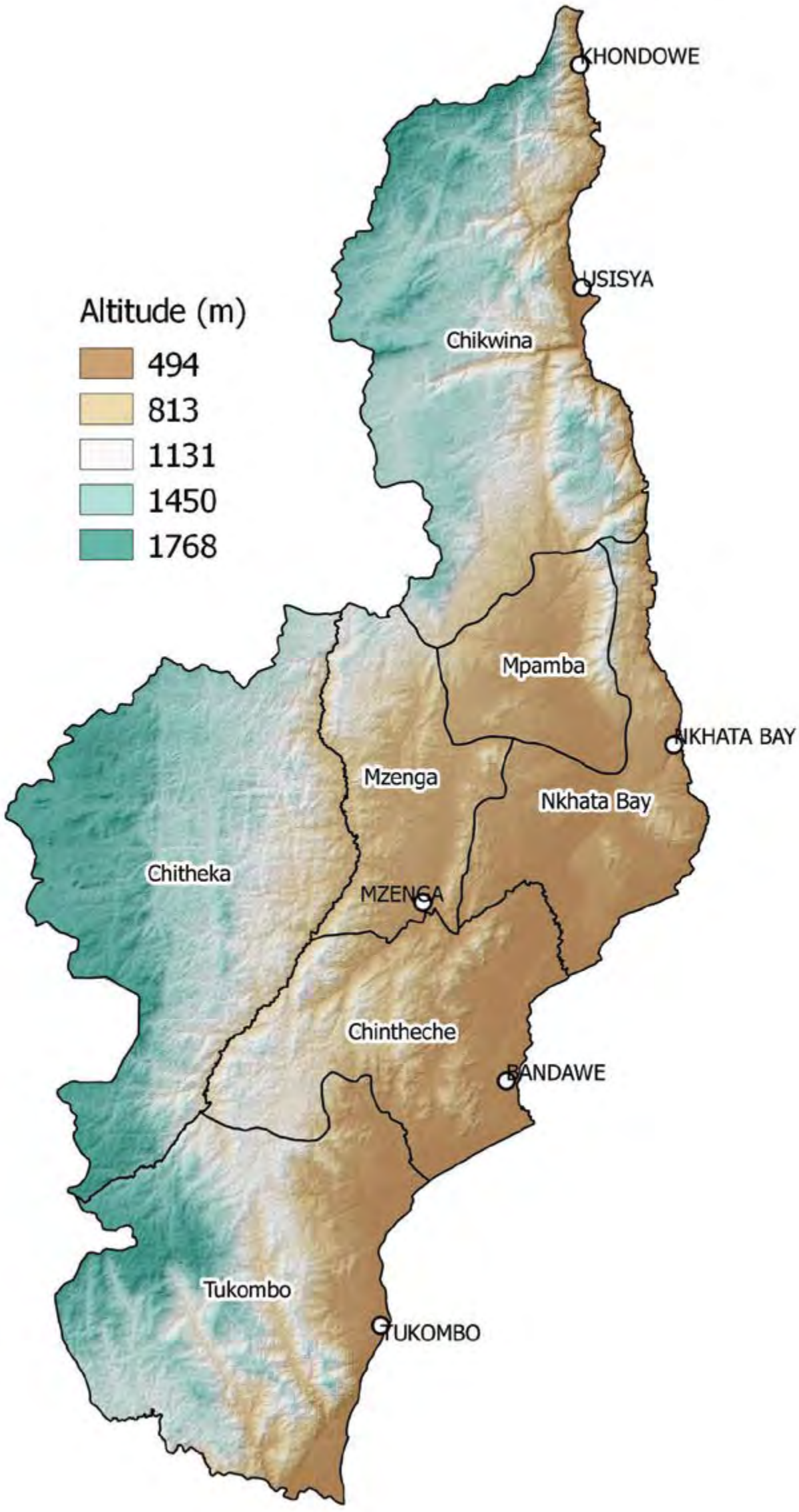
2. Rainfall, relief and soil factors:

Nkhata Bay is a mountainous district with a general gentle slope towards the south. It has deep to moderately deep soil. The major soil types are Lixisol and Cambisol. These soil types are quite vulnerable to soil erosion.

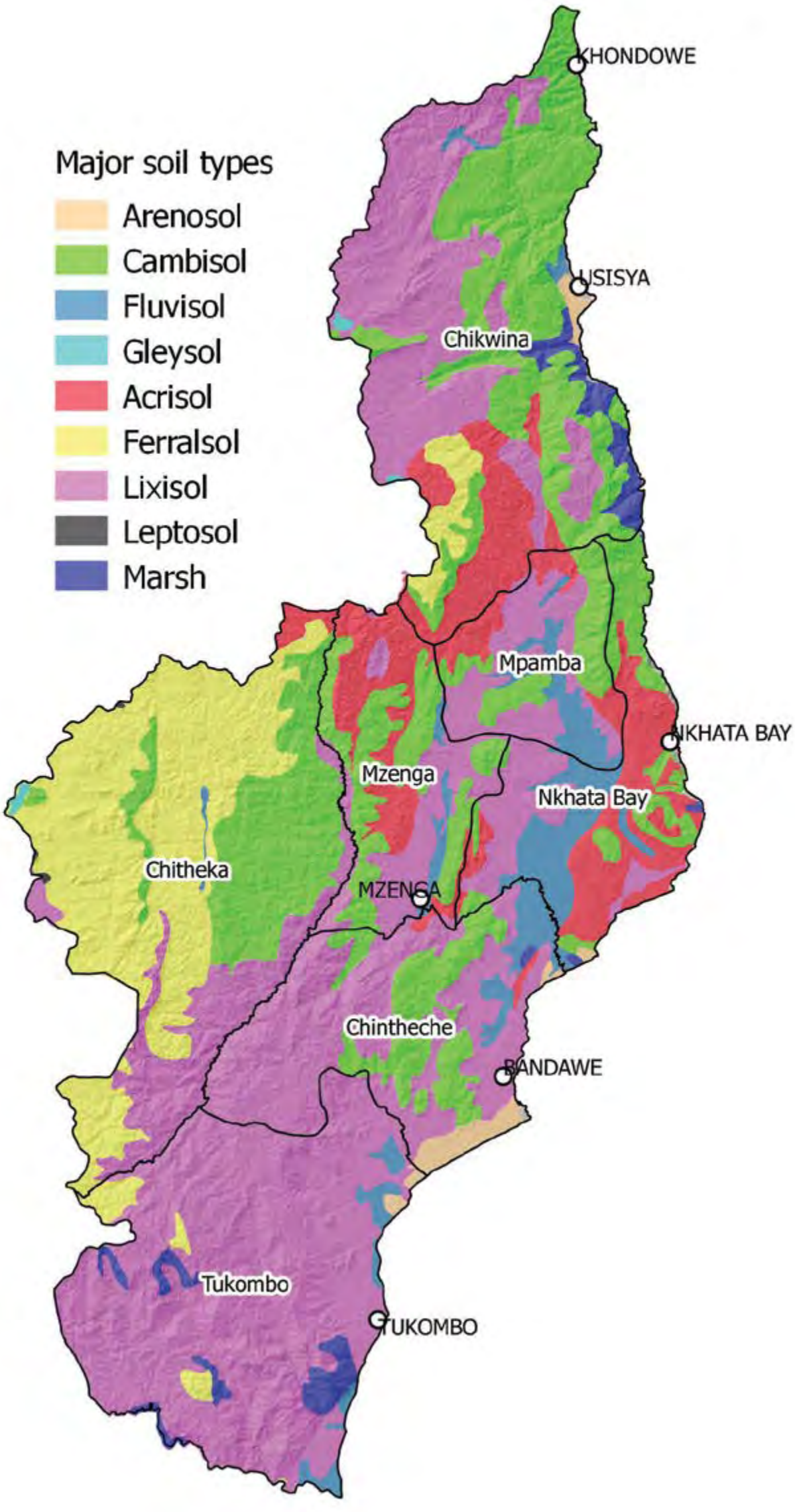
Soils of mixed depths at Zikumuka Munkhokwe

Soils of mixed depths at Zikumuka Munkhokwe

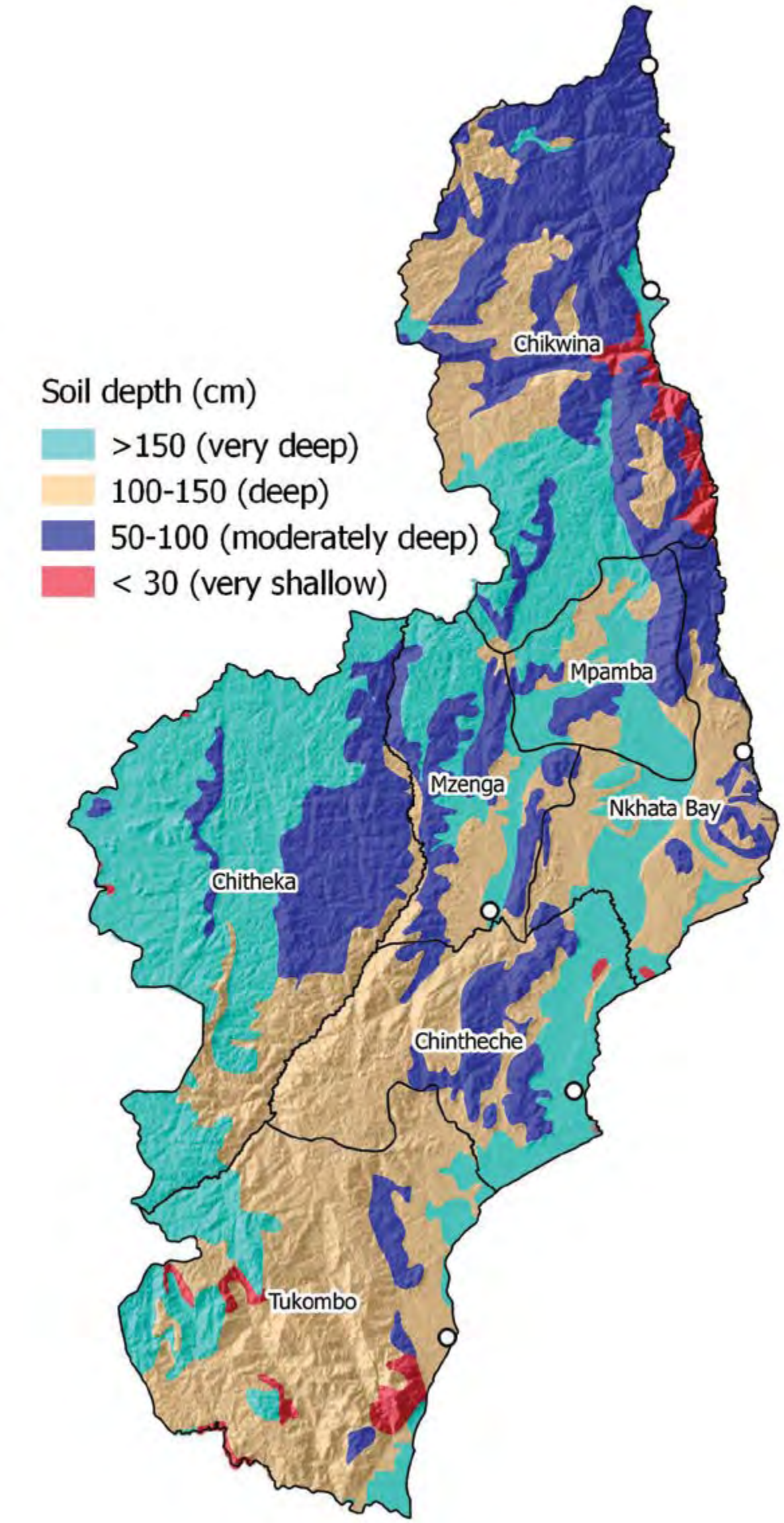
Shallow soil at Kayimikass



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Chikwina	Slight decline	20.0	99.2	999.9	939-1079	Moderate risk
Nkhata Bay	Slight decline	9.3	68.6	1096.2	1051-1141	Moderate risk
Mpamba	Slight increase	10.1	70.4	1060.6	1017-1104	Low risk
Chitheka	Slight decline	15.6	76.3	940.4	870-1008	Moderate risk
Mzenga	Slight decline	13.5	61.4	1016.9	975-1061	Moderate risk
Chintheche	Slight increase	13.9	66.9	1037.2	958-1103	Low risk
Tukombo	Slight decline	18.5	90.8	976.3	903-1053	Moderate risk

Features of soil erosion

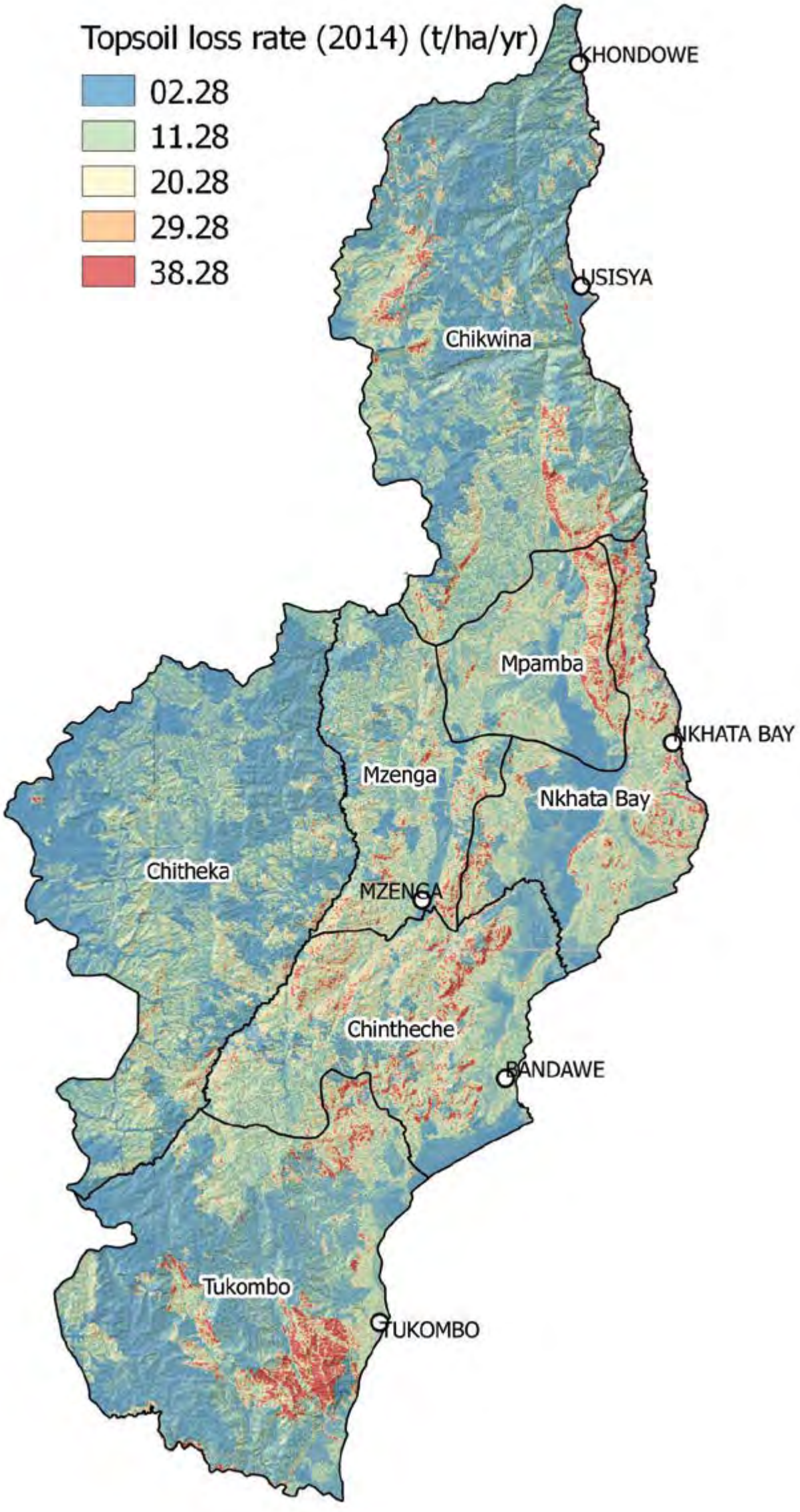
Measuring rill erosion at Sikayilayini

Rill and sheet erosion at Kaning'ina

Gully, sheet and rill erosion are the most common types of erosion in the district. Sheet erosion is prevalent in areas with low vegetation cover and in shallow soils. Gully and rill erosion are common in the valley-heads and in deep soil.

Rill and sheet erosion at Mbonera

Gully erosion at Juwa



Source of base map: Government of Malawi

Shallow soil on steep slopes in forested area at Cheliwali

Agricultural expansion into forest at Sir Martin village

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 19.83 t/ha/yr. The escarpments in the Rift Valley were the most affected areas. The main contributing factors for topsoil loss rates in these areas include the presence of vulnerable soils, shallow soil, loss of vegetation cover, and agricultural expansion in areas with steep slopes.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Chikwina	22.7	0.46	28.84
Nkhata Bay	30.3	1.18	37.58
Mpamba	30.4	1.70	37.44
Chitheka	16.0	0.03	29.31
Mzenga	14.4	1.09	28.05
Chintheche	33.4	1.02	38.01
Tukombo	19.3	1.02	38.01

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chikwina	5.42	2.298	1.135	0.115	57.323	0.441	0.688	3.297	1.245	0.352	0.732	2.522	47.475
Chintheche	4.74	1.292	0.637	0.064	79.916	0.276	0.459	7.505	1.023	0.484	0.727	22.900	10.160
Chitheka	4.78	2.500	1.232	0.125	5.618	0.514	0.539	3.691	1.156	0.247	1.095	46.815	20.232
Limphasa	5.33	4.243	2.091	0.212	4.601	0.507	0.713	11.995	2.802	1.214	0.970	43.920	15.184
Mpamba	5.10	1.845	0.908	0.091	25.134	0.518	0.547	4.169	1.449	1.210	0.635	20.291	18.224
Mzenga	5.09	2.074	1.022	0.104	12.158	0.346	0.634	4.170	1.534	1.461	0.926	22.323	13.911
Tukombo	4.90	1.804	0.889	0.090	90.382	0.133	0.602	4.580	1.353	1.042	0.574	26.041	7.285

Typical croplands in July-August period in 2017

Cropland at Chombe in Limphasa EPA

Cropland at Theti in Chikwina EPA

Cropland at Vyiyapo in Mpamba EPA

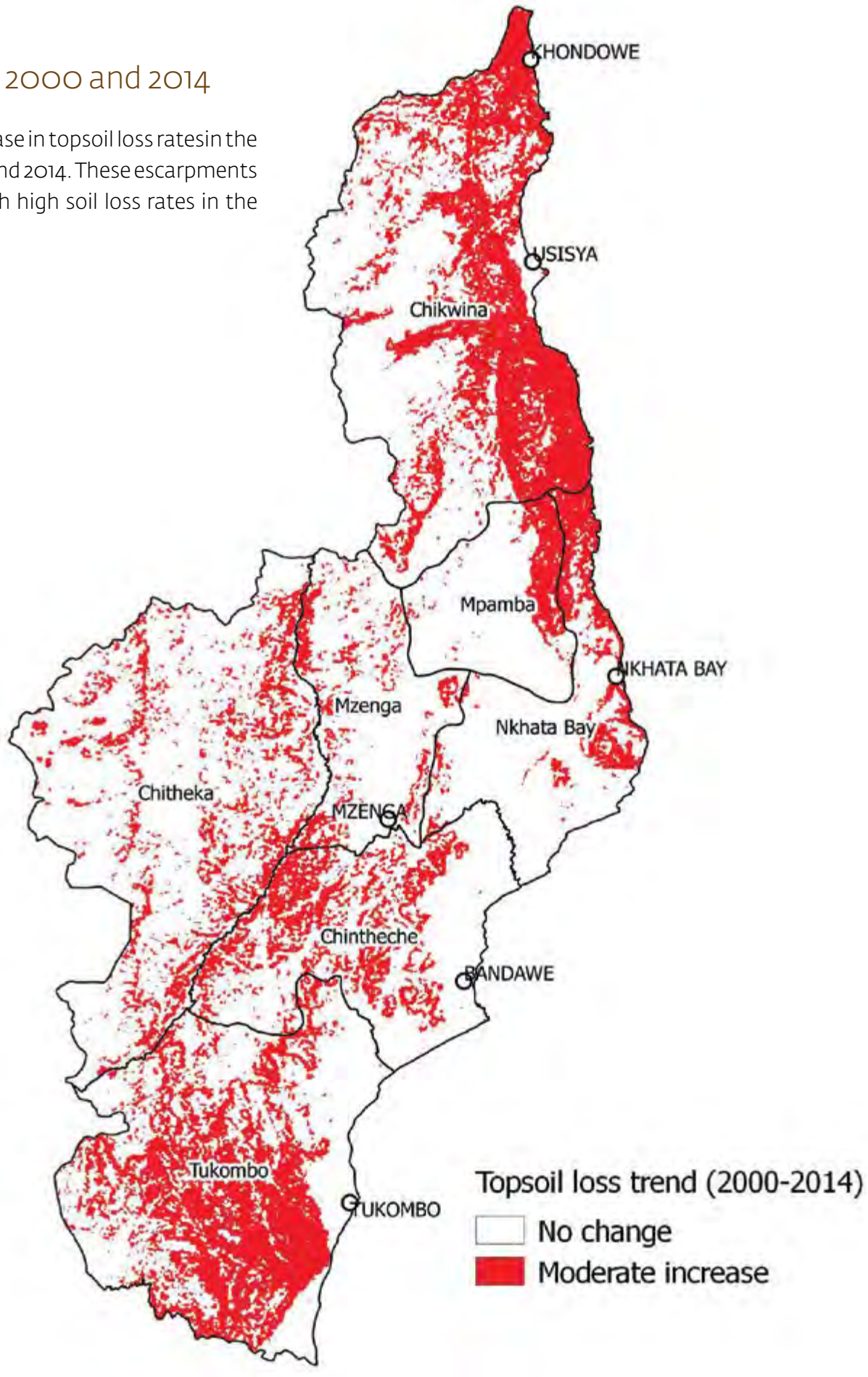
Cropland at Kaimika in Chintheche EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Chikwina	0.075	0.013	0.227	0.316
Nkhata Bay	0.087	0.03	0.233	0.349
Mpamba	0.078	0.003	0.226	0.307
Chitheka	0.052	0.002	0.191	0.245
Mzenga	0.058	0.003	0.194	0.255
Chintheche	0.06	0.008	0.19	0.258
Tukombo	0.067	0.018	0.197	0.282

Topsoil loss between 2000 and 2014

There was a significant increase in topsoil loss ratesin the escarpments between 2000 and 2014. These escarpments were also the same spots with high soil loss rates in the district.



Source of base map: Government of Malawi

Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

Protection of natural forests at Joel

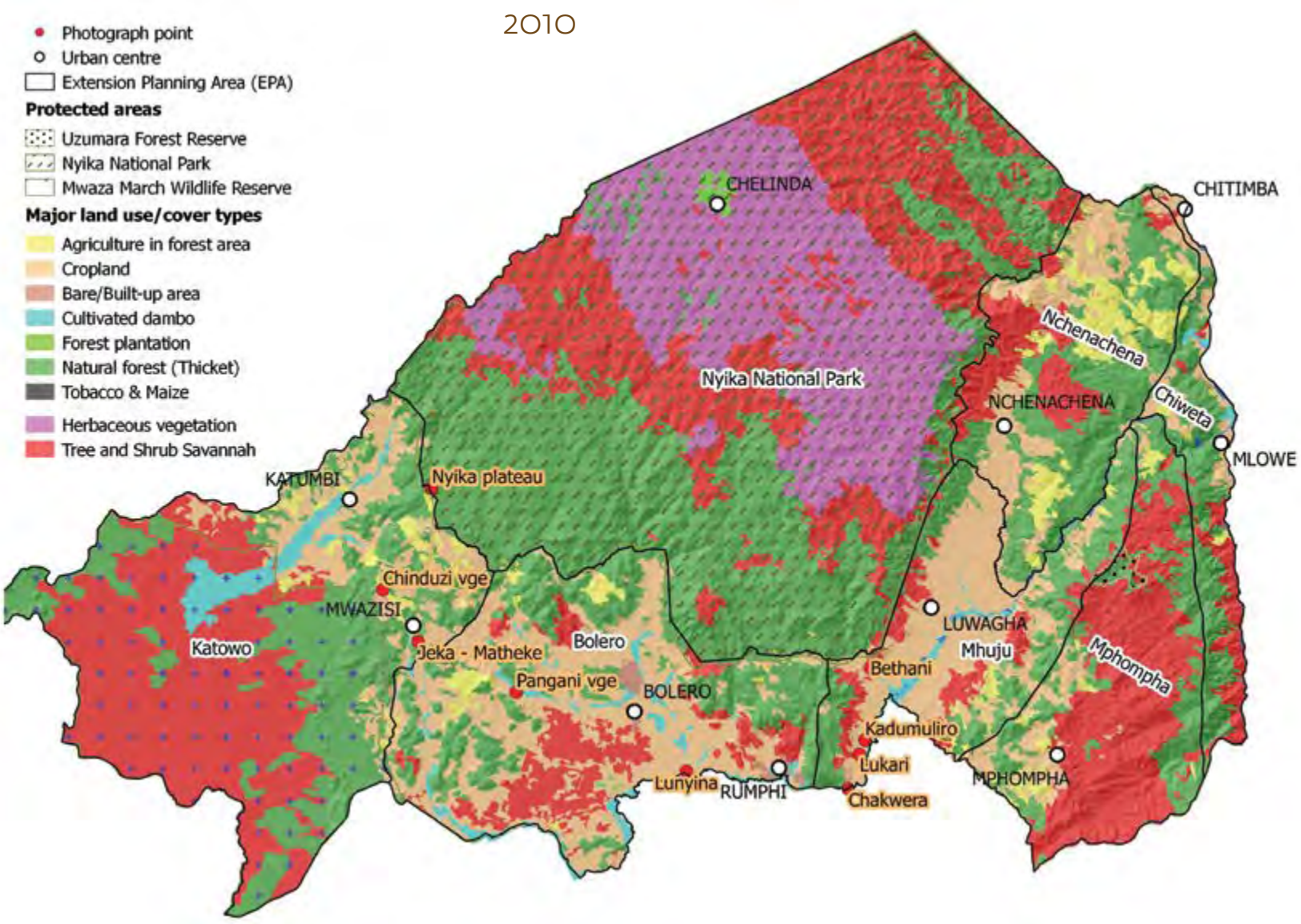
Plantation of tree crops at Vizara Rubber plantation

3.3 Nkhata Bay

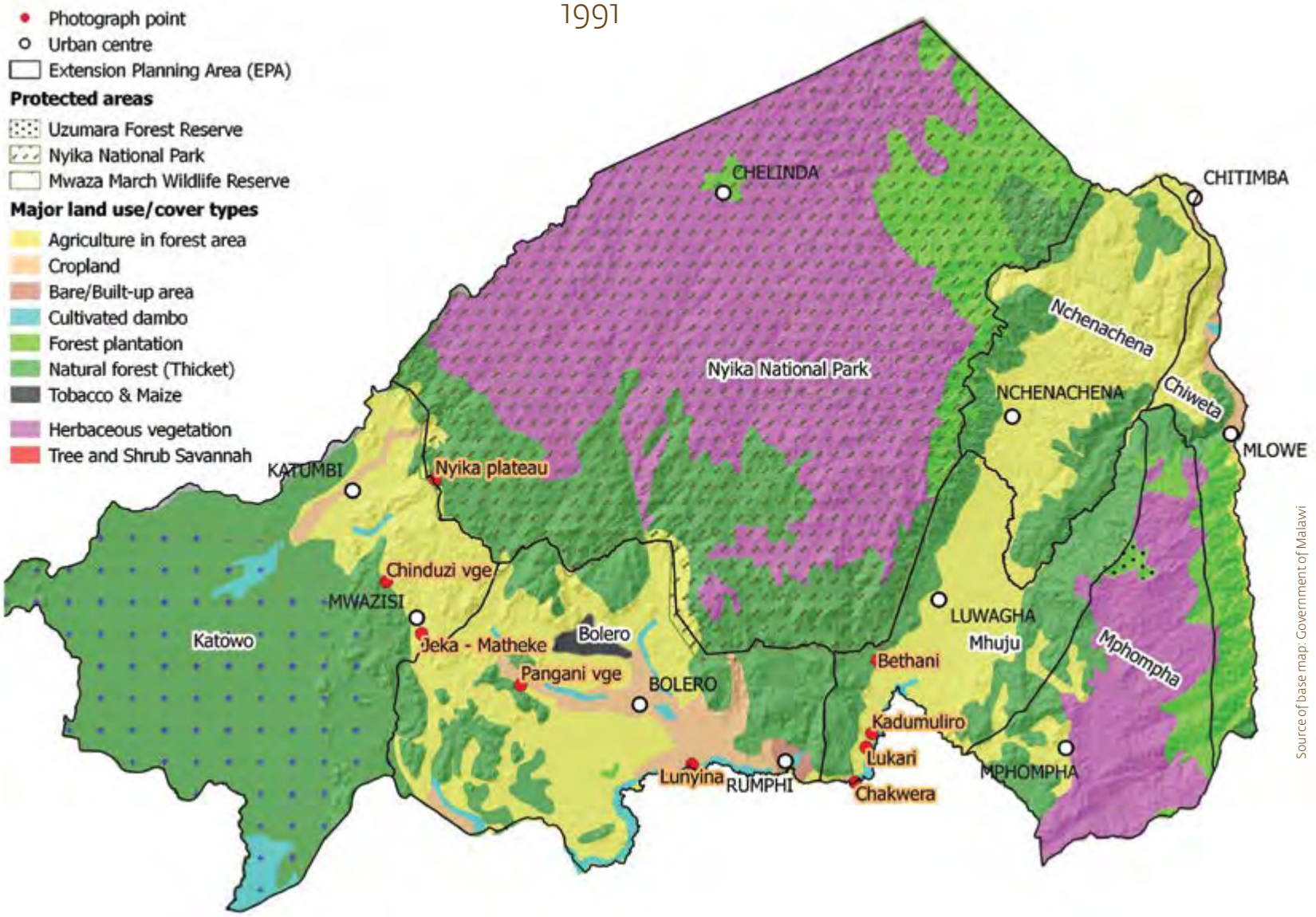
Drivers of soil loss
1. Vegetation cover change:

The main land use/cover types in the district are protected areas (parks and reserves), cropland, and forests. No significant cover change between 1991 and 2010 was discernable, especially due to agricultural expansion and human settlements. This implies that land cover change is not a major driver of soil loss in the district.

Major land cover/use types in 2010 and 1991

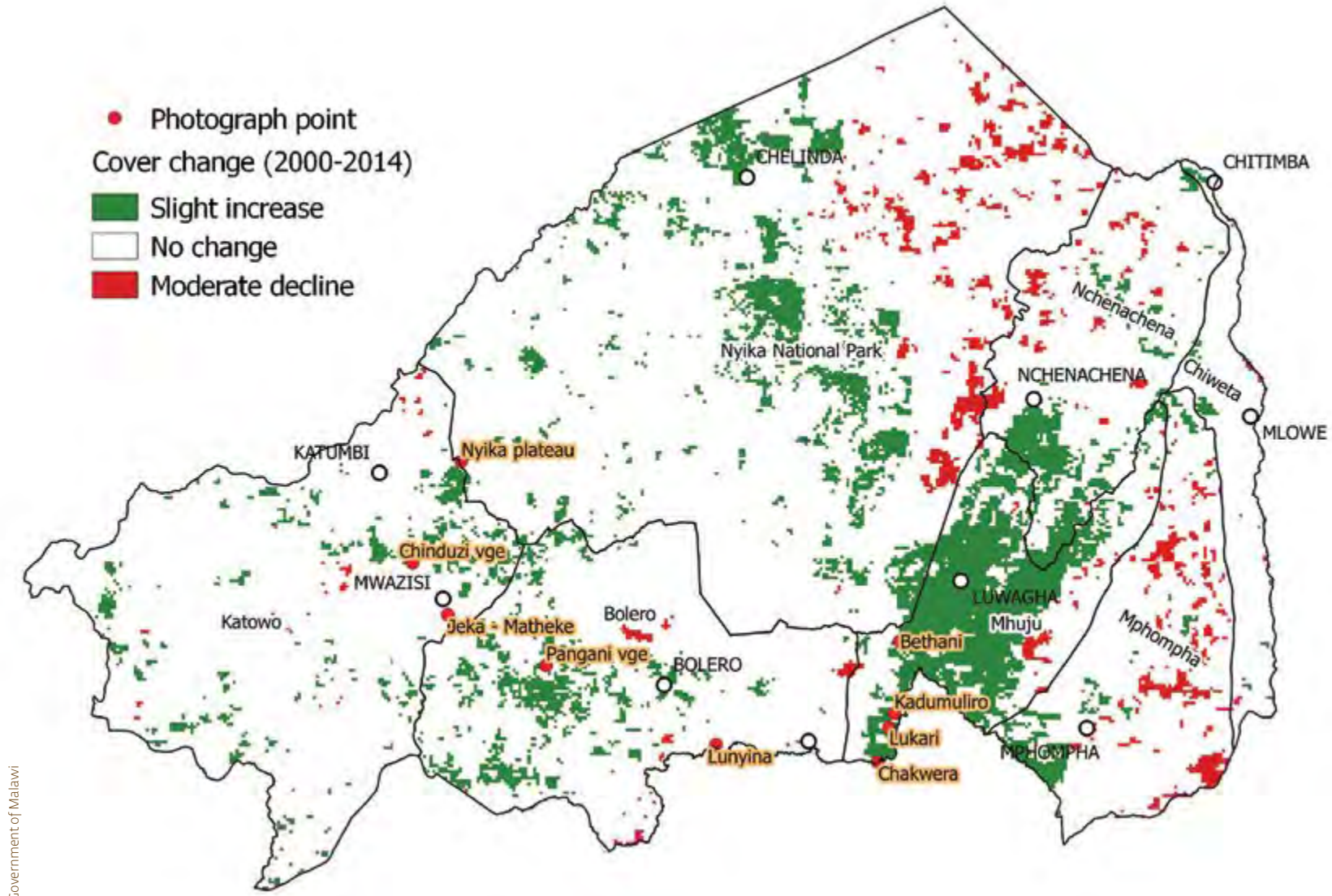


1991



Source of base map: Government of Malawi

Vegetation cover change



Source of base map: Government of Malawi

Example of land cover at Chakwera

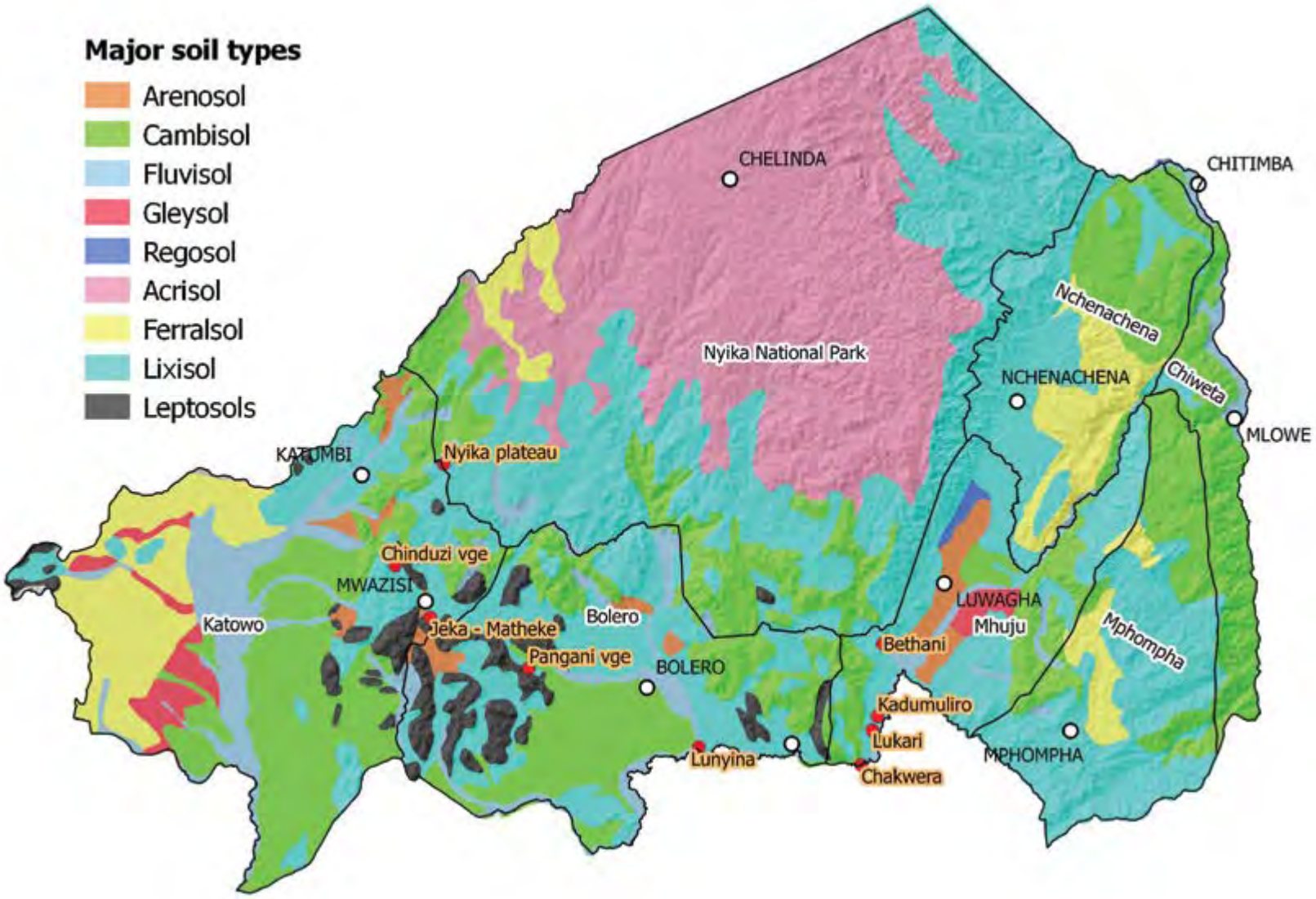
Shallow soil on the mountains at Chinduzi

Deep soil on footslopes and shallow soil on the mountains at Bethani

Photograph point
Road
Altitude (m)
777
1170
1562
1954
2347
CHELINDA
CHITIMBA
Nyika National Park
Nchenachena
NCHENACHENA
Chiweta
MLOWE
KATUMBI
Nyika plateau
Chinduzi vge
MWAZISI
Jeka - Matheke
Bolero
Katowo
Pangani vge
BOLERO
LUWAGHA
Mhuju
Bethani
Mphompha
Kadumuliro
Lukari
Lunyina
Chakwera
MPHOMPHA

Source of base map: Government of Malawi

Soil depth (cm)
>150 (very deep)
100-150 (deep)
50-100 (moderately
30-50 (shallow)
< 30 (very shallow)
CHELINDA
CHITIMBA
Nyika National Park
Nchenachena
NCHENACHENA
Chiweta
MLOWE
KATUMBI
Chinduzi vge
MWAZISI
Jeka - Matheke
Katowo
Pangani vge
BOLERO
LUWAGHA
Bethani
Mhuju
Mphompha
Bolero
Lunyina
RUMPHI
Lukari
Chakwera
MPHOMPHA



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Nyika National Park	Slight increase	18.50	90.48	869	806-926	Low risk
Chiweta	Slight increase	29.62	95.63	960	935-989	Low risk
Nchenachena	Slight decline	20.00	99.96	927	906-945	Low risk
Katowo	Slight increase	5.86	68.31	776	745-814	Low risk
Mphompha	Moderate decline	19.45	88.92	953	918-983	Moderate risk
Mhuju	Slight decline	15.53	73.75	914	881-945	Low risk
Bolero	Slight increase	12.04	78.69	830	788-884	Low risk

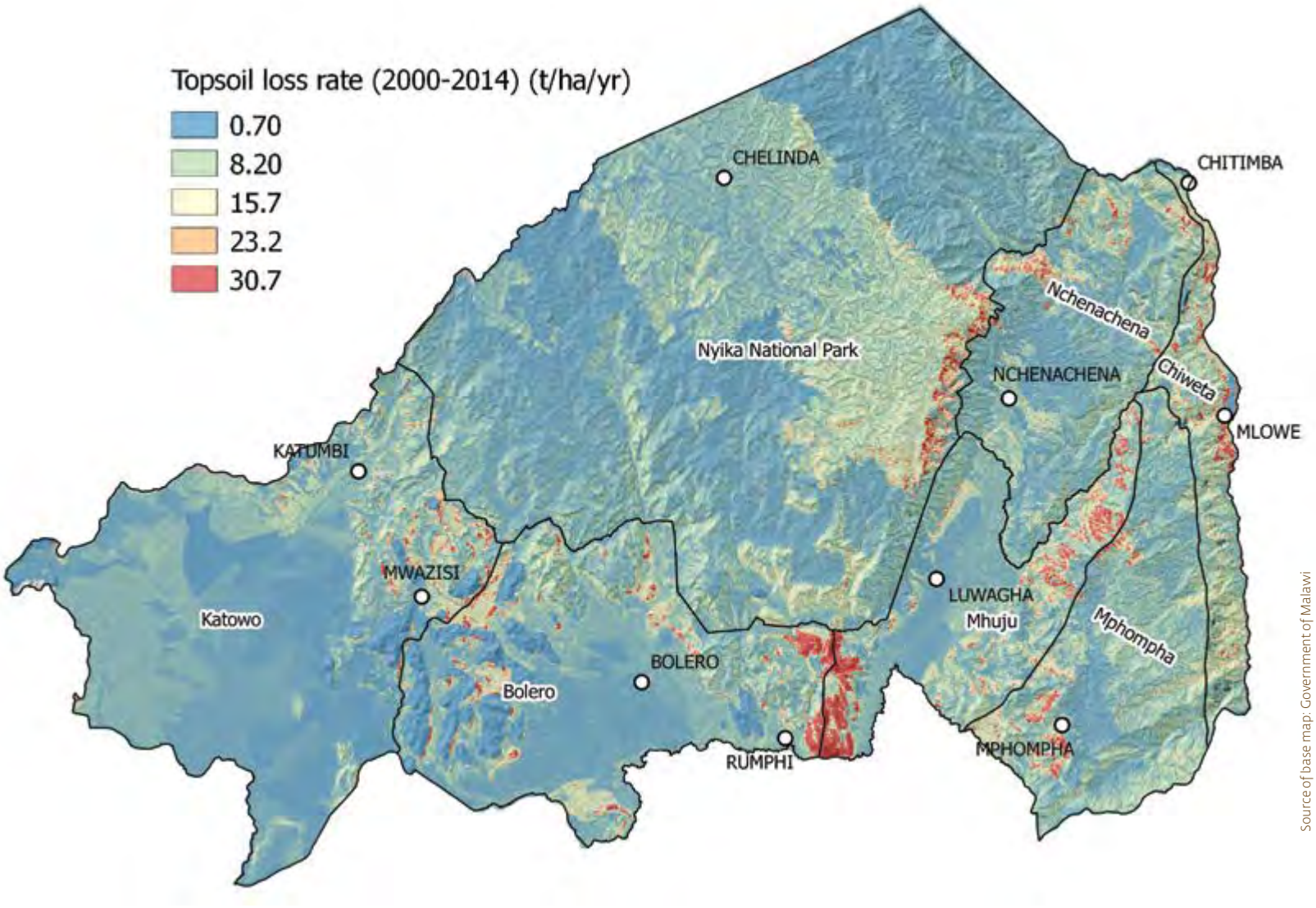
Features of soil erosion

Extension Planning Area (EPA)	2014 Topsoil loss t/ha/yr		
	Mean	Minimum	Maximum
Nyika National Park	10.0	0.7	20.7
Chiweta	20.5	1.1	30.5
Nchenachena	10.1	0.9	25.0
Katowo	9.4	0.8	19.4
Mphompha	14.5	1.1	29.6
Mhuju	14.0	0.7	30.8
Bolero	13.0	0.1	25.0

Sheet erosion and its field measurement at Jeka - Matheke

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 10.22 t/ha/yr. High soil loss rates were mainly in the mountain ranges.The main factors for soil loss rates in these areas include reduced protective vegetative cover, soil vulnerability and steep slopes. Sheet and rill erosion are the most common forms of erosion



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Bolero	5.09	2.358	1.162	0.118	12.729	0.558	0.705	6.060	2.071	2.010	0.763	21.138	20.151
Chiweta	6.10	1.760	0.865	0.085	46.441	0.588	0.552	4.900	1.572	1.464	4.391	26.346	24.151
Katowo	5.58	3.707	1.827	0.185	28.768	0.368	0.693	3.930	0.864	2.000	0.705	18.387	21.567
Mhuju	5.95	2.130	1.050	0.107	57.643	0.444	0.638	4.280	0.964	2.810	1.110	23.472	33.002
Mphopha	5.32	2.415	1.190	0.121	58.674	0.667	0.623	5.675	1.345	1.752	0.559	15.911	1.913
Ntchenachena	4.52	2.571	1.266	0.129	32.786	0.521	0.584	4.325	1.032	1.792	0.749	12.061	13.196
Nyika National Park	4.92	2.069	1.026	0.122	45.197	0.469	0.649	4.415	1.691	1.502	1.280	18.712	16.461

Typical croplands in July-August period in 2017

Cropland at Mangenji in Chiweta EPA

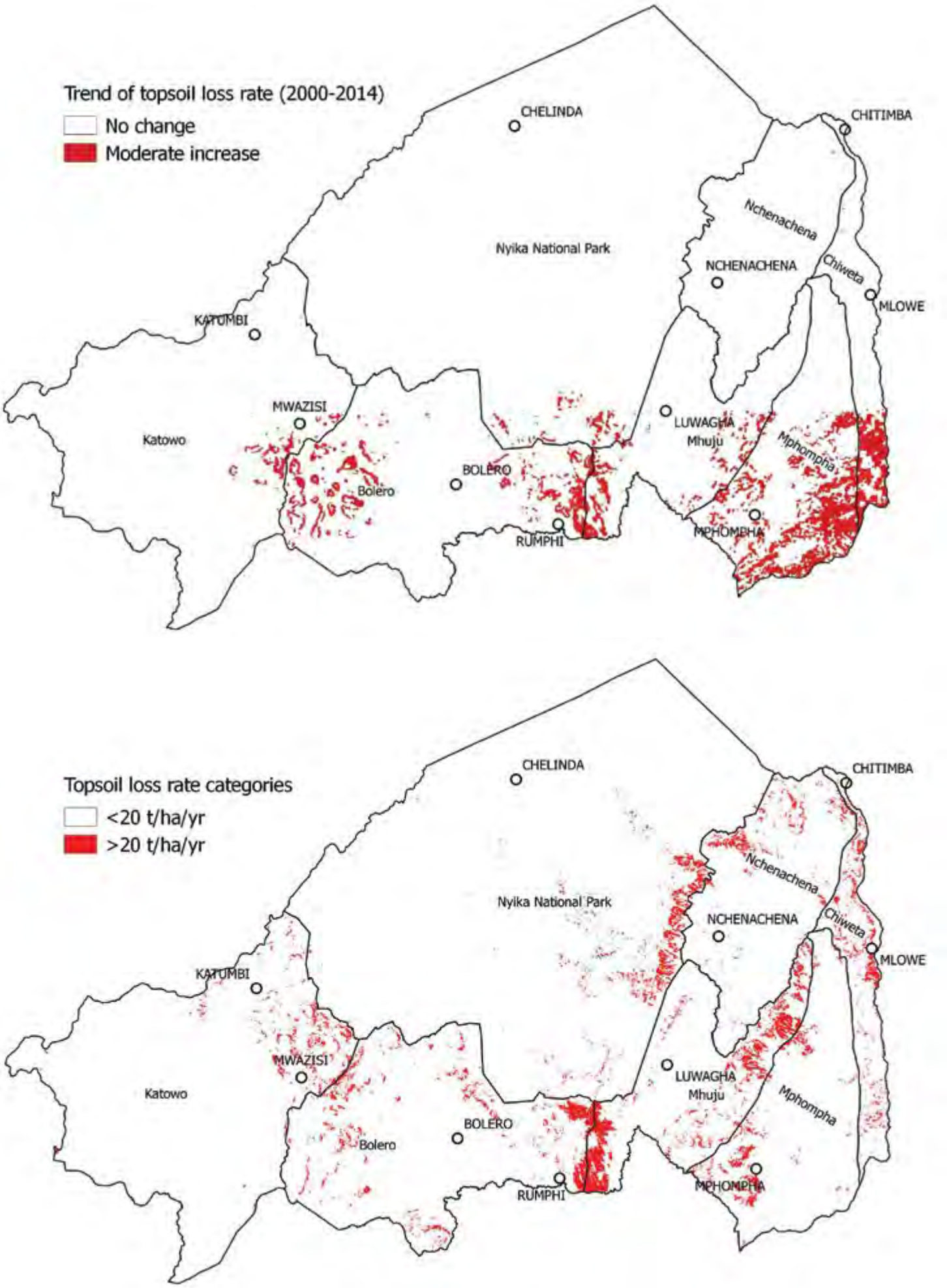
Cropland at Vundu in Ntchenachena EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Nyika National Park	0.074	0.006	0.281	0.361
Chiweta	0.071	0.124	0.177	0.372
Nchenachena	0.05	0.003	0.16	0.214
Katowo	0.08	0.009	0.214	0.303
Mphompha	0.081	0.005	0.177	0.263
Mhuju	0.08	0.003	0.234	0.317
Bolero	0.096	0.004	0.231	0.331

Topsoil loss trend between 2000 and 2014

Majority of areas with high topsoil loss rates seem to have been experiencing increasing trends of soil loss rates between 2000 and 2014. Bolero, Mphompha, and Chiweta EPAs fall in this category. They need more soil conservation efforts to controll the growing trend of topsoil loss rates. The protection at Nyika National Park has saved the EPA from adverse effects of accelerated soil loss. However, its southern border with Bolero EPA need constant surveillance.



Source of base map: Government of Malawi

Some of the soil and water conservation measures

Maintaining vegetative land cover at Lukari

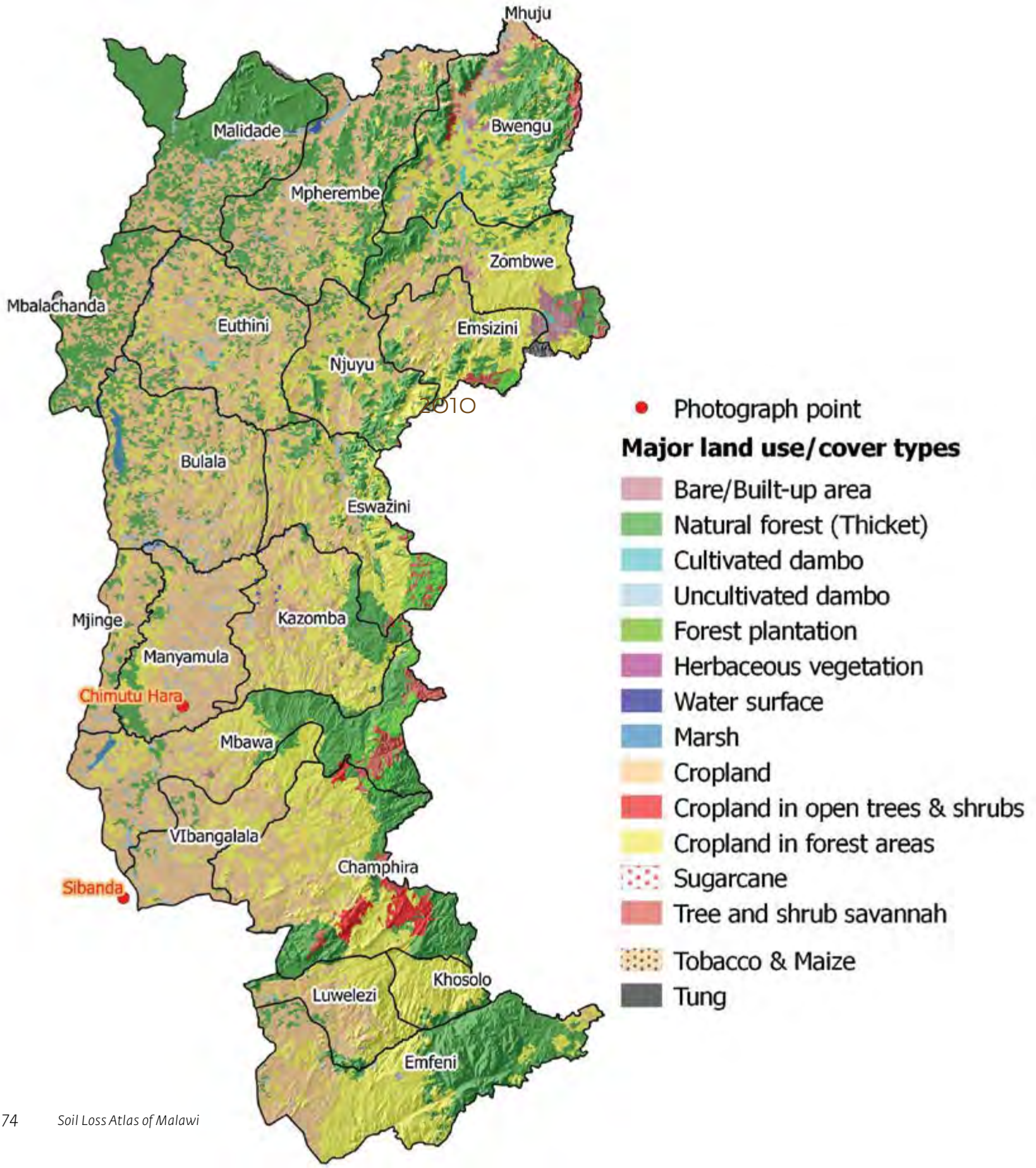
Legal protection at Nyika National Park

Cover crops and agroforestry at Kadumuliro

Drivers of soil loss
1. Vegetation cover change:

The main land use/cover types are smallholder croplands, estates, natural forests, and urban/settlements. There were significant changes in proportion of some of these land use types between 1991 and 2010, notably the decline of natural forest cover and expansion of croplands. The main threat to soil loss is these areas is the loss of protective vegetative cover and conversion of natural forests to croplands.

Major land cover/use types in 2010 and 1991

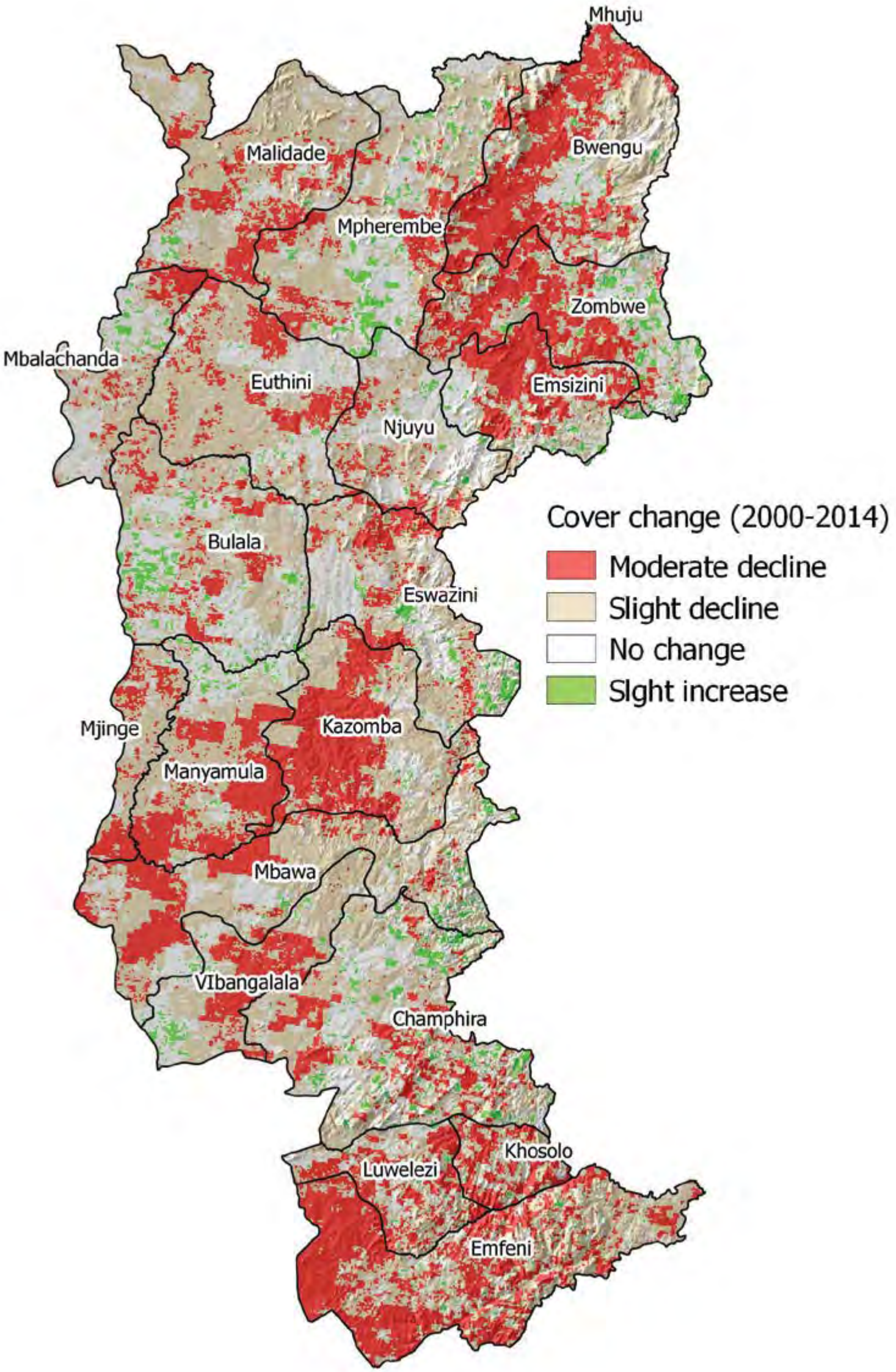


Source of base map: Government of Malawi

1991

Source of base map: Government of Malawi

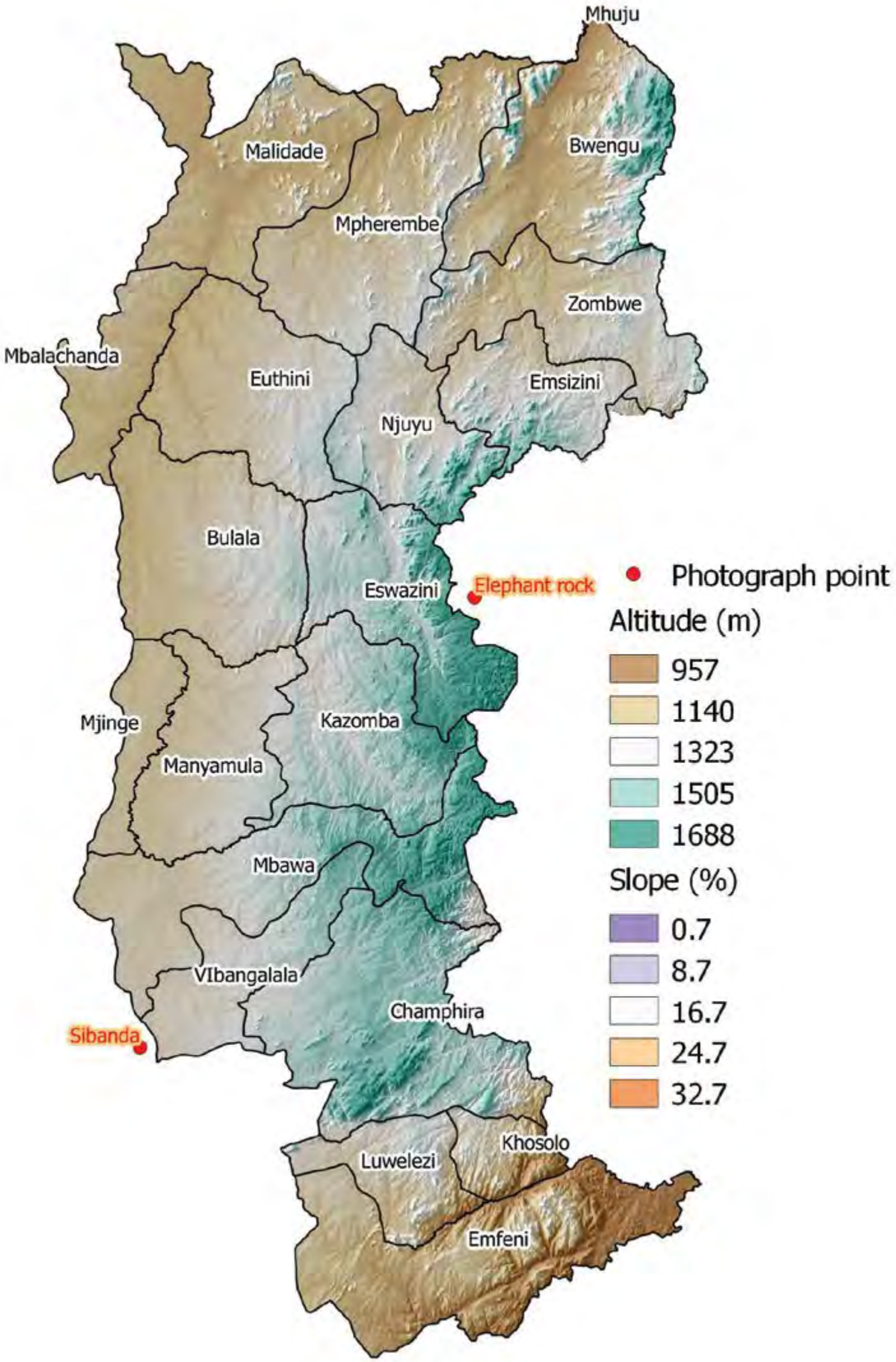
Example of land cover type at Sibanda and Chimuitu Hara



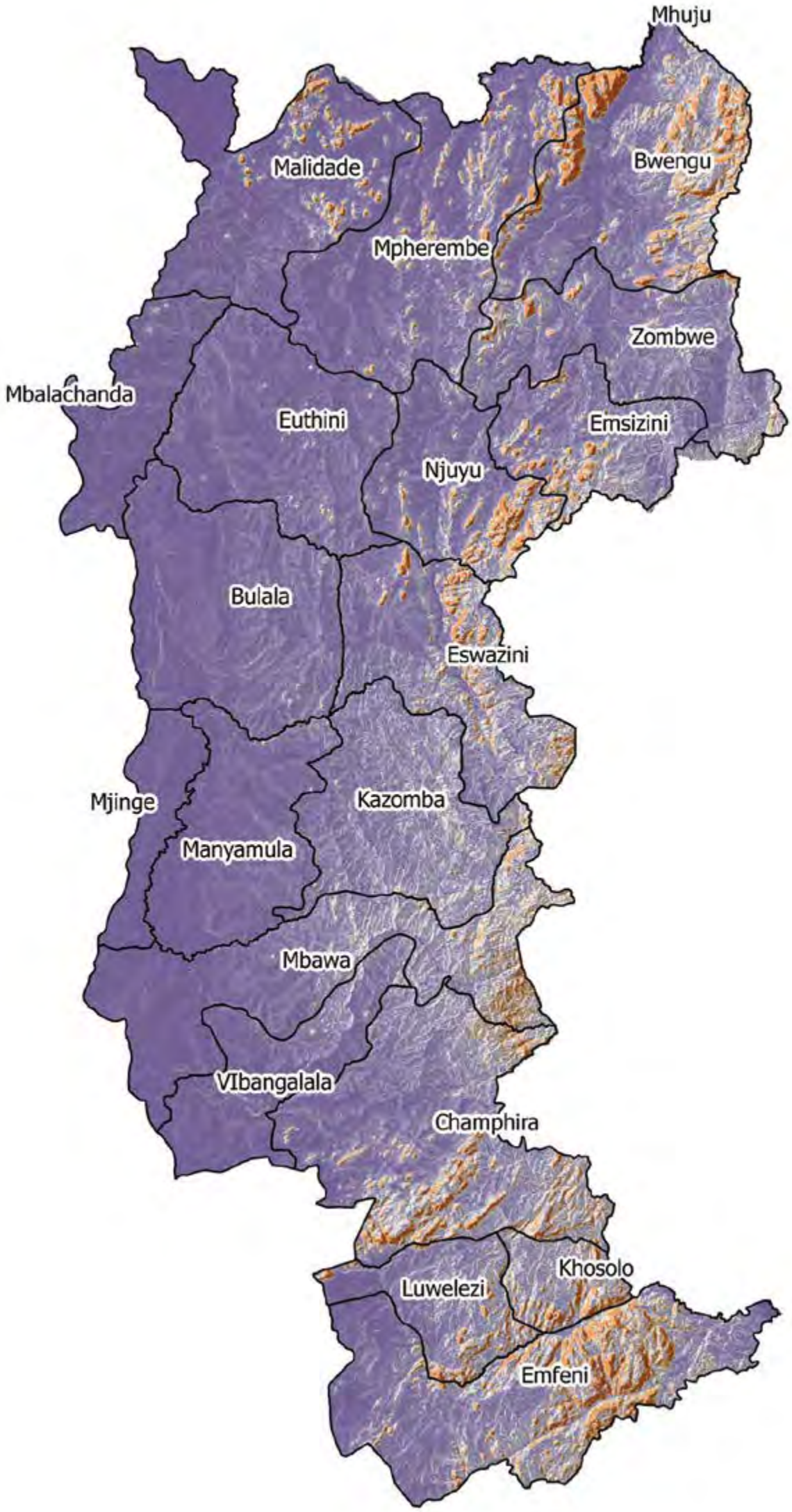
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors:

The District has flat terrain except the eastern side that lies in the Rift Valley. The flat areas have deep Lixisol and Gleysols.



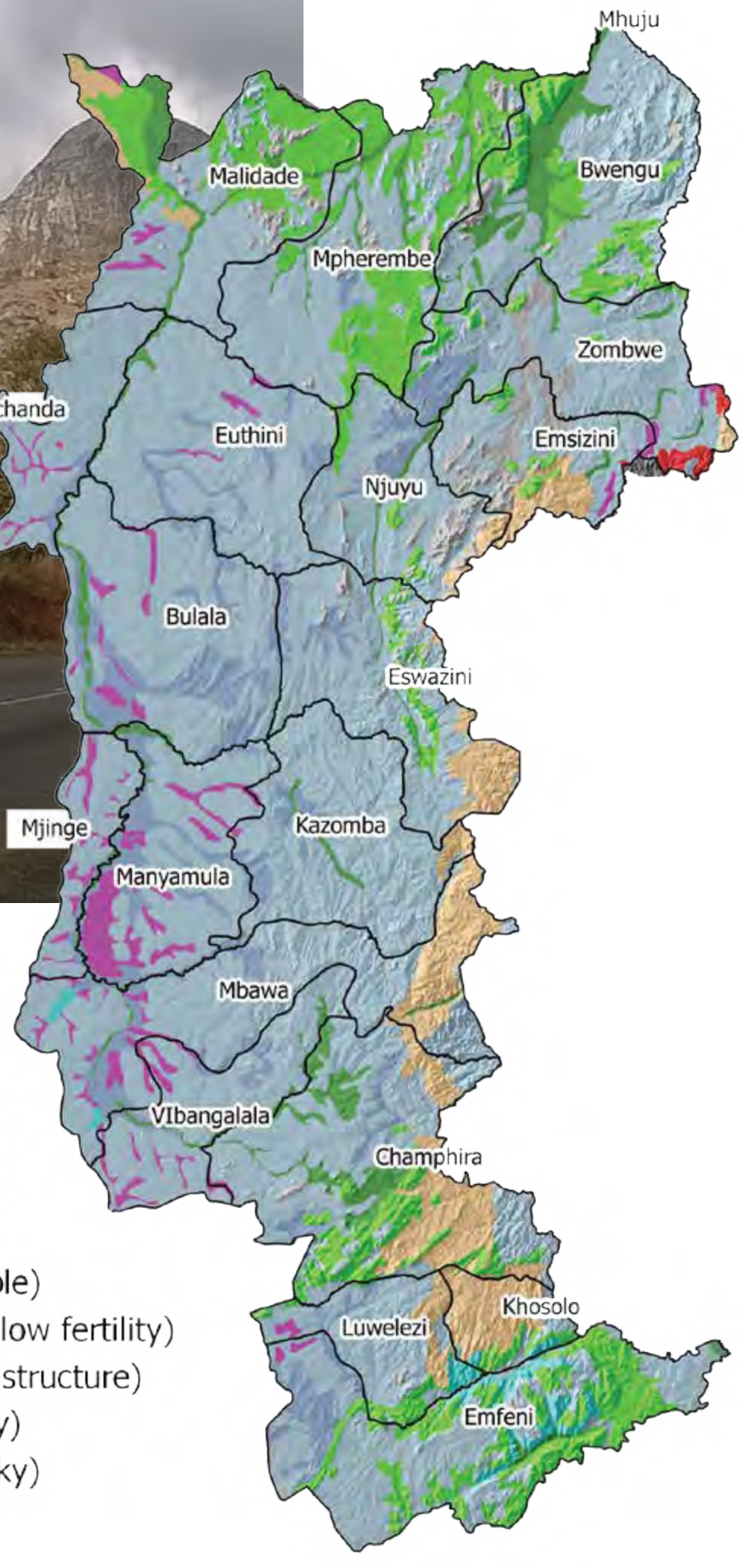
Source of base map: Government of Malawi



Source of base map: Government of Malawi

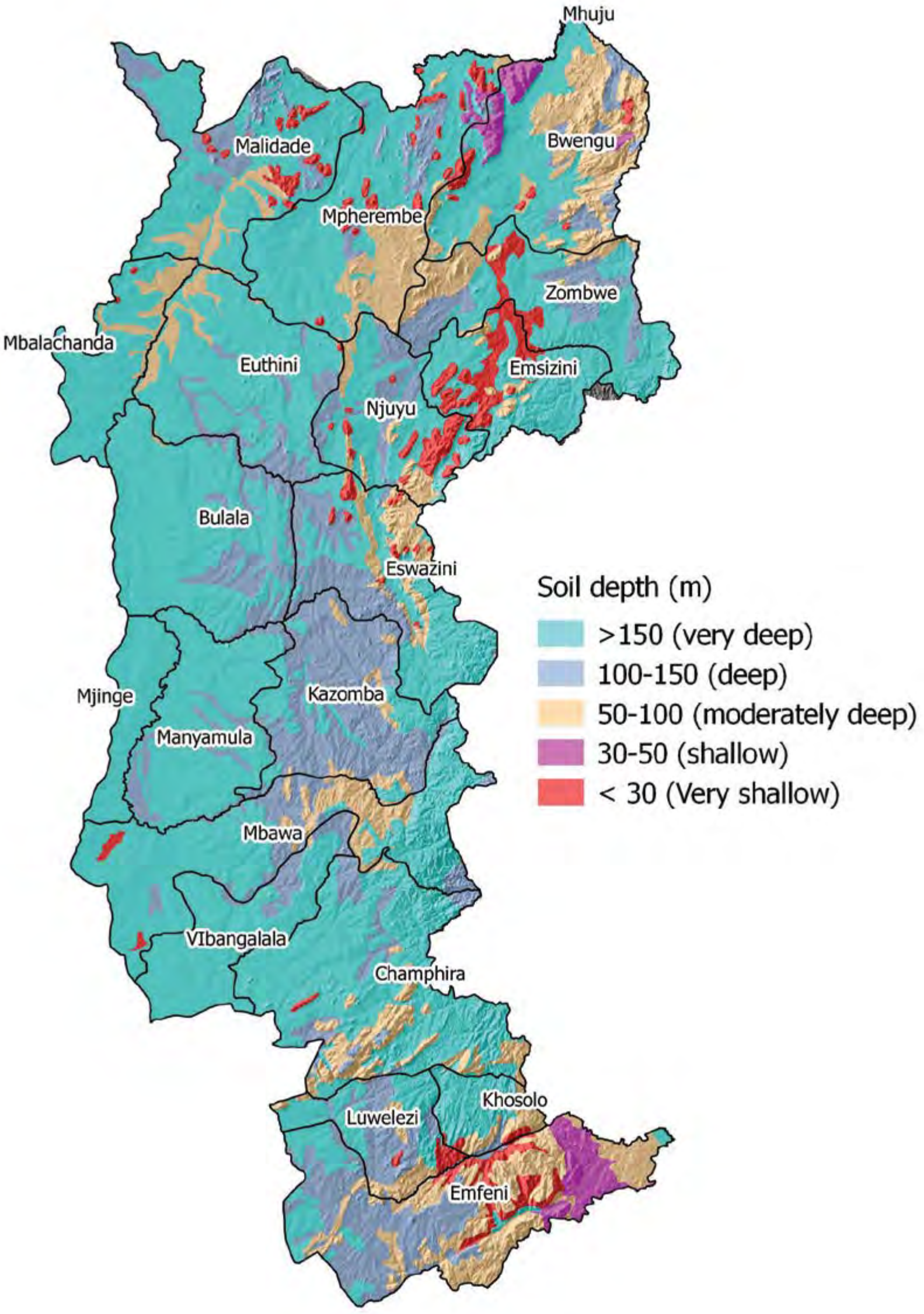
Source of base map: Government of Malawi

Steep slopes and shallow soil at Elephant rock



Major soil types

- Cambisol (Young & fertile)
- Luvisol (Fragile & fertile)
- Fluvisol (Alluvial deposits)
- Gleysol (Poorly drained)
- Regosol (Stony and erodible)
- Acrisol (Acidic, erodible & low fertility)
- Ferralsol (Murram & good structure)
- Lixisol (Fragile & lo fertility)
- Leptosol (Shallow and rocky)
- Marsh



Source of base map: Government of Malawi

Deep soil at Kawandama plantations and Chikangawa Forest

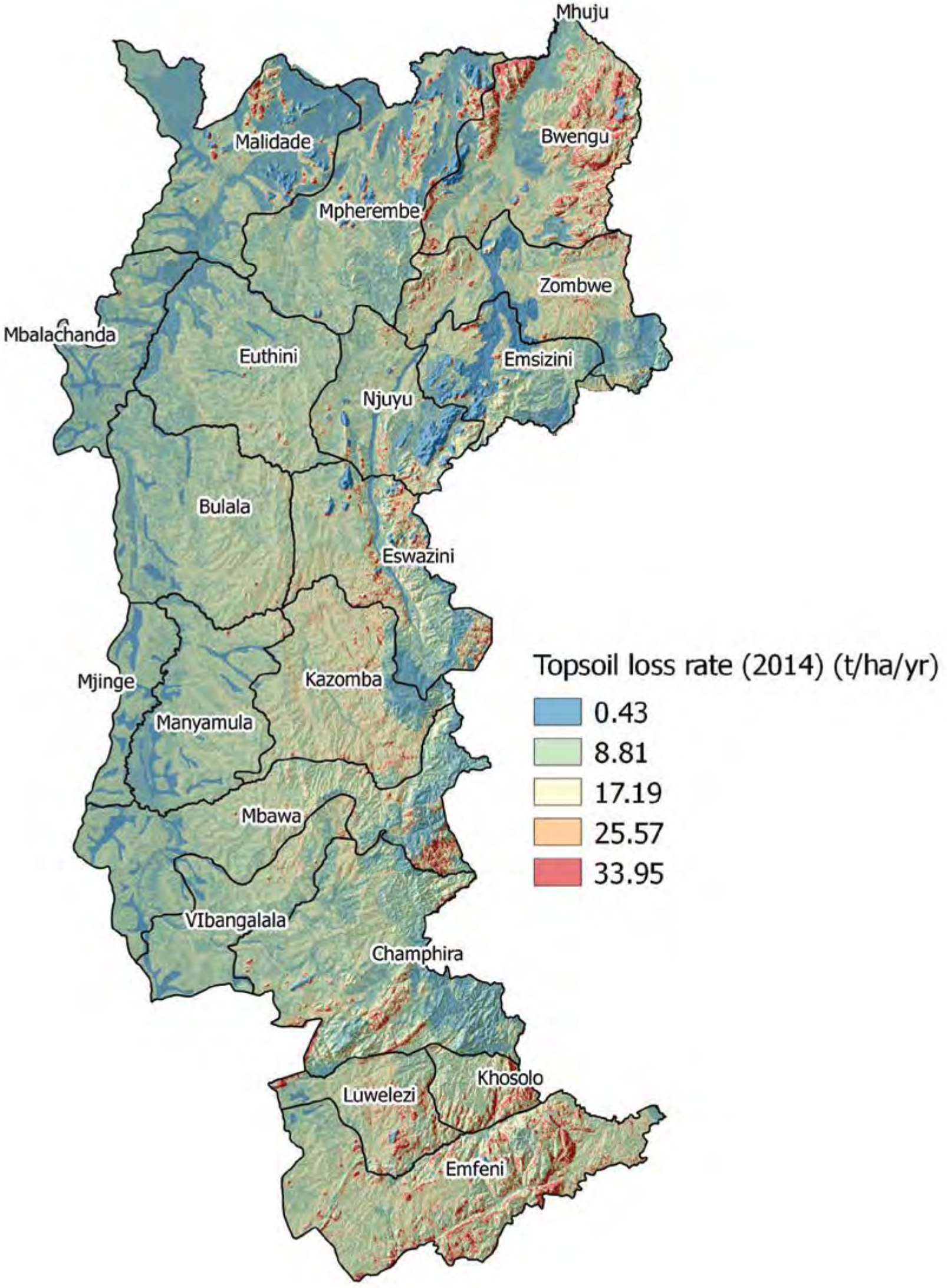
Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Mhuju	Moderate	3.8	24.7	895	895-884	Moderate risk
Bwengu	Moderate	12.7	86.5	900	900-845	Moderate risk
Malidade	Moderate	4.9	64.0	772	772-740	Moderate risk
Mpherembe	Slight to moderate	6.3	99.5	822	822-772	Moderate risk
Zombwe	Moderate	7.8	96.3	919	919-840	Moderate risk
Mbalachanda	Moderate	3.0	44.7	738	738-723	Moderate risk
Euthini	Moderate	3.6	49.0	778	778-743	Moderate risk
Emsizini	Moderate	9.3	74.9	907	907-856	Moderate risk
Njuyu	Slight to moderate	9.0	99.5	846	846-808	Moderate risk
Bulala	Slight to moderate	3.6	36.3	772	772-738	Moderate risk
Eswazini	Slight to moderate	10.0	98.6	860	860-805	Moderate risk
Kazomba	Moderate	7.8	43.6	846	846-795	Moderate risk
Manyamula	Moderate	3.0	51.8	783	783-755	Moderate risk
Mjinge	Moderate	2.3	10.9	757	757-744	Moderate risk
Mbawa	Moderate	7.5	52.0	817	817-740	Moderate risk
VIbangalala	Moderate	3.8	46.5	791	791-750	Moderate risk
Champhira	Slight to moderate	10.2	71.8	848	848-783	Moderate risk
Khosolo	Moderate	15.5	61.9	882	882-854	Moderate risk
Luwelezi	Moderate	10.2	82.8	827	827-781	Moderate risk
Emfeni	Moderate	12.2	96.5	846	846-762	Moderate risk

Sheet erosion at Gausi

Rill erosion at Joel Shawa

Measurement of sheet erosion at Joel Shawa



Source of base map: Government of Malawi

Rill erosion at Katula

Gully erosion at Kasunkha Chisi

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Mhuju	5.4	0.74	30.6
Bwengu	9.4	0.50	20.3
Malidade	4.0	0.48	14.2
Mpherembe	5.4	0.44	20.4
Zombwe	7.2	0.48	33.3
Mbalachanda	3.8	0.43	33.3
Euthini	5.5	0.73	18.7
Emsizini	4.4	0.81	28.5
Njuyu	5.9	0.50	11.2
Bulala	5.8	0.53	19.7
Eswazini	6.9	0.43	23.6
Kazomba	8.1	0.91	18.4
Manyamula	5.2	0.51	17.9
Mjinge	4.1	0.49	28.1
Mbawa	5.9	0.32	33.3
VIbangalala	5.6	0.62	16.5
Champhira	6.0	0.20	26.9
Khosolo	10.0	1.73	32.0
Luwelezi	9.3	0.79	11.0
Emfeni	9.5	0.53	21.8

Sheet and rill erosion at Makhanya

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 2.44 t/ha/yr. The mountainous areas of Bwengu, Emfeni, Khosolo, and Luwelezi EPAs showed signs of high soil loss rates. The main drivers of high topsoil loss rates in these areas include decline of the vegetative cover and agricultural activities in vulnerable soils. Sheet and rill erosion are the common forms of erosion.

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Bulala	4.79	1.378	0.679	0.069	78.232	0.188	0.137	2.408	0.342	0.861	2.861	29.757	15.737
Champhira	4.68	1.432	0.707	0.072	24.768	0.541	0.686	4.292	1.403	1.022	2.931	20.374	15.257
Emsizini	4.96	1.432	0.706	0.072	40.880	0.436	0.669	4.068	1.567	0.853	2.469	25.465	13.717
Luwelezi	5.31	1.223	0.603	0.062	76.798	0.545	0.557	3.551	1.190	0.490	2.114	20.065	11.626
Malidade	4.91	0.770	0.375	0.040	25.105	0.686	0.561	4.632	1.620	1.000	3.001	18.005	16.505
Mbalachanda	5.97	1.178	0.580	0.060	17.602	0.689	0.526	5.101	1.635	0.719	2.157	12.942	11.864
Mbawa	4.52	1.875	0.924	0.094	39.294	0.195	0.170	3.675	0.733	0.428	2.428	25.254	13.356
Mjinge	5.38	0.917	0.452	0.045	49.388	0.659	0.590	4.733	1.586	1.236	3.691	24.065	20.299
Mpherembe	5.39	0.996	0.491	0.051	39.080	0.479	0.562	5.128	1.682	0.893	3.368	15.561	15.122
Vibangalala	4.74	0.709	0.350	0.034	19.344	0.514	1.121	2.842	0.903	0.581	2.511	21.970	11.690
Bwengu	6.09	0.682	0.336	0.034	25.923	0.450	0.511	4.864	1.545	0.387	0.582	20.939	14.823
Zombwe	4.86	1.650	0.898	0.105	30.920	0.465	0.672	3.952	1.553	1.457	1.276	22.274	15.110
Euthini	4.95	1.424	0.890	0.100	37.886	0.470	0.694	3.676	1.702	1.453	1.114	22.155	15.696
Njuyu	5.09	1.510	0.919	0.106	37.653	0.489	0.655	3.990	1.654	1.507	1.188	21.077	14.519
Chitheka	5.00	1.988	0.953	0.106	39.990	0.440	0.615	3.947	1.673	1.525	1.046	19.954	14.258
Eswazini	5.23	1.671	0.949	0.109	38.557	0.451	0.631	4.311	1.920	1.515	0.917	20.358	15.026
Kazomba	5.23	1.566	0.938	0.108	33.091	0.447	0.646	4.145	2.202	1.414	0.735	20.389	14.427
Manyamula	5.12	1.399	0.901	0.098	35.525	0.481	0.680	3.974	2.390	1.405	0.157	22.657	15.679
Khosolo	4.92	1.931	0.902	0.100	33.592	0.460	0.538	3.768	1.388	1.433	0.438	21.430	15.535
Emfeni	5.24	1.756	0.885	0.097	29.459	0.472	0.587	3.924	1.535	1.510	0.362	22.287	15.878

Typical croplands in July-August period in 2017

Cropland at Chinjoka Nkhuna in Mpherembe EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Bwengu	0.148	0.006	0.402	0.557
Malidade	0.093	0.006	0.238	0.337
Mpherembe	0.117	0.005	0.326	0.448
Zombwe	0.125	0.006	0.368	0.499
Mbalachanda	0.069	0.011	0.253	0.333
Euthini	0.096	0.004	0.358	0.458
Emsizini	0.093	0.004	0.315	0.412
Njuyu	0.103	0.005	0.371	0.478
Chitheka	0.052	0.002	0.191	0.245
Bulala	0.107	0.006	0.378	0.49
Eswazini	0.121	0.005	0.423	0.548
Kazomba	0.159	0.007	0.465	0.631
Manyamula	0.127	0.006	0.455	0.588
Mjinge	0.102	0.009	0.338	0.449
Mbawa	0.134	0.006	0.427	0.567
VIbangalala	0.132	0.007	0.434	0.573
Champhira	0.11	0.005	0.279	0.393
Khosolo	0.114	0.005	0.376	0.495
Luwelezi	0.115	0.005	0.444	0.564
Emfeni	0.111	0.005	0.33	0.447

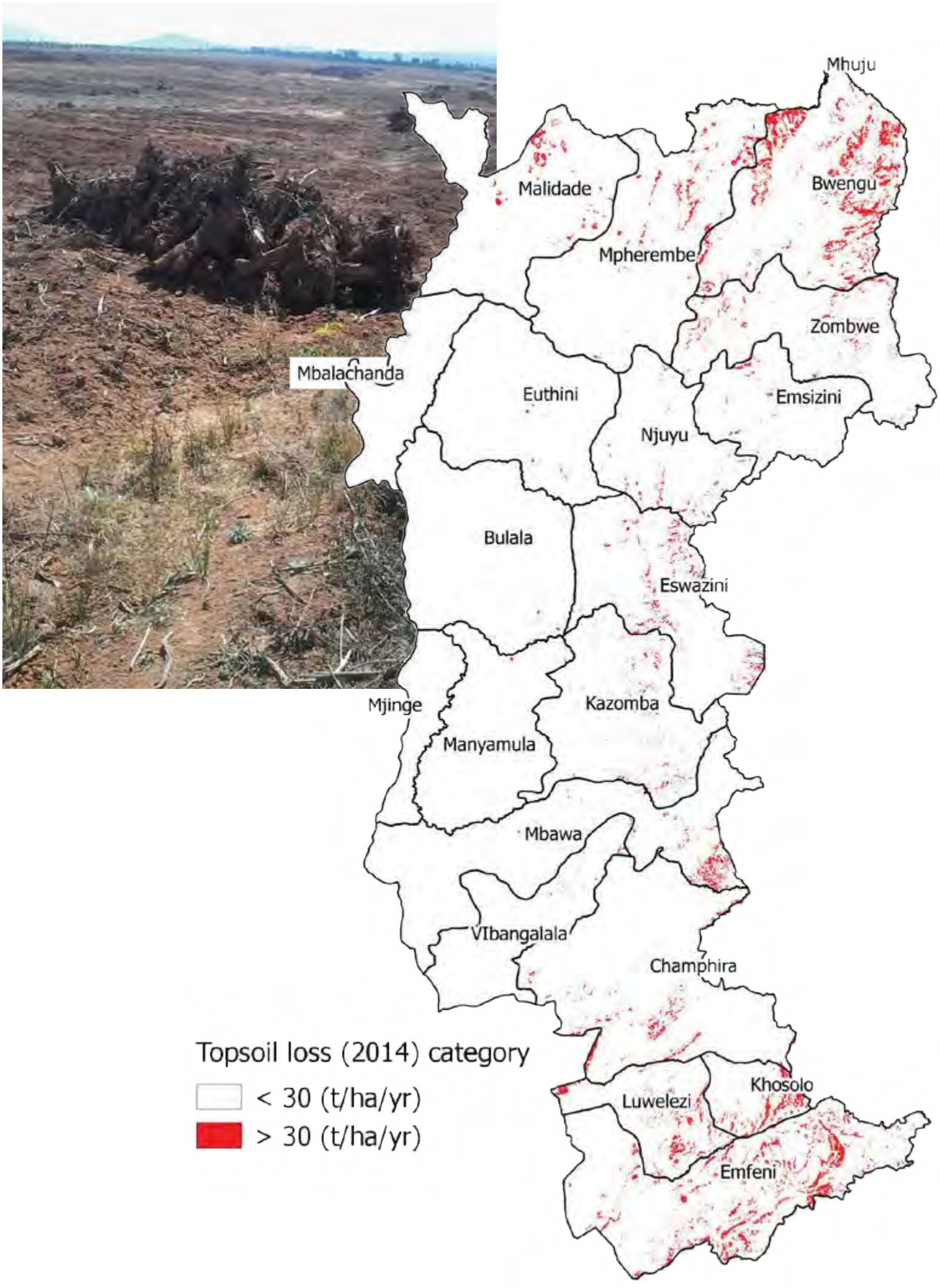
Typical croplands in July-August period in 2017

Cropland at Daulire Moyo in Eswazini Mountain EPA

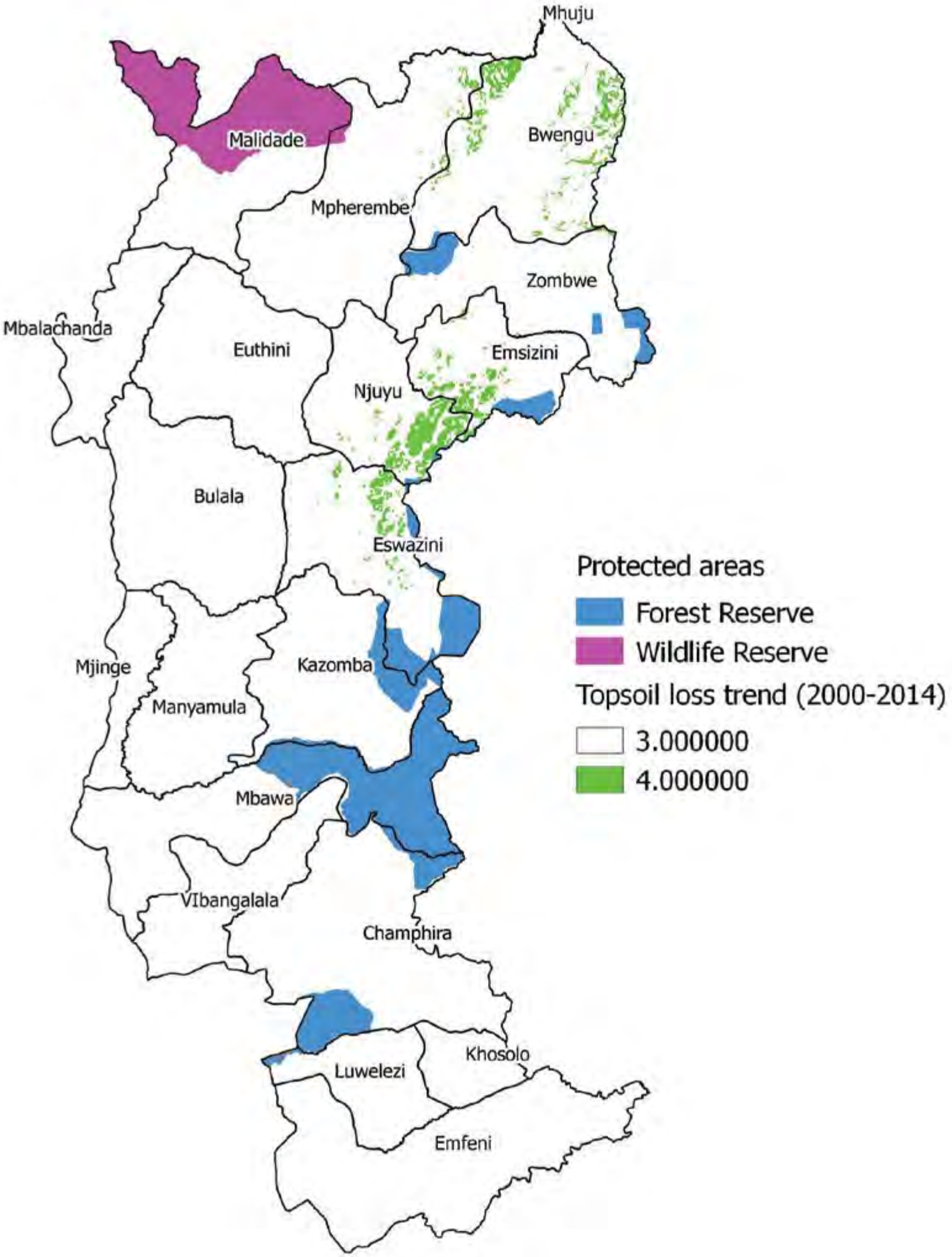
Cropland at Jordan Moyo in Bulala EPA

Topsoil loss between 2000 and 2014

The trend of topsoil loss rates in the District seems to have been constant between 2000 and 2014 except in Bwengu, Emsizini, Njuyu, and Eswazini EPAs.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

Replanted forest at Kamuzu Tree plantation

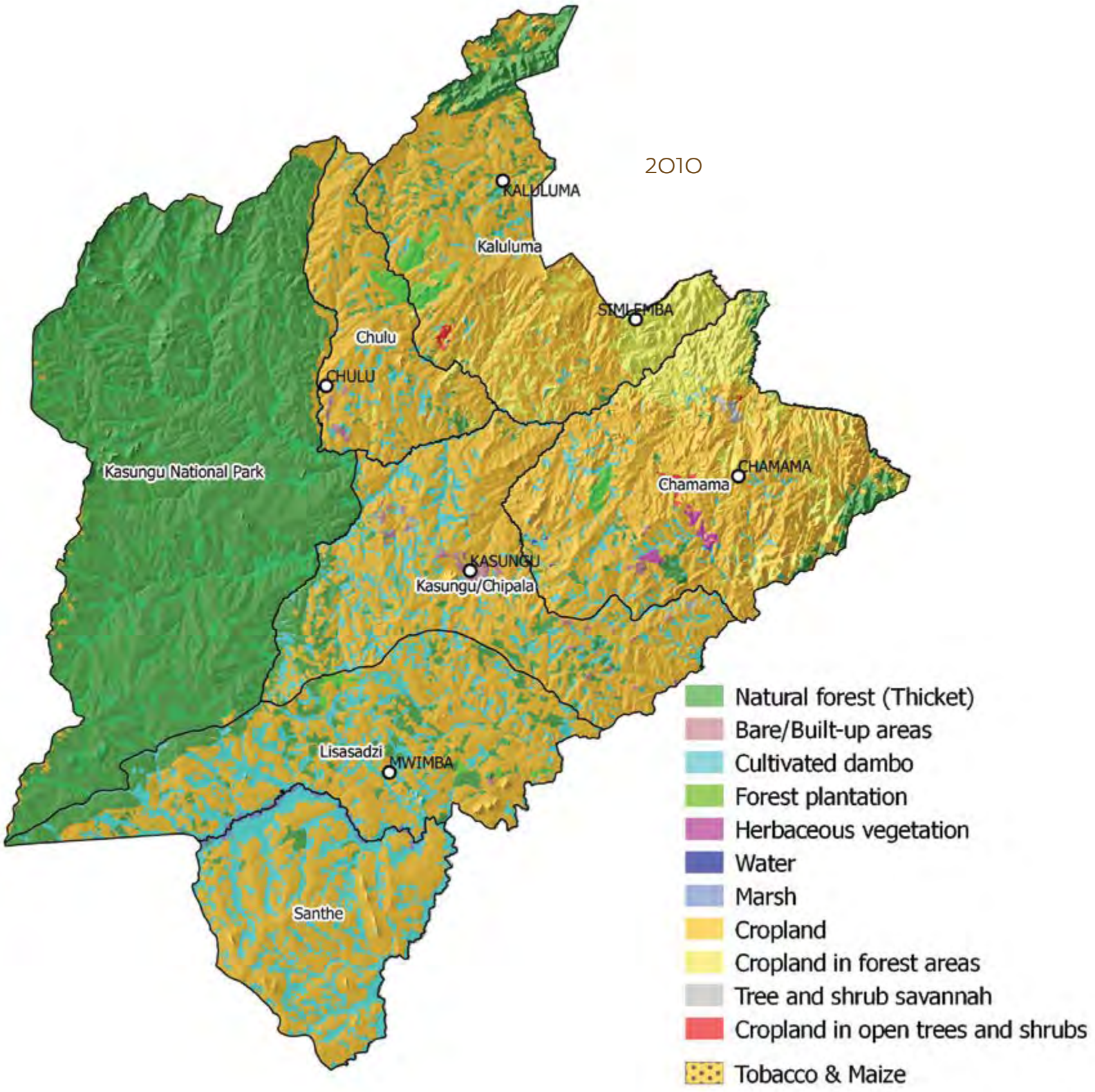
Conservation agriculture at Mihla Nkosi

Protecting natural forest cover at Perekezi and replanting new forests at Kawandama

Drivers of soil loss
1. Vegetation cover change:

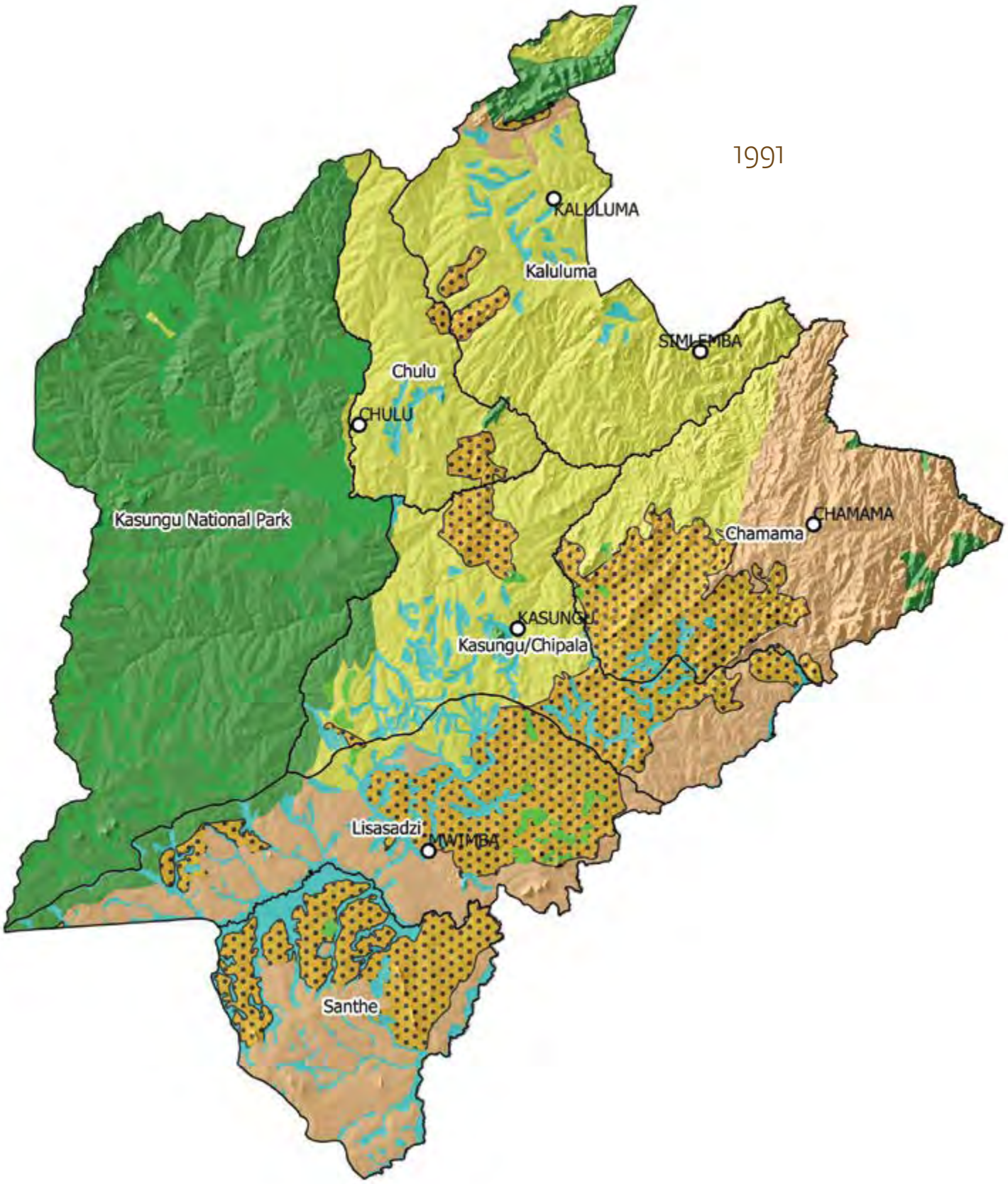
The main land use/cover types in the District are Kasungu National Park, smallholder croplands, natural forests, urban/settlements, estates, and pockets of replanted forest. The district has had a slight decline in vegetative cover in the northern parts and an increase in the southern parts. The threat to soil loss due to land cover decline is minimal.

Major land cover/use types in 2010 and 1991



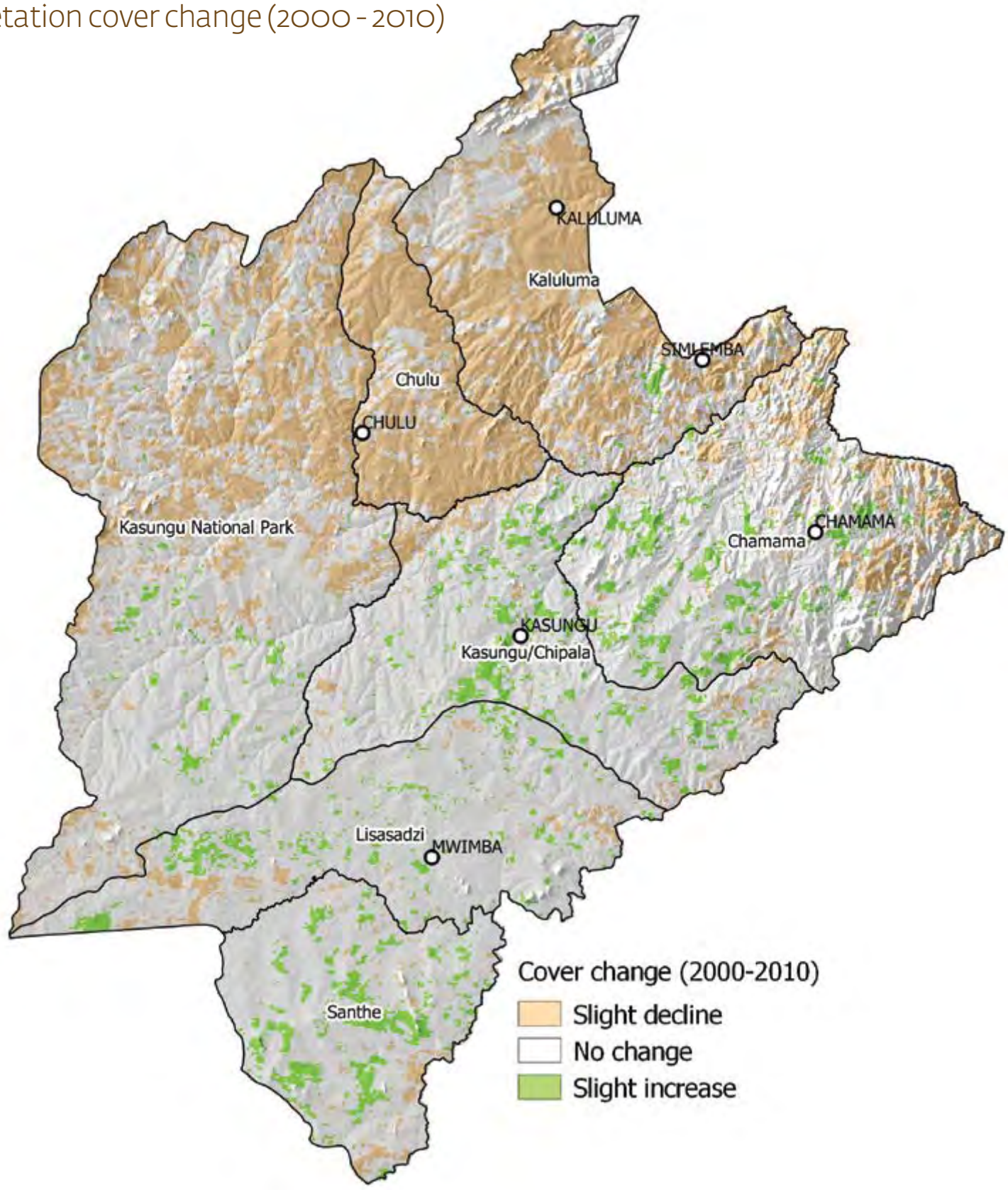
Source of base map: Government of Malawi

1991



Source of base map: Government of Malawi

Vegetation cover change (2000 - 2010)



Source of base map: Government of Malawi

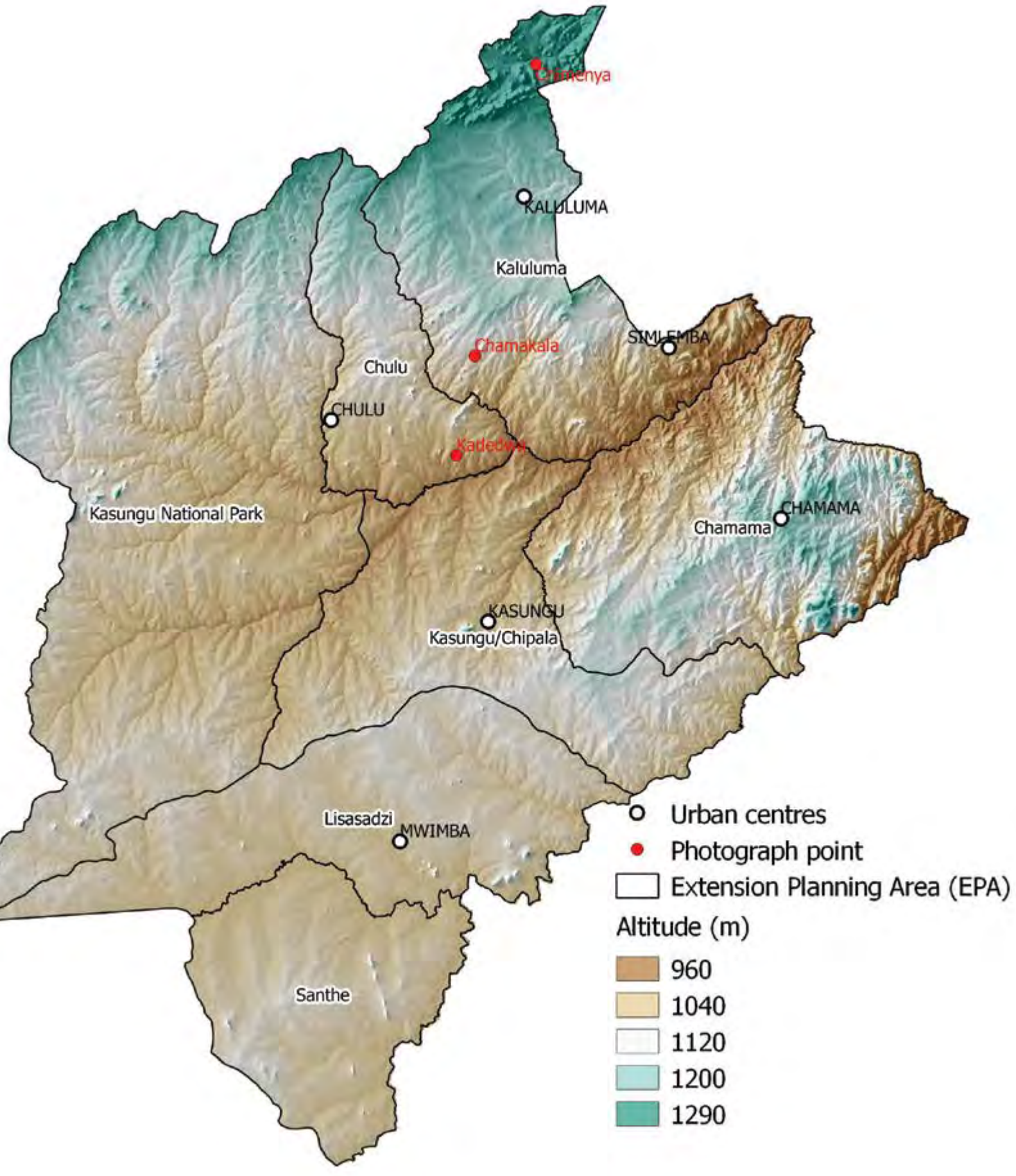
Example of land cover types at Yosefe in Chamama

2. Rainfall, relief and soil factors

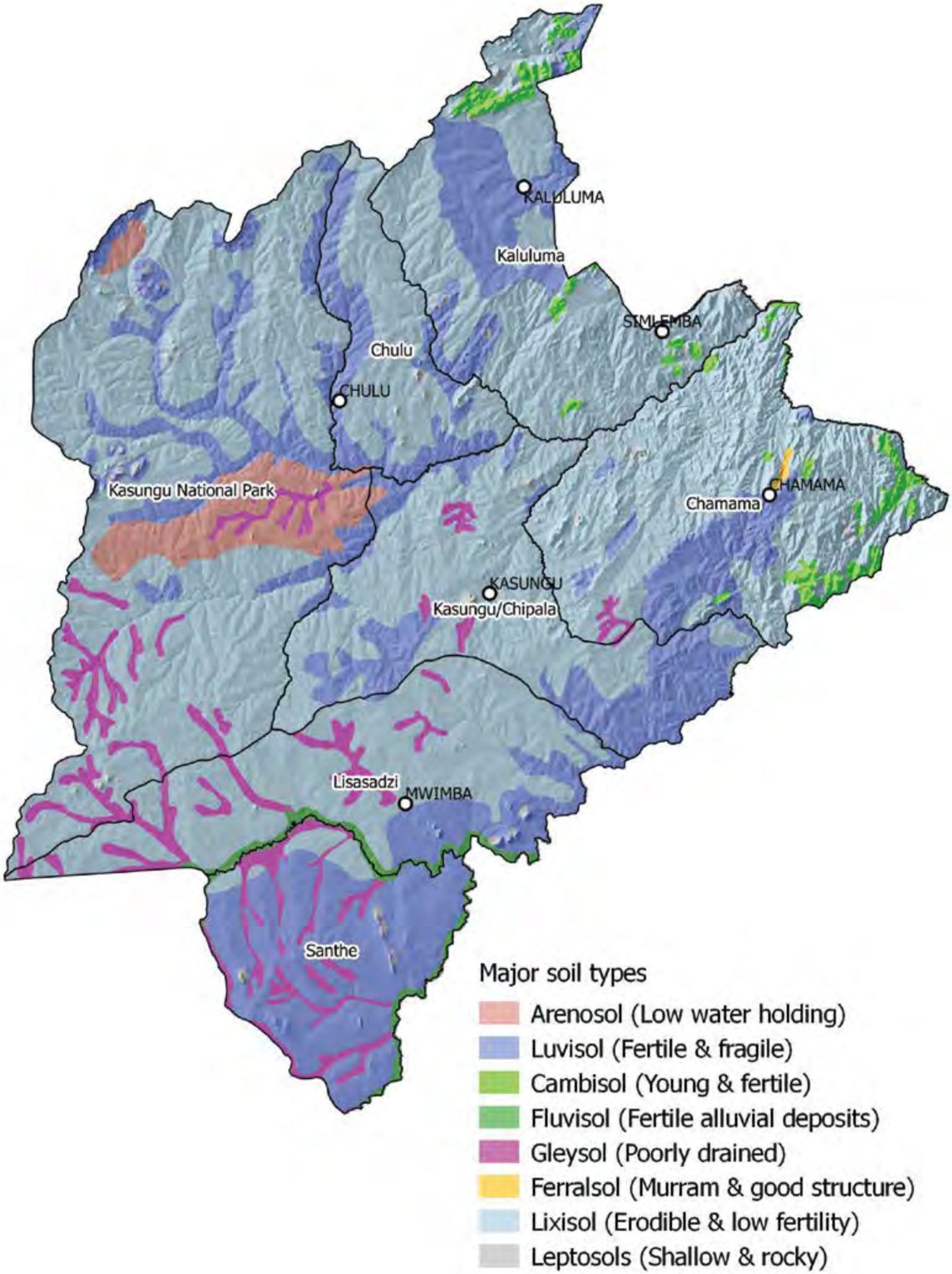
Kasungu is rather flat in most areas, save for a few mountain ranges in the north and east. The soil is deep but susceptible to erosion if not well managed.

Flat terrain and pockets of steep slopes at Chimenya

Deep soil in a flat area at Kadedwa



Source of base map: Government of Malawi



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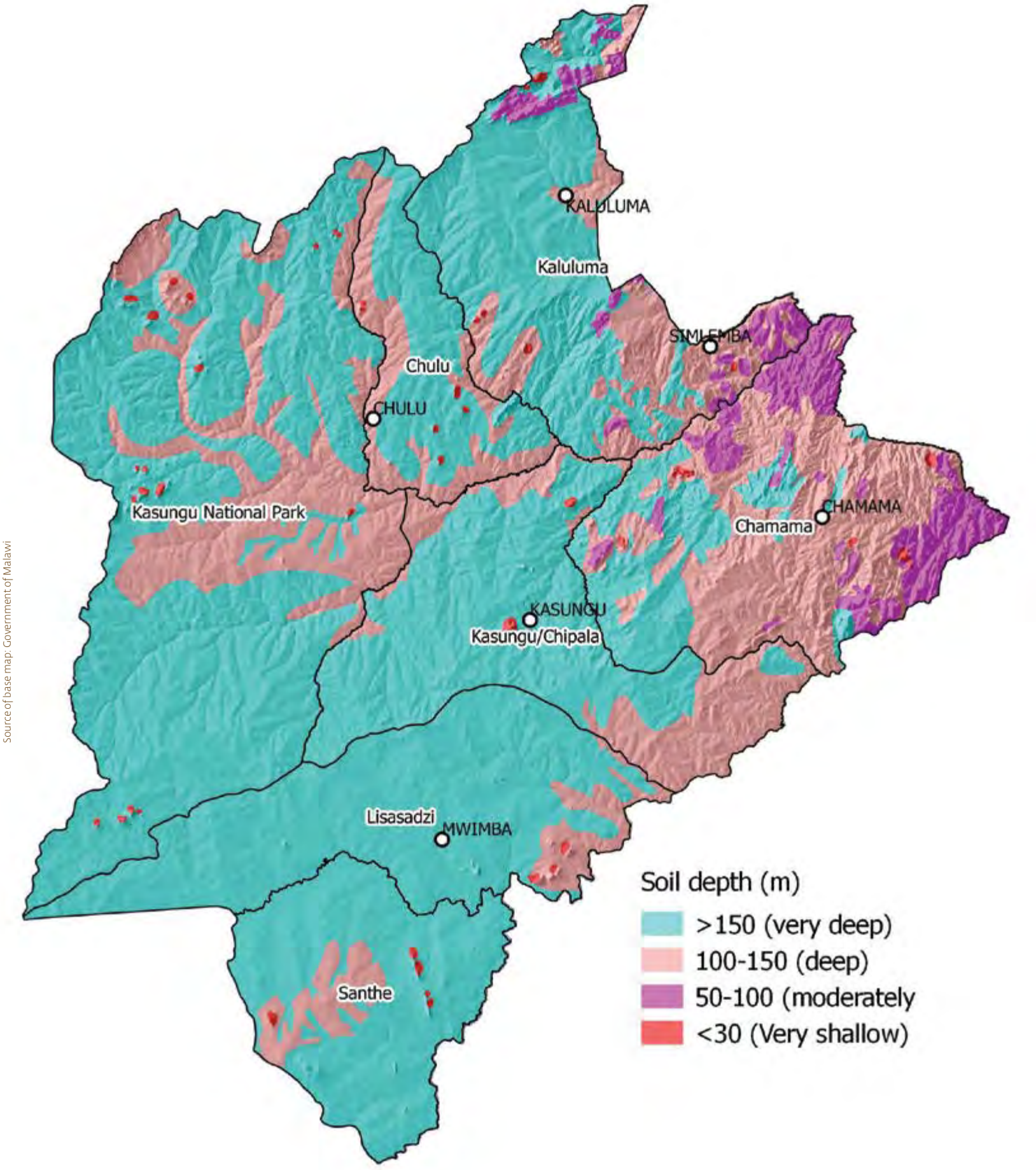


Source of base map: Government of Malawi

Soil loss risk factors

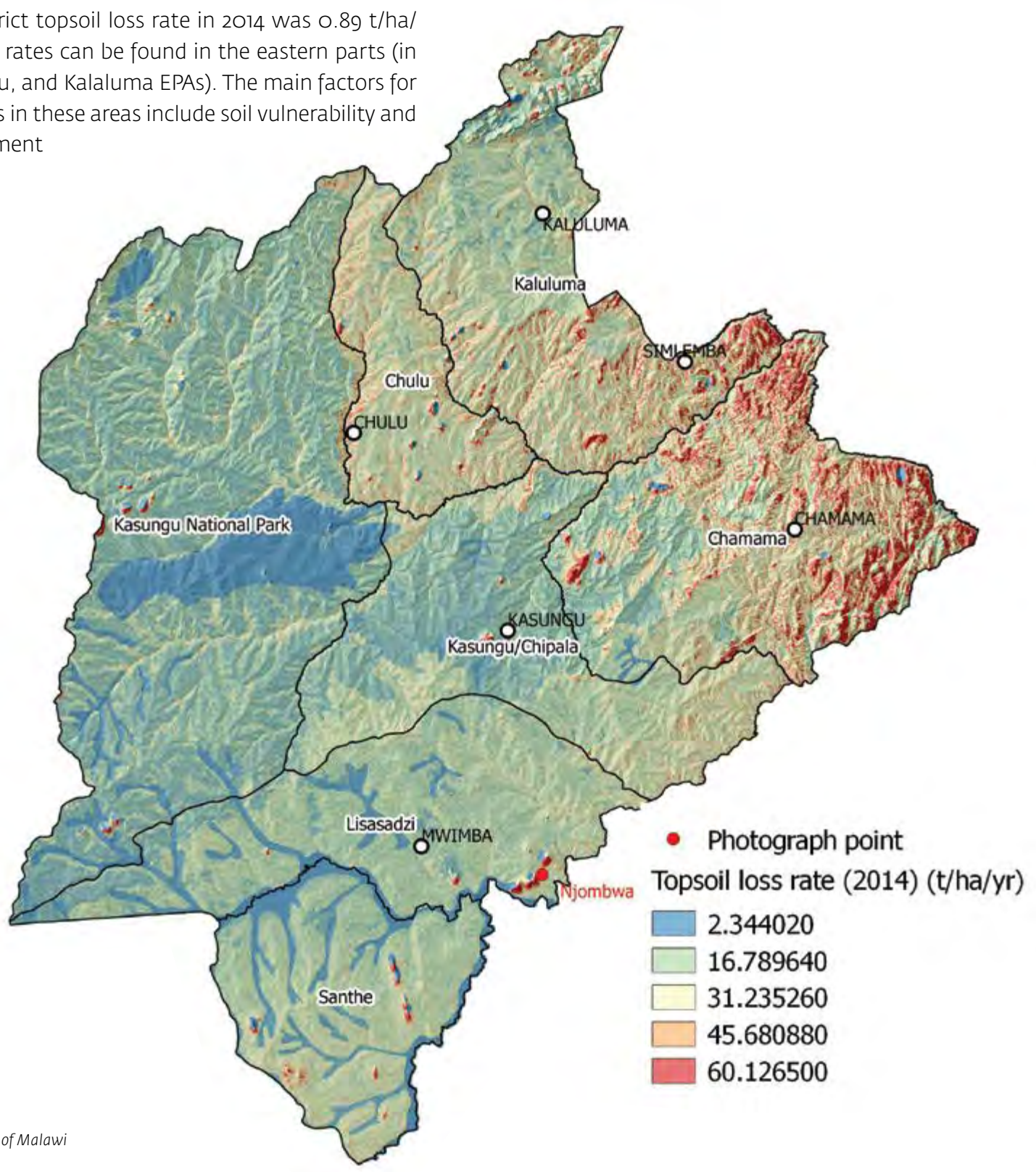
Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Kaluluma	Slight decline	5.04	76.92	749	699-822	Low risk
Kasungu National Park	Slight decline	3.03	95.81	678	658-725	Low risk
Chulu	Slight decline	3.34	61.01	702	680-730	Low risk
Chamama	No change	7.24	77.60	757	718-838	Moderate to Low risk
Kasungu/Chipala	None to slight increase	2.97	73.64	705	658-769	Low risk
Lisasadzi	None to slight increase	1.98	59.11	672	651-723	Low risk
Santhe	None to slight increase	1.79	42.24	648	640-664	Low risk

Sheet nd gully erosion at Njombwa Villageaa

Sheet and gully erosion at Njombwa Village

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 0.89 t/ha/yr. High soil loss rates can be found in the eastern parts (in Chamama, Chulu, and Kalaluma EPAs). The main factors for the soil loss rates in these areas include soil vulnerability and soil mismanagement



Source of base map: Government of Malawi

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Kaluluma	1.48	0.15	14.01
Kasungu National Park	0.27	0.13	8.23
Chulu	1.07	0.14	12.34
Chamama	1.82	0.24	14.55
Kasungu/Chipala	0.56	0.19	11.12
Lisasadzi	0.78	0.13	5.45
Santhe	1.06	0.25	10.23

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chamama	5.66	2.088	1.029	0.104	67.475	0.318	1.143	3.200	1.988	0.235	0.203	12.595	10.773
Chulu	4.89	2.585	1.274	0.129	8.072	0.337	0.395	3.594	1.140	1.143	3.143	32.692	17.289
Kaluluma	4.62	1.463	0.721	0.073	60.736	0.489	0.546	3.873	1.346	1.192	3.192	33.197	17.556
Lisasadzi	5.43	0.881	0.434	0.044	21.976	0.395	1.050	5.825	2.410	0.160	0.152	16.605	11.460
Santhe	4.61	1.207	0.595	0.060	33.871	0.285	1.108	2.698	1.485	0.239	0.220	21.828	11.115
Kasungu/ Chipala	4.73	0.696	0.343	0.035	19.522	0.233	1.083	2.508	1.480	0.116	0.291	12.780	15.938
Kasungu National Park	5.07	1.849	0.905	0.095	24.593	0.497802	0.545	3.724	1.635	1.513	0.48	22.04	14.35

Typical croplands in July-August period in 2017

Cropland at Yosefe, Chamama EPA

Cropland at Julo, Kaluluma EPA

Cropland at Dambo, Lisasadzi EPA

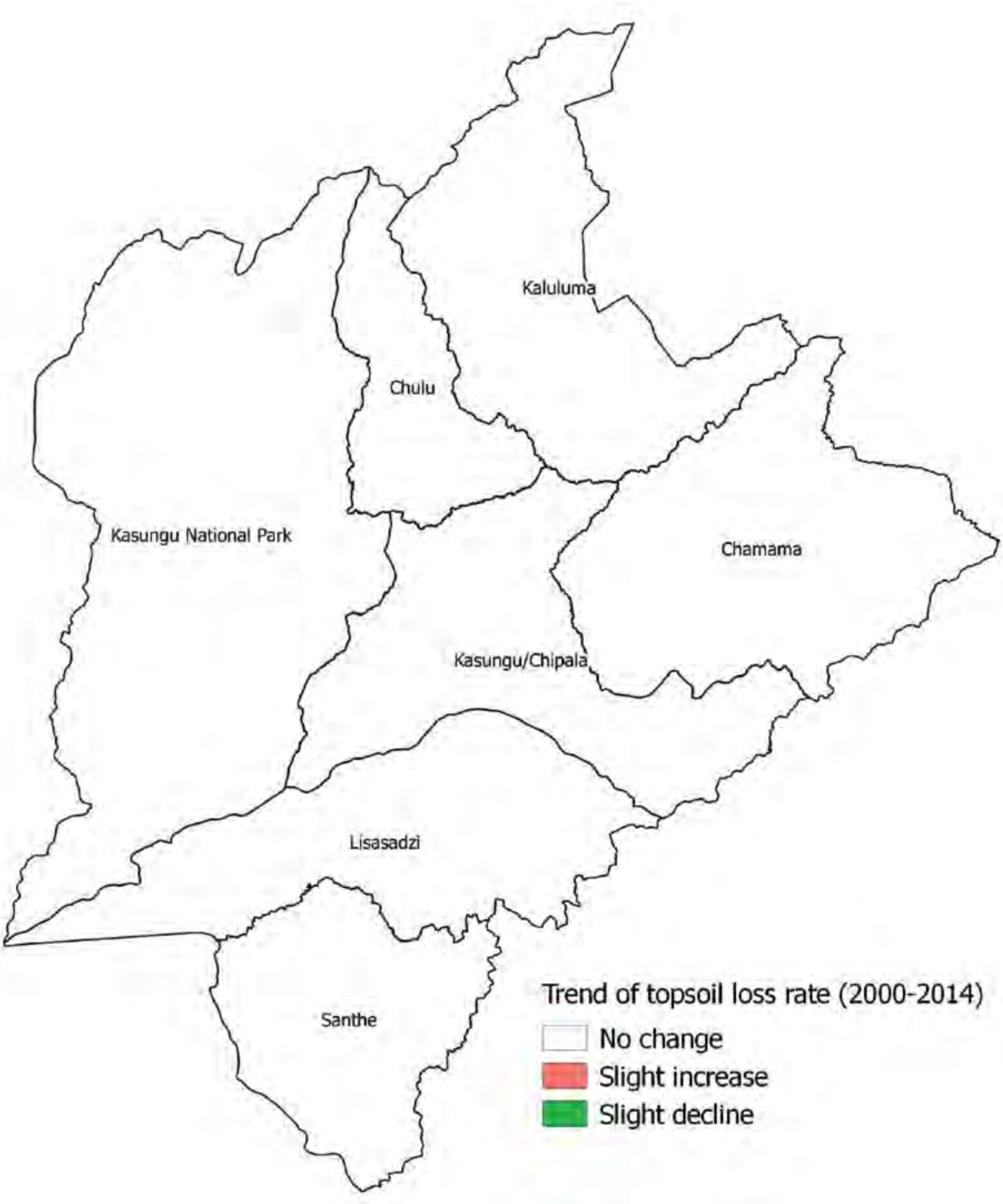
Cropland at Mateyo, Chulu EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Kaluluma	0.125	0.007	0.381	0.512
Kasungu National Park	0.073	0.011	0.192	0.277
Chulu	0.122	0.006	0.332	0.460
Chamama	0.133	0.006	0.401	0.539
Kasungu/ Chipala	0.113	0.005	0.290	0.407
Lisasadzi	0.098	0.004	0.249	0.351
Santhe	0.092	0.003	0.252	0.347

Topsoil loss trend between 2000 and 2014

The trend of topsoil loss rates in the District seem to have been constant between 2000 and 2014. The most common soil erosion problem is sheet and gully erosion. These are largely due to the vulnerability of the dominant soil type and soil management.



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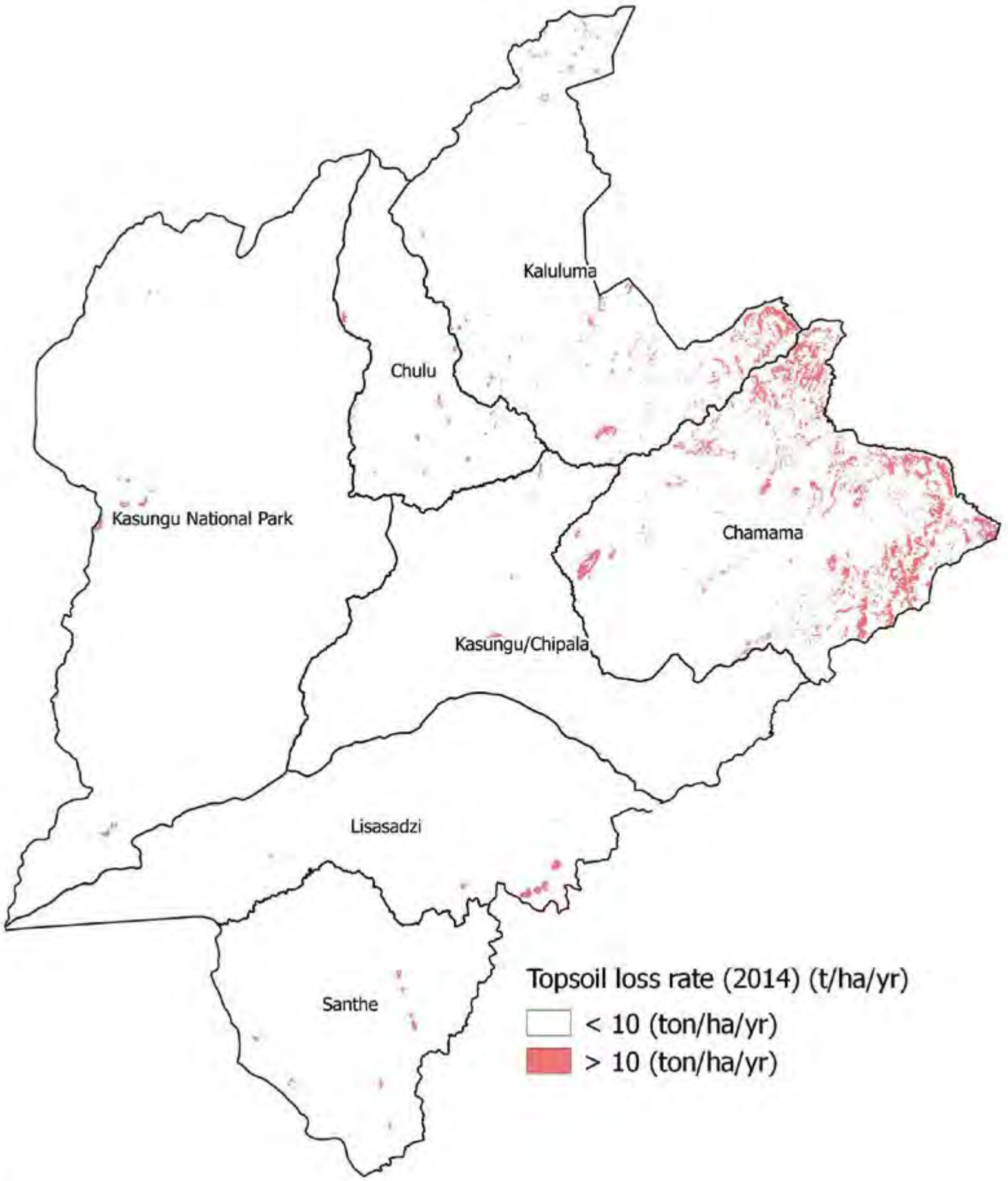


Source of base map: Government of Malawi

Some of the soil and water conservation measures

Maintaining natural vegetation cover at Chamakala west

Gully erosion control at Chikweya Village by Chisikwa conservation group

Slash-and-burn at Kwengwele in Chipala EPA

Vetiver Hedgerow at Chimenya Village as a conservation measure

Maintaining natural forest cover at Chimaliro Forest reserve

Pigeon peas improved fallow at Chimaliro Estate

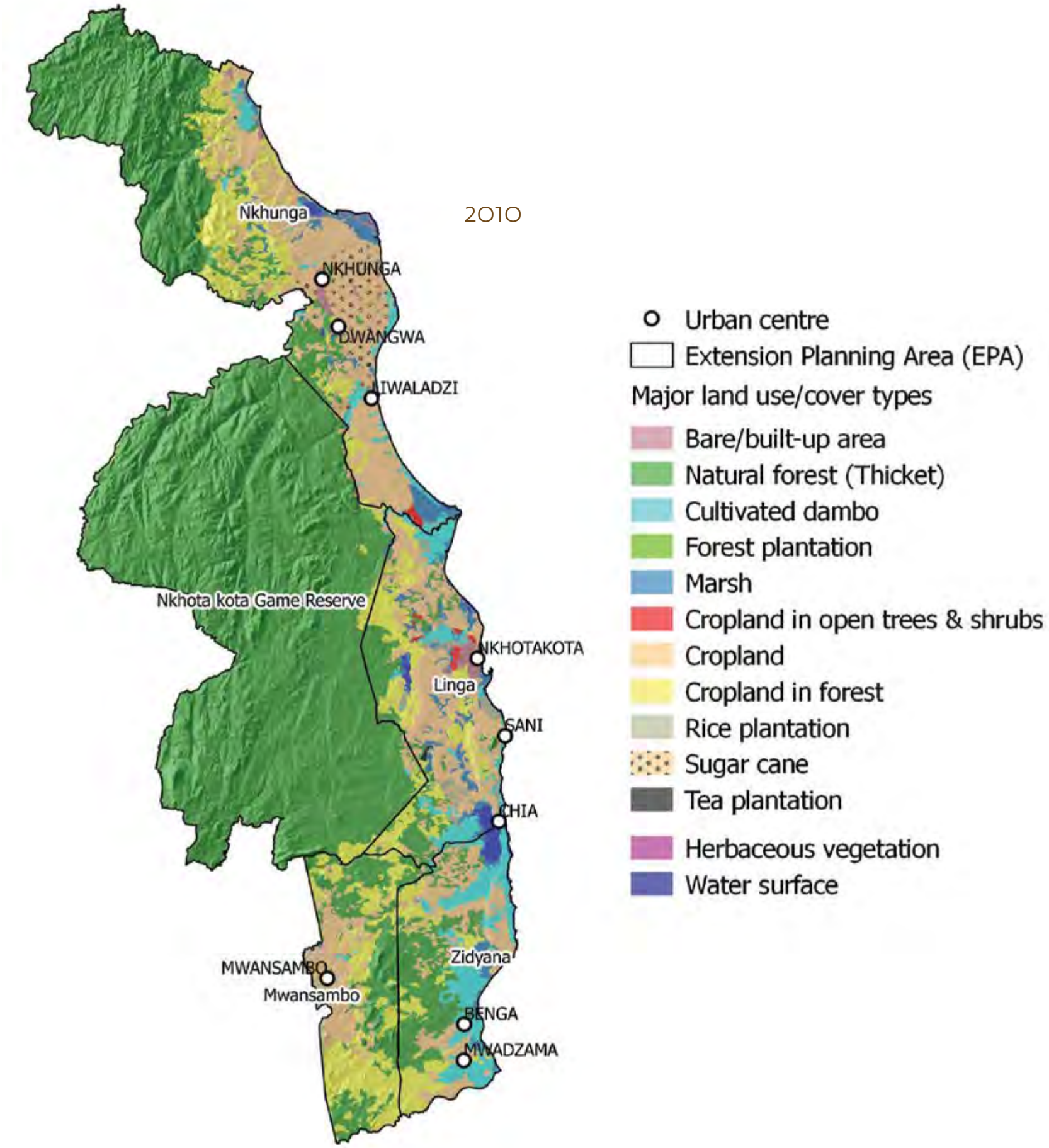
Kakhulajno Community vetiver nursery

Tephrosia vogelli on farm demonstration at Kaluluma

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are game reserve, smallholder croplands, urban/settlements, and forests. The district has had a slight increase in vegetative cover between 2000 and 2014. Consequently, the threat to soil loss in the district was minimal in 2014.

Major land cover/use types in 2010 and 1991



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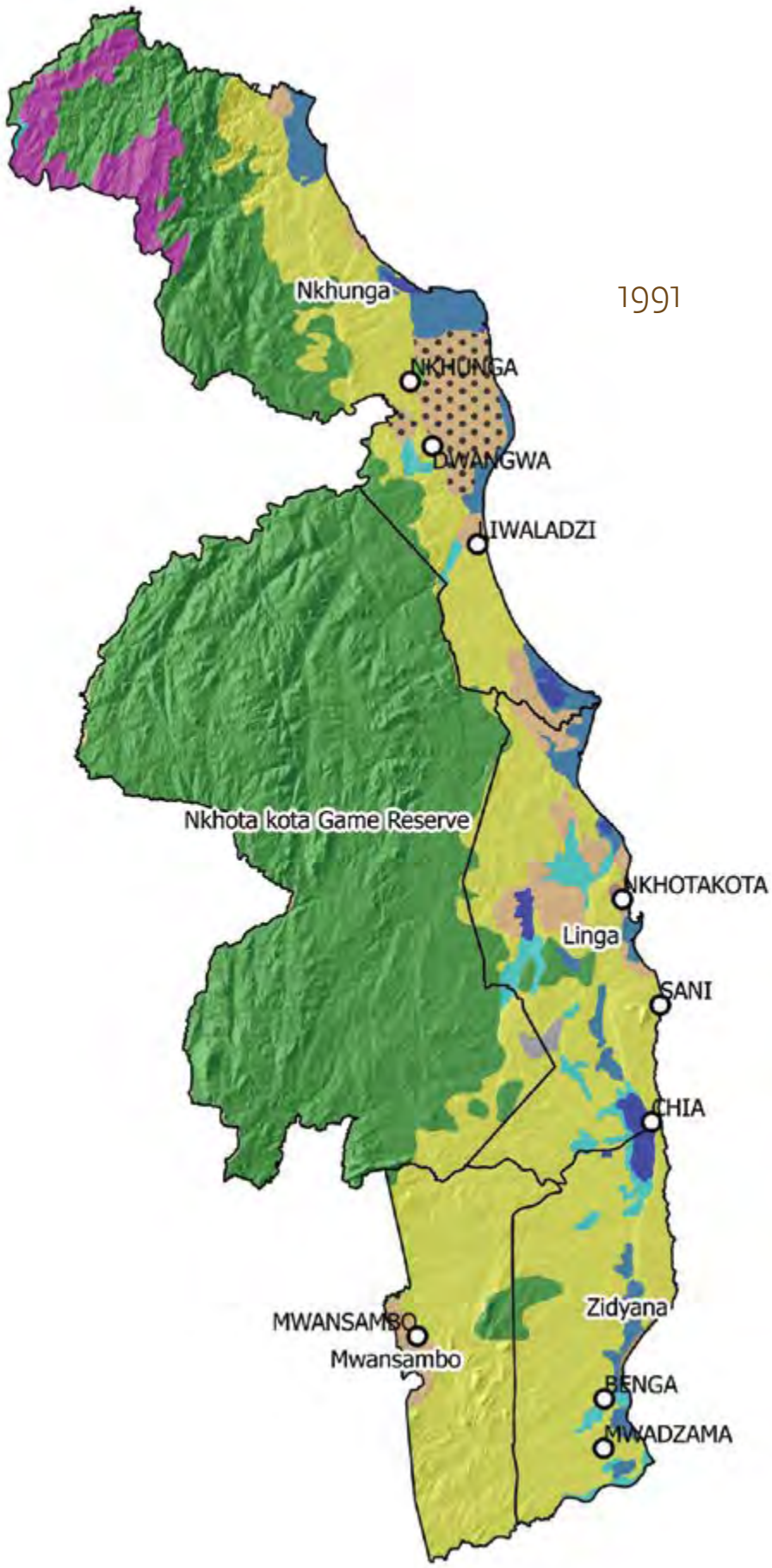
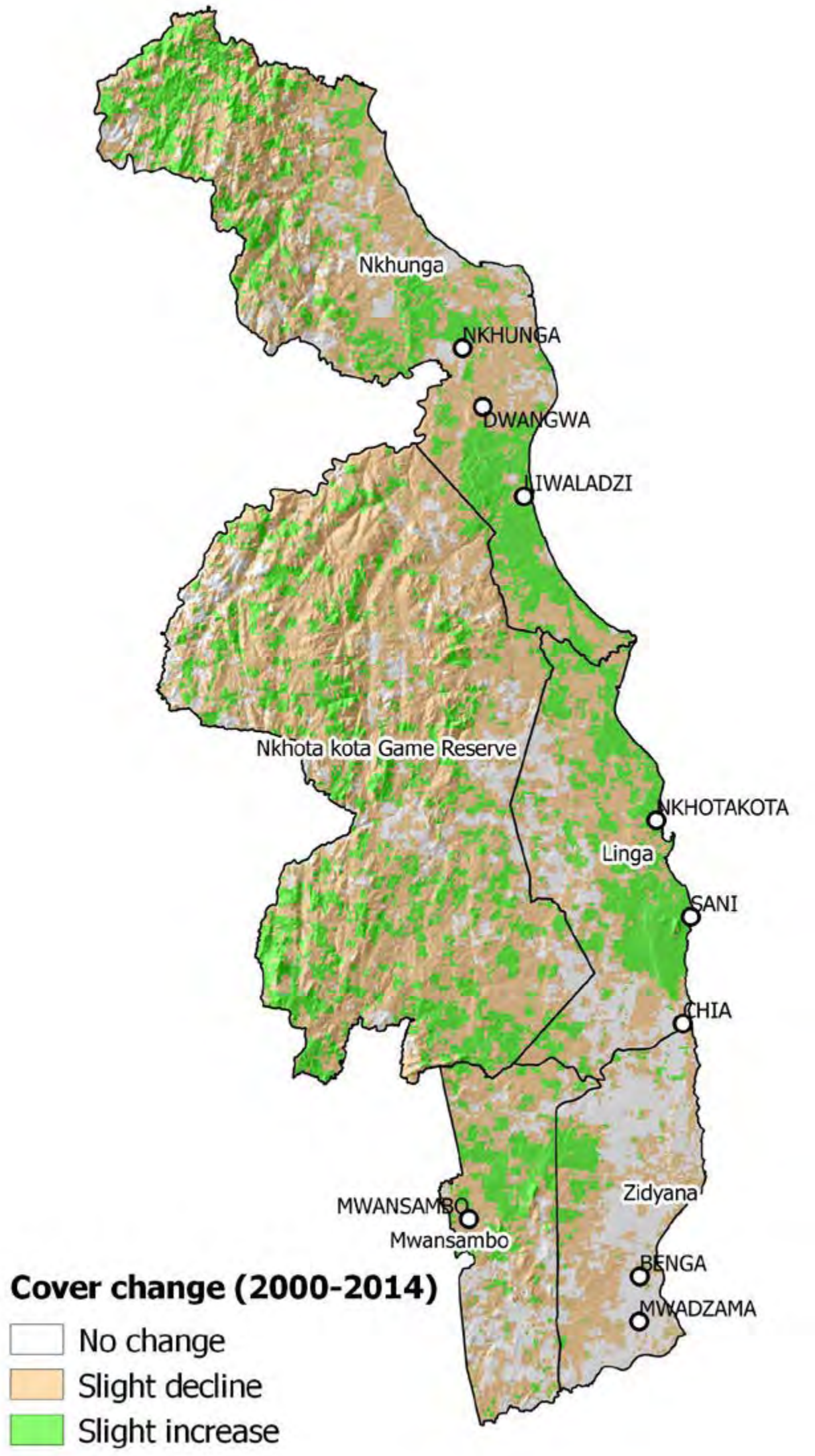


Source of base map: Government of Malawi

Example of land cover types at Phaso and Liwewe in 2016

Vegetation cover change



Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

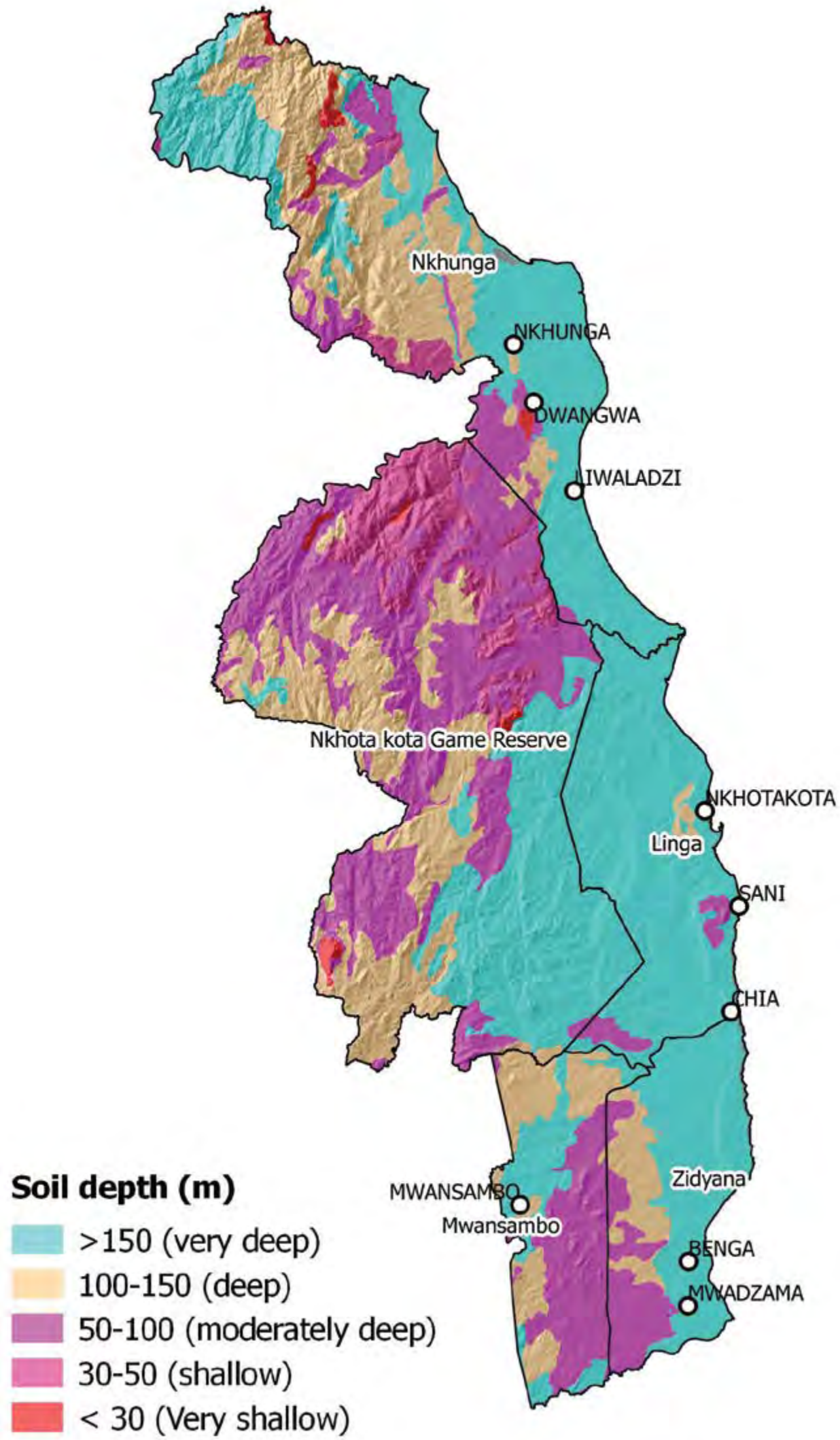
Nkhotakota district has mixed terrain: Hilly and steep slopes in the western parts (in the Rift Valley) which changes into gentle slopes as it tapers into Lake Malawi in the eastern side. The western parts have shallow soil that are susceptible to erosion. The eastern side has deep soil which is also vulnerable to soil erosion.

Mix of flat and ragged terrain at Kapala

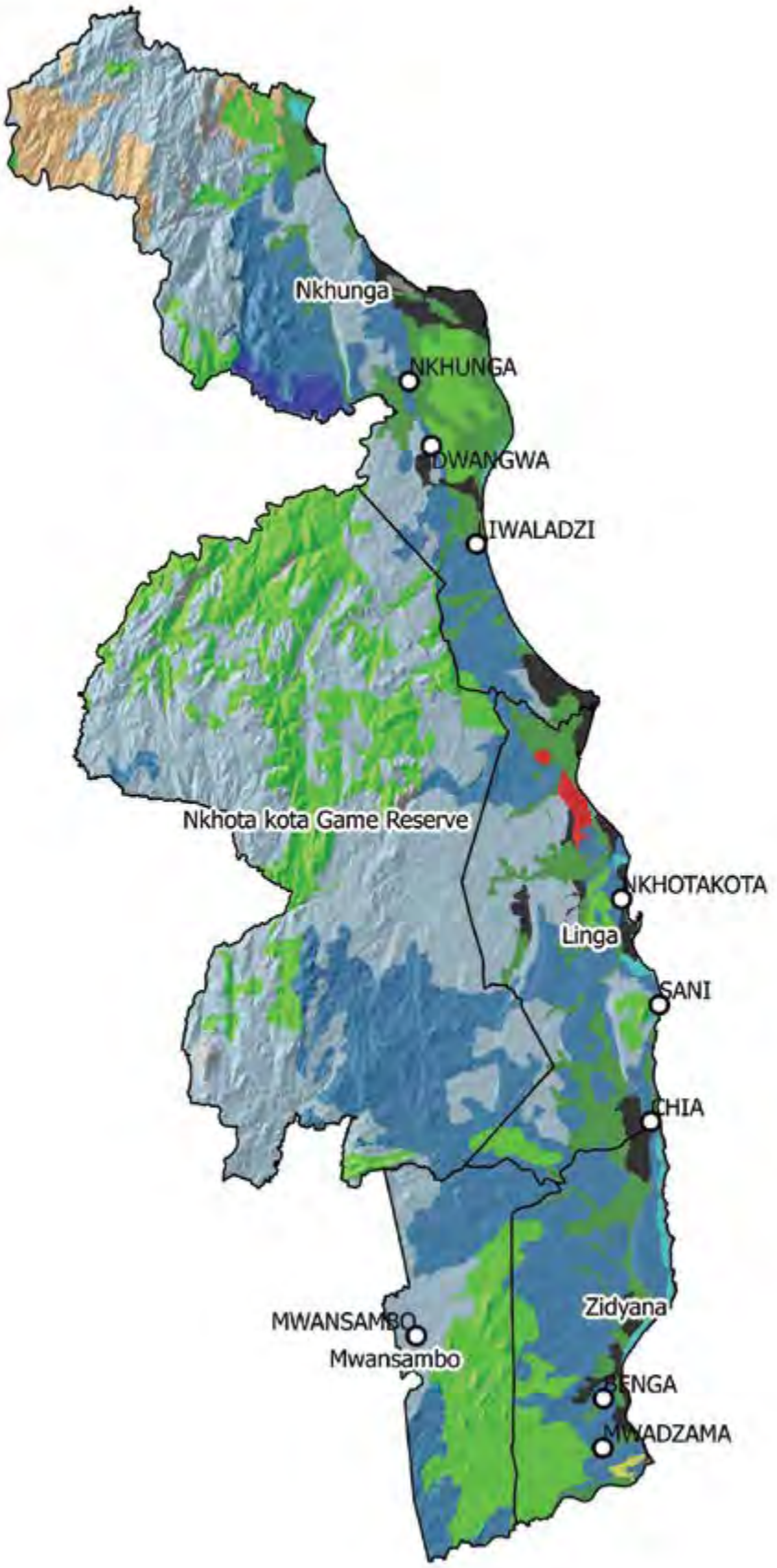
Shallow soil at Nabvundi Game Reserve

Deep soil at Chia lake shore

Source of base map: Government of Malawi



Source of base map: Government of Malawi



Major soil types

- Arenosol (Sandy & low fertility)
- Cambisol (Young & fertile)
- Luvisol (Fragile & fertile)
- Fluvisol (Alluvial deposits)
- Regosol (Stony & erodible)
- Vertisol (Heavy clay)
- Alisol (Acidic & low fertility)
- Ferralsol (Murram & good structure)
- Lixisol (Fragile & low fertility)
- Marsh
- Leptosol (Shallow and rocky)

Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Nkhunga	Slight increase	9.8	89.5	960	813-1040	Low risk
Nhotakota Game Reserve	Slight increase	11.4	97.2	828	757-967	Moderate risk
Linga	Slight increase	3.0	36.8	840	820-860	Low risk
Zidyana	Slight increase	2.5	26.5	805	745-850	Low risk
Mwansambo	Slight increase	5.7	57.6	789	731-830	Low risk

Features of soil erosion

Measuring sheet and gully erosion at Zoto

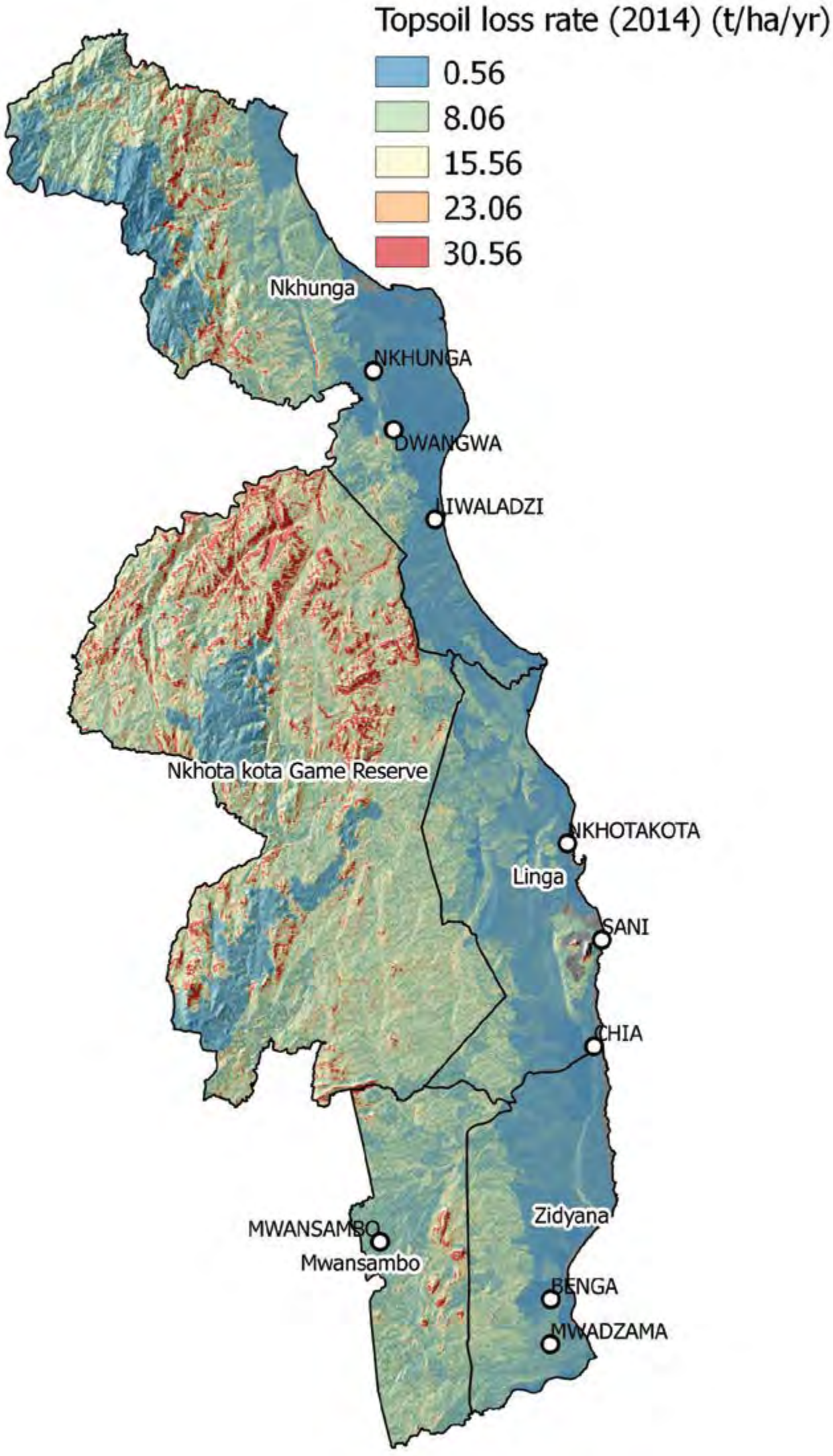
Sheet erosion at Chidothi

Gully erosion at Chilipula

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 6.43 t/ ha/yr. High soil loss rates were mainly in the mountain ranges. The main factors for the soil loss rates in these areas include soil vulnerability and steep slopes. Sheet, rill and gully erosion were the most common forms of erosion.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Nkhunga	6.45	0.81	25.75
Nkhotakota Game Reserve	9.16	1.76	30.56
Linga	2.18	0.87	7.32
Zidyana	2.21	0.65	7.70
Mwansambo	4.30	0.56	25.04



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Linga	5.07	1.042	0.513	0.052	32.004	0.726	0.739	6.165	1.814	0.265	2.265	23.551	12.455
Mwansambo	5.17	1.685	0.831	0.084	37.860	0.514	0.617	5.021	1.656	1.321	3.321	34.536	18.264
Nkhunga	4.88	0.980	0.483	0.049	30.457	0.847	0.704	6.698	1.932	1.252	3.252	33.826	17.889
Zidyana	5.46	1.288	0.635	0.064	35.939	0.555	0.627	5.025	1.729	0.936	2.936	30.536	16.149
Nkhota kota Game Reserve	5.16	2.008	0.885	0.099	23.570	0.563	0.528	4.478	1.876	1.659	0.726	23.141	15.756

Typical cropland in July-August period in 2017

Cropland at GVH Chimweyo in Kasitu EPA

Cropland at Kasomkanji in Nkhung EPA

Cropland at Kwacha in Linga EPA

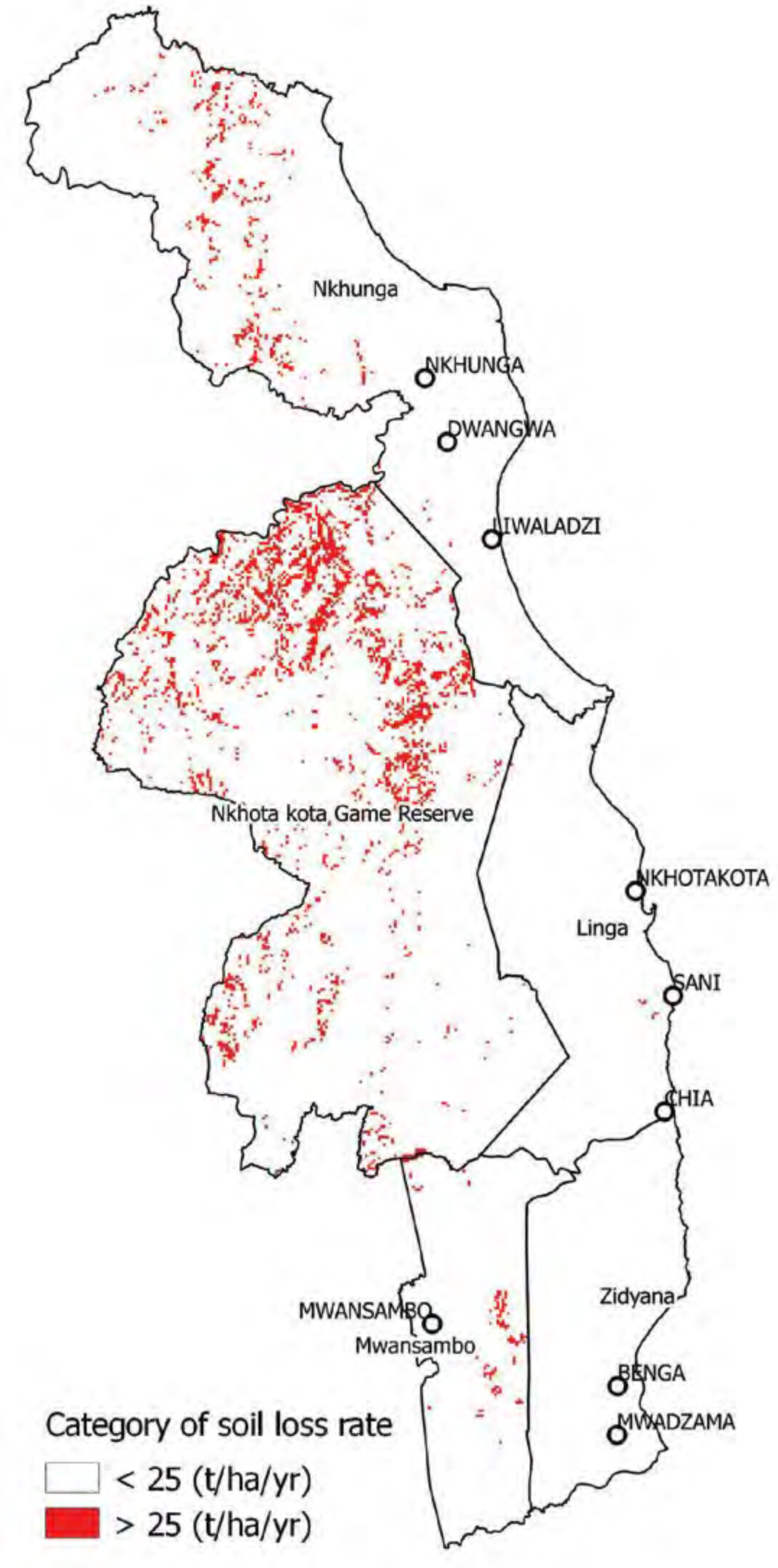
Cropland at Chitanje in Mwansambo EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

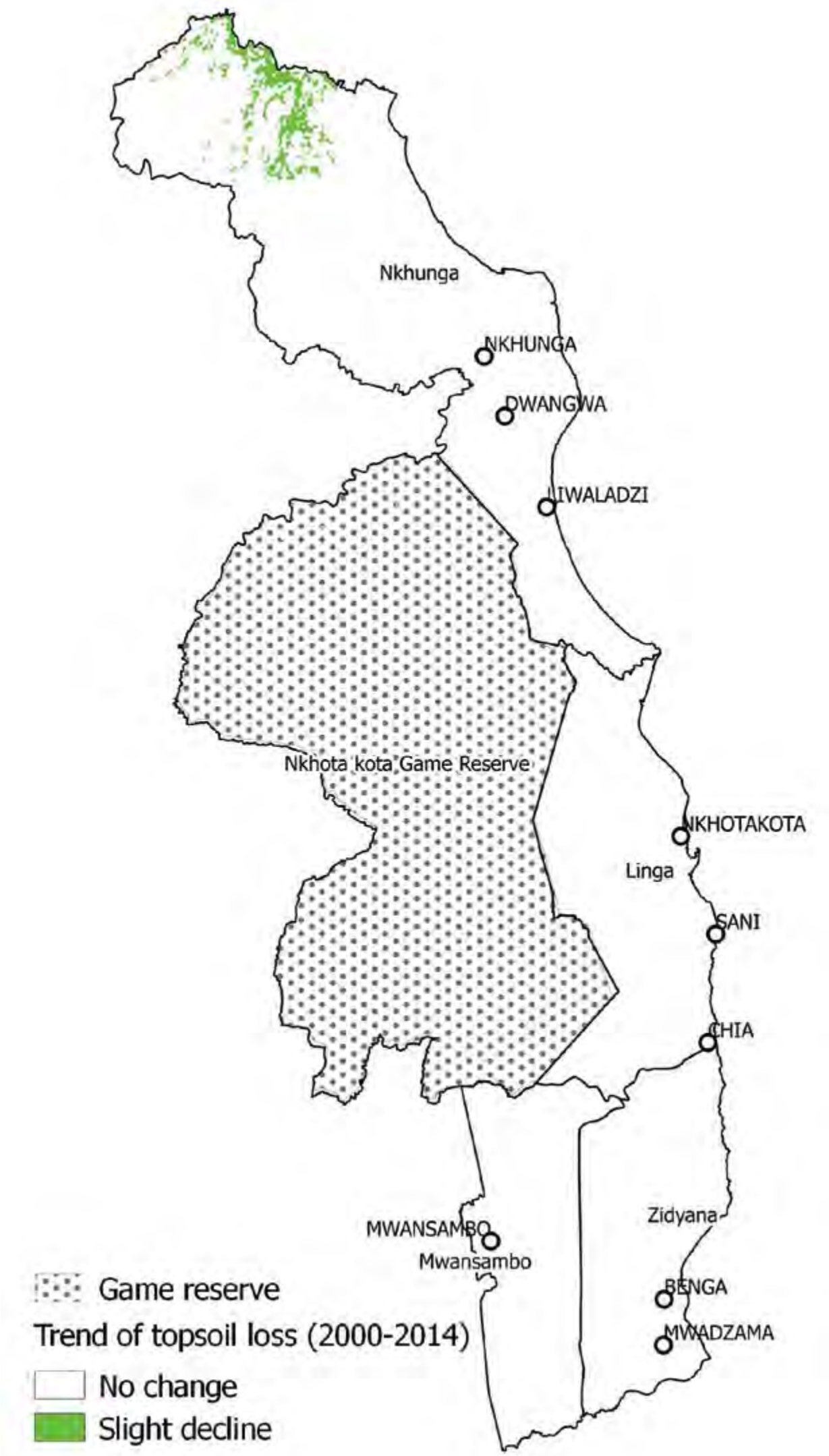
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Nkhunga	0.152	0.024	0.434	0.611
Nkhota kota Game Reserve	0.155	0.01	0.352	0.517
Linga	0.187	0.021	0.498	0.706
Zidyana	0.111	0.027	0.386	0.523
Mwansambo	0.15	0.009	0.469	0.627

Topsoil loss trend between 2000 and 2014

The trend of topsoil loss rates in the District seem to have been constant between 2000 and 2014. Only the northern parts experienced slight decline in soil loss rates. Sheet and gully are the most common forms of soil erosion problems. The main problem areas are those lying in the Rift Valley sections.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the soil and water conservation measures

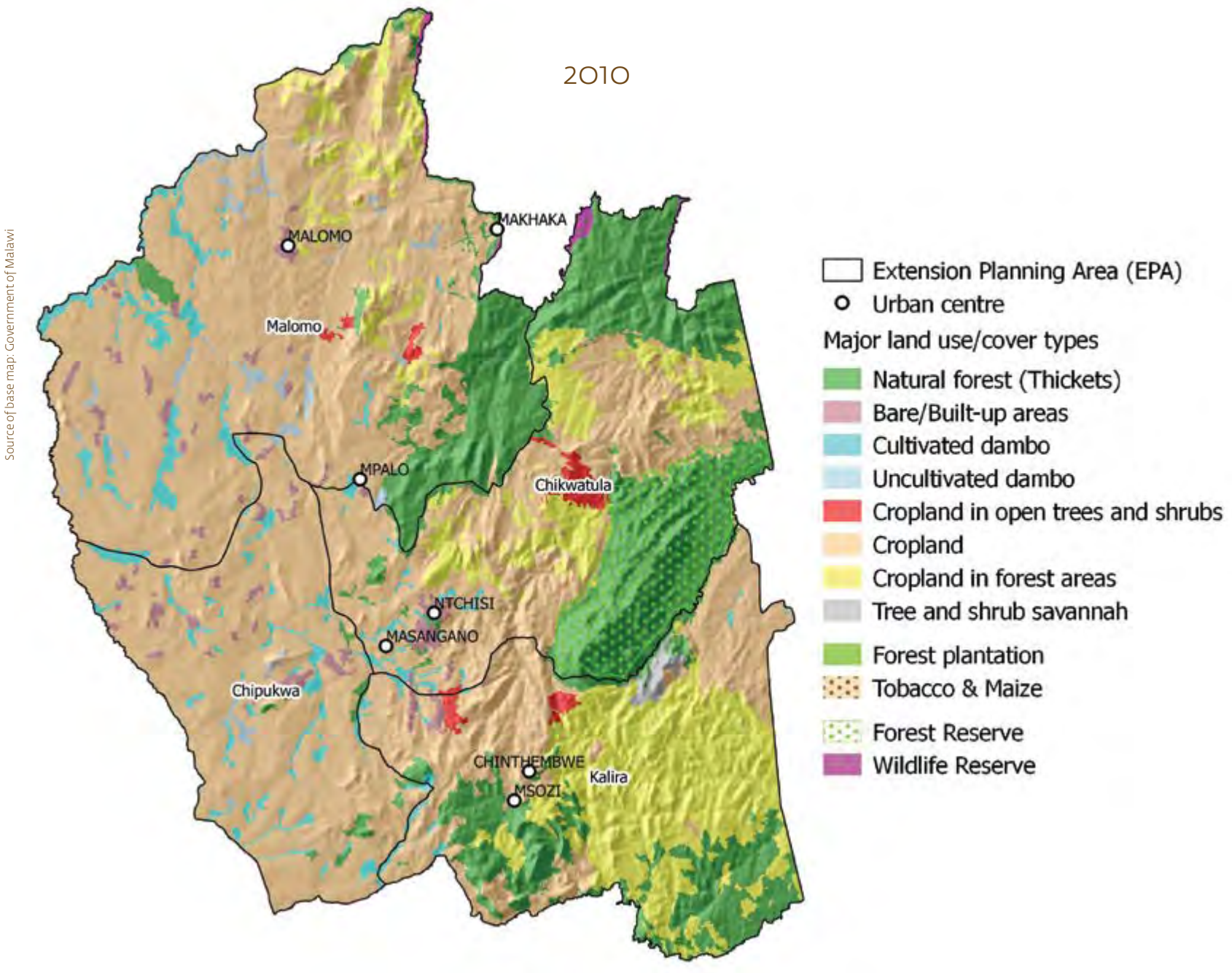
Cropland at Kasomkanji in Nkhung EPA

Cropland at Kwacha in Linga EPA

Drivers of soil loss

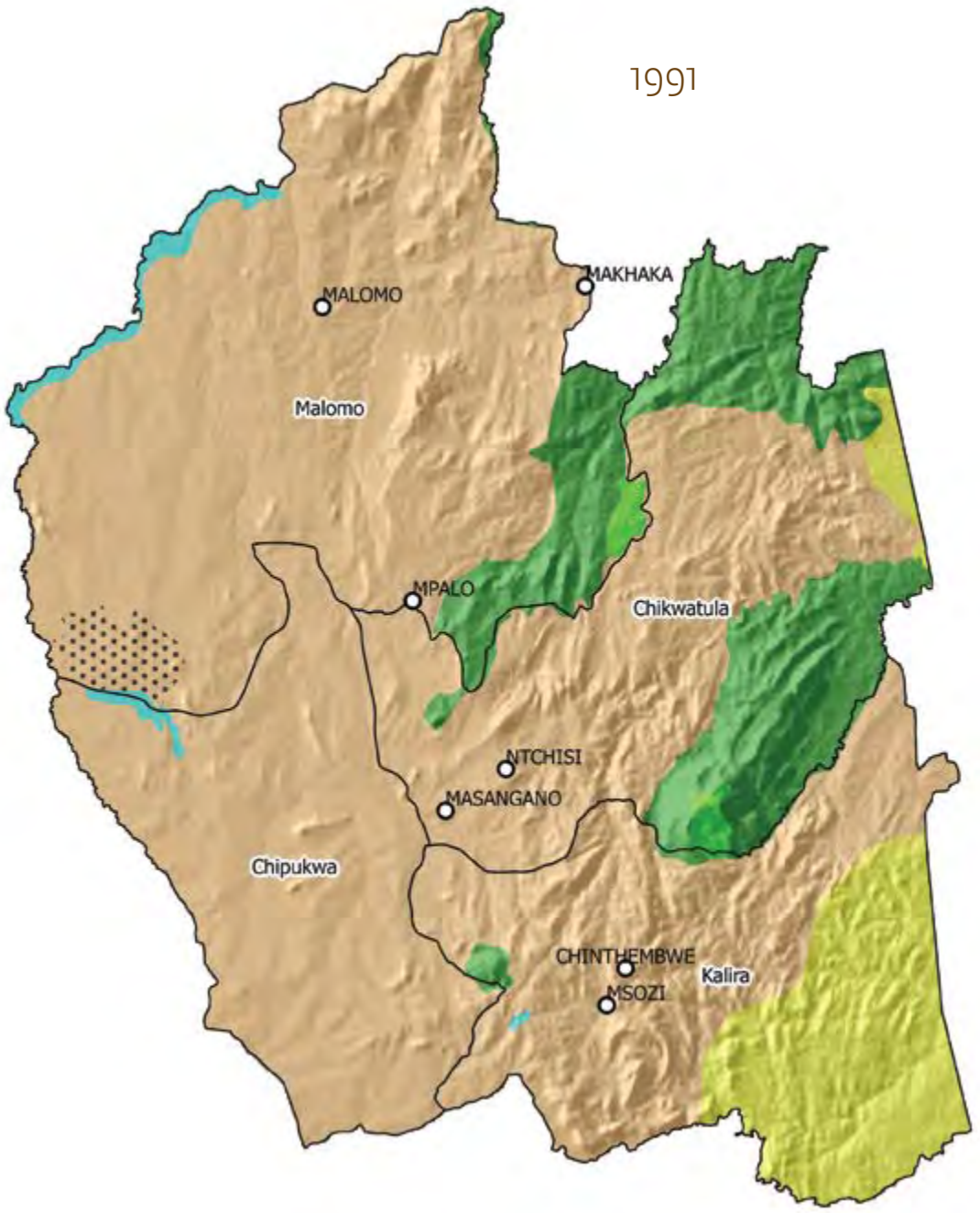
1. Vegetation cover change: The main land use/cover types are natural forests, smallholder croplands, urban/settlements, and pockets of replanted forest. The district has had a slight increase in vegetative cover between 2000 and 2014. Consequently, the threat to soil loss in the district was minimal in 2014. Ntchisi forest reserve has done well in preserving the natural forest cover in its jurisdiction

Major land cover/use types in 2010 and 1991



Source of base map: Government of Malawi

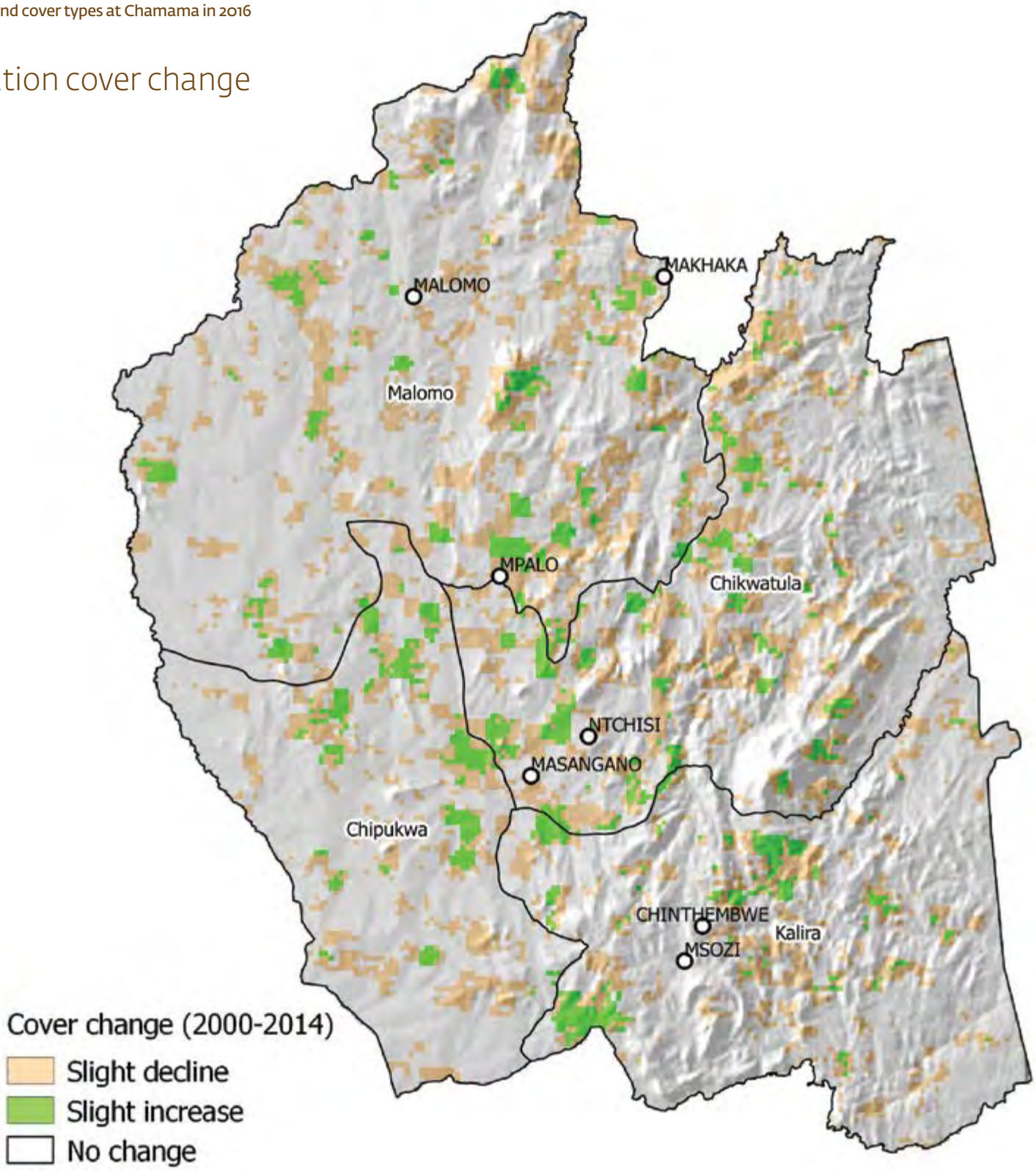
1991



Source of base map: Government of Malawi

Example of land cover types at Chamama in 2016

Vegetation cover change

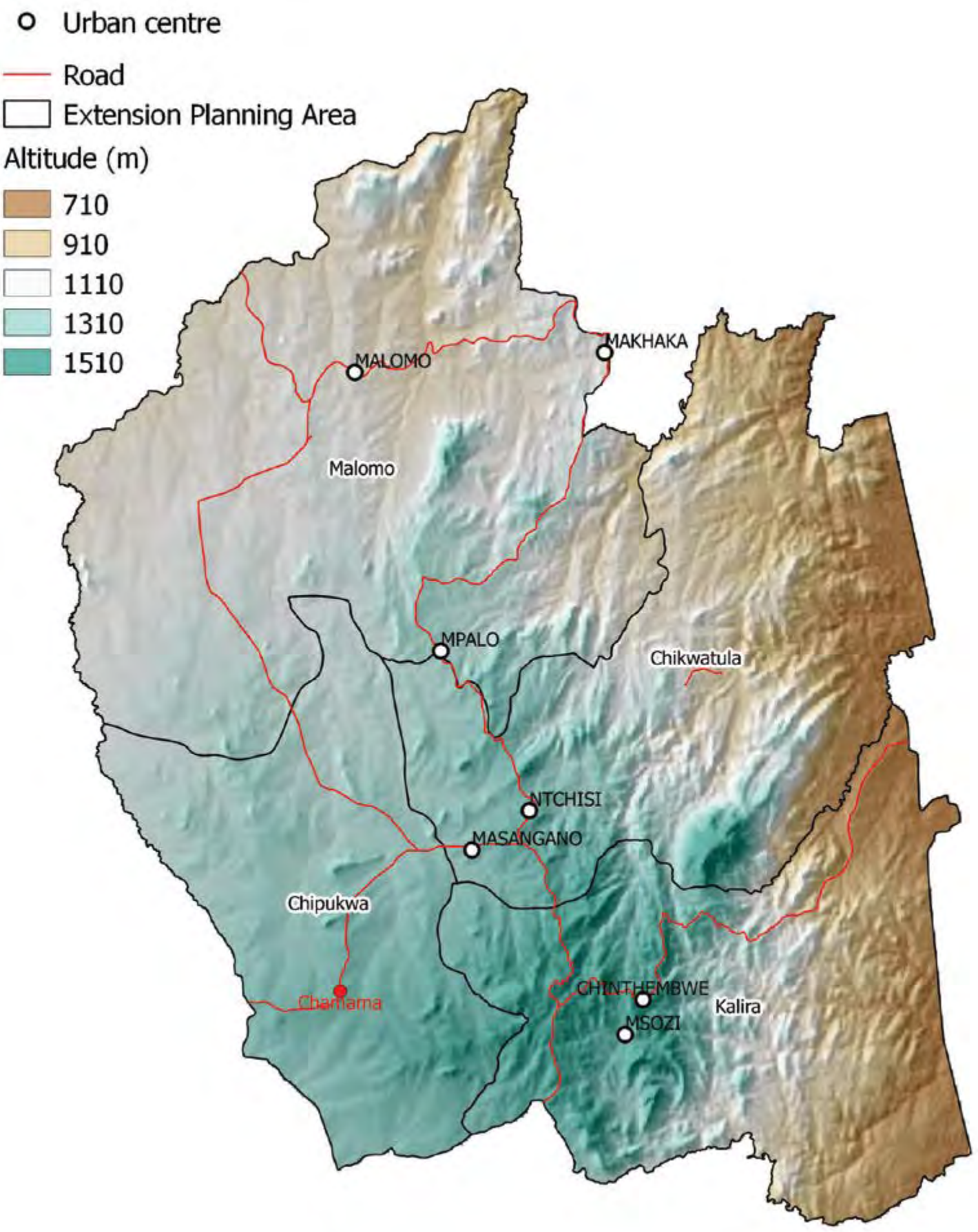


Source of base map: Government of Malawi

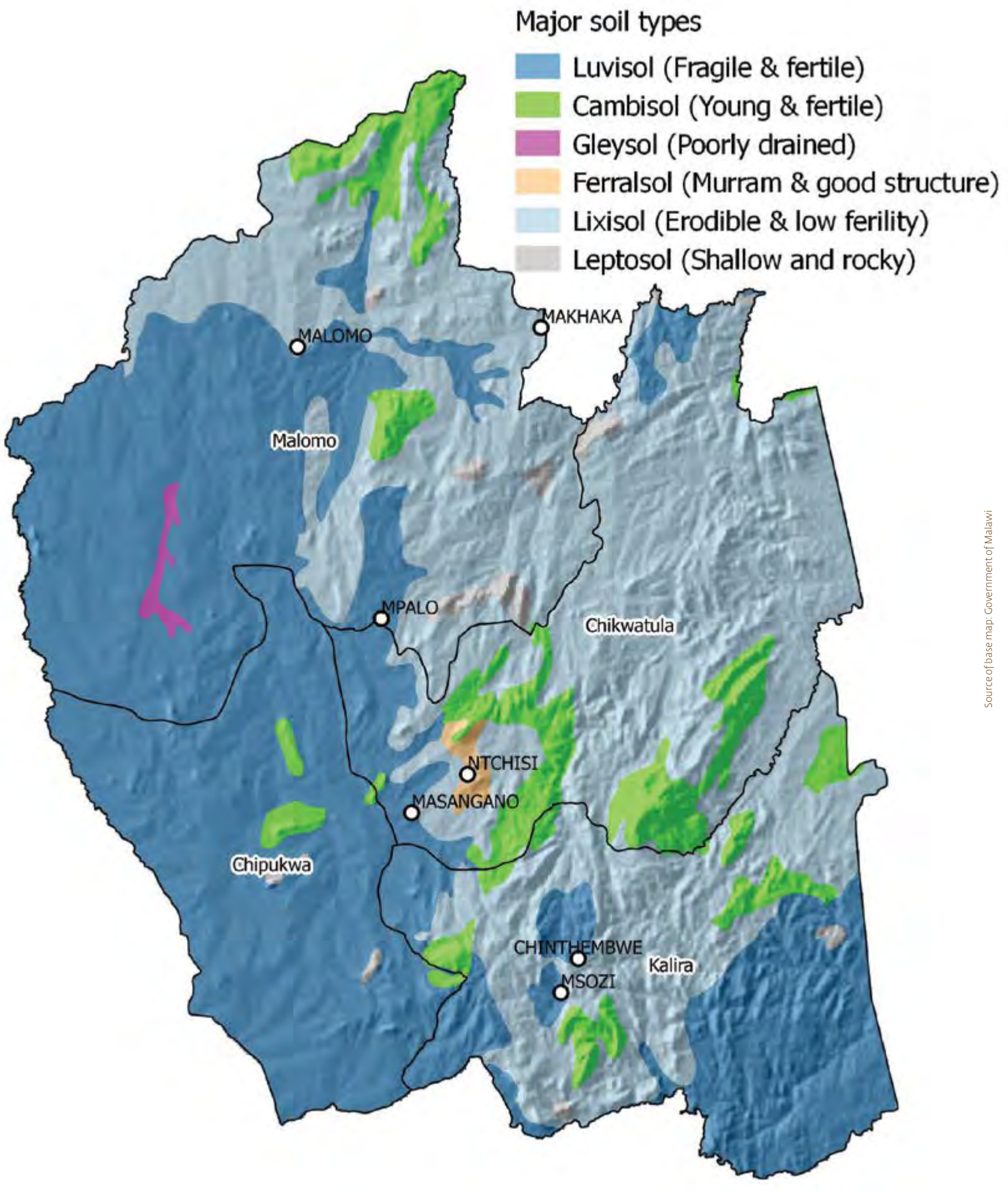
2. Rainfall, relief and soil factors

Ntchisi District is flat to the west and slightly raised in the eastern parts. The north-south axis lying in the Rift Valley has a few mountain ranges.The western parts have deep Luvisols while the mountain ranges have shallow Cambisols and moderately deep Lixisols. These soils are fragile and easily erodible.

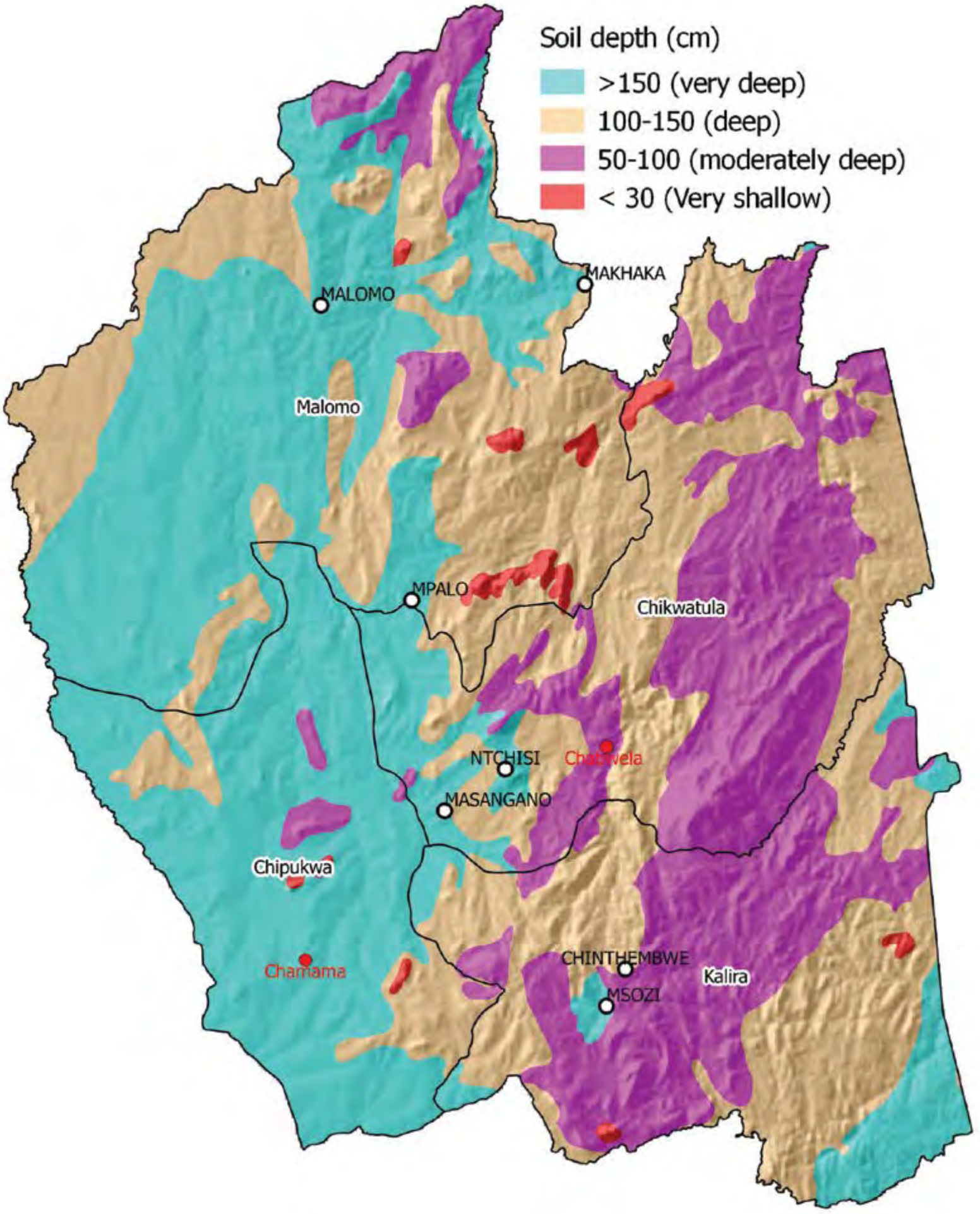
Mix of flat and hilly terrains of Ntchisi at Chamama in Chipukwa EPA



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

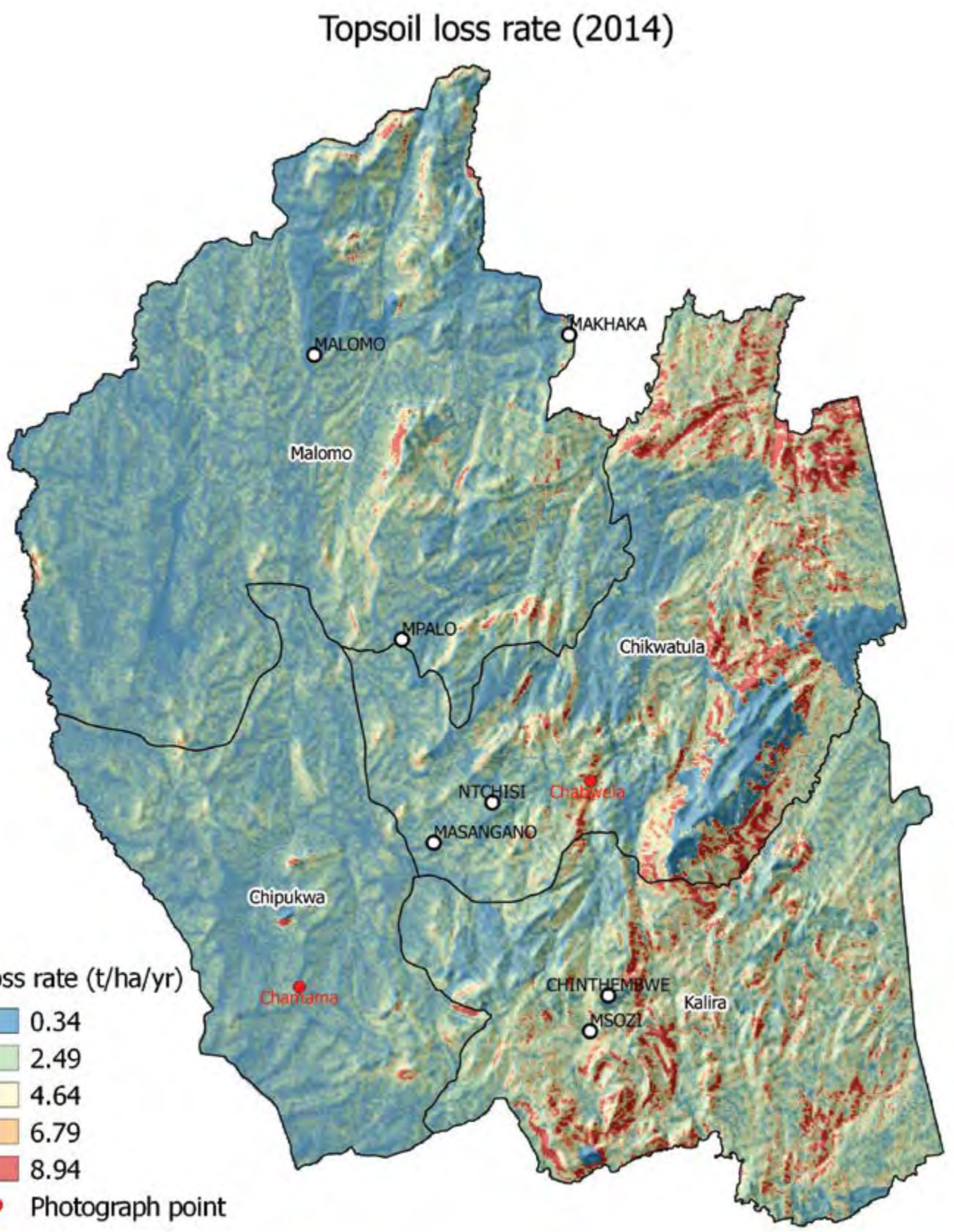
Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Malomo	Slight decline to slight increase	7.3	96.4	768	729-793	Low risk
Chikwatula	Slight decline to slight increase	12.9	74.3	782	746-810	Low risk
Chipukwa	Slight decline to slight increase	4.9	59.0	732	703-762	Low risk
Kalira	Slight decline to slight increase	13.4	72.3	746	716-791	Low risk

Sheet and gully erosion at Chabwela

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 2.76 t/ha/yr. High soil loss rates are mainly in the eastern parts of the district (in Chipukwa, and Kalira EPAs). The main factors for the soil loss rates in these areas include soil vulnerability and soil management. Sheet, rill and gully erosion are the most common forms of erosion. Gully erosion are common in the hilly areas (in the eastern parts) of the district.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Malomo	1.86	0.41	4.02
Chikwatula	3.43	0.98	8.93
Chipukwa	1.57	0.34	5.58
Kalira	4.28	0.57	6.70



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chikwatula	4.87	1.506	0.742	0.075	35.382	0.263	0.945	3.723	1.338	0.143	0.132	14.703	9.518
Chipuka	4.38	2.812	1.386	0.141	6.365	0.507	0.573	4.053	1.547	0.974	2.974	30.932	16.358
Kalira	4.76	3.011	1.484	0.151	6.099	0.435	0.852	3.592	1.541	0.576	2.940	23.493	11.790
Malomo	5.22	1.278	0.630	0.064	32.431	0.230	0.943	3.333	1.485	0.310	0.192	17.828	13.690

Typical croplands in July-August period in 2017

Cropland at Kalakata in Kalira EPA

Cropland at Laisi in Chipuka EPA

Cropland at Kambandu in Malomo EPA

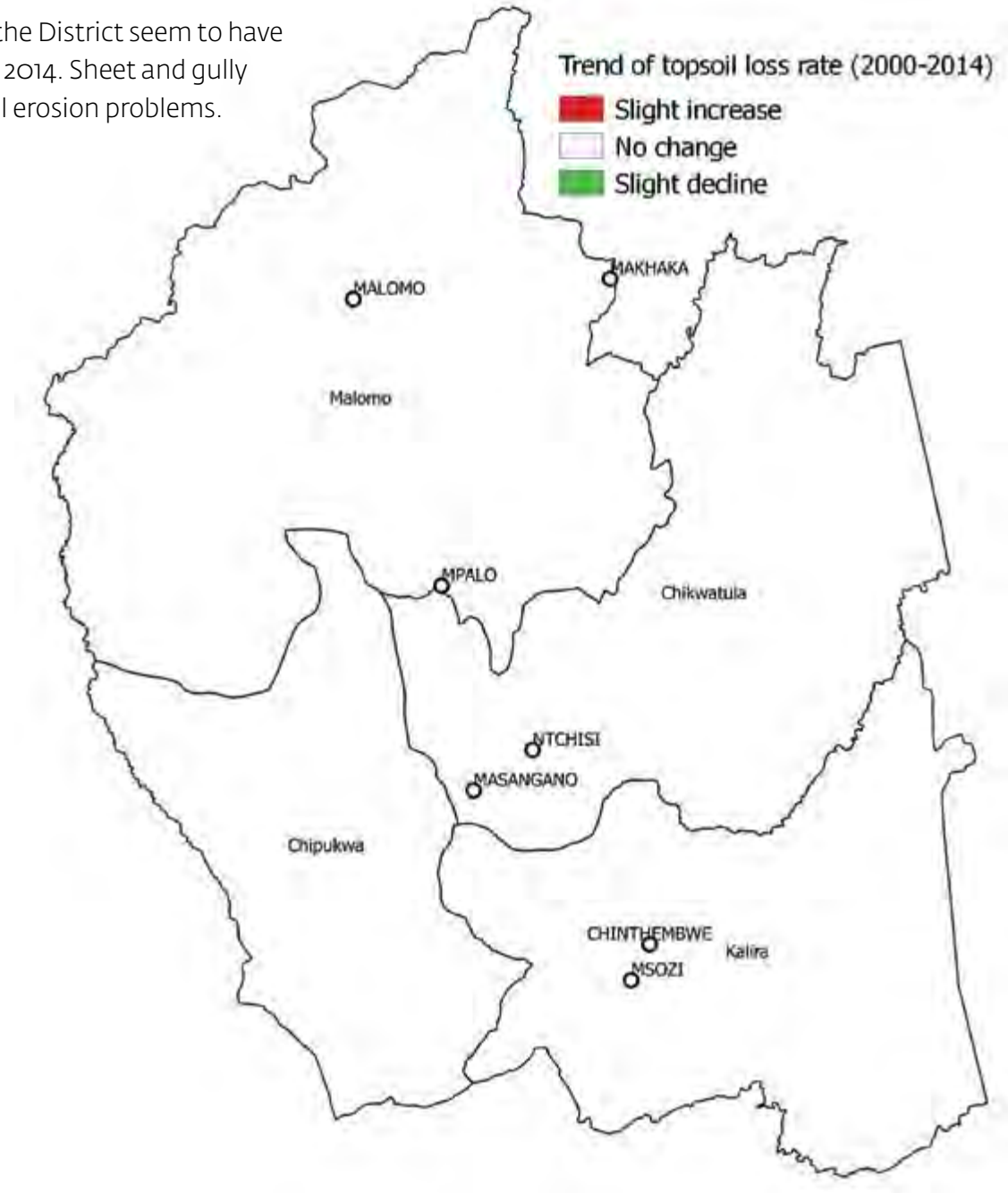
Cropland at Mkuziwaduka in Malomo EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

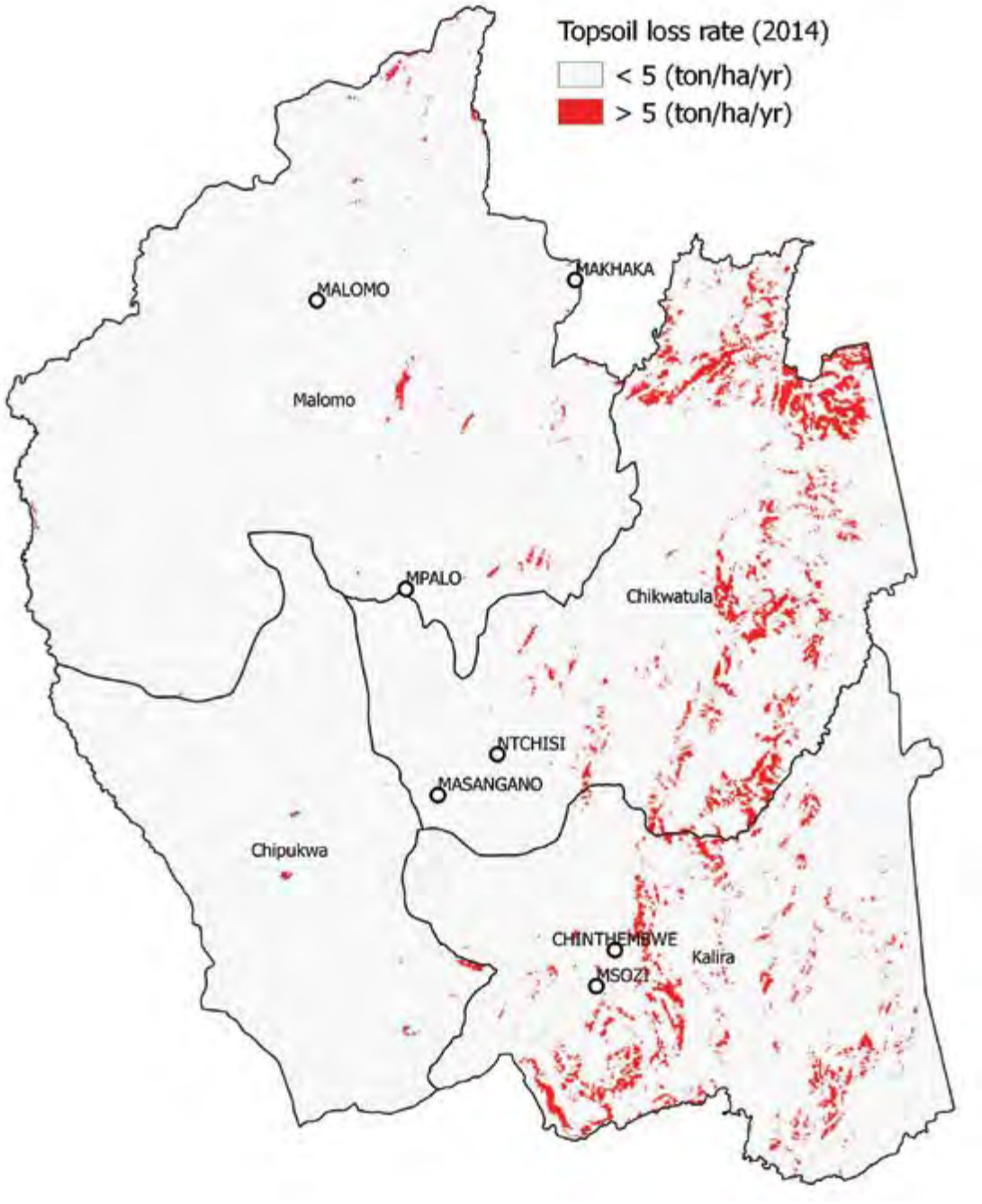
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Malomo	0.12	0.005	0.349	0.474
Chikwatula	0.145	0.018	0.391	0.554
Chipukwa	0.127	0.006	0.416	0.549
Kalira	0.165	0.007	0.435	0.607

Topsoil loss trend between 2000 and 2014

The trend of topsoil loss rates in the District seem to have been constant between 2000 and 2014. Sheet and gully are the most common forms of soil erosion problems.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Sheet and rill erosion at Thondo in Chikwatula EPA

Some of the soil and water conservation measures

Combination of contour ridges and slush-and-burn at Laisi in Chipuka EPA

Contour ridges at Thondo in Chikwatula EPA

Residue incorporation at Kamchetechete in Chipuka EPA

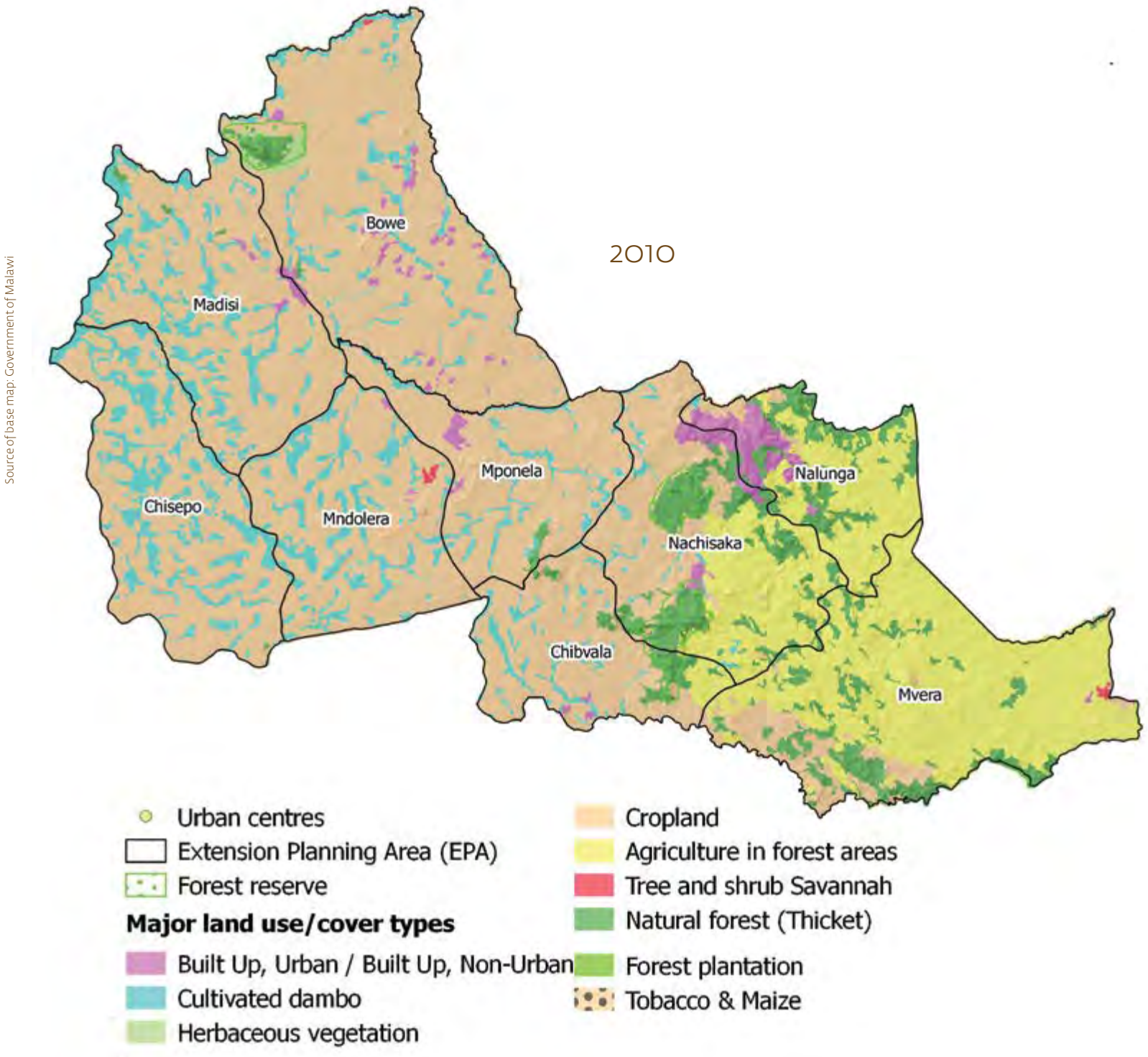
Preserving natural vegetation at Thondo in Chikwatula

Contour rindges and planting pits at Kalakata in Kalira EPA

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are smallholder croplands, urban/ settlements, natural forests, and pockets of replanted forest. The district has had a slight increase in vegetative cover between 2000 and 2014. Consequently, the threat to soil loss in the district was minimal in 2014. The forest reserves have done well in preserving the natural forest cover in their jurisdiction

Major land cover/use types in 2010 and 1991

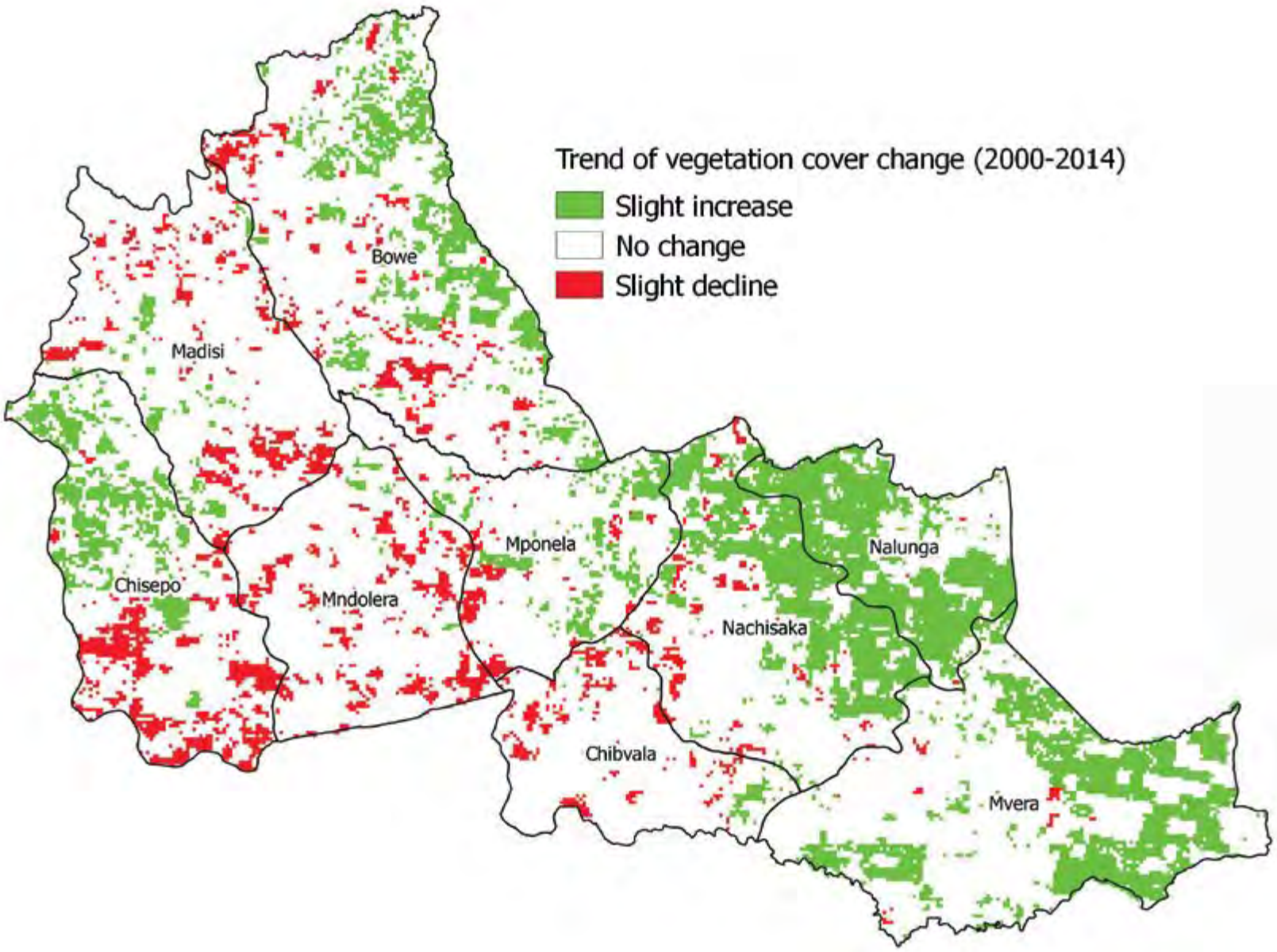


Source of base map: Government of Malawi

Source of base map: Government of Malawi

Examples of land cover types at Mvera in 2016

Vegetation cover change

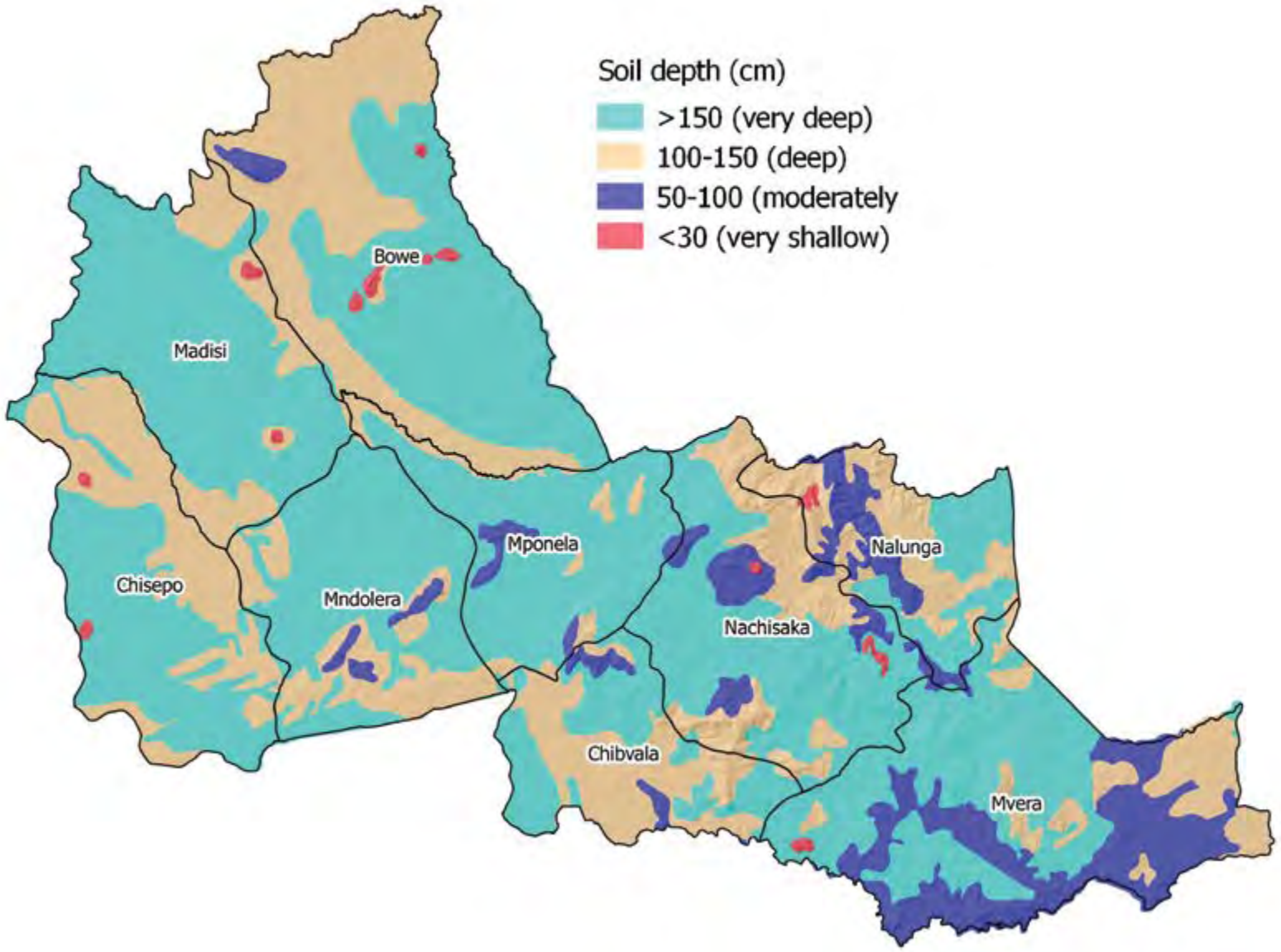


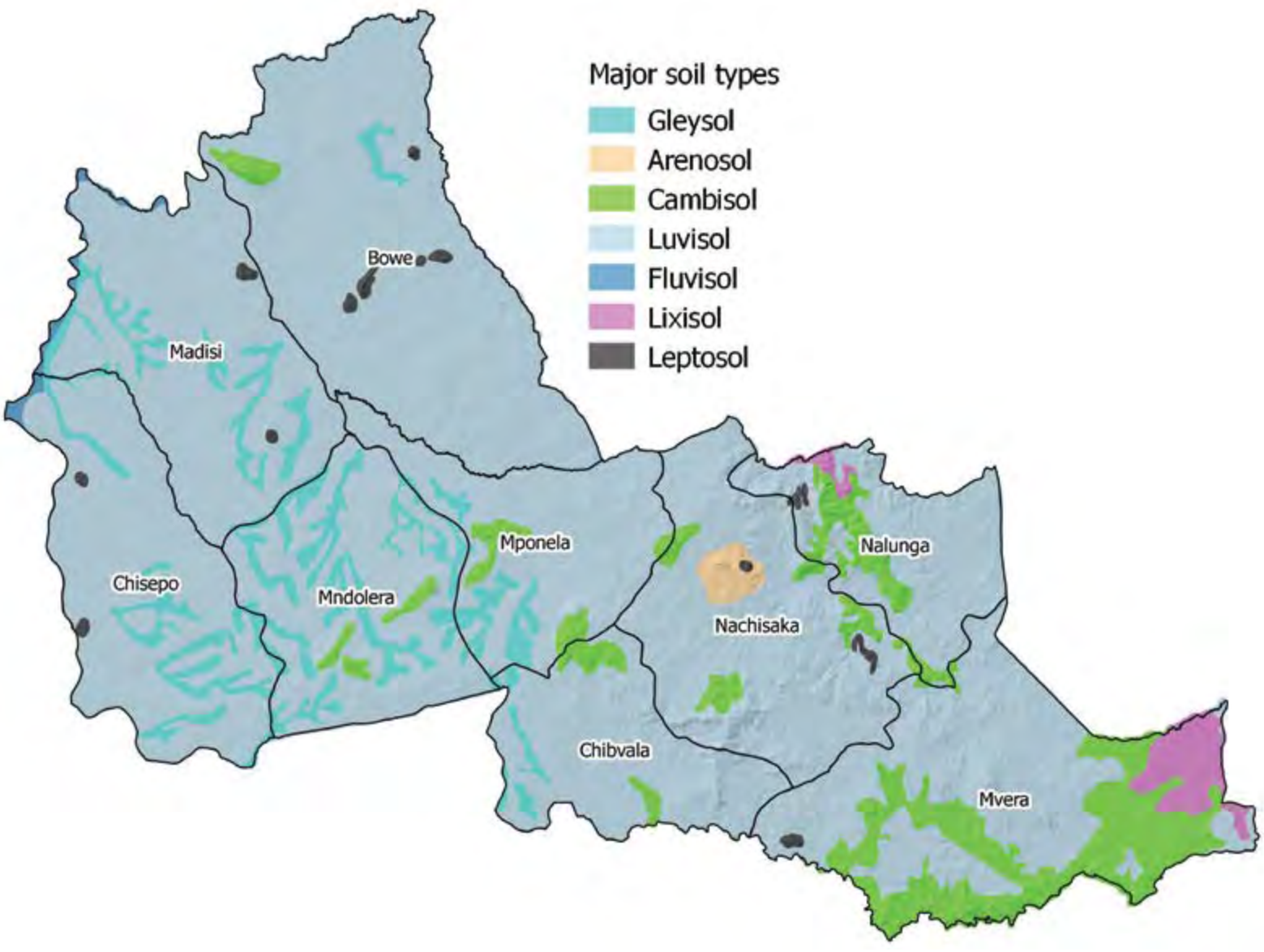
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

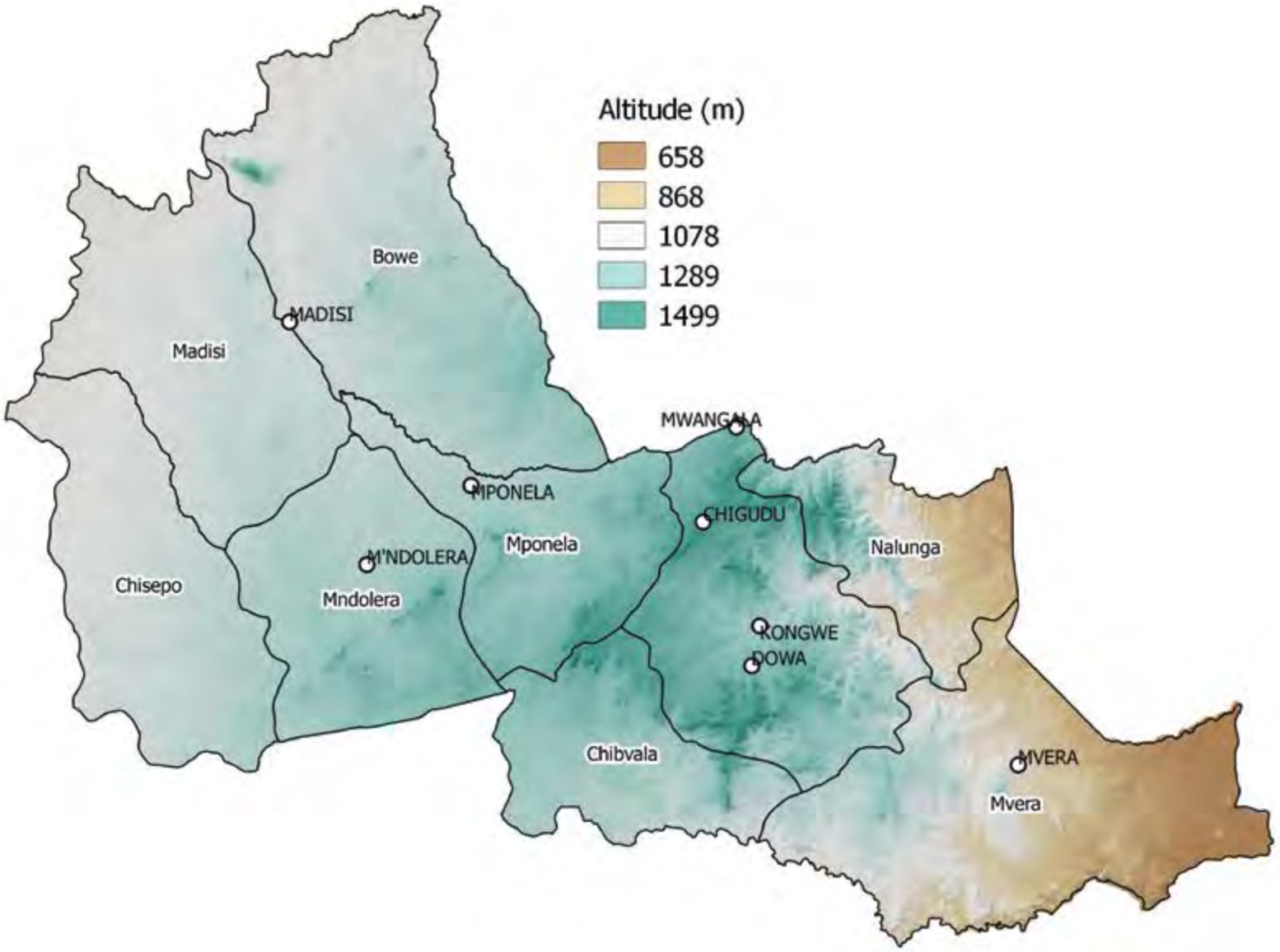
Dowa District is flat in many areas. Its south-eastern part lies in the Rift Valley with a bit of steep escarpments and shallow soil. Luvisol is the major soil type but pockets Gleysols in the Dambos areas and Cambisols in the steep escarpments can also be found in the district.

Shallow soil at Nsakambewa





Source of base map: Government of Malawi



Source of base map: Government of Malawi

Deep soil in the plains at around Dowa

Varied soil depths in the plains at Msakambewa

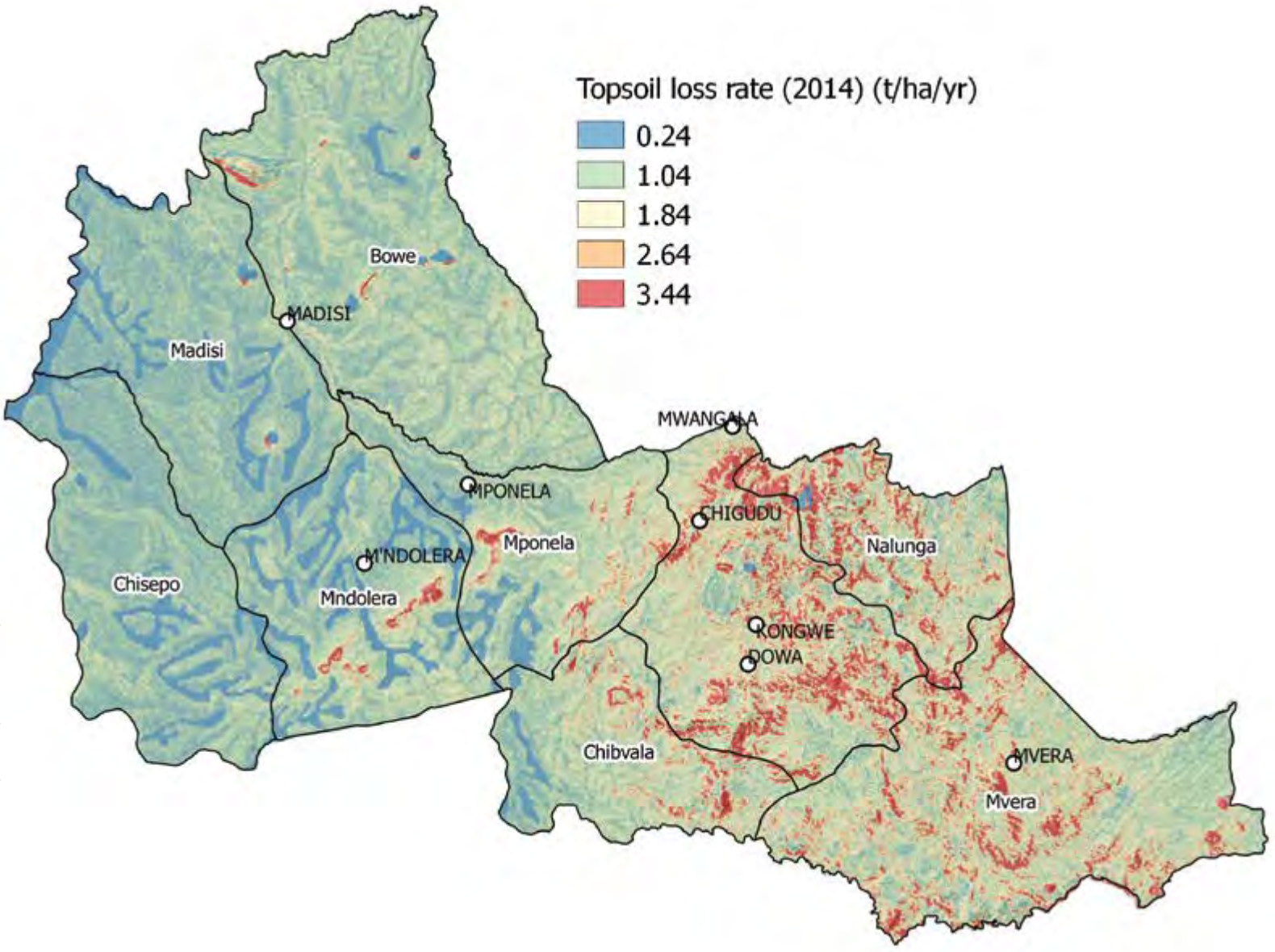
Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Bowe	No change	3.27	65.09	706	679-743	Low risk
Madisi	No change	1.87	38.94	666	648-690	Low risk
Chisepo	No change	1.95	22.12	643	637-655	Low risk
Mponela	No change	4.44	43.07	683	662-710	Low risk
Nachisaka	No change	10.64	57.74	688	669-723	Low risk
Mndolera	No change	3.21	47.22	659	642-679	Low risk
Nalunga	Slight increase	12.65	66.76	707	684-728	Low risk
Mvera	No change	8.31	62.40	676	667-699	Low risk
Chibvala	No change	5.90	52.08	665	652-678	Low risk

Sheet and gully erosion at Msakambewa

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 0.9 t/ha/yr. High soil loss rates were mainly in the escarpments in the Rift Valley (in Nalunga, Mvera, and Nachisaka EPAs). The main factors for the soil loss rates in these areas include soil vulnerability and soil management. Sheet, rill and gully erosion are the most common forms of erosion.



Source of base map: Government of Malawi

Gully erosion at Msakambewa

Extension Planning Area (EPA)	2014 Topsoil loss (ton/ha/yr)		
	Mean	Minimum	Maximum
Bowe	0.49	0.27	1.88
Madisi	0.66	0.22	1.56
Chisepo	0.76	0.24	1.68
Mponela	0.91	1.58	1.94
Nachisaka	2.01	0.37	3.39
Mndolera	0.64	1.39	2.65
Nalunga	1.95	0.56	2.48
Mvera	1.51	4.72	3.18
Chibvala	0.86	2.77	1.47

Gully erosion measurement at Msakambewa

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Bowe	5.223	2.13	1.05	0.107	38.778	0.575949	0.532569	5.4535	1.694138	1.258	3.258	33.885	17.92
Madisi	4.91	1.613	0.795	0.081	55.203	0.397538	0.529004	3.3216	1.120878	0.807	2.807	29.189	15.437
Mndolera	4.973	2.216	1.092	0.111	58.585	0.413548	0.514744	3.6115	1.167998	1.045	3.045	31.666	16.747
Mponela	4.893	1.15	0.567	0.058	74.153	0.613544	0.53909	4.511	1.706625	0.818	2.818	29.308	15.499
Mvera	5.673	2.887	1.423	0.144	27.879	0.420453	0.526482	4.16925	1.344071	0.92	1.66	21.117	7.931
Nachisaka	5.21	2.841	1.4	0.142	22.83	0.399993	0.530395	2.832	0.85581	1.069	3.069	31.919	16.88
Nalunga	4.888	3.096	1.526	0.155	58.905	0.554722	0.503441	5.1575	1.820678	1.493	3.493	36.329	19.213
Chisepo	5.27	1.661	0.911	0.098	28.426	0.419	0.641	4.049	1.751	1.304	0.609	21.960	15.704
Chibvala	5.10	1.626	0.894	0.099	32.263	0.477	0.655	3.684	1.411	1.380	0.822	22.526	15.676

Typical croplands in July-August period in 2017

Cropland at Kumwembe, Mvera EPA

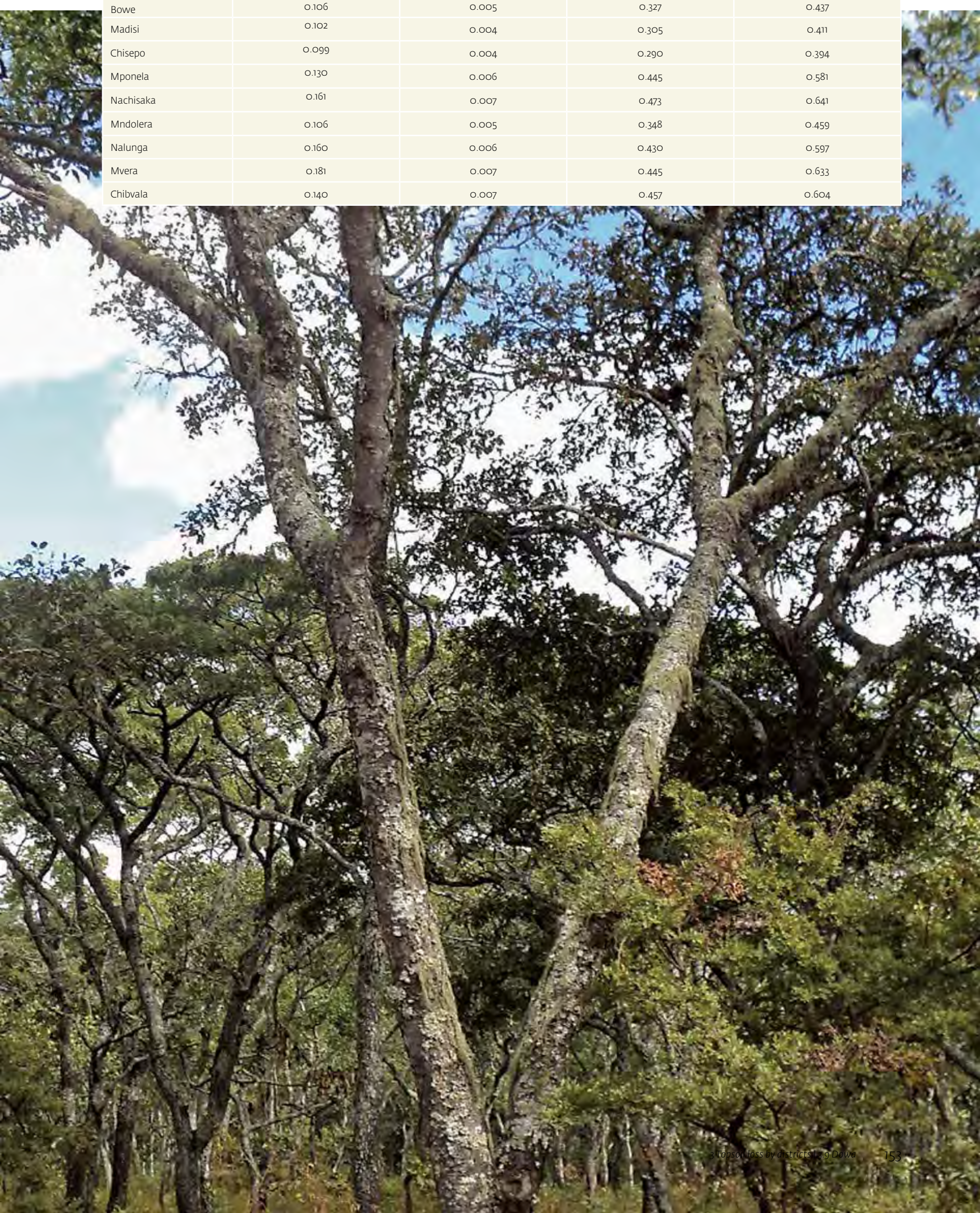
Cropland at Cropland at Kumwembe, Mvera EPA Simbi, Madisi EPA

Cropland at Mzuzi, Mndolera EPA

Cropland at Mzuzi, Mndolera EPA

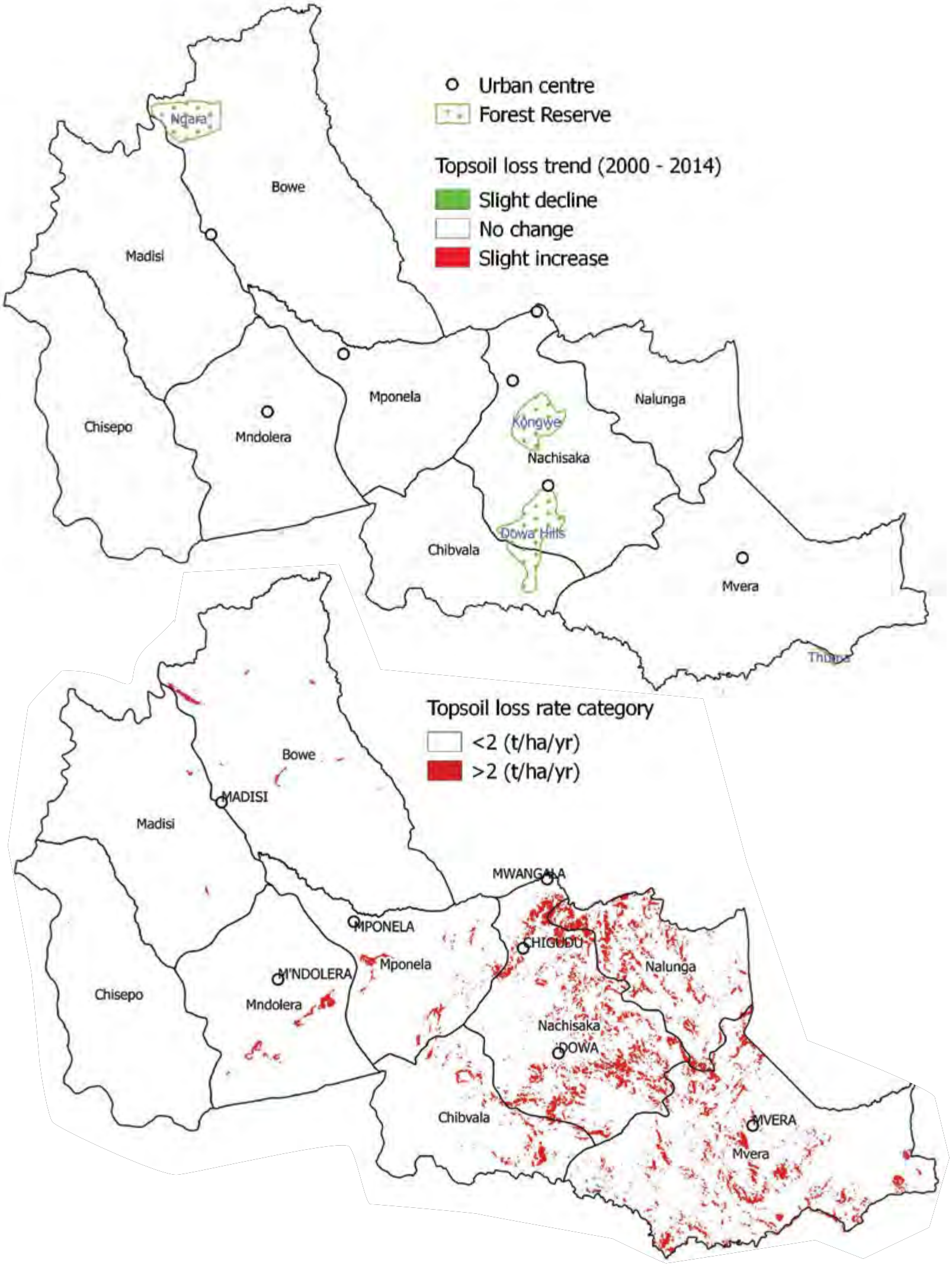
Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Bowe	0.106	0.005	0.327	0.437
Madisi	0.102	0.004	0.305	0.411
Chisepo	0.099	0.004	0.290	0.394
Mponela	0.130	0.006	0.445	0.581
Nachisaka	0.161	0.007	0.473	0.641
Mndolera	0.106	0.005	0.348	0.459
Nalunga	0.160	0.006	0.430	0.597
Mvera	0.181	0.007	0.445	0.633
Chibvala	0.140	0.007	0.457	0.604



Topsoil loss trend between 2000 and 2014

The trend of topsoil loss rates in the District seem to have been constant between 2000 and 2014. Only the escarpments in the south-eastern parts of the district seem to have minor soil erosion problems.



Some of the soil and water conservation measures

Conservation of natural forest at Kongwe Forest Reserve

Crop residue incorporation and agroforestry at Ngozi

Crop residue incorporation and contour ridges at Ngozi

Vetivar hedge row at Silapa

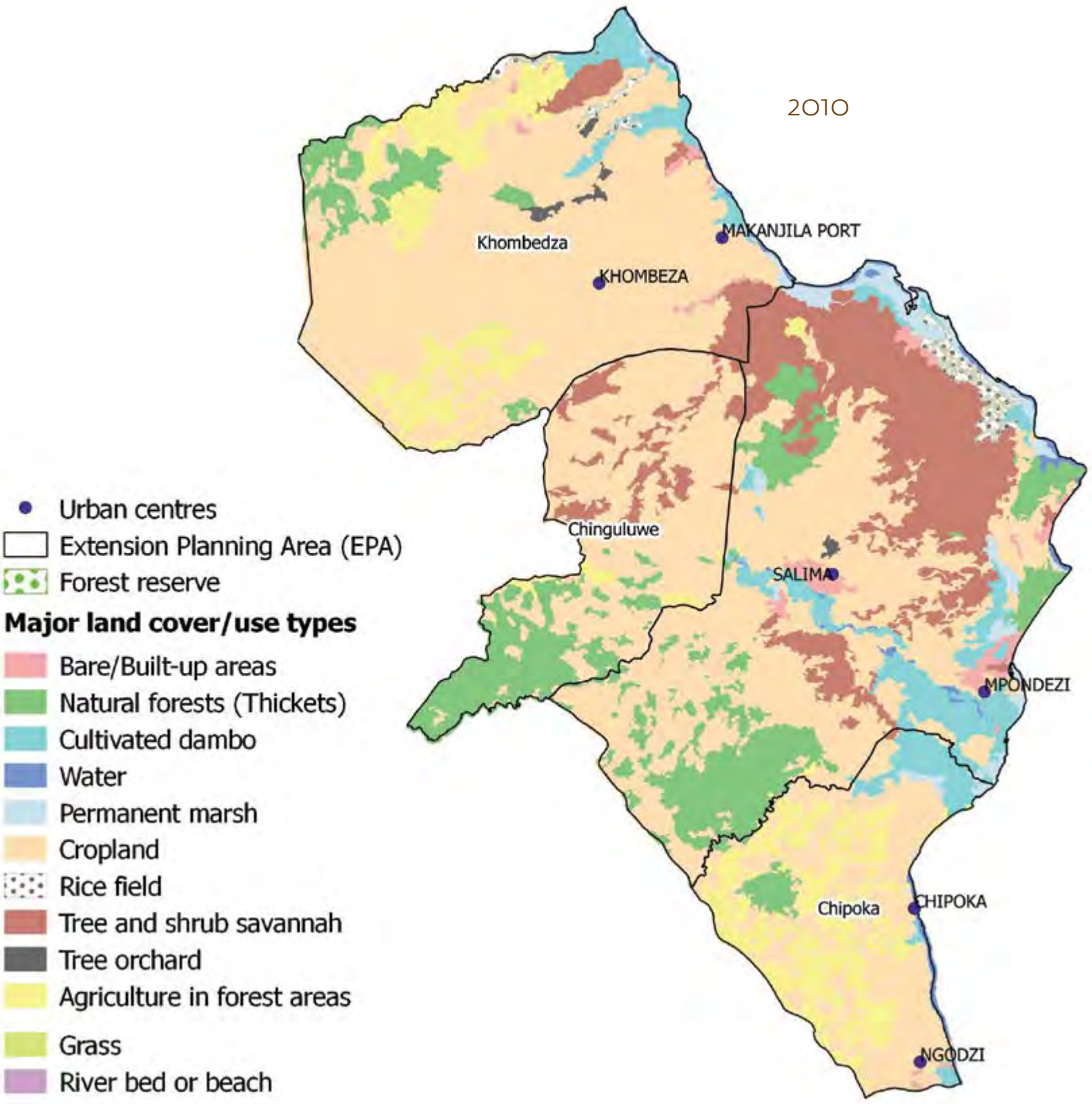
Agroforestry and contour ridges at Chisamba, Madisi

Contour ridges at Mkutuma, Mponela

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are smallholder croplands, forest reserve, natural forests and grassland. The district experienced a slight increase in vegetative cover proportions between 1991 and 2010. The main threat -to soil loss is mainly due to cropland farming practices.

Major land cover/use types in 2010 and 1991



Source of base map: Government of Malawi

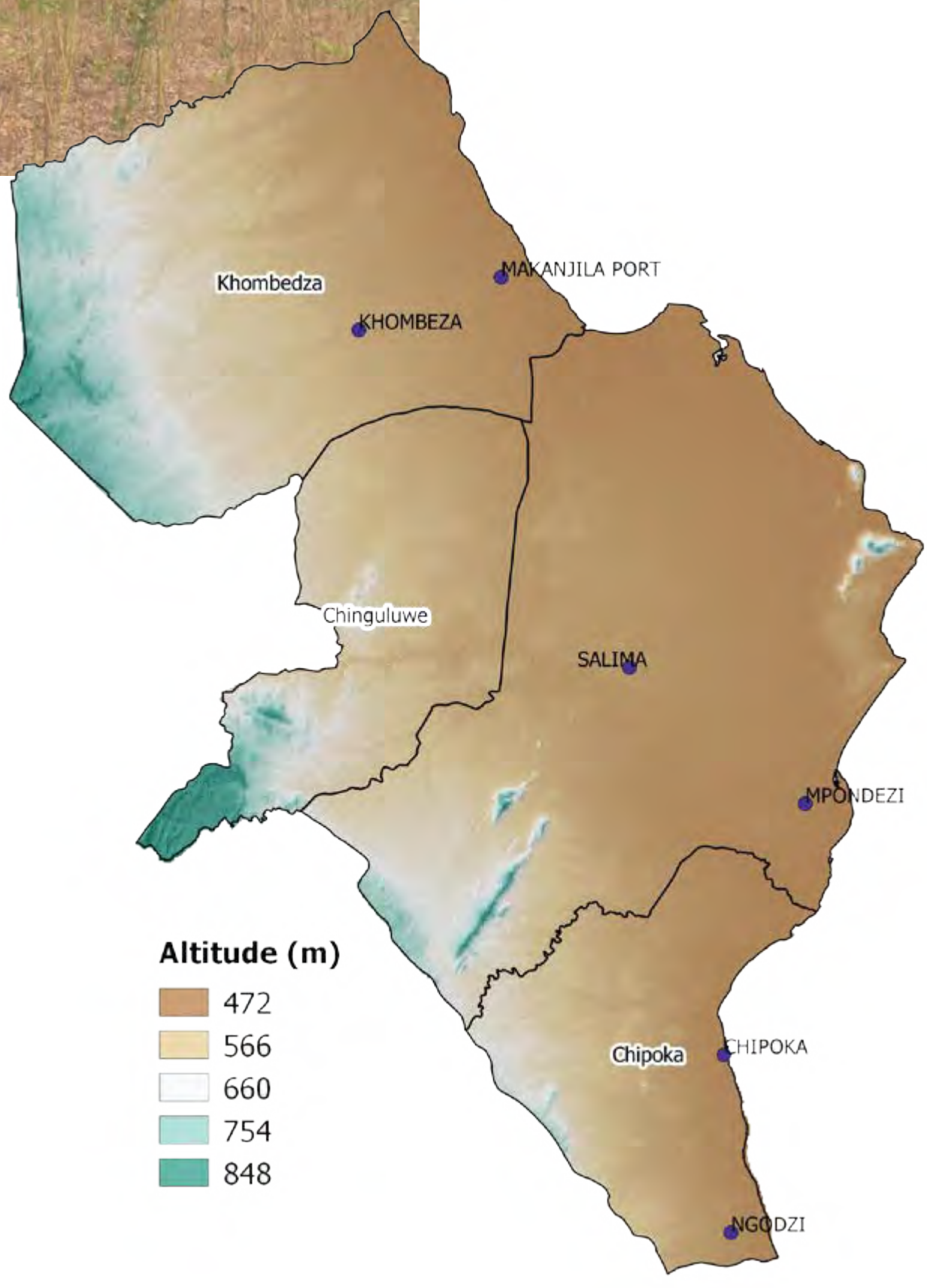
1991

Source of base map: Government of Malawi

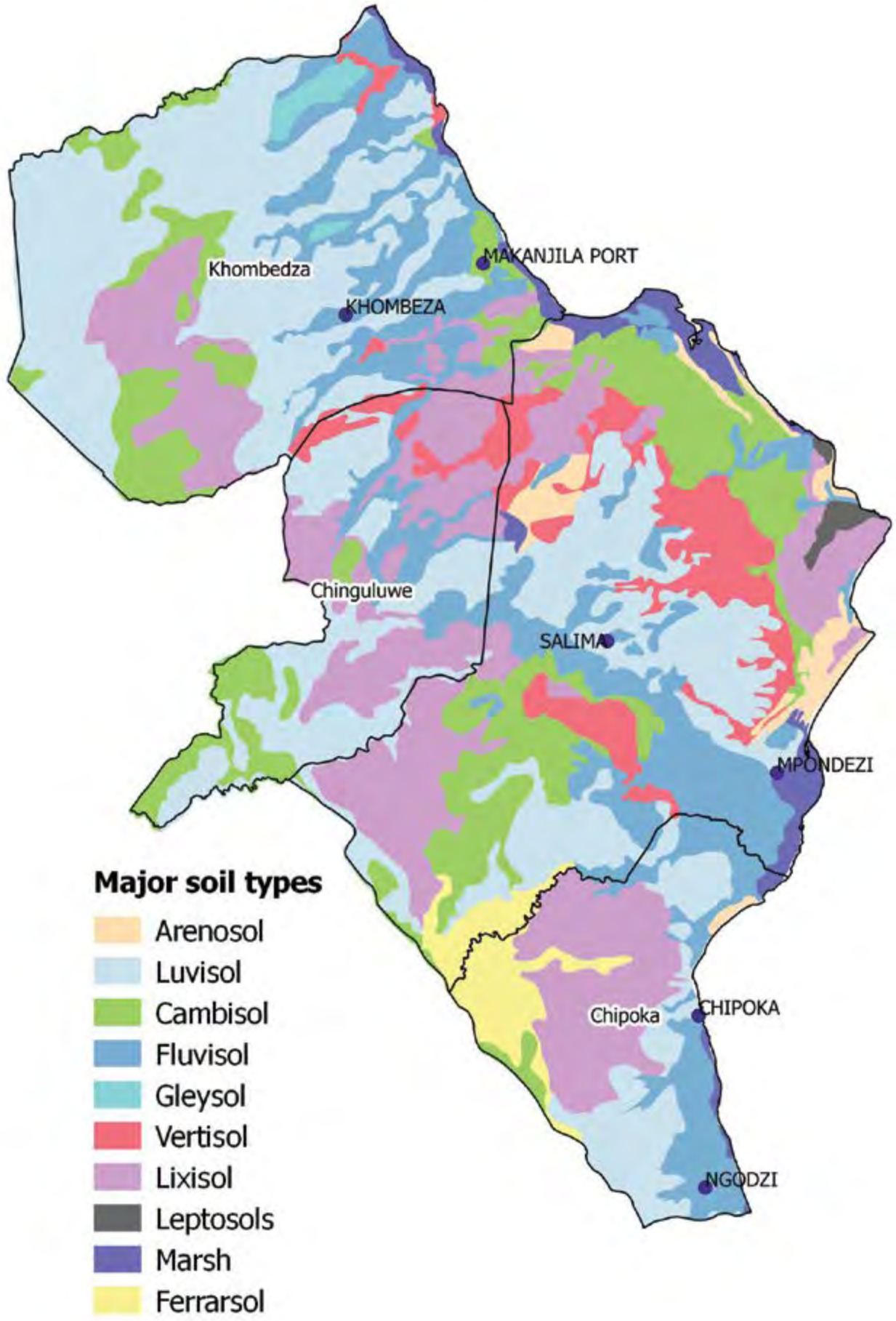
Typical land cover types in Salima

Deep soil on flat terrain near Salima town

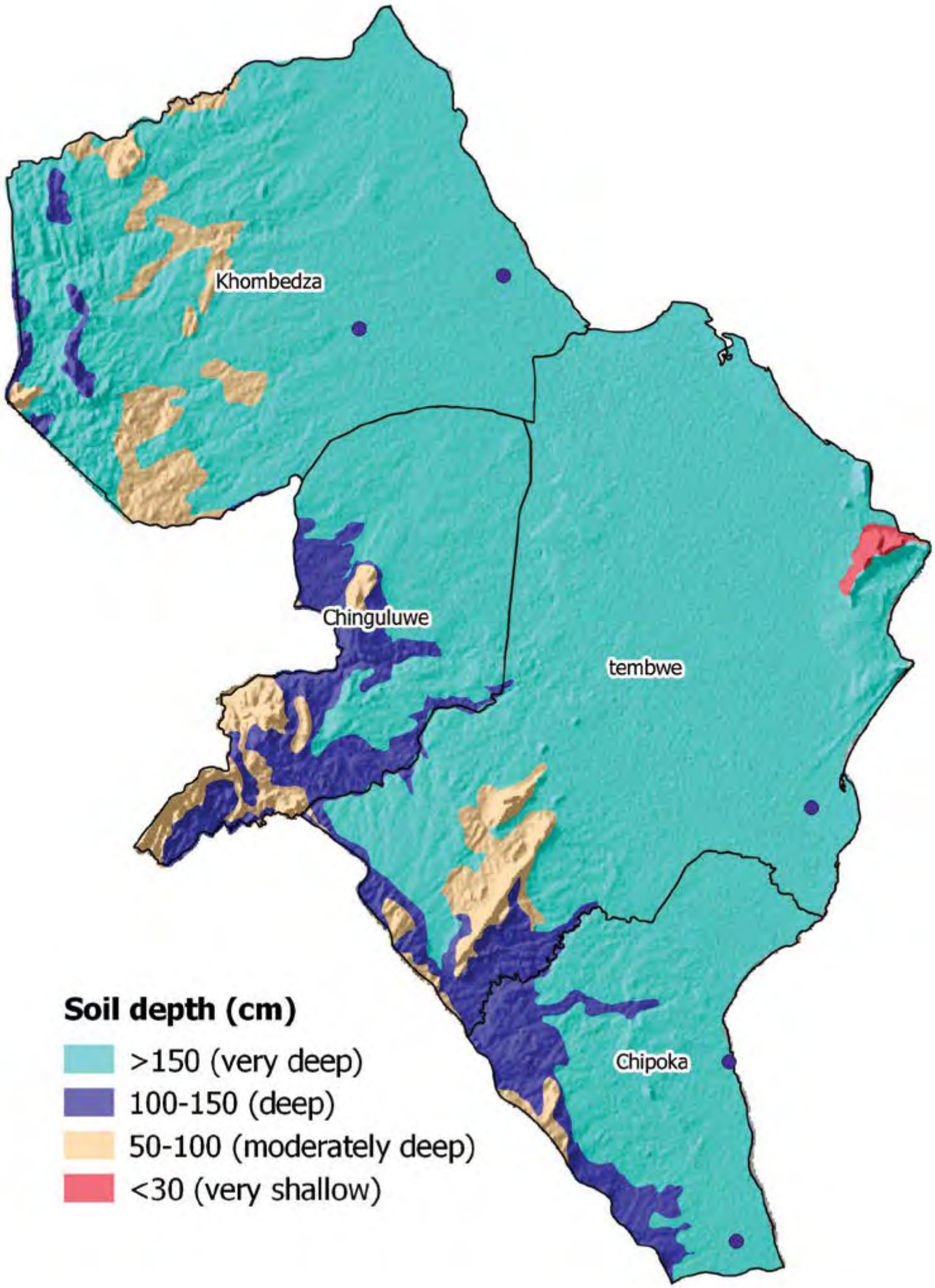
Deep soil on the plains at Chinguluwe



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Khombedza	Slight increase	2.76	43.64	714.54	680-770	Low risk
Chinguluwe	No change	4.31	62.87	681.40	675-698	Low risk
Chipoka	No change	2.42	35.67	707.10	693-725	Low risk
tembwe	No change	2.72	63.91	695.80	678-727	Low risk

Features of soil erosion

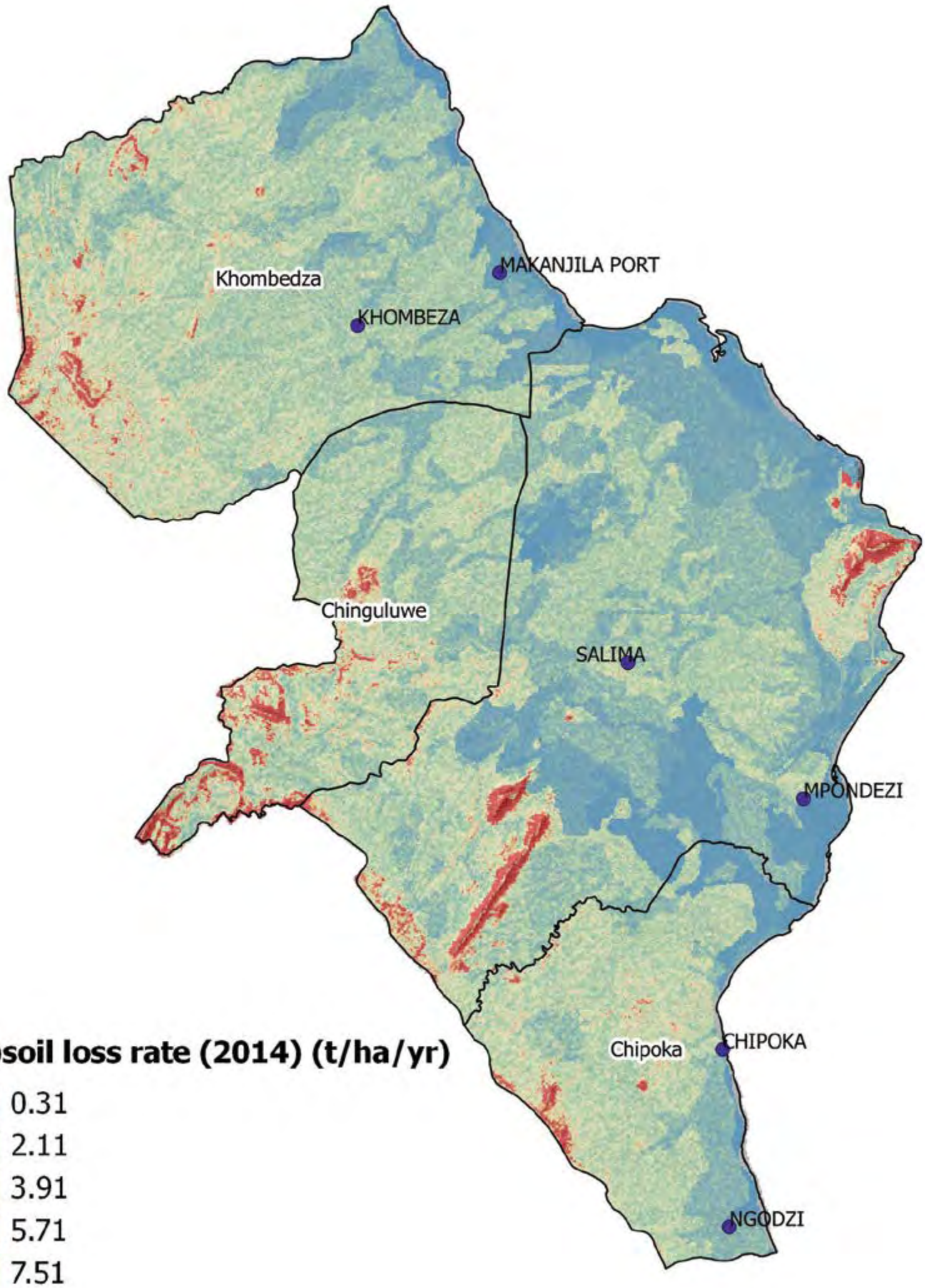
Sheet and rill erosion at Maonga inTembwe EPA

Sheet and rill erosion at Maonga inTembwe EPA

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Khombedza	1.38	0.55	6.29
Chinguluwe	1.66	0.80	7.23
Chipoka	1.37	0.62	5.77
Tembwe	1.10	0.31	5.56

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 1.10 t/ha/yr. Khombedza and Chinguluwe were the only EPAs with indications of high soil loss rates in the district. The main contributing factors for high topsoil loss rates in these areas include the presence of vulnerable soils and agricultural intensification. The most common types of erosion in the district are sheet and rill erosion.



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chinguluwe	6.43	1.932	0.952	0.097	51.360	0.461	0.628	4.957	1.683	1.033	2.204	26.284	38.618
Chipoka	6.56	3.039	1.498	0.152	63.271	0.358	0.538	4.155	1.280	1.199	3.050	31.312	65.129
Khombedza	5.17	1.541	0.760	0.077	20.770	0.562	0.590	4.909	1.489	1.084	3.084	32.073	16.961
Tembwe	6.02	2.201	1.085	0.110	76.415	0.348	0.581	4.821	1.791	1.001	1.348	19.445	31.719
Matenje	5.94	2.514	1.239	0.126	32.892	0.438	0.545	4.025	1.262	1.039	2.543	27.253	48.537

Typical croplands in July-August period in 2017

Cropland at Nyanja in Tembwe EPA

Cropland at Bauleni in Chinguluwe EPA

Cropland at Chapalpat in Matenje EPA

Cropland at Chimomba in Tembwe EPA

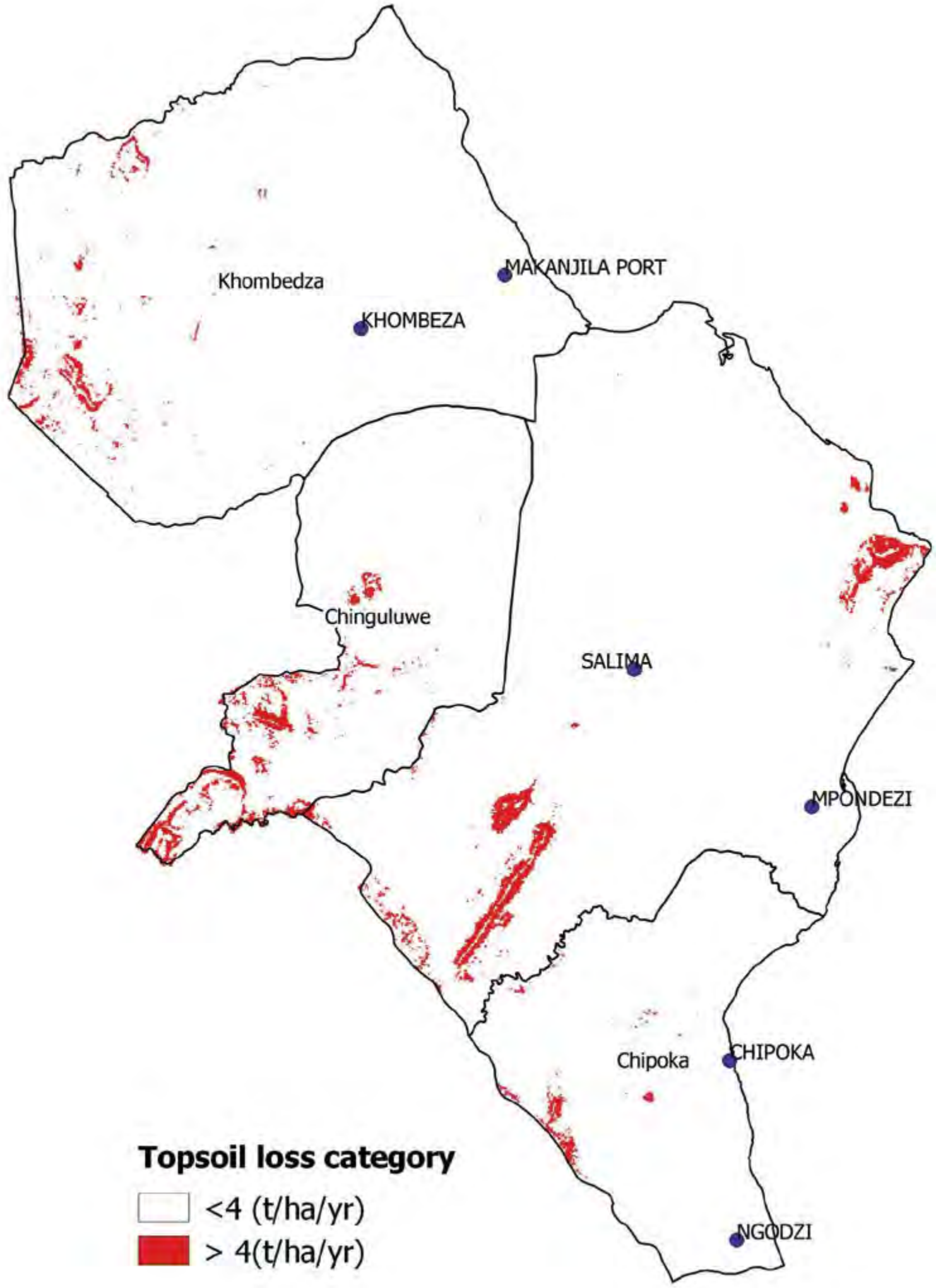
Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Khombedza	0.117	0.014	0.361	0.492
Chinguluwe	0.133	0.006	0.367	0.505
Chipoka	0.179	0.013	0.574	0.767
Tembwe	0.094	0.019	0.318	0.431

Topsoil loss between 2000 and 2014

There was no significant trend of topsoil loss rates observed for the District between 2000 and 2014. There were some notable spots of slight decline in Tembwe EPA. These areas with declining rates also had high topsoil loss rates

Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

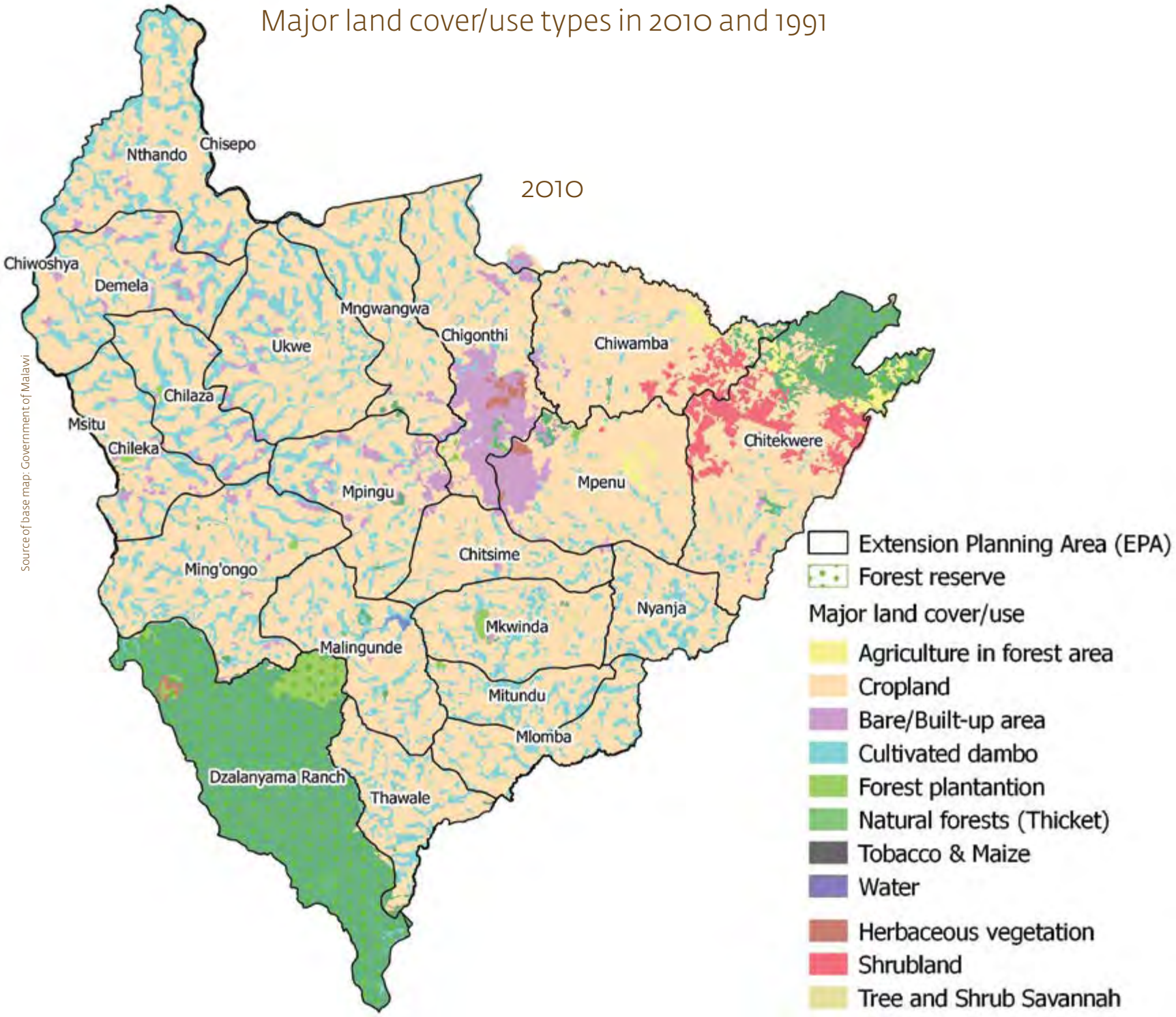
Establishment of Senna simea woodlot at Matenje

Conservation agriculture at Mpanje

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types in the District are smallholder croplands, natural and planted forests, forest reserve and a ranch, and settlement/ urban centre. The main observable land cover/use changes between 1991 and 2010 are the intensification of agriculture in the croplands and expansion of urban/settlement areas.

Major land cover/use types in 2010 and 1991



Source of base map: Government of Malawi

1991

Source of base map: Government of Malawi

Example of land cover type at Mkhumbi in Thawale EPA

Vegetation cover change

There was a slight decline in vegetation cover proportion in the north-west and in the centre between 1991 and 2010. There were also areas which experienced increase in vegetation cover during the same period.

Source of base map: Government of Malawi

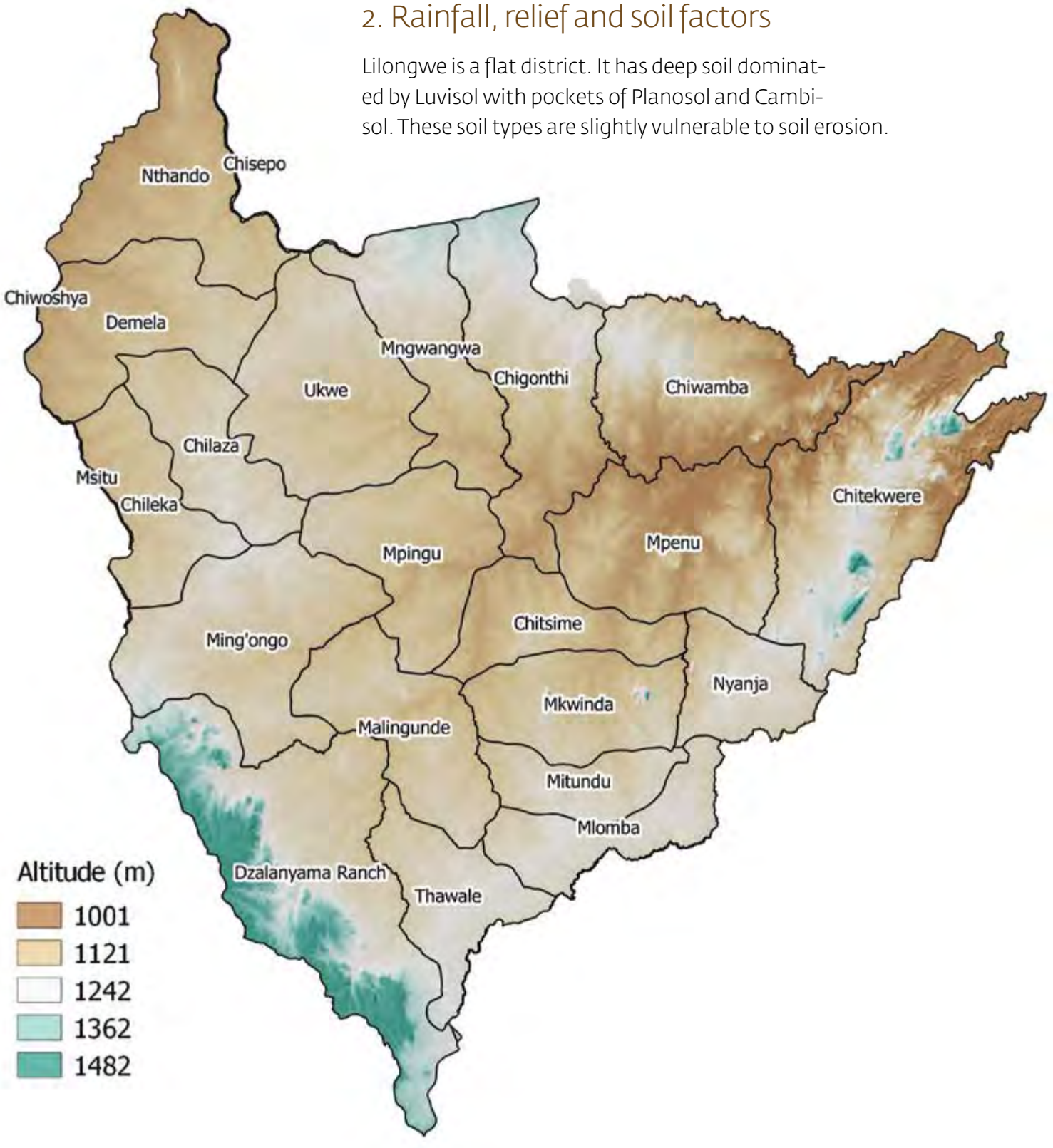
Nthando
Chisepo
Chiwoshya
Demela
Mngwangwa
Chigonthi
Chiwamba
Ukwe
Chilaza
Msitu
Chileka
Chitekwere
Mpenu
Mpingu
Chitsime
Ming'ongo
Nyanja
Mkwinda
Malingunde
Mitundu
Mlomba
Dzalanyama Ranch
Thawale

Vegetation cover change (2000-2014)
Slight decline
No change
Slight increase

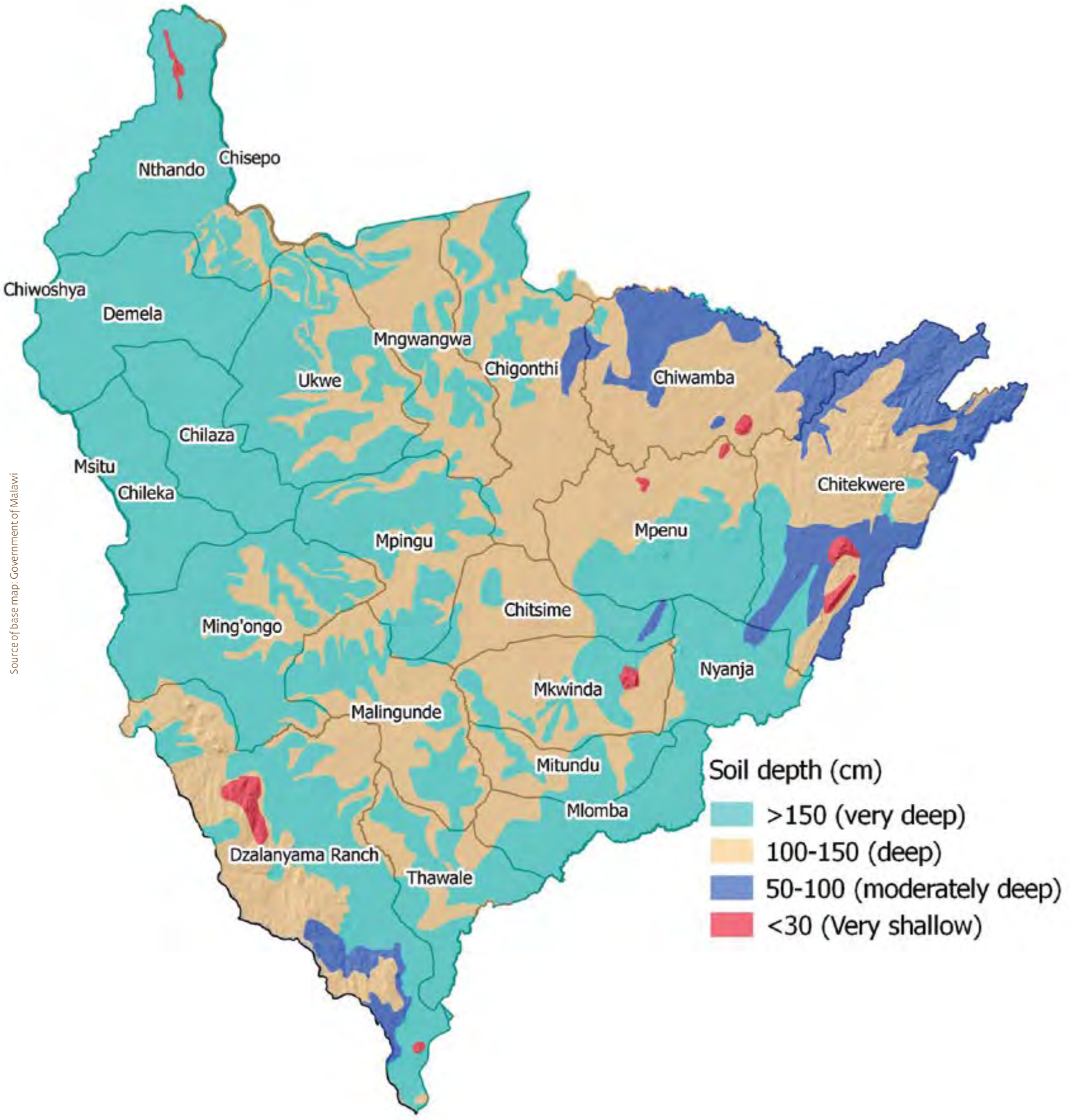
Example of land cover types at Mbabvi

2. Rainfall, relief and soil factors

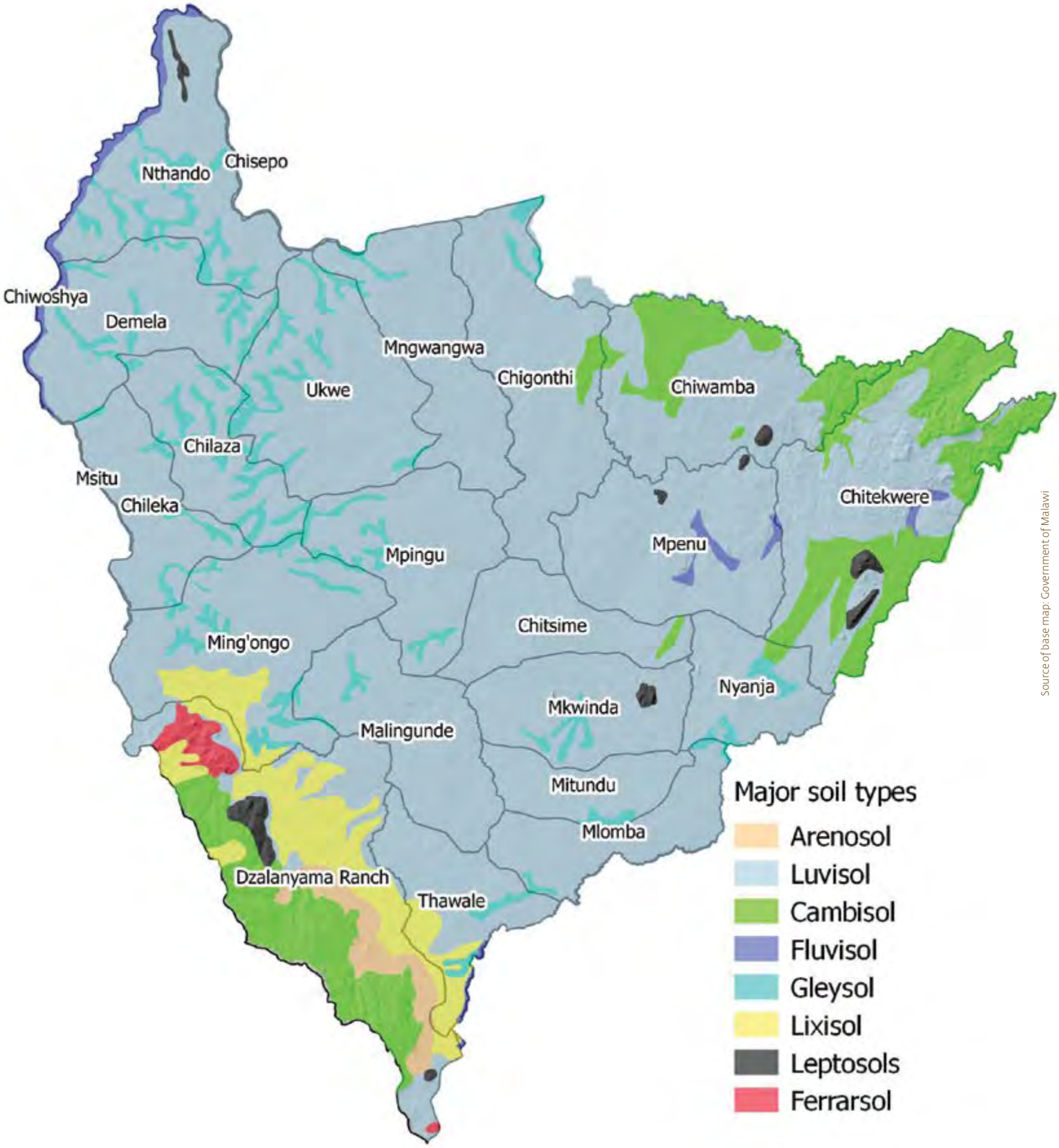
Lilongwe is a flat district. It has deep soil dominated by Luvisol with pockets of Planosol and Cambisol. These soil types are slightly vulnerable to soil erosion.



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Example of cropland at Mbabvi

Soil loss risk factors

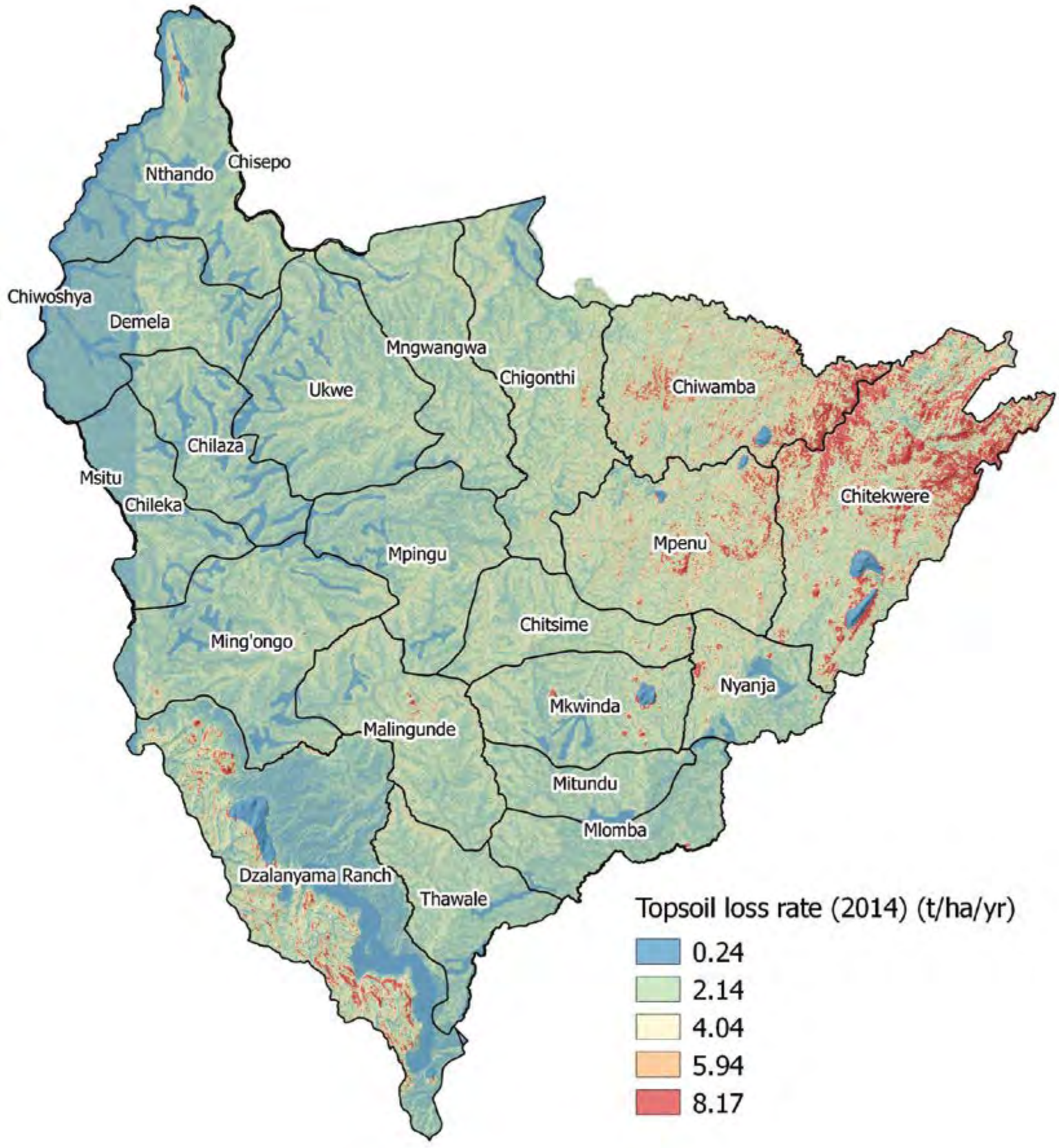
Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Chisepo	No change	3.37	8.78	639.4	637-646	Low risk
Nthando	No change	1.82	44.40	640.8	636-656	Low risk
Chigonthi	No change	3.09	12.89	653.3	644-668	Low risk
Mngwangwa	No change	2.38	7.81	643.4	637-654	Low risk
Demela	No change	1.85	9.06	647.4	636-666	Low risk
Chiwoshya	No change	1.28	3.09	660.2	655-666	Low risk
Ukwe	No change	2.00	7.68	638.8	636-644	Low risk
Chiwamba	No change	6.81	77.40	667.3	656-681	Low risk
Chitekwere	No change	12.35	96.64	692.1	674-724	Low risk
Chilaza	No change	1.83	5.71	644.7	639-650	Low risk
Msitu	No change	2.79	11.08	661.7	658-673	Low risk
Chileka	No change	2.04	7.64	654.5	647-664	Low risk
Mpenu	No change	4.93	45.75	679.7	660-706	Low risk
Mpingu	No change	2.17	7.89	651.7	643-665	Low risk
Ming'ongo	No change	2.24	16.84	658.8	646-674	Low risk
Chitsime	No change	2.93	21.52	673.4	658-697	Low risk
Nyanja	Slight increase	3.31	46.49	710.2	692-726	Moderate risk
Malingunde	No change	2.37	31.95	671.8	655-695	Low risk
Mkwinda	No change	3.45	97.06	688.1	670-708	Low risk
Dzalanyama Ranch	No change	8.20	75.29	693.6	665-750	Low risk
Mitundu	Slight increase	2.21	15.49	698.0	679-712	Moderate risk
Mlomba	Slight increase	2.00	28.88	708.3	691-723	Low risk
Thawale	No change	2.07	7.75	701.3	678-729	Low risk
Chafumbwa	Slight increase	3.35	7.83	714.8	709-722	Moderate risk

Features of soil erosion

Sheet, rill and gully erosion at Chileka

Sheet, rill and gully erosion at Chileka

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Chisepo	2.83	4.11	6.94
Nthando	1.95	1.15	3.10
Chigonthi	3.12	2.48	4.01
Mngwangwa	2.84	4.70	7.53
Demela	1.84	5.43	7.26
Chiwoshya	0.20	6.93	7.13
Ukwe	2.47	3.20	5.67
Chiwamba	4.95	4.79	7.74
Chitekwere	6.08	3.70	6.79
Chilaza	2.10	4.89	7.00
Msitu	1.34	3.43	4.77
Chileka	1.94	6.23	8.18
Mpenu	4.39	1.47	5.87
Mpingu	2.52	3.32	5.85
Ming'ongo	2.45	5.71	8.15
Chitsime	3.29	2.07	5.36
Nyanja	3.16	3.45	6.60
Malingunde	3.00	1.37	4.38
Mkwinda	3.03	3.19	6.22
Dzalanyama Ranch	2.52	1.65	4.16
Mitundu	2.57	5.50	8.07
Mlomba	2.40	2.62	5.01
Thawale	2.56	2.35	4.91
Chafumbwa	3.18	3.74	4.92



Source of base map: Government of Malawi

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 1.05 t/ha/yr. This was a low rate. Only Chitwere, Chiwamba and Mpenu EPAs had indications of the high soil loss rates. The main soil loss contributing factors are the presence of vulnerable soils and agricultural intensification. Sheet and rill erosion are the most common types of erosion in the district.

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chigonthi	5.30	1.38	0.68	0.07	19.99	0.69	0.39	6.50	2.32	0.43	0.51	37.37	28.37
Chilaza	5.18	3.49	1.72	0.17	25.83	0.44	0.58	11.89	1.37	0.34	0.69	28.15	83.04
Chileka	5.61	9.13	4.50	0.46	13.56	0.73	0.56	2.63	0.94	1.50	0.48	28.33	8.13
Chitsime	5.41	2.30	1.13	0.12	7.21	0.41	0.35	4.37	1.26	0.94	0.45	23.82	12.59
Chiwamba	5.46	1.65	0.82	0.08	5.25	0.43	0.65	3.84	1.08	1.06	3.06	31.80	16.82
Demela	5.16	2.53	1.25	0.13	17.53	0.44	0.50	3.97	1.30	0.71	1.90	29.58	14.28
Malingunde	5.28	1.87	0.92	0.09	10.09	0.85	0.57	3.56	1.30	0.87	1.07	10.72	12.91
Ming'ongo	5.51	1.53	0.76	0.08	31.71	0.26	0.36	2.35	0.89	0.93	0.95	17.17	15.32
Mitundu	4.82	1.34	0.66	0.07	40.63	0.37	0.78	2.40	0.99	0.56	1.50	25.30	13.12
Mlomba	4.72	1.99	0.98	0.10	23.26	0.63	0.80	3.68	1.03	0.69	2.69	27.97	14.79
Mnkwinda	5.15	2.78	1.37	0.14	97.22	0.36	0.47	3.67	1.25	1.80	3.80	39.53	20.91
Mpenu	5.11	3.30	1.62	0.16	6.69	0.53	0.58	4.44	1.16	1.07	3.07	31.92	16.88
Mpingu	5.31	1.62	0.80	0.08	15.23	0.60	0.51	5.00	1.53	3.66	0.90	41.27	18.08
Mthondo	5.09	1.82	0.90	0.09	18.78	0.48	0.63	4.01	1.50	0.67	1.99	20.20	15.12
Nyanja	5.29	1.59	0.78	0.08	34.14	0.57	0.61	3.80	1.06	1.01	3.01	31.29	16.55
Thawale	4.81	1.54	0.76	0.08	36.12	0.27	0.79	3.06	1.14	0.58	0.79	17.32	11.45
Ukwe	5.43	1.83	0.90	0.09	31.57	0.53	0.43	4.66	1.54	0.40	0.48	22.16	23.19
Mngwangwa	6.03	2.23	1.10	0.11	20.75	0.49	0.52	4.49	1.37	0.23	0.66	29.91	15.24
Mkwinda	5.17	2.49	1.23	0.12	26.44	0.48	0.62	4.64	1.35	1.08	3.08	31.98	16.91
Chitekwere	4.45	1.82	0.90	0.09	12.09	0.50	0.74	12.16	0.97	1.06	3.06	31.84	16.84

Cropland at Mchonkhwe in Mitundu EPA

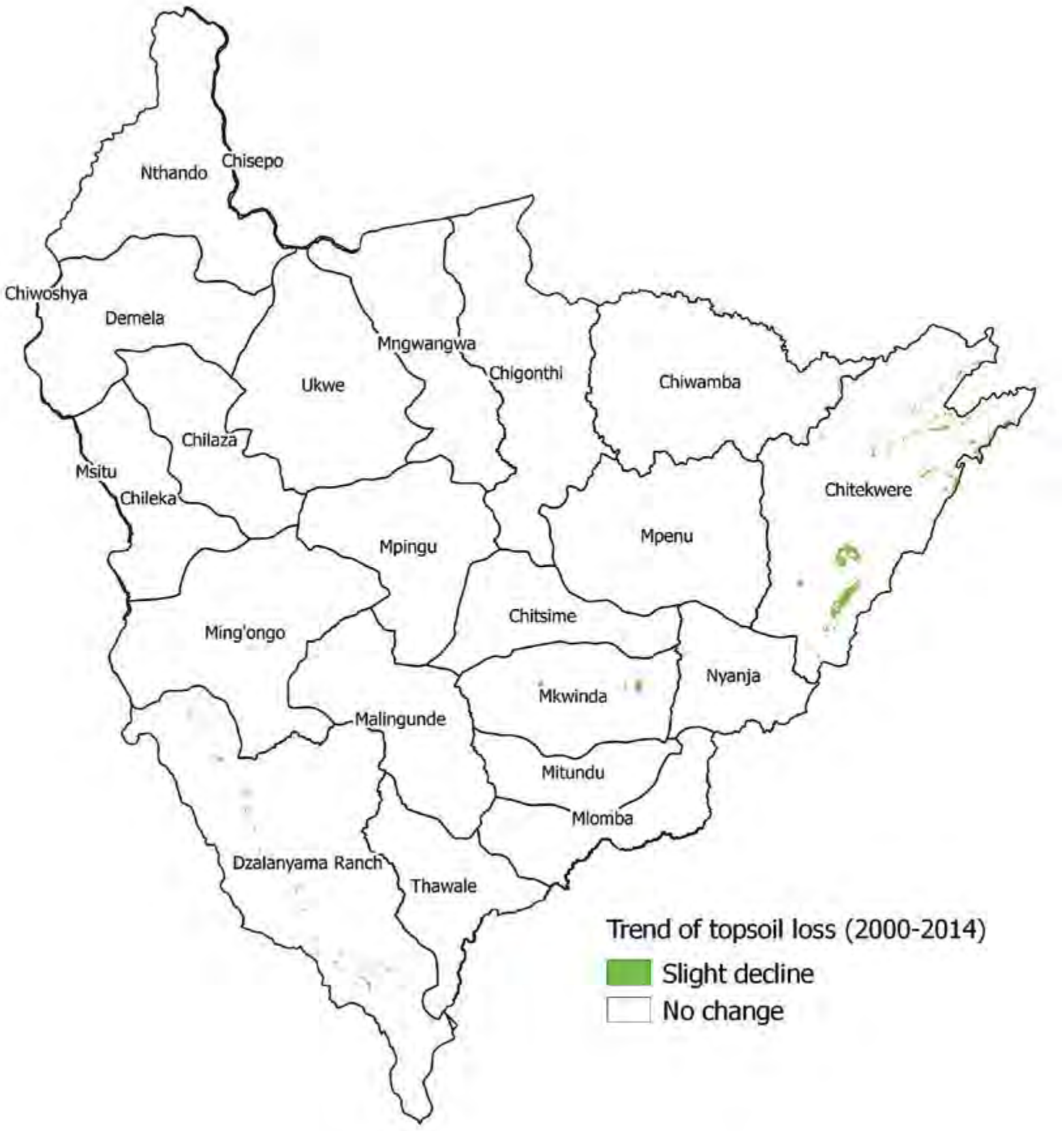
Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Nthando	0.087	0.004	0.244	0.335
Chigonthi	0.127	0.006	0.365	0.497
Mngwangwa	0.111	0.005	0.306	0.422
Demela	0.085	0.004	0.209	0.298
Ukwe	0.105	0.004	0.247	0.356
Chiwamba	0.149	0.006	0.403	0.558
Chitekwere	0.136	0.006	0.356	0.498
Chilaza	0.091	0.004	0.22	0.315
Chileka	0.1	0.004	0.274	0.379
Mpenu	0.129	0.005	0.368	0.502
Mpingu	0.105	0.005	0.306	0.416
Ming'ongo	0.101	0.005	0.286	0.391
Chitsime	0.117	0.005	0.34	0.462
Nyanja	0.106	0.005	0.298	0.409
Malingunde	0.107	0.005	0.301	0.413
Mkwinda	0.108	0.005	0.307	0.42
Dzalanyama Ranch	0.088	0.006	0.293	0.387
Mitundu	0.107	0.005	0.289	0.401
Mlomba	0.098	0.005	0.287	0.389
Thawale	0.102	0.004	0.282	0.389

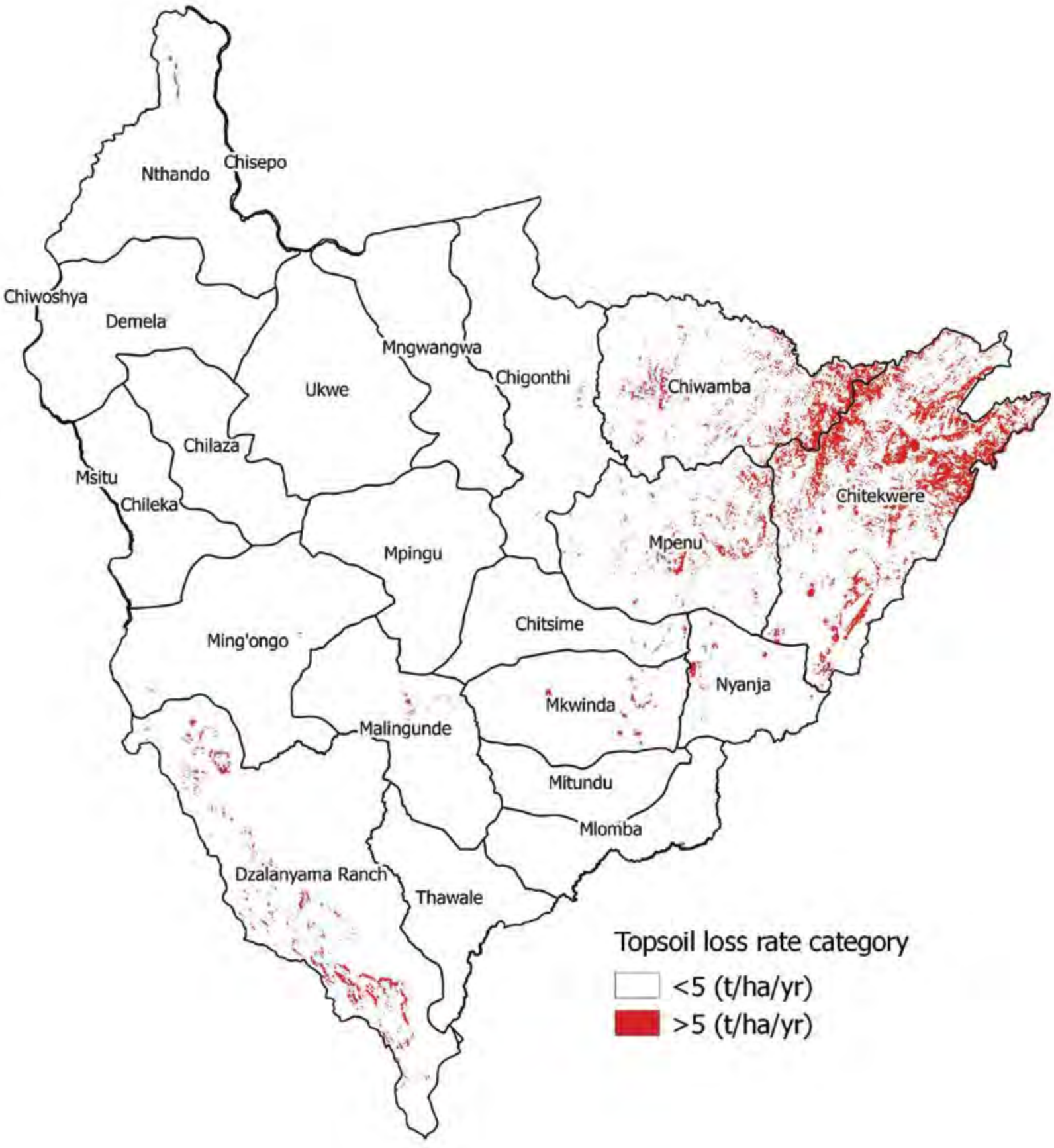
Cropland at Chithonje in Mtundu EPA

Topsoil loss between 2000 and 2014

There was no significant trend of topsoil loss rates observed for the District between 2000 and 2014 except in Chitekwere. This part of the district also seemed to have had highest soil loss rate. However, it had positive decline in soil loss rate before 2014.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

Maintaining vegetayive cover

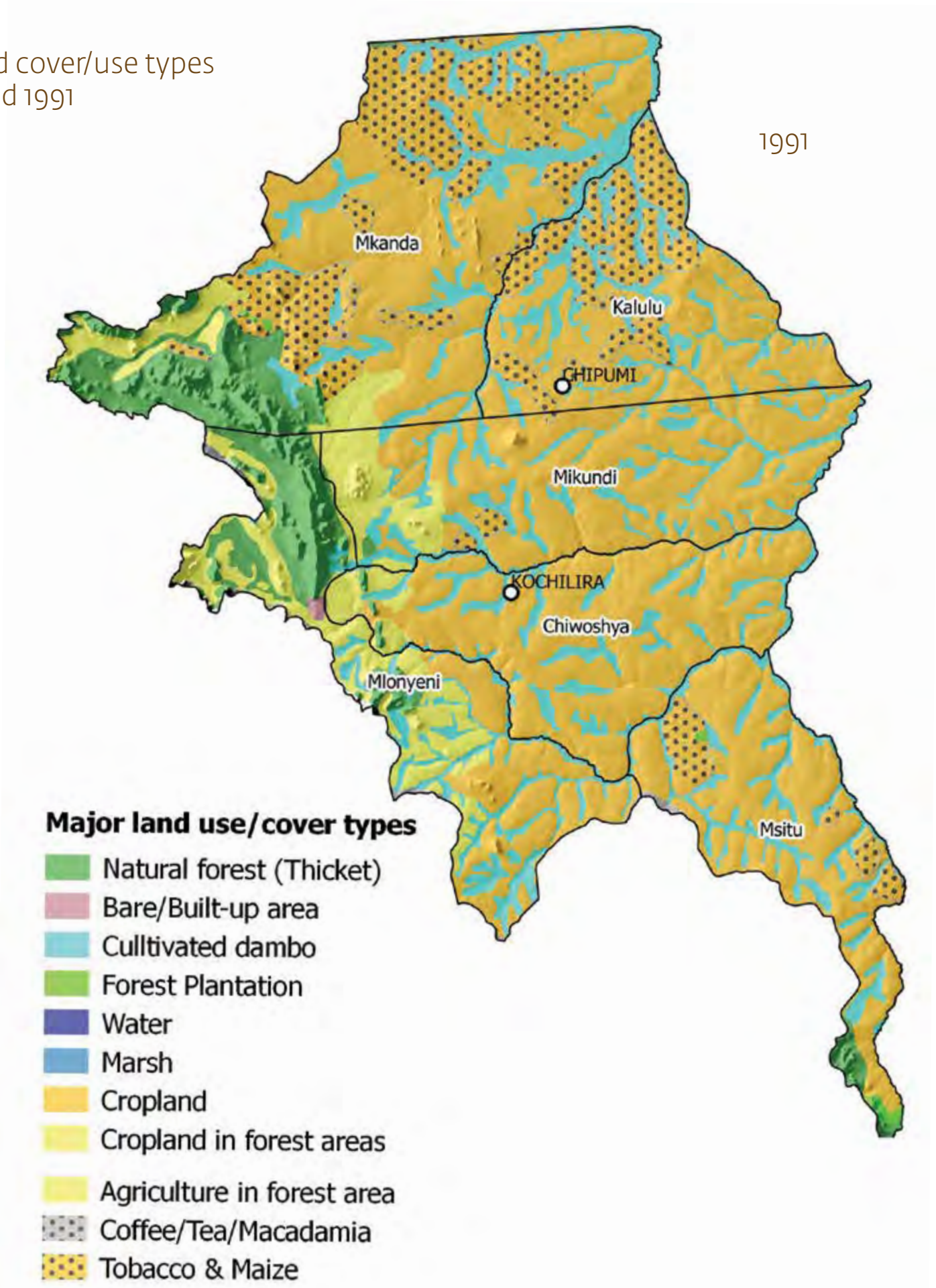
Conservation agriculture

3.11 LILONGWE

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are natural forests and forest reserves (Mchinji and Dzalanyama), smallholder croplands, urban/settlements, estates, and pockets of replanted forest in Mkanda, Chiwoshya, and Msitu EPAs. The district has had a slight decline in vegetative cover between 2000 and 2014.

Major land cover/use types in 2010 and 1991



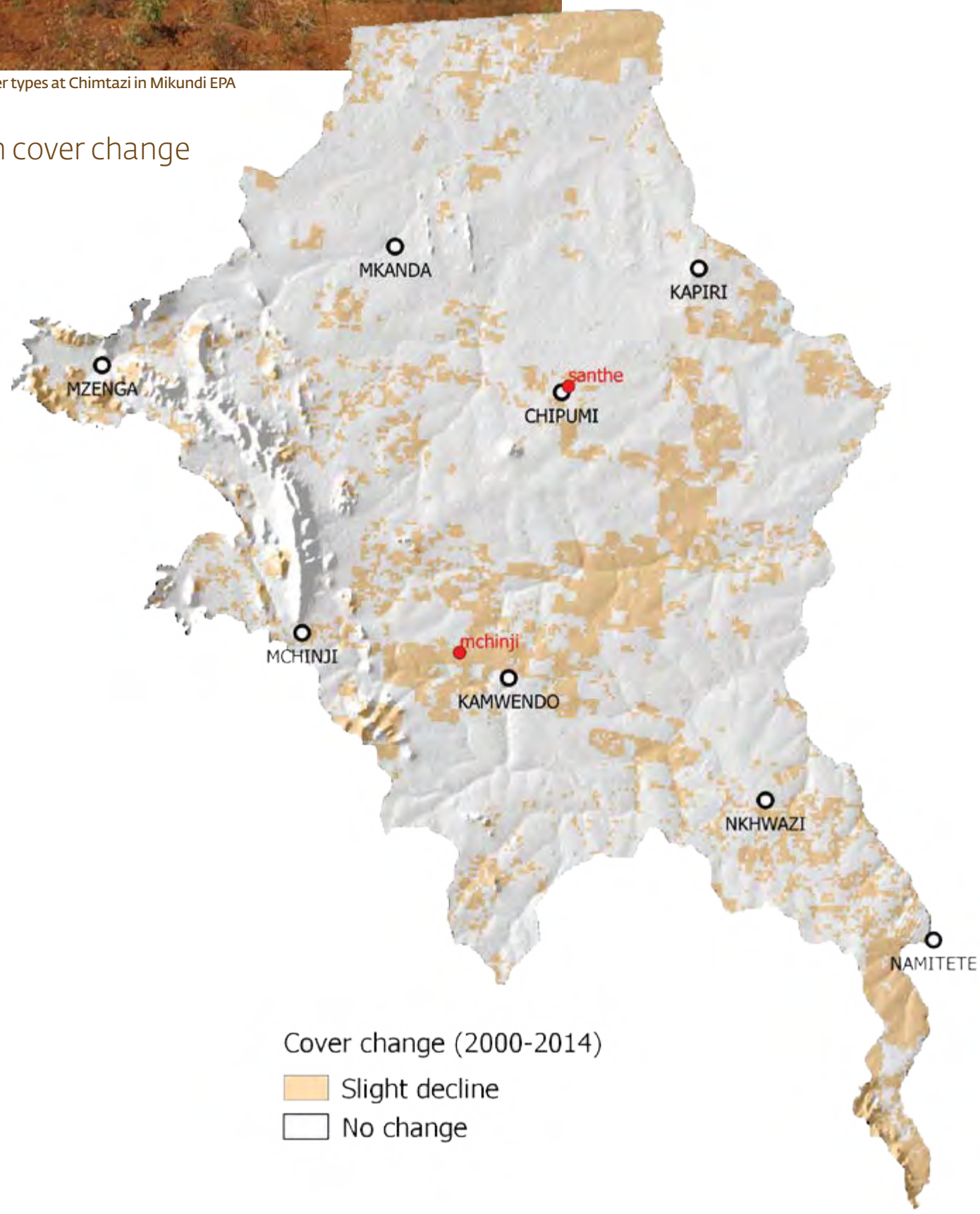
Source of base map: Government of Malawi

Source of base map: Government of Malawi

3.12 Mchinji

Example of land cover types at Chimtazi in Mikundi EPA

Vegetation cover change

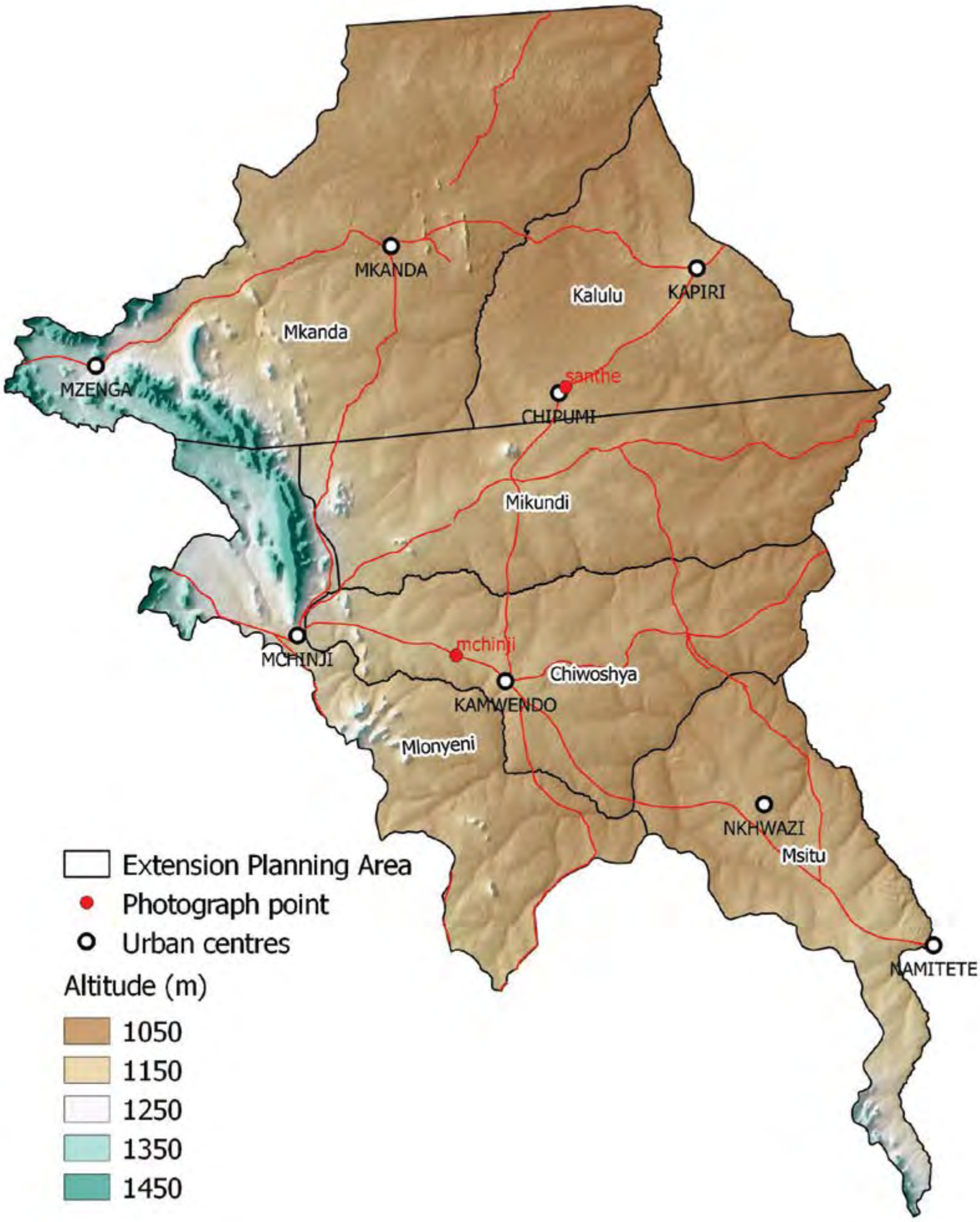


Source of base map: Government of Malawi

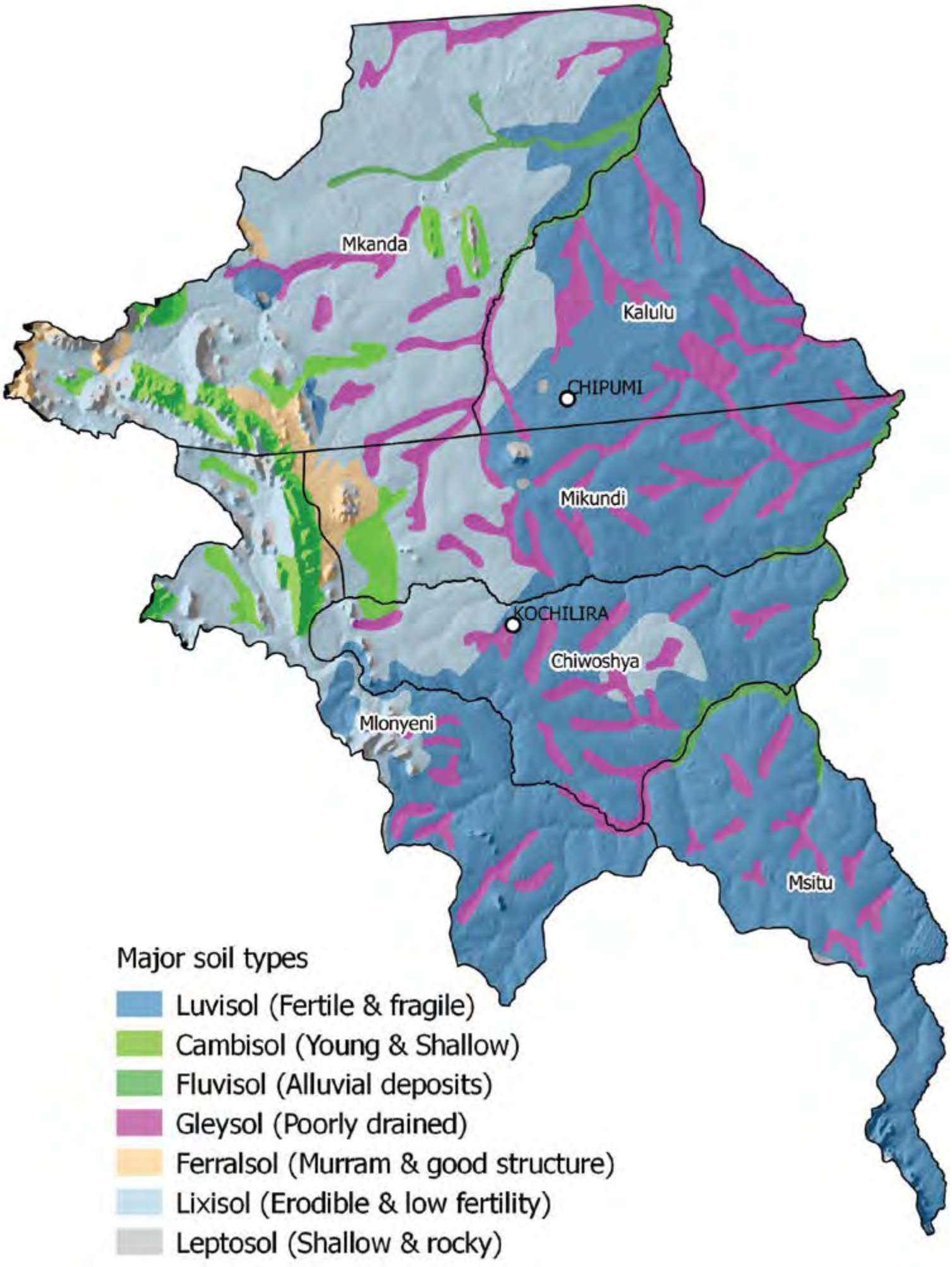
2. Rainfall, relief and soil factors

Mchinji is rather flat save for a few mountain ranges in the west. The soil is deep except in the mountain ranges. In the north towards the west, the soil type is Lixisol while in the east and south the soil type is Luvisol.

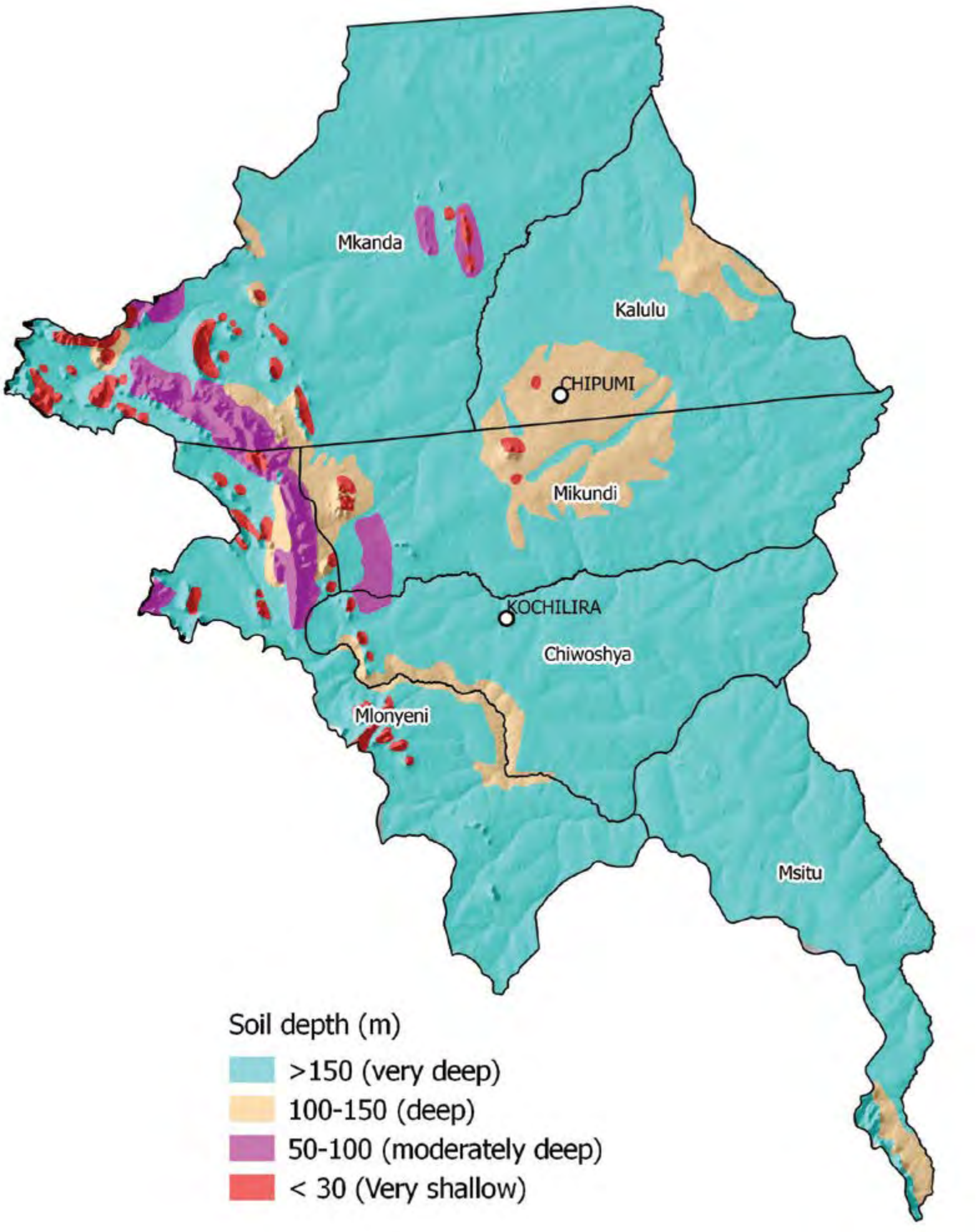
Gentle to fat terrains of Mchinji (between Kamwendo and Mchinji and between Chipumi and Kapiri



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Mkanda	Slight decline	2.4	39.6	708	659-744	Low risk
Kalulu	Slight decline	1.0	4.7	672	645-706	Low risk
Mikundi	Slight decline	1.2	31.5	691	644-735	Low risk
Mlonyeni	Slight decline	3.8	39.5	727	694-748	Moderate to Low risk
Chiwoshya	Slight decline	1.2	24.4	698	655-739	Low risk
Msitu	Slight decline	1.4	24.1	673	658-695	Low risk

Features of soil erosion

Sheet and rill erosion at Kachilili

Gully erosion at Luzale

Gully erosion Mtenje

Topsoil loss rate

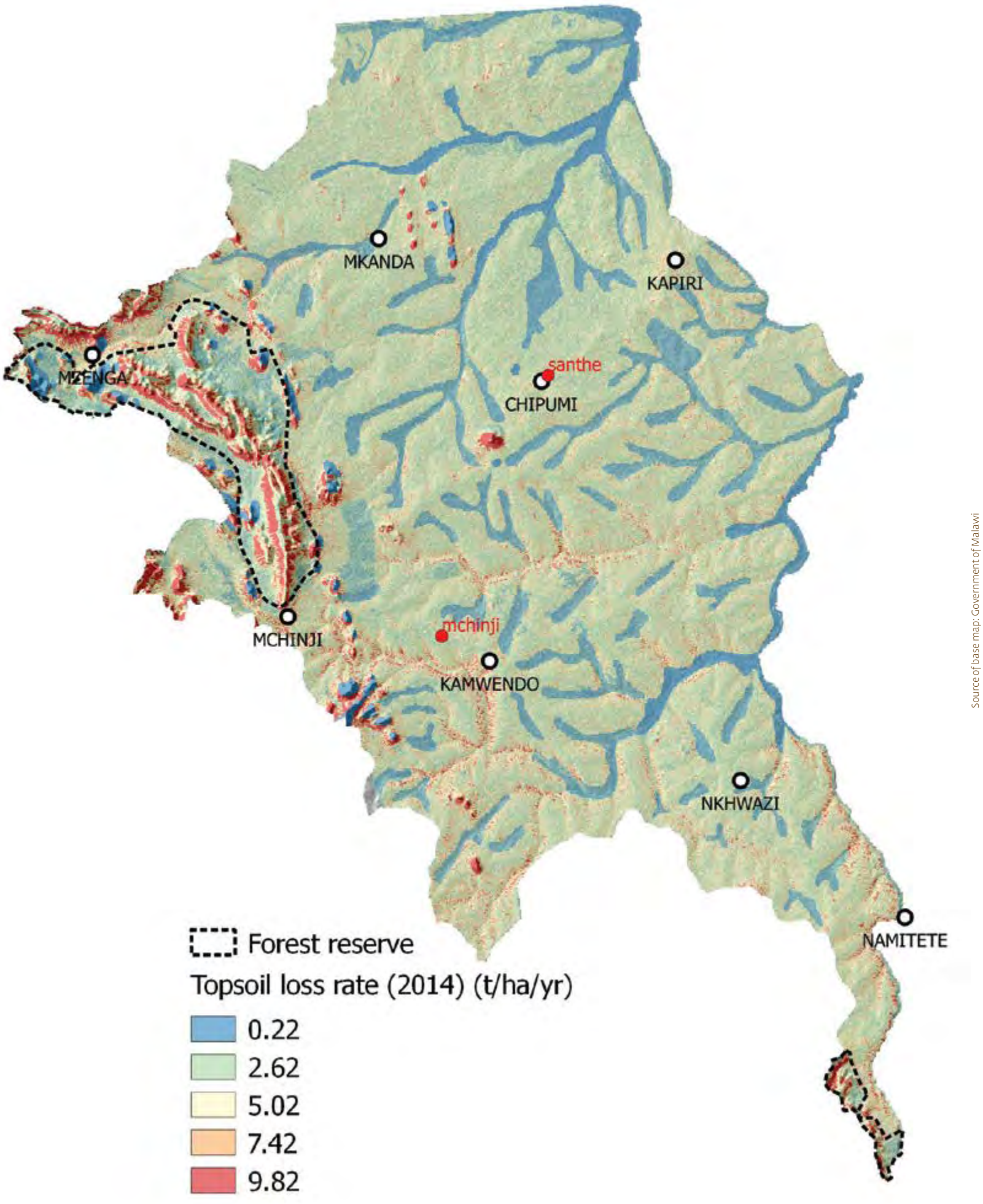
The mean district level topsoil loss rate in 2014 was 1.07 t/ha/yr. High soil loss rates are mainly in the western parts of the district (in Mlonyeni, and Mkanda EPAs). The main drivers for the soil loss rates in these areas include soil vulnerability and soil management.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Mkanda	1.20	0.12	9.81
Kalulu	0.66	0.29	4.72
Mikundi	0.82	0.15	7.06
Mlonyeni	1.81	0.13	9.77
Chiwoshya	0.95	0.48	7.07
Msitu	1.06	1.25	6.36

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
		-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm
Mkanda	5.20	1.755	0.978	0.107	31.077	0.433	0.597	3.933	1.548	1.398	0.489	21.853	15.412
Kalulu	5.43	1.804	0.975	0.106	30.810	0.409	0.568	3.951	1.682	1.376	0.673	22.255	15.519
Mikundi	5.37	1.779	0.969	0.109	31.104	0.442	0.587	3.891	1.553	1.366	0.615	22.178	15.442
Mlonyeni	5.22	1.740	0.938	0.104	31.500	0.472	0.627	3.848	1.426	1.417	0.293	21.968	15.760
Chiwoshya	5.32	1.716	0.951	0.106	29.998	0.458	0.612	3.750	1.491	1.340	0.624	21.740	15.583
Msitu	5.26	1.721	0.945	0.106	30.233	0.454	0.639	3.772	1.529	1.345	0.989	21.567	15.356



Source of base map: Government of Malawi

Typical croplands in July-August period in 2017

Cropland at Malizani in Mikundi EPA

Cropland at Mphanga in Chiwoshya EPA

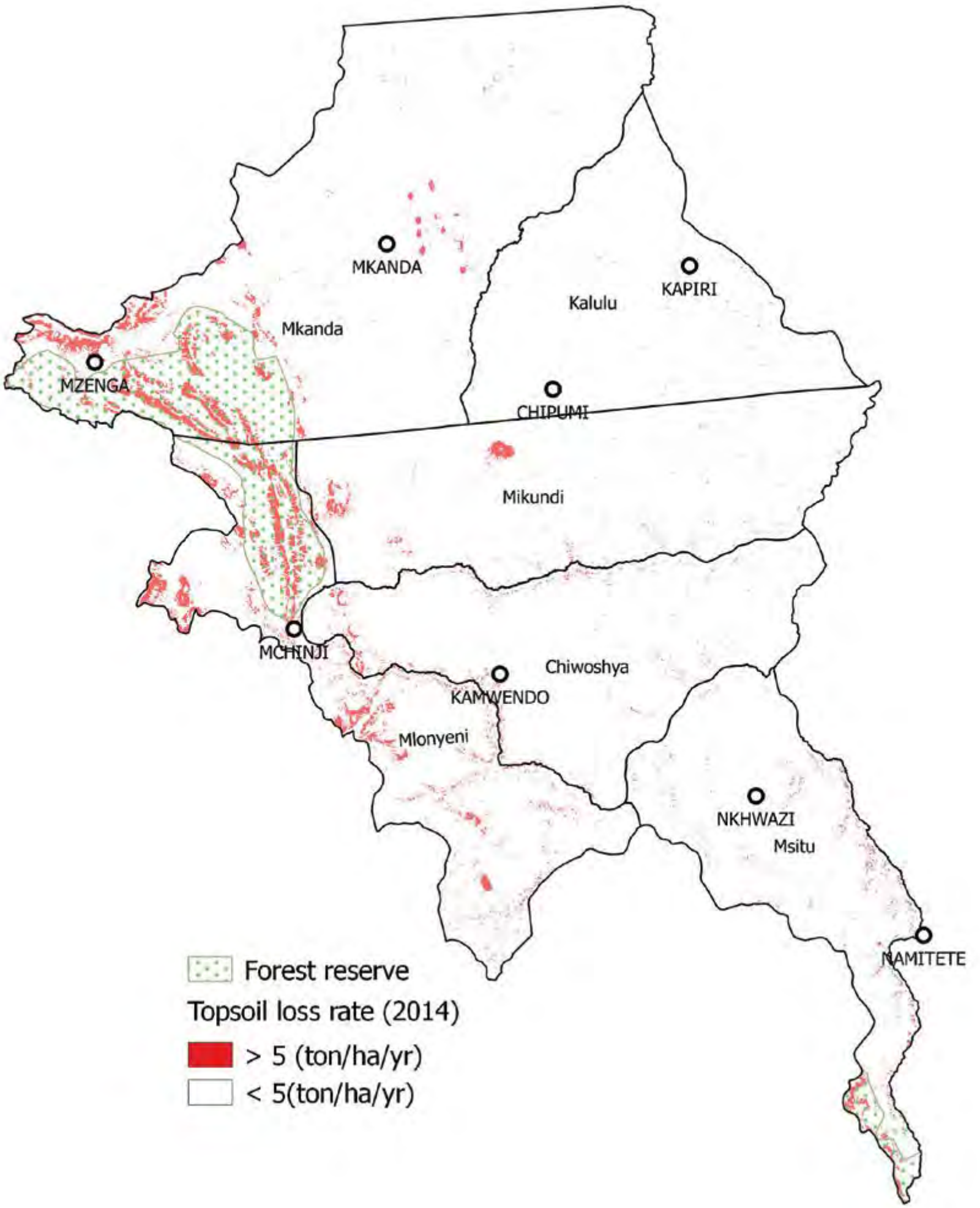
Cropland at Zele in Kalulu EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

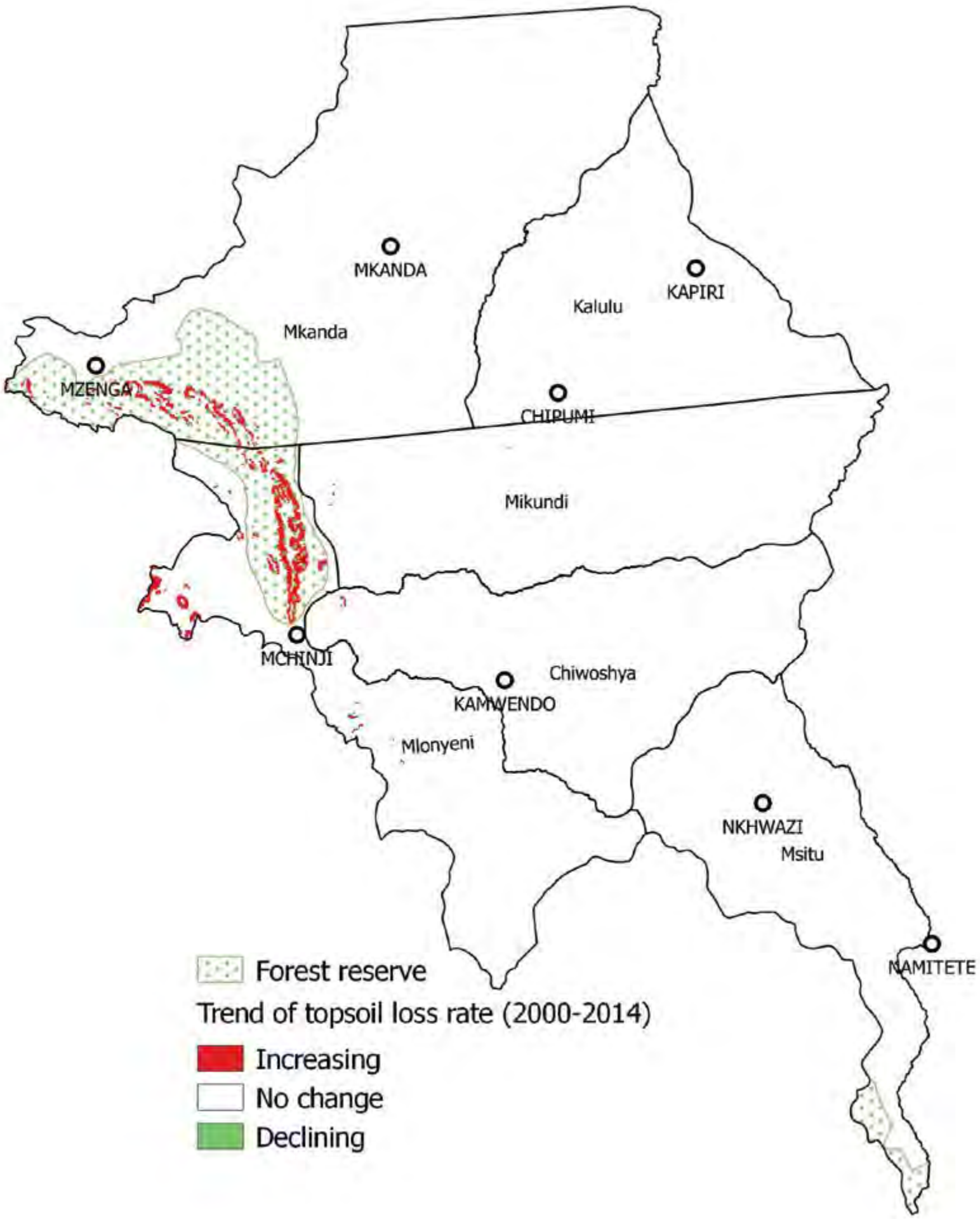
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Mkanda	0.075	0.006	0.22	0.301
Kalulu	0.084	0.003	0.249	0.336
Mikundi	0.071	0.003	0.212	0.285
Mlonyeni	0.066	0.014	0.198	0.278
Chiwoshya	0.066	0.003	0.194	0.264
Msitu	0.098	0.006	0.287	0.391

Topsoil loss trend between 2000 and 2014

The trend of topsoil loss rates in the district seems to have been increasing in the mountain ranges between 2000 and 2014. The other places had constant soil loss rates between 2000 and 2014. The most common soil erosion problems in the district are sheet and gully erosion. These are largely due to the vulnerability of the dominant soil type and due to soil management.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the soil and water conservation measures

Contour ridges at Kambani in Kalulu EPA

Planting pits at chiponzi EPA

Undersowing at Tsumba

Ground nut harvesting and residue incorporation at Chipumi in Kalulu EPA

Vetiver hedgerows establishment at Chimtazi

Senna Siamea woodlot at Tsumba

Agroforestry nursery at Mphomwa

Crop residue incorporation at Jete

Gully reclamation at Tsumba

Mulching at Chiponzi

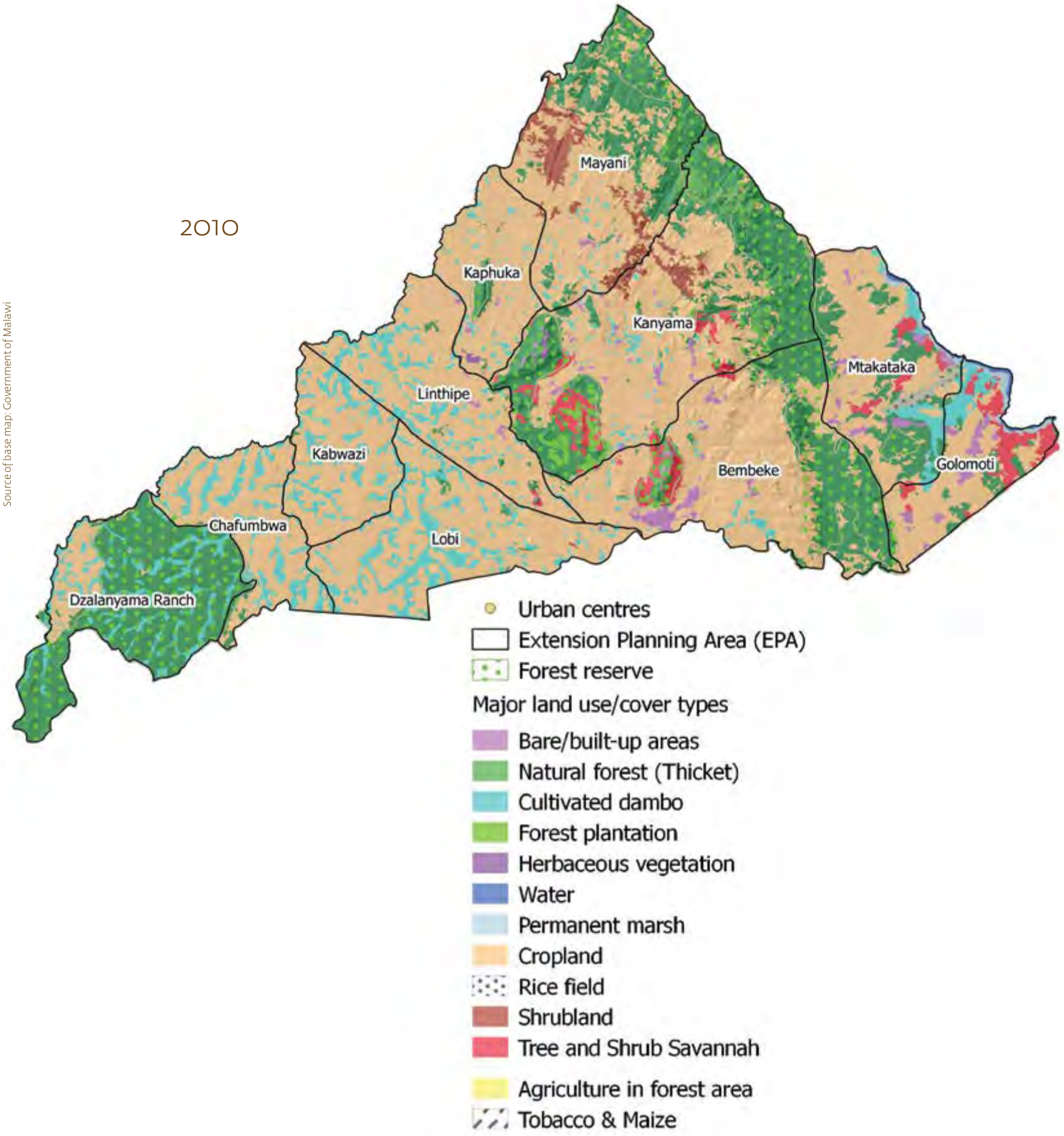
Manure making at Sigaleta

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are smallholder croplands, natural forests, and Liwonde national park. There was slight decline in vegetative cover in the northern parts of the district between 1991 and 2010. However, many areas seem to have gained the cover. The main threat to soil loss was due to farming practices in the cropland areas.

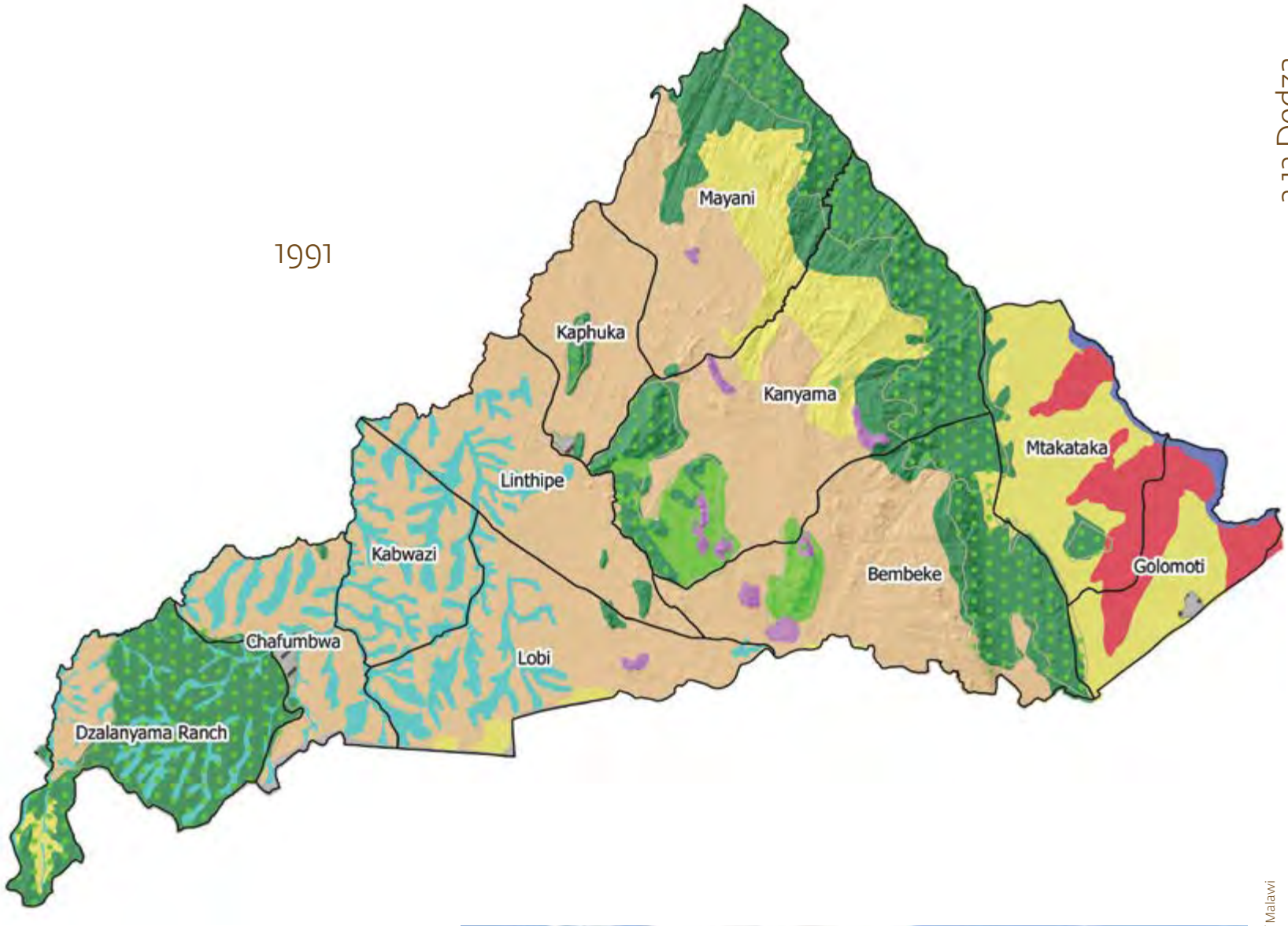
Major land cover/use types in 2010 and 1991

2010



Source of base map: Government of Malawi

1991

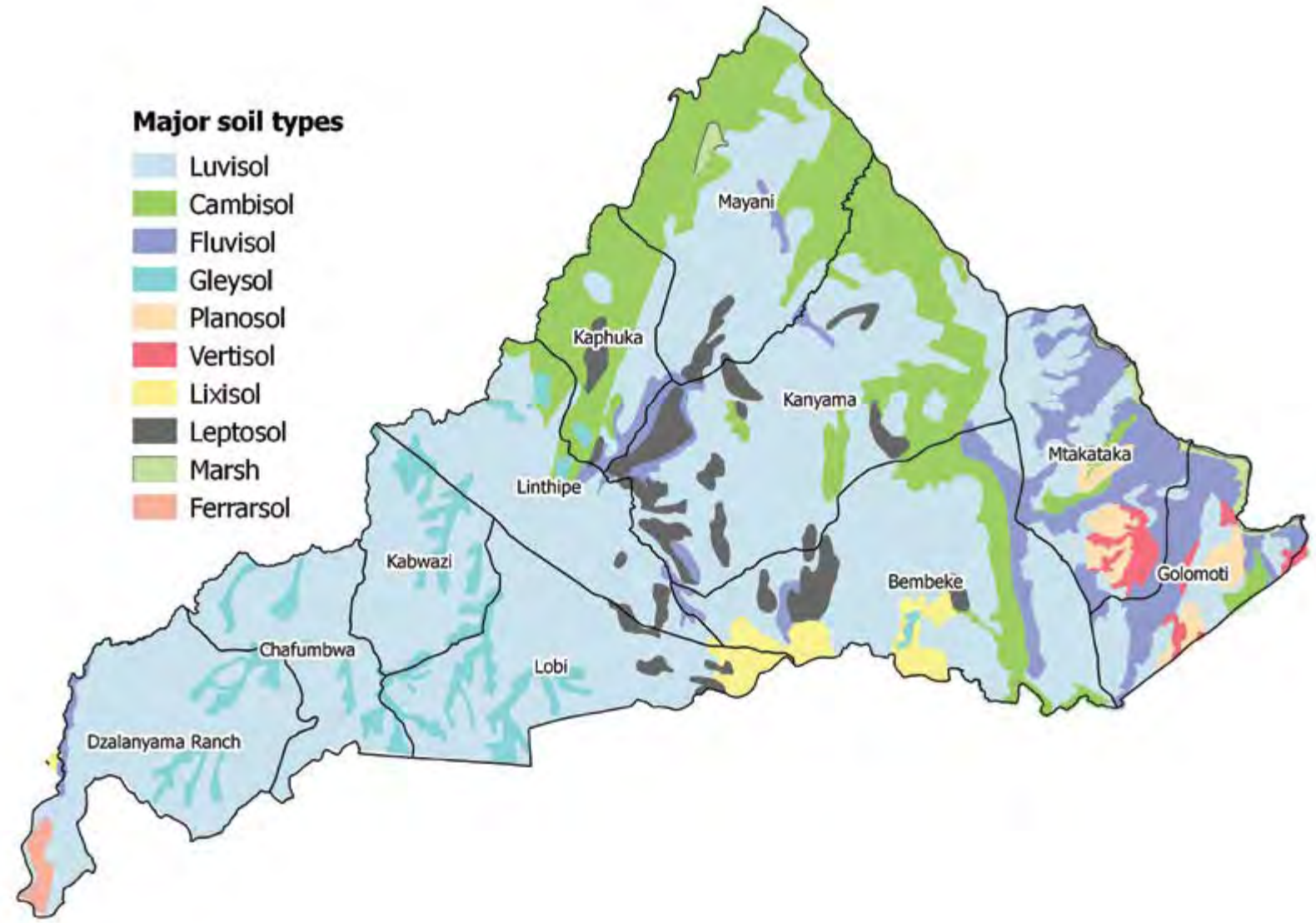


Source of base map: Government of Malawi

Example of land cover types at Kabola

2. Rainfall, relief and soil factors

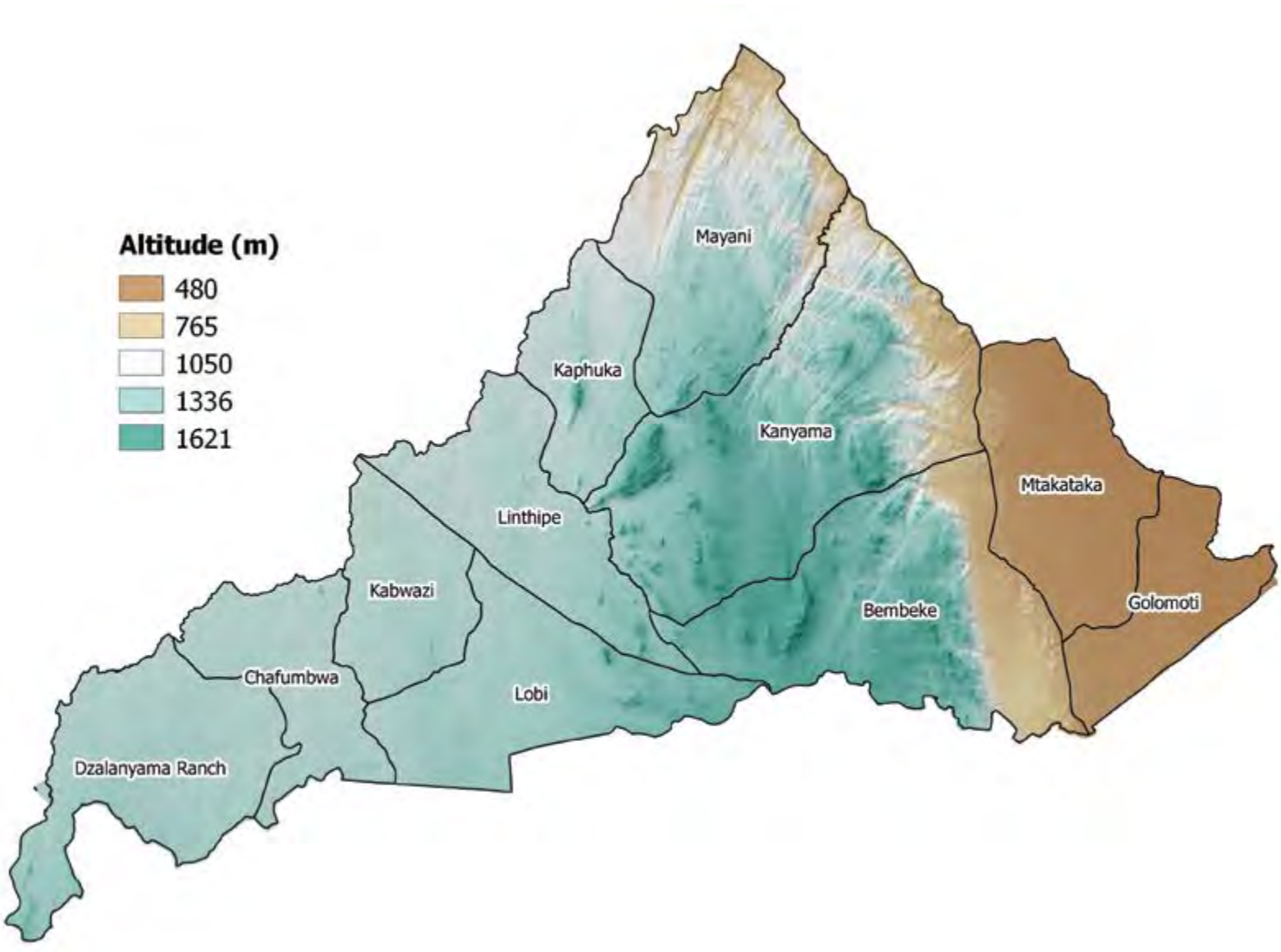
The central (north-south axis) of Dedza district is mountainous with steep slopes. The soils here are shallow and dominated by Leptosols. The remaining parts are rather flat with deep soil that are largely Luvisol with pockets of Planosol and Fluvisols. The main drivers of soil loss are the steep slopes, high rainfall, and vulnerable soil types.



Source of base map: Government of Malawi

Example of shallow soil on Dedza mountains

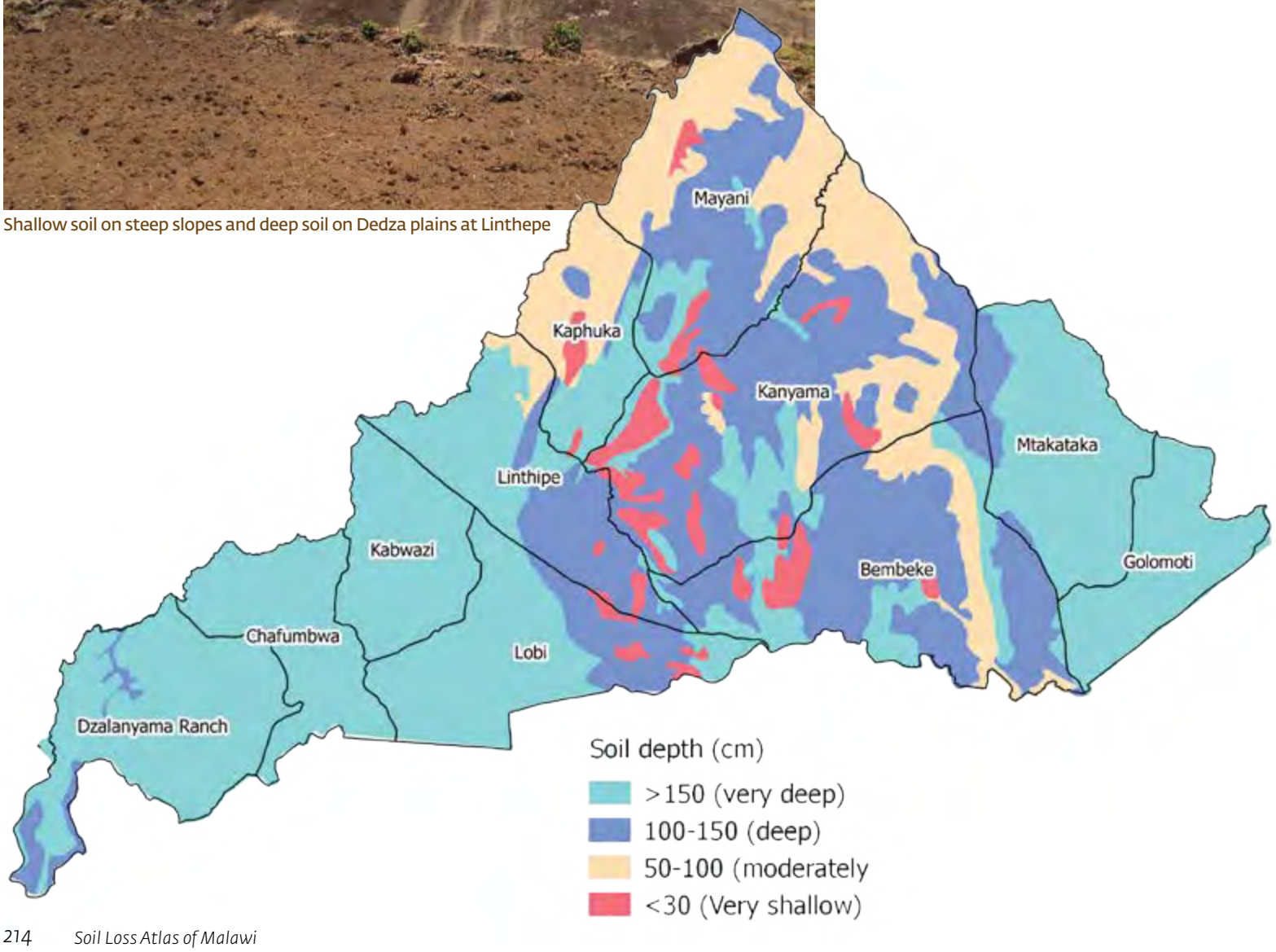
Steep slopes on Dedza escarpment and variable soil depths in the footslopes



Source of base map: Government of Malawi

Shallow soil on steep slopes and deep soil on Dedza plains at Linthepe

Source of base map: Government of Malawi



Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Mayani	No change	14.5	78.9	710.3	680-740	Low risk
Kanyama	No change	15.7	90.0	740.0	703-756	Low risk
Kaphuka	No change	6.3	70.5	728.2	707-744	Low risk
Mtakataka	Slight increase	2.1	30.1	725.0	709-740	Moderate risk
Linthipe	Slight increase	3.7	69.1	738.0	715-754	Moderate risk
Dzalanyama Ranch	No change	3.1	40.0	726.4	709-754	Low risk
Bembeke	No change	13.5	99.0	747.5	724-756	Low risk
Kabwazi	Slight increase	2.3	36.9	729.8	715-739	Moderate risk
Golomoti	Slight increase	1.4	24.8	705.6	677-729	Moderate risk
Lobi	No change	3.4	91.9	743.0	732-755	Low risk
Chafumbwa	No change	2.1	49.8	723.8	709-735	Low risk

Features of soil erosion

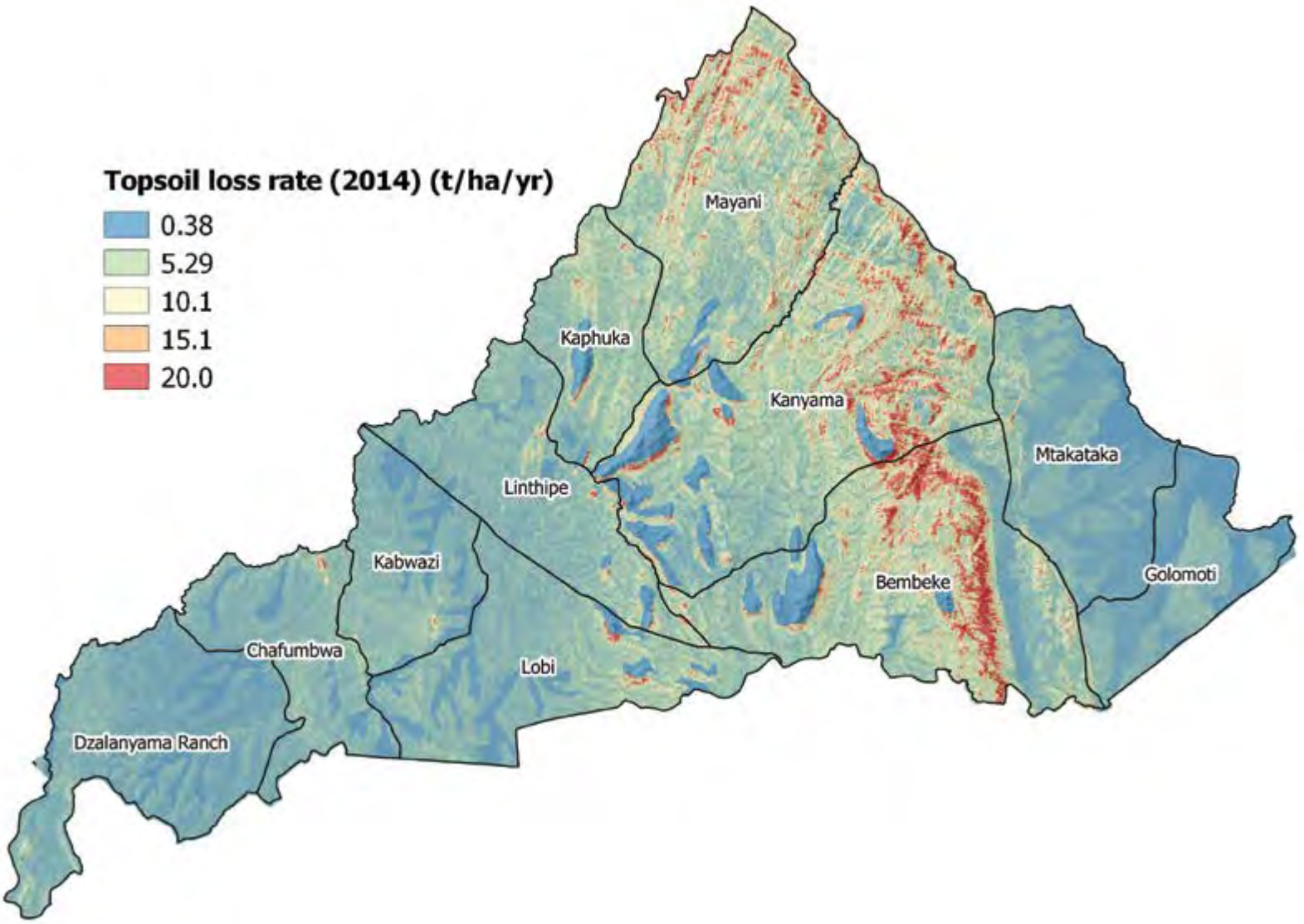
Sheet, rill and gully erosion are the most common types of erosion in the district. Gullies are mainly in the valley heads while sheet and rill erosion are common in farmlands.

Example of gully erosion in Kabola

Example of sheet and rill erosion in Kabola

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 4.71 t/ha/yr. Bembeke and Kanyama EPAs had indications of the highest soil loss rates. The main contributing factors for the soil loss rates in these areas include steep slopes, the presence of vulnerable soils, and agricultural intensification.



Source of base map: Government of Malawi

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Mayani	8.95	0.39	12.16
Kanyama	9.06	0.42	18.51
Kaphuka	4.12	0.40	10.33
Mtakataka	1.16	0.61	16.92
Linthipe	2.28	0.16	8.13
Dzalanyama Ranch	1.14	1.01	13.93
Bembeke	10.70	0.10	14.00
Kabwazi	2.21	0.63	17.58
Golomoti	1.33	0.68	12.61
Lobi	2.30	0.29	17.37
Chafumbwa	3.94	0.38	10.54

Example of rill and gully erosion in a farmland at Chilenda ukwe village

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Bembeke	4.90	1.463	0.721	0.073	69.169	0.506	0.643	4.294	1.415	0.679	1.216	27.537	34.991
Chafumbira	4.74	1.633	0.805	0.082	34.315	0.361	0.428	3.726	1.225	1.413	3.413	35.493	18.770
Golomoti	6.26	3.110	1.533	0.156	40.587	0.805	0.273	13.87	2.260	0.996	0.549	35.655	30.431
Kabwazi	4.94	2.216	1.092	0.111	21.280	0.434	0.694	5.581	1.915	0.886	0.890	26.207	32.819
Kanyama	5.06	1.506	0.742	0.075	62.563	0.490	0.570	5.857	1.818	0.537	1.899	25.855	11.289
Lithipe	5.31	1.946	0.959	0.097	17.771	0.599	0.614	7.588	2.568	1.375	1.235	29.595	27.624
Lobi	5.38	1.790	0.882	0.089	23.575	0.637	0.543	5.490	1.633	1.322	2.276	29.135	43.461
Mayani	5.45	1.690	0.833	0.085	51.701	0.390	0.510	9.780	2.758	0.976	0.461	45.563	42.644
Mtakataka	6.22	1.136	0.560	0.057	74.081	0.610	0.318	9.213	2.425	0.349	0.469	26.145	19.116
Kaphuka	5.25	1.846	0.910	0.092	31.256	0.447	0.497	5.916	1.645	0.634	0.130	33.510	21.706
Dzalanyama Ranch	5.20	1.789	0.850	0.089	30.877	0.478	0.543	4.122	1.647	1.504	0.521	22.624	14.497

Typical croplands in July-August period in 2017

Example of rill and gully erosion in a farmland at Chilenda ukwe village

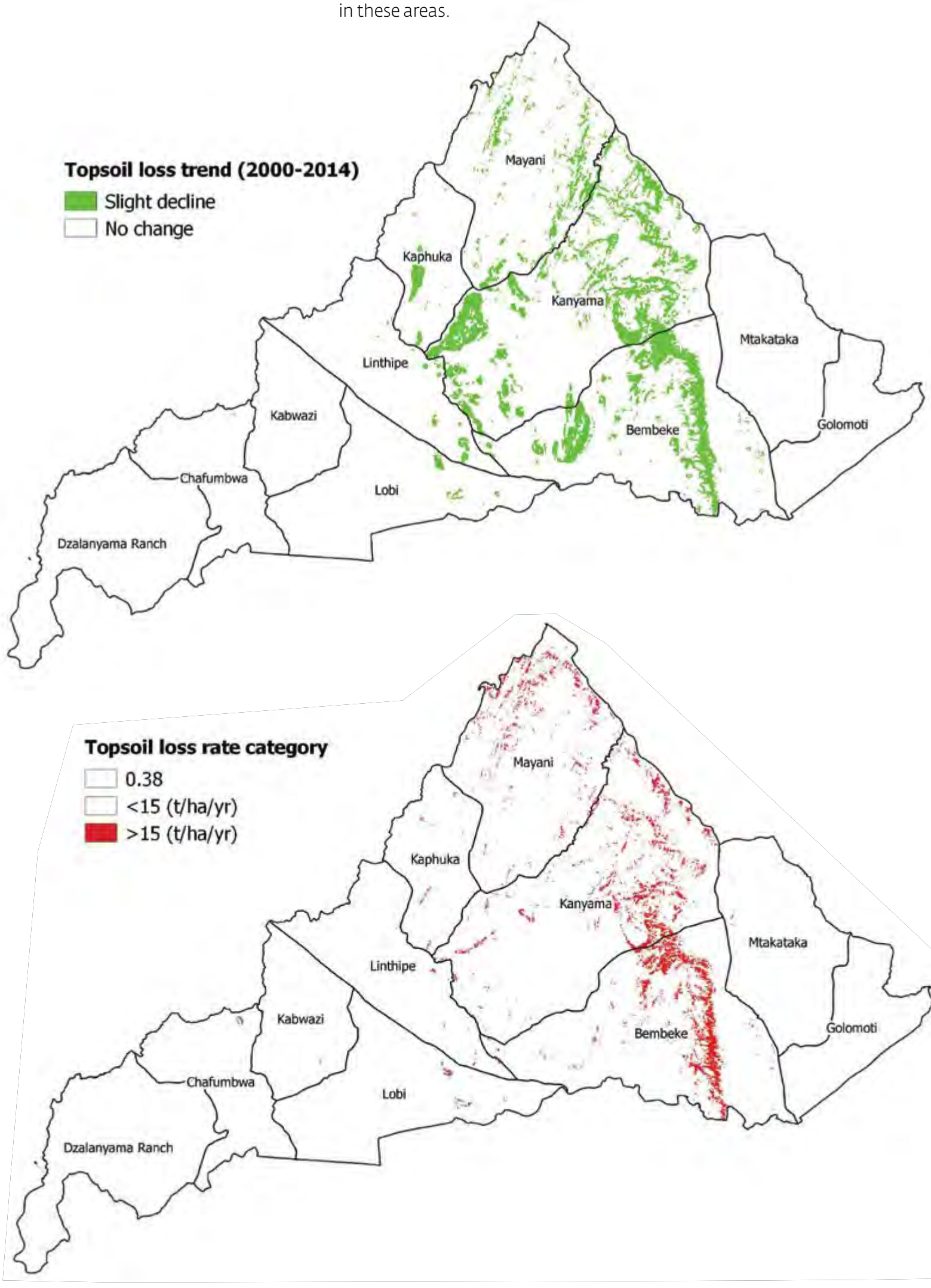
Example of rill and gully erosion in a farmland at Chilenda ukwe village

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Mayani	0.1255	0.0060	0.3655	0.4970
Kanyama	0.1144	0.0057	0.3660	0.4860
Kaphuka	0.1017	0.0048	0.2929	0.3995
Mtakataka	0.2020	0.0179	0.6075	0.8274
Linthipe	0.0897	0.0044	0.2688	0.3629
Bembeke	0.1334	0.0068	0.4109	0.5510
Kabwazi	0.0810	0.0040	0.2492	0.3342
Golomoti	0.1761	0.0234	0.4974	0.6969
Lobi	0.0828	0.0080	0.2593	0.3502
Chafumbwa	0.0896	0.0057	0.2609	0.3562
Dzalanyama Ranch	0.0883	0.0058	0.2926	0.3867

Topsoil loss between 2000 and 2014

There were significant decline in topsoil loss rates observed for the District between 2000 and 2014 especially for the areas that showed high topsoil loss rates. These areas included the escarpments in central part of the district. Perhaps, this was because of the impacts from the forest reserves in these areas.



Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

Protection of gully floor and gully erosion advancement

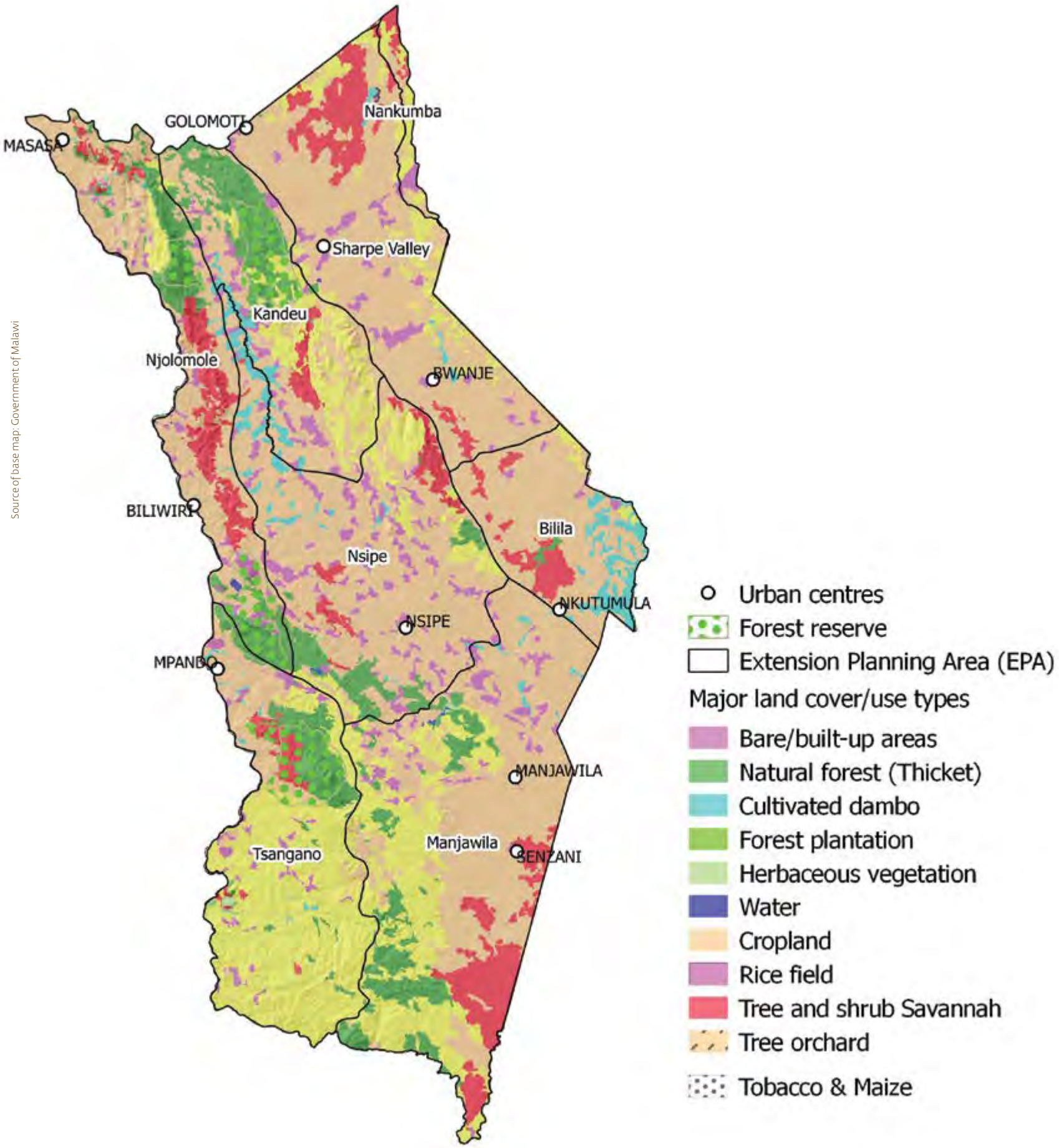
Protecting native vegetation at Dedza

Establishing woodlots at Mdyanthula village

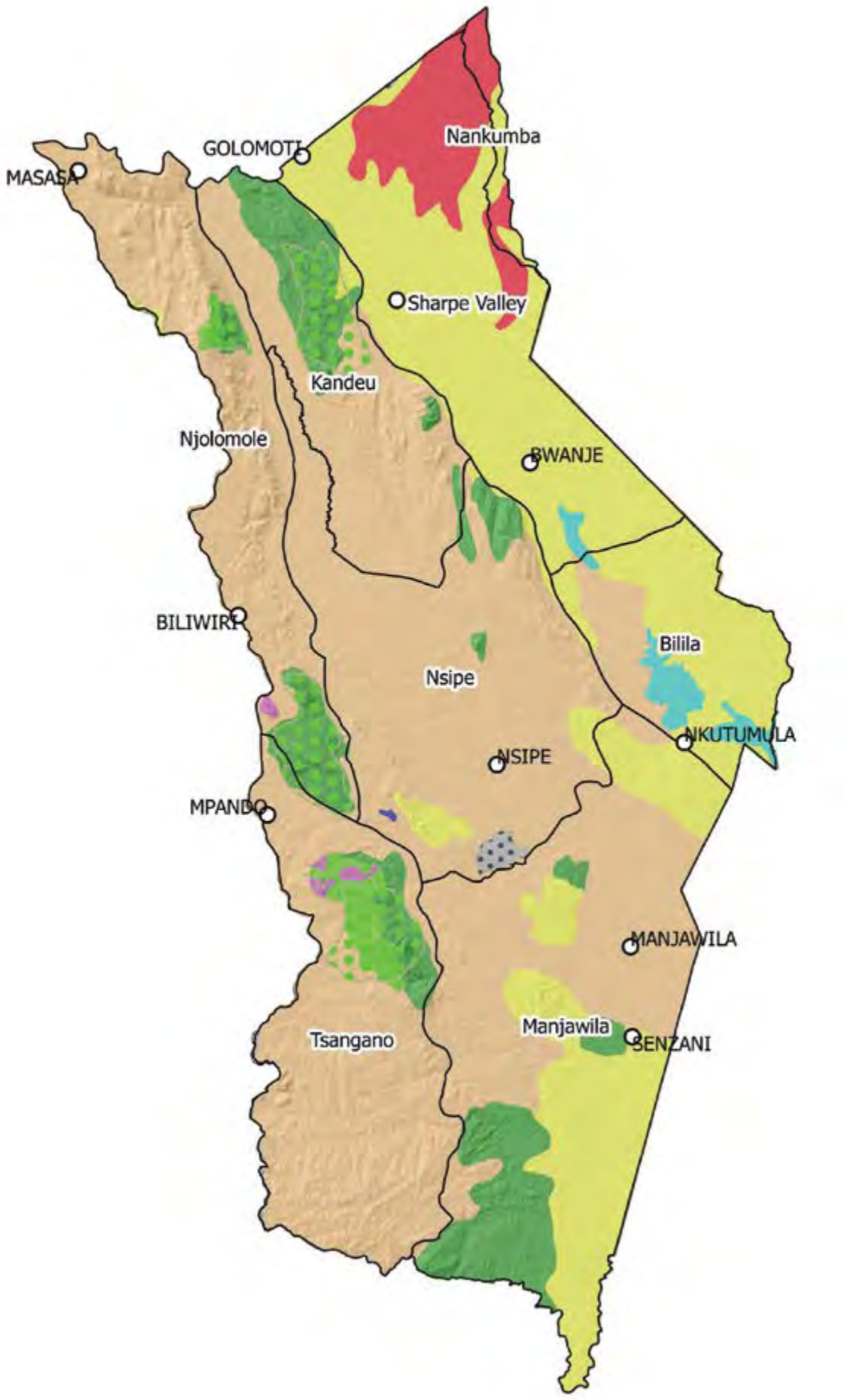
Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are smallholder croplands, forest reserves, and natural forests. The district experienced a significant decline in vegetative cover proportions between 1991 and 2010. The main threat to soil loss is therefore loss of protective vegetation cover.

Major land cover/use types in 2010 and 1991



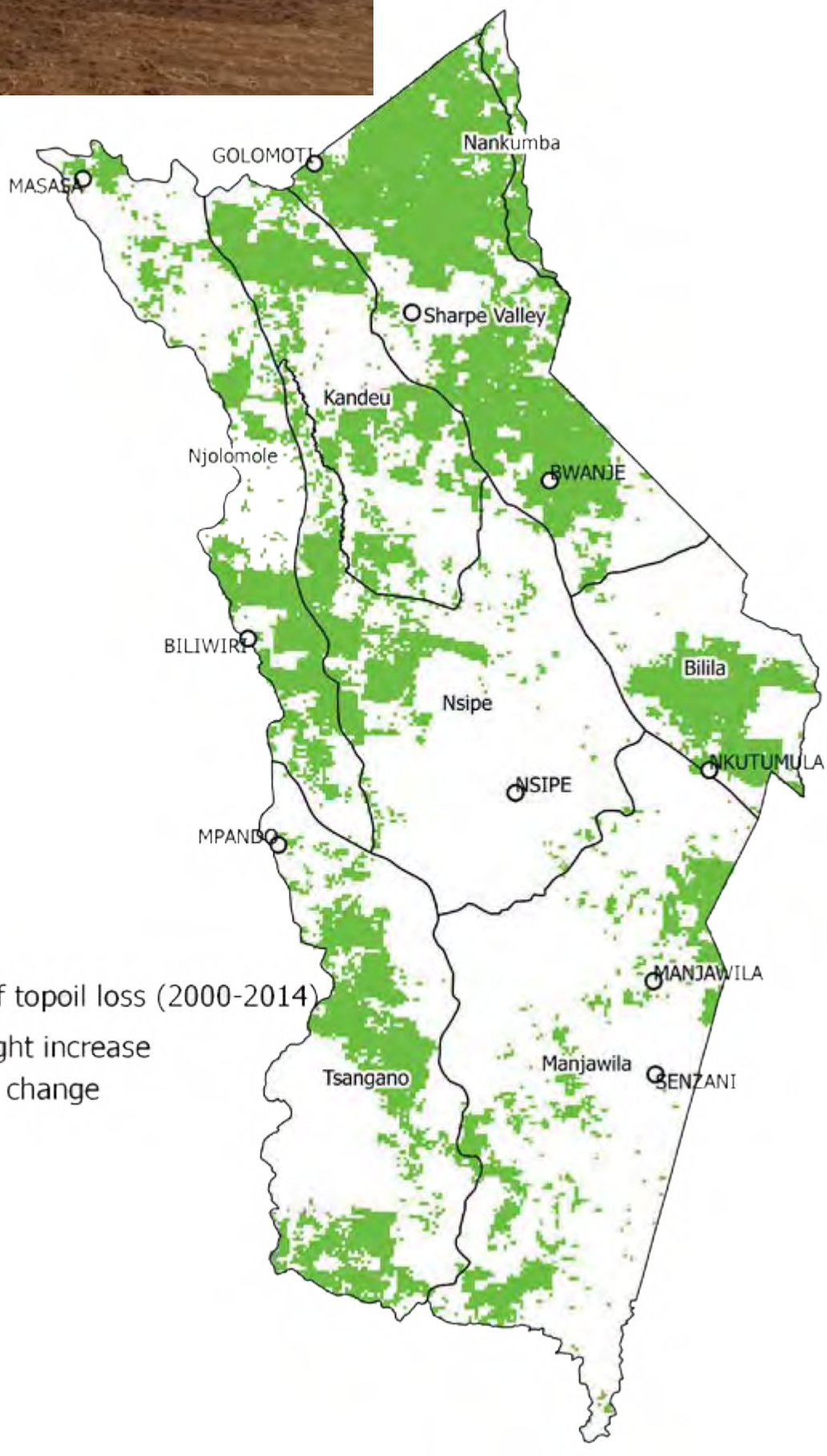
Source of base map: Government of Malawi



Source of base map: Government of Malawi

Typical cropland at Chilobwe

Vegetation cover change



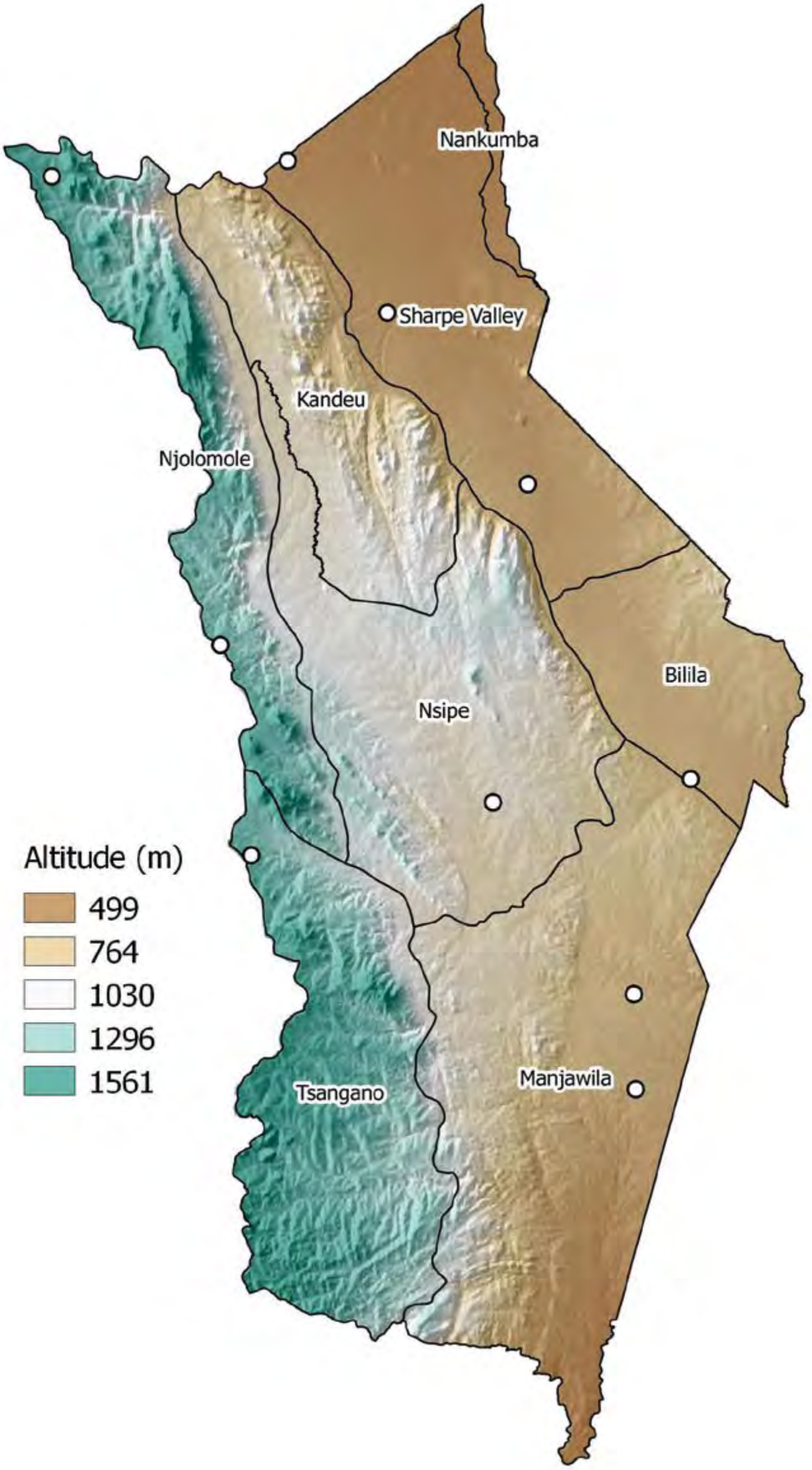
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

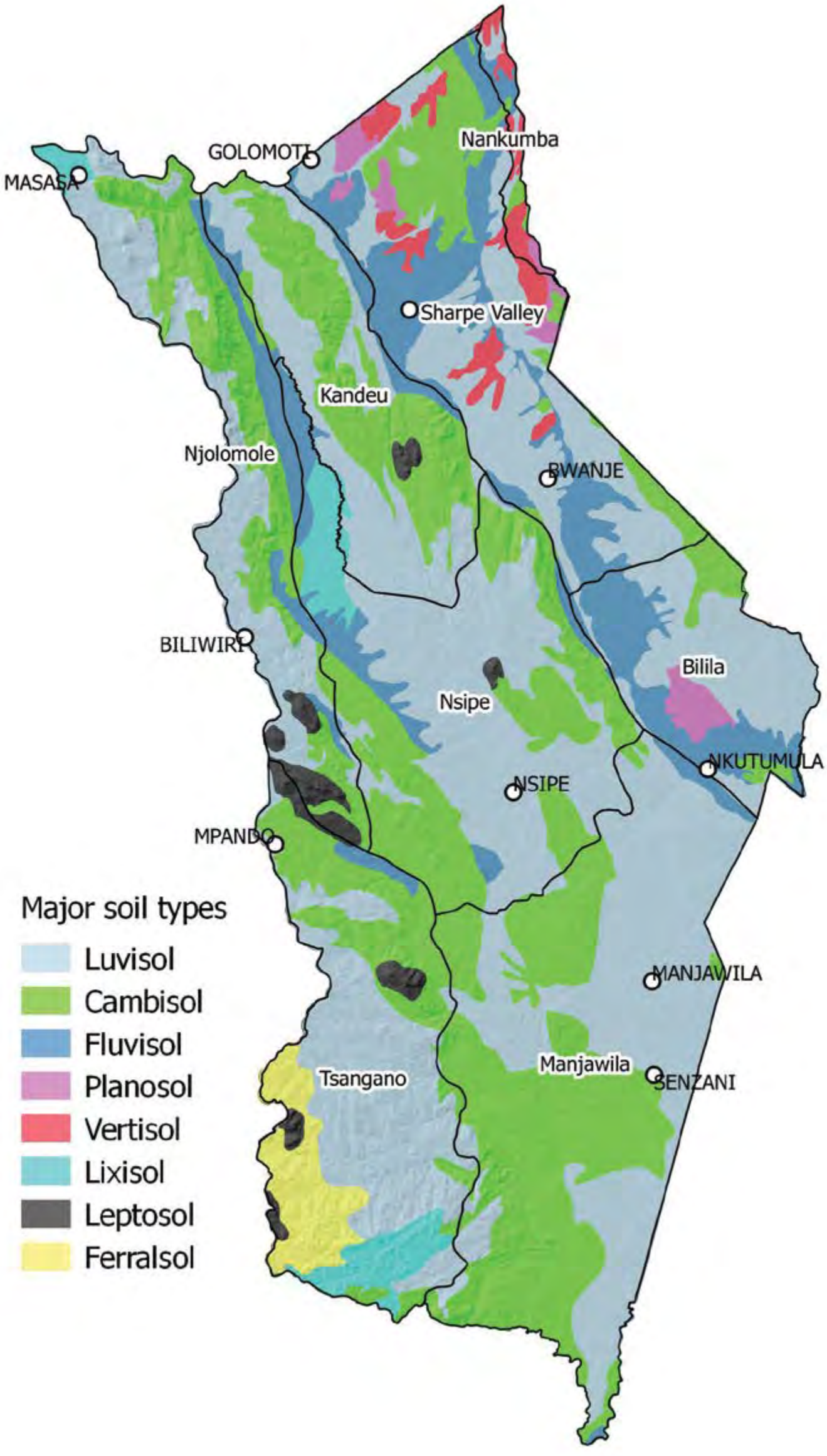
Ntcheu is a mountainous district with a general gentle slope towards the south. It has deep to moderately deep soil. The major soil types are Lixisol and Cambisol . These soil types are quite vulnerable to soil erosion.

Shallow soil on hills and footslopes at Chilobwe

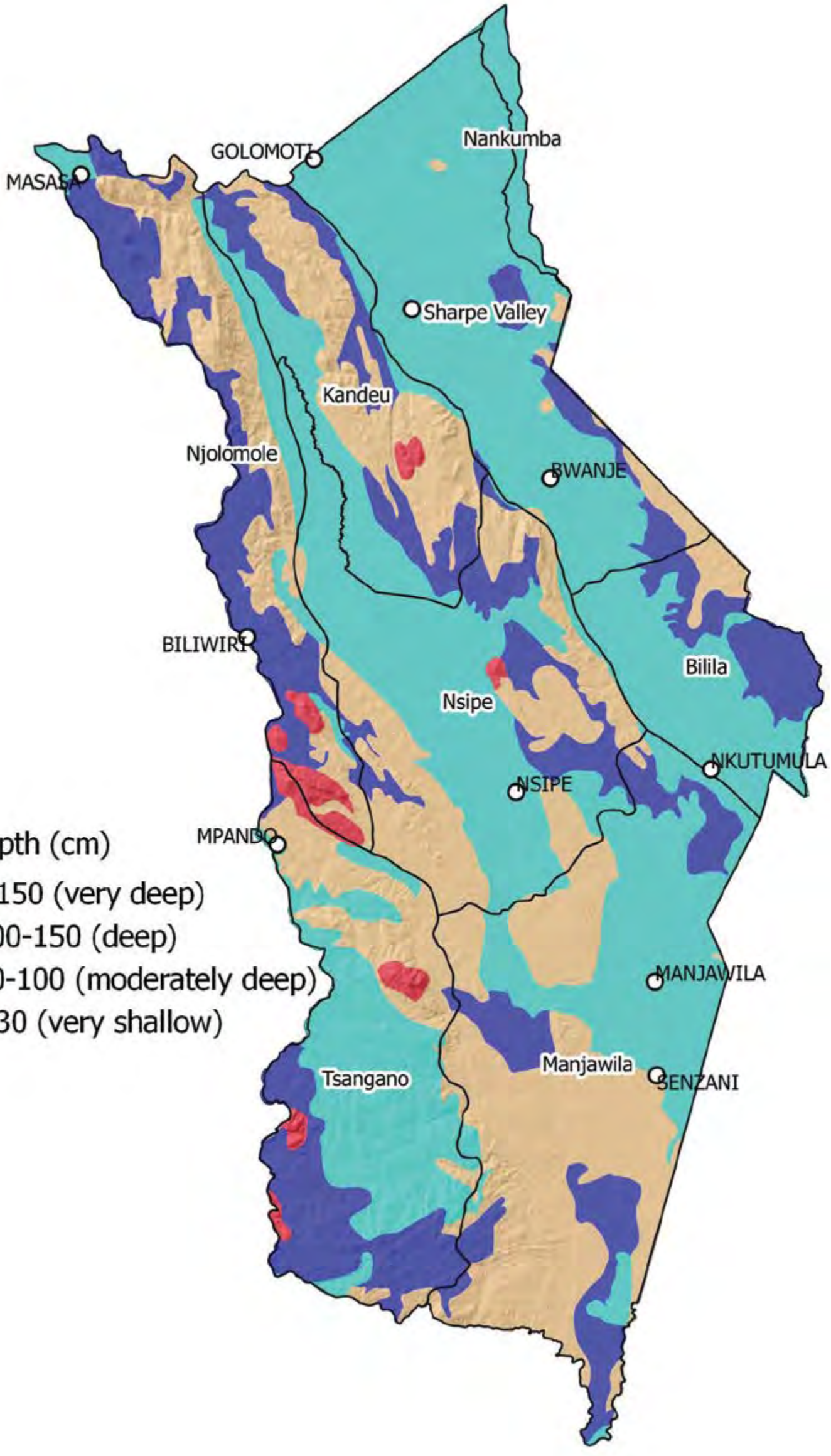
Deep soil in the plains at Kayimika at Hauya village



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Nankumba	Slight increase	1.1	6.2	669.8	654-681	Low risk
Sharpe Valley	Slight increase	1.7	54.5	681.8	641-723	Low risk
Njolomole	No change	17.1	94.9	738.8	726-753	Low risk
Kandeu	Slight increase	10.2	70.1	714.4	689-737	Low risk
Nsipe	No change	6.3	69.7	718.7	679-748	Low risk
Bilila	No change	2.2	48.7	668.3	640-695	Low risk
Manjawila	No change	5.8	61.6	751.2	689-779	Low risk
Tsangano	No change	12.4	70.5	763.2	745-772	Low risk

Features of soil erosion

Gully erosion at Zidana village

Sheet and gully erosion at Zidana village

Topsoil loss rate

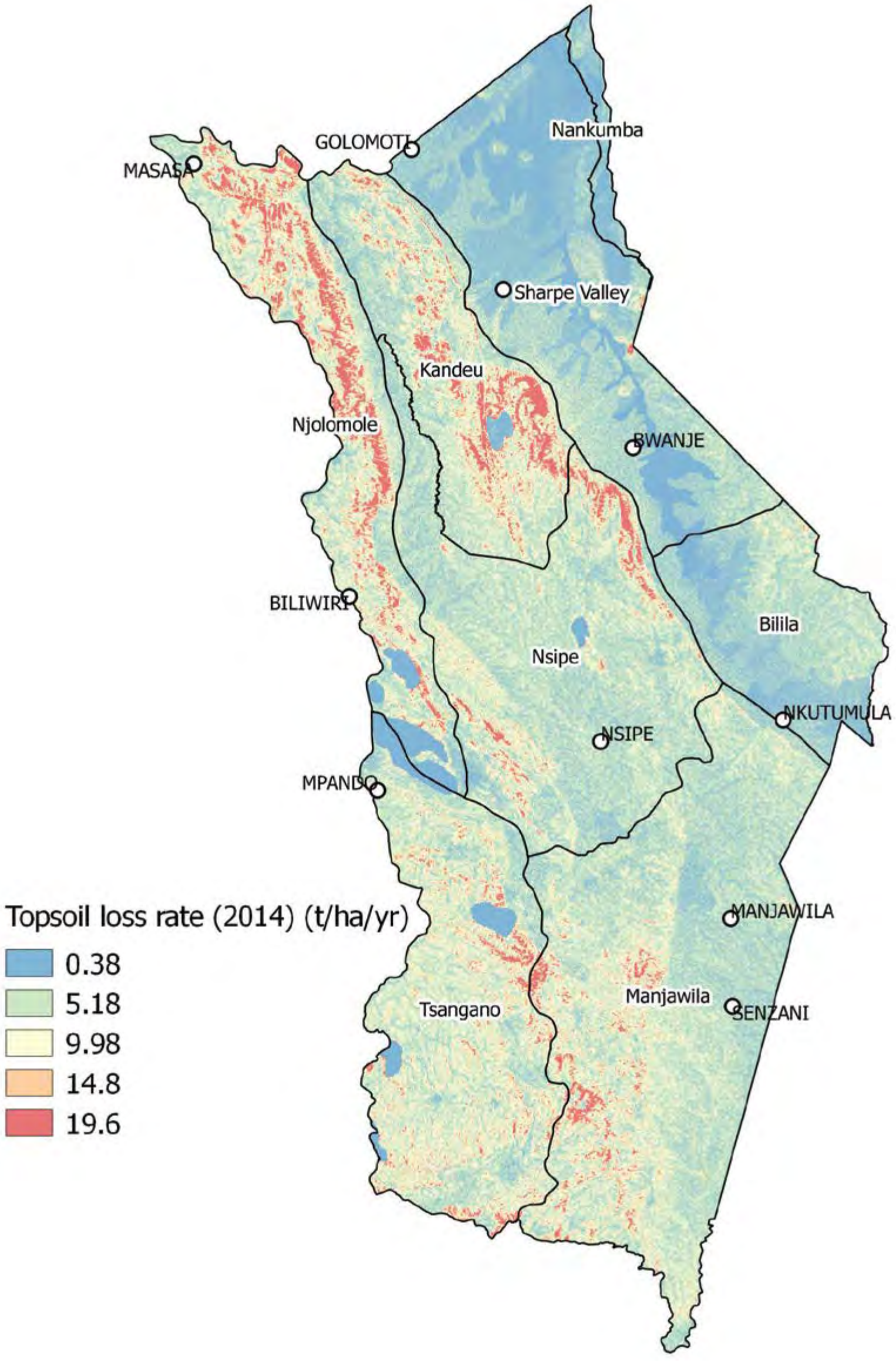
The mean district topsoil loss rate in 2014 was 4.53 t/ha/yr. The escarpments in the Rift Valley were the most affected areas. The main contributing factors for topsoil loss rates in these areas include the presence of vulnerable soils, shallow soil, and agricultural expansion in steep slopes. Sheet and rill erosion are the most common types of erosion in the district.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Nankumba	4.34	0.90	6.58
Sharpe Valley	1.72	0.38	9.04
Njolomole	3.59	0.17	19.48
Kandeu	7.83	1.12	18.54
Nsipe	4.19	0.49	14.60
Bilila	2.17	0.38	9.42
Manjawila	4.07	1.75	10.89
Tsangano	5.88	1.17	15.40

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Bilila	5.76	0.994	0.490	0.050	41.709	0.483	0.614	4.603	1.960	0.802	1.118	17.118	23.020
Kandeu	5.29	2.571	1.267	0.129	24.279	0.549	0.721	11.435	3.512	1.239	1.654	32.494	35.037
Manjawila	5.53	1.231	0.607	0.062	41.682	0.353	0.679	10.788	4.060	0.848	0.742	8.592	27.782
Njolomole	5.06	1.832	0.903	0.092	61.358	0.515	0.652	5.694	2.071	1.025	1.807	21.923	40.640
Sharp Valley	5.63	2.501	1.233	0.123	115.086	10.306	1.156	8.039	2.147	1.106	2.231	17.195	38.969
Tsangano	5.21	2.343	1.155	0.117	55.781	0.286	0.651	4.495	2.281	1.400	1.265	24.655	30.332
Nankumba	6.32	2.869	1.414	0.143	107.727	1.714	0.477	15.075	4.815	1.703	0.708	32.684	32.365
Nsipe	4.49	1.733	0.854	0.087	69.346	0.279	0.644	5.115	2.398	1.545	0.698	30.771	25.916



Source of base map: Government of Malawi

Typical croplands in July-August period in 2017

Cropland at Kadungu in Mwanza EPA

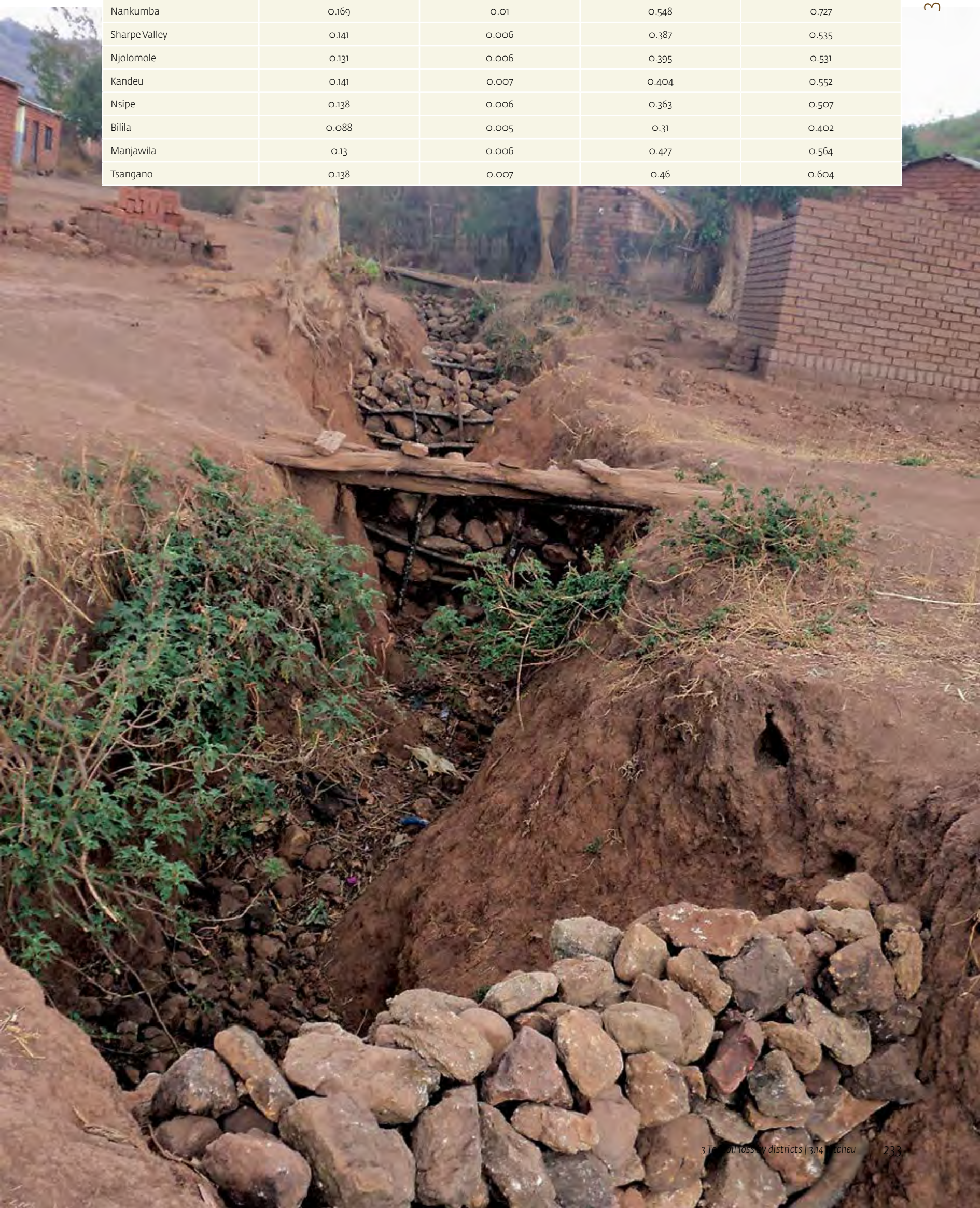
Cropland at Phanga in Sharp Valley EPA

Cropland at Laiti in Tsangano EPA

Cropland at Daudi in Njolomole EPA

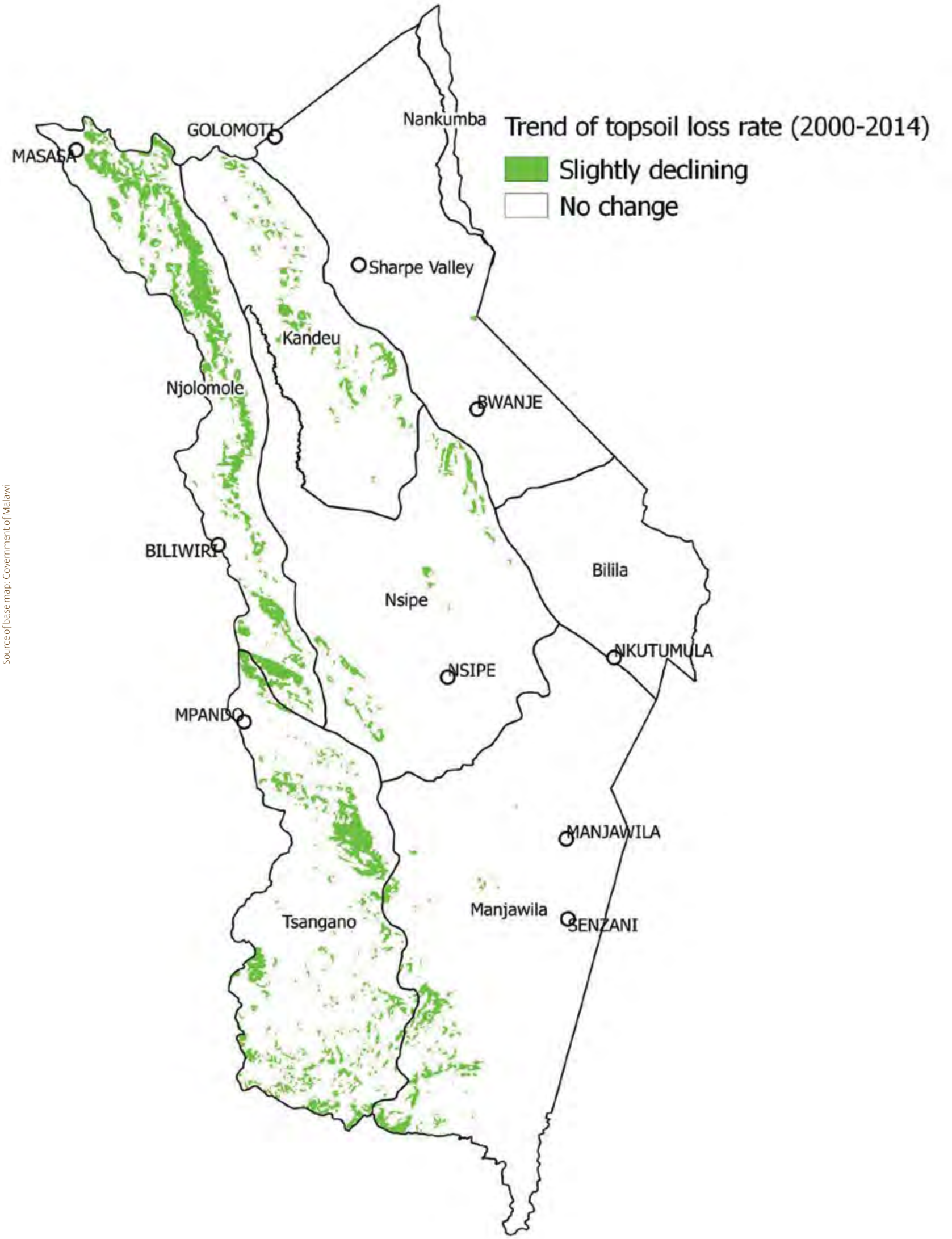
Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Nankumba	0.169	0.01	0.548	0.727
Sharpe Valley	0.141	0.006	0.387	0.535
Njolomole	0.131	0.006	0.395	0.531
Kandeu	0.141	0.007	0.404	0.552
Nsipe	0.138	0.006	0.363	0.507
Bilila	0.088	0.005	0.31	0.402
Manjawila	0.13	0.006	0.427	0.564
Tsangano	0.138	0.007	0.46	0.604

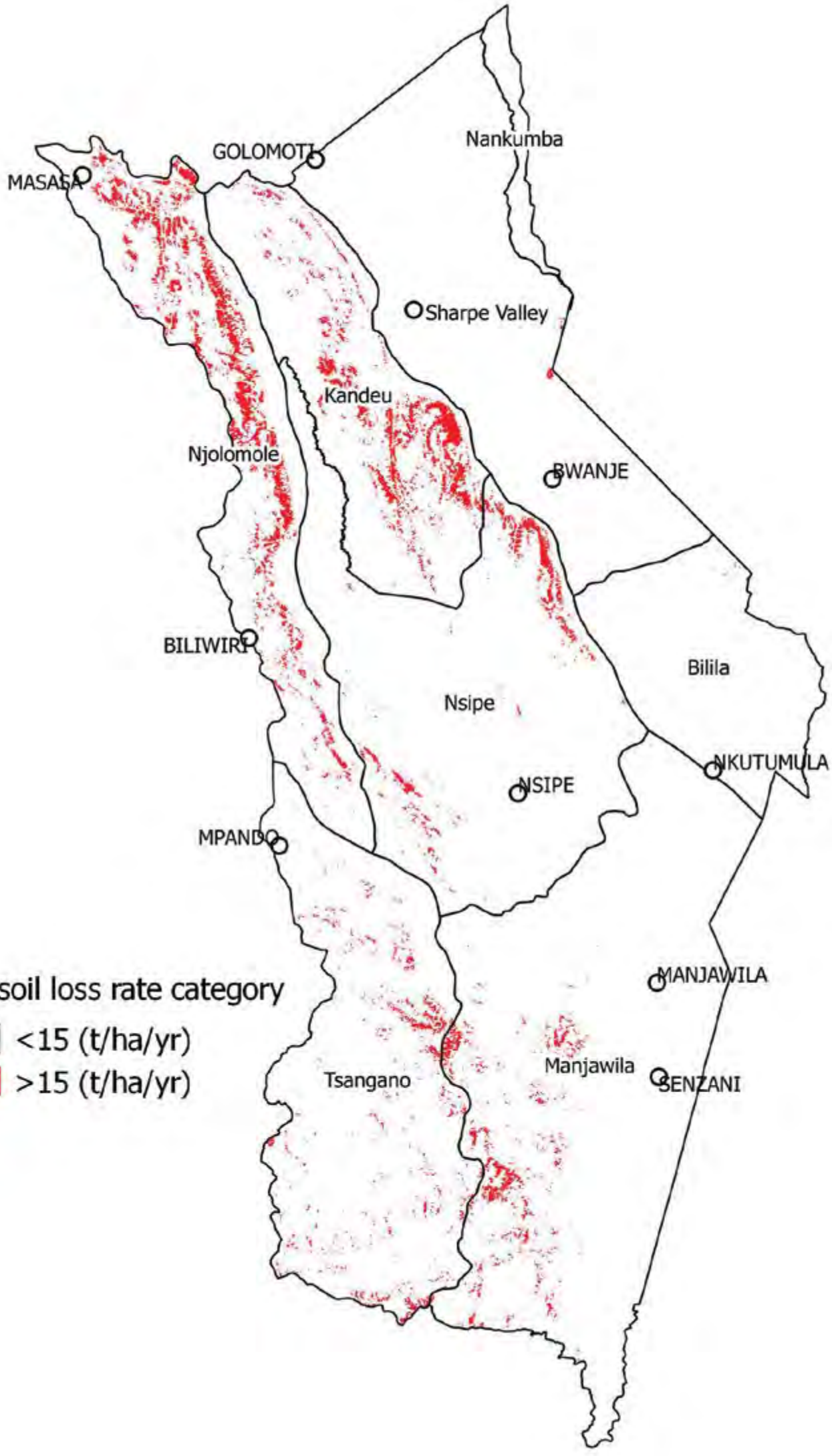


Topsoil loss between 2000 and 2014

There was a significant decline in topsoil loss rates in the escarpments between 2000 and 2014. These escarpments were also the same spots of with high soil loss rates in the district.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

Residue incorporation agriculture at Njolomole

Gully erosion control at Chilobwe

Manure incorporation at Chilobwe in Njolomole EPA

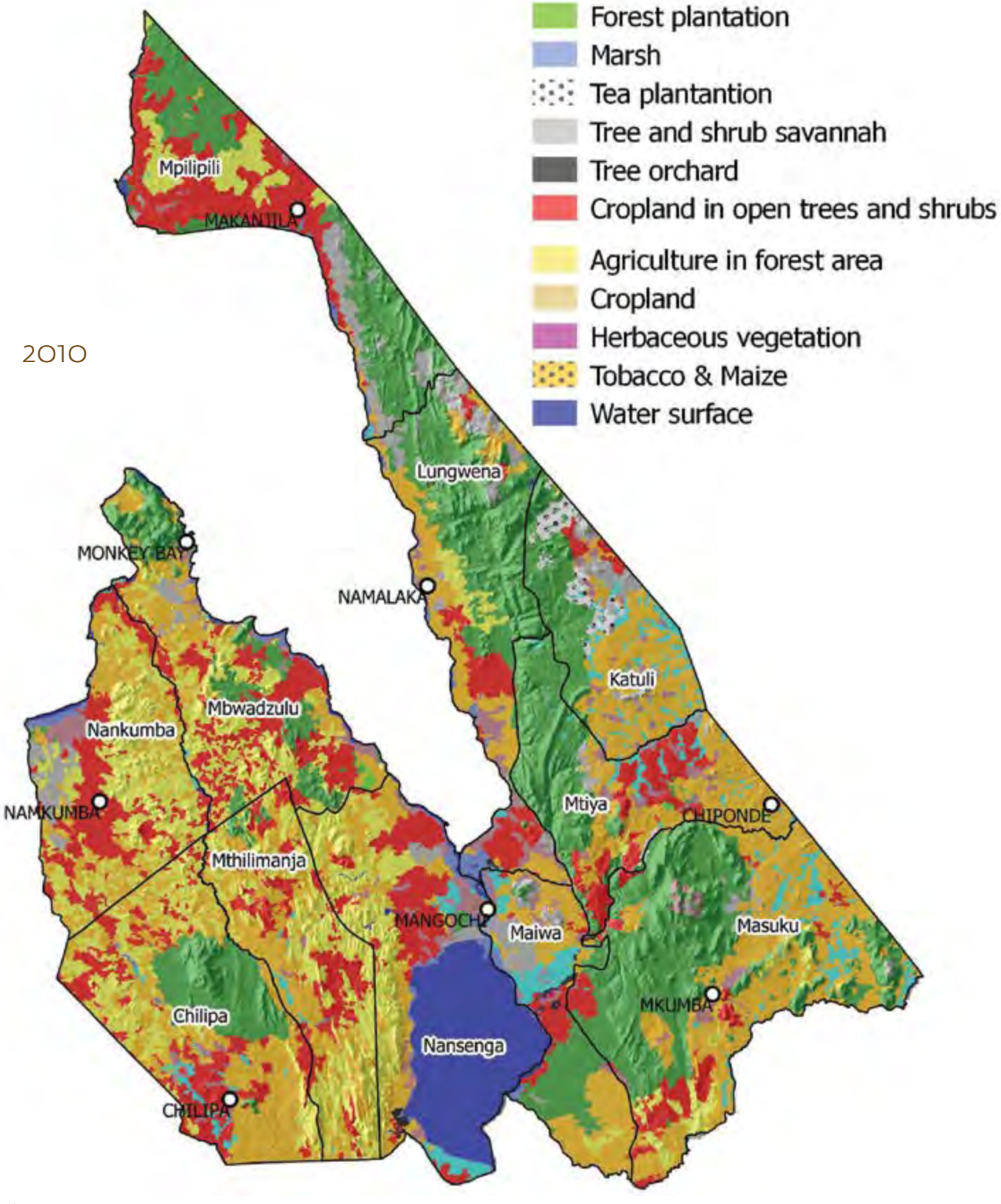
Cropland at Daudi in Njolomole EPA

Cropland at Kadungu in Mwanza EPA

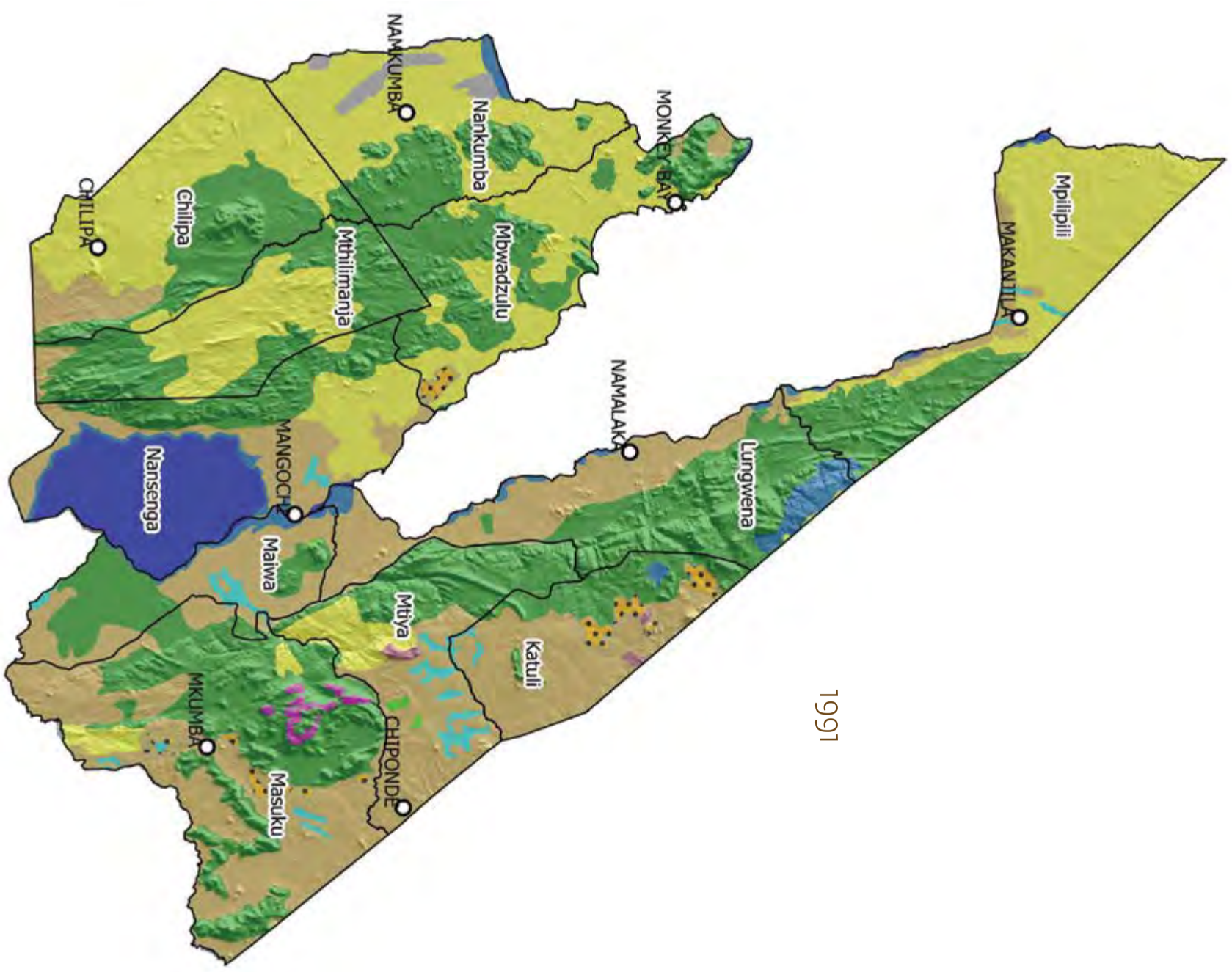
Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are smallholder croplands, natural forests, urban/settlements, cropland estates, and pockets of replanted forest. There was a significant decline of the natural forest cover in Mthilimanja, Nansenga, Nankumba, and Mbwadzulu EPAs. The forest cover decline corresponded with increase in croplands in the same period and areas.

Major land cover/use types in 2010 and 1991



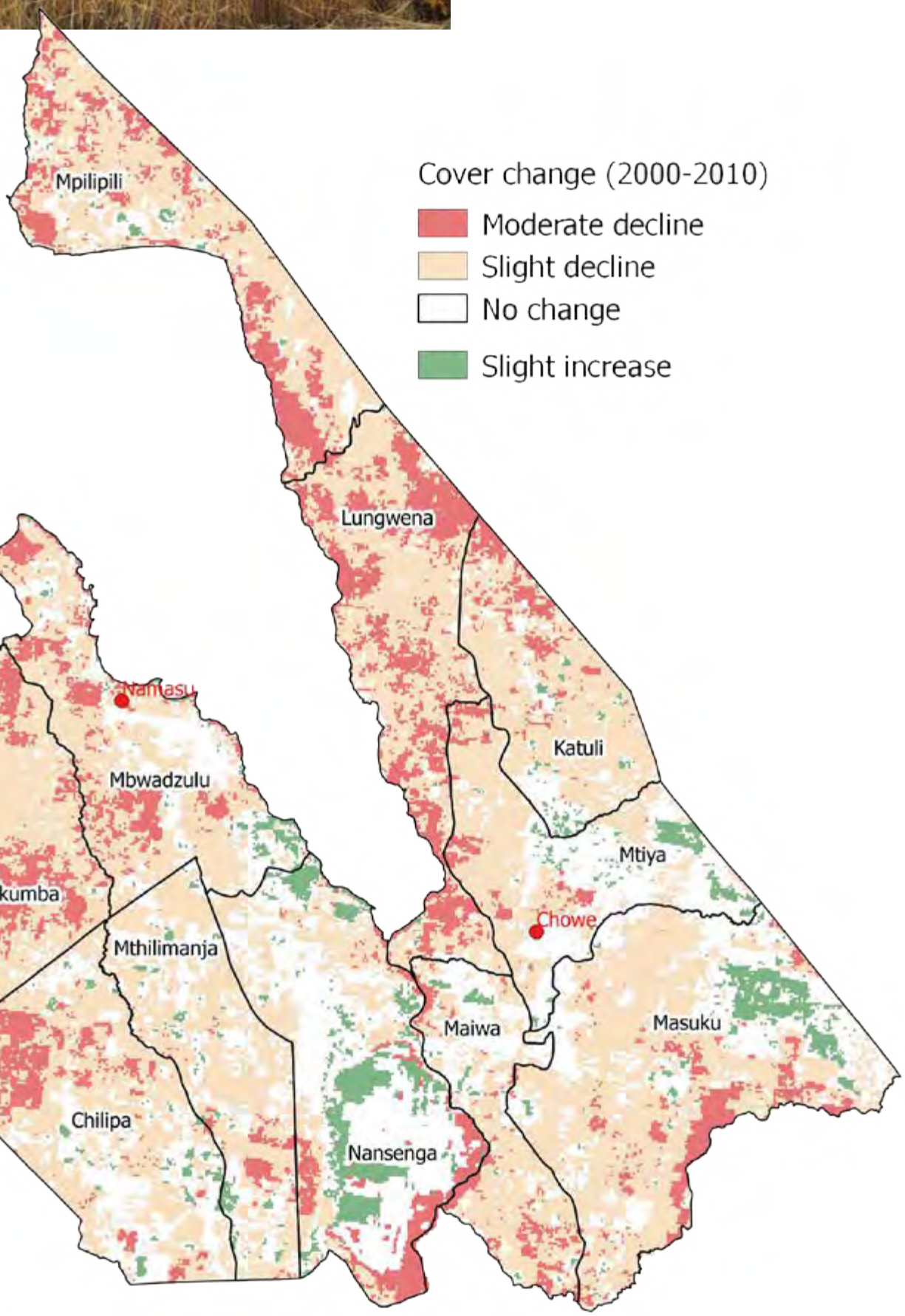
Source of base map: Government of Malawi



Source of base map: Government of Malawi

3.15 Mangochi

Example of land cover types at Chowe



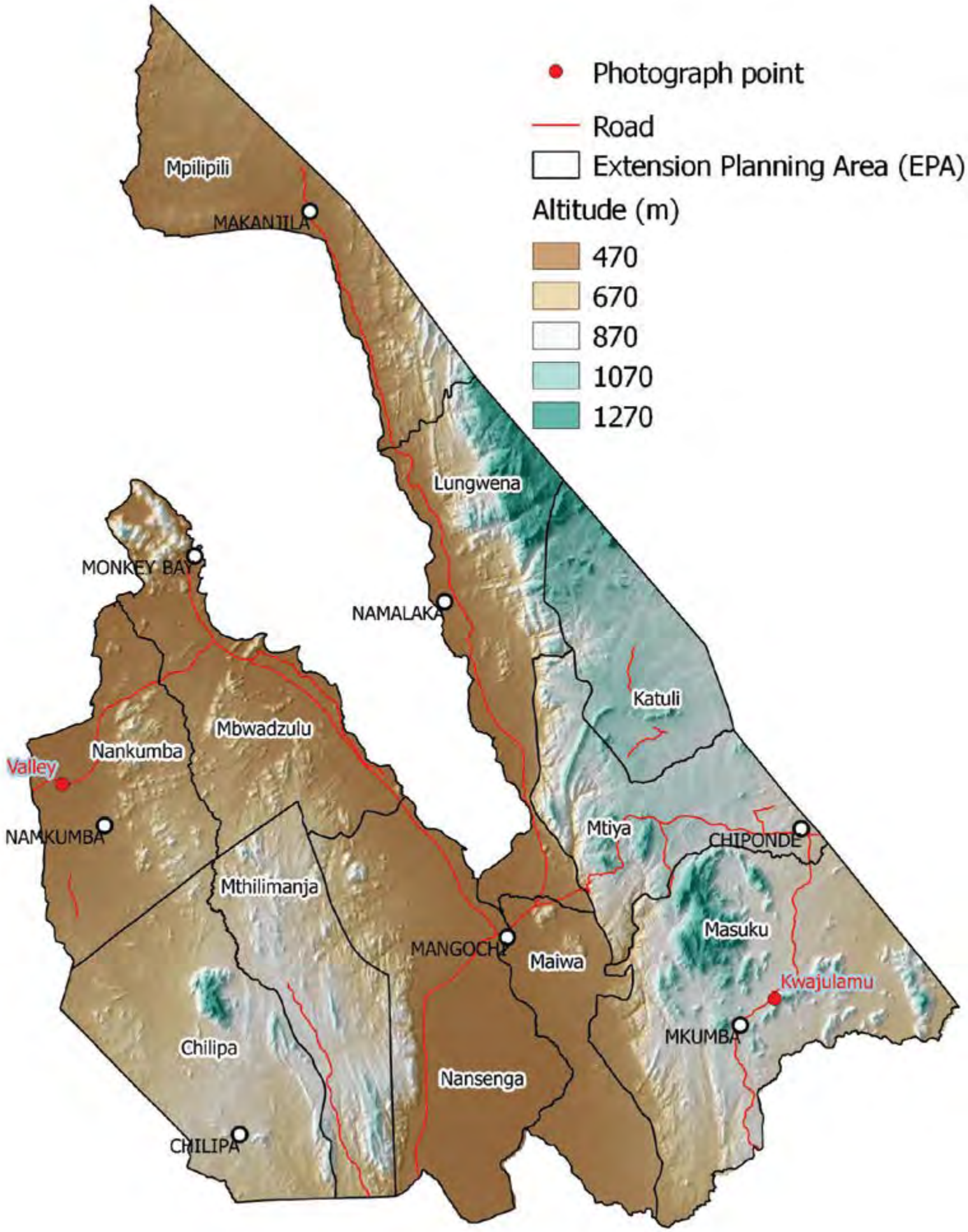
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

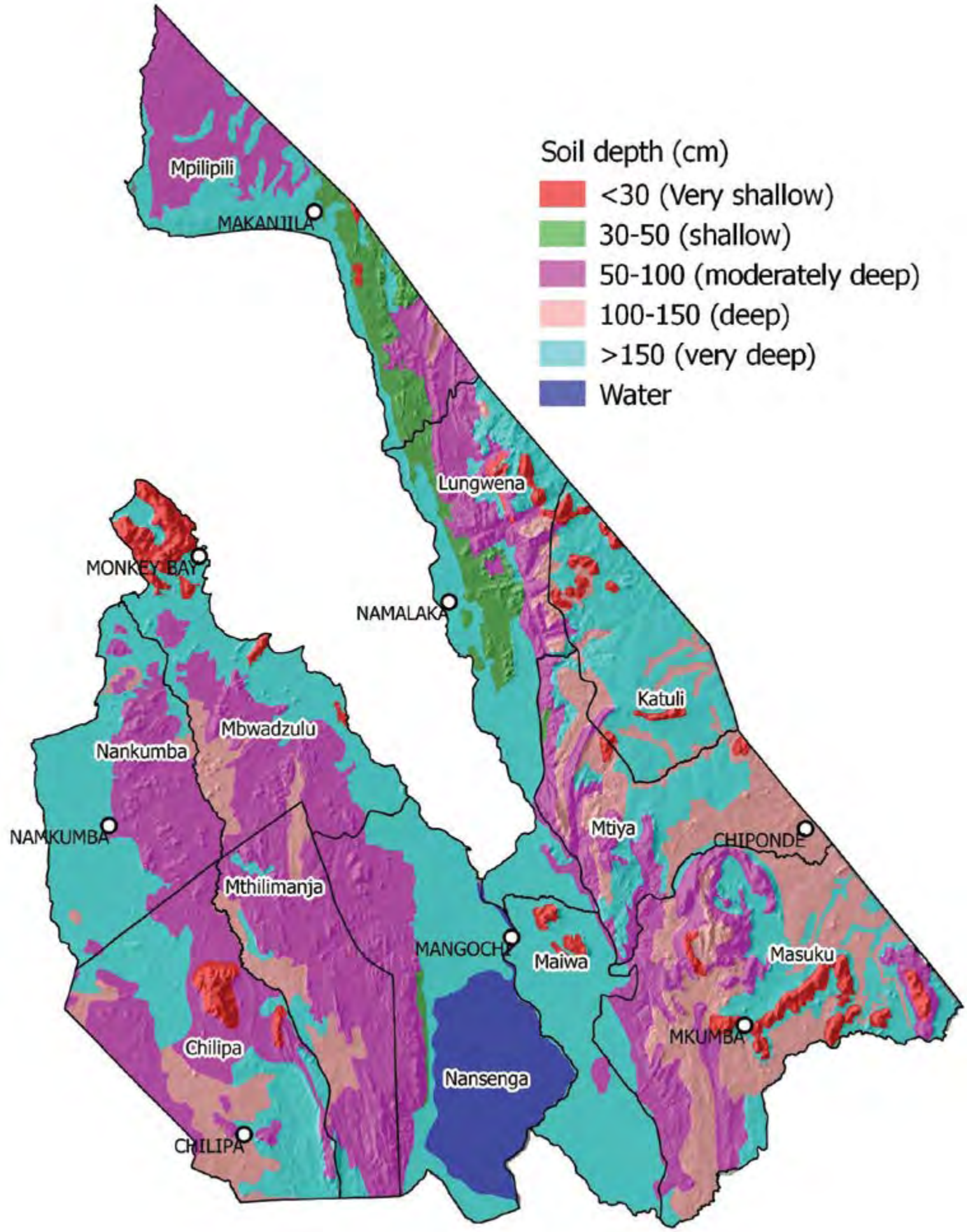
Mangochi is divided into two by Lake Malawi and Lake Malombe. Two escarpments are on both sides of these lakes. The escarpments have steep slopes and shallow soil. A rather flat terrain with deep soil can be found away from these escarpments. The shallow soil are quite vulnerable to soil erosion especially.

Steep slope, rocky and shallow soil at Kwajulamu

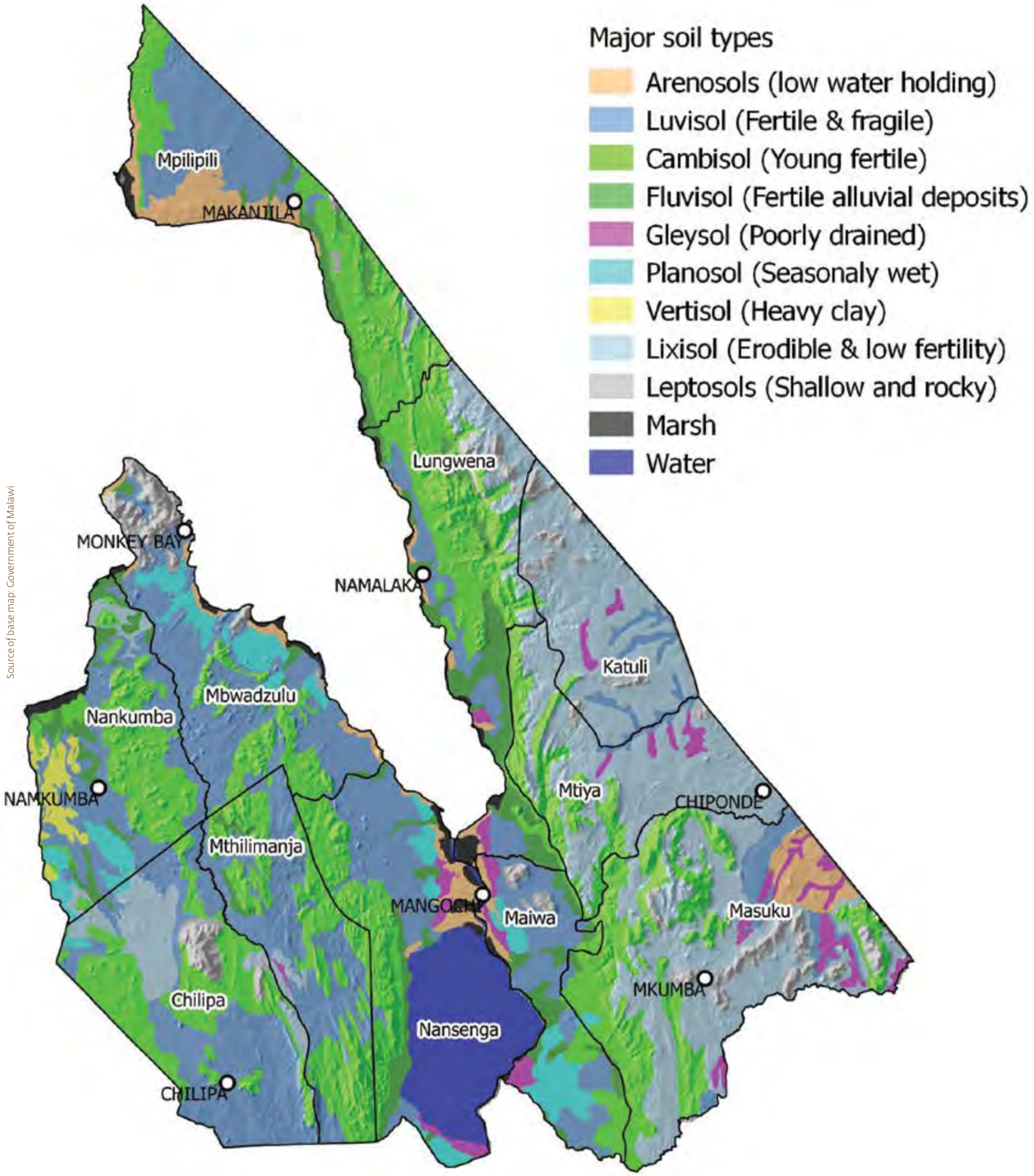
Deep soil in a flat area in Bwanje valley



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Mpilipili	Slight decline	6.5	93.0	768	713-797	Moderate risk
Mbwadzulu	Moderate to slight decline	9.7	90.3	629	575-707	Low risk
Katuli	Slight decline	7.8	98.0	634	584-708	Low risk
Nankumba	Moderate to slight decline	5.6	88.5	644	601-680	Low to Moderate risk
Mtiya	Slight decline	11.9	97.3	581	561-628	Low risk
Nansenga	Moderate to slight decline	4.5	85.2	575	558-634	Low to Moderate risk
Mthilimanja	Moderate to slight decline	10.6	79.3	585	564-628	Moderate risk
Masuku	Slight decline	11.7	93.9	574	561-645	Low risk
Chilipa	Slight decline	7.3	88.1	619	584-663	Low risk
Maiwa	Slight decline	3.0	71.7	580	558-640	Low to Moderate risk
Lungwena	Slight decline	12.1	94.1	653	559-744	Low risk

Features of soil erosion

Sheet and gully erosion at Kela Village

Sheet and gully erosion at Matui Village

Topsoil loss rate

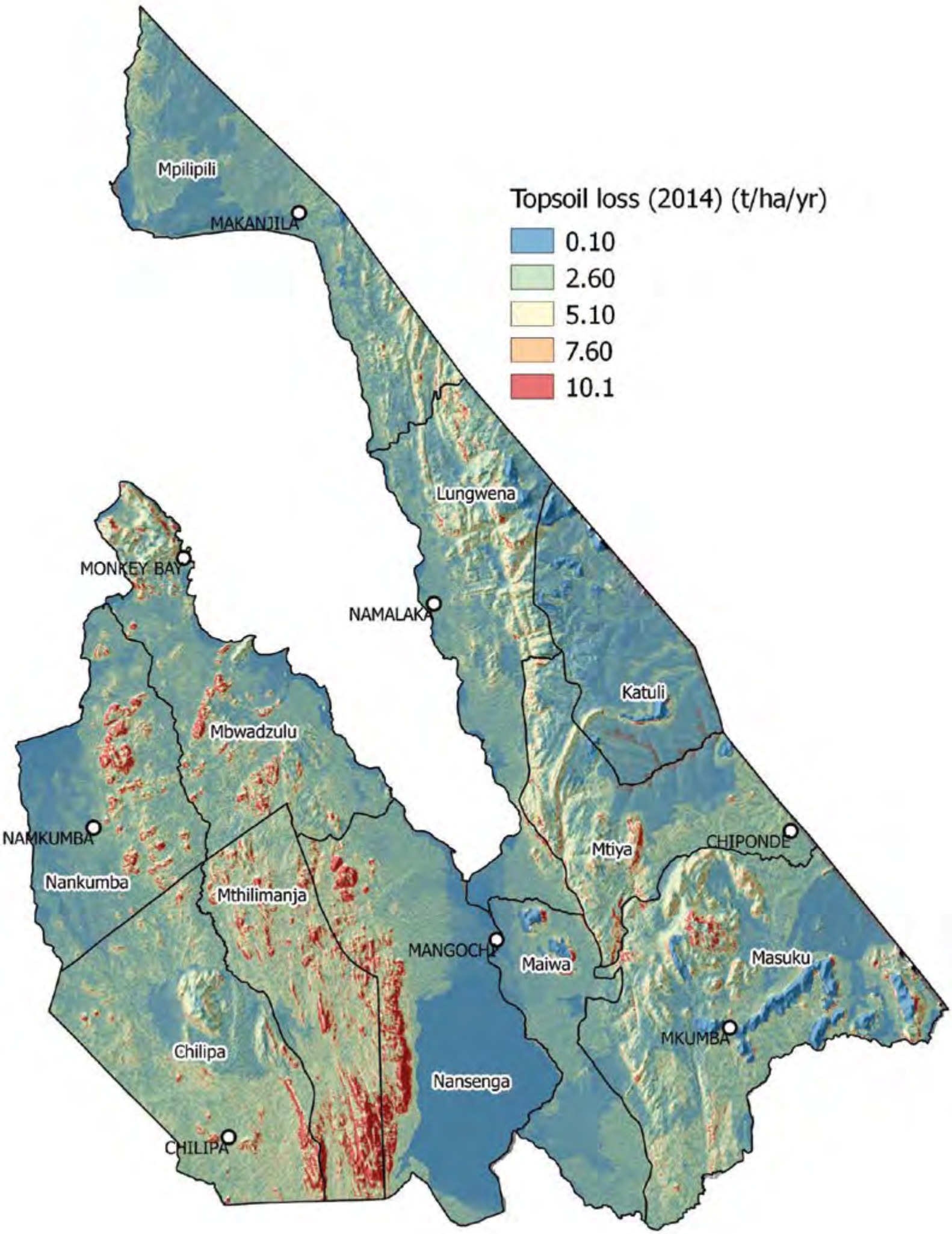
The mean district topsoil loss rate in 2014 was 1.44 t/ha/yr. Mthilimanja EPA had indicaTIons of the highest soil loss rates. The main contributing factors for the soil loss rates in this area include agricultural expansion into vulnerable soils especially in steep slopes that have low vegetative cover.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Mpilipili	1.33	0.22	7.21
Mbwadzulu	1.15	0.38	9.09
Katuli	0.42	0.11	2.22
Nankumba	1.21	0.82	9.03
Mtiya	1.14	0.16	8.63
Nansenga	1.63	0.38	8.71
Mthilimanja	4.79	0.78	9.92
Masuku	0.64	0.19	7.82
Chilipa	1.35	0.51	6.26
Maiwa	1.22	0.32	3.32
Lungwena	1.58	0.21	8.25

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chilipa	6.14	1.478	0.728	0.075	25.194	0.709	0.602	4.105	1.343	0.731	2.194	13.166	12.069
Katuli	5.21	3.238	1.596	0.163	44.628	0.525	0.632	3.777	1.161	0.942	2.823	19.020	17.221
Lungwena	5.32	2.585	1.274	0.129	57.572	0.448	0.503	2.656	0.939	0.802	2.802	29.139	15.410
Maiwa	5.35	1.790	0.882	0.089	34.635	0.333	0.597	3.623	1.196	0.710	1.064	21.737	6.992
Masuku	5.42	1.803	0.888	0.090	65.839	0.641	0.570	3.945	1.303	0.551	1.652	9.915	9.088
Mbwadzulu	5.48	1.179	0.582	0.060	79.423	0.718	0.563	4.569	1.508	1.289	3.708	29.196	20.395
Mpilipili	5.82	2.486	1.225	0.124	26.652	0.545	0.544	4.212	1.353	1.107	2.513	26.922	13.232
Mthilamanja	5.34	1.534	0.757	0.078	27.417	0.542	0.555	3.733	1.204	0.763	1.719	19.520	14.159
Mtiya	5.25	2.063	1.016	0.103	38.796	0.448	0.550	3.230	1.009	0.811	2.358	22.736	12.128
Namkumba	6.19	2.305	1.135	0.115	99.070	0.737	0.510	3.714	1.265	1.431	4.294	25.764	23.617
Nansenga	5.92	1.264	0.623	0.062	68.791	0.509	0.582	3.878	1.221	0.780	2.088	15.880	11.469



Source of base map: Government of Malawi

Typical croplands in July-August period in 2017

Cropland at Mpopo in Chilipa EPA

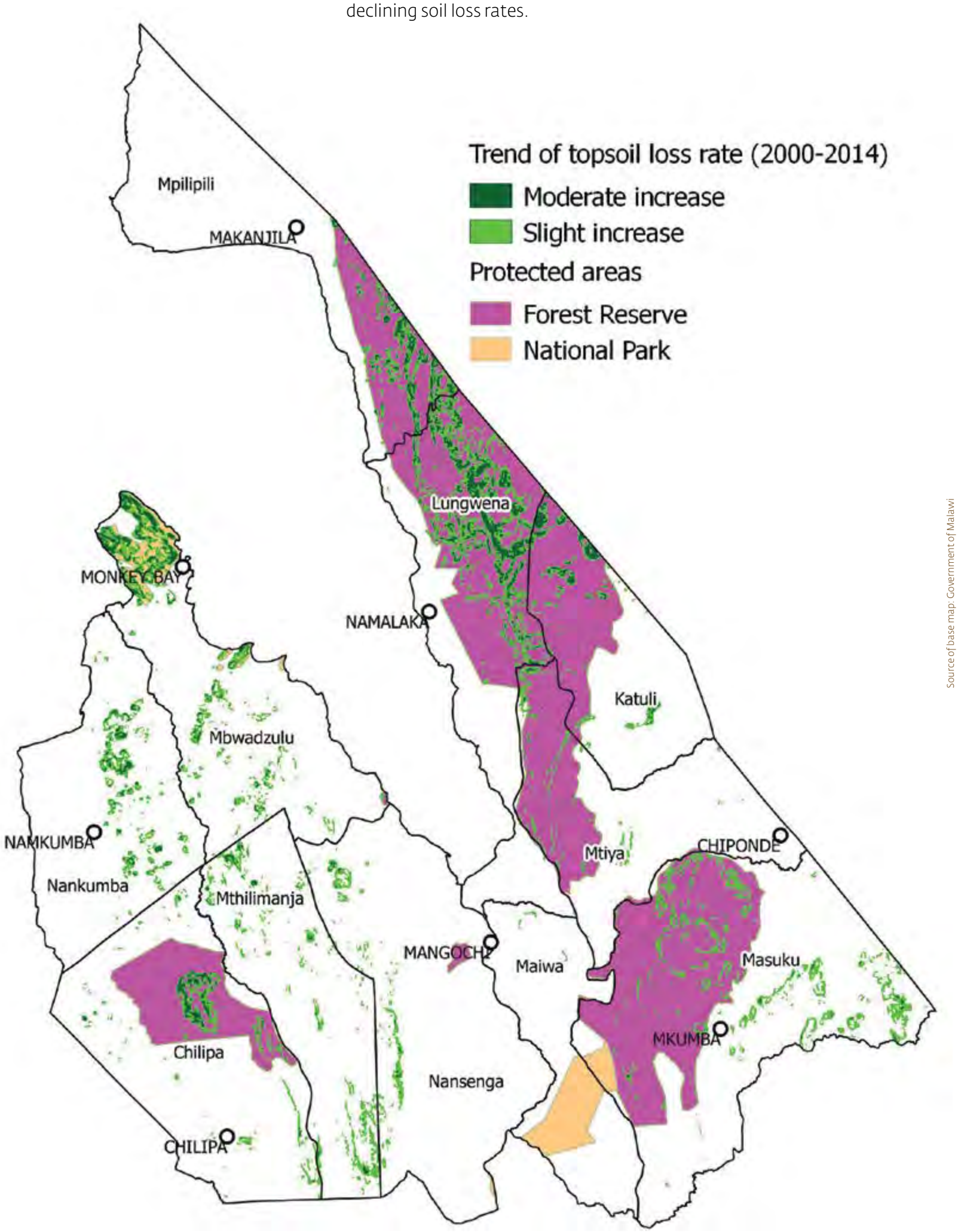
Cropland at Changale in Nansenga EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Mpilipili	0.179	0.028	0.44	0.646
Mbwadzulu	0.154	0.028	0.529	0.711
Katuli	0.138	0.017	0.324	0.479
Nankumba	0.169	0.01	0.548	0.727
Mtiya	0.162	0.022	0.385	0.569
Nansenga	0.081	0.008	0.299	0.388
Mthilimanja	0.177	0.008	0.537	0.722
Masuku	0.114	0.007	0.338	0.459
Chilipa	0.126	0.007	0.418	0.551
Maiwa	0.158	0.006	0.432	0.597
Lungwena	0.141	0.014	0.412	0.567

Topsoil loss trend between 2000 and 2014

The trend of topsoil loss rates in the District seem to have been declining between 2000 and 2014. The high numbers of forest reserves and two national parks (Lake Malawi and Liwonde) may have contributed to the declining soil loss rates.



Source of base map: Government of Malawi

Some of the soil and water conservation measures

Maintaining natural vegetative over in shallow soil at Namasu

Maintaining vegetative cover at Chamtulo

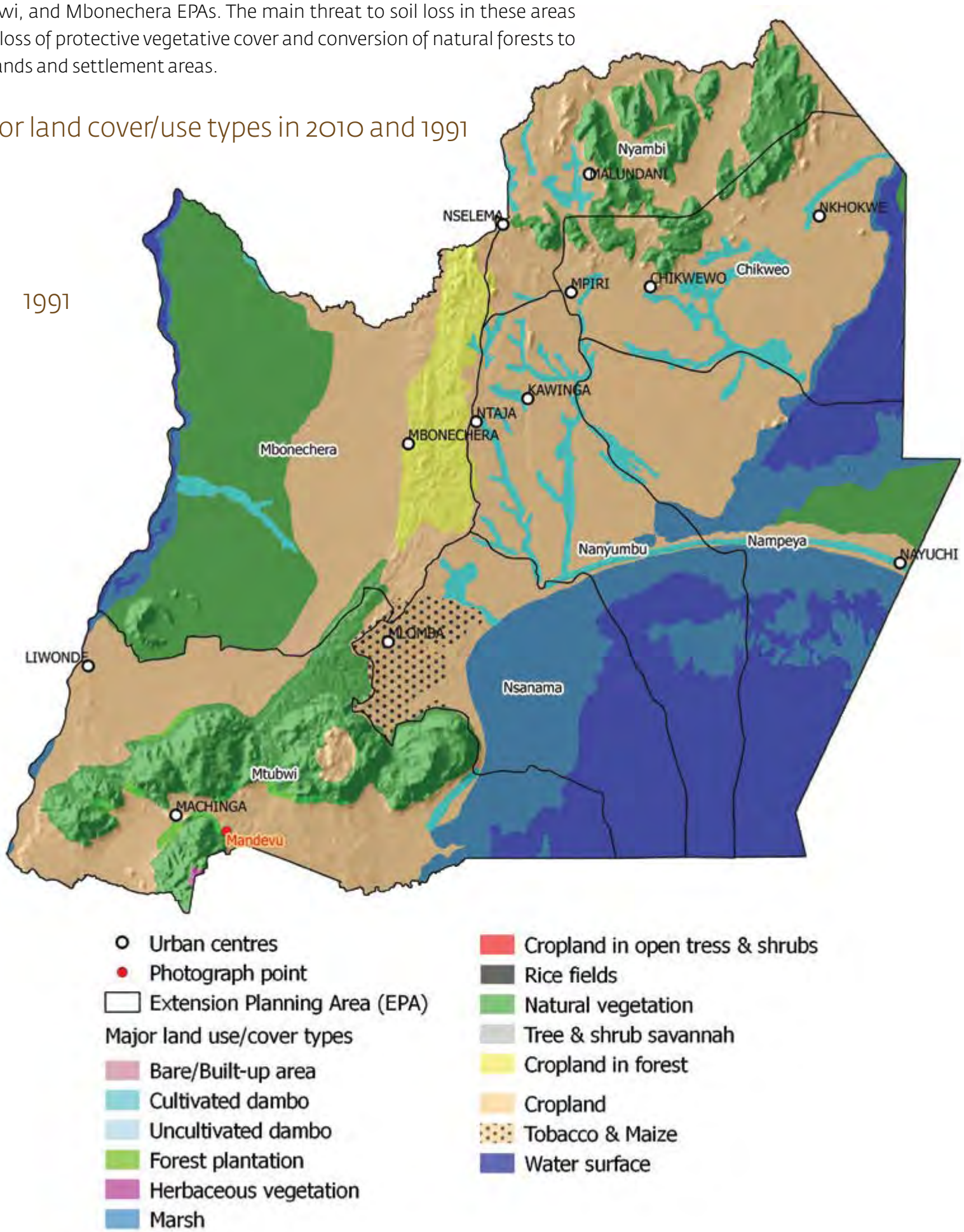
Combination of contour ridges and residue incorporation at Chamtulo in Nankumba EPA

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are smallholder croplands, estates, natural forests, and urban/ settlements. There were significant changes in proportion of these land use types between 1991 and 2010, notably the decline of natural forest cover in Nyambi, Nampeya (around Nayuchi), Mtubwi, and Mbonechera EPAs. The main threat to soil loss in these areas is the loss of protective vegetative cover and conversion of natural forests to croplands and settlement areas.

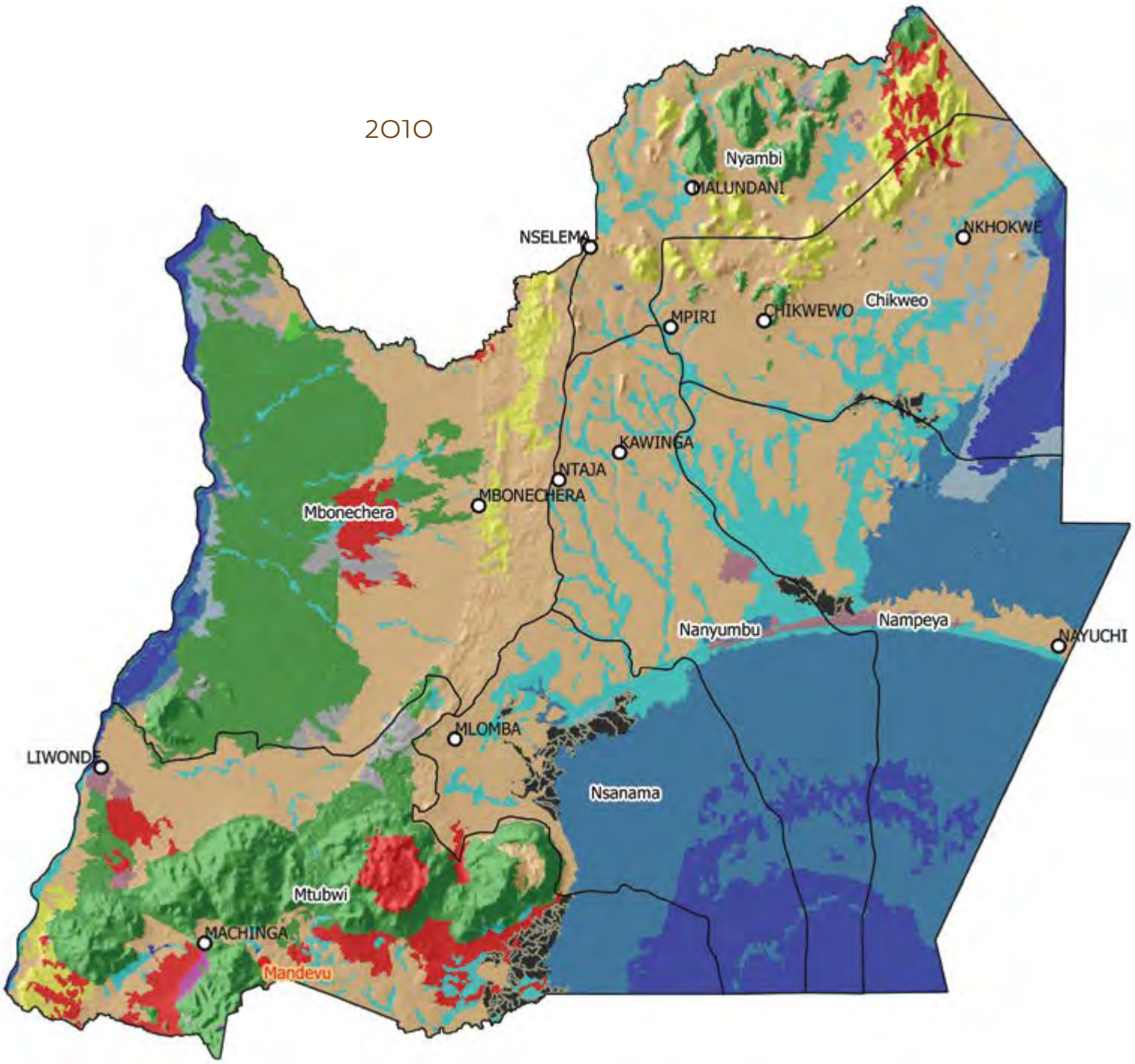
Major land cover/use types in 2010 and 1991

1991



Source of base map: Government of Malawi

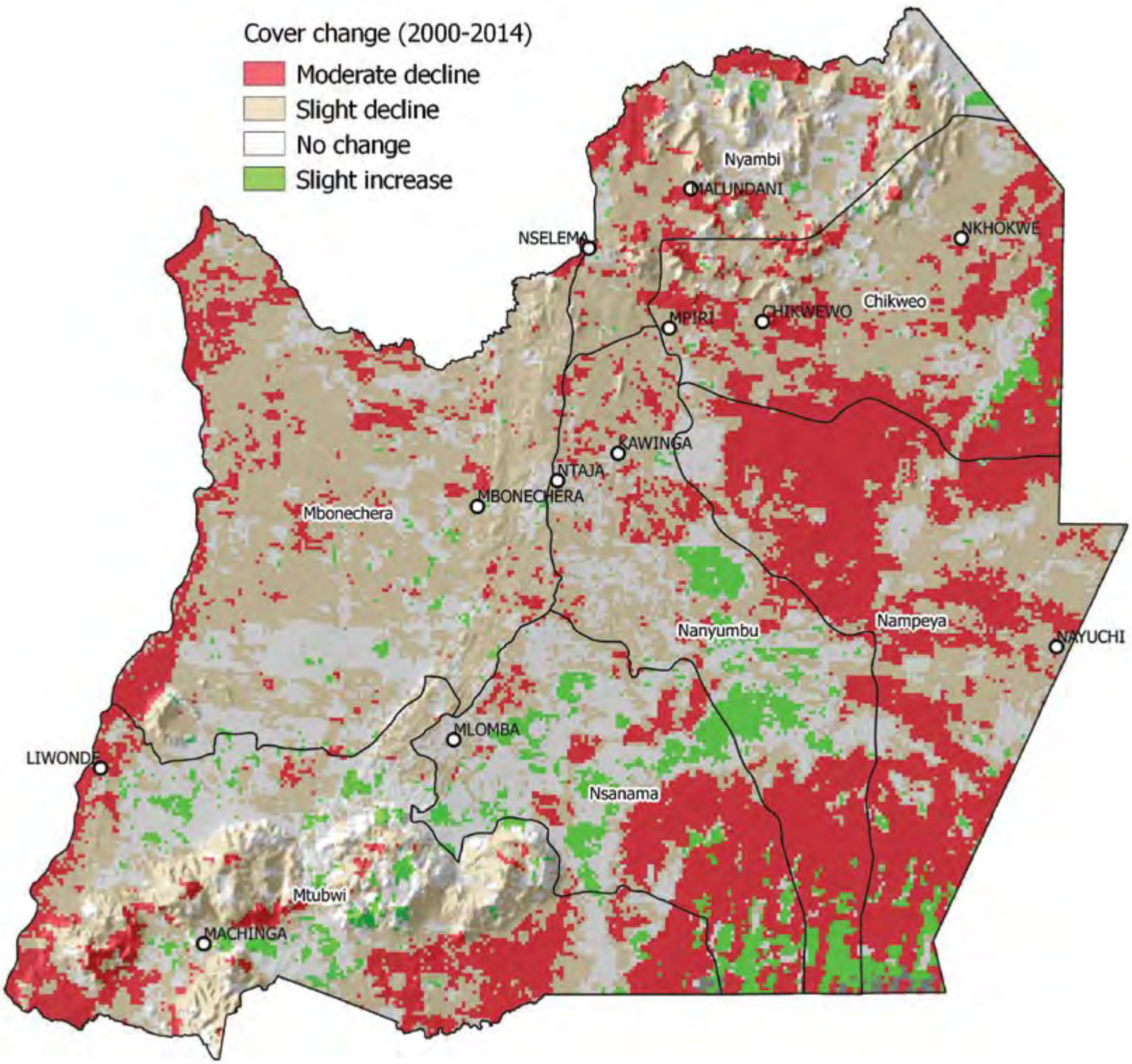
2010



Source of base map: Government of Malawi

Example of land cover types at Mandevu

Vegetaton cover change



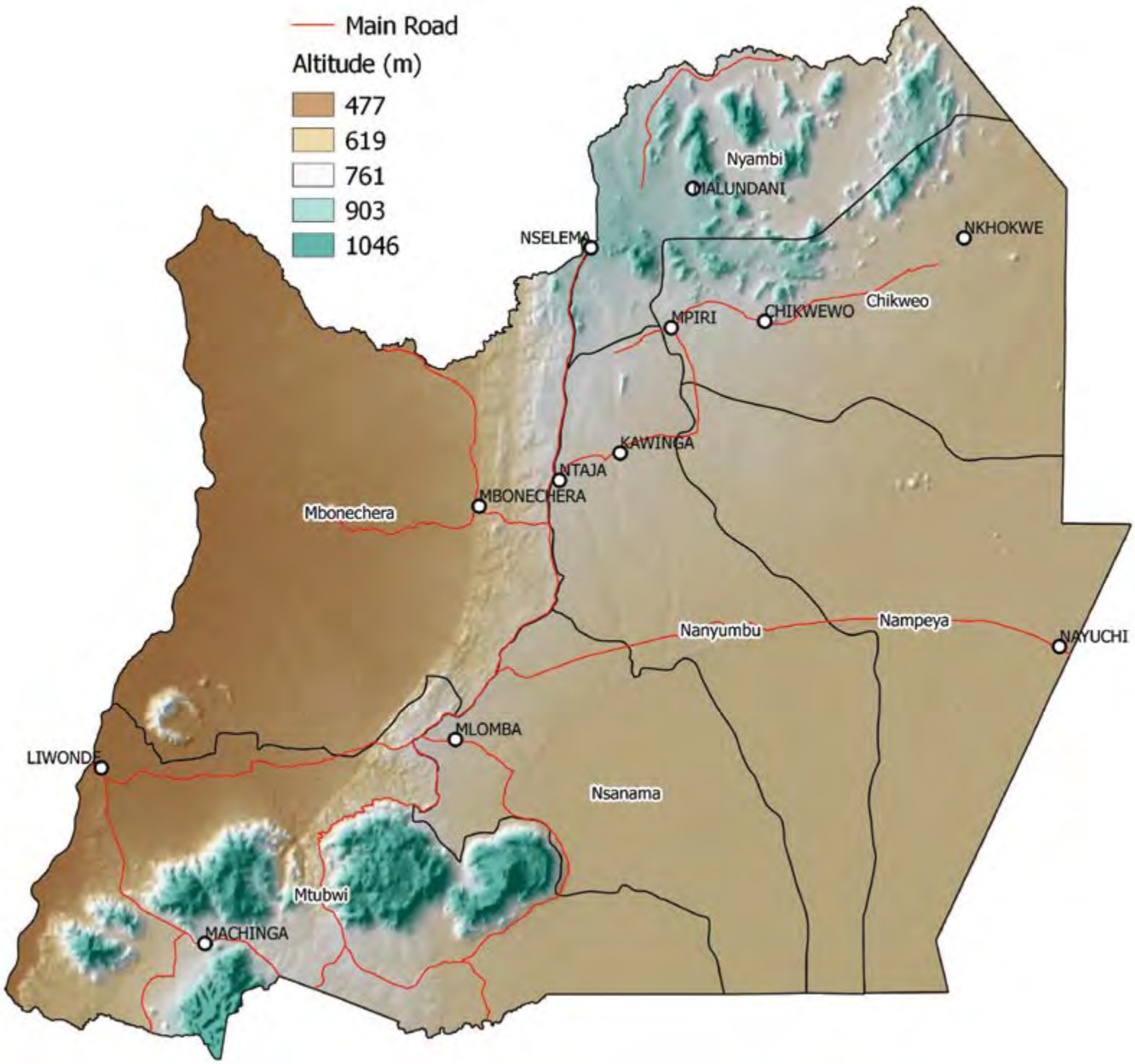
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

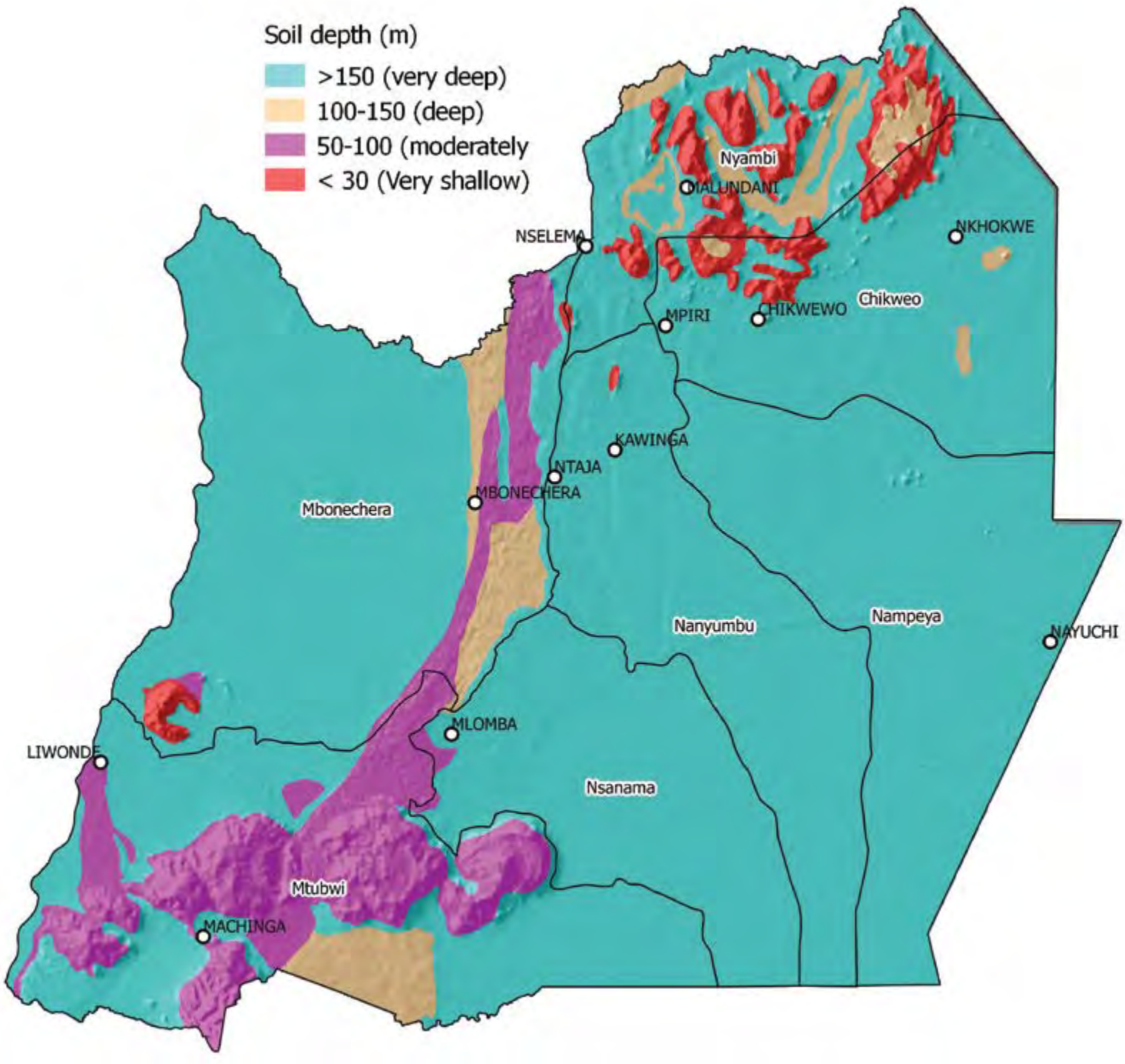
The south and north of Machinga have the only mountainous areas in the District. Other places are flat. The mountains have steep slopes and shallow soil. The southern mountains have shallow Cambisol while the northern mountains have Lixisol.

Steep slopes and shallow soil on mountains at Ndaje

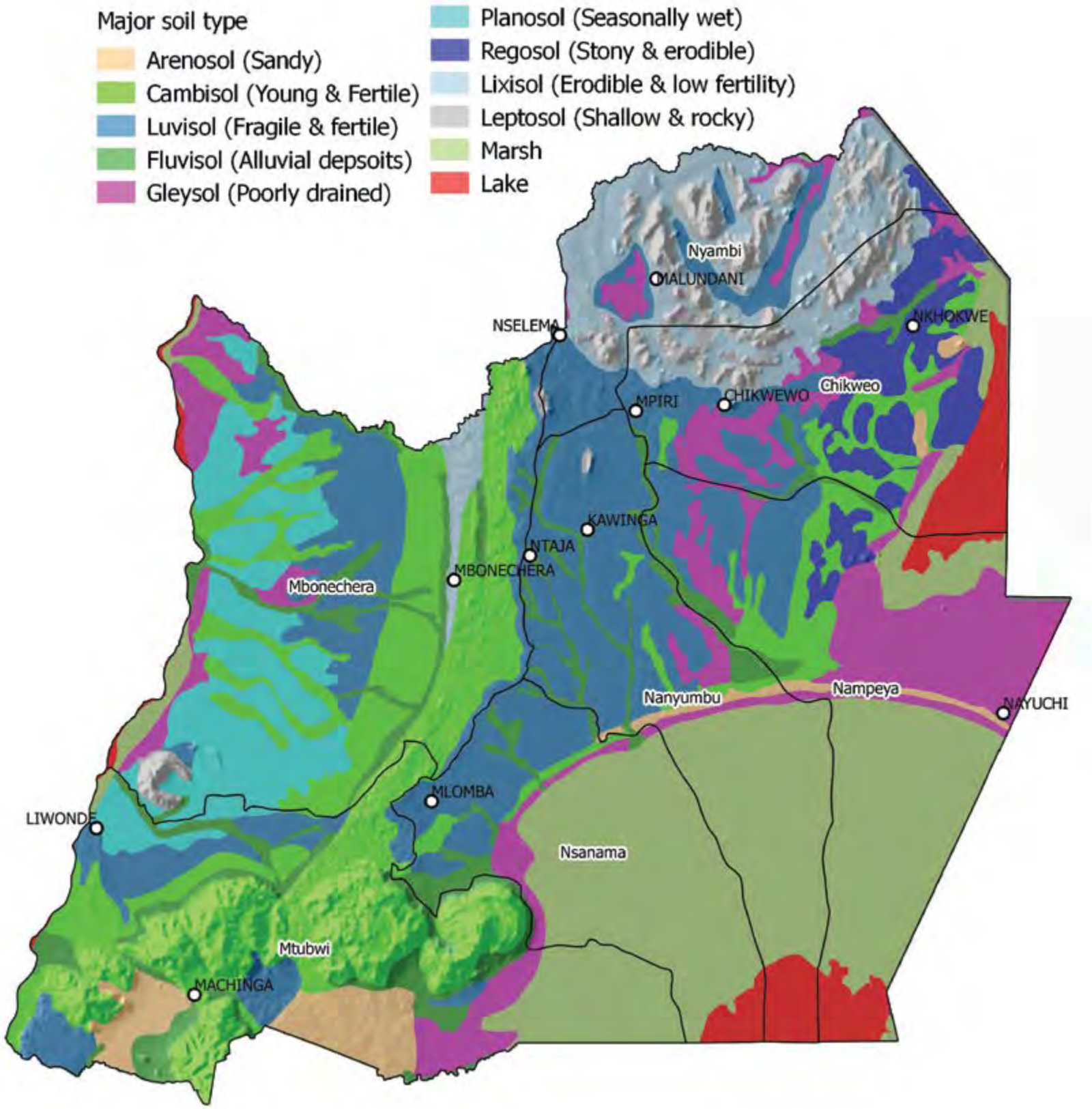
Shallow and stony soil at Mandevu



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Nyambi	Moderate	6.32	51.4	589	569-645	Low risk
Chikweo	Moderate	2.37	48.1	618	578-665	Low risk
Mbonechera	Moderate	1.75	35.2	700	593-798	Low risk
Nanyumbu	Moderate	0.85	25.4	745	630-865	Low risk
Nampeya	Moderate	0.90	34.9	728	647-861	Low risk
Nsanama	Moderate	0.82	20.0	814	744-870	Low risk
Mtubwi	Moderate	6.62	55.4	833	762-874	Low risk

Features of soil erosion

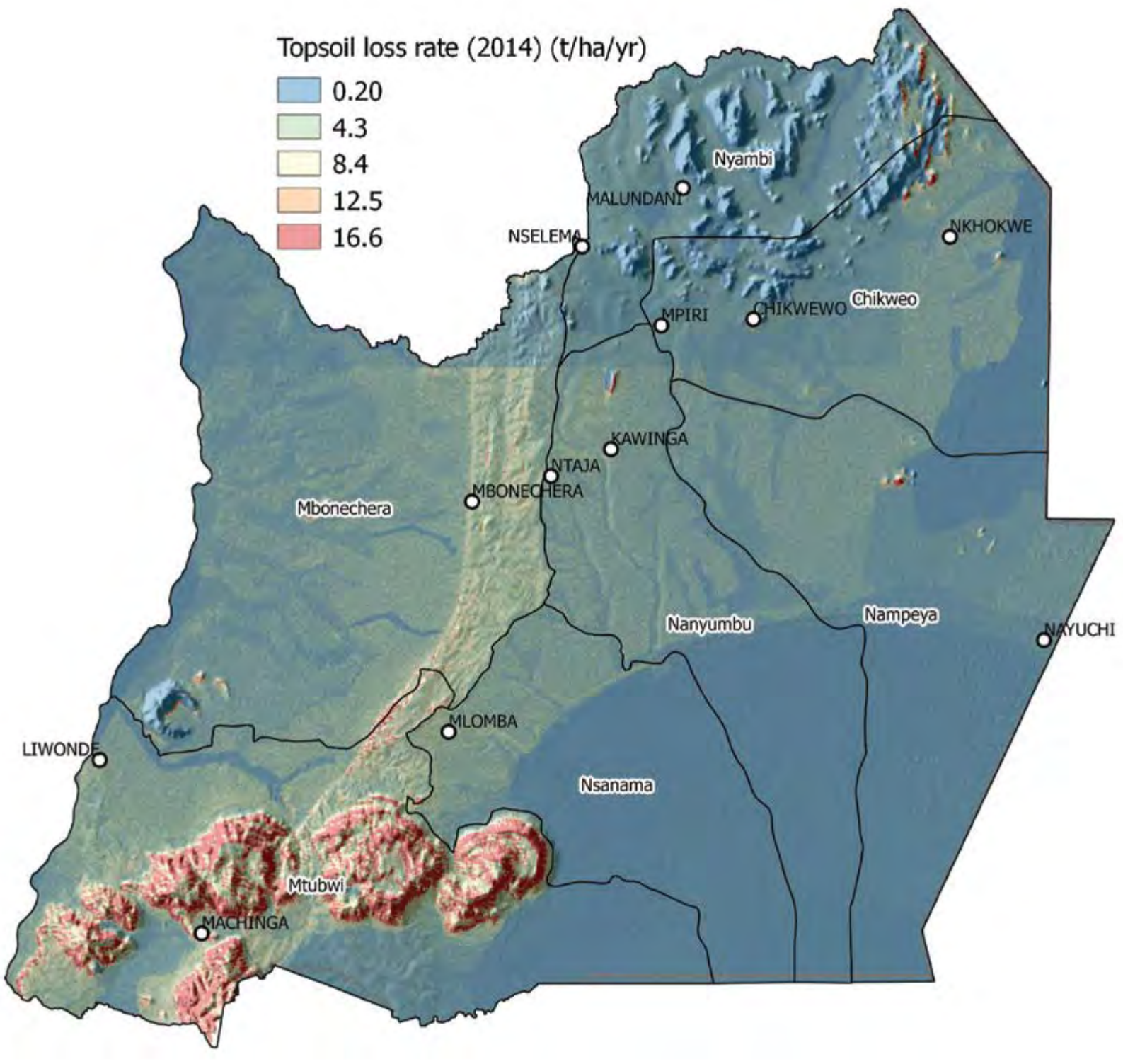
Sheet and gully erosion at Kunenenji

Sheet erosion at Machinga

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 2.44 t/ha/yr. The mountainous areas of Mtubwi and Mbonechera EPAs have signs high soil loss rates. The main contributing factors for the soil loss rates in these areas are vegetative cover decline and agricultural activities in vulnerable soil. Sheet and rill erosion are the prevalent forms of erosion.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Nyambi	1.49	0.24	9.44
Chikweo	1.15	0.28	6.52
Mbonechera	2.11	0.56	8.98
Nanyumbu	0.85	0.60	3.92
Nampeya	0.85	0.28	8.87
Nsanama	0.69	0.20	6.51
Mtubwi	7.25	0.80	16.35



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Mbonechera	4.83	0.540	0.266	0.027	53.660	1.465	0.610	2.705	2.680	0.153	3.980	11.225	13.270
Msanama	5.32	0.085	0.042	0.004	44.183	0.245	1.118	3.165	1.973	0.085	0.190	14.970	11.725
Mtubwi	4.76	0.398	0.196	0.020	53.980	0.170	1.100	1.890	1.125	0.172	0.155	30.820	11.105
Nampeya	5.04	1.378	0.679	0.069	26.279	0.255	1.083	2.880	1.985	0.169	0.164	16.173	11.295
Nyambi	4.92	0.611	0.301	0.031	57.323	0.303	1.075	3.395	1.953	0.109	0.407	12.605	9.948
Chikweo	5.19	1.479	0.913	0.085	31.116	0.460	0.446	3.832	1.545	1.382	1.231	21.333	14.536
Nanyumbu	5.74	1.498	0.913	0.087	29.596	0.462	0.381	4.105	1.670	1.444	1.435	19.656	14.032

Typical croplands in July-August period in 2017

Cropland at Makuya in Msanama EPA

Cropland at Chesine in Nyambi EPA

Cropland at Chesine in Nyambi EPA

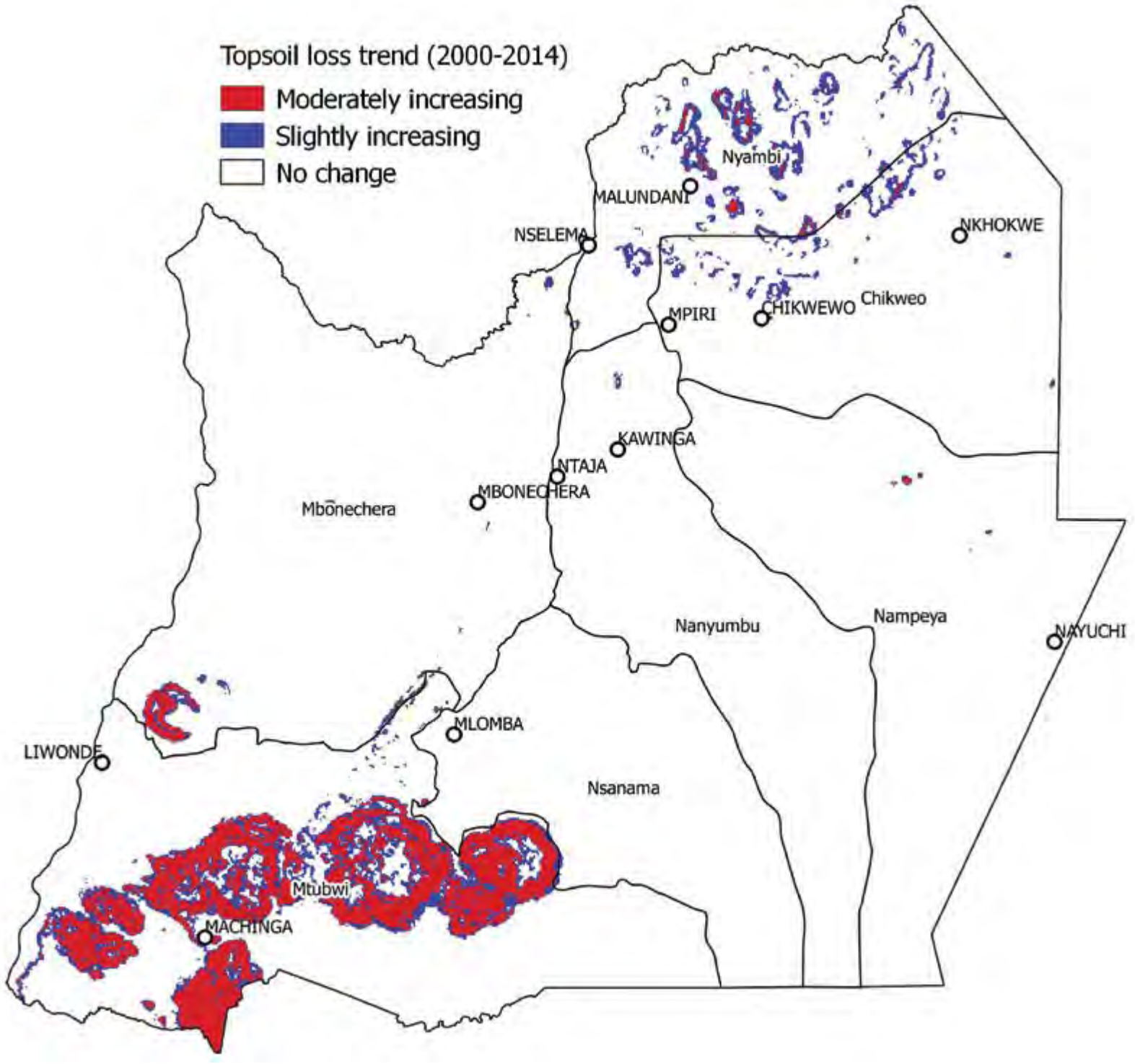
Cropland at Makuya in Msanama EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

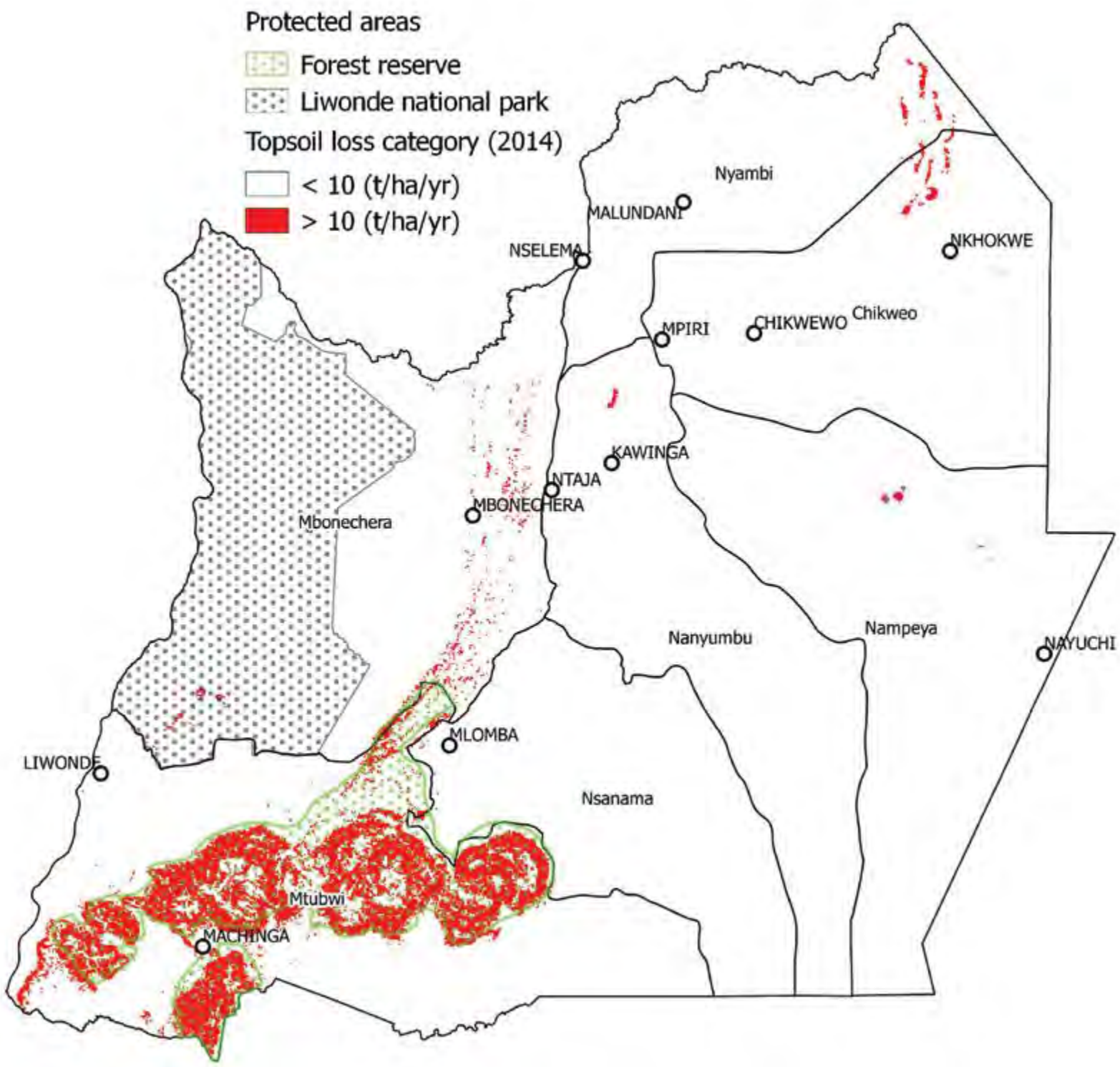
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Nyambi	0.098	0.014	0.342	0.455
Chikweo	0.079	0.011	0.304	0.393
Mbonechera	0.127	0.006	0.406	0.539
Nanyumbu	0.056	0.003	0.196	0.255
Nampeya	0.053	0.014	0.235	0.302
Nsanama	0.041	0.002	0.145	0.187
Mtubwi	0.087	0.005	0.261	0.353

Topsoil loss between 2000 and 2014

The trend of topsoil loss rates in the District seem to have been increasing between 2000 and 2014 in the mountainous areas and in steep slopes. This increasing trend is the same even for the protected areas (such as national park and forest reserves).



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the soil and water conservation measures

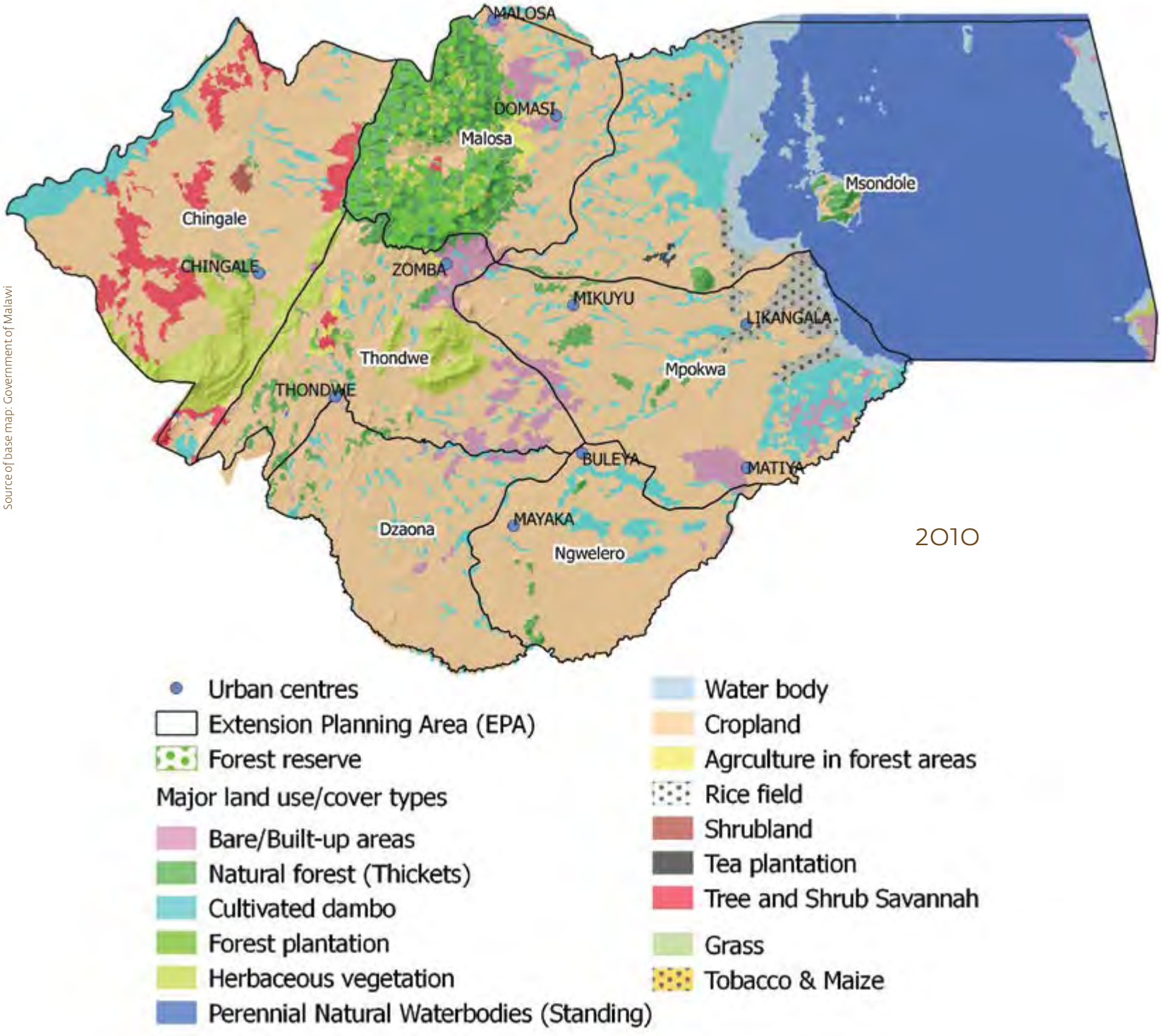
Combination of contour ridges and legume plants at Makuya in Msanama EPA

Fallowing at Bangombe in Msanama EPA

Drivers of soil loss
1. Vegetation cover change

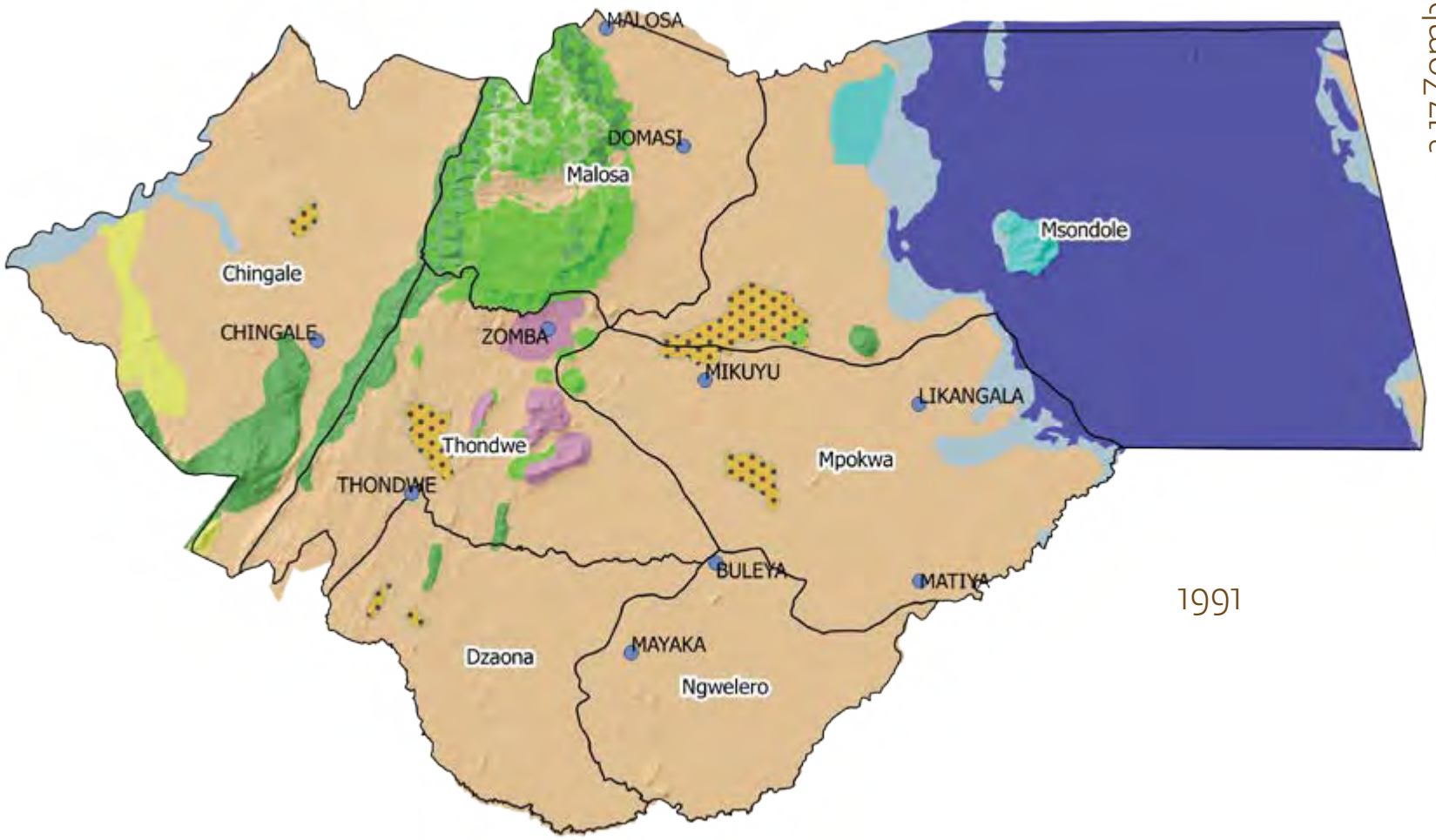
The main land use/cover types are smallholder croplands, forest reserve, natural forests, and water bodies. The district experienced a slight increase in vegetative cover proportions between 1991 and 2010. However, the main threat to soil loss is mainly due to cropland farming practices .

Major land cover/use types in 2010 and 1991



Source of base map: Government of Malawi

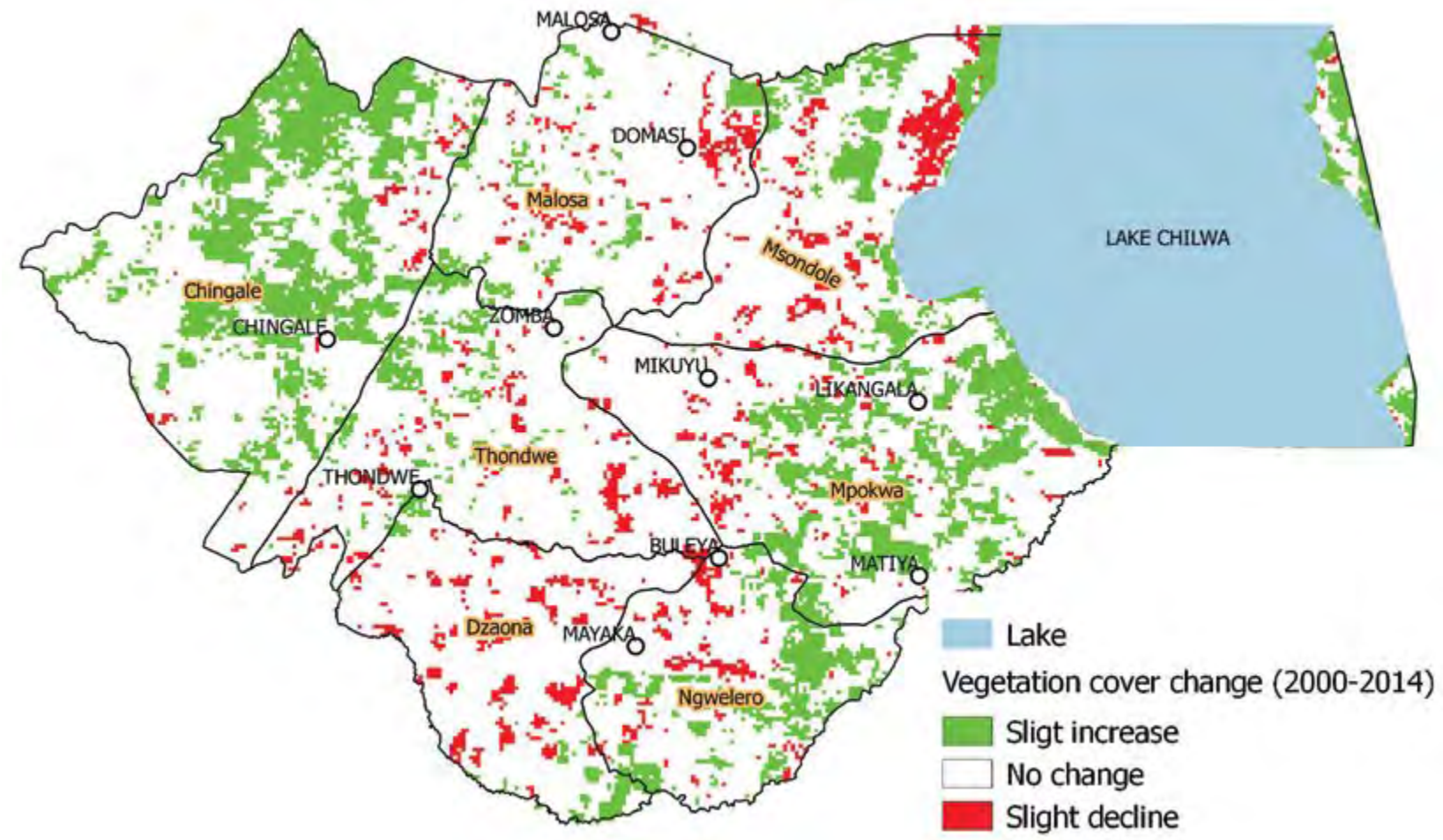
3.17 Zomba



1991

Typical land cover at Chiganga

Source of base map: Government of Malawi



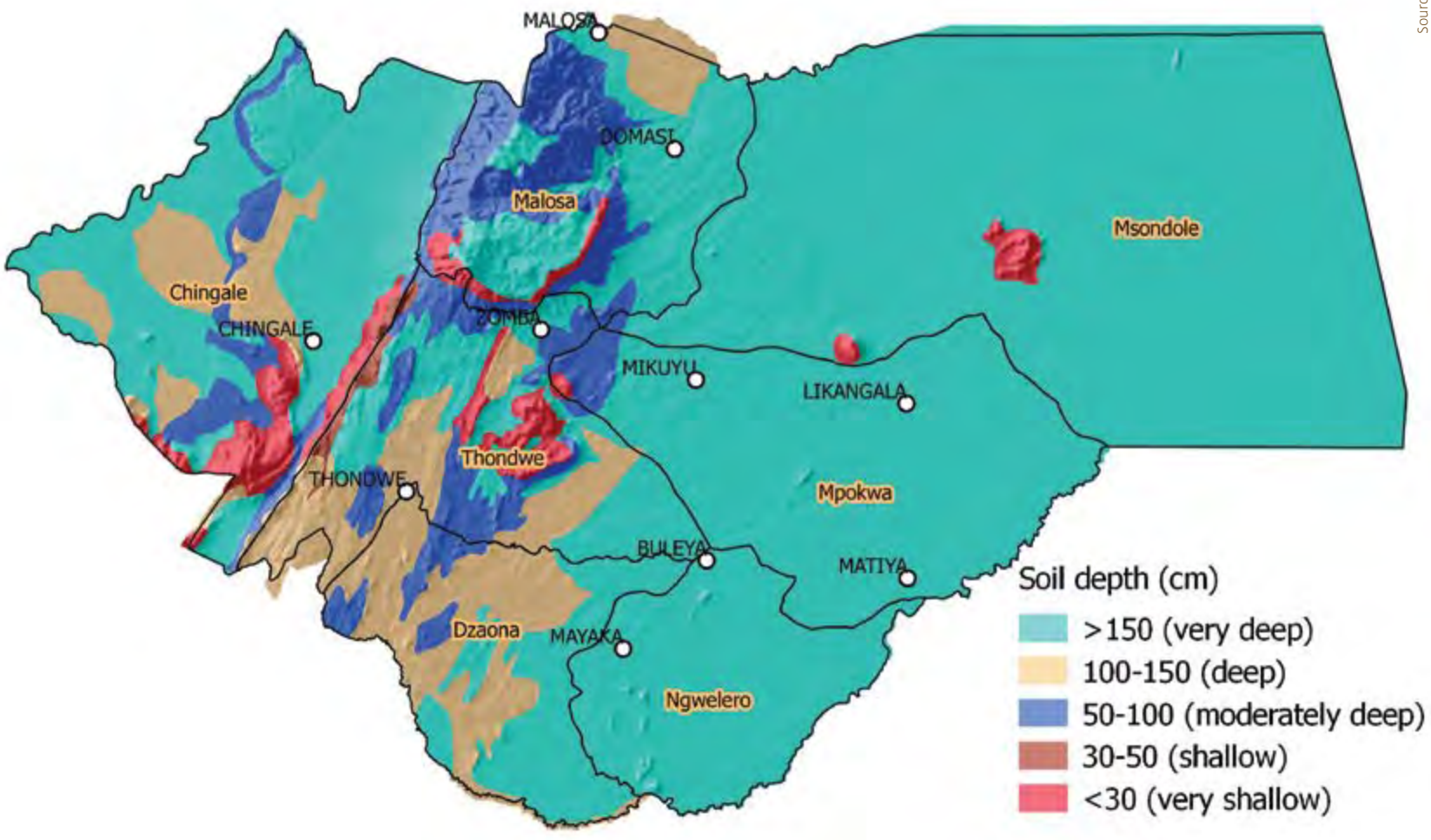
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

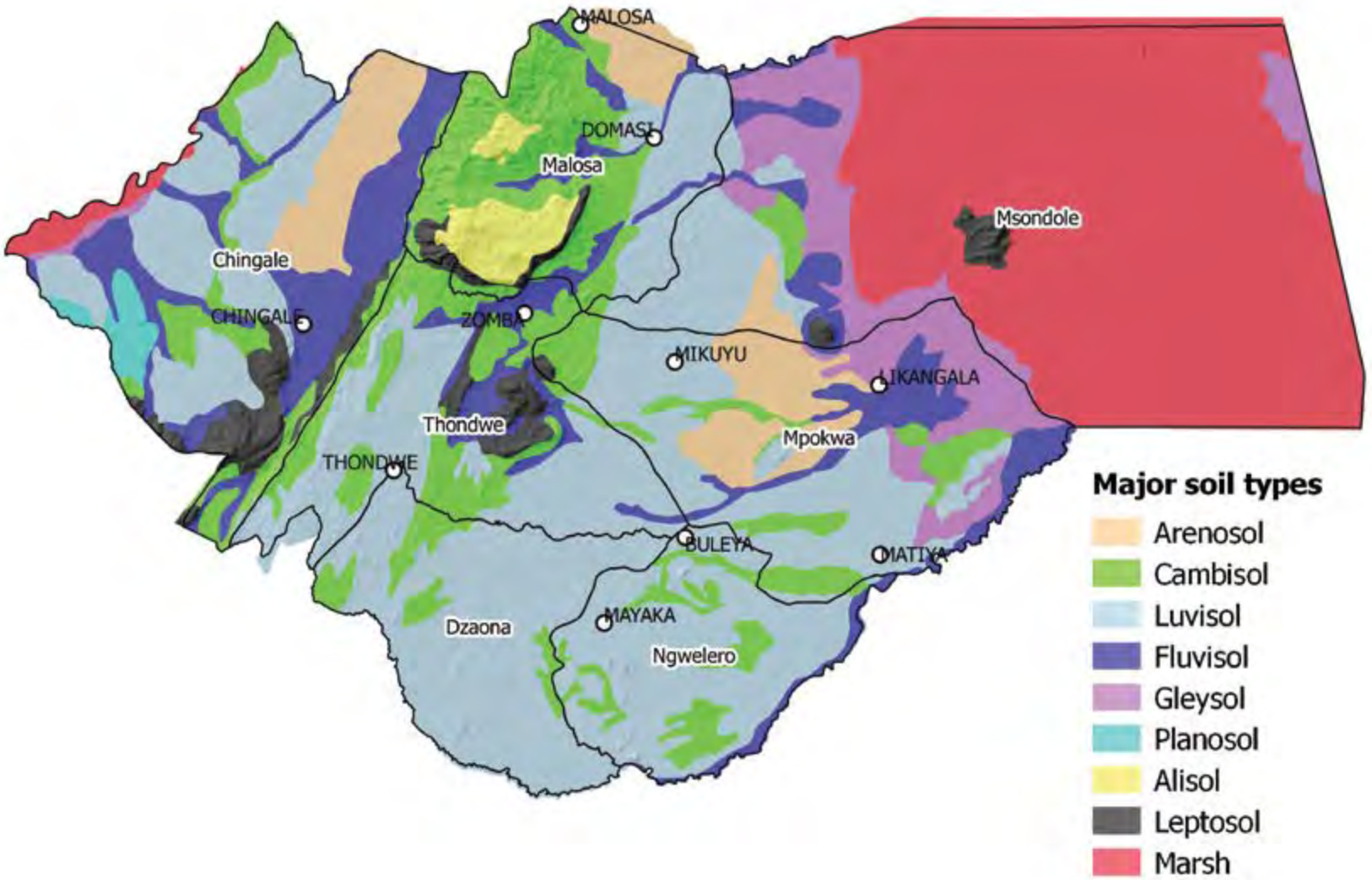
Zomba is a flat district with a general gentle slope towards the east. It has deep Luvisol, Lixisol and Fluvisols as the dominant soil types.

Shallow soil on mountain tops at Kuntumanji

Deep soil the plains at Kachulu



Source of base map: Government of Malawi



Source of base map: Government of Malawi

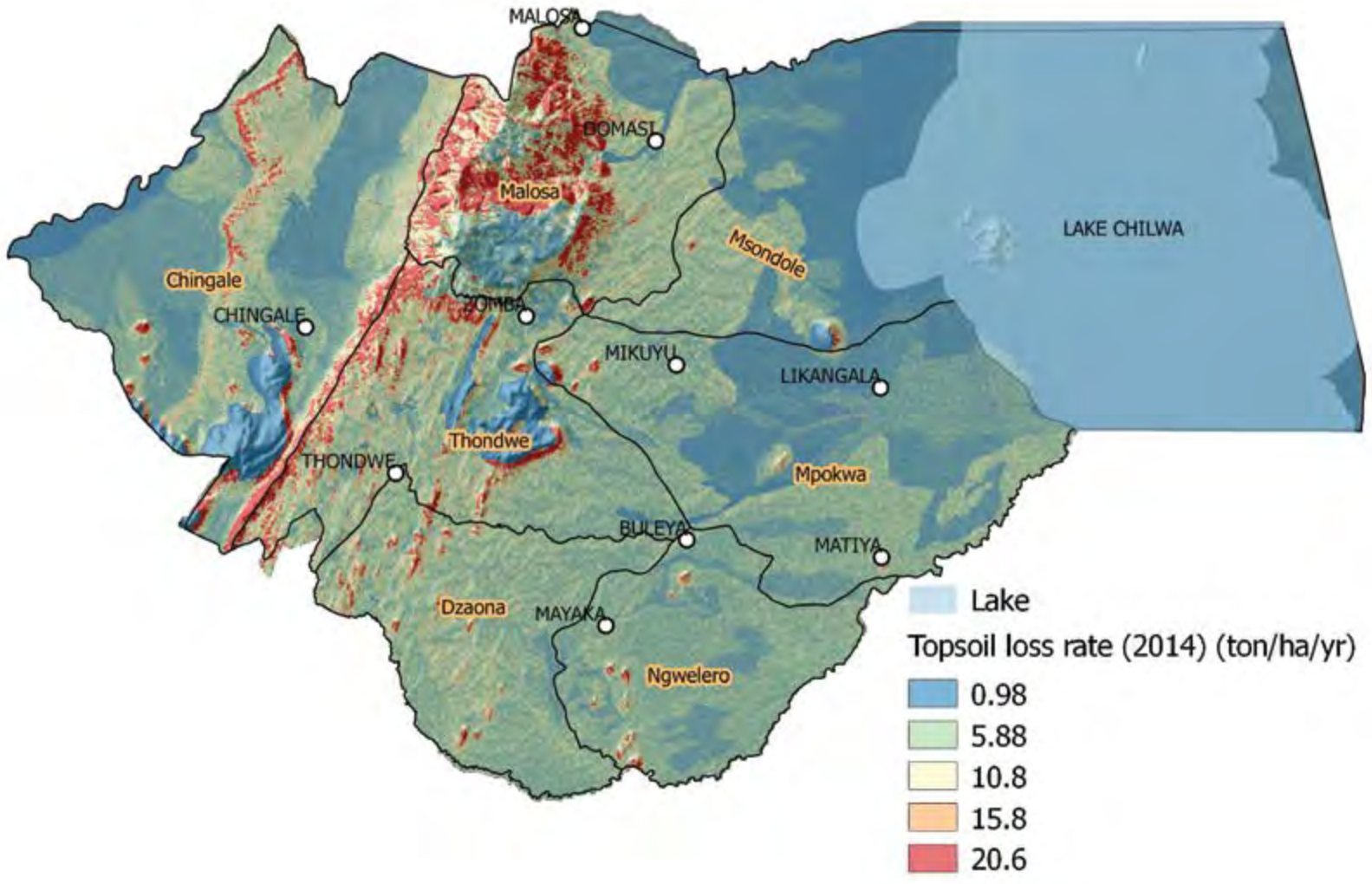
Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Malosa	No change	19.0	95.8	866	852-881	Low risk
Chingale	No change	6.4	71.8	830	802-854	Low risk
Msondole	Slight increase	1.0	94.6	892	852-929	Moderate risk
Thondwe	No change	9.0	72.7	852	813-884	Low risk
Mpokwa	No change	1.9	59.6	900	863-934	Low risk
Dzaona	No change	3.5	35.0	852	822-890	Low risk
Ngwelero	No change	1.9	53.8	896	863-930	Low risk

Features of soil erosion

Gully, sheet and rill erosion at Mbepula

Gully, sheet and rill erosion at Mbepula



Source of base map: Government of Malawi

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 4.92 t/ha/yr. The escarpments in Malosa and Thondwe EPAs were the only areas with indications of high soil loss rates in the district. The main contributing factors for topsoil loss rates in these areas include the presence of vulnerable soils, shallow soil and loss of vegetation cover. Gully, sheet and rill erosion are the most common types of erosion in the district.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Malosa	9.4	1.49	20.50
Chingale	8.0	0.98	14.34
Msondole	7.7	0.98	15.29
Thondwe	5.6	1.09	20.19
Mpokwa	4.6	1.03	16.31
Dzaona	4.6	1.18	19.90
Ngwelero	4.9	1.54	19.84

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chingale	6.06	1.635	0.805	0.083	70.800	0.533	0.536	7.463	1.230	1.226	3.677	22.062	20.223
Dzaone	5.13	2.045	1.005	0.100	39.223	0.519	0.623	11.853	1.392	1.014	3.043	18.256	16.735
Mpokwa	4.87	0.227	0.112	0.011	59.883	0.263	1.113	2.308	1.705	0.126	0.173	11.170	18.243
Msondole	4.62	0.696	0.343	0.035	50.477	0.200	1.075	4.830	2.445	0.343	0.134	10.368	13.890
Ngwelero	5.58	1.673	0.828	0.088	12.837	0.146	0.569	9.968	0.783	1.040	3.120	18.718	17.159
Thondwe	5.00	1.780	0.877	0.087	30.985	0.141	0.556	7.011	0.786	1.054	3.162	18.969	17.389
Malosa	5.62	1.790	0.969	0.099	36.330	0.476	0.431	4.519	1.813	1.459	0.826	21.477	15.174

Typical croplands in July-August period in 2017

Cropland at Amuhiriri in Ngwerero EPA

Cropland at Mdera in Thondwe EPA

Cropland at Mwinje in Chingale EPA

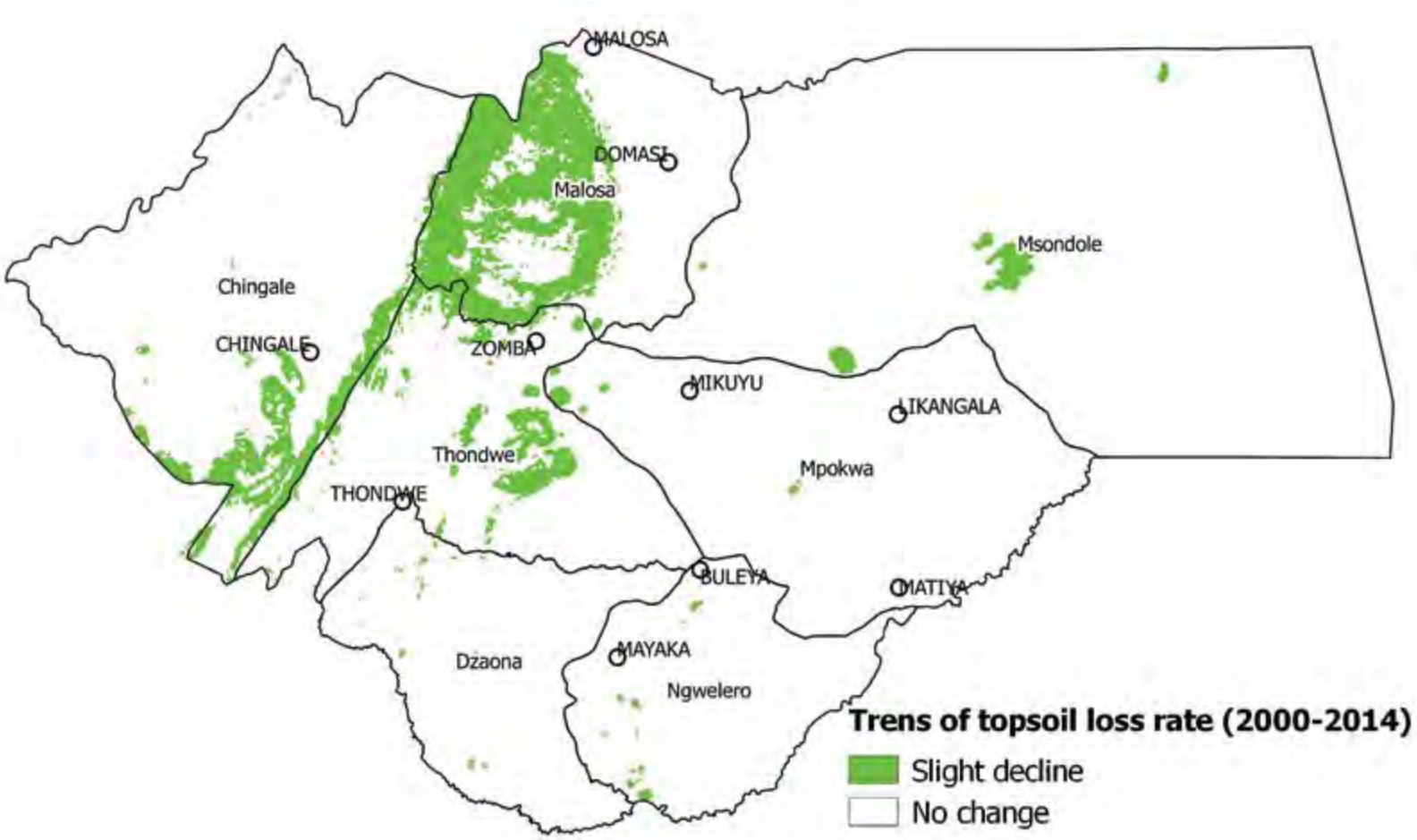
Cropland at Namatha in Mpokwa EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

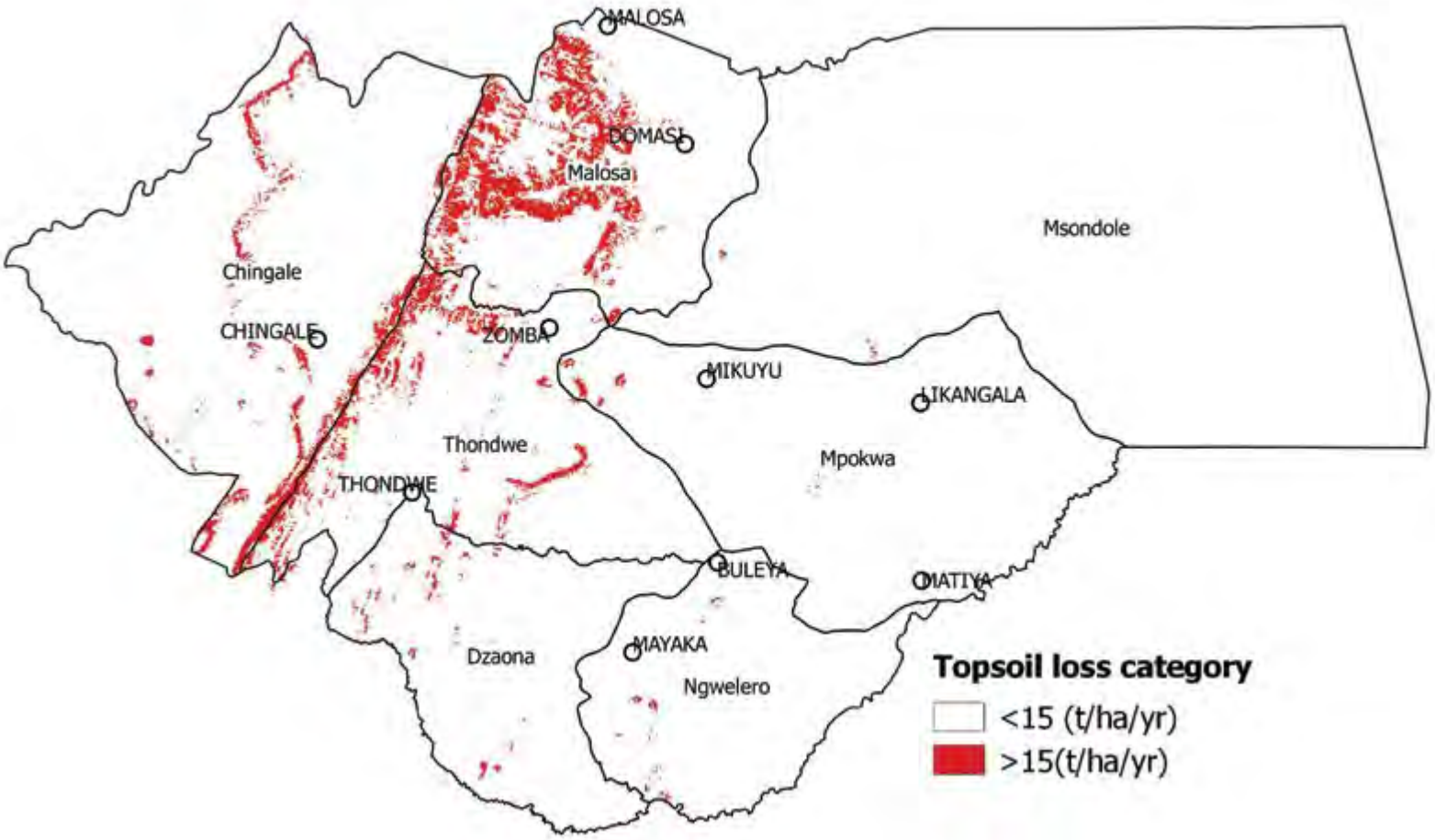
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Malosa	0.081	0.004	0.281	0.366
Chingale	0.103	0.006	0.4	0.509
Msondole	0.029	0.008	0.093	0.13
Thondwe	0.123	0.006	0.374	0.502
Mpokwa	0.077	0.004	0.278	0.359
Dzaona	0.112	0.005	0.377	0.494
Ngwelero	0.078	0.004	0.29	0.372

Topsoil loss between 2000 and 2014

There was a significant decline in topsoil loss rates in the escarpments between 2000 and 2014. These escarpments were also the same spots with high soil loss rates in the district.



Source of base map: Government of Malawi



Some of the land, soil and water conservation measures

Rill erosion control at Mbepula

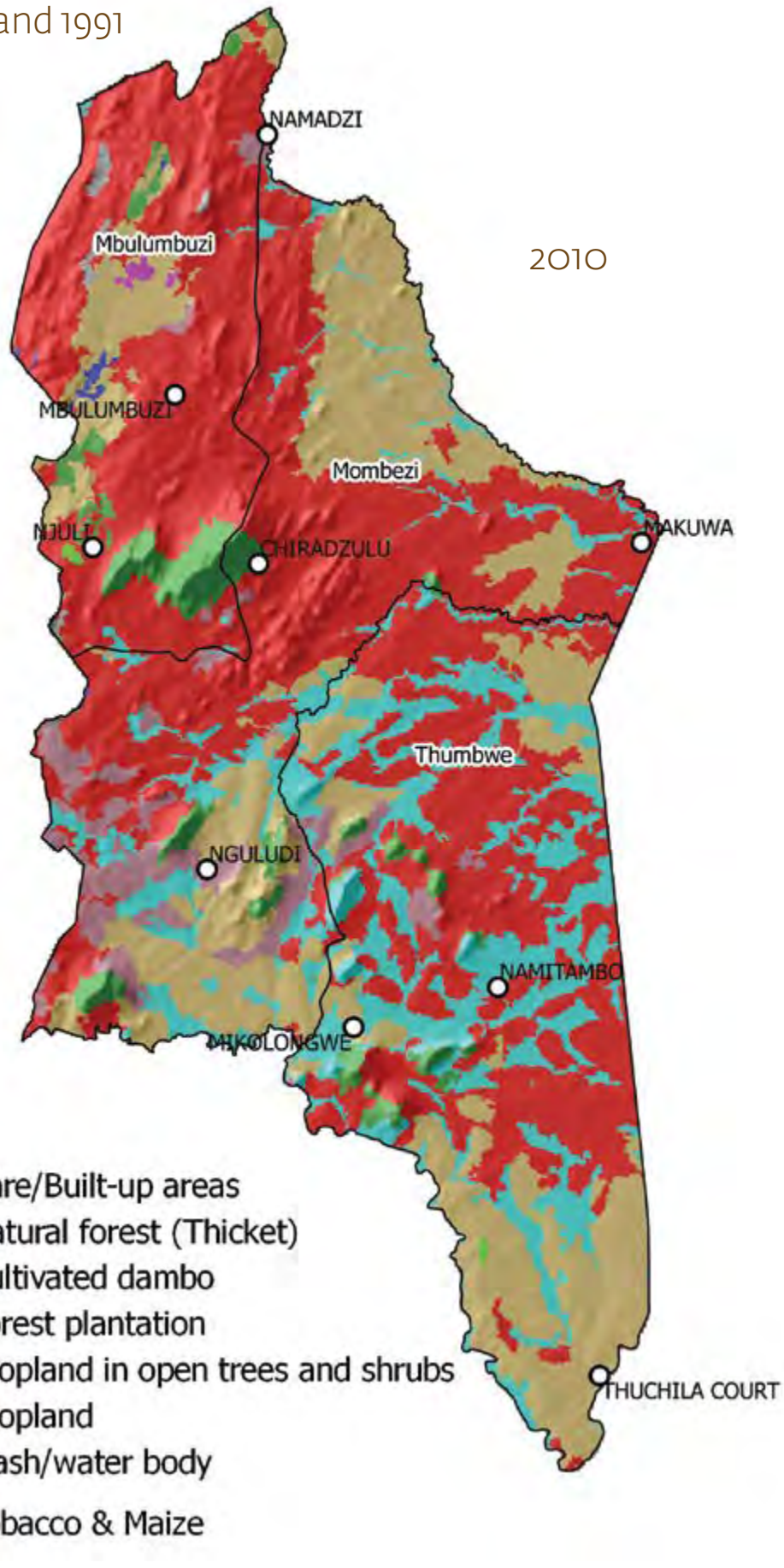
Protection of native vegetation Rover at Chingale

Source of base map: Government of Malawi

Drivers of soil loss
1. Vegetation cover change

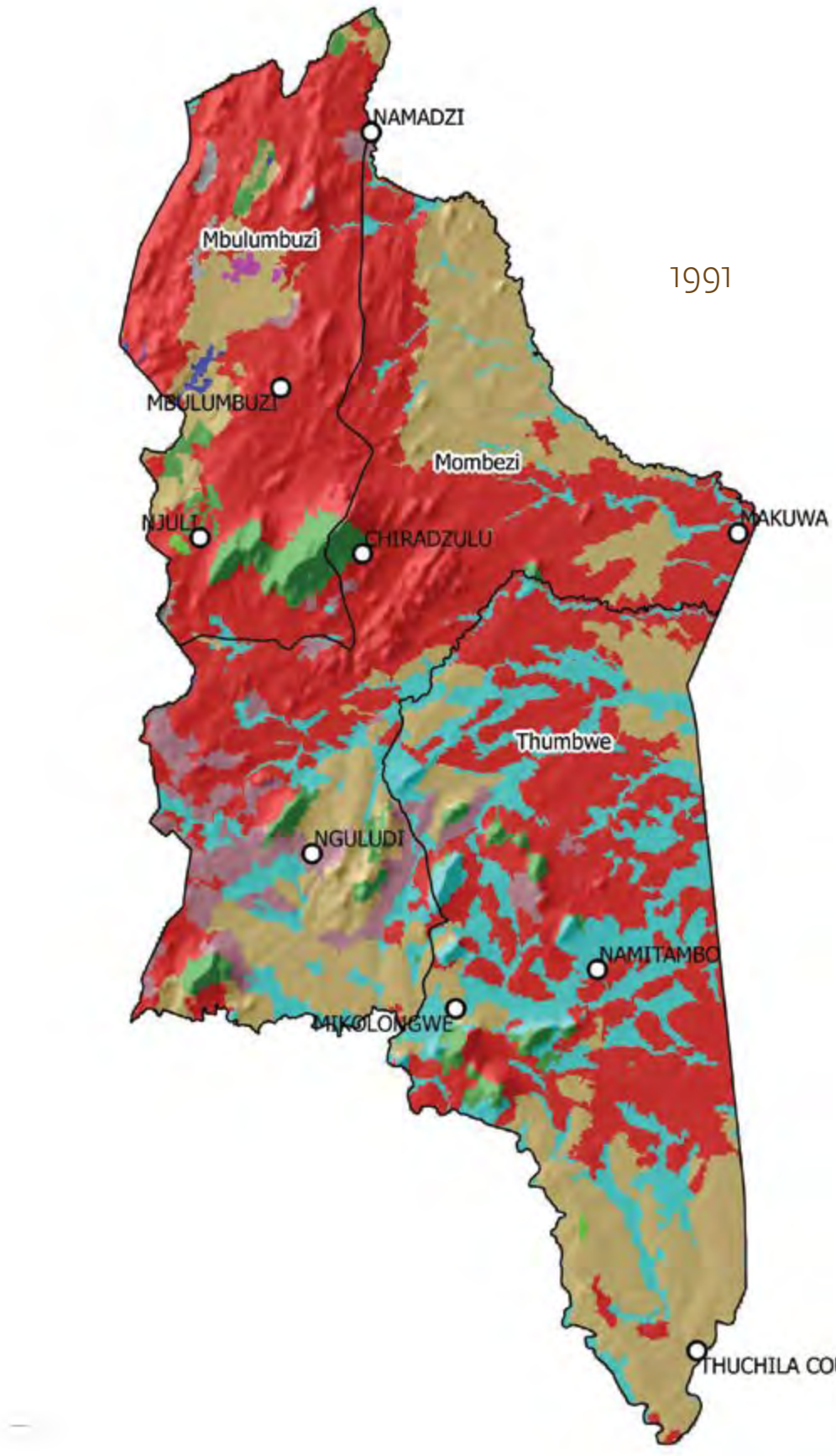
The main land use/cover types are smallholder croplands, forests, and urban/settlements. There was no significant changes in proportion of these land use types between 1991 and 2010, except for the intensification and diversification of agriculture within the cropland areas. The main threat to soil loss is the intensification and diversification of agriculture within the croplands especially in the steep slopes that have shallow and vulnerable soil.

Major land cover/use types in 2010 and 1991



2010

Source of base map: Government of Malawi

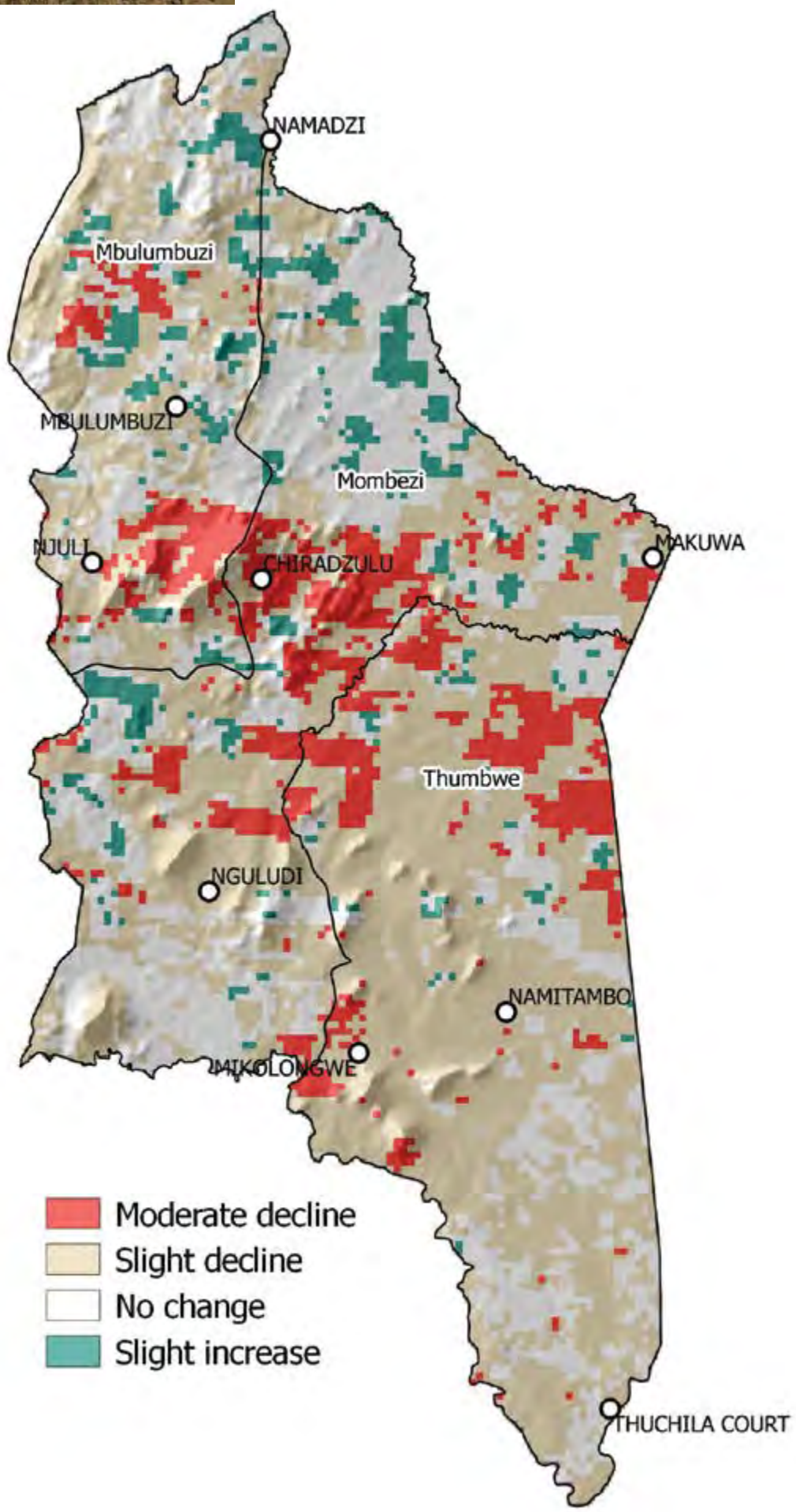


1991

Source of base map: Government of Malawi

Example of land cover types at Mwalabu

Trend of vegetation cover change (2000 - 2010)



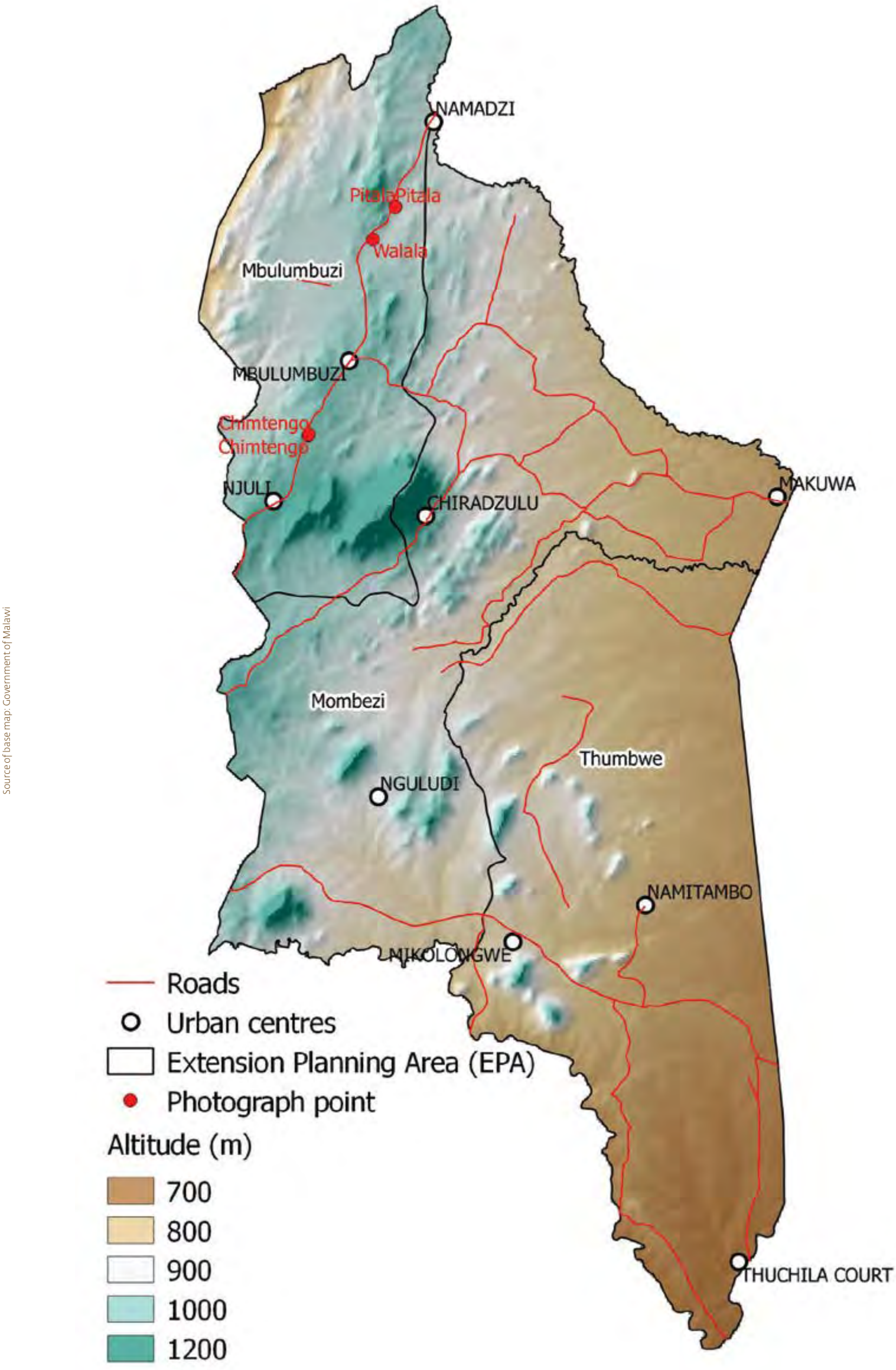
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors:

Chiradzulu's axis from the north to south has many escarpments, being in the Rift Valley. The escarpments have steep slopes and shallow soil. The south-western side has rather flat terrain with deep soil. The shallow soils are more vulnerable to soil erosion especially where there is agricultural intensification and low vegetation cover.

Stony soil on steep slopes at Nasulu mountain

Variable soil depth at Mwanja



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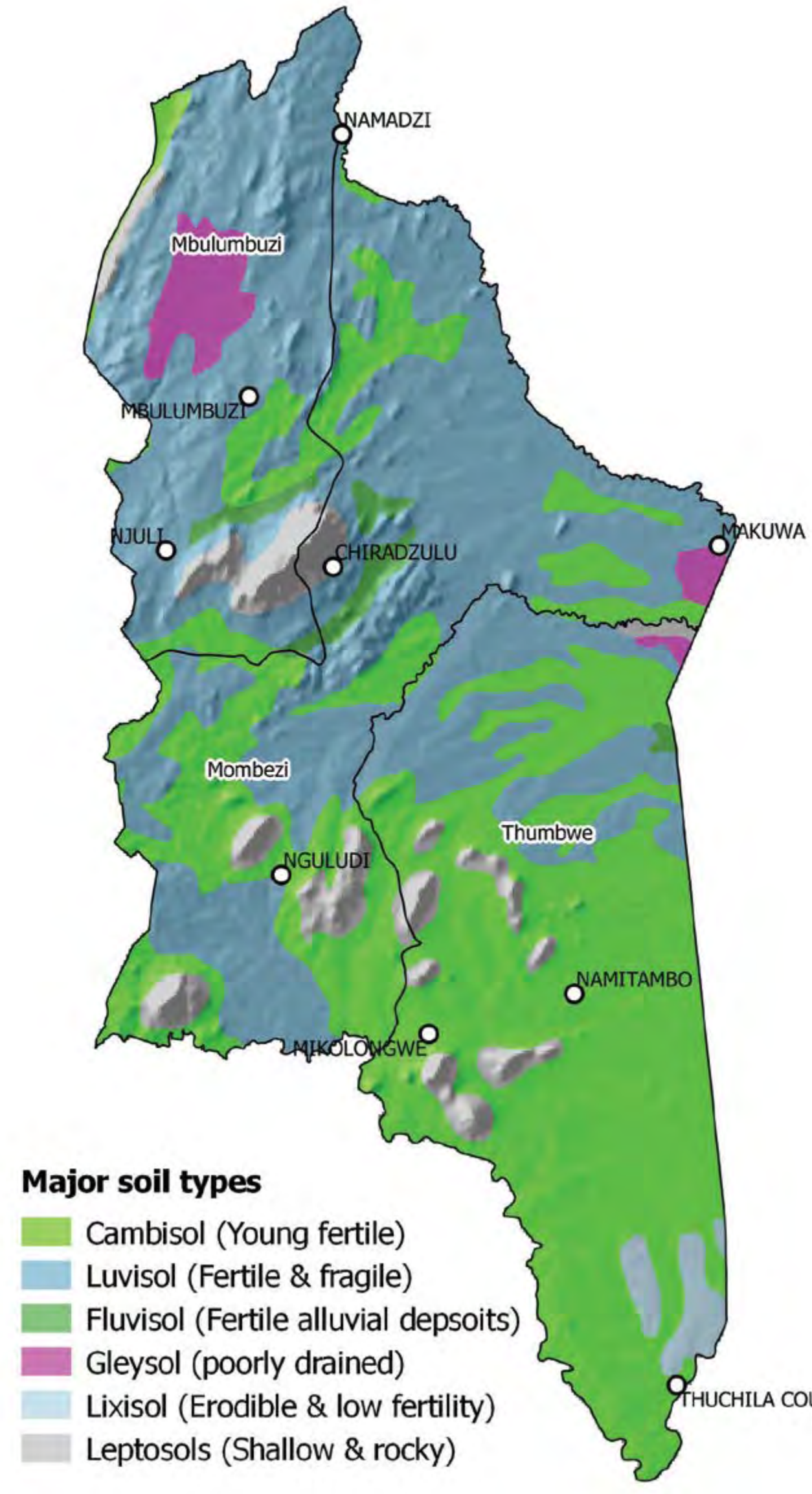
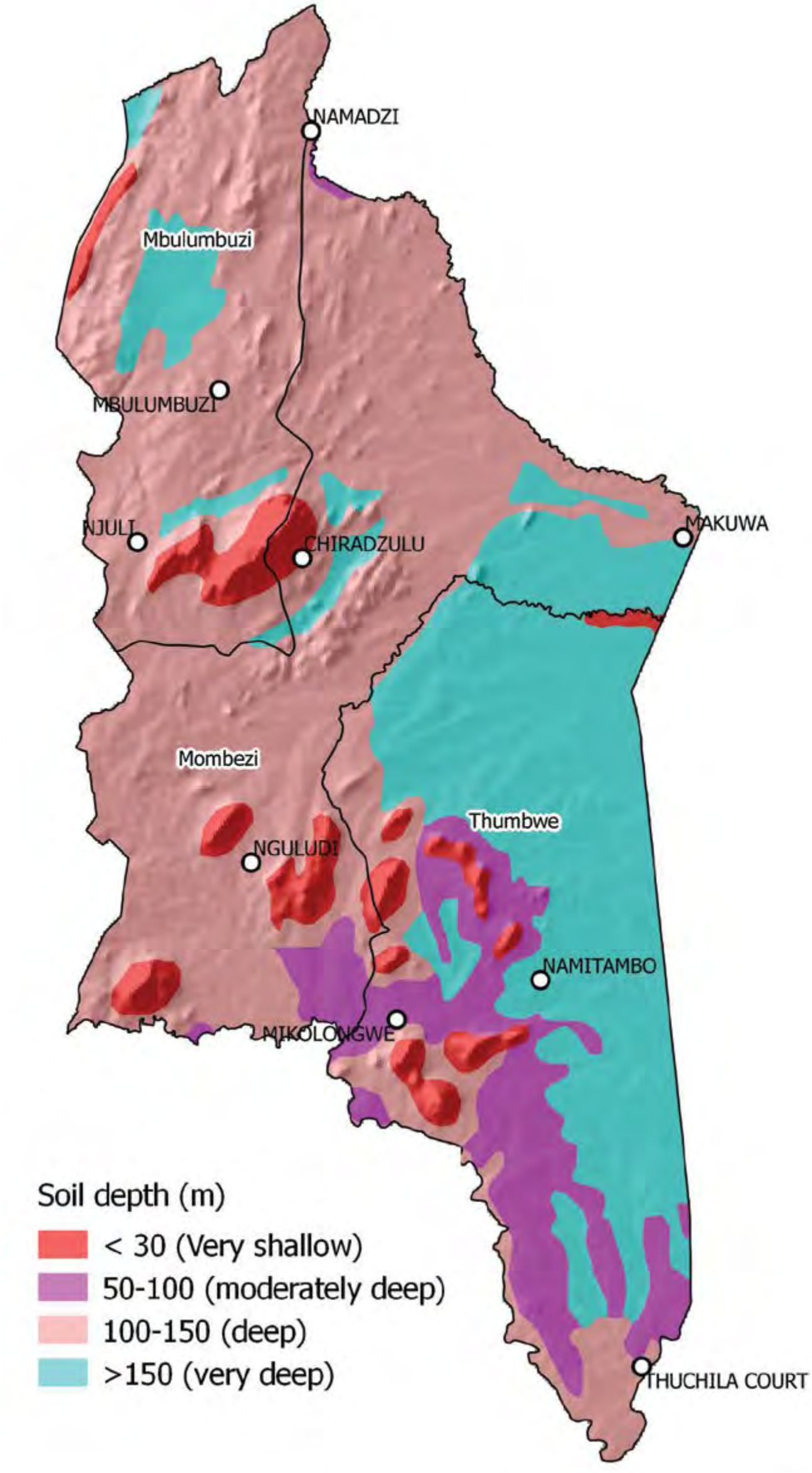


Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Mbulumbuzi	Slight decline	11.5	98.5	810	790-830	Moderate risk
Mombezi	Moderate to slight decline	7.96	97.9	840	790-890	Low risk
Thumbwe	Slight decline	5.13	85.3	880	820-920	Low risk

Features of soil erosion

Gully erosion at Nauma

Sheet and rill erosion in agriculture areas and steep slopes activities at Nauma

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 5.37 t/ha/yr. Thumbwe EPA had indications of the lowest soil loss rates. The main contributing factors for the soil loss rates in these areas include the presence of vulnerable soils and agricultural intensification, especially in steep slopes.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Mbulumbuzi	11.39	1.24	18.42
Mombezi	7.00	1.44	16.12
Thumbwe	2.29	1.22	15.01

Soil nutrients

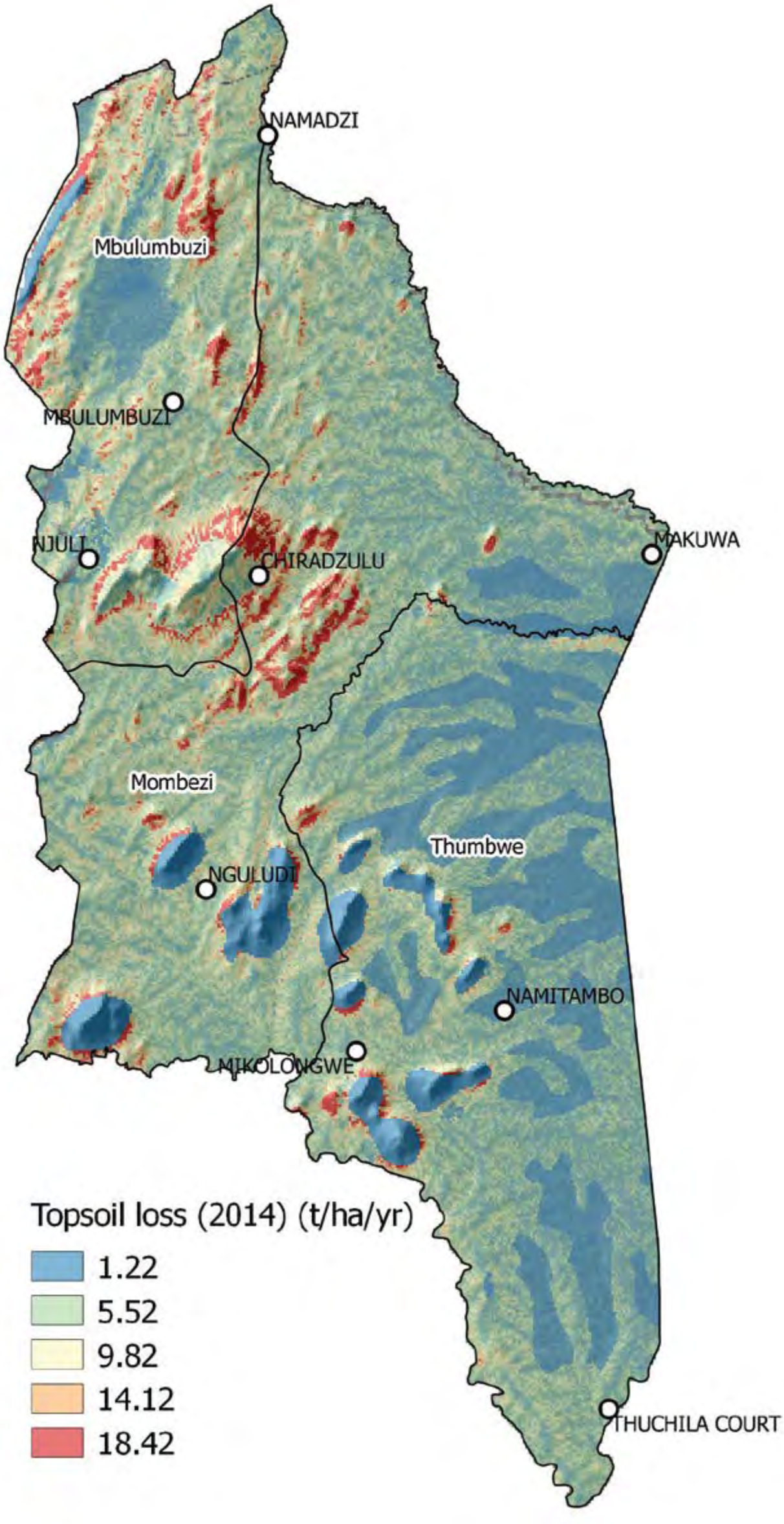
Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Mbulumbuzi	5.62	2.201	1.085	0.109	55.744	0.568	0.781	5.175	2.537	0.931	0.698	12.252	11.718
Mombezi	5.43	2.118	1.044	0.106	89.406	0.302	0.373	4.381	1.110	1.068	3.068	31.904	16.872
Thumbwe	5.82	2.443	1.204	0.122	5.761	0.301	0.539	5.885	1.591	0.435	0.679	16.977	19.755

Typical croplands in July-August period in 2017

Cropland at Mitepa, Mbulumbuzi EPA

Cropland at Koneliwa, Thumbwe EPA



Source of base map: Government of Malawi

Cropland at Lipalama, Mombezi EPA

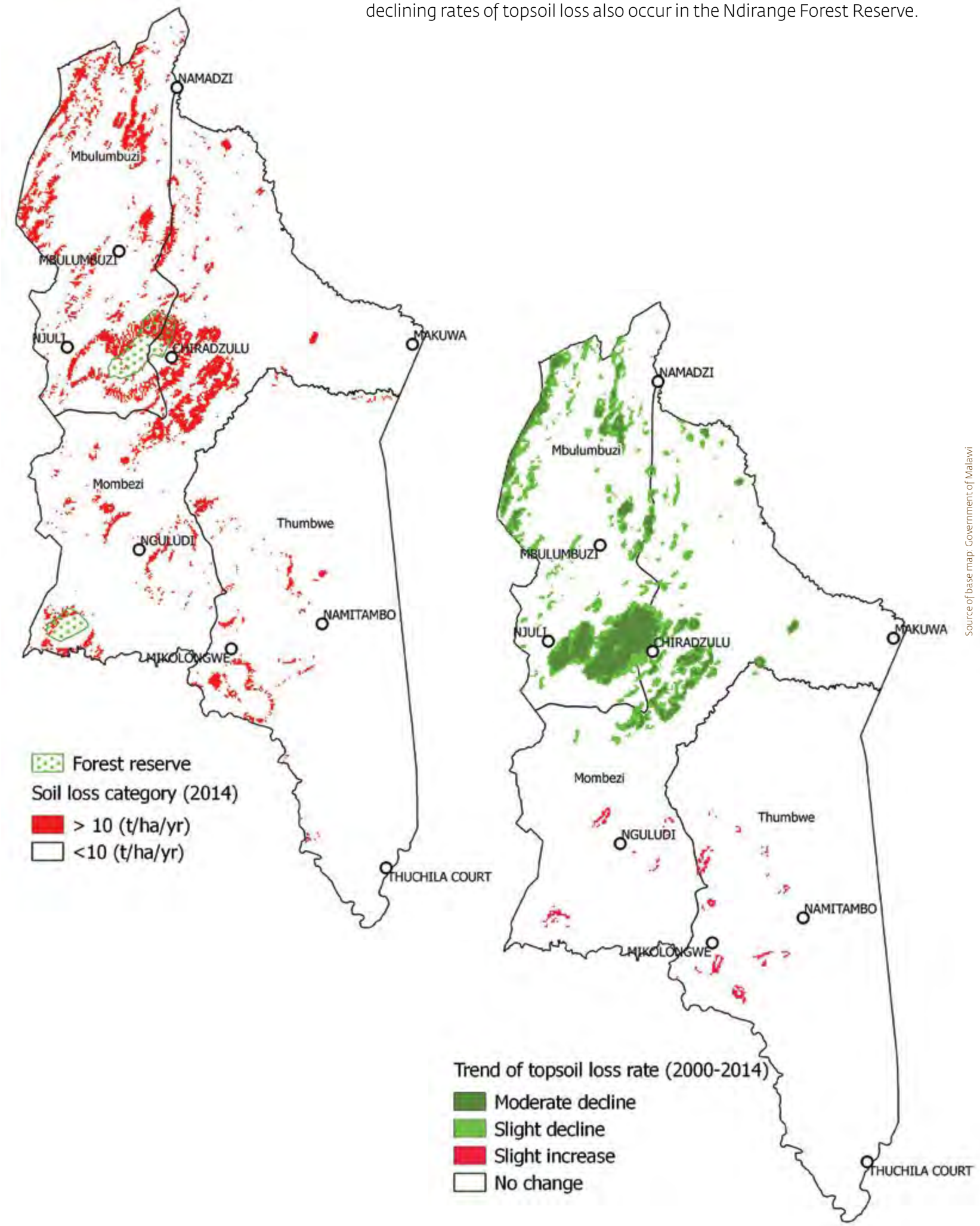
Cropland at Nkhongodzo, Mombezi EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Mbulumbuzi	0.1810	0.0084	0.4832	0.6726
Mombezi	0.1269	0.0054	0.3773	0.5096
Thumbwe	0.0707	0.0032	0.2567	0.3305

Topsoil loss between 2000 and 2014

The trend of topsoil loss rates in the District is declining in the northern parts and increasing in the southern parts between 2000 and 2014. Notably, in Mbulumbuzi, the areas with high soil loss rates in 2014 had declining soil loss rates. In Chiradzulu, the Forest Reserve contributed to the declining soil loss rates in its jurisdiction. Similarly, in Ntonda (north of Blantyre City), the declining rates of topsoil loss also occur in the Ndirange Forest Reserve.



Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

Conservation agriculture at Mkwedza

Contour plots & cover improvement at Chimtengo

Maintaining cover on steep slopes at Walala

Contour ridges at Umali, Mbulumbuzi EPA

Planted forest and natural vegetation at Umali, Mbulumbuzi EPA

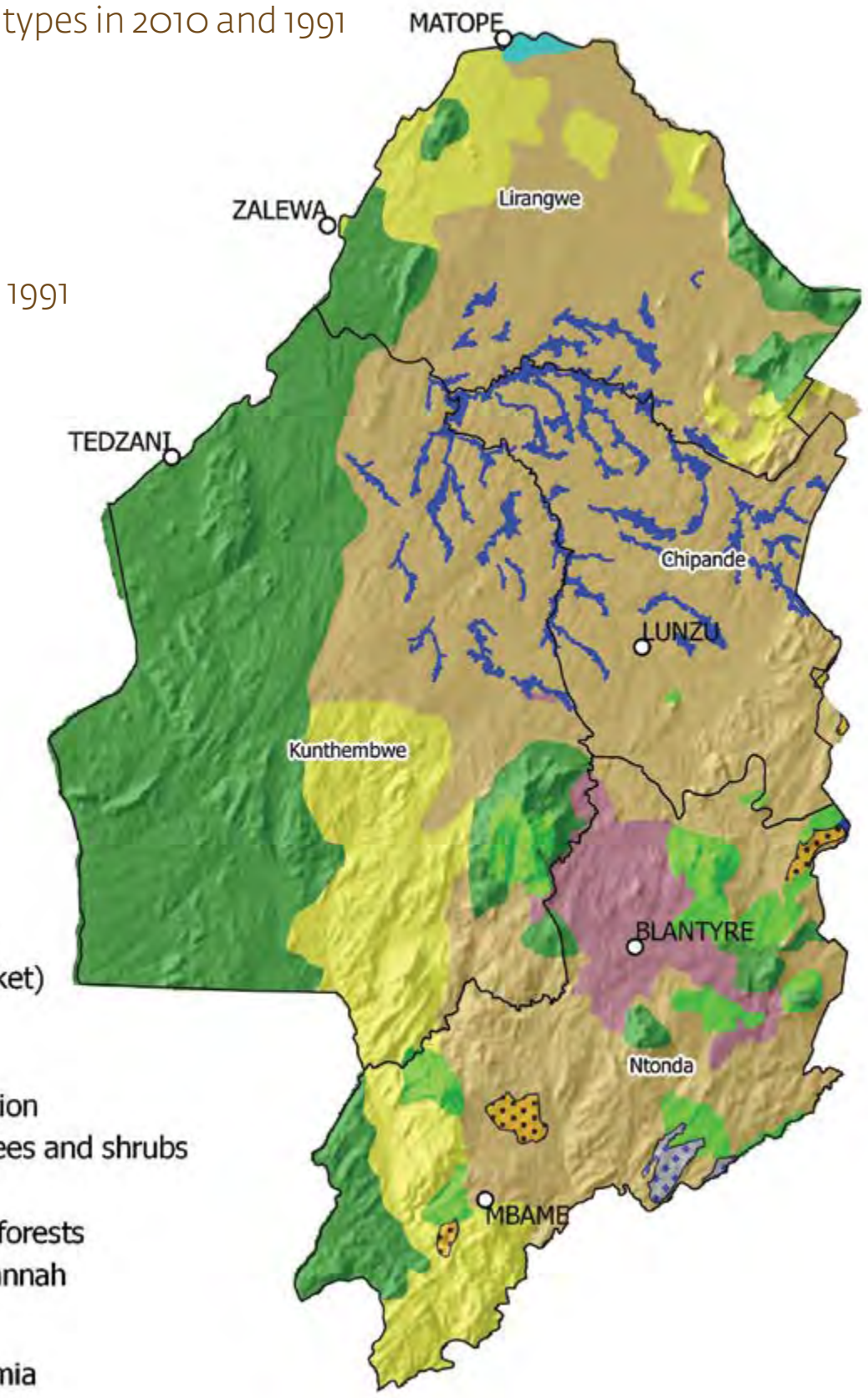
Combination of residue incorporation and contour ridges at Mitawa in Thumbwe EPA

Drivers of soil loss
1. Vegetation cover change

The main and use/cover types are smallholder croplands, tree-cropland, estates, forest, and urban/ settlements. Significant changes in proportion of these land use types have been observed between 1991 and 2010. The most noticeable change was the decline of forest cover, increase of urban (built-up) and cropland areas, and proportion of open trees and shrub-savannah. These could be the result of human activities reclaiming the natural forests.

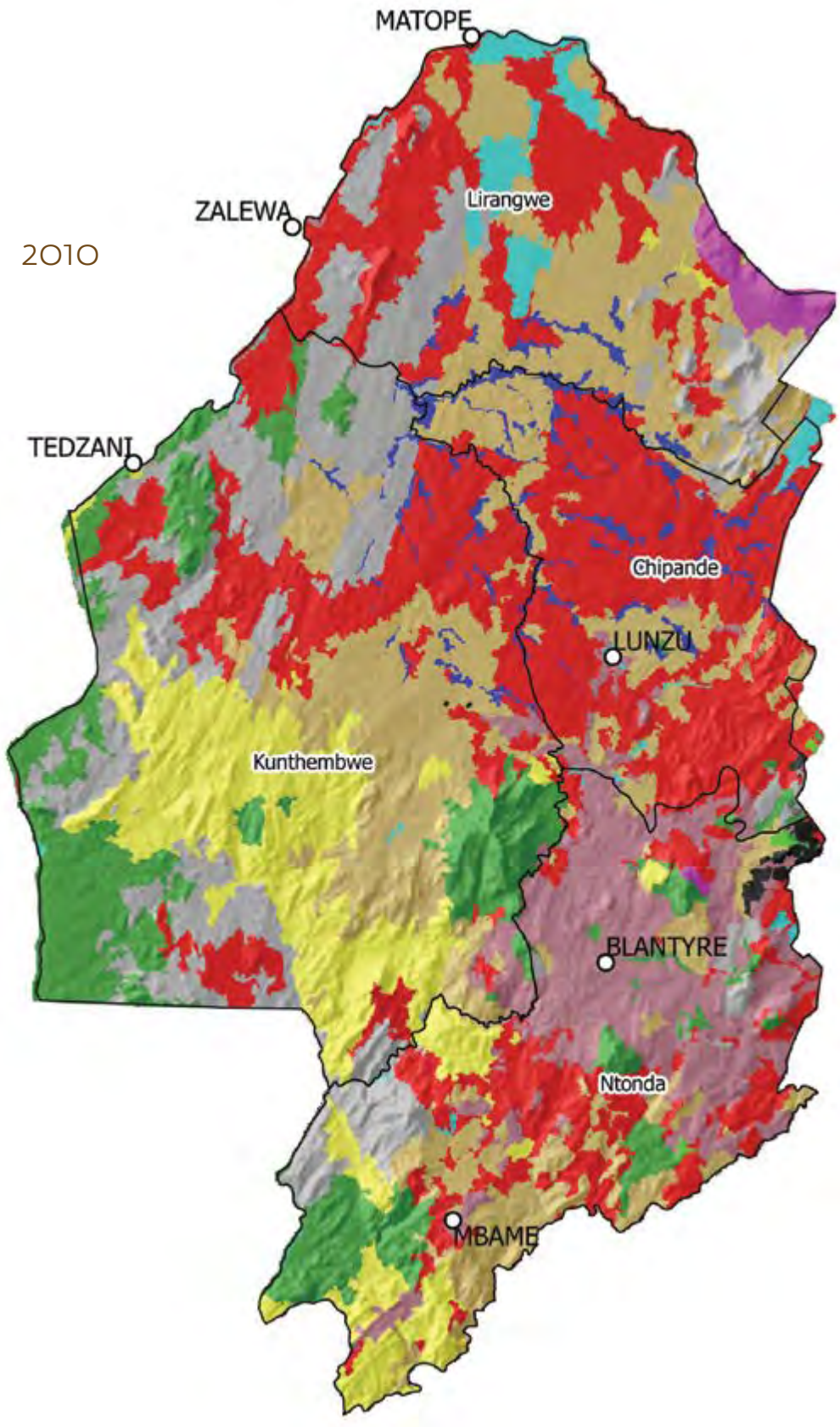
Major land cover/use types in 2010 and 1991

1991



Source of base map: Government of Malawi

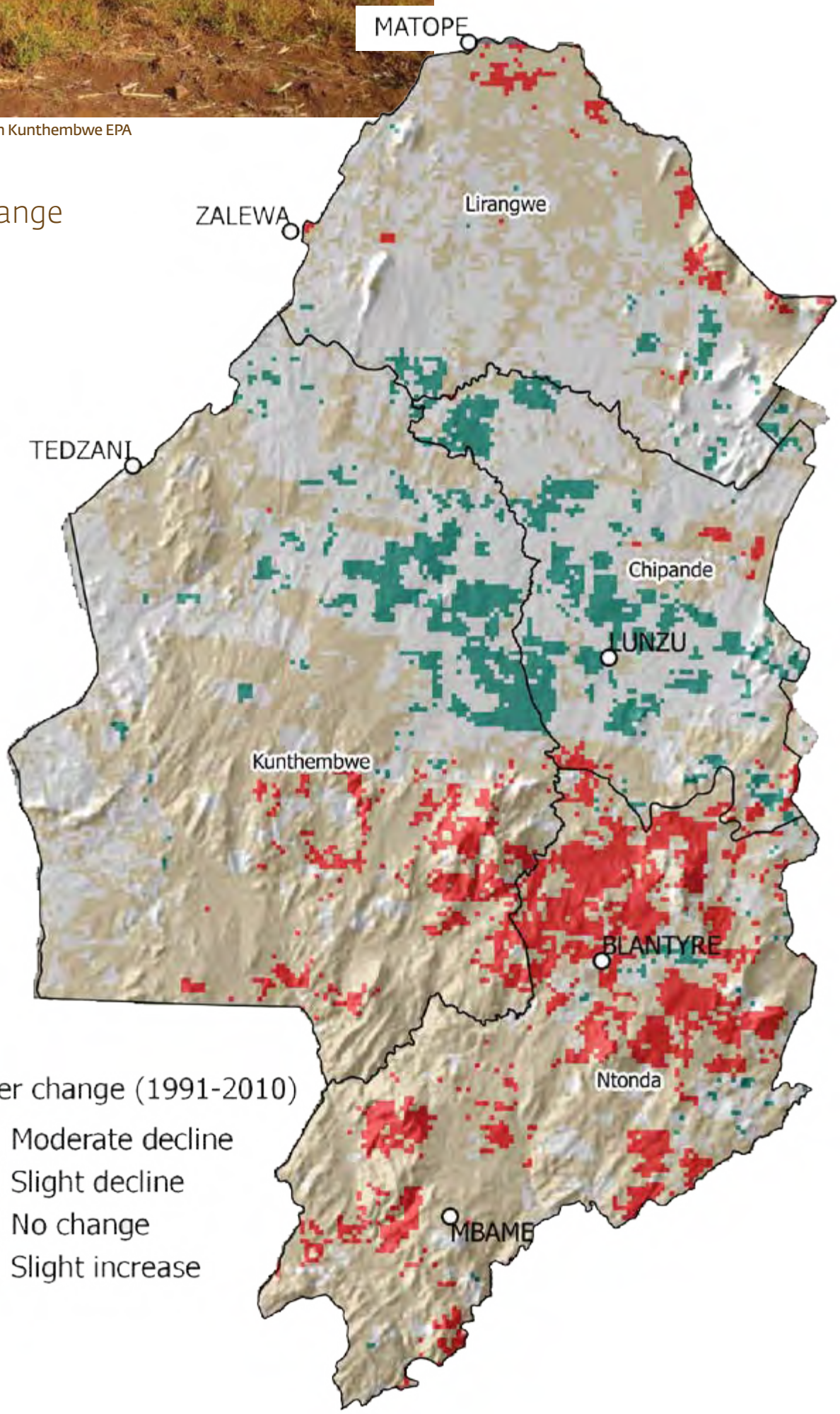
2010



Source of base map: Government of Malawi

Example of land cover types at Jaweta in Kunthembwe EPA

Vegetation cover change



Source of base map: Government of Malawi

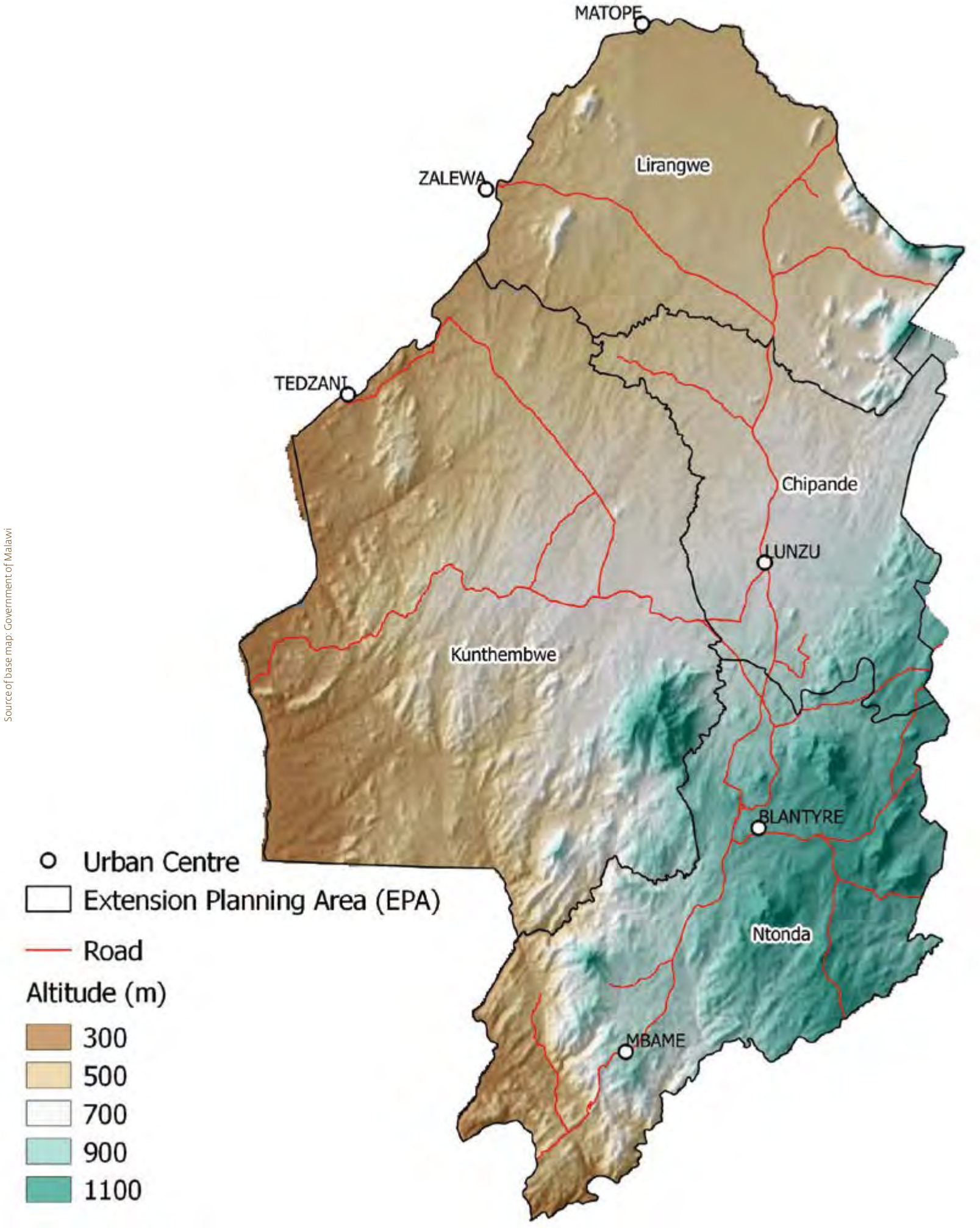
2. Rainfall, relief and soil factors

Blantyre has mixed relief characteristics. The northern parts are rather flat while the south has steep slopes. The steep slopes (especially in the mountain ranges) have shallow soil and largely with low vegetation cover. Flat areas have deep soil (e.g. in Solmoni). Deep soil has low erodibility characteristics compared to shallow soil.

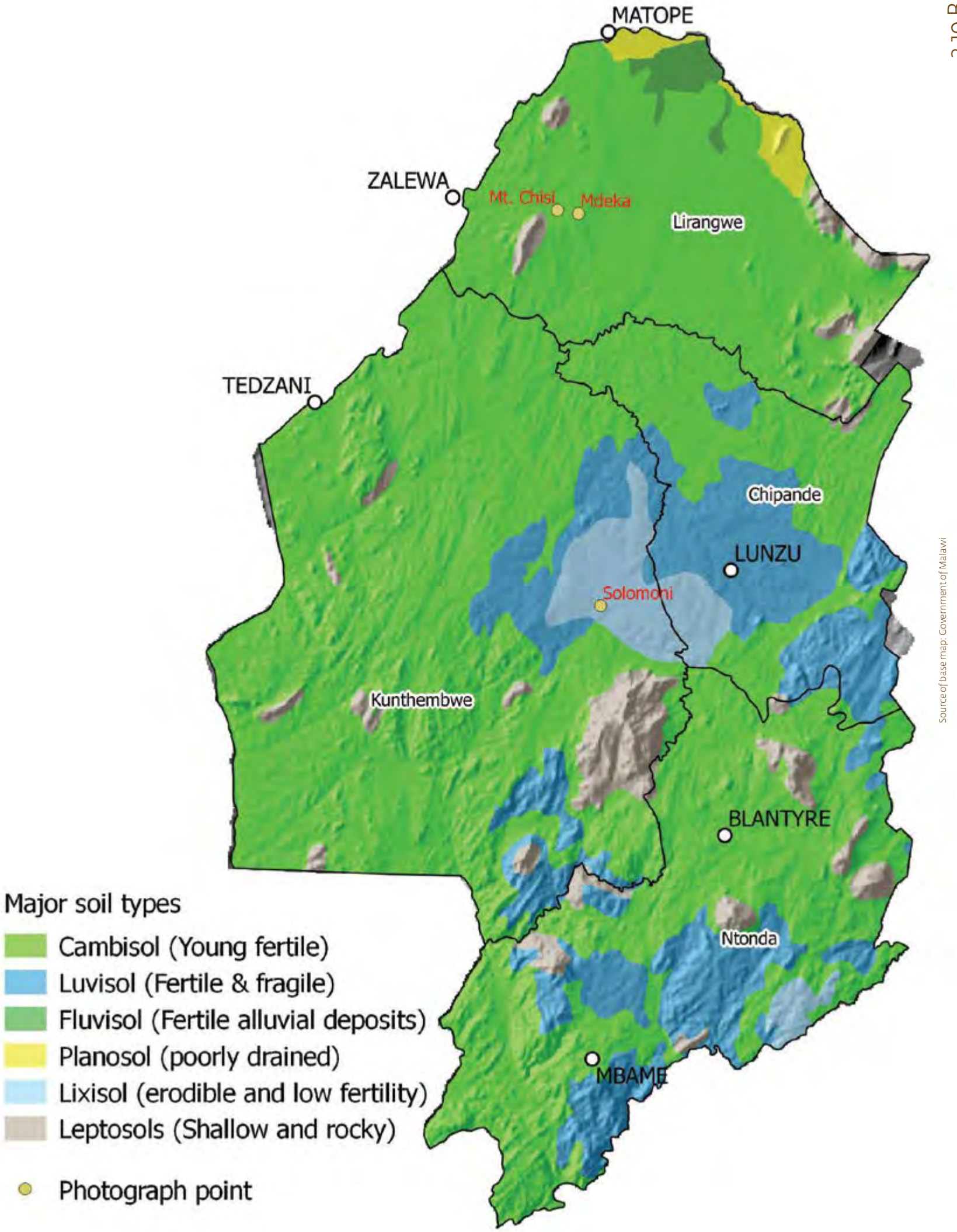
Flat terrain, deep soil, and low vegetation cover at Solomoni

Stony and shallow Leptosol soil at Mdeka

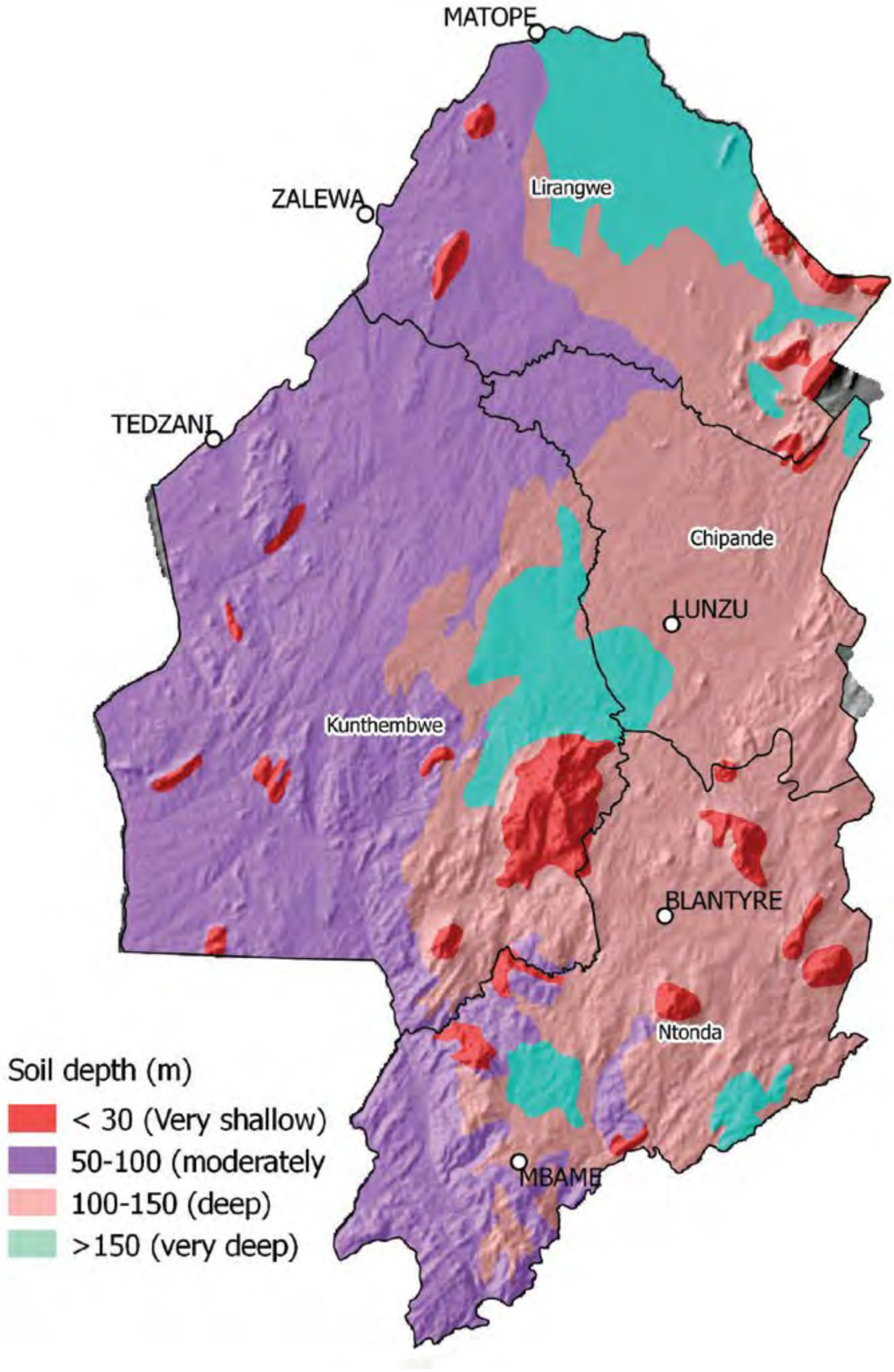
p slope, sallow soil and low vegetation cover at Mt. Chisi



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Lirangwe	Slight decline to no-change	6.40	98.5	790	760-820	Low risk
Kunthembwe	Slight decline	9.75	87.9	760	720-830	Moderate risk
Chipande	No-change	6.03	71.8	780	760-810	Low risk
Ntonda	Moderate decline	13.5	96.7	810	750-860	Moderate risk

Features of soil erosion

Rill erosion at Gwadani

Sheet erosion at Dzunga

Gully erosion at Gwadani

Gully erosion at Gwadani

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 5.49 t/ha/yr. Ntonda and Kunthembwe EPAs had indications of the high soil loss rates. The main contributing factors for the soil loss rates in these areas include the presence of vulnerable soils in steep slopes and low cover of the protective vegetation. Human activities responsible for the low vegetative cover include opening up of the natural vegetation for agricultural activities, exploitative use of forests, urbanization, and a slow rate of replenishment of vegetation cover.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Lirangwe	1.09	1.07	14.22
Kunthembwe	7.42	1.14	16.12
Chipande	2.37	1.33	12.01
Ntonda	7.84	1.18	16.16

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Chipande	5.09	1.008	0.497	0.050	79.28	0.422	0.555	8.082	1.027	1.35	3.35	34.87	18.44
Kunthembwe	4.96	1.430	0.705	0.071	68.38	0.316	0.541	3.247	0.964	0.67	2.02	22.53	15.74
Lirangwe	6.29	1.719	0.847	0.086	12.57	0.320	0.525	4.109	0.966	0.82	1.32	14.88	42.43
Ntonda	5.65	2.206	1.087	0.110	40.92	0.431	0.533	4.798	1.510	0.93	1.81	14.38	37.24

Typical croplands in July-August period in 2017

Cropland at Chepuka, Ntonda EPA

Cropland at Kunthembwe, Kunthembwe EPA

Cropland at Padoko, Chipande EPA

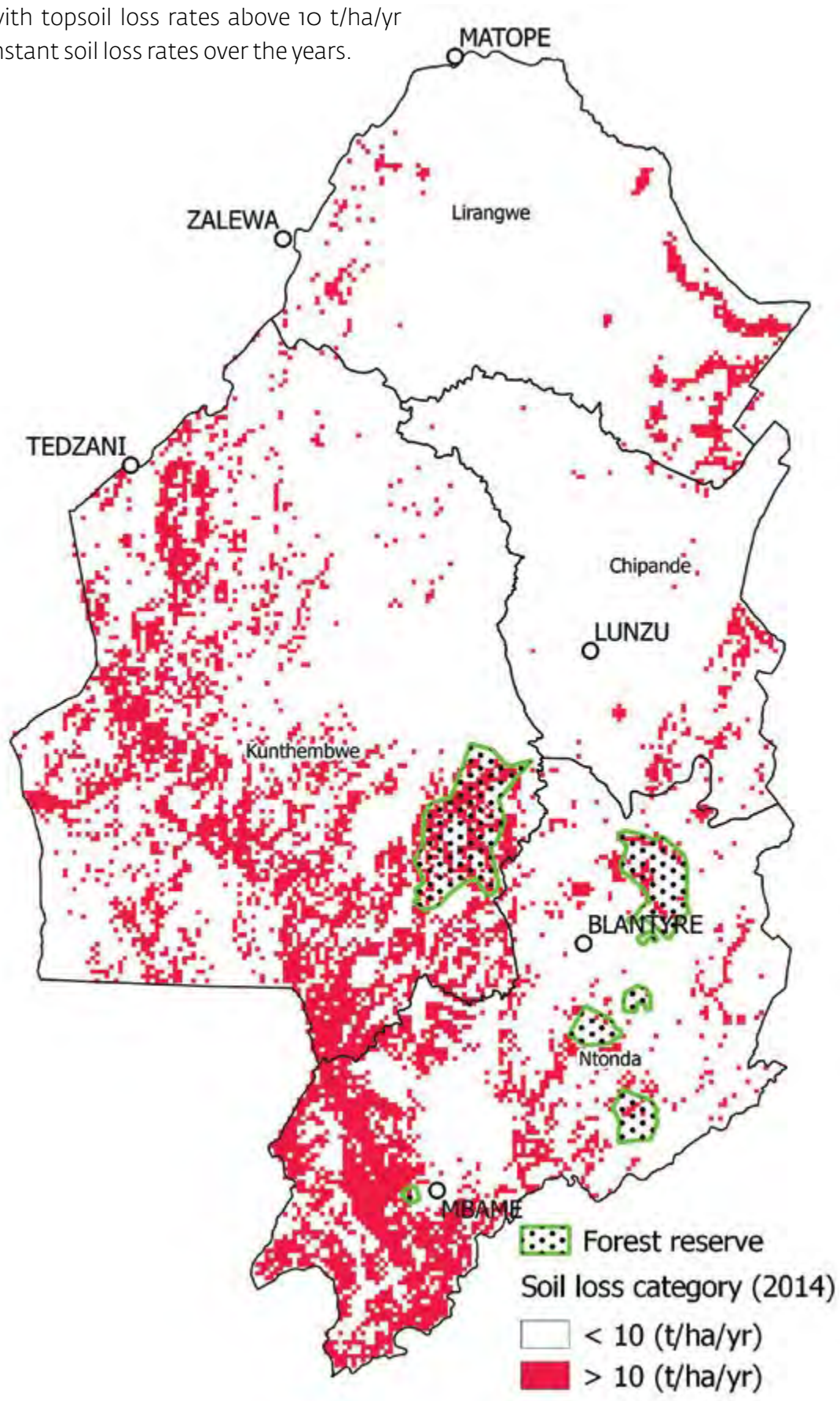
Cropland at Jordan, Liragwe EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

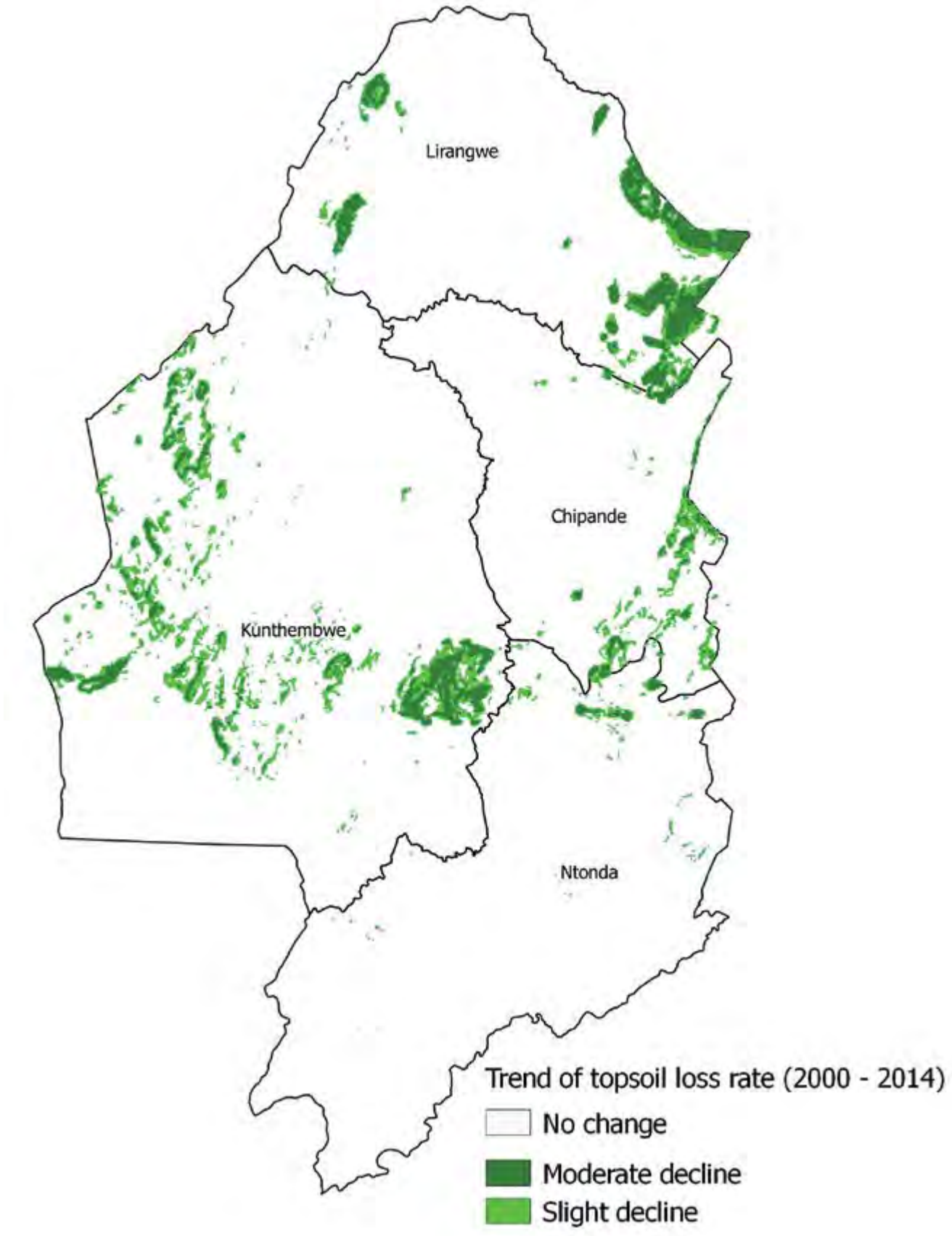
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Lirangwe	0.1398	0.0087	0.5382	0.6867
Kunthembwe	0.1687	0.0101	0.6289	0.8077
Chipande	0.1841	0.0093	0.6056	0.7991
Ntonda	0.1500	0.0072	0.4771	0.6343

Topsoil loss between 2000 and 2014

The trend of topsoil loss rates in the District seem to have been declining in many parts of the District between 2000 and 2014. Notably, in Kunthembwe, the areas with high soil loss rates in 2014 seem to have been having declining soil loss rates. Most of the areas with topsoil loss rates above 10 t/ha/yr seemed to have had more or less constant soil loss rates over the years.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

Vetiver and ridge realignment at Mkwedza

Macadamia plantation at Mapanga

Some of the land, soil and water conservation measures

Maintenance of ground cover and planted forest at Mapanga

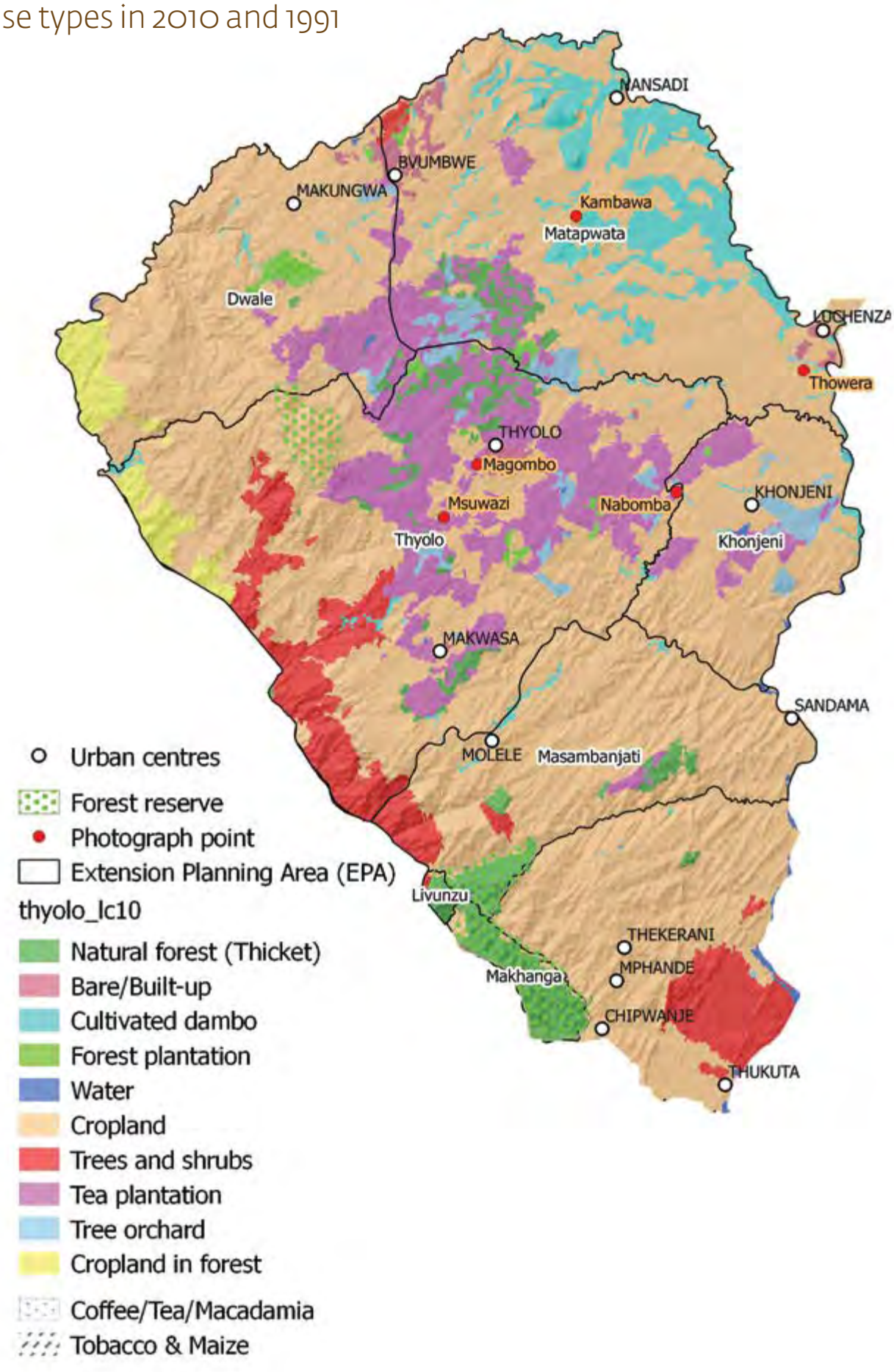
Contour ridges at Ntema in Luzu

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types in the district are cropland, forest reserve, and forests. No significant cover changes between 1991 and 2010 was discernable. The cover change was therefore not a major driver of soil loss in the district. However, there were signs of agricultural intensification in the cropland areas, which could be a significant driver of soil loss in the district.

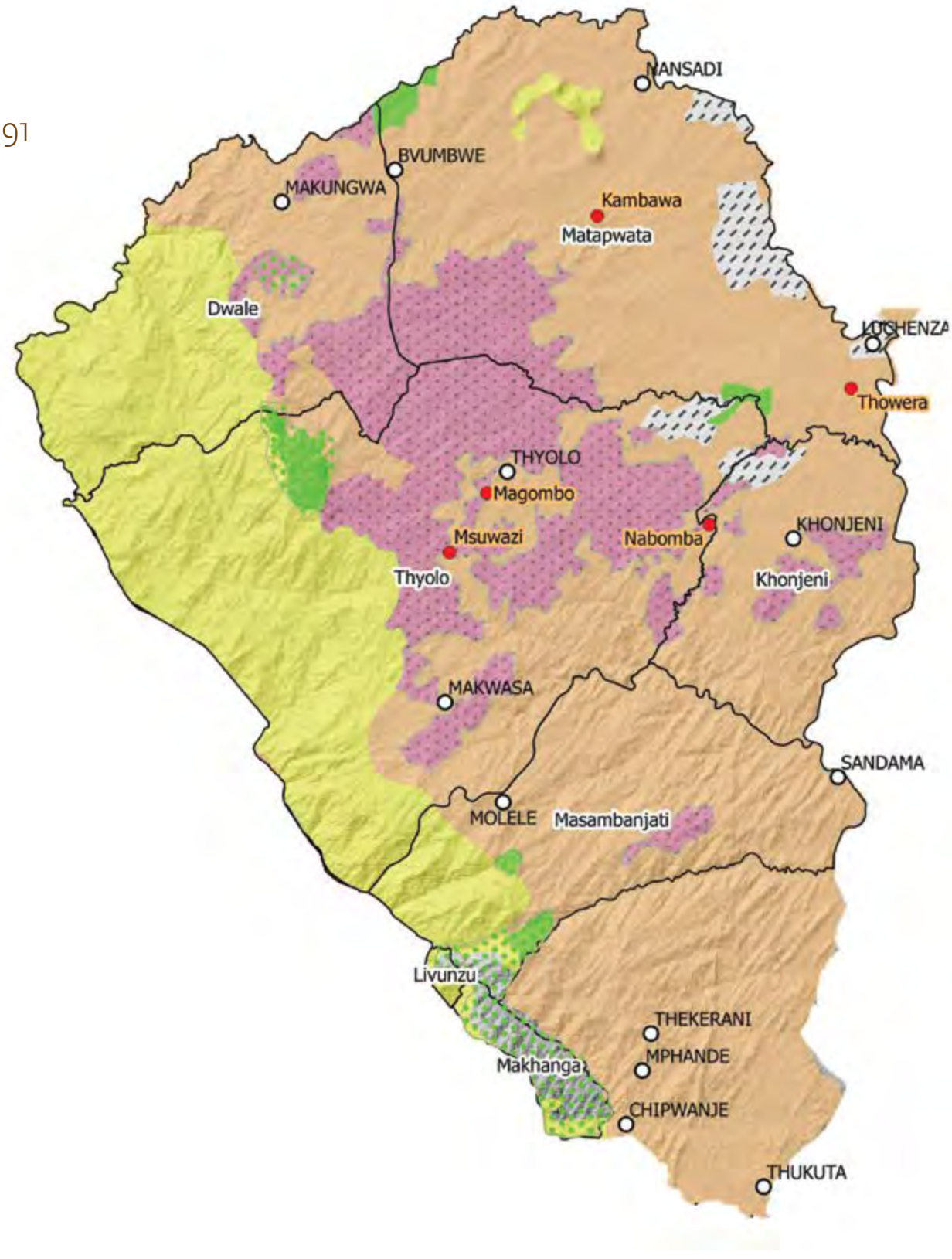
Major land cover/use types in 2010 and 1991

2010



Source of base map: Government of Malawi

1991



Source of base map: Government of Malawi

Macadamia plantation at Mapanga

Vegetation cover change

Source of base map: Government of Malawi

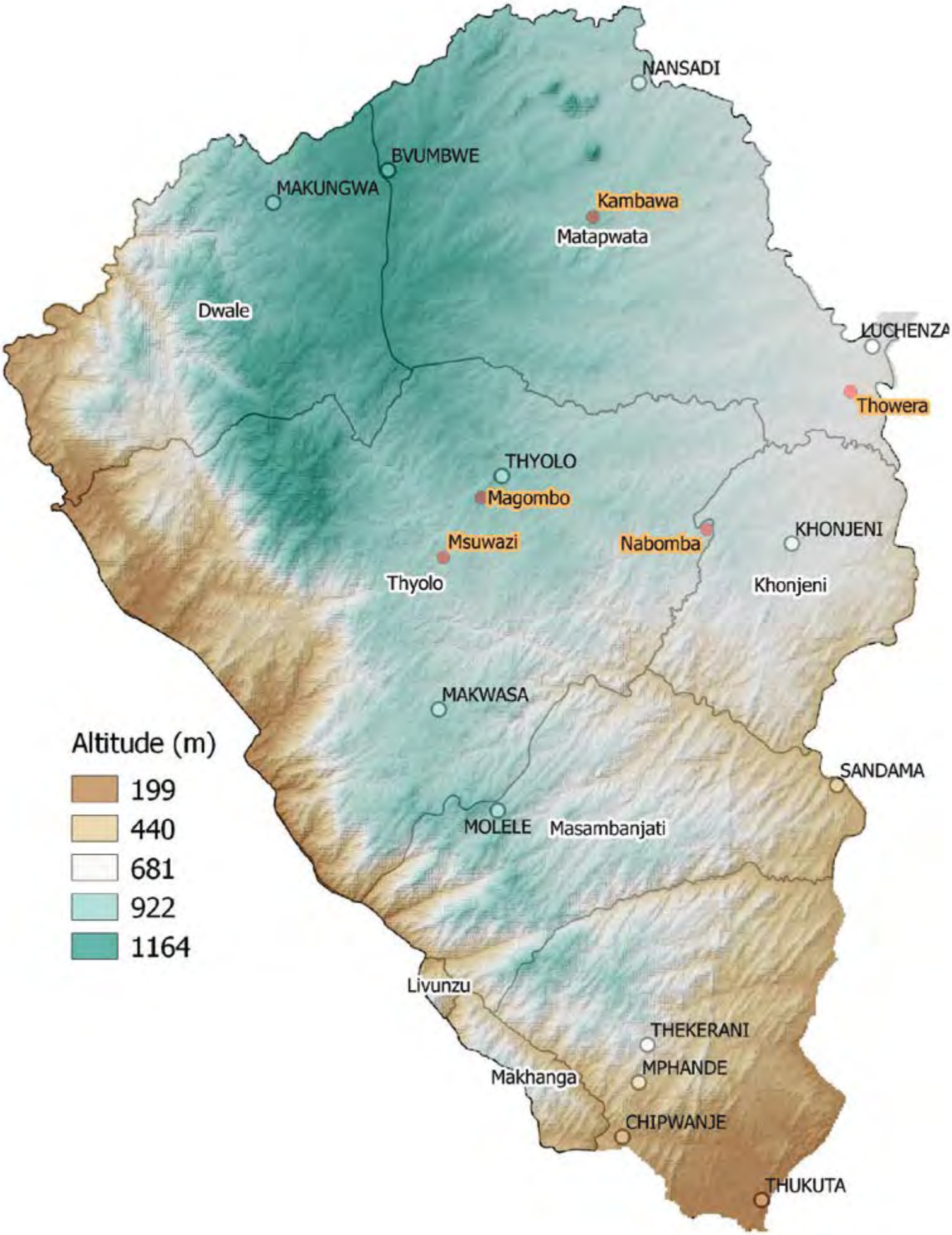
2. Rainfall, relief and soil factors:

Thyolo district is largely a flat plateau with deep soil except in the escarpments. The District has soil dominated by the young and fertile Cambisol. The footslopes have deep to moderately Luvisols.

Deep soil at Kautuka

Mixed depth soil Kambawav

Deep soil at Msuwadzi



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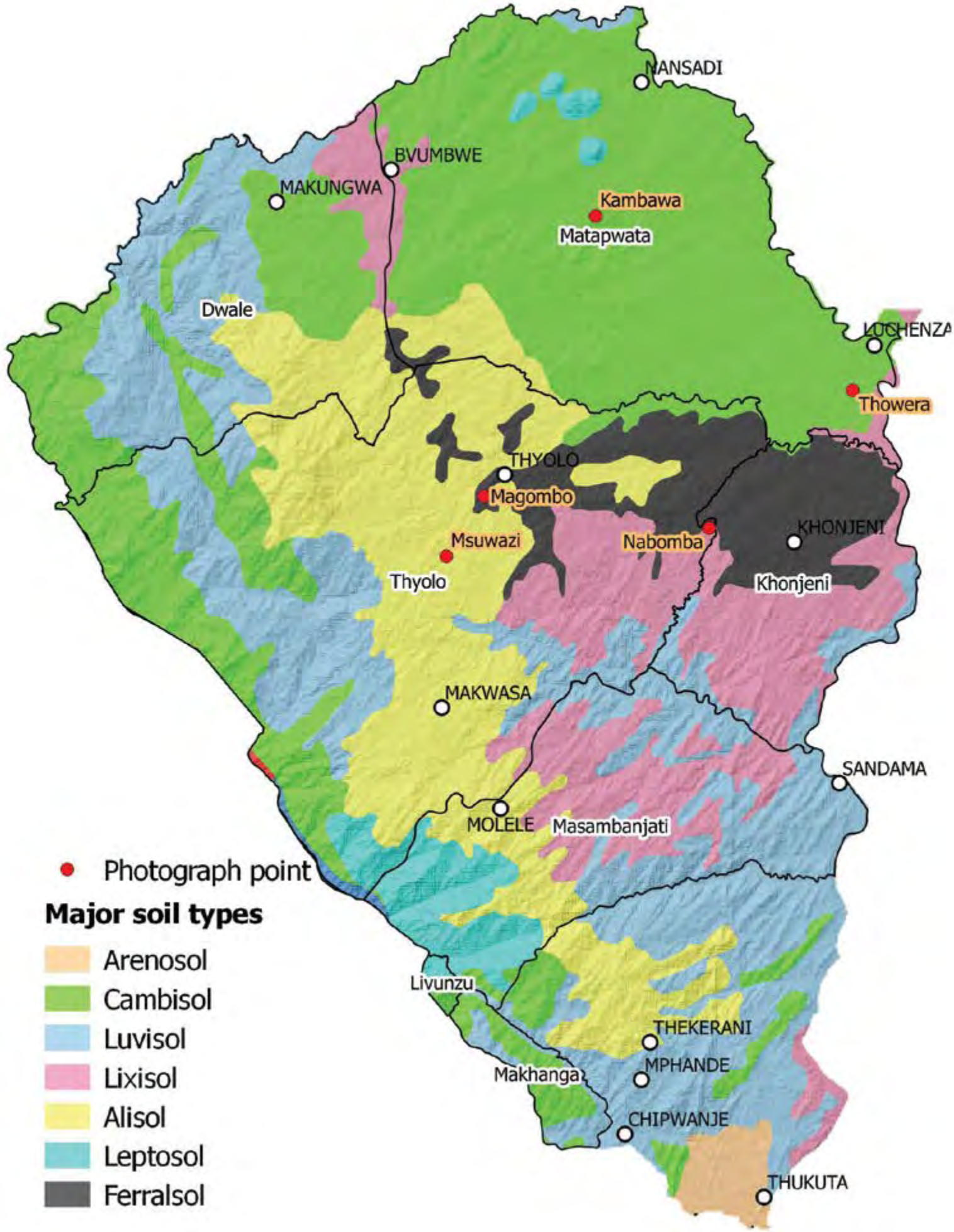

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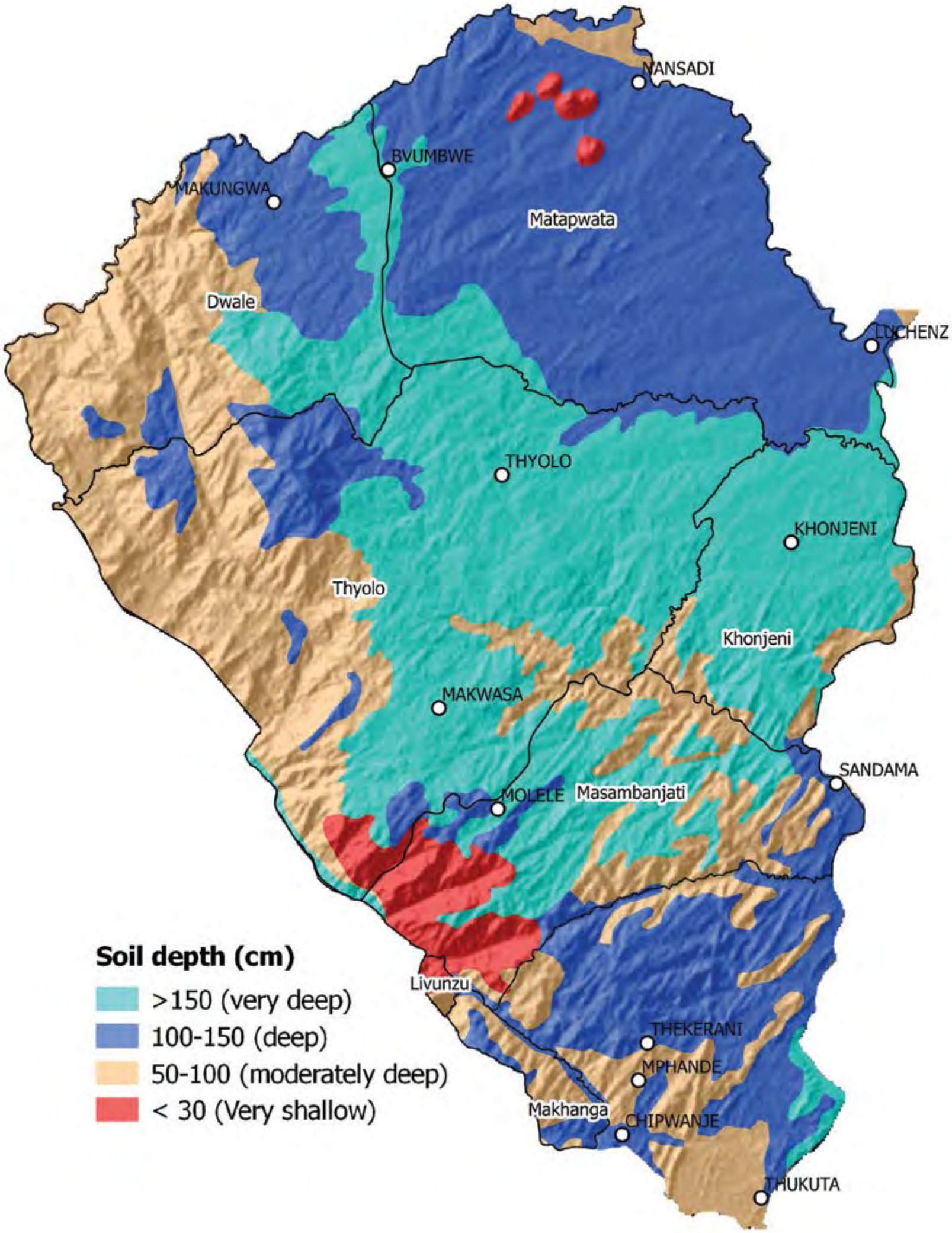


Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Matapwata	No change	6	72	852	818-882	Low risk
Dwale	No change	14	65	801	770-832	Low risk
Livunzu	No change	27	56	773	769-776	Low risk
Thyolo	No change	13	91	804	768-859	Low risk
Khonjeni	No change	8	48	847	823-870	Low risk
Makhanga	No change	20	51	775	769-780	Low risk
Thekerani	No change	14	53	795	774-824	Low risk
Masambanjati	No change	17	89	805	772-836	Low risk

Features of soil erosion

Sheet and gully erosion at Chandamale in Thekerani EPA

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 6.11 t/ha/yr. High soil loss rates were mainly in the steep escarpments. The main driving factors for the soil loss rates in these areas include shallow soil, vulnerable soil, and high rainfall. Sheet and rill erosion are the most common forms of erosion.

Extension Planning Area (EPA)	2014 Topsoil loss t/ha/yr		
	Mean	Minimum	Maximum
Matapwata	3.82	0.76	10.73
Dwale	9.90	1.06	15.35
Livunzu	4.16	0.94	11.74
Thyolo	9.22	0.91	15.37
Khonjeni	3.89	0.91	11.48
Makhanga	7.14	1.74	13.22
Thekerani	9.90	1.11	15.74
Masambanjati	9.62	1.64	14.63

Features of soil erosion

Sheet and rill erosion at Salijeni in Thekerani EPA

Gully and riverbank erosion at Msuwazi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm
Dwale	4.73	1.378	0.679	0.069	106.716	0.624	0.873	5.602	1.578	2.175	2.179	44.999	31.506
Khonjeni	4.80	2.064	1.017	0.103	16.049	0.377	0.428	4.935	2.397	0.592	2.592	26.958	14.257
Masambanjati	5.18	2.500	1.232	0.125	3.698	0.535	0.365	4.615	2.130	0.790	2.790	29.019	15.346
Matapwata	5.16	1.695	0.835	0.085	46.785	0.627	0.215	4.105	1.527	0.980	2.980	30.987	16.387
Thekerani	4.26	3.039	1.498	0.152	3.520	0.453	0.520	5.690	2.670	0.760	1.495	41.402	18.139
Thyolo	4.57	3.086	1.521	0.154	6.454	0.625	0.401	2.353	1.224	1.027	3.027	31.483	16.650
Livunzu	4.95	1.688	0.950	0.097	32.668	0.644	0.626	13.780	1.619	1.488	0.525	20.019	13.447
Makhanga	5.13	1.730	0.949	0.095	31.479	0.659	0.634	13.617	1.805	1.592	0.647	19.426	11.919

Typical cropland in July-August period in 2017

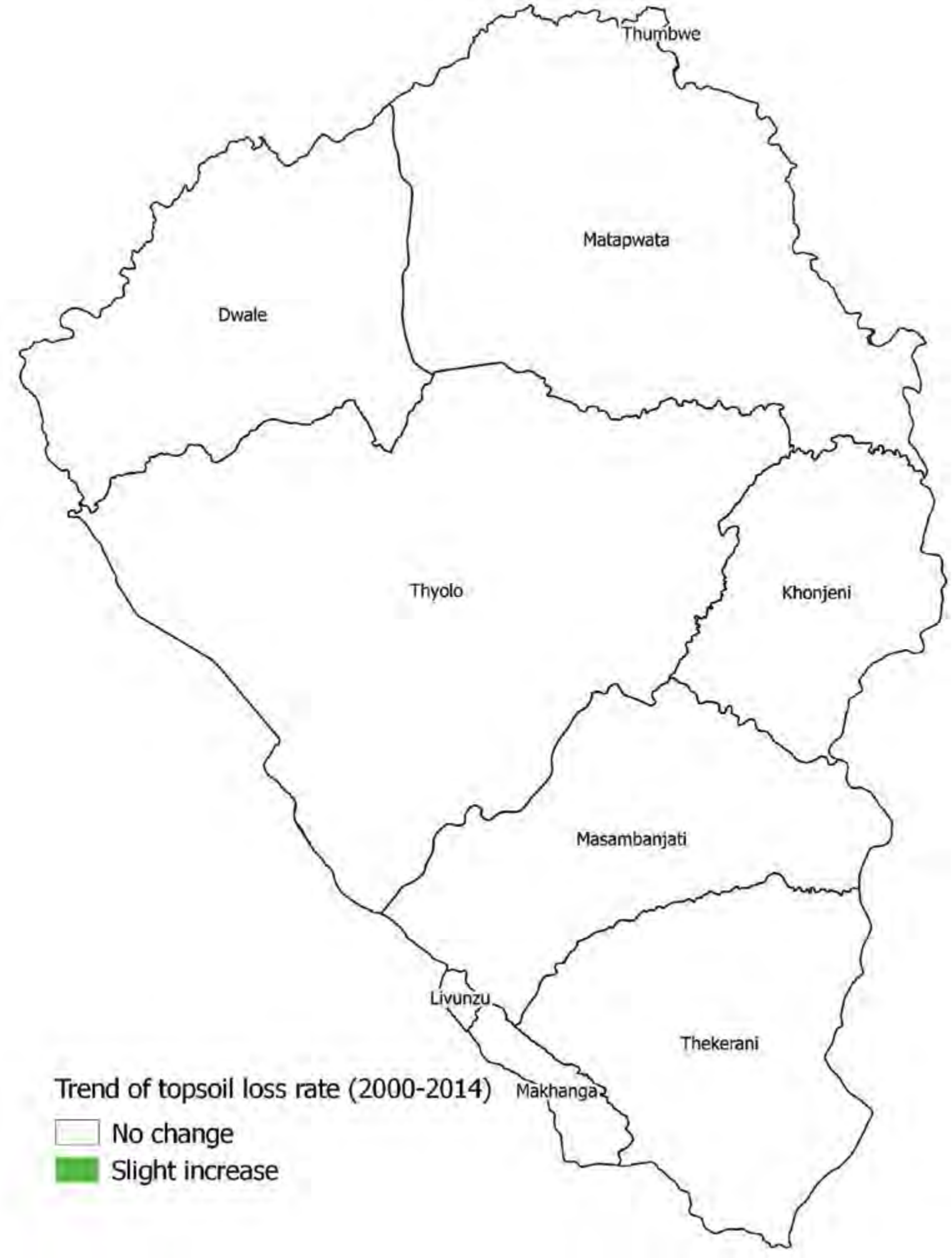
Cropland at Cedric in Matapwata EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

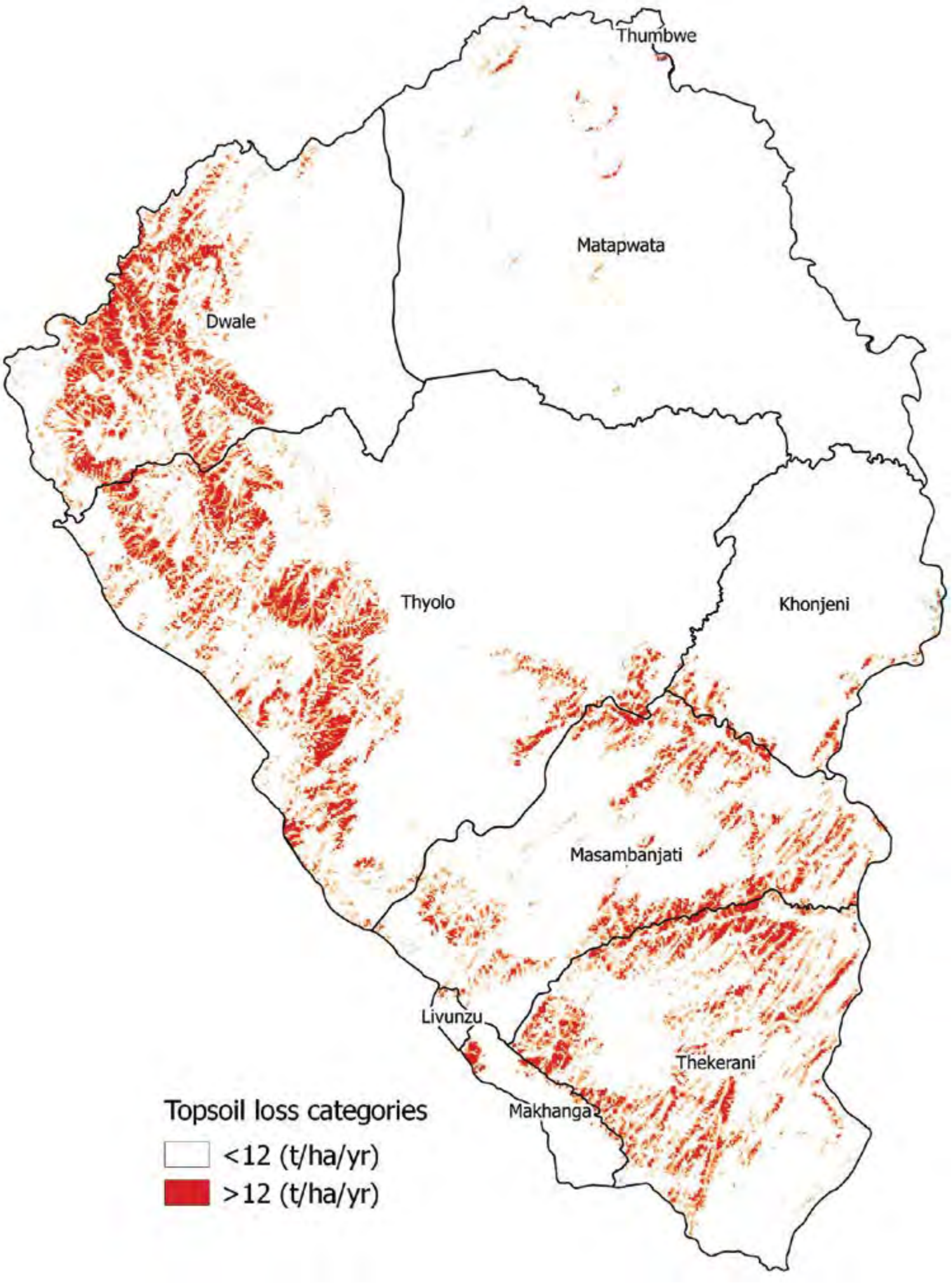
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Matapwata	0.096	0.004	0.308	0.409
Dwale	0.11	0.006	0.375	0.49
Livunzu	0.051	0.004	0.189	0.244
Thyolo	0.085	0.004	0.264	0.353
Khonjeni	0.047	0.003	0.172	0.222
Thekerani	0.113	0.024	0.403	0.54
Makhanga	0.059	0.012	0.207	0.279
Masambanjati	0.078	0.007	0.268	0.352

Topsoil loss trend between 2000 and 2014

Although the district has had no significant change in topsoil loss rates 2000 and 2014, its escarpments which run from the south and western parts may need monitoring as they have disproportionately high soil loss rates. They need more soil conservation efforts or protection from unsustainable land use practices.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the soil and water conservation practices

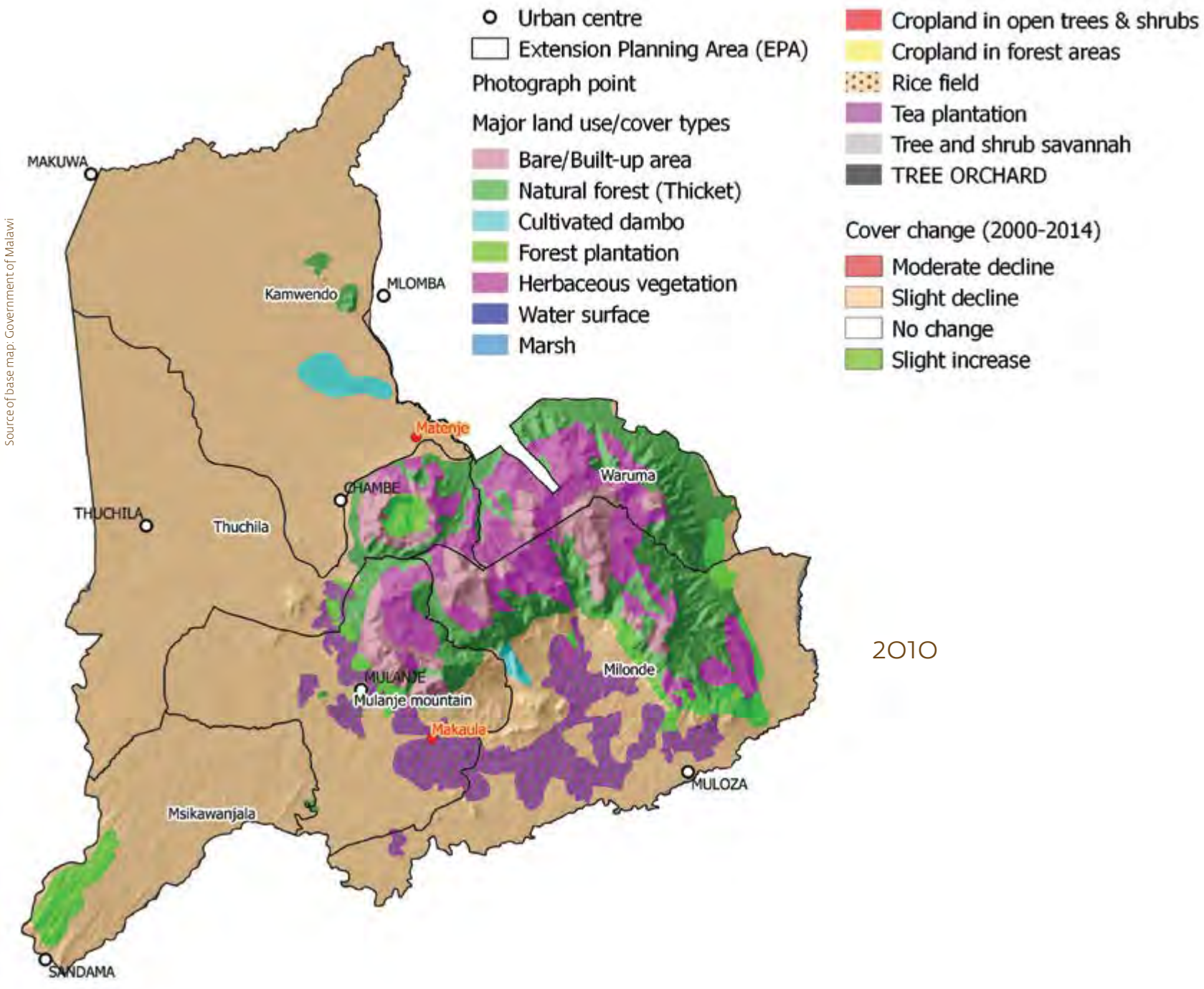
Maintenance of cover and fruit tree crops at Nabomba

Soil bunds and maintenance of cover crops at Thowera

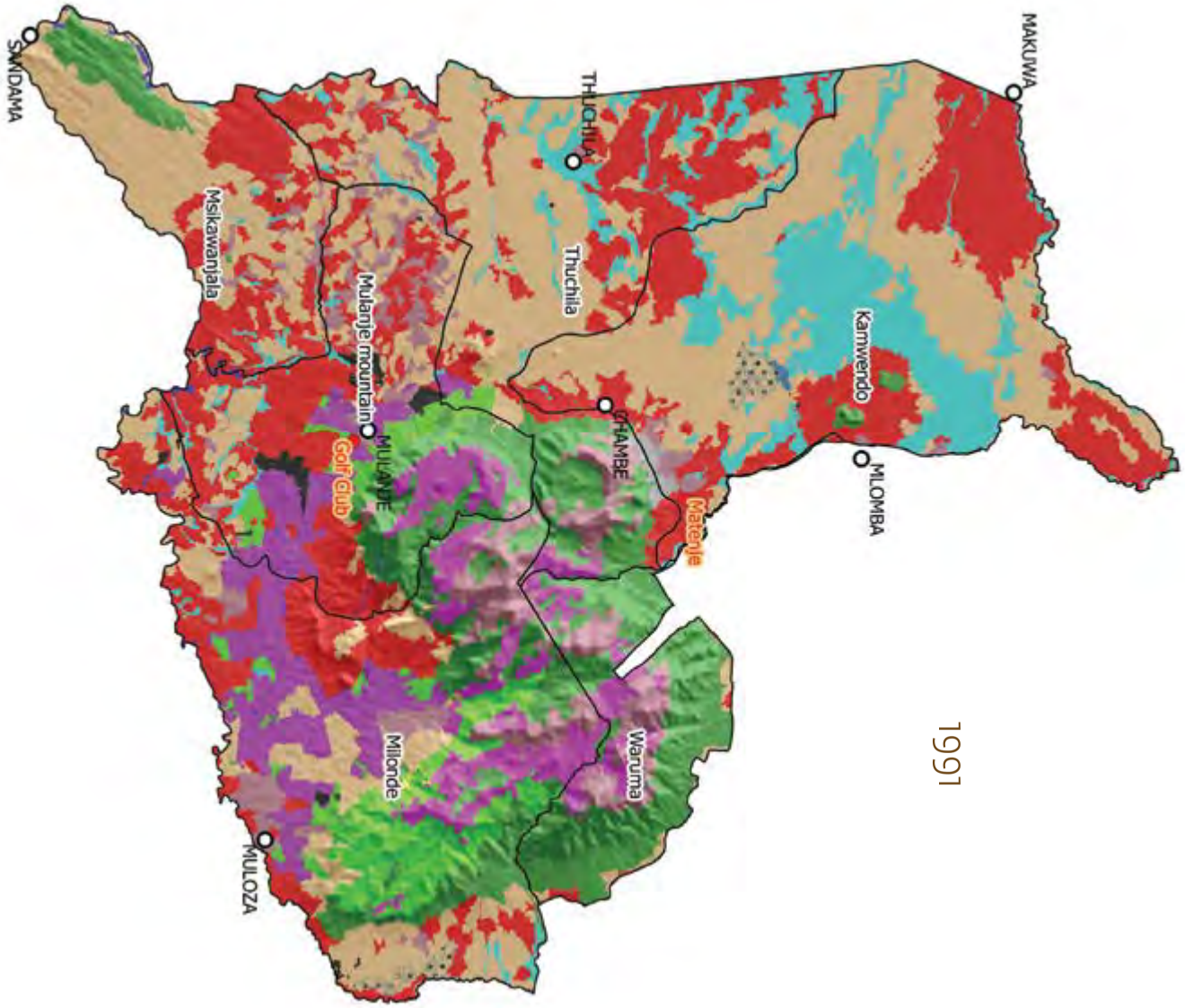
Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are smallholder croplands, estates, natural forests, and urban/ settlements. There was significant changes in proportion of the croplands between 1991 and 2010, notably the increase of tree crops in the plains and footslopes. The main threat to soil loss is the agricultural intensification

Major land cover/use types in 2010 and 1991



2010



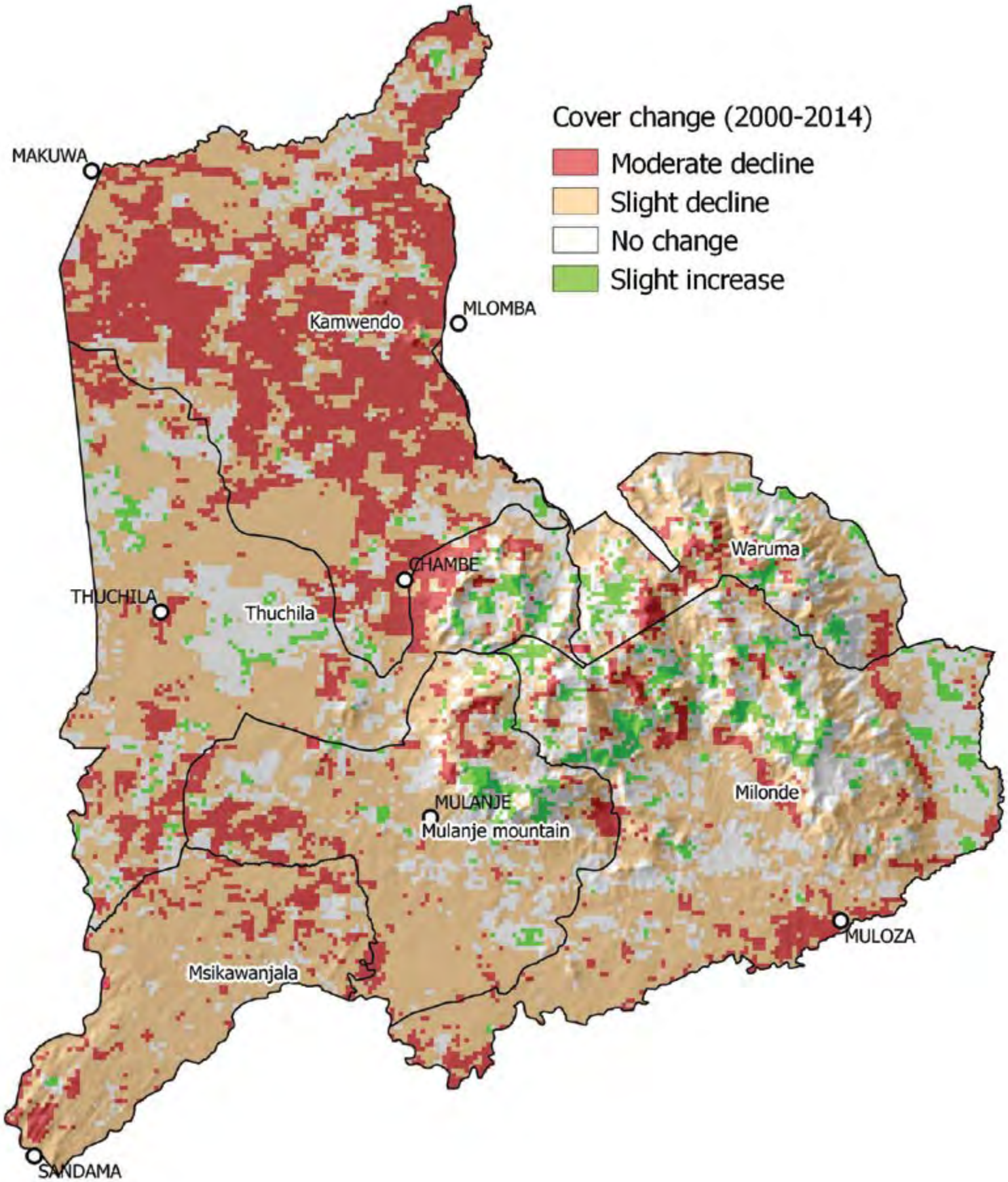
1991

Source of base map: Government of Malawi

3.21 Mulanje

Example of land cover type at Matenje and at Makula

Vegetation cover change

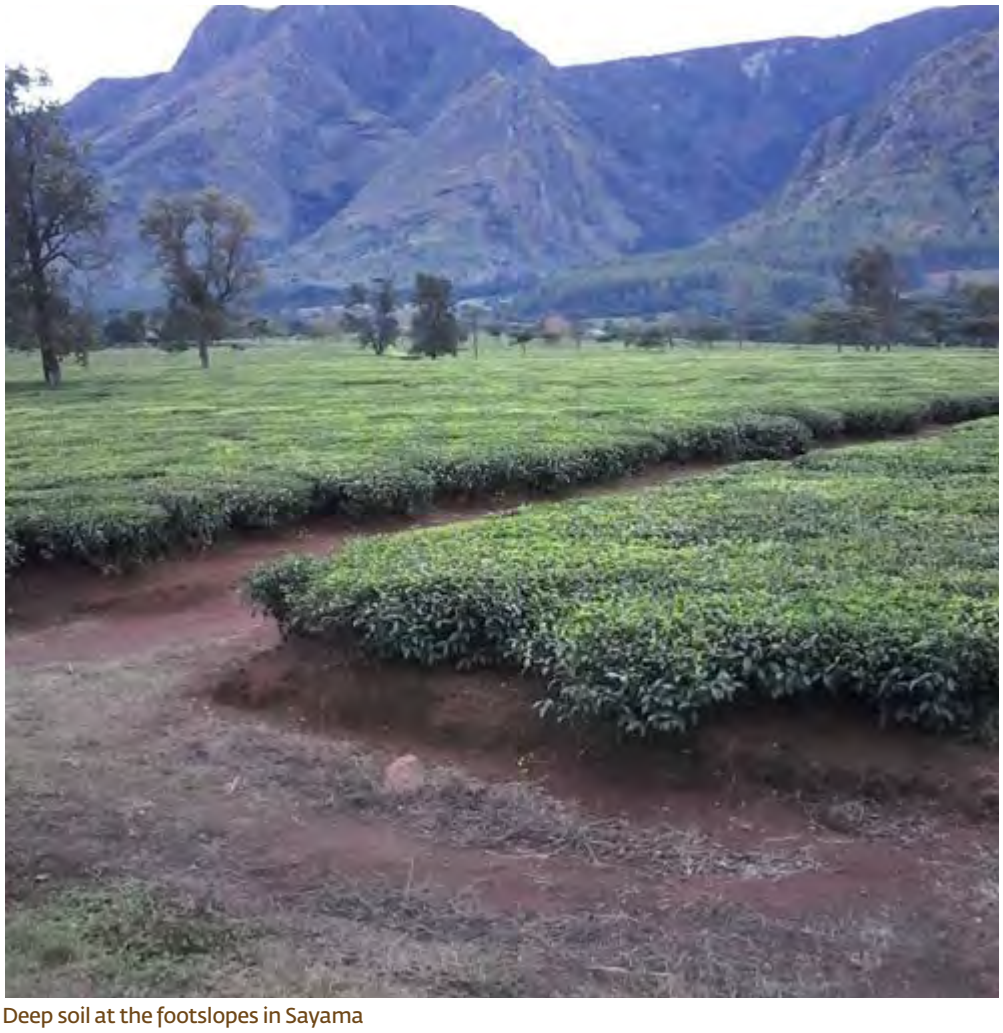


Source of base map: Government of Malawi

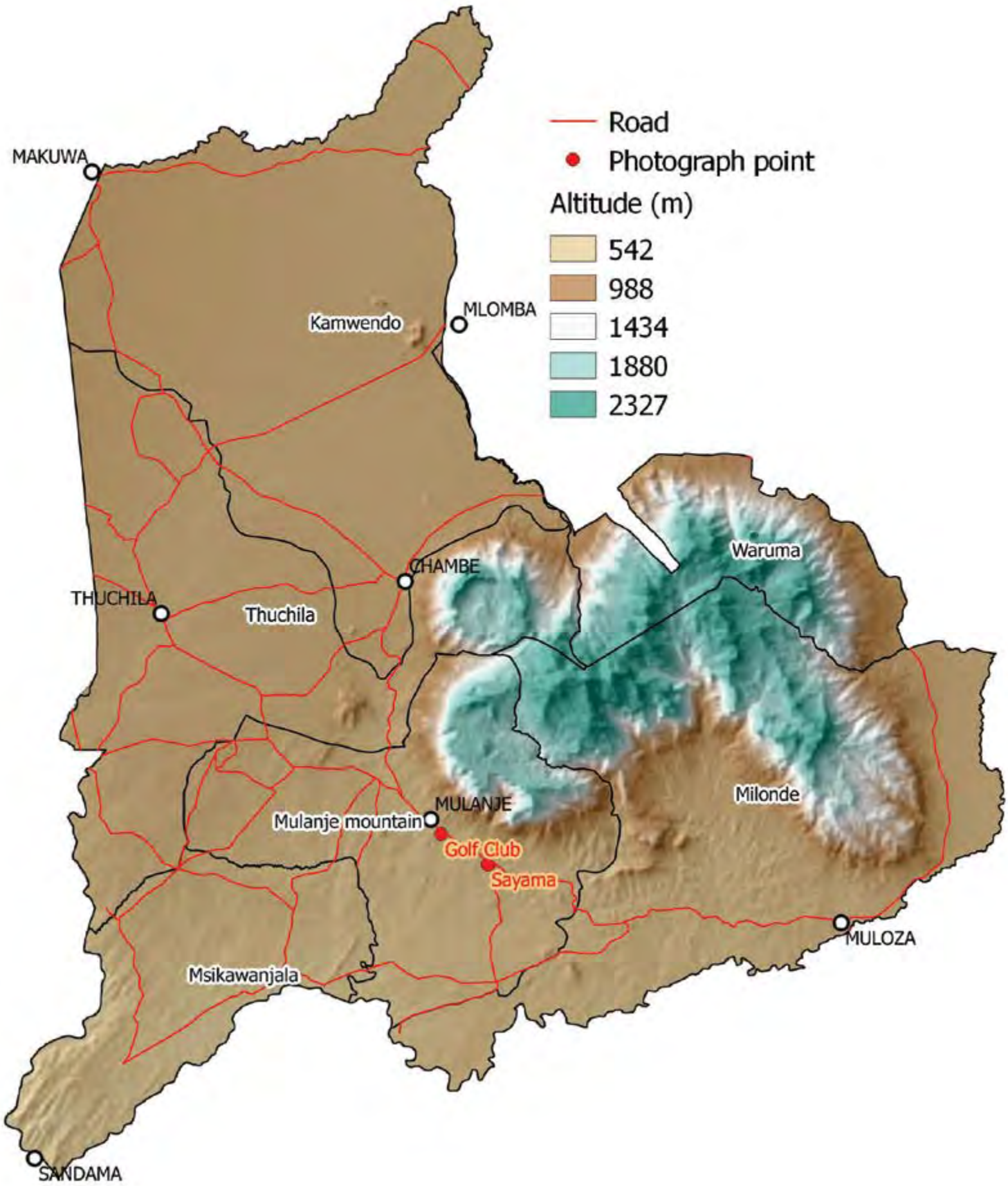
2. Rainfall, relief and soil factors

Mulanje District is rather flat save for the mountains in the central towards the eastern parts. The mountains have steep slopes and shallow soil. The shallow soil are more vulnerable to soil erosion especially where there is agricultural intensification and low vegetation cover.

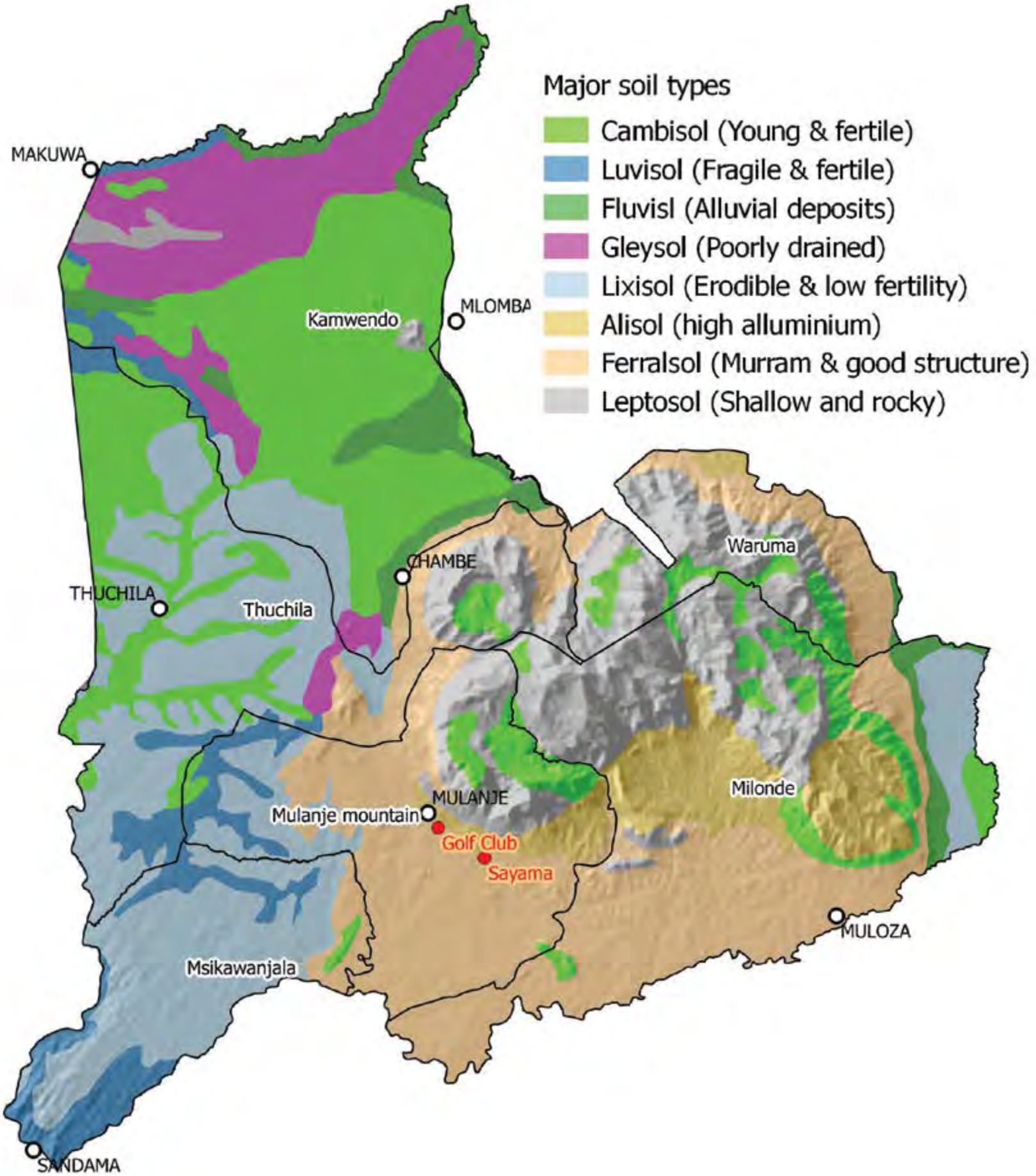
Steep slopes and shallow soil on the mountains at Mt. Mulanje



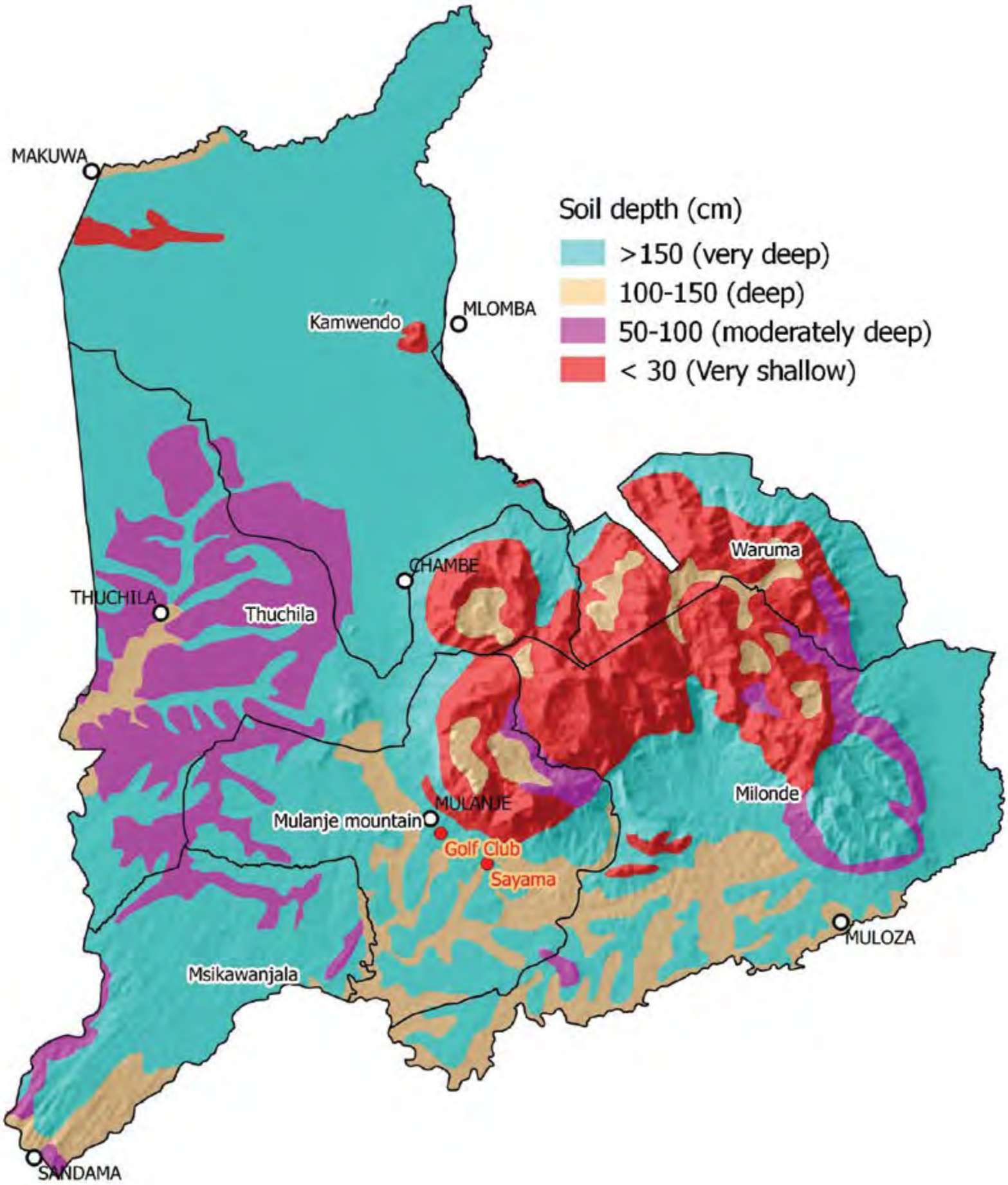
Deep soil at the footslopes in Sayama



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Kamwendo	Moderate	1.1	34.5	935	867-988	Moderate risk
Waruma	Slight	19.5	63.8	1001	965-1026	Moderate risk
Thuchila	Slight	5.1	68.5	919	866-980	Moderate risk
Milonde	Slight	12.2	66.8	975	896-1031	Moderate risk
Mulanje mountain	Slight	8.0	65.8	925	889-959	Moderate risk
Msikawanjala	Slight	3.9	29.4	875	834-912	Moderate risk

Features of soil erosion

Sheet and gully erosion at Mphaya

Sheet and gully erosion at Bafuta

Sheet and gully erosion at Bafuta

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 9.64 t/ha/yr. Milonde and Msikawanjala EPAs had indications of the highest soil loss rates. The main contributing factors for the soil loss rates in these areas included the presence of vulnerable soils and agricultural intensification.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Kamwendo	2.4	1.57	11.4
Waruma	12.4	1.12	21.5
Thuchila	5.8	1.50	33.4
Milonde	15.0	2.10	23.4
Mulanje mountain	9.6	1.17	33.1
Msikawanjala	17.4	3.59	33.0

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Kamwendo	5.89	1.444	0.710	0.072	10.469	0.719	0.588	5.173	1.475	0.886	2.962	23.536	23.469
Milonde	4.37	1.758	0.868	0.088	20.394	0.567	0.439	3.013	1.036	0.379	0.697	16.567	22.590
Msikawanjala	4.76	4.770	2.355	0.240	11.201	0.592	0.604	4.738	1.538	1.450	4.350	26.102	23.927
Mulanje Mountain	4.33	1.958	0.965	0.098	21.336	0.590	0.510	3.460	1.280	0.825	0.771	14.288	10.018
Thuchira	4.89	2.415	1.190	0.120	21.798	0.740	0.538	4.960	1.205	1.792	0.728	11.837	11.484
Waruma	5.47	1.725	0.966	0.094	33.653	0.488	0.701	4.329	2.302	1.507	0.614	21.342	14.514

Typical croplands in July-August period in 2017

Cropland at Machwambo in Mulanje Mountain EPA

Cropland at Mtepuwa in Msikwanjala EPA

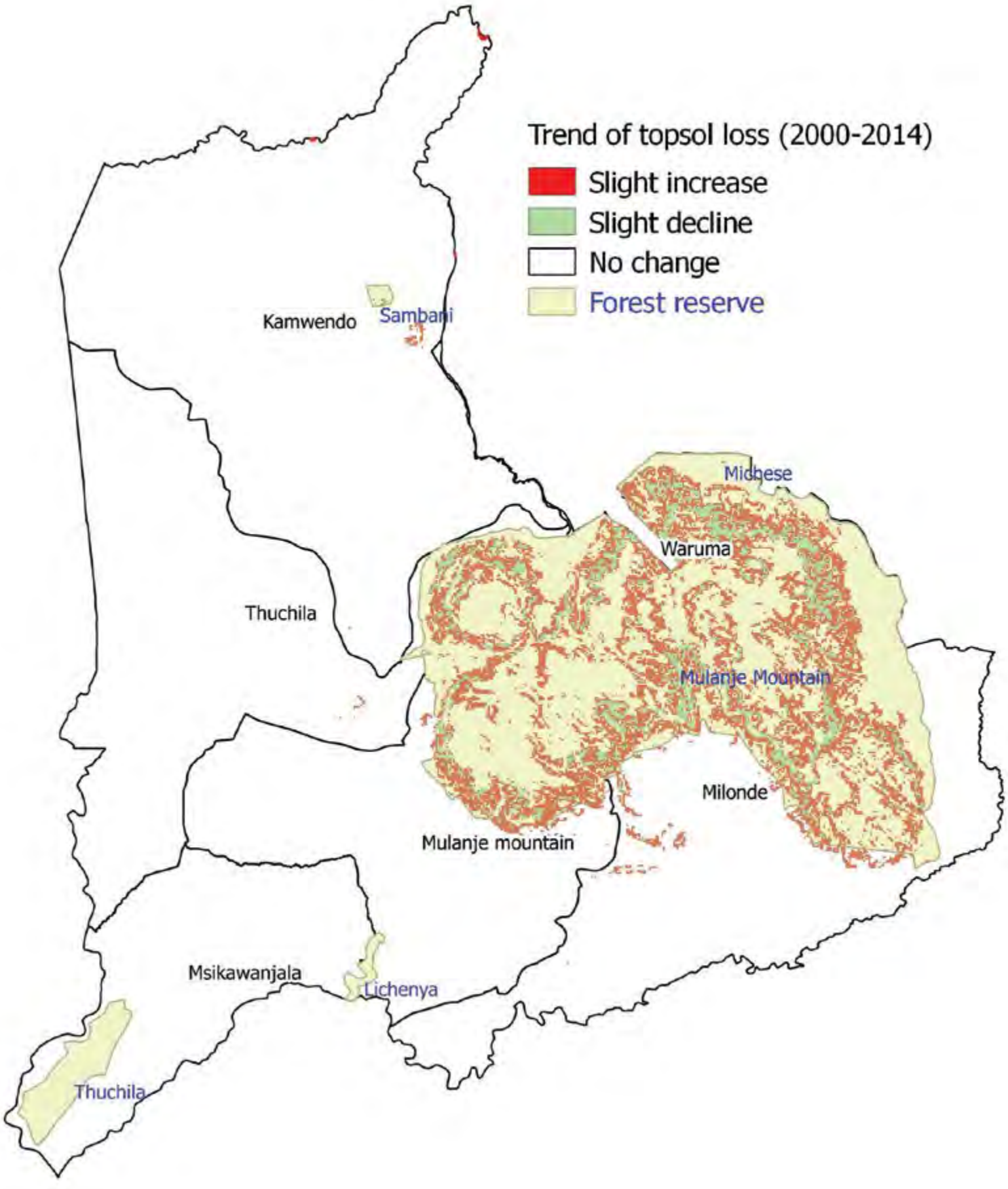
Cropland at Mchiwa in Kamwendo EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

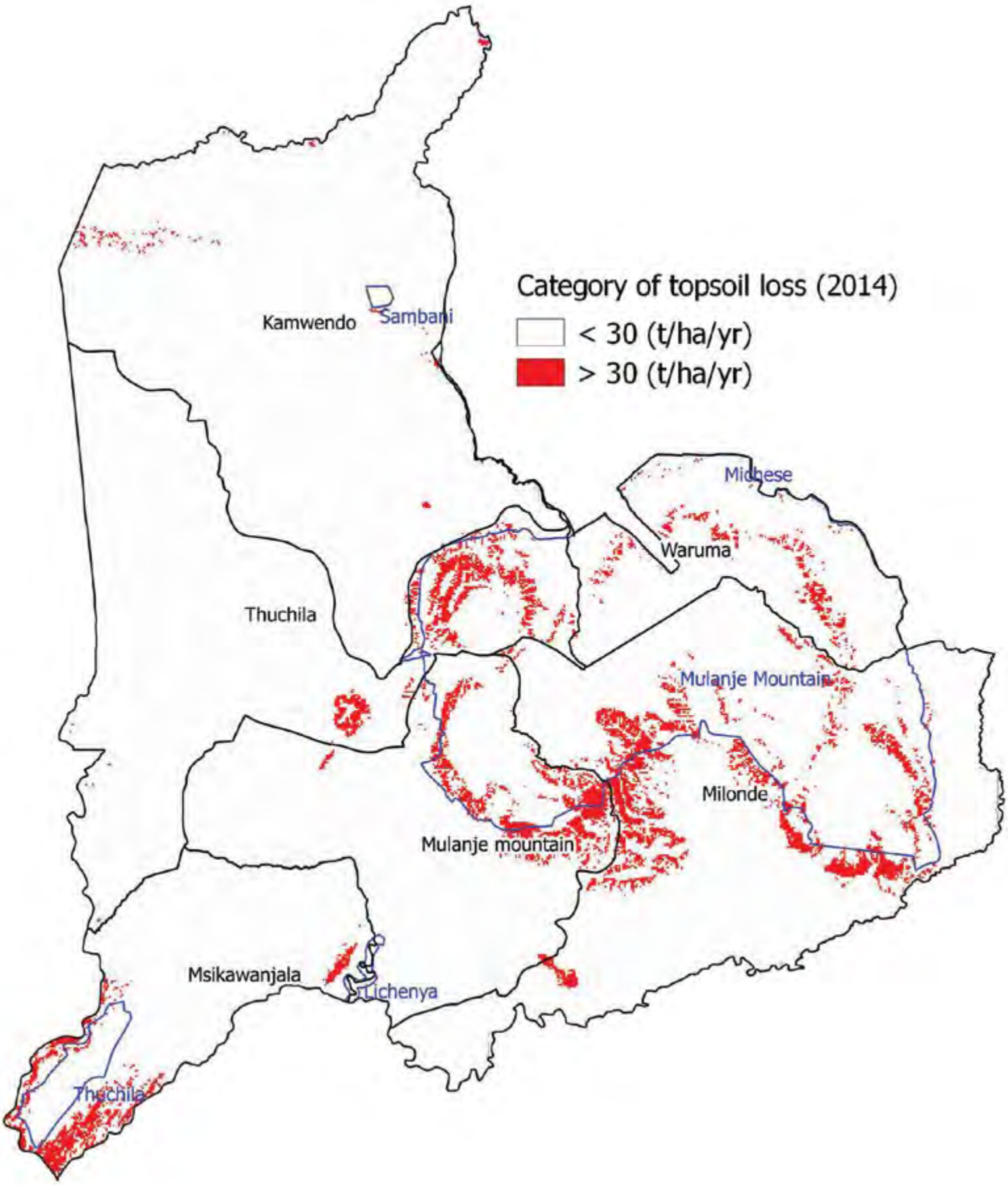
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean anvailable P loss	Sum of mean NPK loss
Kamwendo	0.062	0.003	0.2	0.265
Waruma	0.073	0.004	0.239	0.316
Thuchila	0.059	0.003	0.186	0.248
Milonde	0.047	0.01	0.154	0.212
Mulanje mountain	0.039	0.002	0.139	0.18
Msikawanjala	0.068	0.01	0.248	0.326

Topsoil loss between 2000 and 2014

The trend of topsoil loss rates in the District was increasing between 2000 and 2014 in the mountainous areas and in places with intensified agriculture. Except for Mulanje Mountain Forest Reserve, the other forest reserves had some effects in controlling soil loss within their jurisdiction.



Source of base map: Government of Malawi

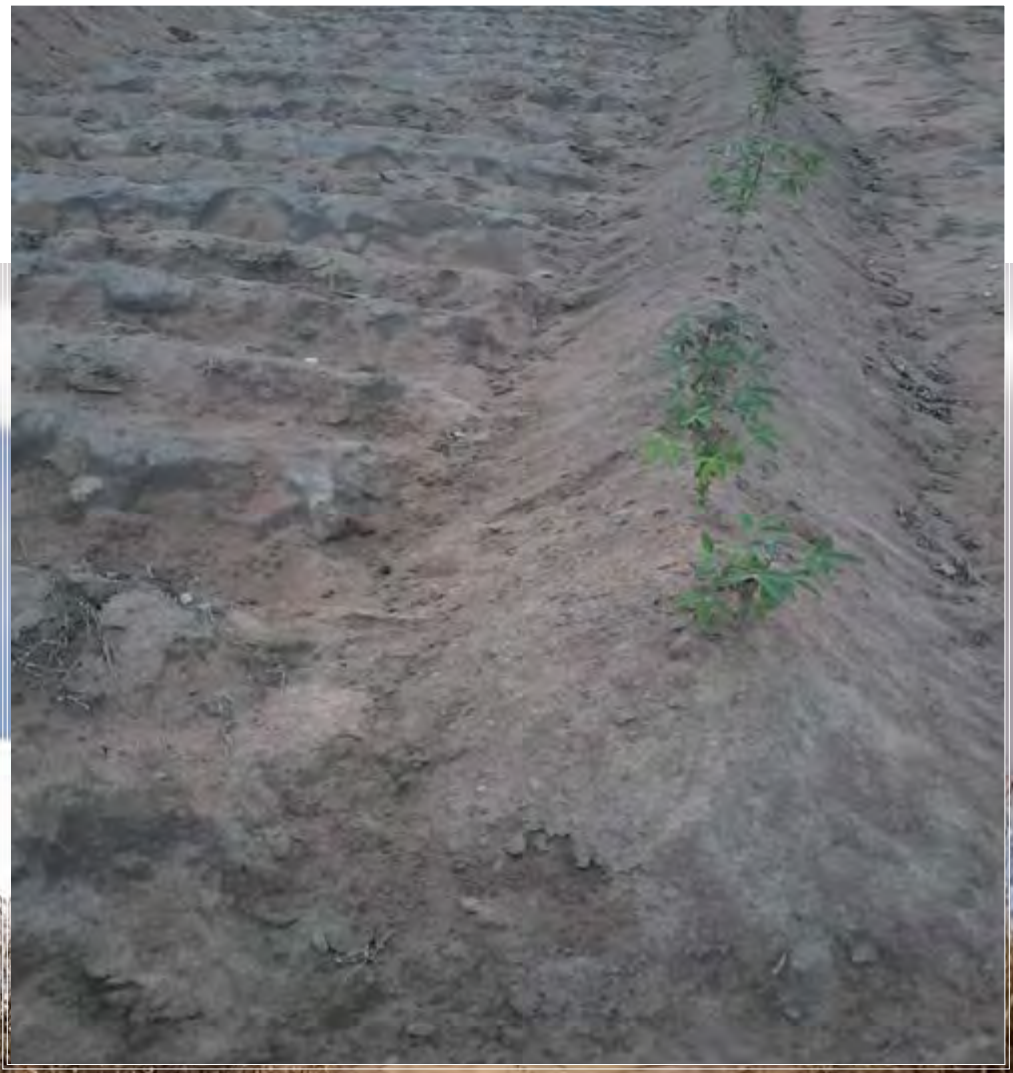


Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

Planted forest at Sayama

Contour and border ridges at Juma and Musisi



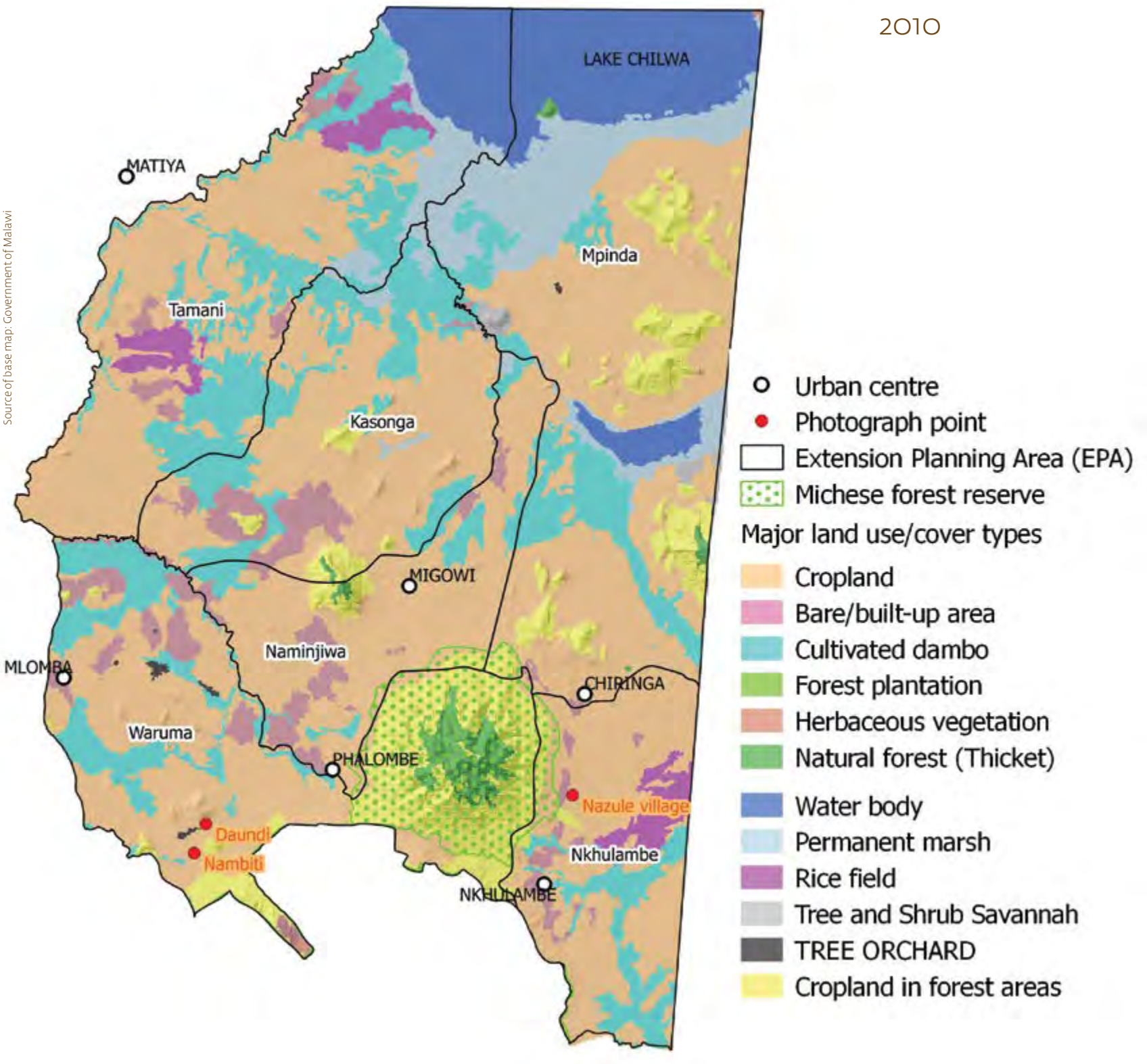
Contour and border ridges at Juma and Musisi

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are smallholder croplands, urban/ settlements, water bodies, and forests. In terms of cover change, the district has had a significant decline in natural forest cover especially due to agricultural expansion and human settlements. This a major driver of soil loss in the district.

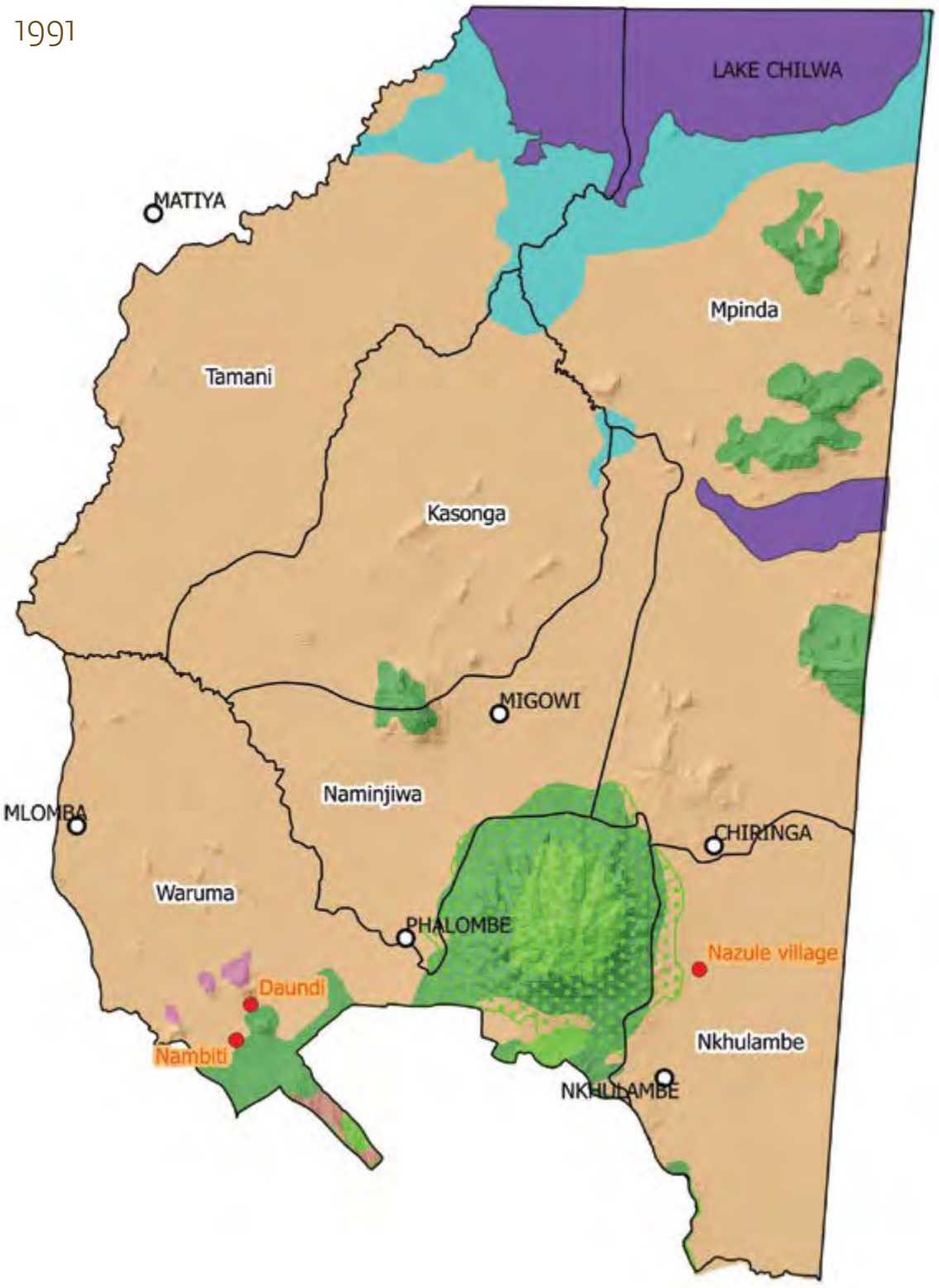
Major land cover/use types in 2010 and 1991

2010



Source of base map: Government of Malawi

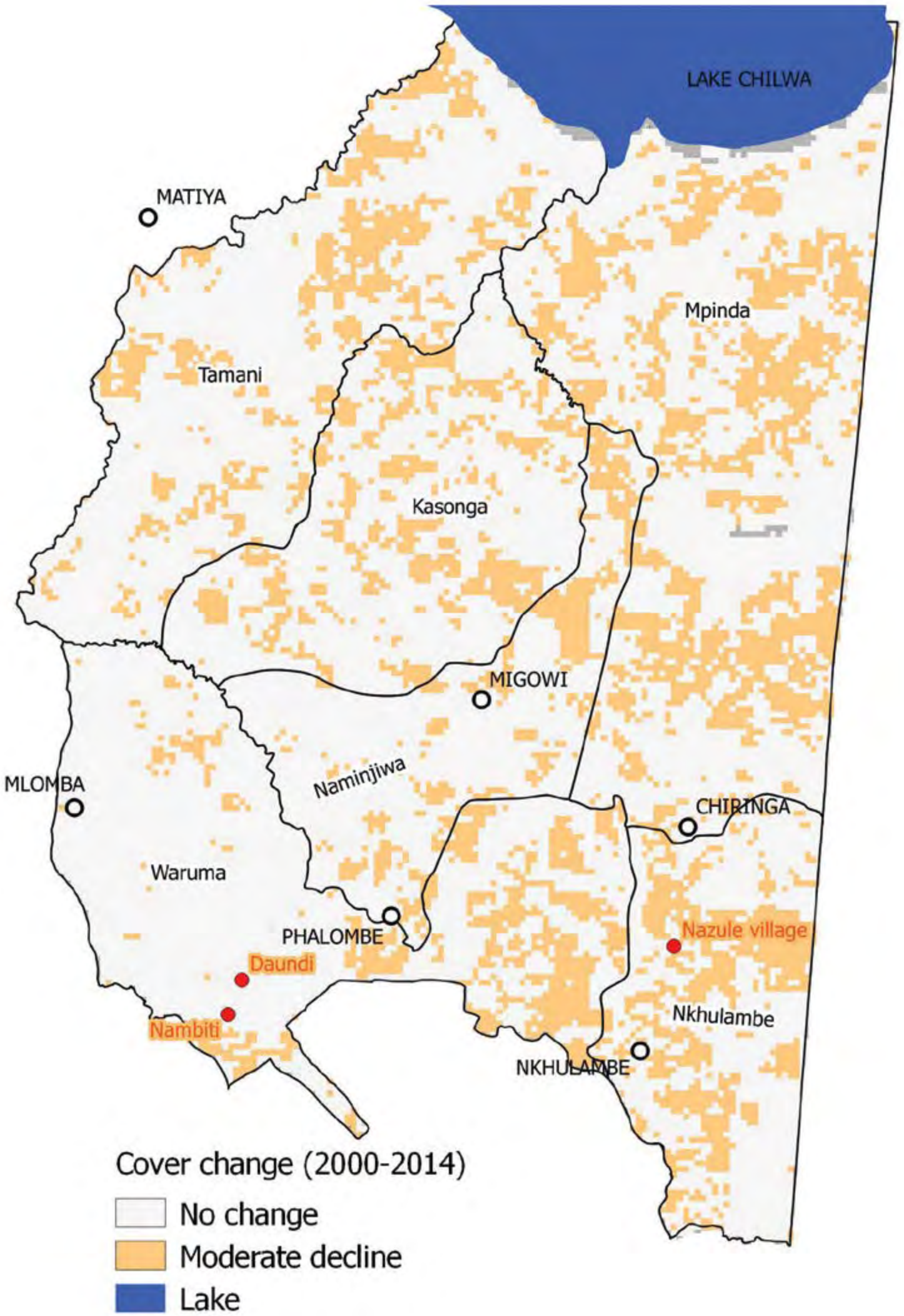
1991



Source of base map: Government of Malawi

Example of land cover types at Chiringa in Lolo village in 2016

Vegetation cover change



Source of base map: Government of Malawi

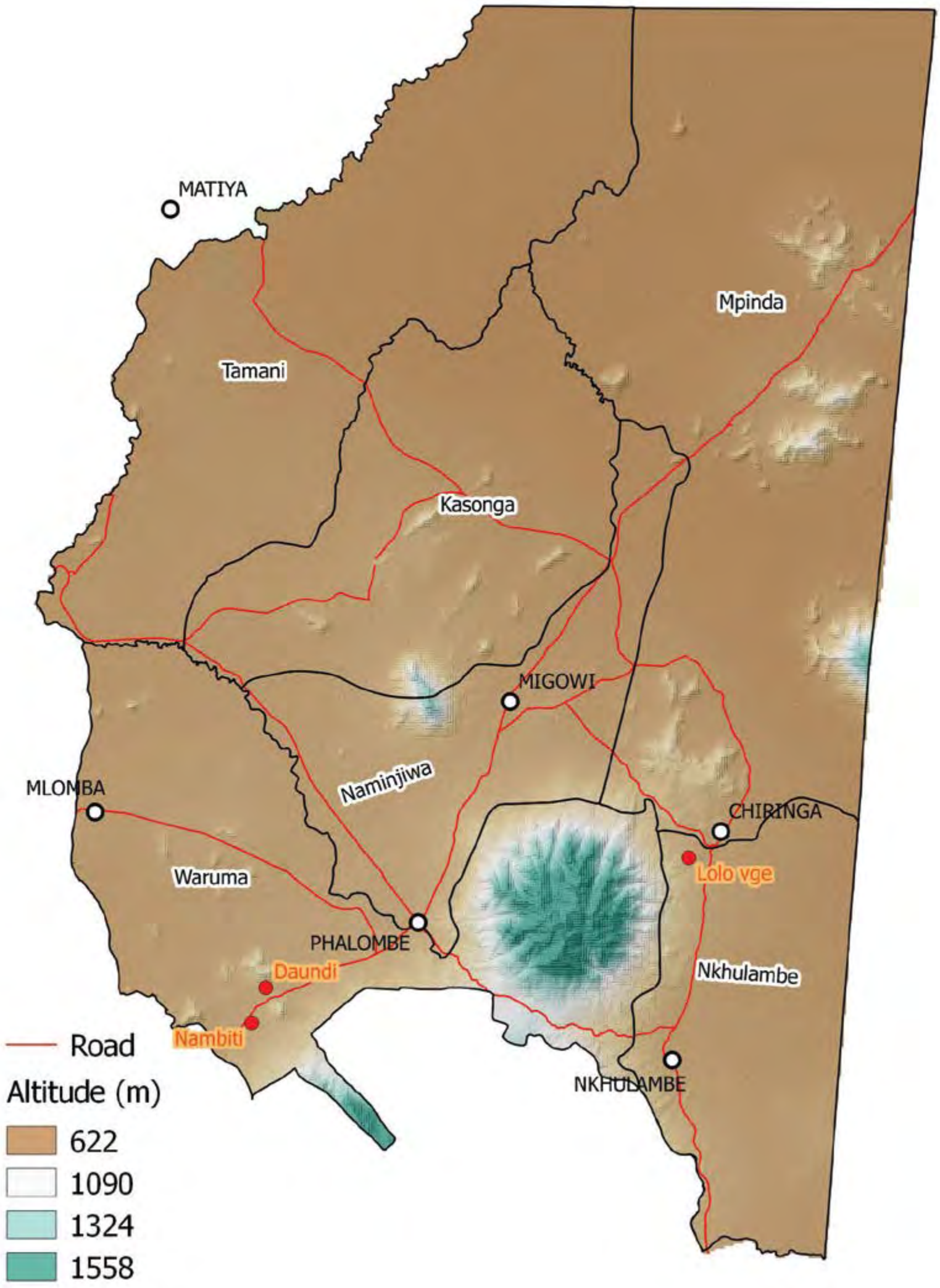
2. Rainfall, relief and soil factors

Phalombe district is flat except the eastern parts where there are Michesi mountains. The soil is deep elsewhere except for the escarpments. Most of the areas have young and fertile Cambisol soil type. There is a potential for exploitation of this soil through agricultural activities; implying some chances of vulnerability to soil loss.

Deep soil on gentle-flat terrain at Khalima

Deep soil on footslope at Mandanda

Cropland at Mchiwa in Kamwendo EPA



Source of base map: Government of Malawi

Source of base map: Government of Malawi

3.22 Phalombe

Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Tamani	Slight decline	1.26	39	949	923-988	Low risk
Mpinda	Slight decline	4.73	81	1010	927-1150	Low risk
Kasonga	Slight decline	3.41	93	1003	960-1053	Low risk
Naminjiwa	Slight decline	3.73	94	1044	1003-1110	Low risk
Waruma	Moderate decline	13.00	99	1005	963-1048	Moderate risk
Nkhulambe	Slight decline	3.04	37	1043	1020-1071	Low risk

Features of soil erosion

Sheet and rill erosion at Mphipa

Rill and gully erosion at Mulera

Gully erosion at Chibuka

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 10.22 t/ha/yr.High soil loss rates were mainly in the mountain ranges. The main factors for the soil loss rates in these areas include reduced protective vegetative cover, soil vulnerability and steep slopes. Sheet and rill erosion are the most common forms of erosion.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Tamani	10.05	1.06	17.85
Mpinda	7.61	0.39	9.68
Kasonga	11.34	0.63	16.35
Naminjiwa	10.09	0.83	35.17
Waruma	14.17	0.54	34.69
Nkhulambe	8.28	3.92	10.61

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Kasonga	5.52	1.430	0.706	0.072	28.690	0.578	0.583	3.628	1.239	1.521	4.564	27.384	25.102
Mpinda	6.15	1.038	0.510	0.053	36.182	0.648	0.805	4.153	1.434	0.941	2.823	16.937	15.526
Nkhulambe	4.95	1.578	0.778	0.080	30.439	0.541	0.516	2.922	1.048	0.929	0.879	22.934	26.702
Tamani	6.23	1.845	0.908	0.093	20.874	0.338	0.570	7.483	1.291	1.369	4.107	24.642	22.588
Waruma	5.57	1.450	0.713	0.073	31.151	0.583	0.504	3.121	1.050	1.409	1.213	19.781	30.875
Naminjiwa	5.33	1.462	0.922	0.085	32.975	0.491	0.699	4.102	2.342	1.356	0.052	19.880	14.834

Typical cropland in July-August period in 2017

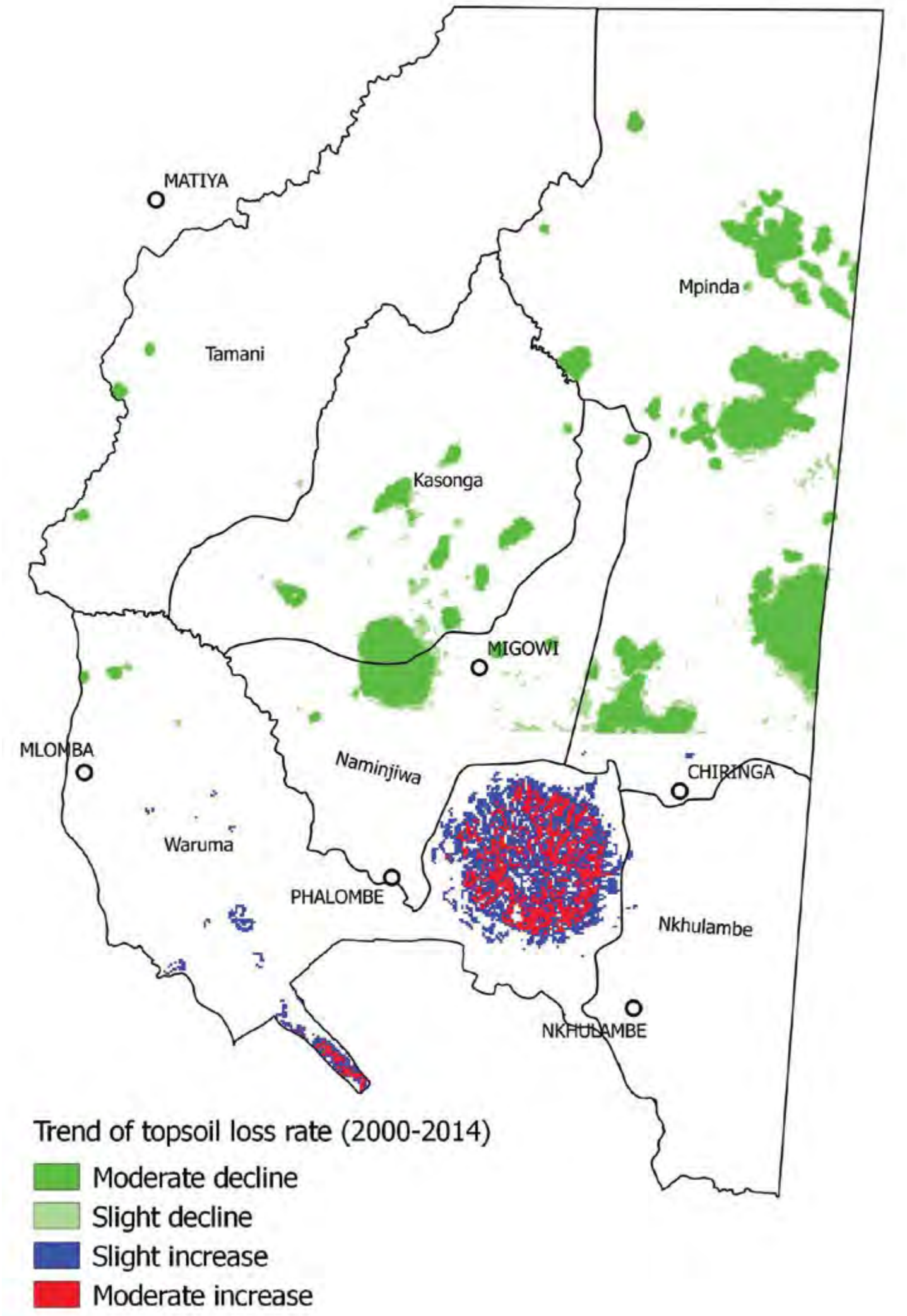
Cropland at Chiduba in Nkhulambe EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

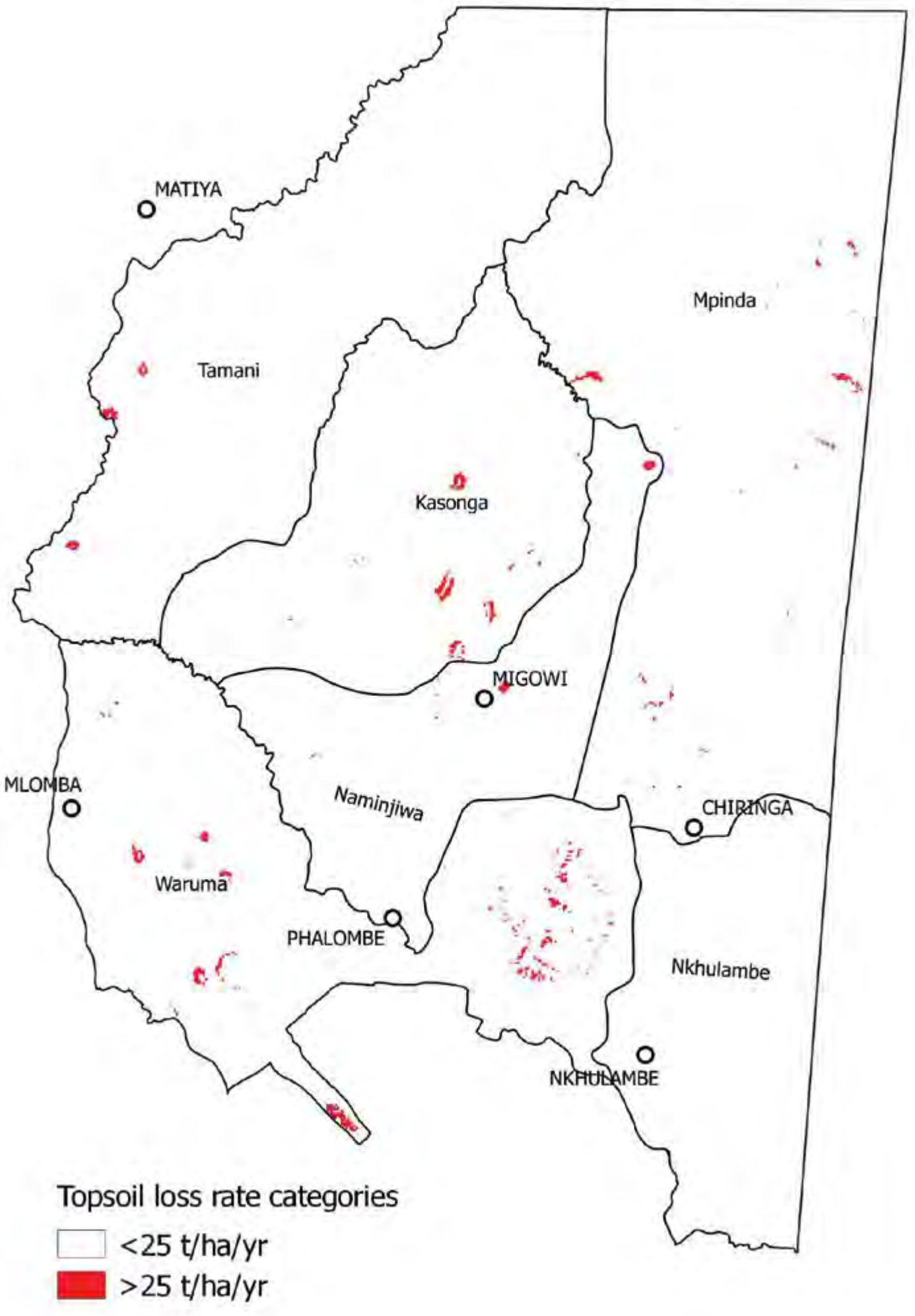
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Tamani	0.076	0.004	0.294	0.374
Mpinda	0.062	0.015	0.218	0.295
Kasonga	0.089	0.005	0.331	0.426
Naminjiwa	0.098	0.006	0.39	0.494
Nkhulambe	0.096	0.025	0.361	0.482
Waruma	0.073	0.004	0.239	0.316

Topsoil loss trend between 2000 and 2014

The rate of topsoil loss in the District was constant between 2000 and 2014. Sheet and rill erosion are the most common forms of soil erosion problems. The affected areas are those in the Rift Valley sections.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Bare cropland exposed to raindrop splash erosion at Salanya in Waruma EPA

Some of the soil and water conservation measures

Vegetative cover maintenance at Zambasa tree plantation

Vetivar hedge and residue incorporation at Nambiti

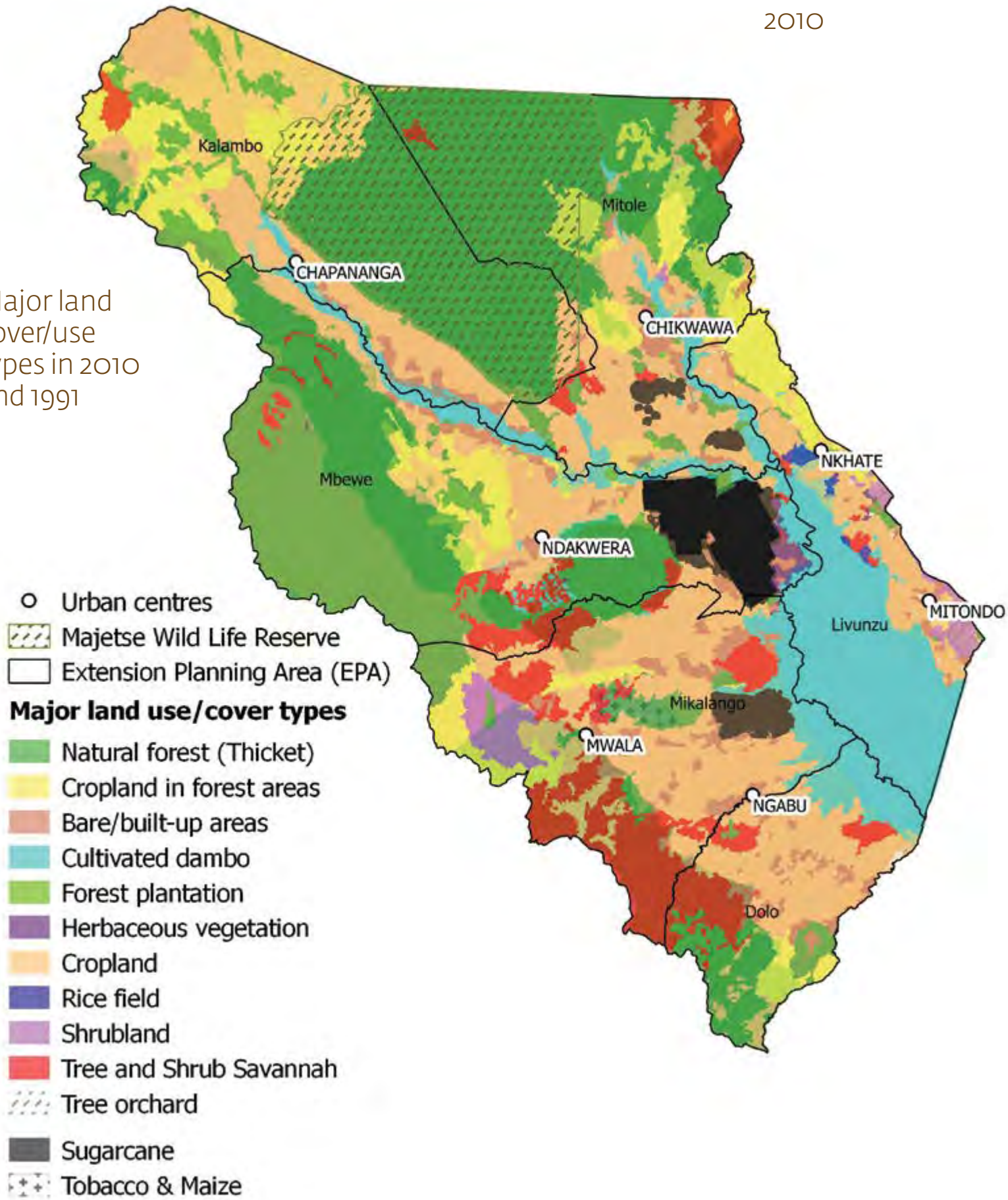
Contour ridges in a cropland at Mkhwayi in Tamani EPA

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types in the district are cropland and forests. There is also extensive stretch of Dambos in the south-eastern part of the district. Some noticeable increase in the vegetative cover between 1991 and 2010 was discernable in the eastern and southern parts of the district. In the north, signs of vegetation cover loss especially due to the conversion of natural forest into croplands have been spotted.

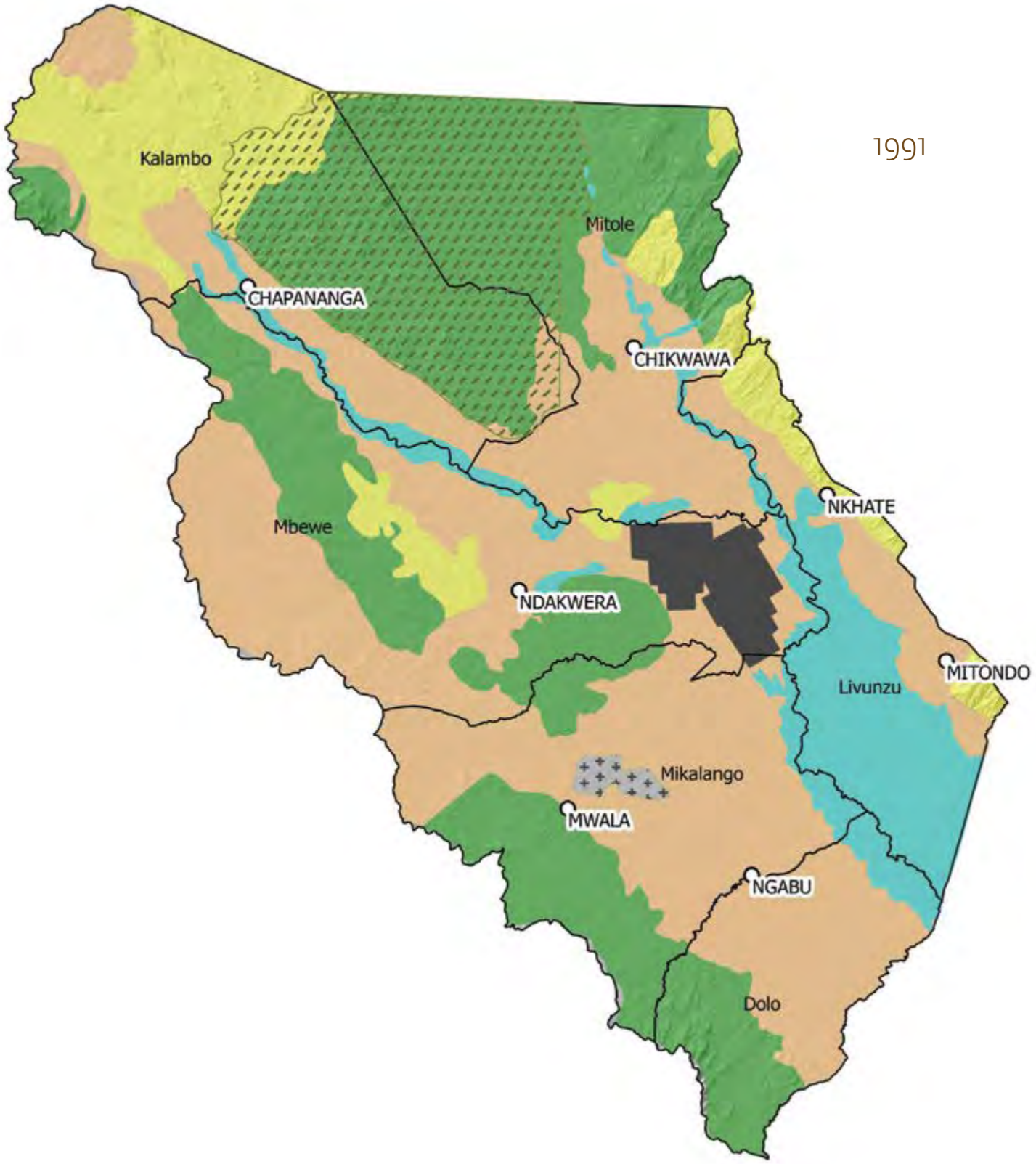
Major land cover/use types in 2010 and 1991

2010



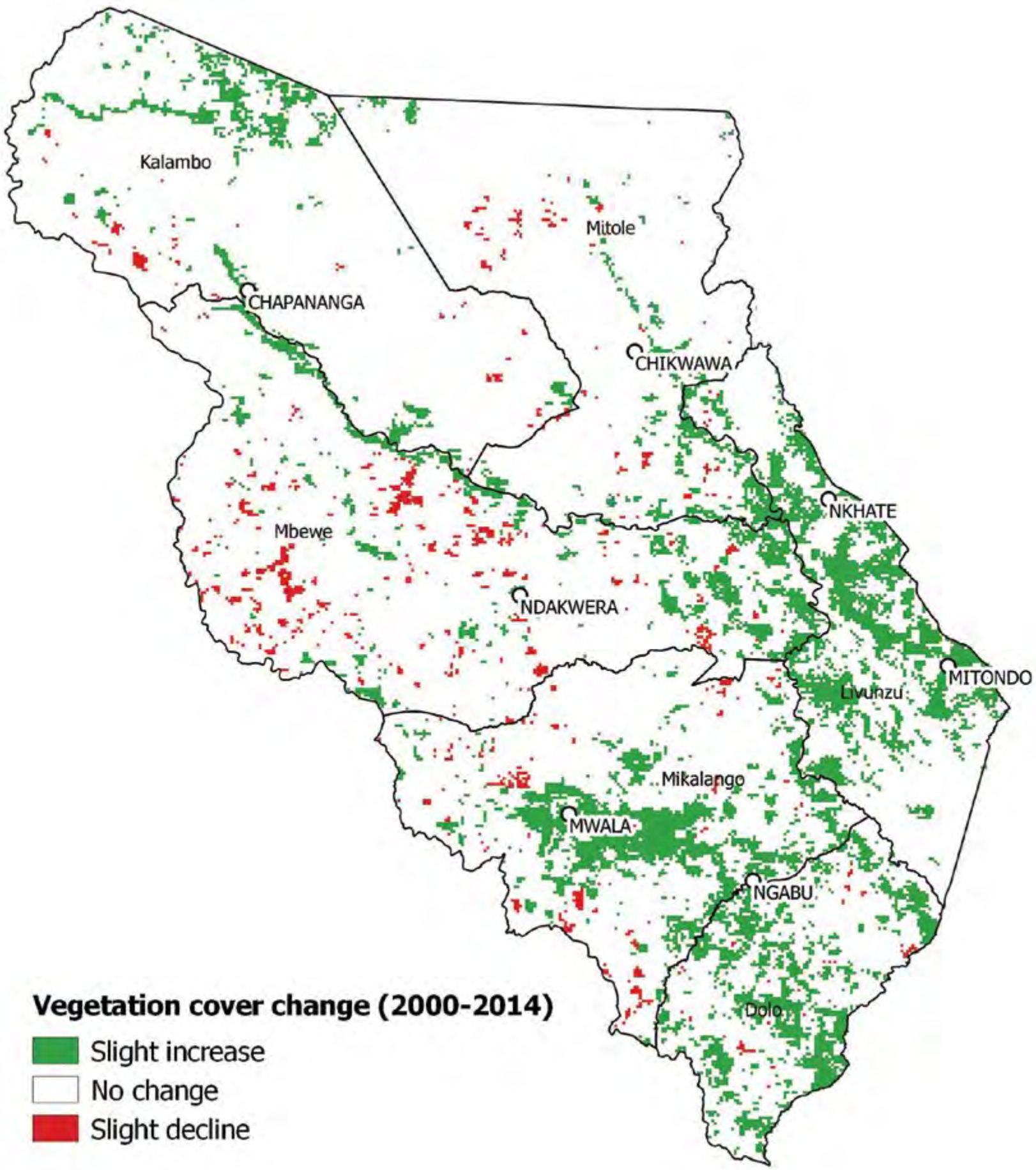
Source of base map: Government of Malawi

1991



Source of base map: Government of Malawi

Vegetation cover change



Source of base map: Government of Malawi

Example of land cover at Nkhate

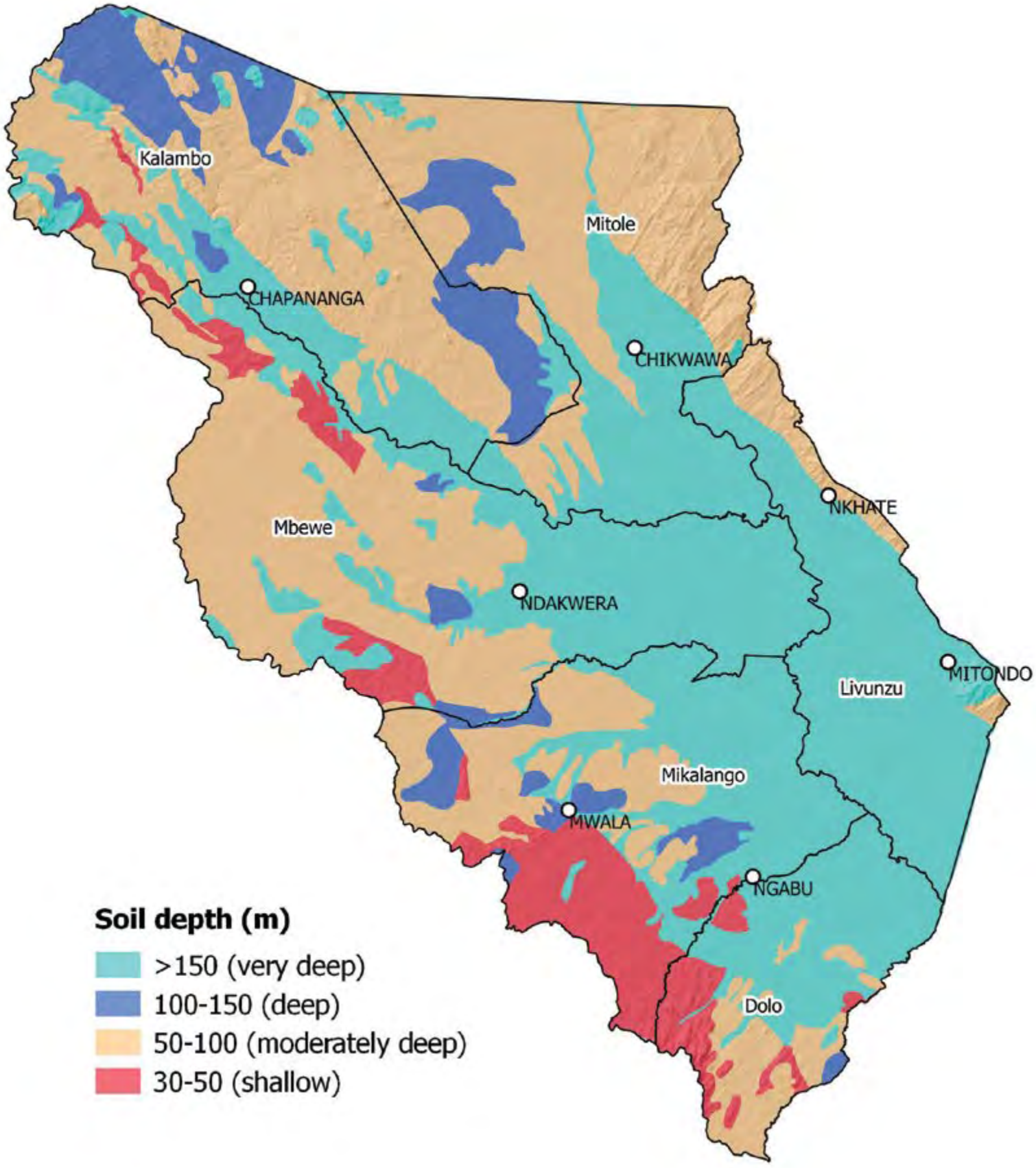
2. Rainfall, relief and soil factors

Chikwawa district slopes towards southeast. Its depth also increases southeast-wards. The shallower soils are dominated by the young and fertile Cambisol while deep soils are mainly Fluvisol and Luvisols. Fluvisols, Glaysols and Marshland are along the Shire River Valley. They are very deep black soils.

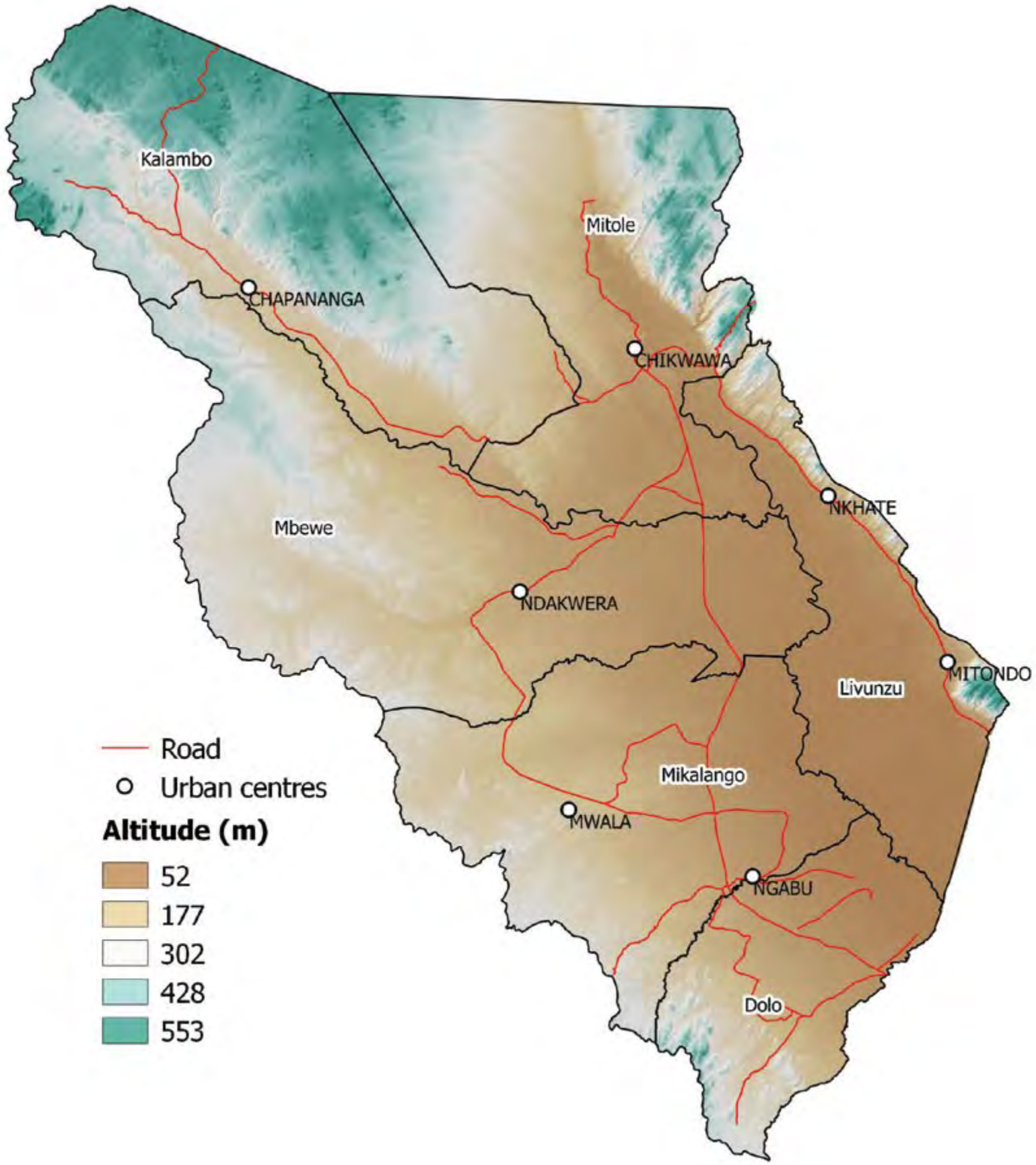
Shallow soil on rolling slopes at Saidi

Mixed soil depth at Kanjedza

3.23 Chikwawa



Source of base map: Government of Malawi



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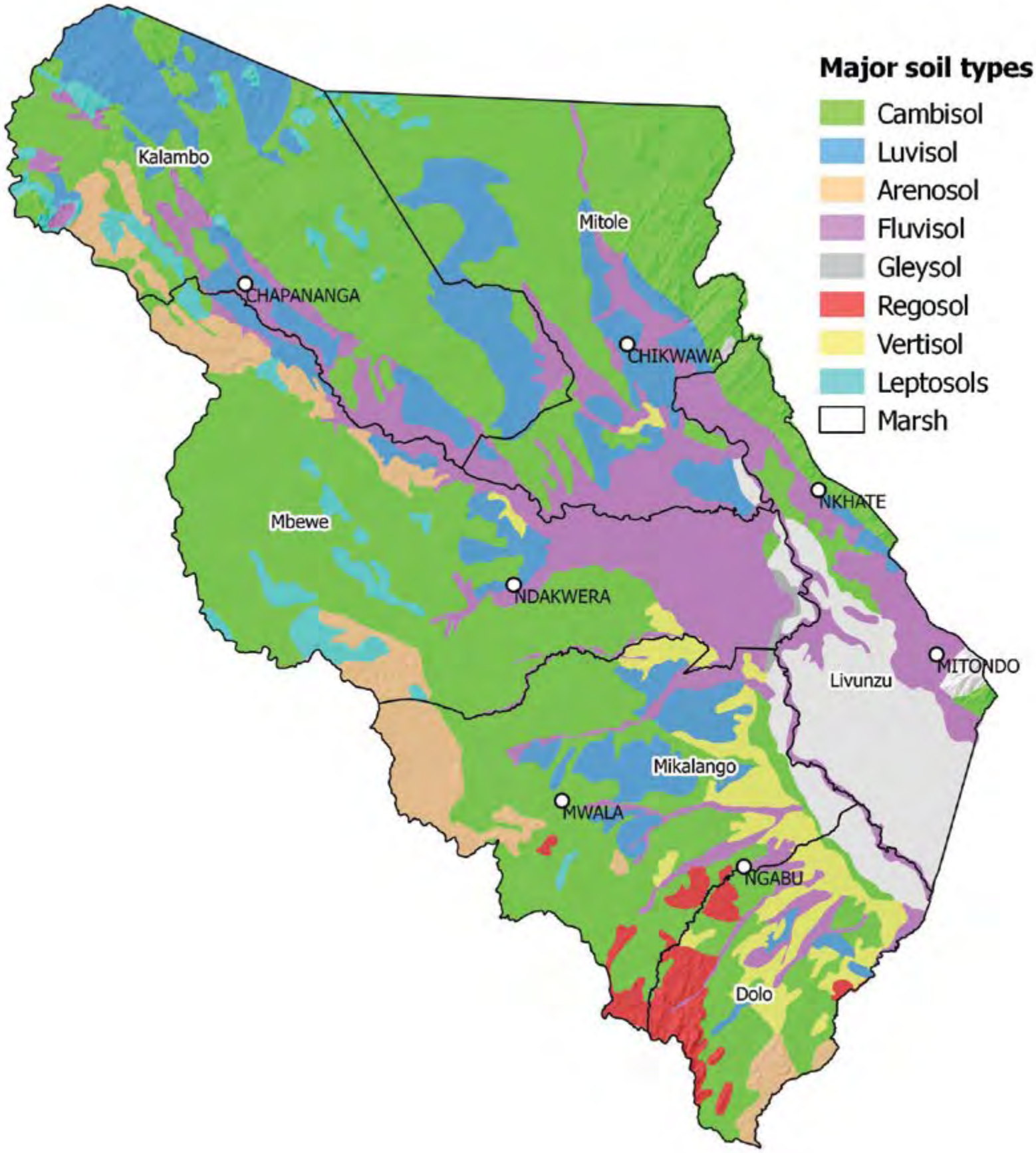


Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Kalambo	Slight decline	7.2	68.9	691.4	650-732	Moderate risk
Mitole	Slight decline	5.7	60.6	742.7	702-789	Moderate risk
Mbewe	Slight decline	2.8	28.4	688.7	646-755	Moderate risk
Livunzu	Slight decline	3.9	69.5	752.7	723-775	Low risk
Mikalango	Slight decline	2.1	38.0	690.7	654-736	Low risk
Dolo	Slight decline	3.6	56.0	692.5	658-730	Low risk

Features of soil erosion

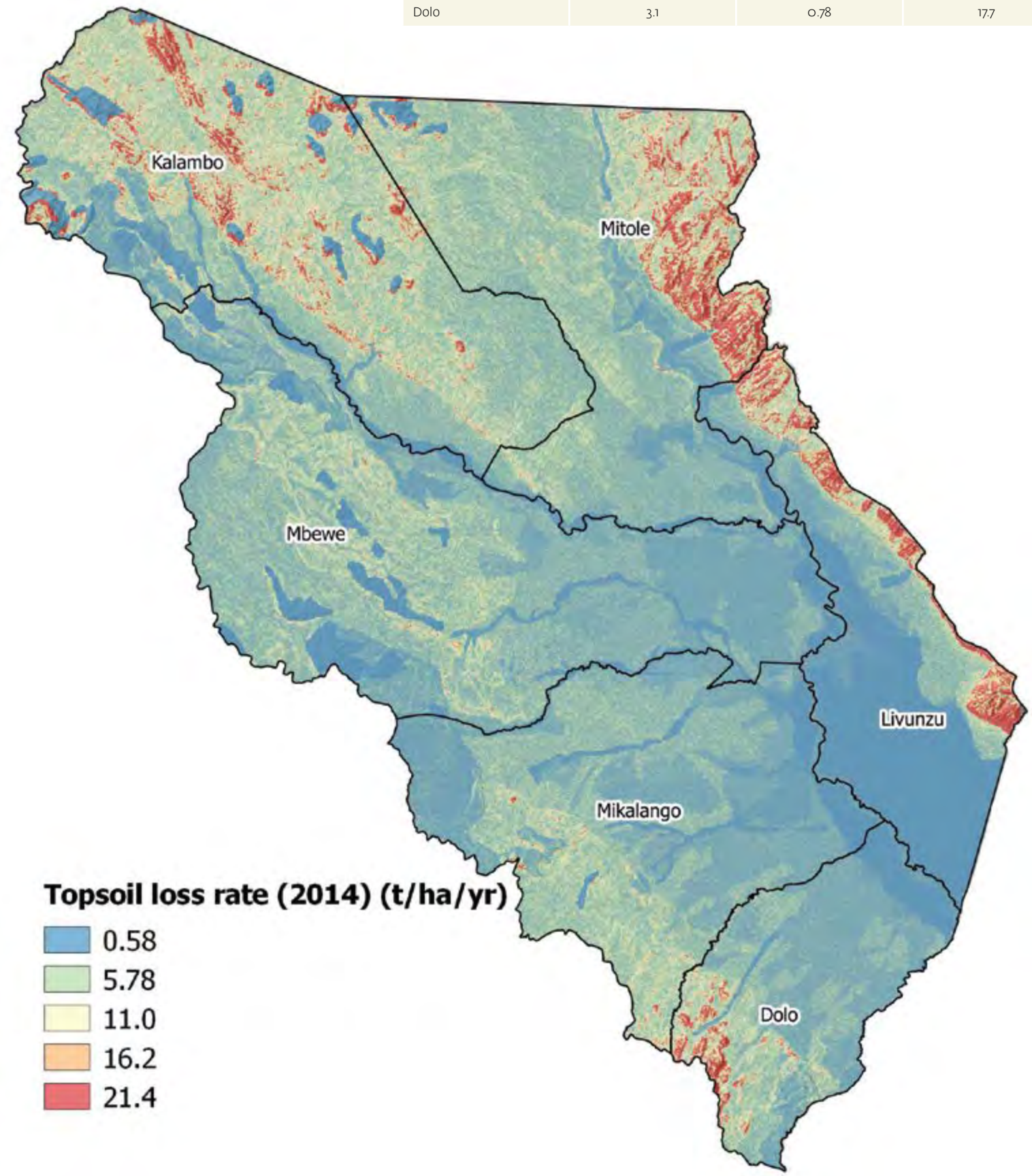
Riverbank erosion at Shire River (near Mwamphazi bridge)

Riverbank erosion at Shire River (near Kamuzu bridge)

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 3.35 t/ha/yr. High soil loss rates were mainly in the steep escarpments. The main driving factors of soil loss in these areas are shallow of soil depth and vulnerable soils in high rainfall areas. Riverbank erosion, sheet, and rill erosion are the most common forms of erosion.

Extension Planning Area (EPA)	2014 Topsoil loss t/ha/yr		
	Mean	Minimum	Maximum
Kalambo	6.4	0.83	20.3
Mitole	5.0	0.63	21.3
Mbewe	1.8	0.48	18.6
Livunzu	2.1	0.58	19.5
Mikalango	2.7	0.69	18.9
Dolo	3.1	0.78	17.7



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Dolo	7.51	2.652	1.307	0.133	17.742	0.955	1.050	45.74	16.37	2.361	0.492	4.774	1.056
Kalambo	5.88	1.384	0.682	0.069	58.721	0.532	0.541	7.975	3.252	0.552	1.460	10.96	15.06
Livunzu	6.52	1.079	0.532	0.054	42.029	0.183	0.347	6.250	3.268	2.821	0.387	4.164	3.633
Mbewe	6.03	1.657	0.817	0.083	64.277	0.556	0.561	11.83	4.356	0.843	1.535	9.215	15.27
Mikalango	7.30	2.468	1.216	0.123	19.106	1.142	0.817	29.29	10.29	1.479	0.532	7.400	2.188
Mitole	6.12	1.605	0.791	0.080	78.703	0.729	0.826	7.757	4.959	1.991	1.138	15.41	10.35

Typical croplands in July-August period in 2017

Cropland at Phazi, Mikalango EPA

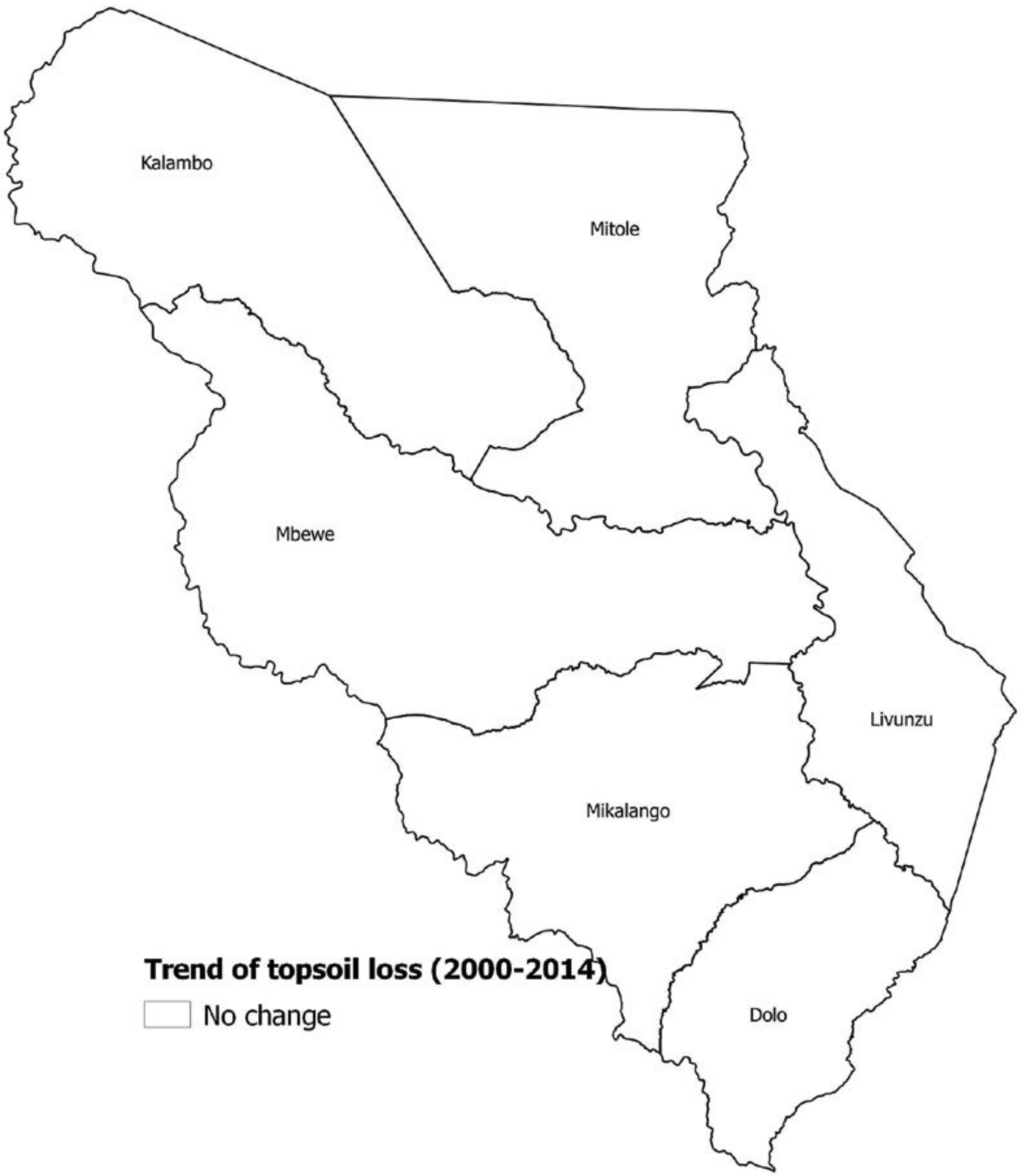
Cropland at Bwalo, Mitole EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangea-ble K^+ loss	Mean availa-ble P loss	Sum of mean NPK loss
Kalambo	0.1570	0.0104	0.5927	0.7601
Mitole	0.1283	0.0090	0.5194	0.6567
Mbewe	0.1015	0.0088	0.3695	0.4798
Livunzu	0.0514	0.0035	0.1892	0.2442
Mikalango	0.0879	0.0075	0.2718	0.3673
Dolo	0.0843	0.0071	0.2938	0.3852

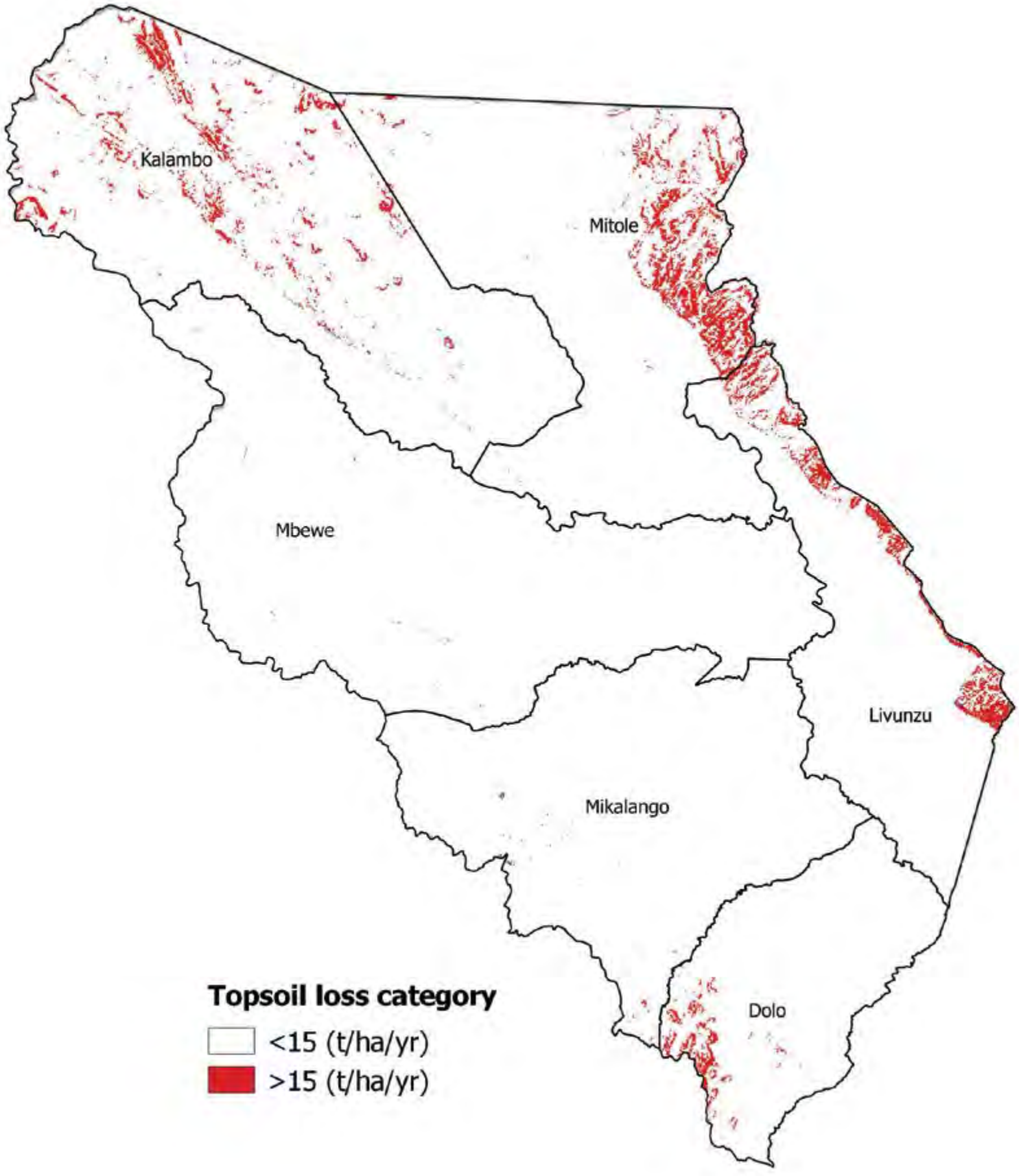
Topsoil loss trend between 2000 and 2014

Although the district has had no significant change in topsoil loss rates between 2000 and 2014, most of the escarpments may need monitoring since they have disproportionately high soil loss rates.



Source of base map: Government of Malawi

3.23 Chikwawa



Source of base map: Government of Malawi

Some of the soil and water conservation practices

Maintenance of cover on riverbanks at Maperera

Incorporation of crop residue at Saliva in Kalambo EPA

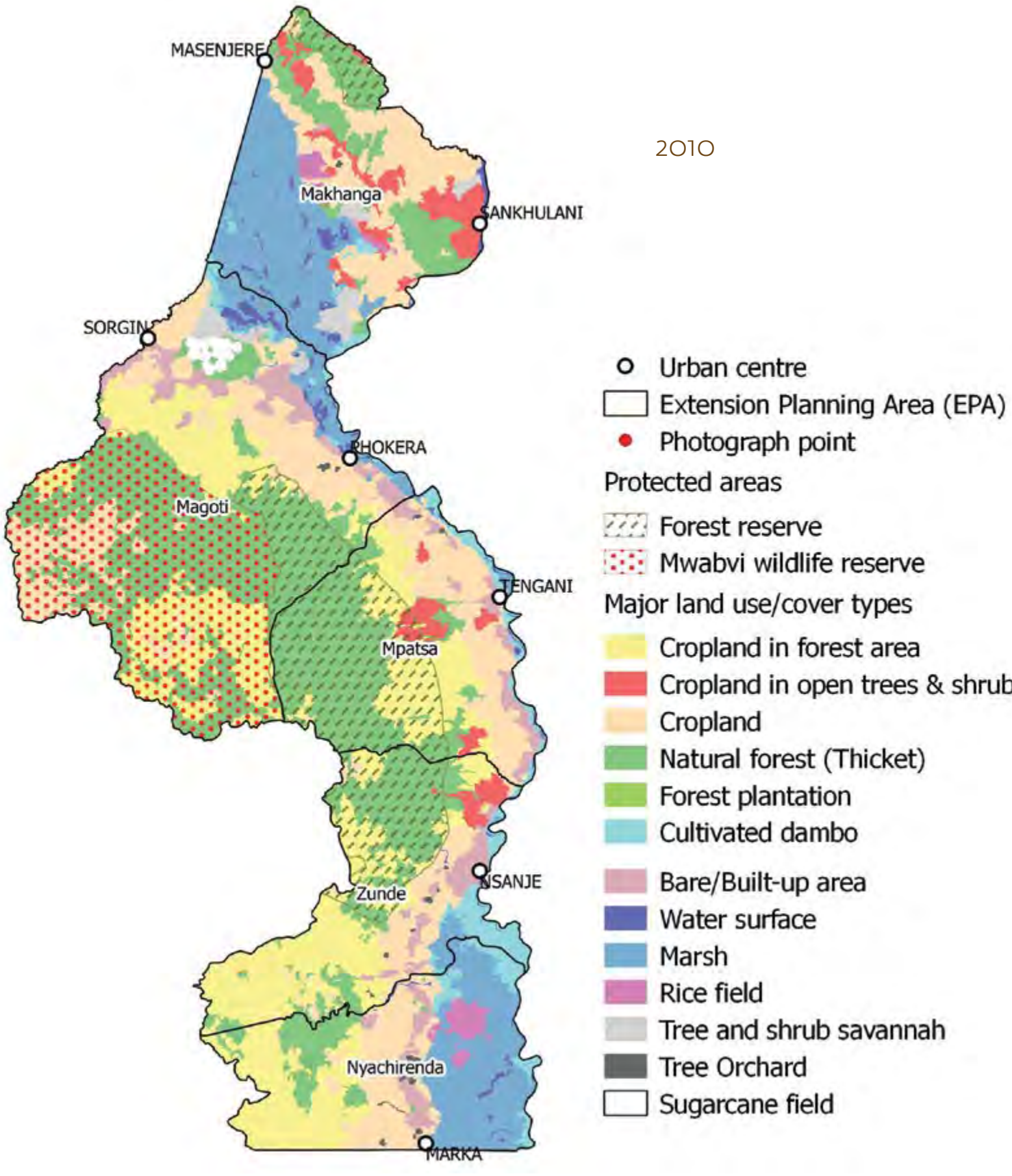
Drainage line in floodplain at Dzaonanji in Livunza EPA

Cut-off drain at Tokhwe in Mbewe EPAs

Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are wildlife and forest reserve, smallholder croplands, urban/settlements, and forest. The district has had a significant decline in forest cover between 2000 and 2014. Consequently, the threat to soil loss in the district was driven by loss of vegetative cover and agricultural activities in the steep slopes.

Major land cover/use types in 2010 and 1991



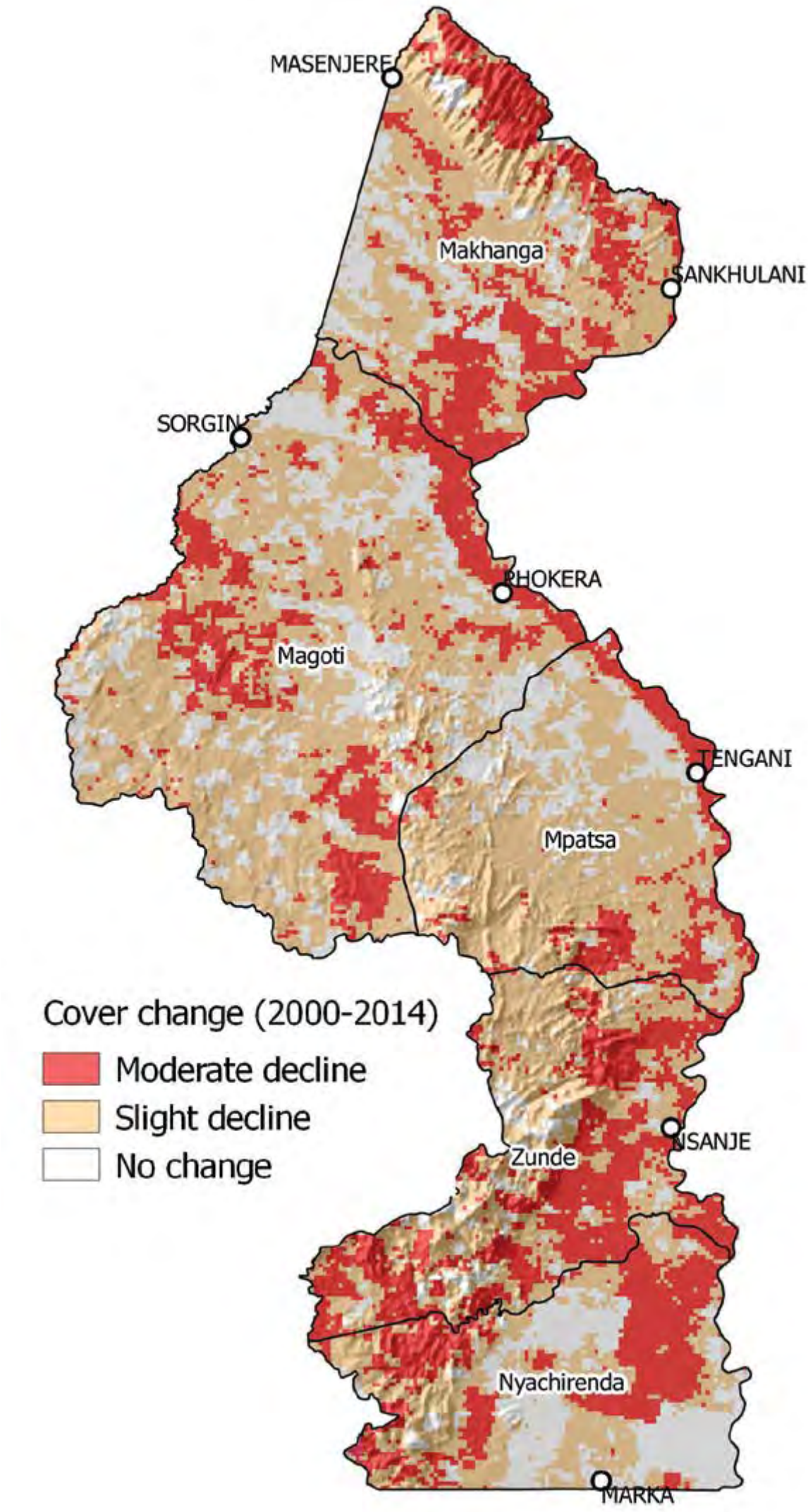
Source of base map: Government of Malawi

1991

Source of base map: Government of Malawi

Example of land cover types at Nyamdzere and Lamdwe in 2016

Vegetation cover change



Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

Nsanje district is flat except in the central and in some pockets in the north (which lie in the Rift Valley). The soil is deep except in the escarpments. Most of the areas are dominated by the young and fertile Cambisol.

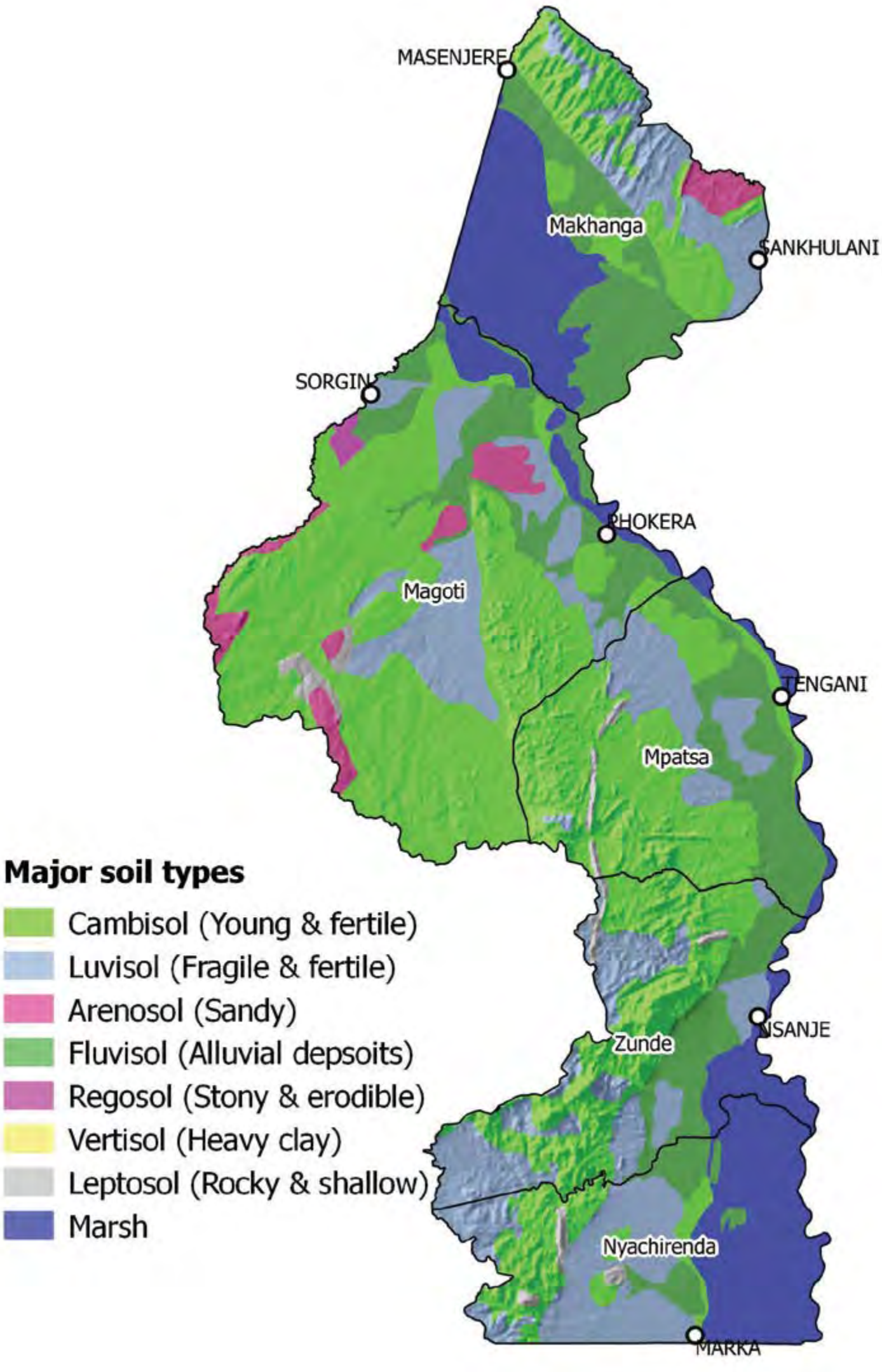
Undulating terrain at Mt. Chididi

Shallow soil at Gerevolo

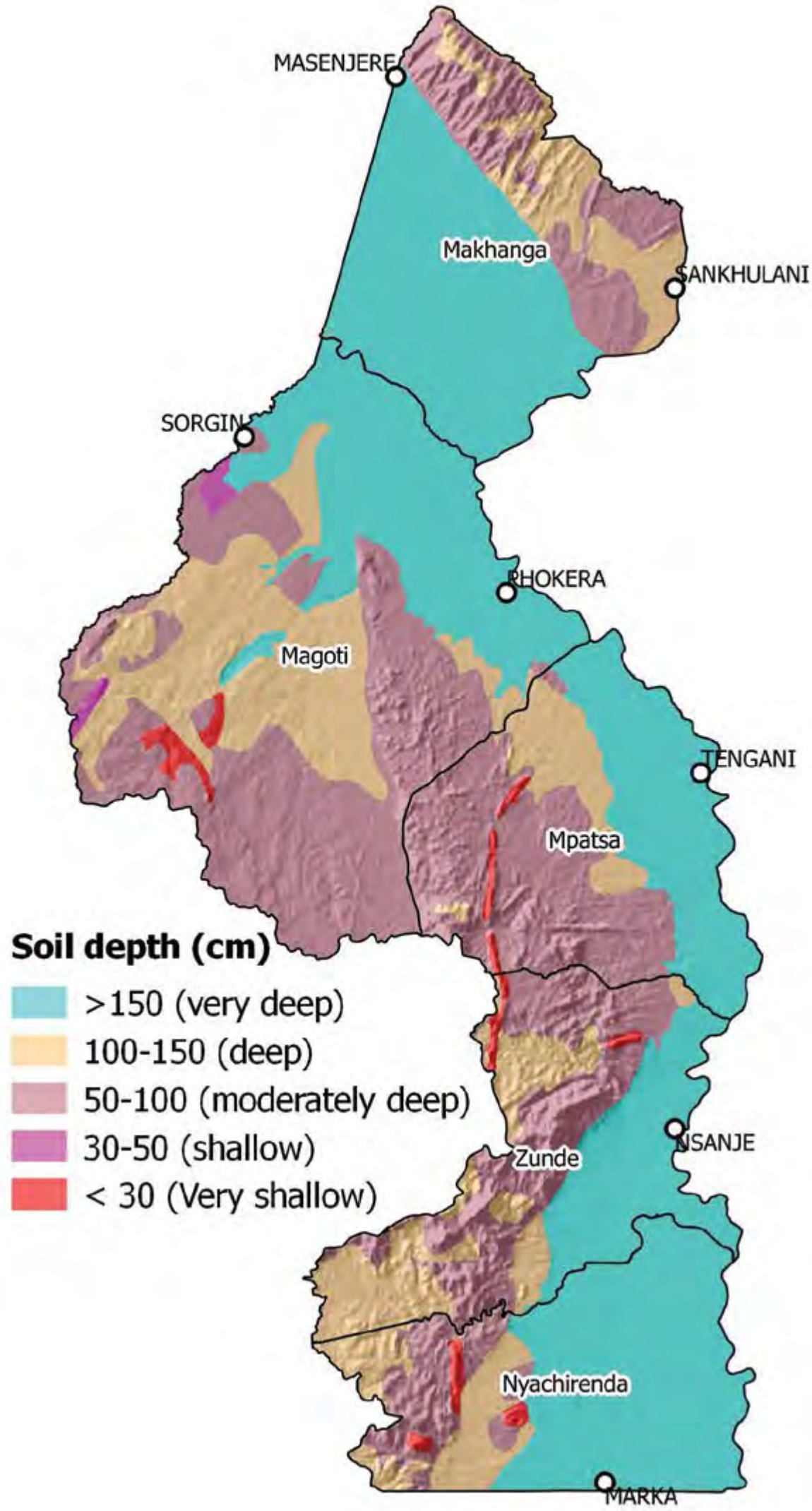
Flat land and deep soil at Mtayamoyo

3.24 Nsanje

Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Makhanga	Moderate decline	3.7	31.7	755	726-783	Low risk
Magoti	Slight decline	2.5	27.9	691	655-730	Low risk
Mpatsa	Slight decline	4.1	34.9	695	670-724	Low risk
Nyachirenda	Moderate decline	3.3	35.2	631	609-658	Low risk
Zunde	Moderate decline	8.0	46.7	655	619-687	Low risk

Features of soil erosion

Sheet erosion at Lambwe

Sheet erosion at Mtayamoyo

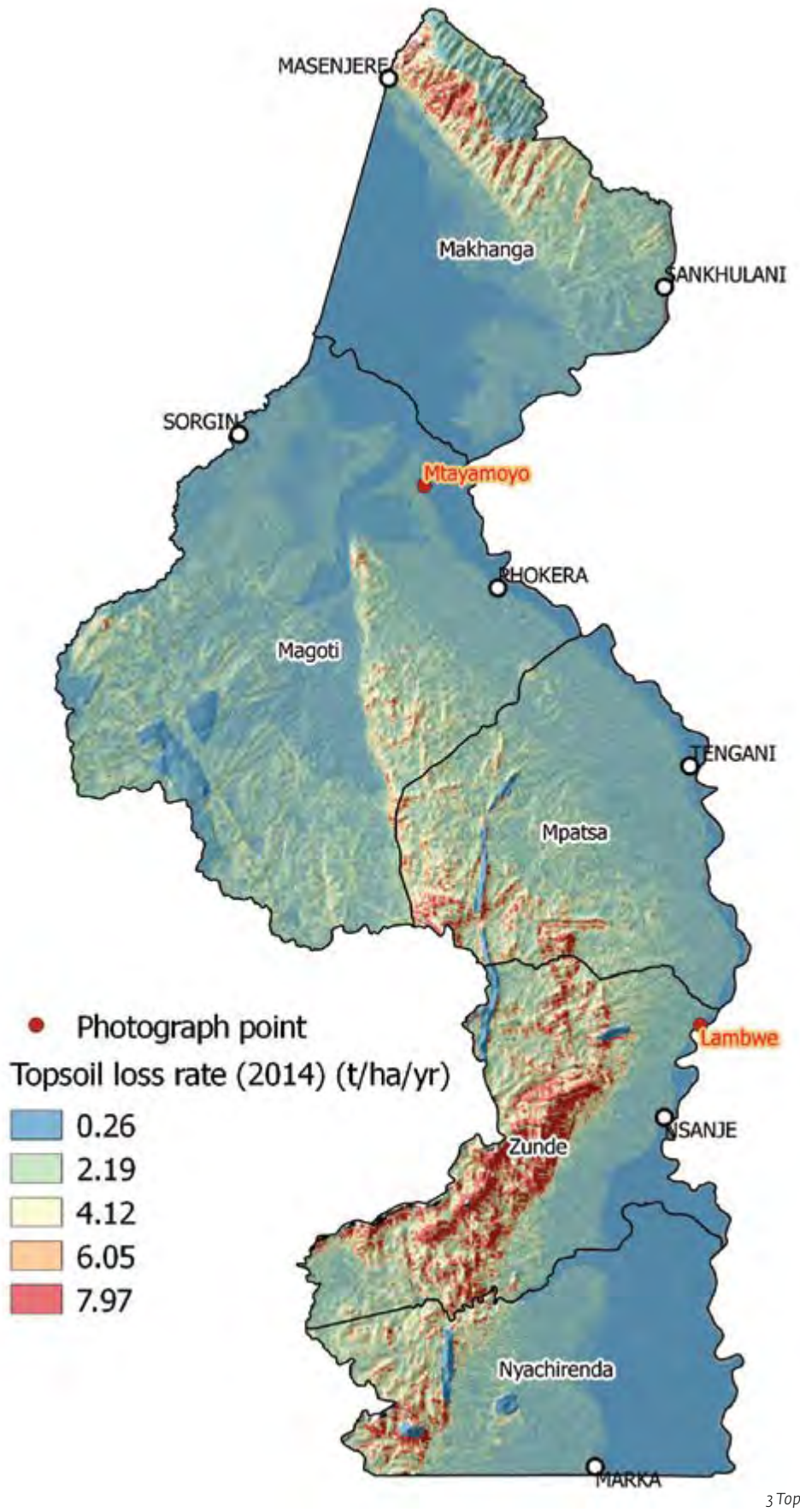
Sheet and rill erosion at Mtayamoyo

Sheet erosion at Sazondeka in Mpatsa EPA

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 1.46 t/ha/yr. High soil loss rates were mainly in the mountain ranges. The main factors for soil loss rates in these areas include soil vulnerability and steep slopes. Sheet and rill erosion are the most common forms of erosion.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Makhanga	1.27	0.31	6.23
Magoti	0.78	0.26	4.74
Mpatsa	1.89	0.93	7.20
Nyachirenda	1.35	0.28	4.68
Zunde	2.87	0.86	7.96



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Magoti	6.70	1.372	0.676	0.069	44.331	0.674	0.843	13.217	5.577	1.502	1.090	12.662	10.968
Makhanga	6.21	1.250	0.616	0.062	32.773	0.196	0.242	4.690	1.973	1.228	0.607	6.516	4.455
Mpatsa	7.02	1.549	0.763	0.077	31.179	0.222	0.624	15.268	3.862	1.208	0.518	6.391	3.944
Nyachilenda	6.06	1.226	0.604	0.061	62.815	0.557	0.709	10.717	4.098	1.493	1.620	21.459	18.068
Zunde	5.78	0.824	0.406	0.041	49.900	0.292	0.580	5.172	2.652	0.418	0.882	11.167	8.733

Typical croplands in July-August period in 2017

Cropland at GVH Chimweyo in Kasitu EPA

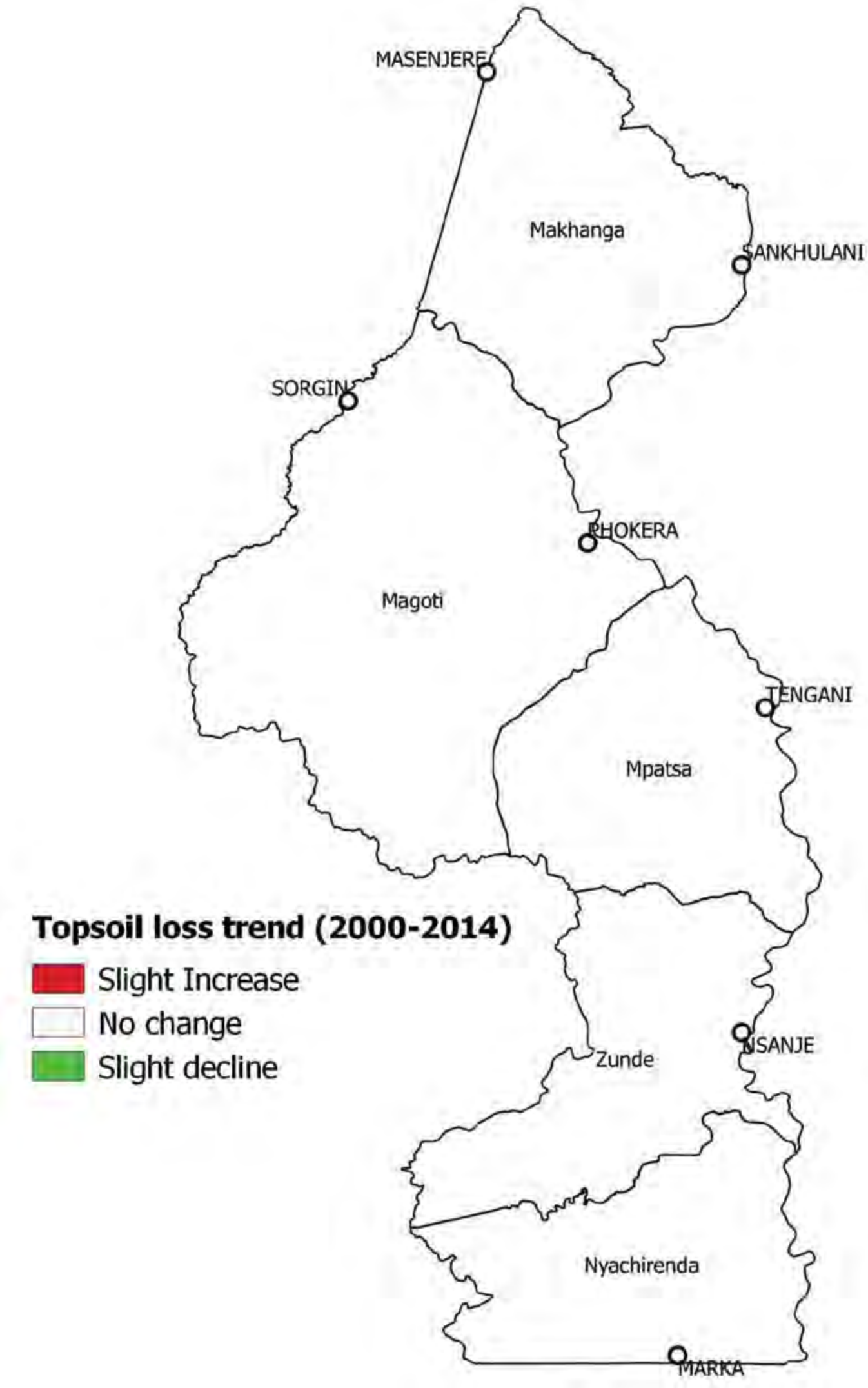
Cropland at Kasomkanji in Nkhung EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

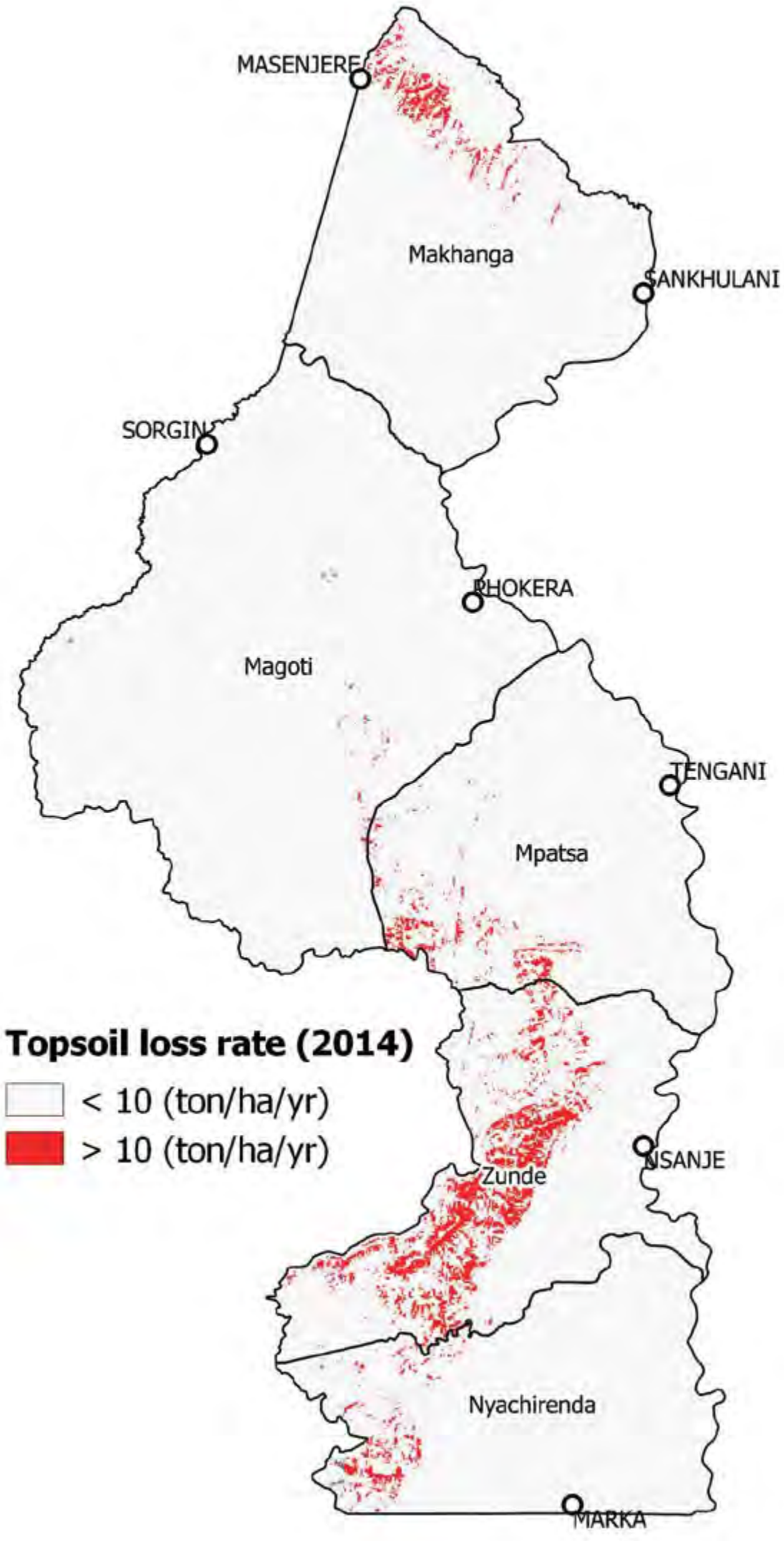
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Makhanga	0.059	0.012	0.207	0.279
Magoti	0.101	0.012	0.413	0.527
Mpatsa	0.123	0.025	0.532	0.68
Nyachirenda	0.082	0.016	0.352	0.449
Zunde	0.146	0.025	0.571	0.742

Topsoil loss trend between 2000 and 2014

The rate of topsoil loss rates in the District has been constant between 2000 and 2014. Sheet and rill erosion are the most common forms of soil erosion problems. The main problem areas are those lying in the Rift Valley sections.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Sheet erosion at Guta in Zunde EPA

Some of the soil and water conservation measures

Vegetative cover maintenance at Zambasa tree plantation

Cut-off drain at Khembo at Magoti EPA

Residue incorporation at Khembo at Magoti EPA

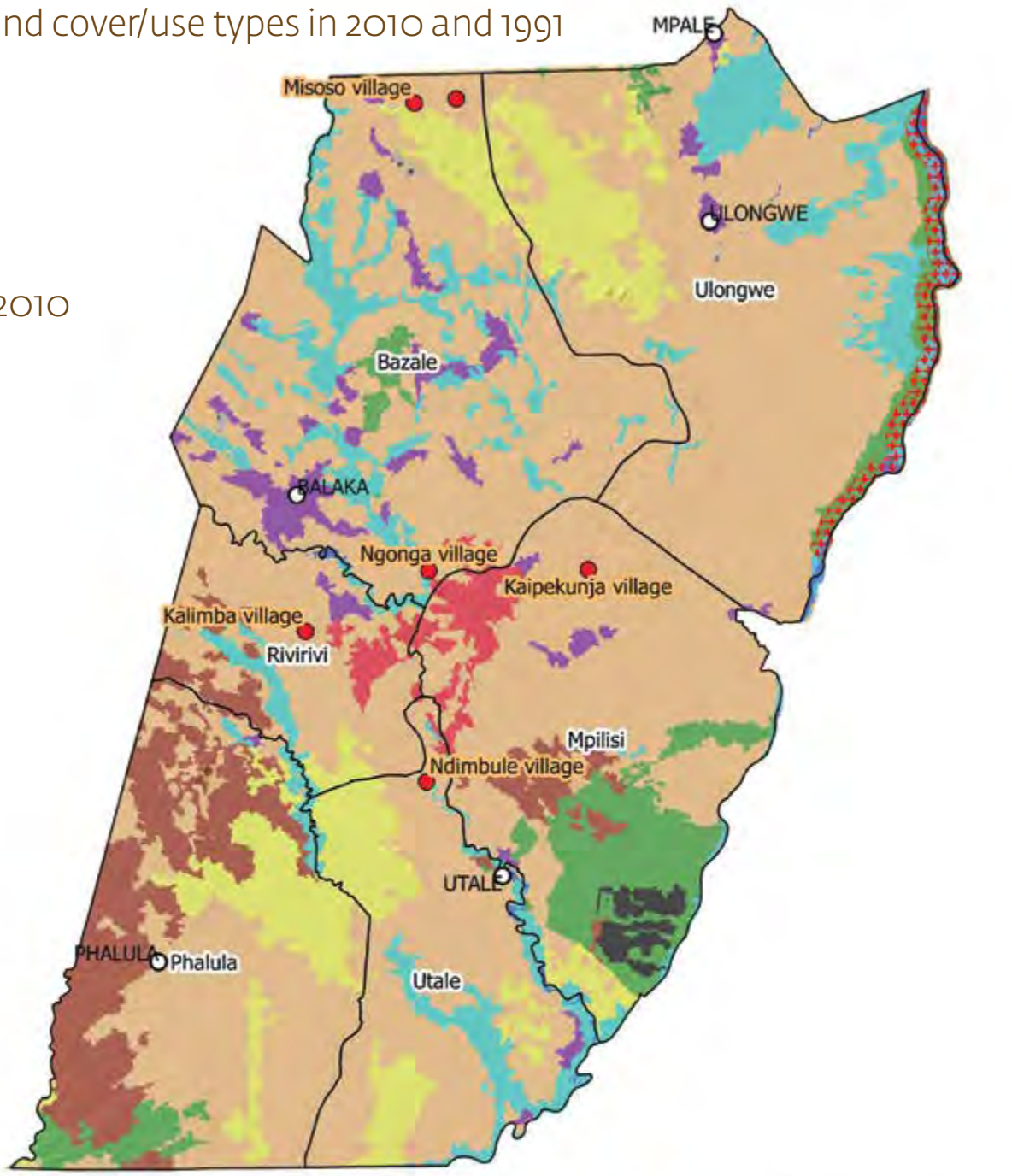
Contour ridges in a cropland at Ndinde

Drivers of soil loss
1. Vegetation cover change

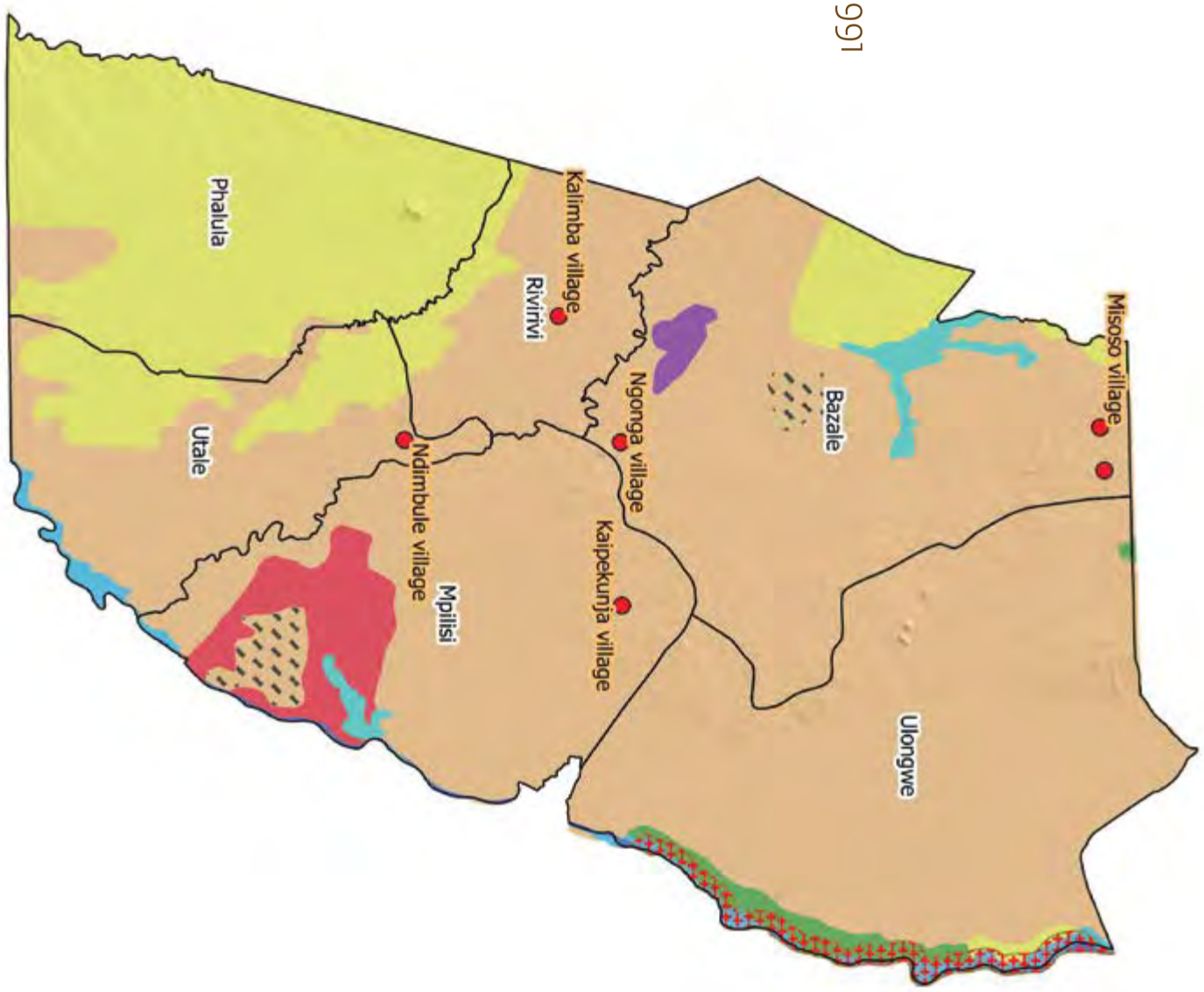
The main land use/cover types are smallholder croplands, natural forests, and Liwonde national park. There was a slight increase in vegetative cover proportions between 1991 and 2010. The main cover threat to soil loss is in the District is the cropland farming practices.

Major land cover/use types in 2010 and 1991

2010



Source of base map: Government of Malawi

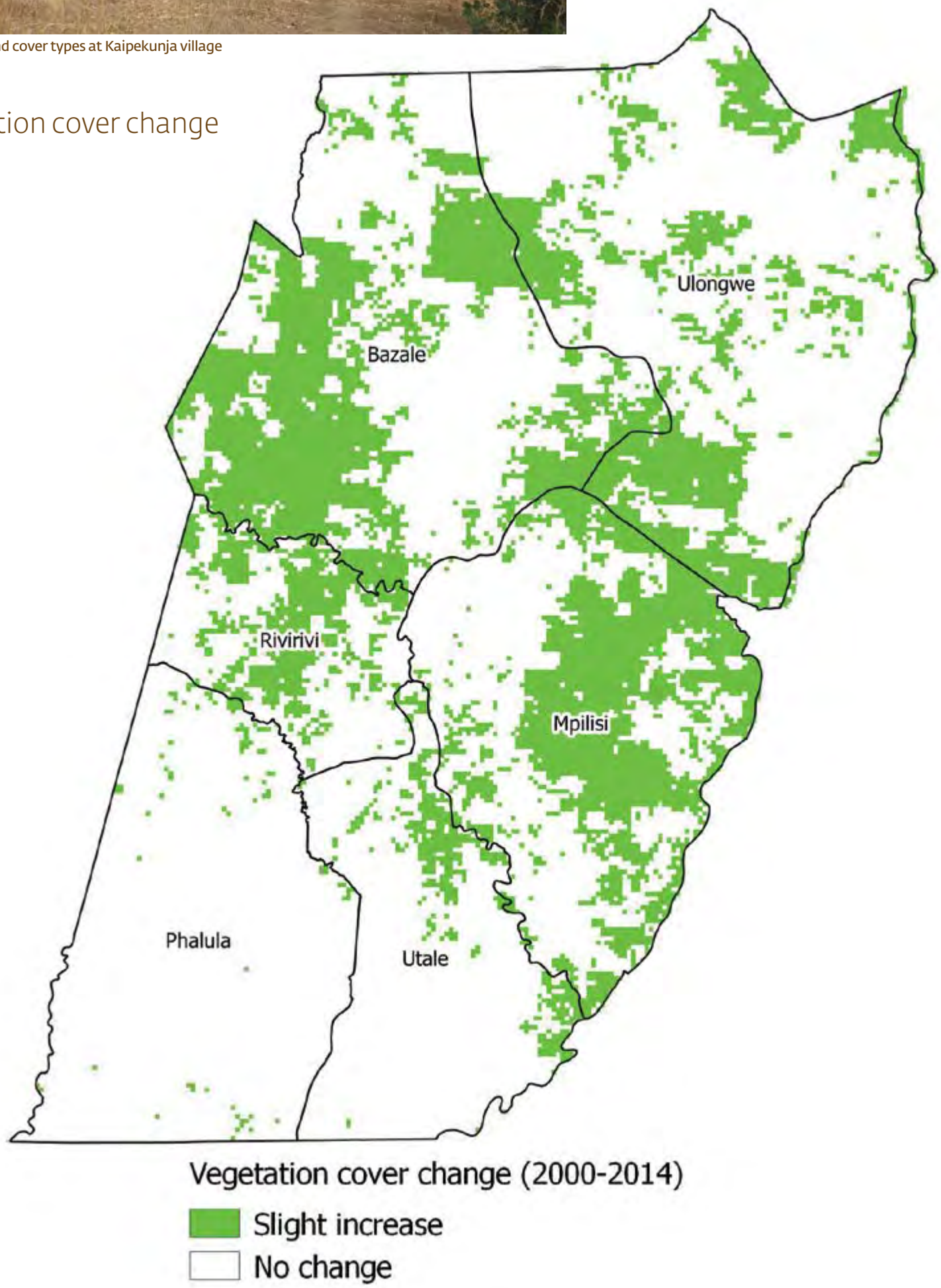


Source of base map: Government of Malawi

3.25 Balaka

Example of land cover types at Kaipekunja village

Vegetation cover change



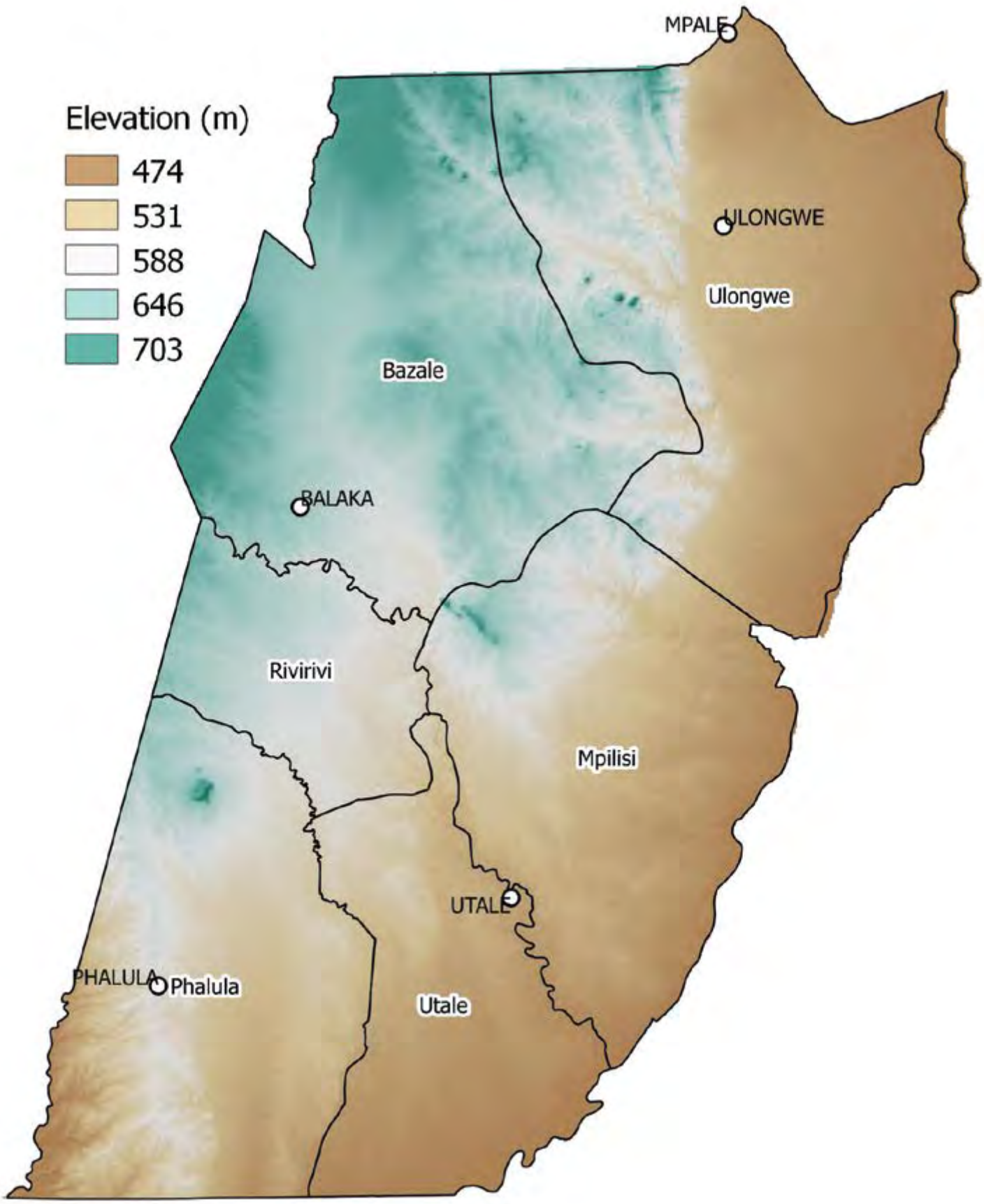
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

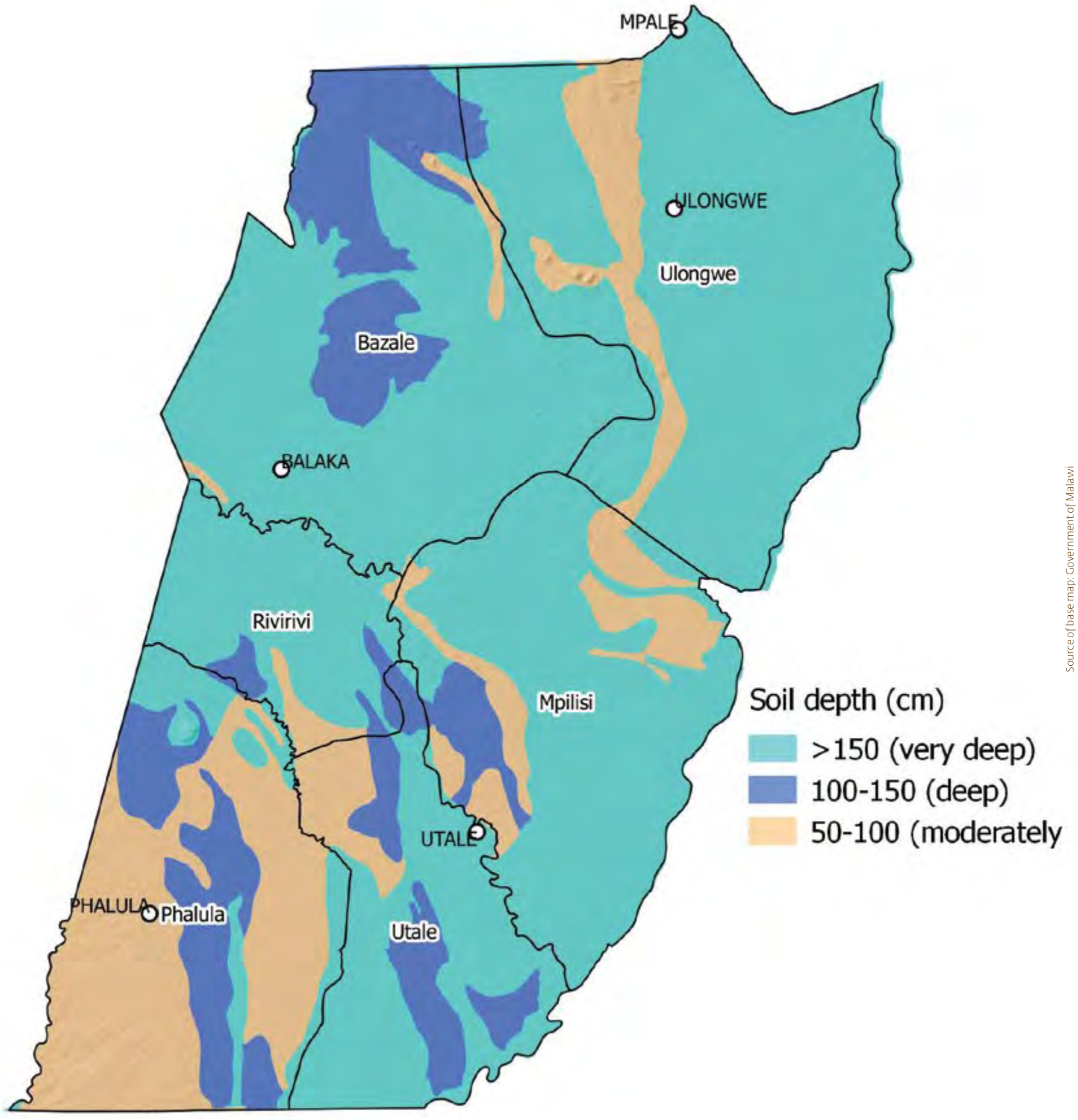
Balaka is a rather flat district with few mountains in the northwest. The mountain escarpments have steep slopes and shallow soil. The remaining flat terrain have deep soil. The soil is largely Luvisol with pockets of Planosol and Cambisol that are slightly vulnerable to soil erosion.

Deep soil on footslopes and shallow soil on mountains at Nonga village

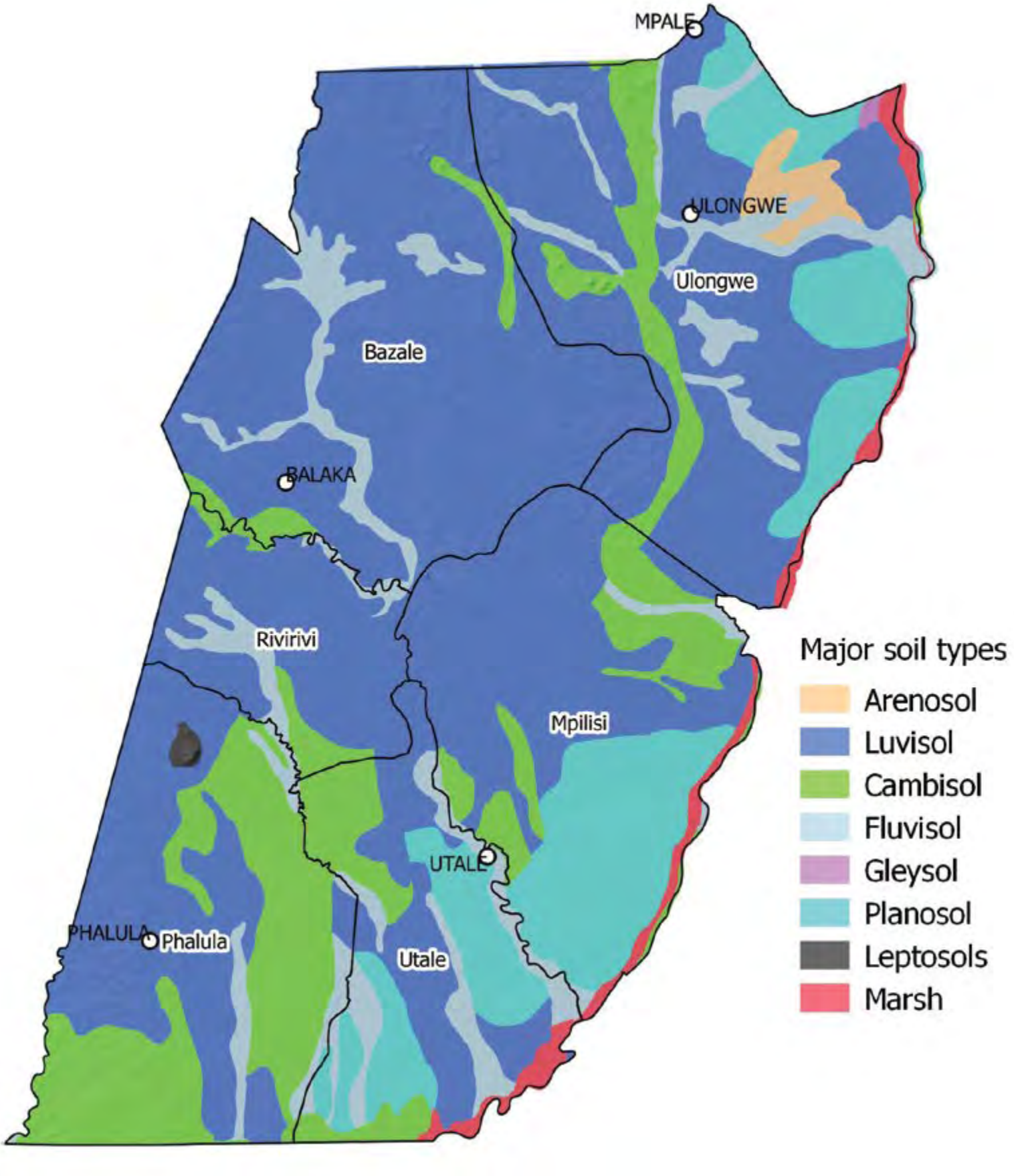
Deep soil on the plains at Kalimba village



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		
		Mean	Maximum	Mean	Range	Soil erodibility risk factor
Ulongwe	Slight increase	2.3	51.9	680.7	610-775	Low risk
Bazale	Slight increase	2.6	41.7	701.2	633-754	Low risk
Mpilisi	Slight increase	1.9	36.8	786.0	732-827	Low risk
Rivirivi	Slight increase	1.6	19.4	760.1	736-783	Low risk
Phalula	No change	2.6	48.3	784.5	762-802	Low risk
Utale	Slight increase	1.2	11.4	804.0	771-826	Low risk

Features of soil erosion

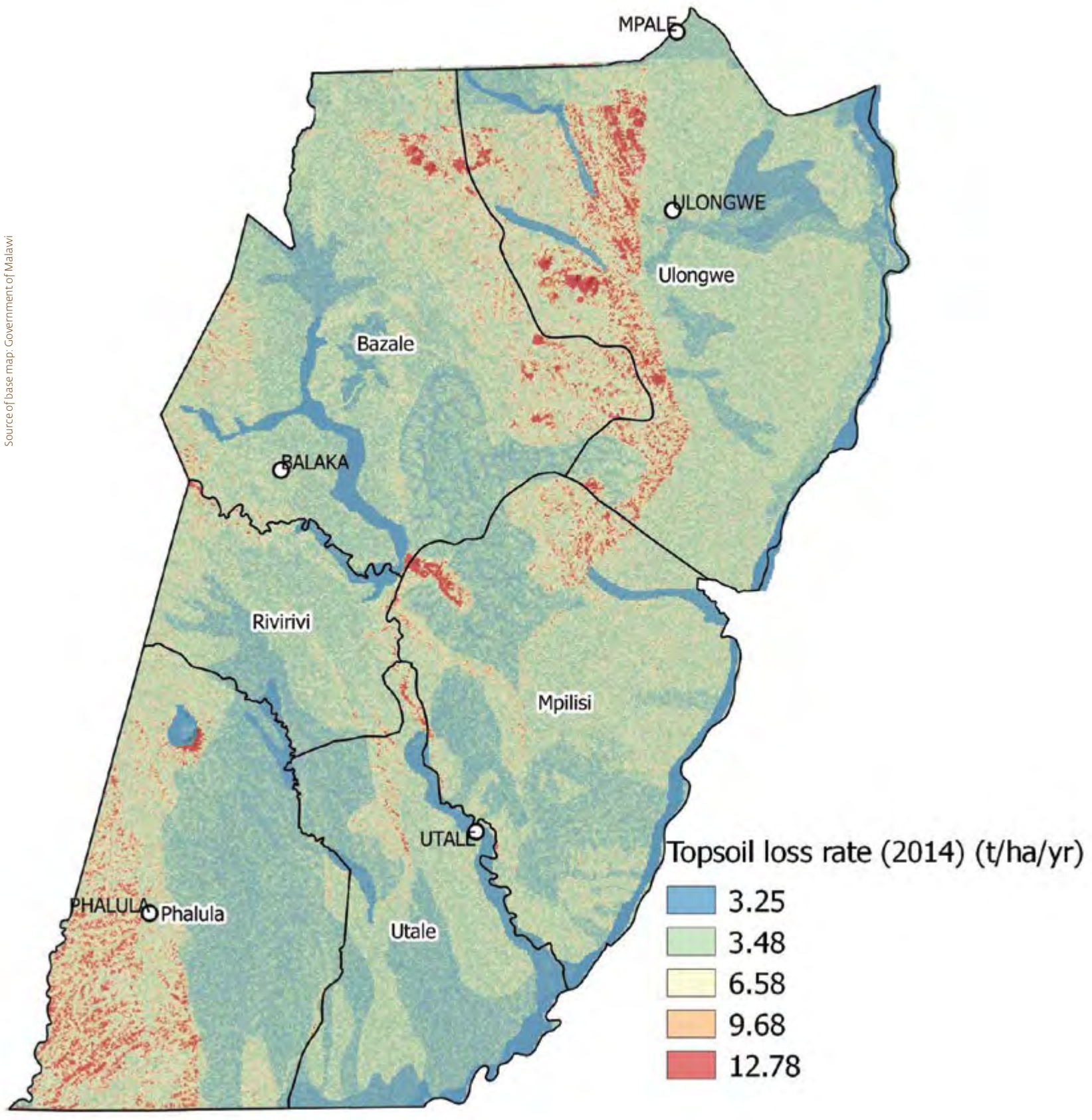
Gully erosion at Ndimbule village

Rill and sheet erosion measurement at Kaipekunja village

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 2.11 t/ha/yr. Ulongwe EPA had indications of the highest soil loss rates. The main contributing factors for the soil loss rates in these areas include the presence of vulnerable soils and agricultural intensification. Sheet and rill erosion are the most common types of soil erosion in the district.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Ulongwe	3.7	0.36	12.2
Bazale	3.3	0.38	12.6
Mpilisi	2.2	0.47	11.3
Rivirivi	1.4	0.65	9.2
Phalula	3.3	0.88	11.9
Utale	1.2	0.39	8.4



Source of base map: Government of Malawi

Soil nutrients

Some of the topsoil (0-30 cm) nutrient indicators in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Bazale	5.80	0.909	0.448	0.045	97.03	0.473	1.045	5.550	2.348	0.202	0.308	15.41	14.17
Mpilisi	5.76	1.648	0.812	0.082	38.69	0.427	0.854	3.793	1.774	0.533	1.316	22.57	10.43
Phalura	5.67	1.250	0.616	0.062	10.81	0.552	0.598	5.043	1.692	1.118	3.118	32.43	17.15
Rivirivi	5.72	1.023	0.504	0.051	56.47	0.388	1.025	6.000	2.233	0.216	0.155	20.01	8.31
Ulongwe	6.04	0.937	0.462	0.047	87.78	0.513	1.058	10.050	2.833	0.316	0.251	13.90	12.76
Utale	6.45	0.898	0.442	0.045	30.41	0.523	0.713	4.651	1.458	0.812	2.053	25.66	15.59

Typical features of croplands in July-August period in 2017

Cropland at Makawa in Ulongwe EPA

Cropland at Jasiya in Utale EPA

Cropland at Nhunde in Rivirivi EPA

Cropland at Makanzie in Bazale EPA

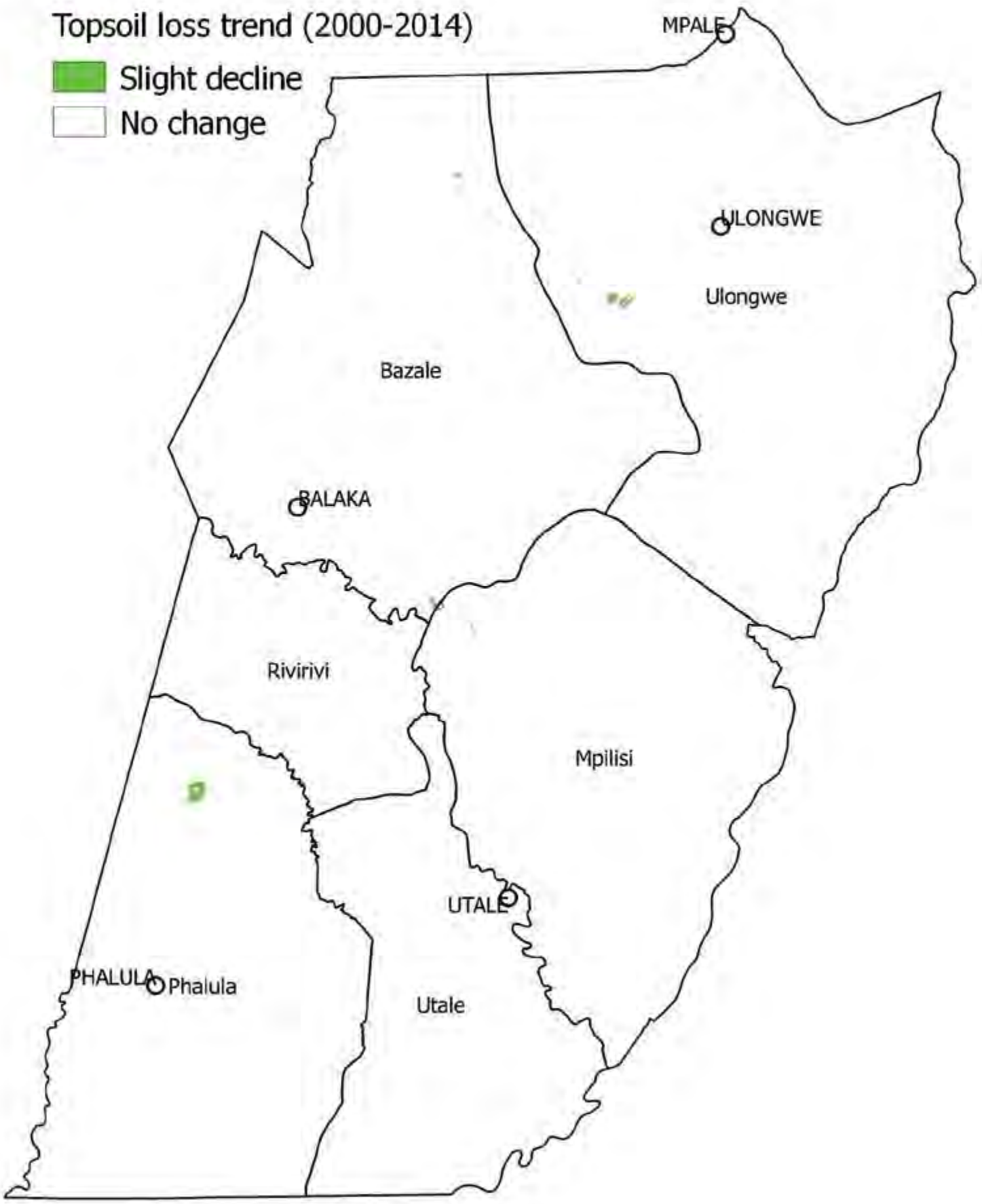
Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Ulongwe	0.1266	0.0060	0.4734	0.6059
Bazale	0.0969	0.0054	0.4266	0.5288
Mpilisi	0.1712	0.0070	0.5045	0.6826
Rivirivi	0.1256	0.0069	0.4956	0.6281
Phalula	0.1177	0.0067	0.4485	0.5730
Utale	0.1153	0.0060	0.4009	0.5222

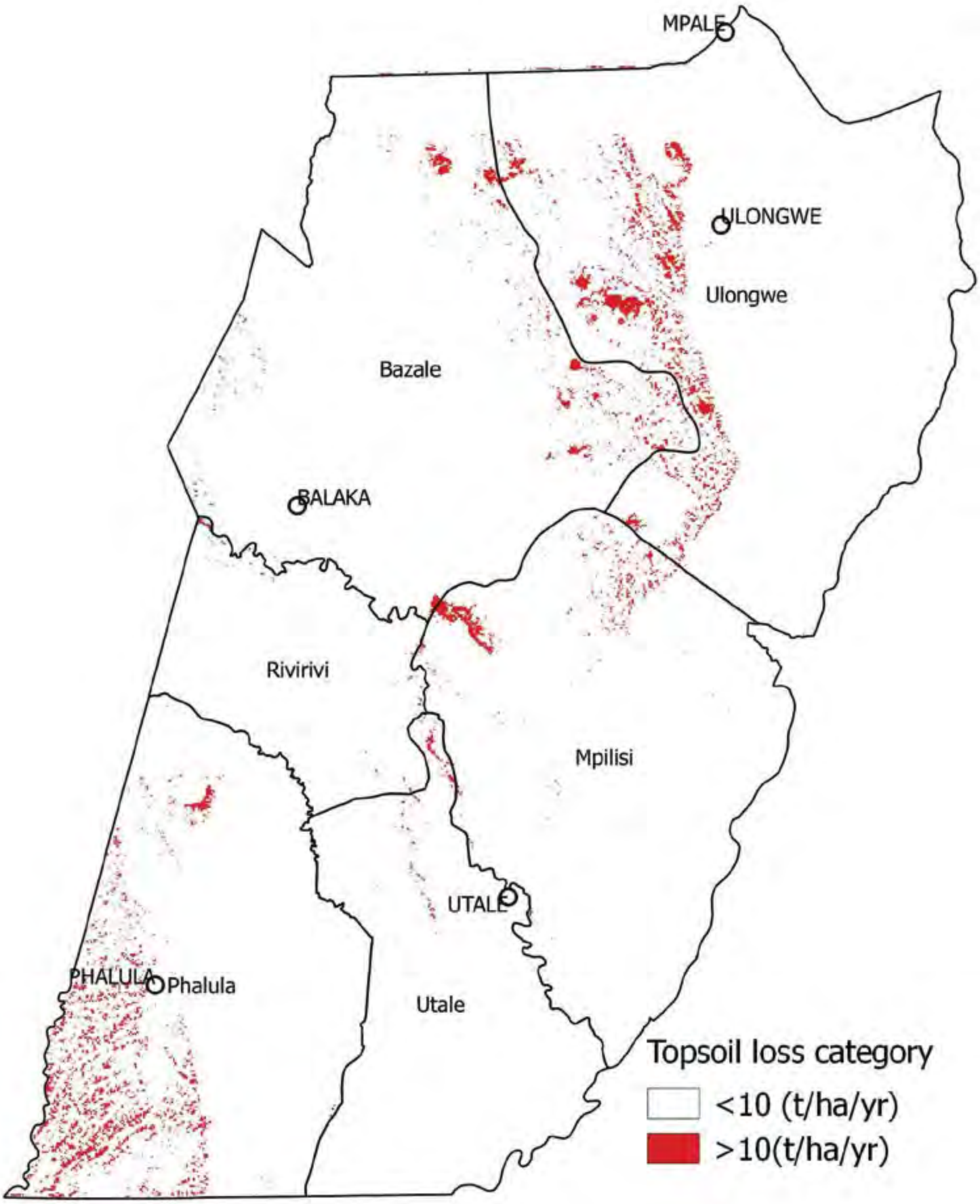
3.25 Balaka

Topsoil loss between 2000 and 2014

There was no significant trend of topsoil loss rates observed for the District between 2000 and 2014. However, there were some notable spots of slight decline in Ulongwe and Phalula EPAs.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the land, soil and water conservation measures

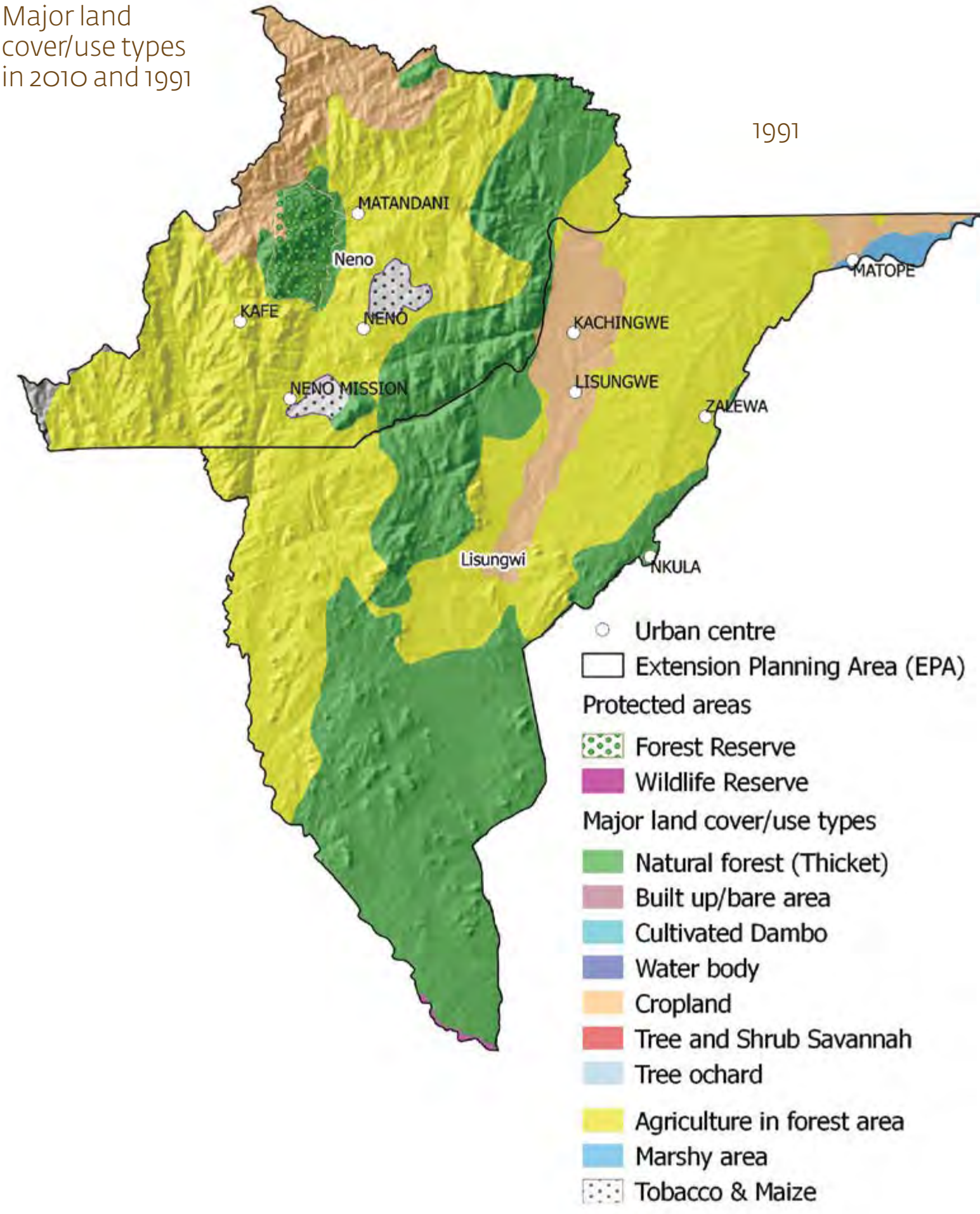
Manure pits in horticultural plots at Ngonga village

Cut-off drain at Khembo at Magoti EPA

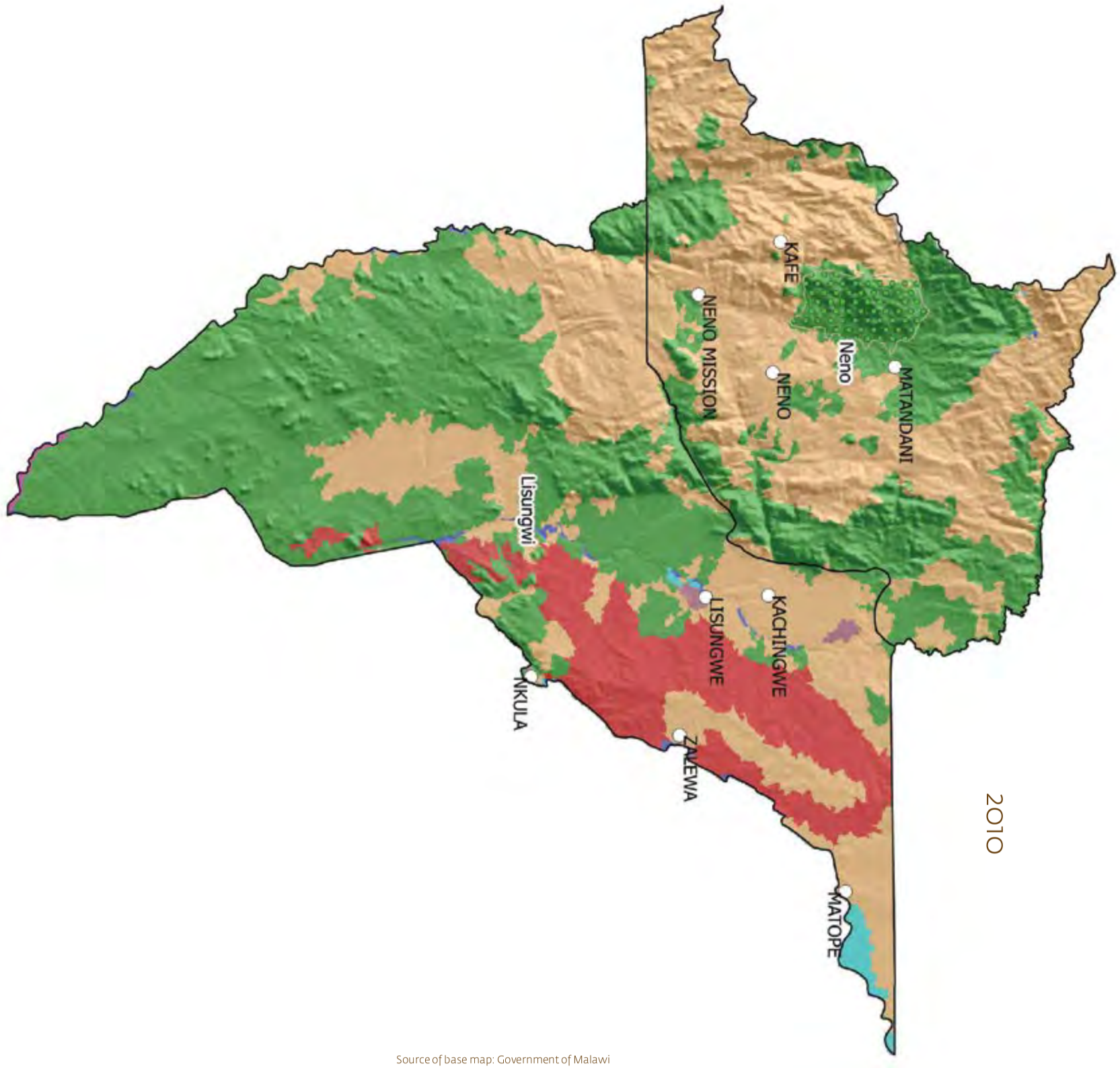
Drivers of soil loss
1. Vegetation cover change

The main land use/cover types in the district are cropland, forest reserve, and forests. There was a slight decline in vegetative cover between 1991 and 2010, mainly in Neno EPA. The cover change was therefore a soil loss risk factors in the EPA.

Major land cover/use types in 2010 and 1991



Source of base map: Government of Malawi



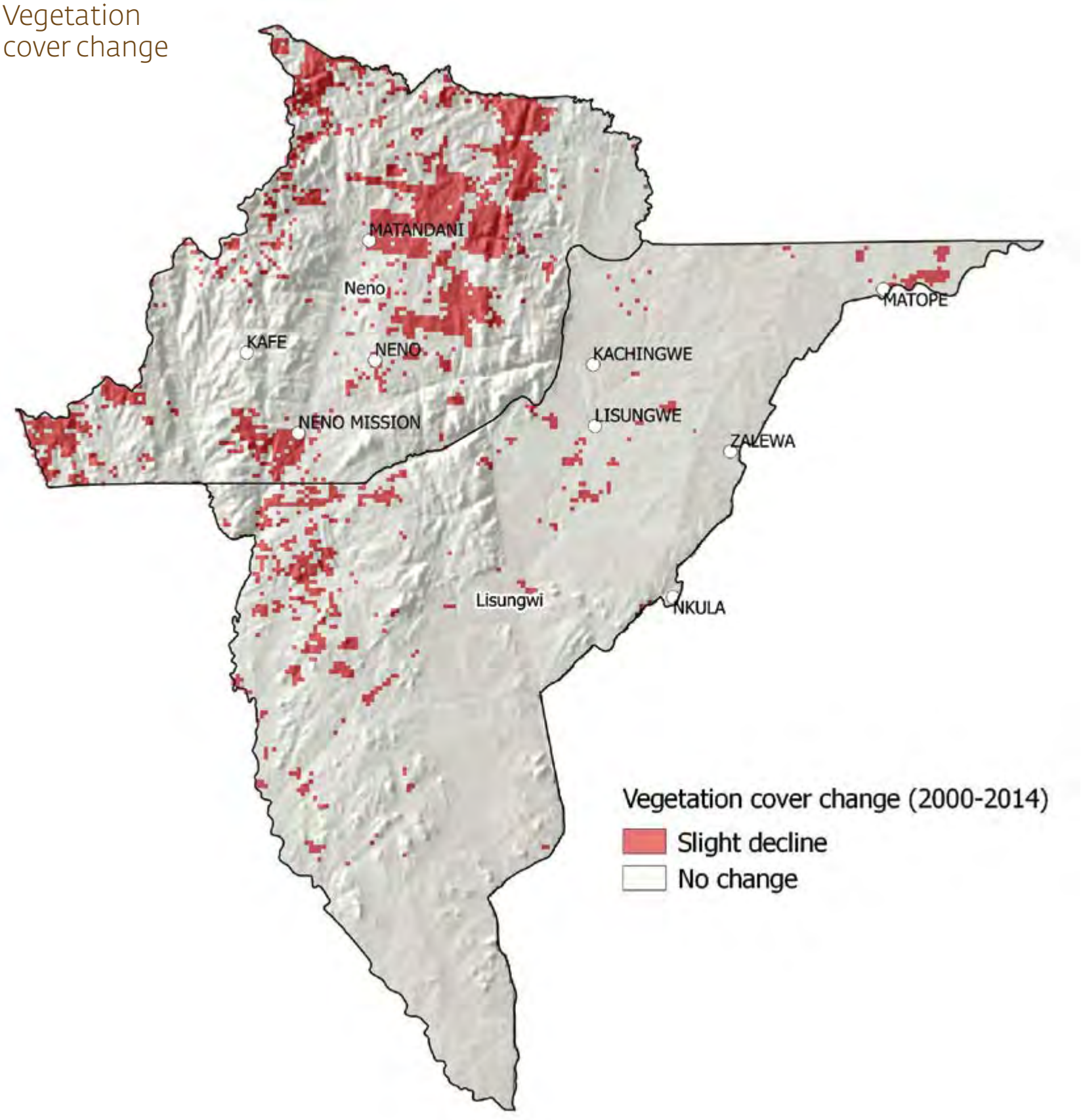
2010

Source of base map: Government of Malawi

3.26 Neno

Example of land cover at Mpakati in Neno EPA

Vegetation cover change



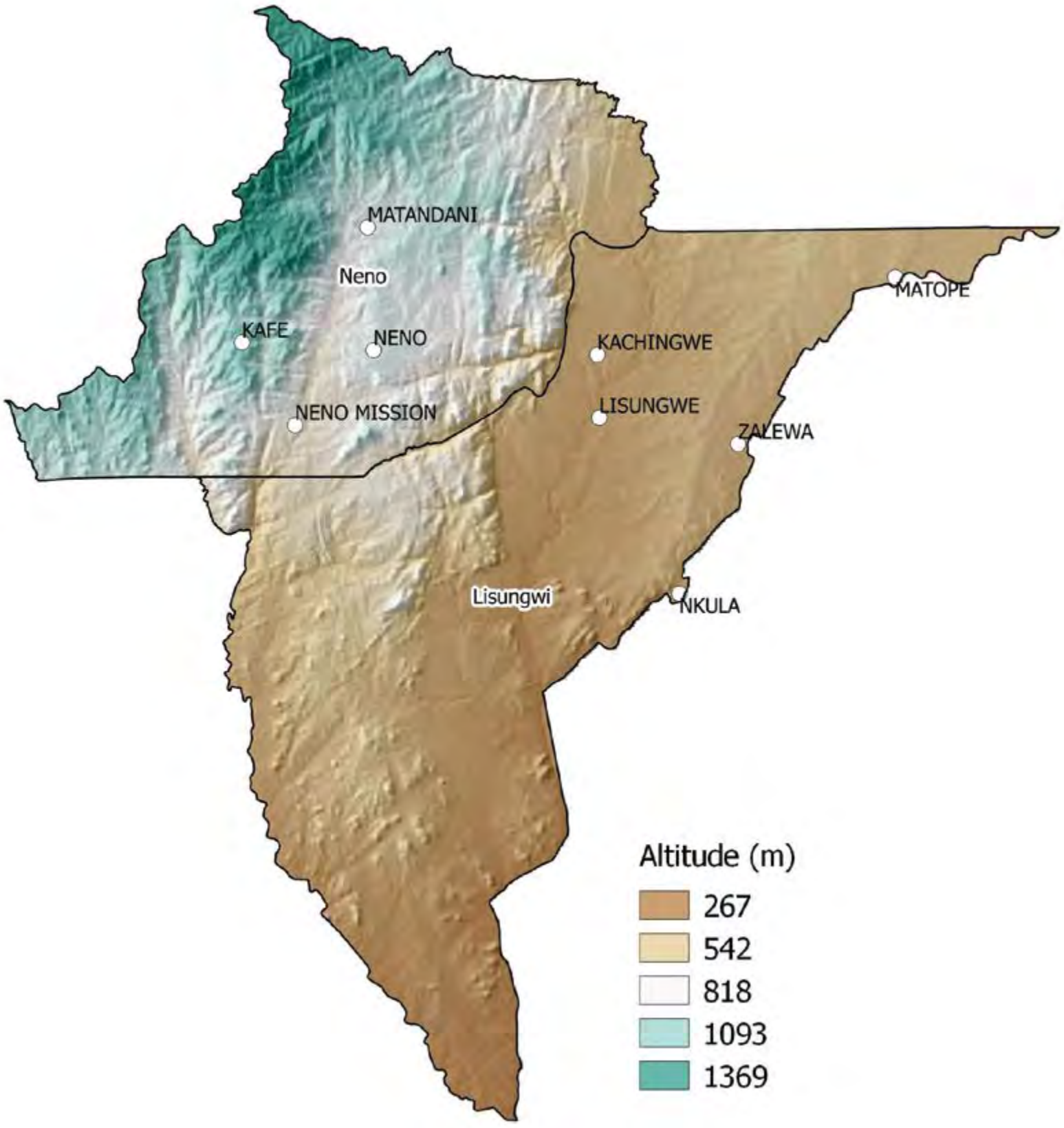
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

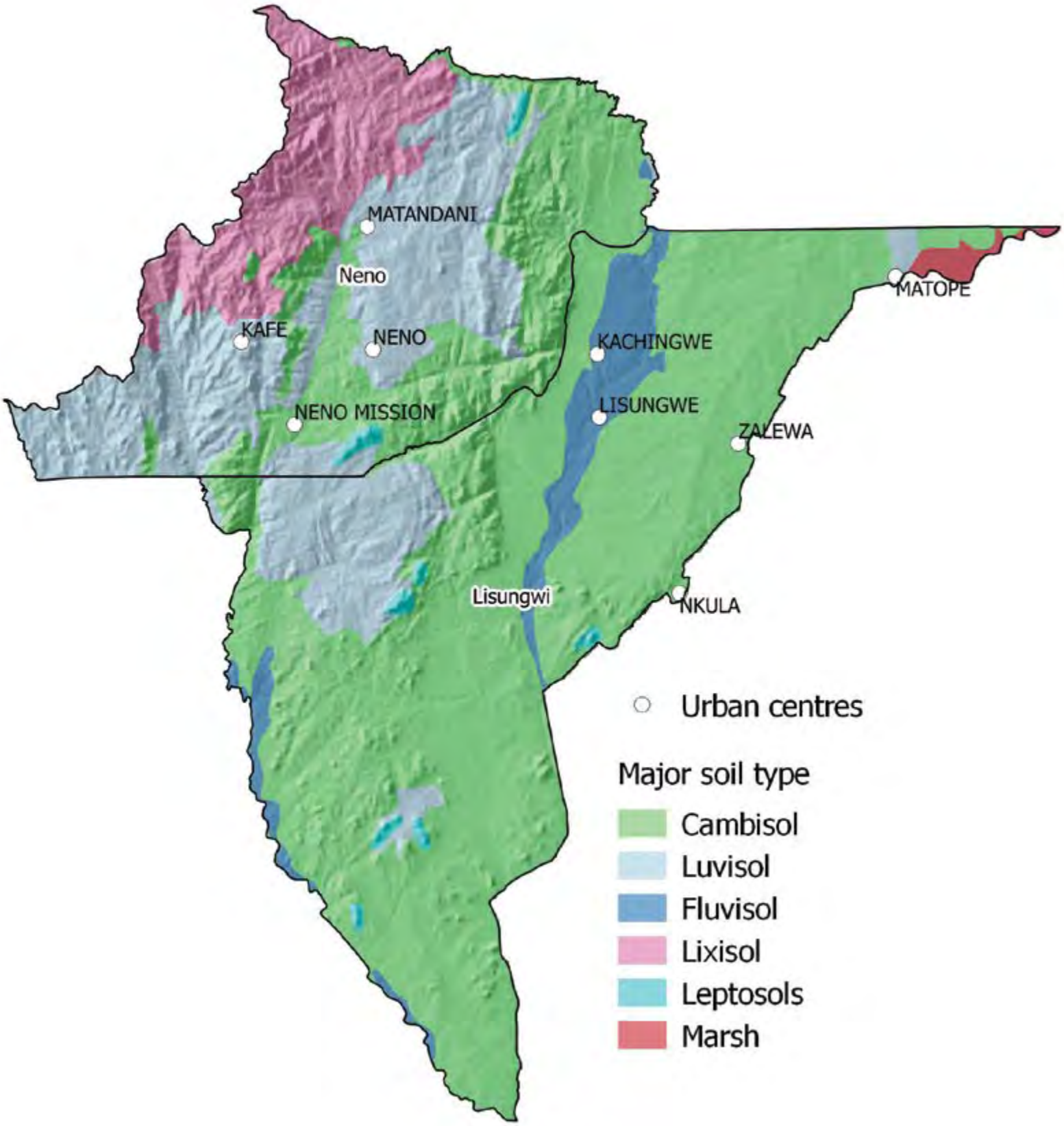
Neno district is slightly raised in the northwest and slopes towards southeast. The footslopes are mostly dominated by Cambisol while the plateau has deep to moderately deep Lixisol and Luvisol.

Mixed depth soil at Nkoka

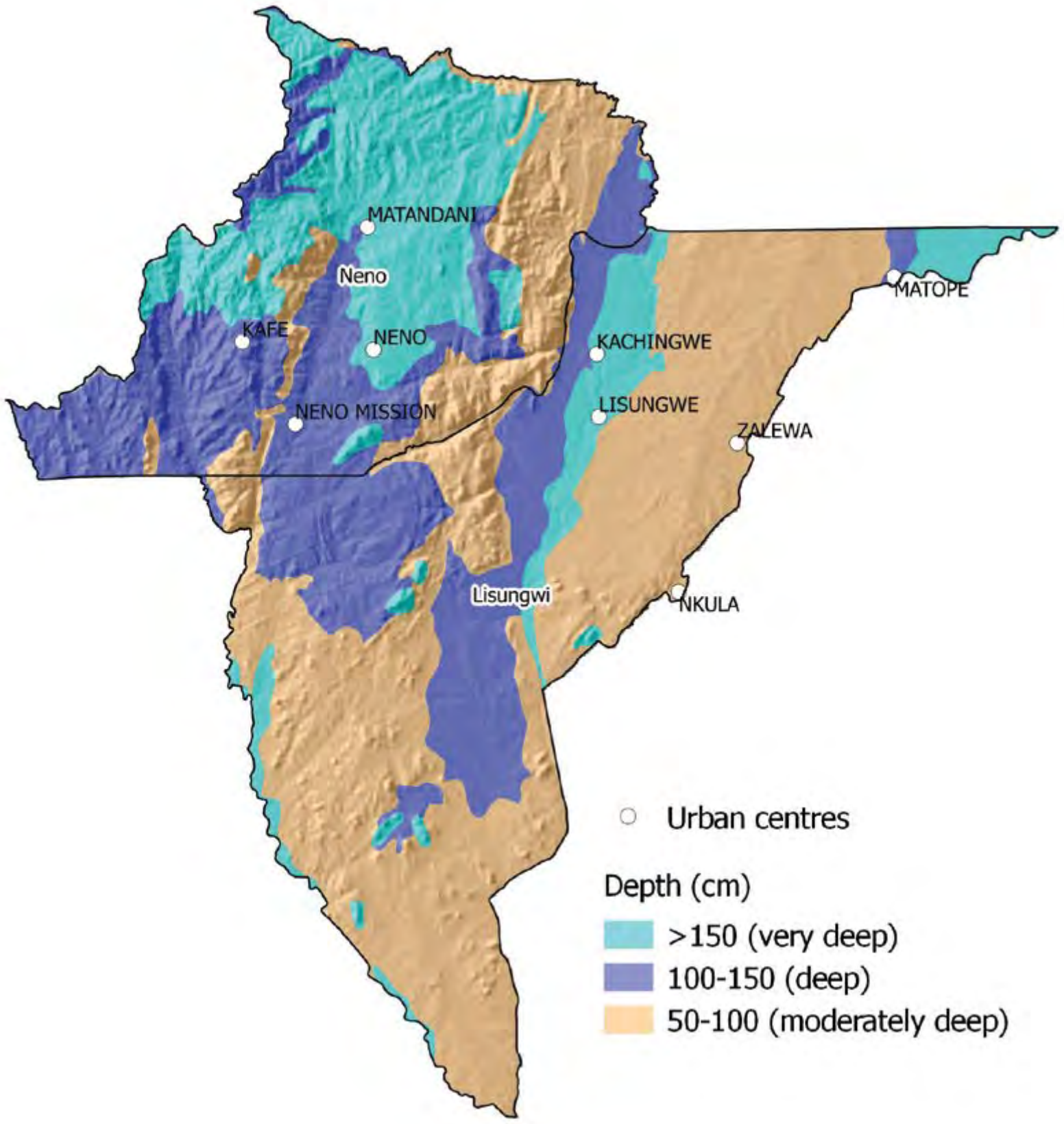
Deep soil at Nseula in Neno EPA



Source of base map: Government of Malawi



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Neno	No change	10	60	763	750-775	Moderate risk
Lisungwi	No change	4.5	53	748	715-811	Low risk

Sheet and gully erosion at Nkundika

Sheet and gully erosion at Njalammano

Cropland at Nhunde in Rivirivi EPA

Features of soil erosion

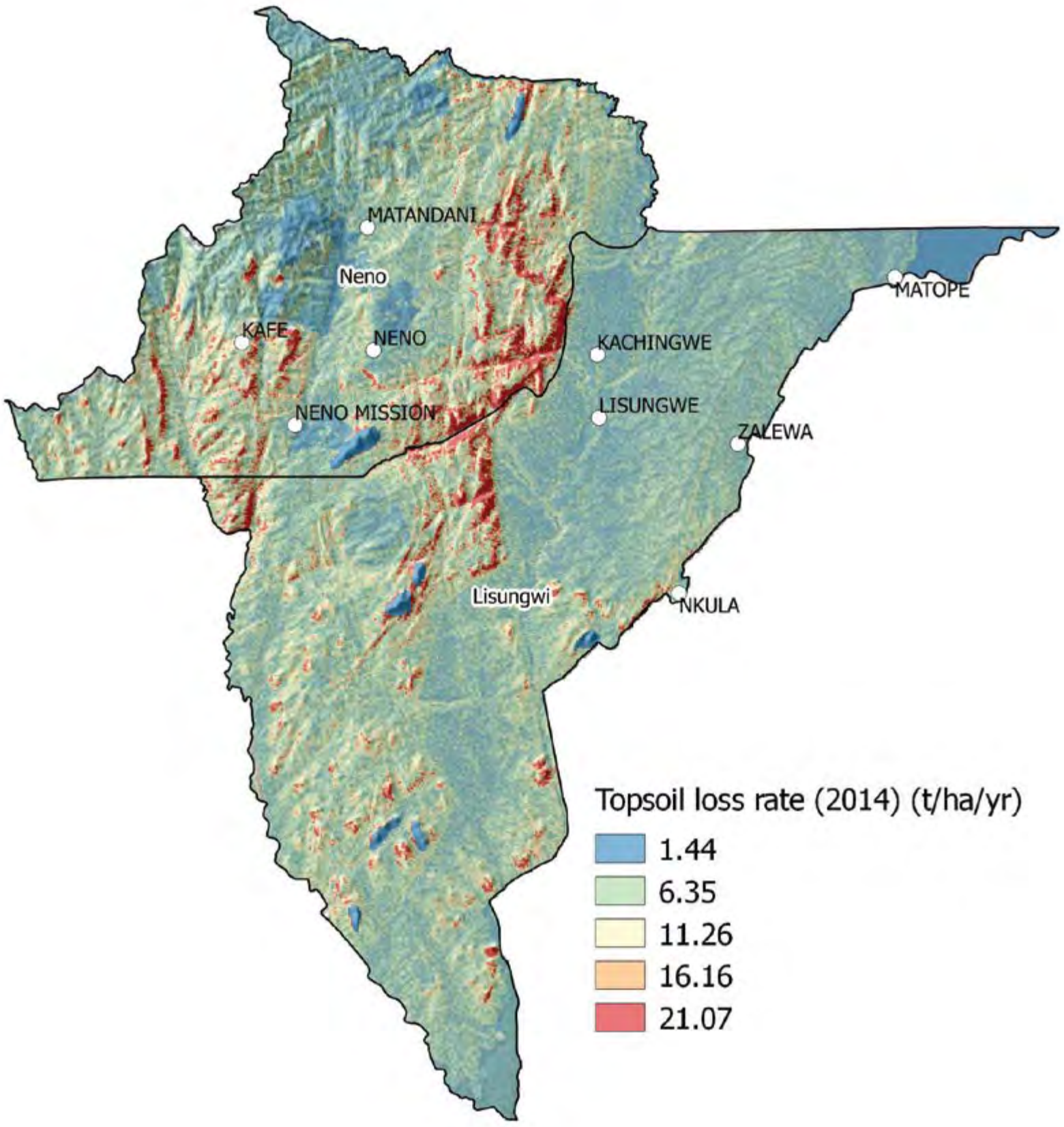
Sheet and rill erosion measurement at Wayiyatsa

Sheet and gully erosion at Njalammano

Topsoil loss rate

The mean district topsoil loss rate in 2014 was 7.44 t/ha/yr. High soil loss rates were mainly in Neno EPA. The main driving factors for the soil loss rates in these areas include vulnerable soil, loss of vegetation cover, and high rainfall. Sheet and rill erosion are the most common forms of erosion.

Extension Planning Area (EPA)	2014 Topsoil loss t/ha/yr		
	Mean	Minimum	Maximum
Neno	8.82	1.76	21.07
Lisungwi	6.90	1.44	18.35



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm	ppm
Lisungwi	7.81	2.407	1.187	0.120	3.592	0.735	0.670	15.693	2.582	0.596	0.845	14.787	14.386
Neno	5.31	9.019	4.445	0.451	41.001	0.250	0.313	2.263	1.460	0.691	2.691	27.991	14.803

Typical croplands in July-August period in 2017

Cropland at Nseula in Neno EPA

Cropland at Kumpakiza in Lisungwi EPA

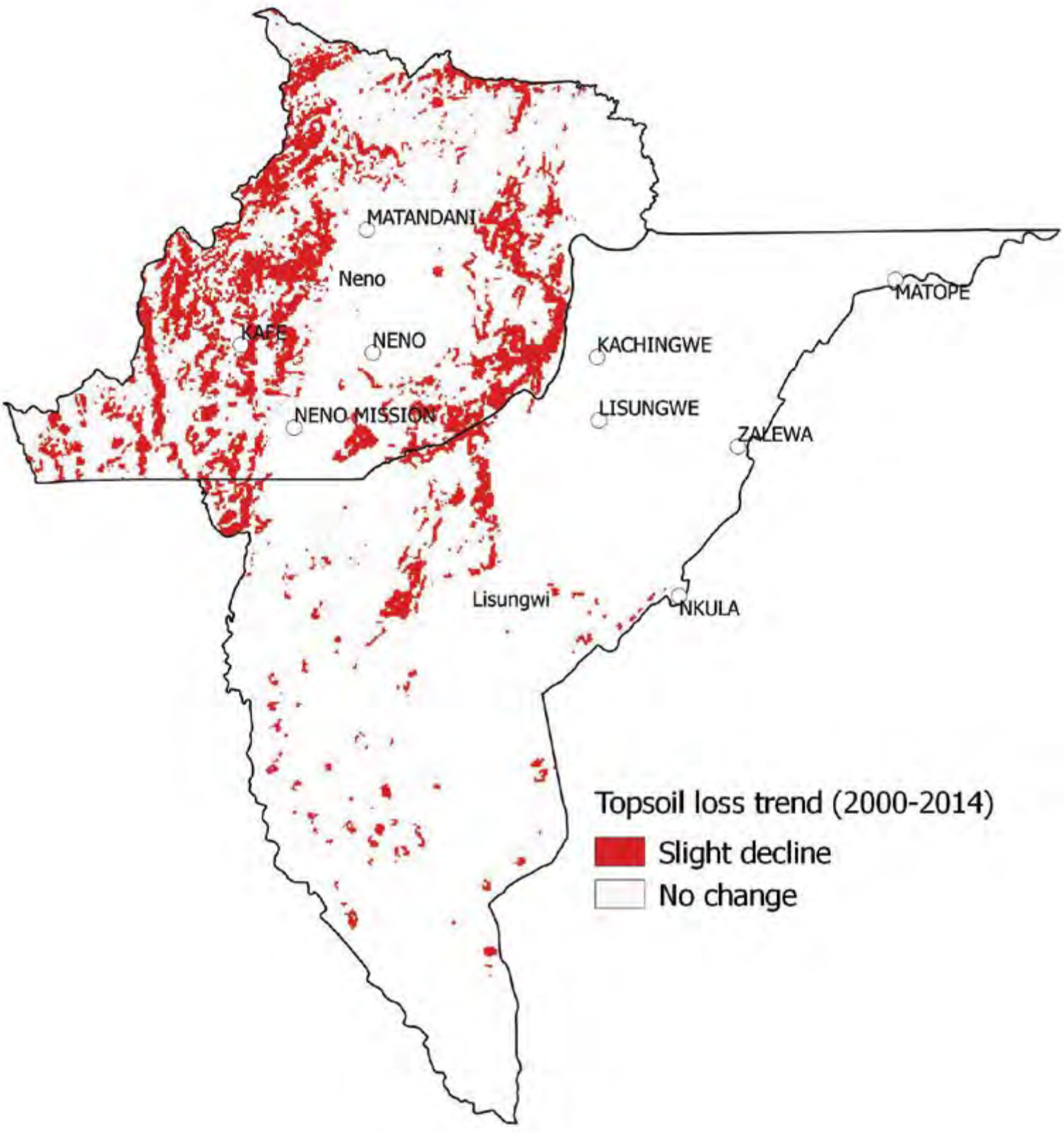
Cropland at Kumpakiza in Lisungwi EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

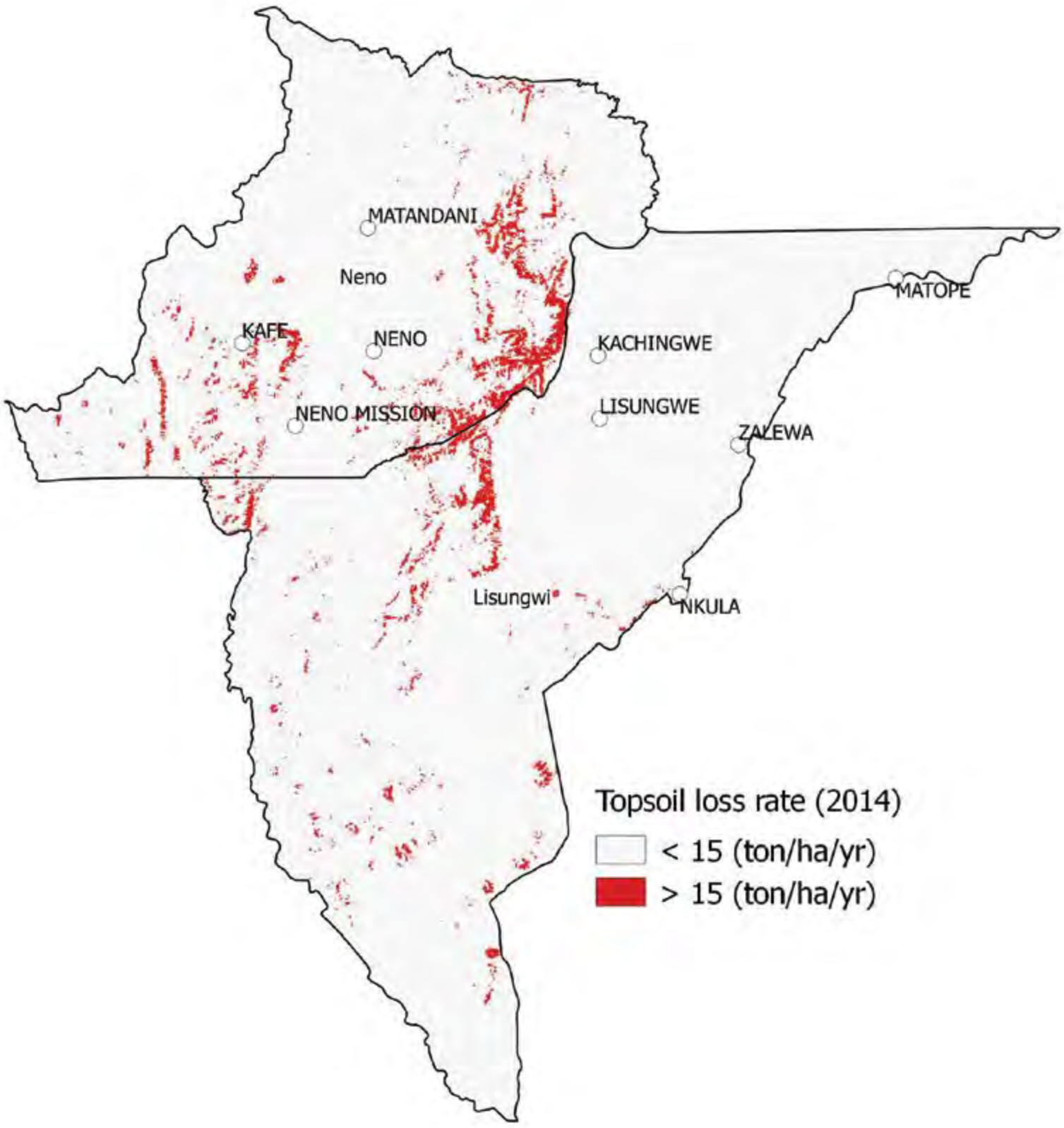
EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Matapwata	0.096	0.004	0.308	0.409
Dwale	0.11	0.006	0.375	0.49

Topsoil loss trend between 2000 and 2014

Contour Maintenance of natural forest at Mapundi ridging at Funsani Neno EPA in the district had signs of significant change in topsoil loss rates between 2000 and 2014. In Lisungwi EPA, the southwestern parts had similar signs of increasing trend of topsoil loss. In general, most of the areas with increasing trend of soil loss also had high topsoil loss rates.



Source of base map: Government of Malawi



Source of base map: Government of Malawi

Some of the soil and water conservation practices

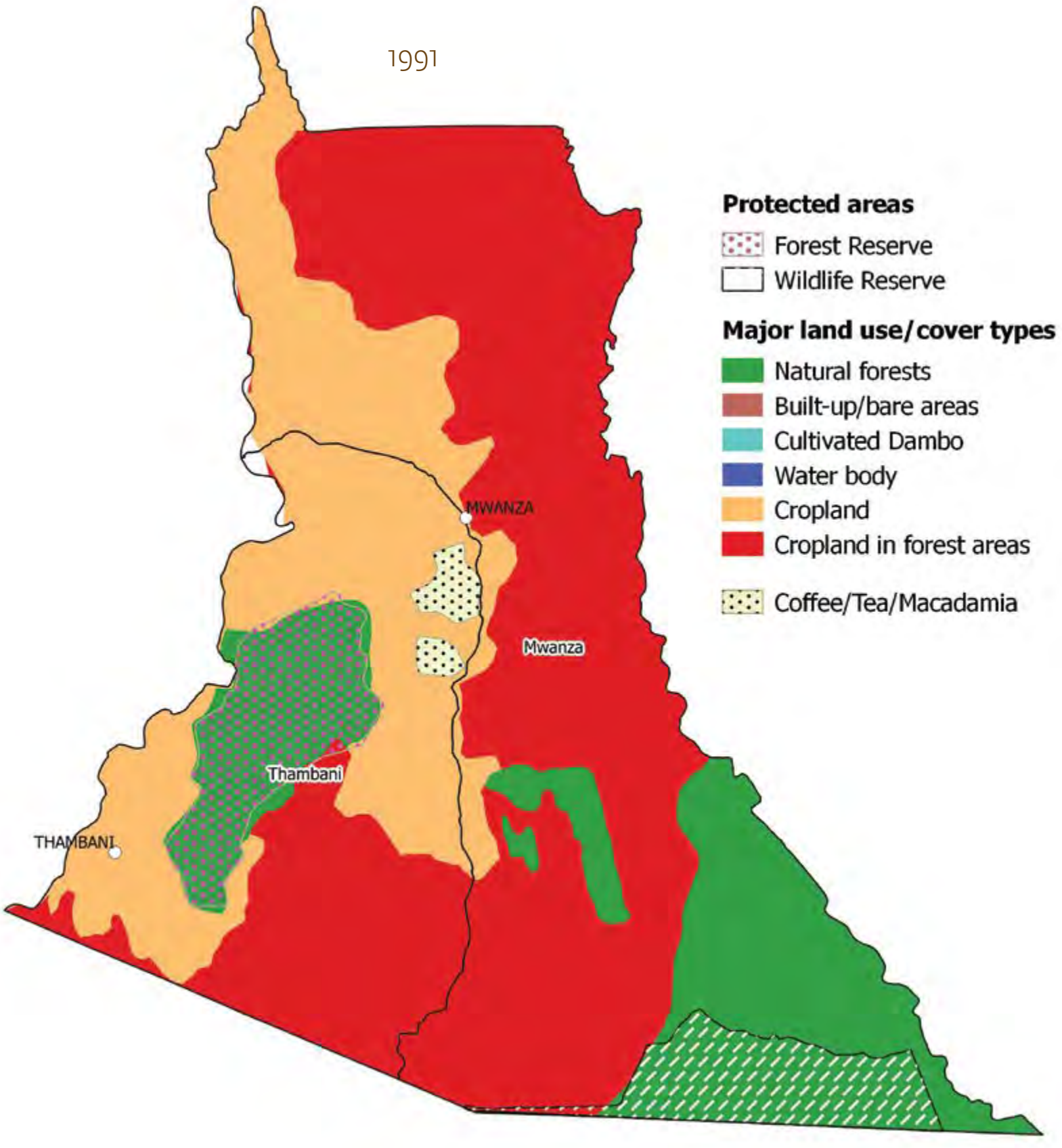
Maintenance of natural forest at Mapundi

Contour ridging at Funsani

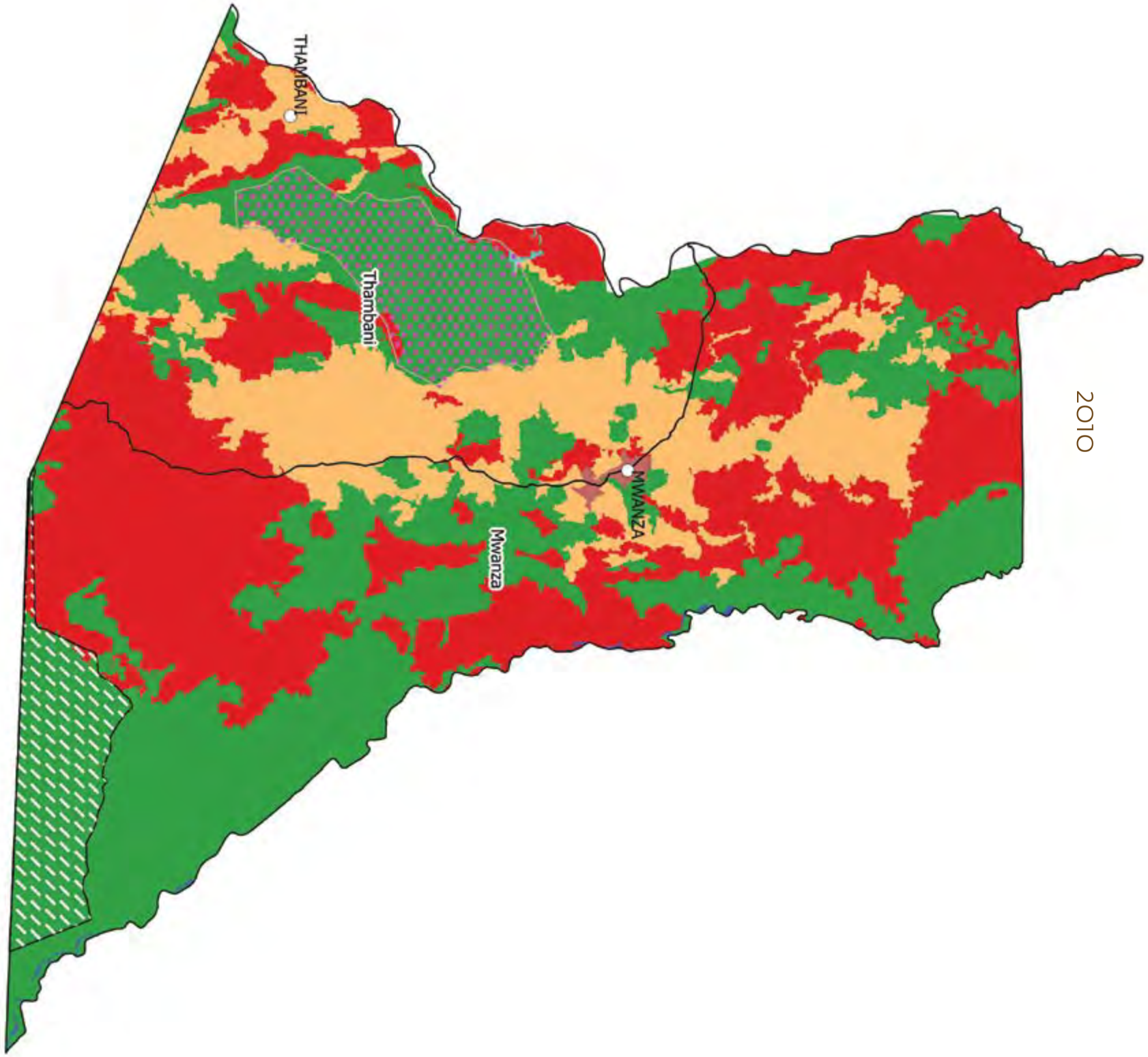
Drivers of soil loss
1. Vegetation cover change

The main land use/cover types are natural forests, Thambani forest reserve, Majete Wildlife Reserve, smallholder croplands, and urban/settlements. The district has had a slight decline in vegetative cover between 2000 and 2014 in the central towards the northern parts. This perhaps due to increase in cropland areas.

Major land cover/use types in 2010 and 1991



Source of base map: Government of Malawi



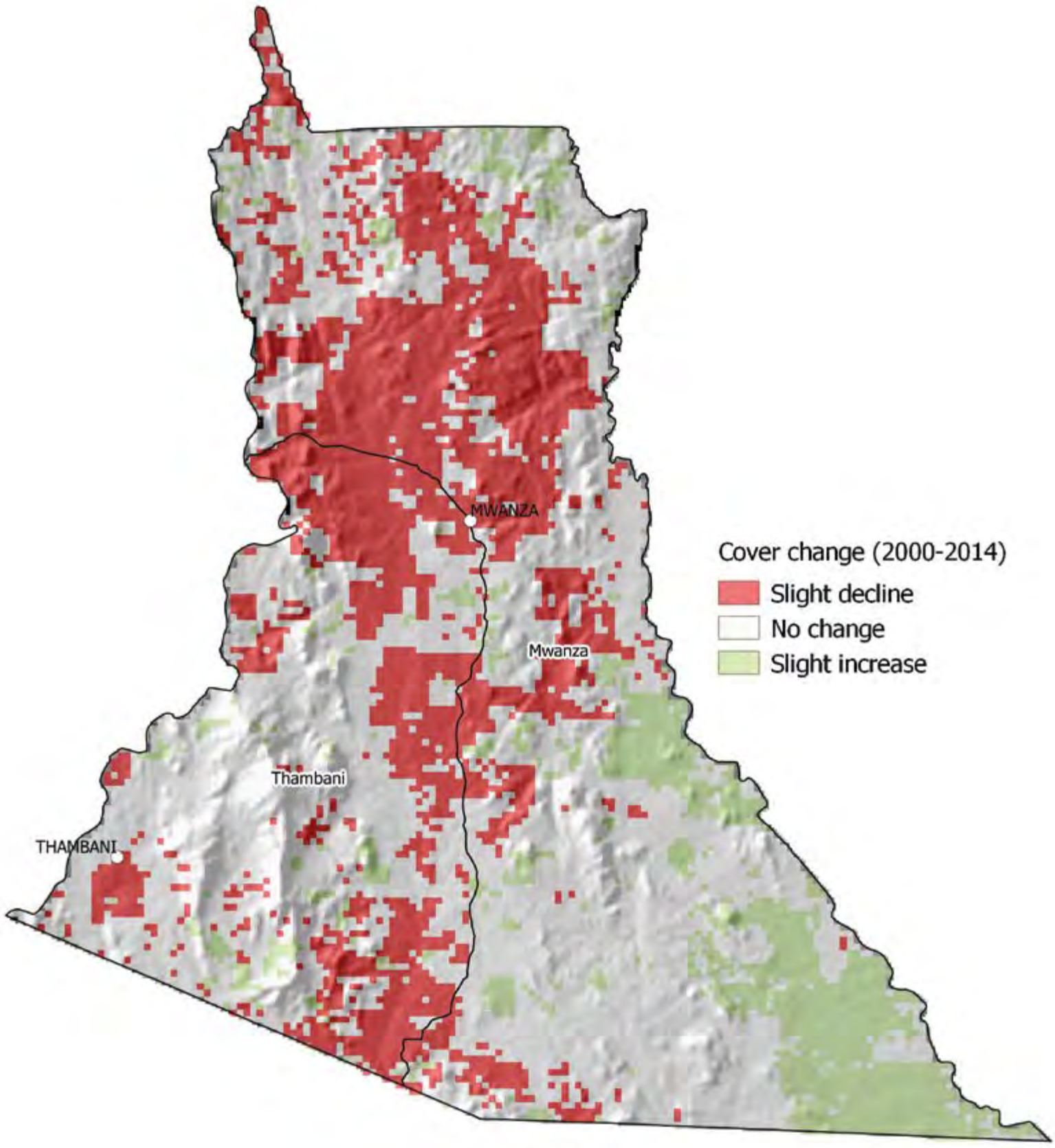
2010

Source of base map: Government of Malawi

3.27 Mwanza

Example of land cover types at Thambani EPA

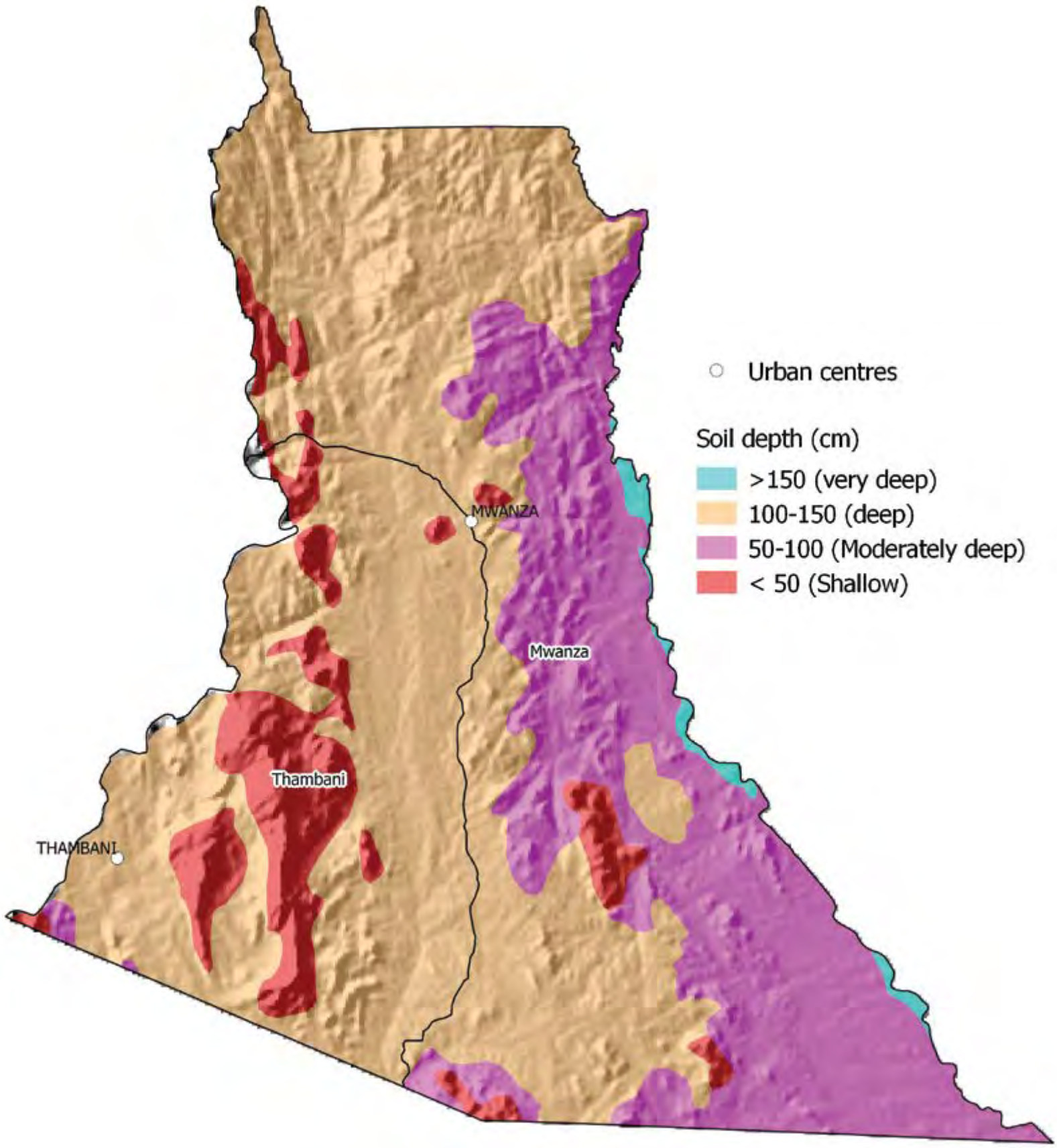
Vegetation cover change



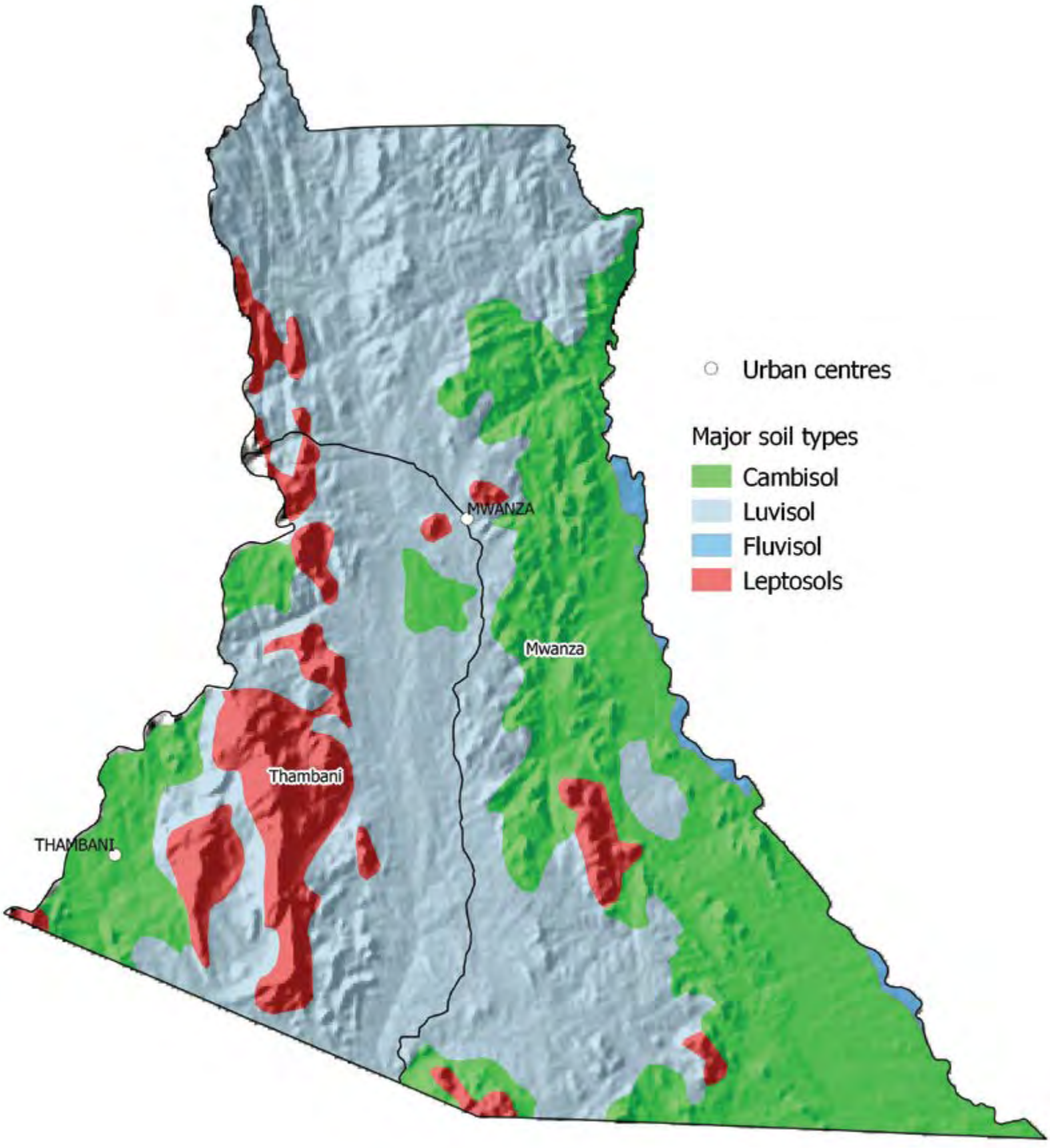
Source of base map: Government of Malawi

2. Rainfall, relief and soil factors

Mwanza has undulating terrain. There are mountains on the west and eastern sides; leaving a valley that runs from the north to the south. The valley has deep soil that is largely dominated by Luvisols. The plateau on the eastern side is dominated by Cambisols while the Western side has shallow Leptosols and Cambisols.



Source of base map: Government of Malawi



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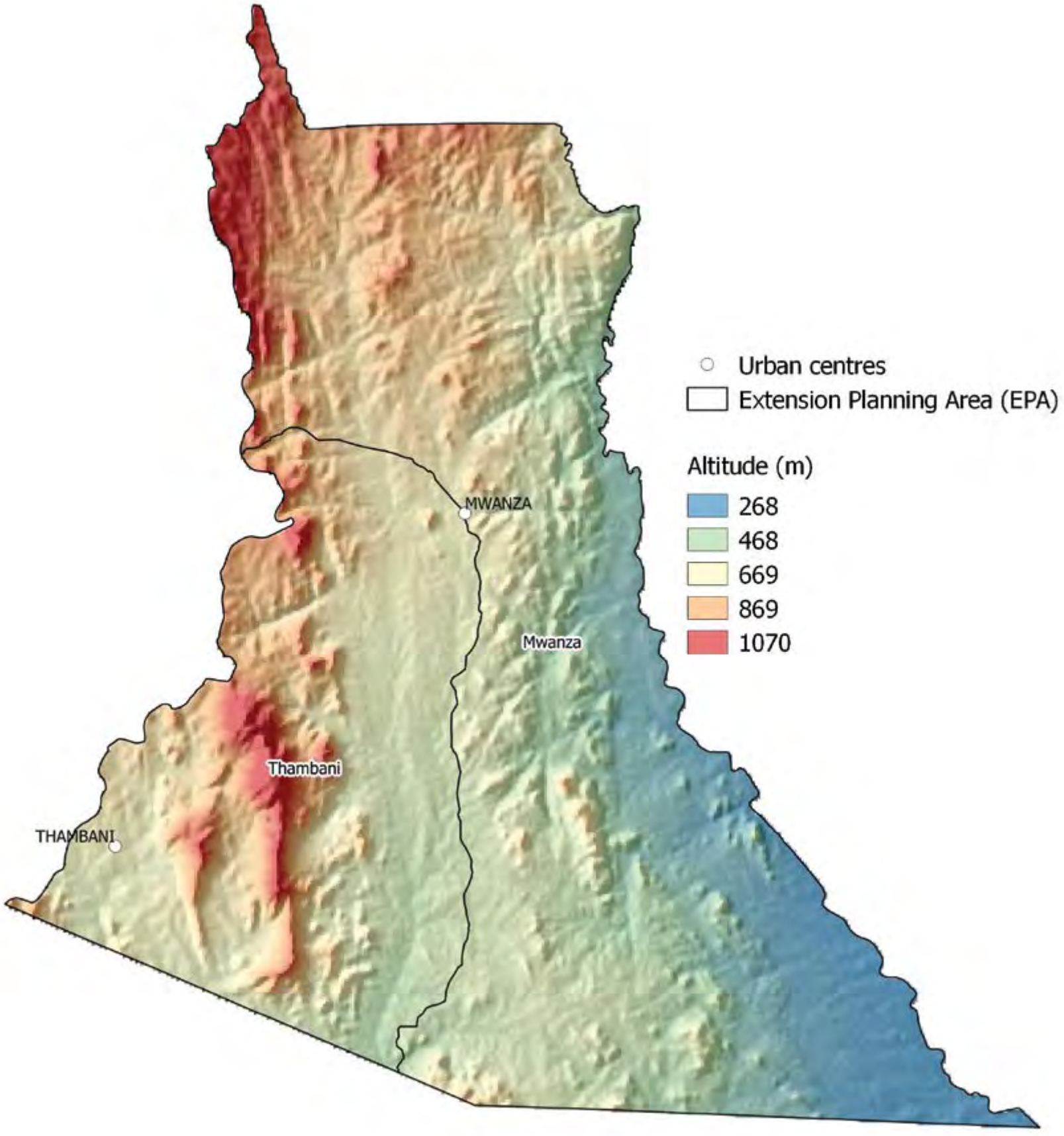


Source of base map: Government of Malawi

Soil loss risk factors

Extension Planning Area (EPA)	Vegetation cover change	Slope (%)		Annual rainfall (mm)		Soil erodibility risk factor
		Mean	Maximum	Mean	Range	
Mwanza	Slight decline	6.1	43.3	733	705-766	Medium risk
Thambani	Slight decline	7.6	50.3	724	692-742	Medium risk

Features of soil erosion

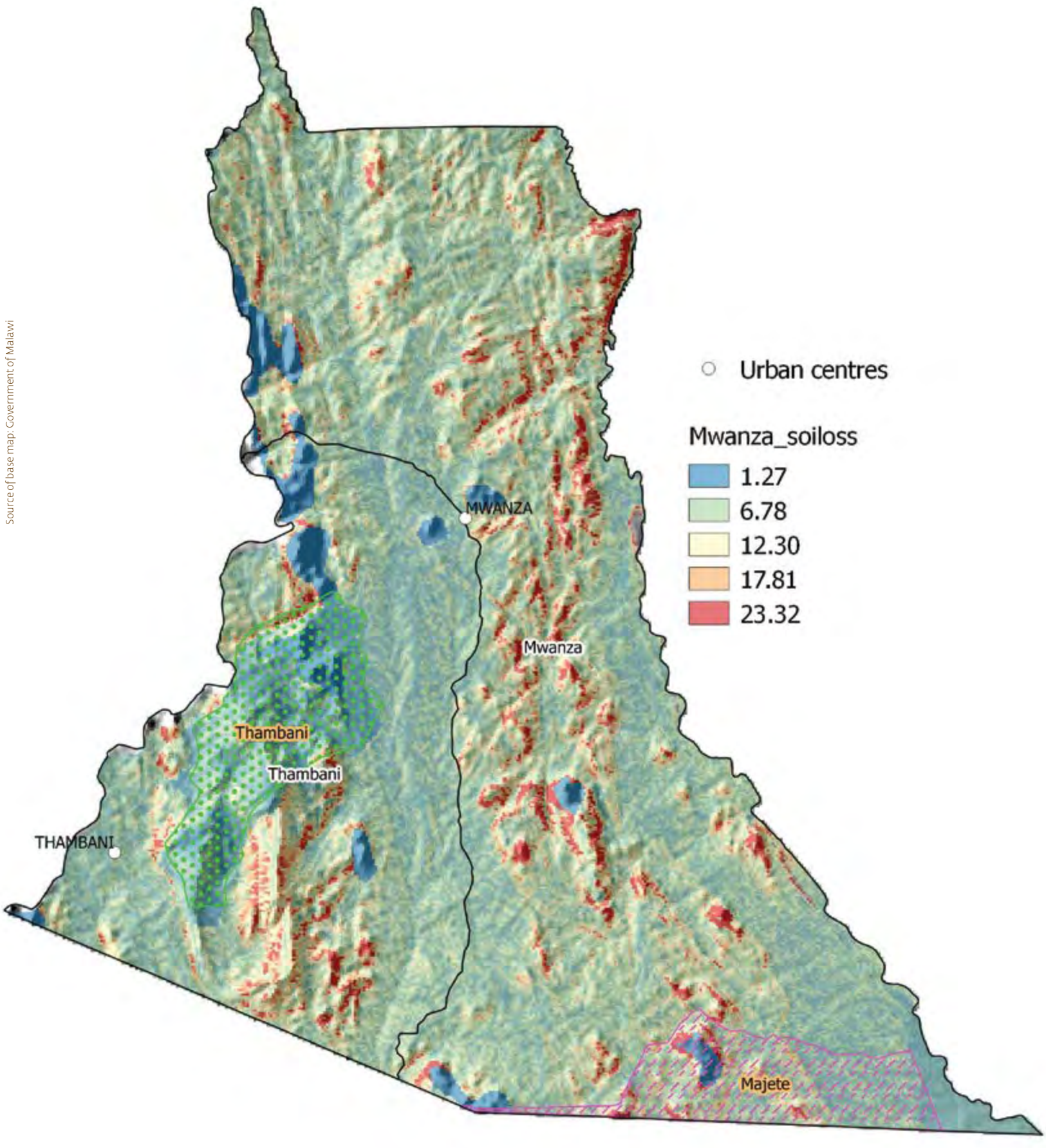
Sheet erosion at Nthache

Sheet and rill erosion Kanduku

Topsoil loss rate

The mean district level topsoil loss rate in 2014 was 9.03 t/ha/yr. High soil loss rates are mainly in the raised eastern and western parts of the district. The main drivers for the soil loss rates in these areas include soil vulnerability, steep slopes, and soil management.

Extension Planning Area (EPA)	2014 Topsoil loss ton/ha/yr		
	Mean	Minimum	Maximum
Mwanza	10.20	0.12	23.32
Thambani	8.68	0.19	20.09



Source of base map: Government of Malawi

Soil nutrients

Summary of topsoil (0-30 cm) nutrient levels in the District in 2017

EPA	pH	OM	OC	EN	P	K	Na	Ca	Mg	Cu	Zn	Mn	Fe
	-	%	%	%	ppm	me-q/100g	me-q/100g	me-q/100g	me-q/100g	me-q/100g	ppm	ppm	ppm
Mwanza	5.49	0.996	0.492	0.051	37.905	0.504	0.620	4.769	2.086	3.970	1.225	10.463	7.175
Thambani	6.28	1.023	0.504	0.051	49.122	0.277	0.496	6.260	1.885	0.540	1.805	14.218	1.787

Typical cropland in July-August period in 2017

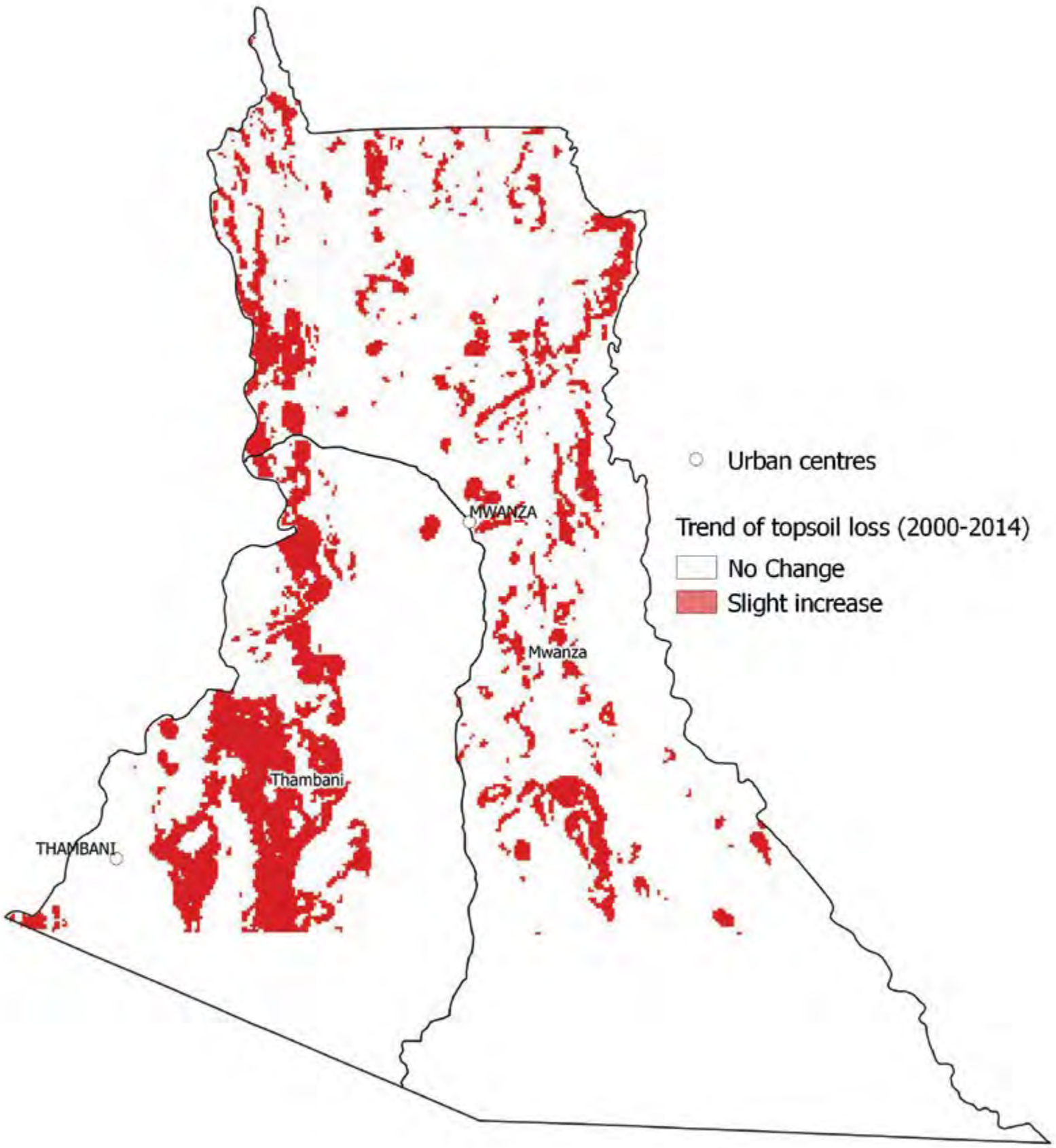
Cropland at Kadungu in Mwanza EPA

Mean topsoil nutrient loss (kg/ha/yr) of major soil nutrients due to topsoil loss in 2017

EPA	Mean Total N loss	Mean Exchangeable K^+ loss	Mean available P loss	Sum of mean NPK loss
Mwanza	0.161	0.012	0.588	0.761
Thambani	0.134	0.01	0.482	0.625

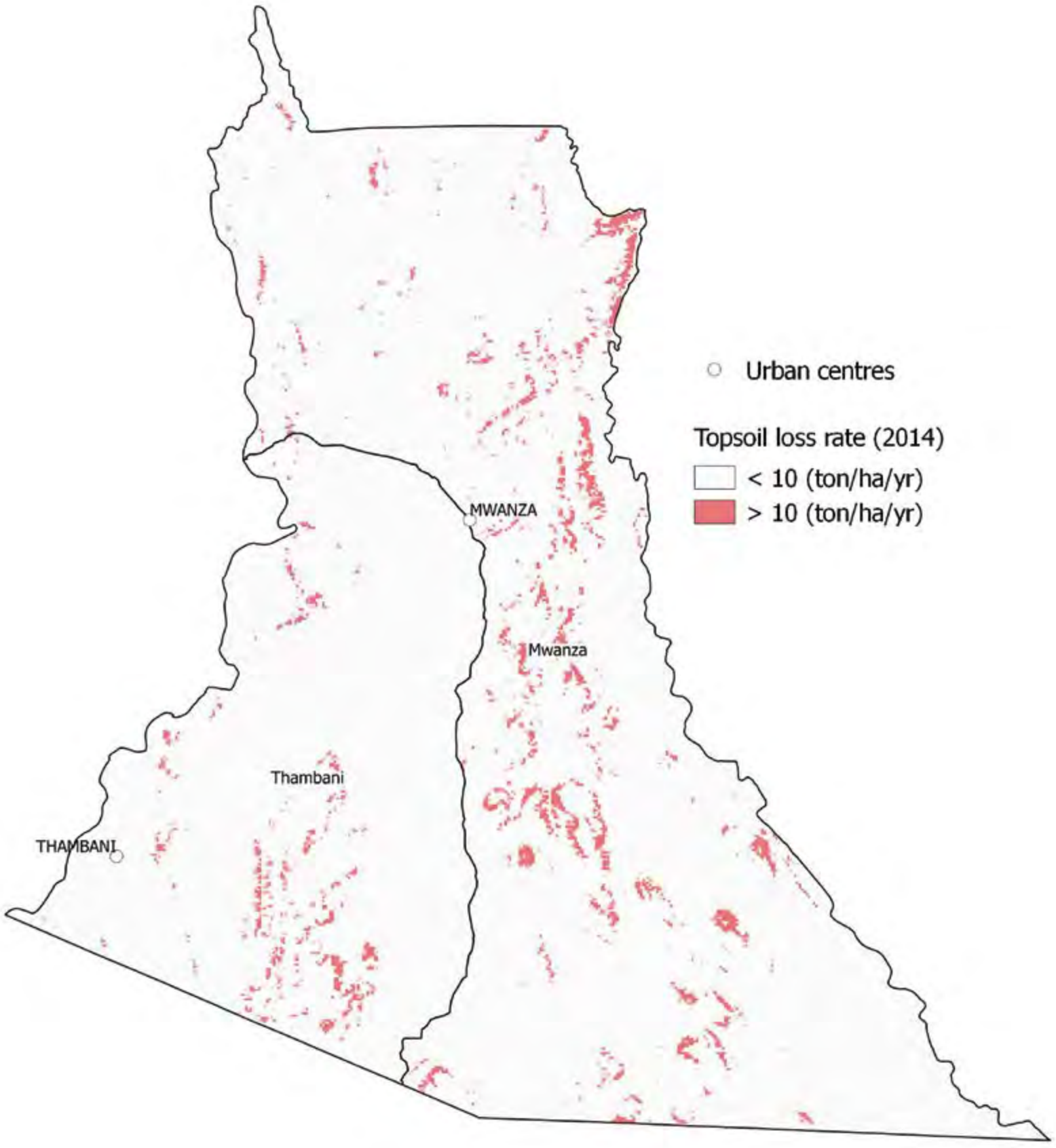
Topsoil loss trend between 2000 and 2014

The trend of topsoil loss rates in the district was increasing in the mountain ranges between 2000 and 2014. Most of the eastern plateau which had high topsoil loss rate also showed signs of increasing trend of soil loss over the years. The most common soil erosion problem is sheet and gully erosion. These are largely due to the vulnerability of the dominant soil type, steep slopes, and soil management.



Source of base map: Government of Malawi

3.27 Mwanza



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Some of the soil erosion features in the District

Sheet erosion and soil surface hard-setting at Katunga

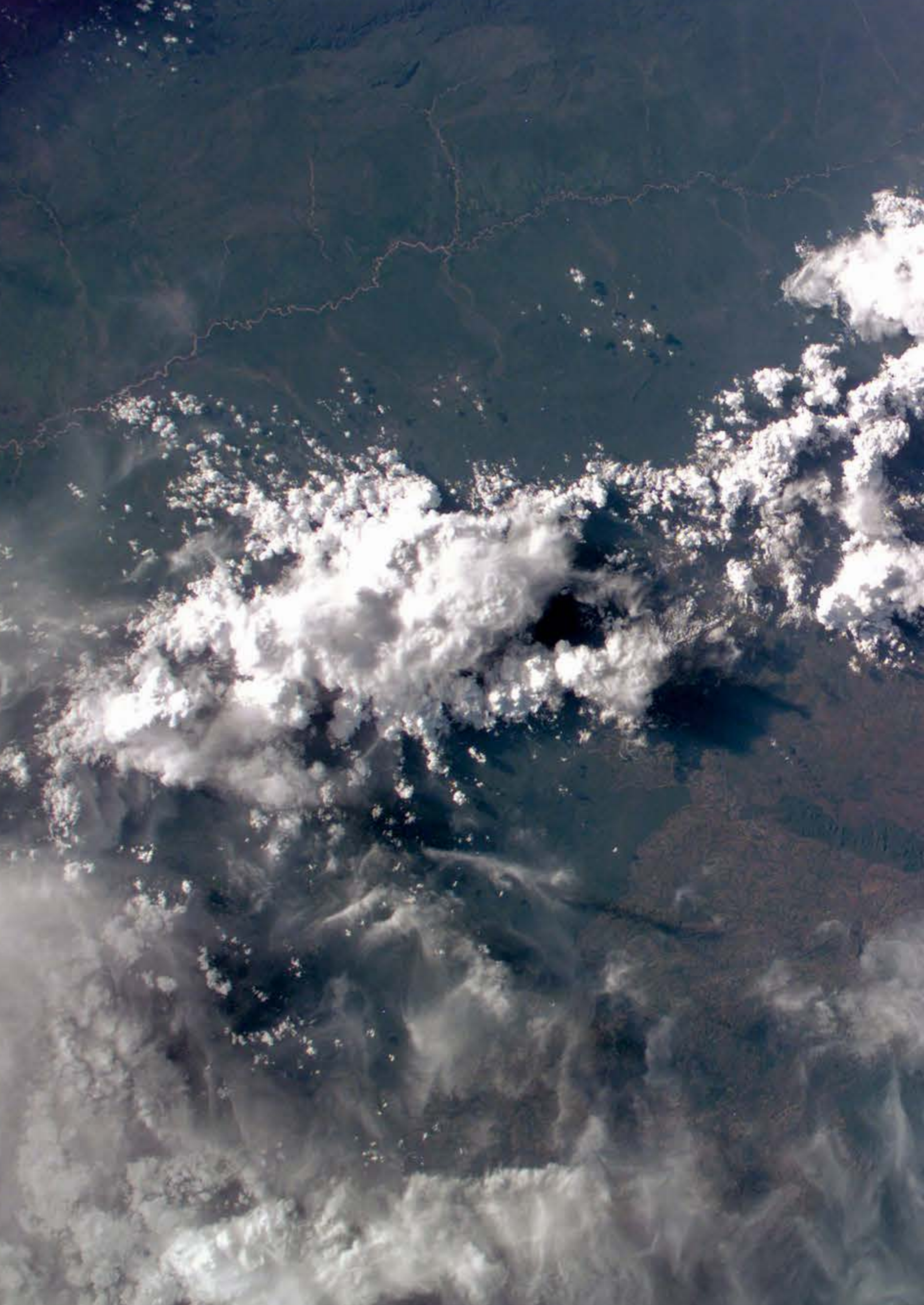
Riverbank erosion at Katunga

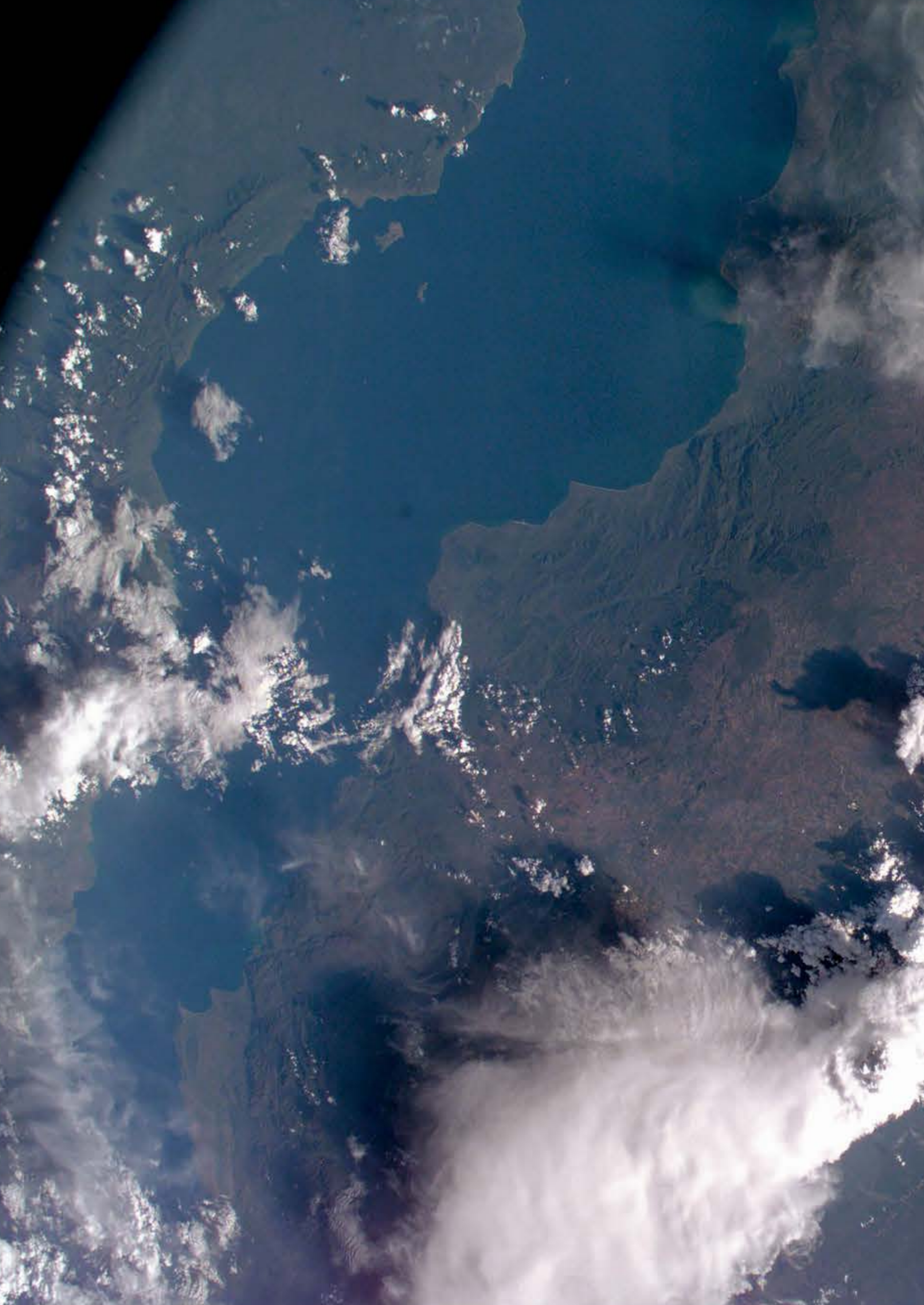
Some of the soil and water conservation measures

Preserving natural vegetation at Kanduku

Combination of legumes and contour ridges at Chikomba

Maintaining cover at Chiwembu





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The **Global Soil Partnership (GSP)** is a globally recognized mechanism established in 2012. Our mission is to position soils in the Global Agenda through collective action. Our key objectives are to promote Sustainable Soil Management (SSM) and improve soil governance to guarantee healthy and productive soils, and support the provision of essential ecosystem services towards food security and improved nutrition, climate change adaptation and mitigation, and sustainable development.

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