LEPUS CONFERENCE
SOILS, LAND USE AND PLAGUE

Lushoto, Tanzania

EXCURSION GUIDE

30-31 August 2013

NOTES

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FOREWORD

The five years project (2009 - 2013), dubbed “LEPUS” (Landscape-ecological clarification of bubonic plague distribution and outbreaks in the West-Usambara Mountains, Tanzania) was initiated to clarify the existence, distribution and recurrence of the human plague in the Lushoto area, Tanzania in function of environmental factors and wider spatial scale than hitherto assumed in the previous plague related projects.

This excursion guide leads you to the case study area of the LEPUS project. The study area is located in a 200 km2 section of the Western Usambara Mountains and within the Lushoto district (map 1). It is centred over the region in which during the period 1980 - 2004 many bubonic plague cases were registered. Within the case area, there is west-east gradient from high to low plague incidence.

Since the early 2000-s onwards different researchers from both Tanzania and Belgium have intensively scrutinized this area and developed a body of data concerning landscape, soil, land use, vegetation and fauna, to assess their linkage to the historical distribution of plague.

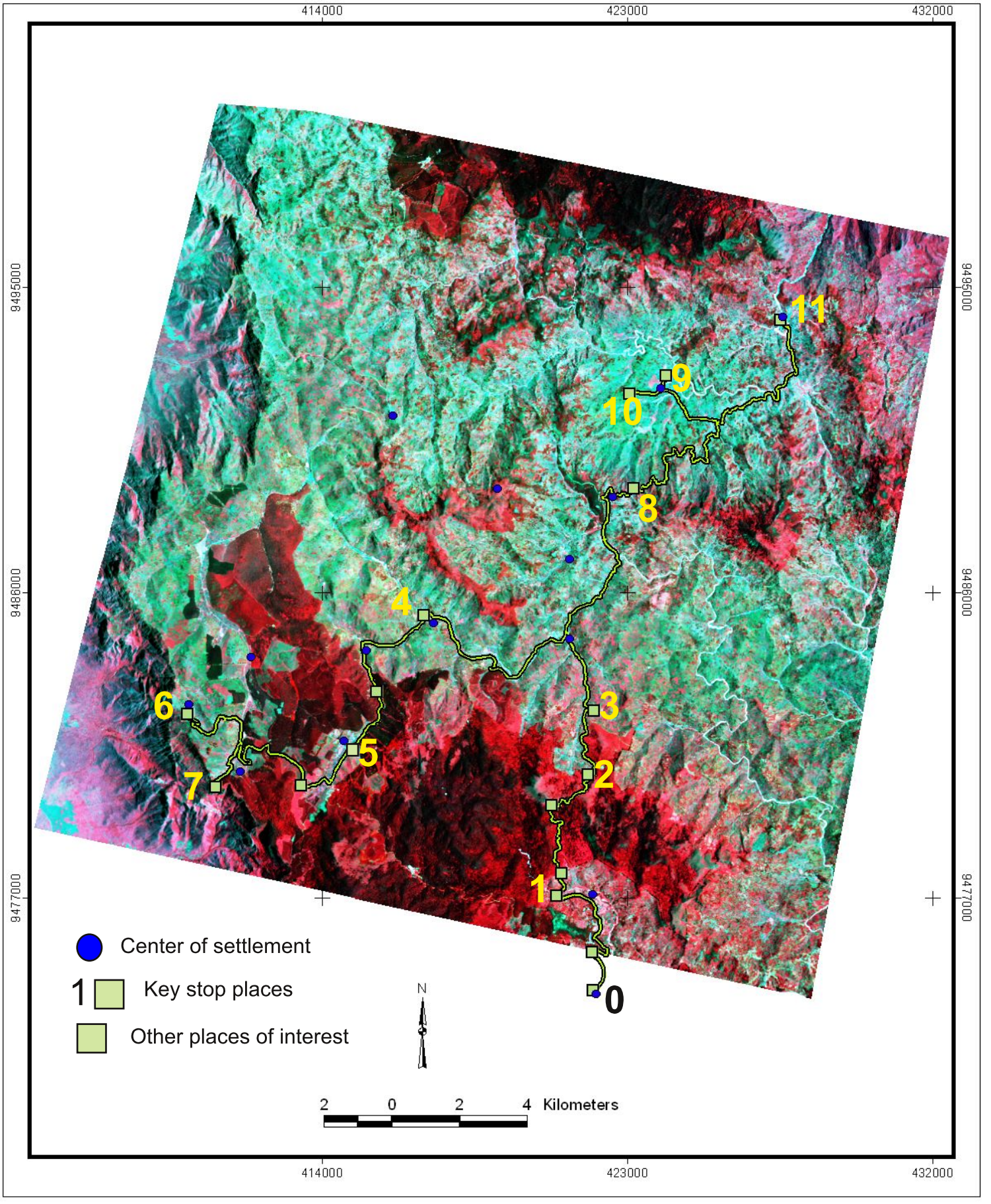
Initially and in continuation of former studies, LEPUS concentrated on the geography of the plague cases to that of individual environmental and land use factors. Some of the original factors being investigated were natural and semi-natural vegetation, agricultural land use practices and human actions and activity spaces.

Three causes hampered and still hamper a more direct empirical study on the plague-environment interactions. First of all, apparently (and luckily for the local communities) plague has become dormant since 2004 in West Usambaras. Secondly, the resolution at which plague cases have been reported does not allow for a fine-grain interpretation of the effects of environmental and land use factors, many of which, such as miraba structures or the presence of rodent burrows, are expressed at much finer scales. Thirdly and most importantly, in the period after the last plague outbreaks, *Yersinia pestis* could not be detected in fleas and rodents in this area, despite very intensive studies parallel to LEPUS.

Therefore in the course of these five years of the project, we concentrated on rodents and fleas as proximate dependent factors - irrespective of their current role as hosts and vectors. They were actively captured along with data collection on soil, landscape and land use. In doing so, this research has not only helped to consolidate the insights in complex landscape ecological interactions, but also provided information of interest for the overall sustainable development of this area, in terms of different interrelated aspects like biodiversity, rural livelihoods, soil conservation and ecotourism.

We will guide you during the two days of excursion through a section of the fascinating Usambara landscape, show you the different environmental and land use features which we link to plague reported cases, hosts and vectors, and meet people and their interactions with their proper physical and ecological environment.

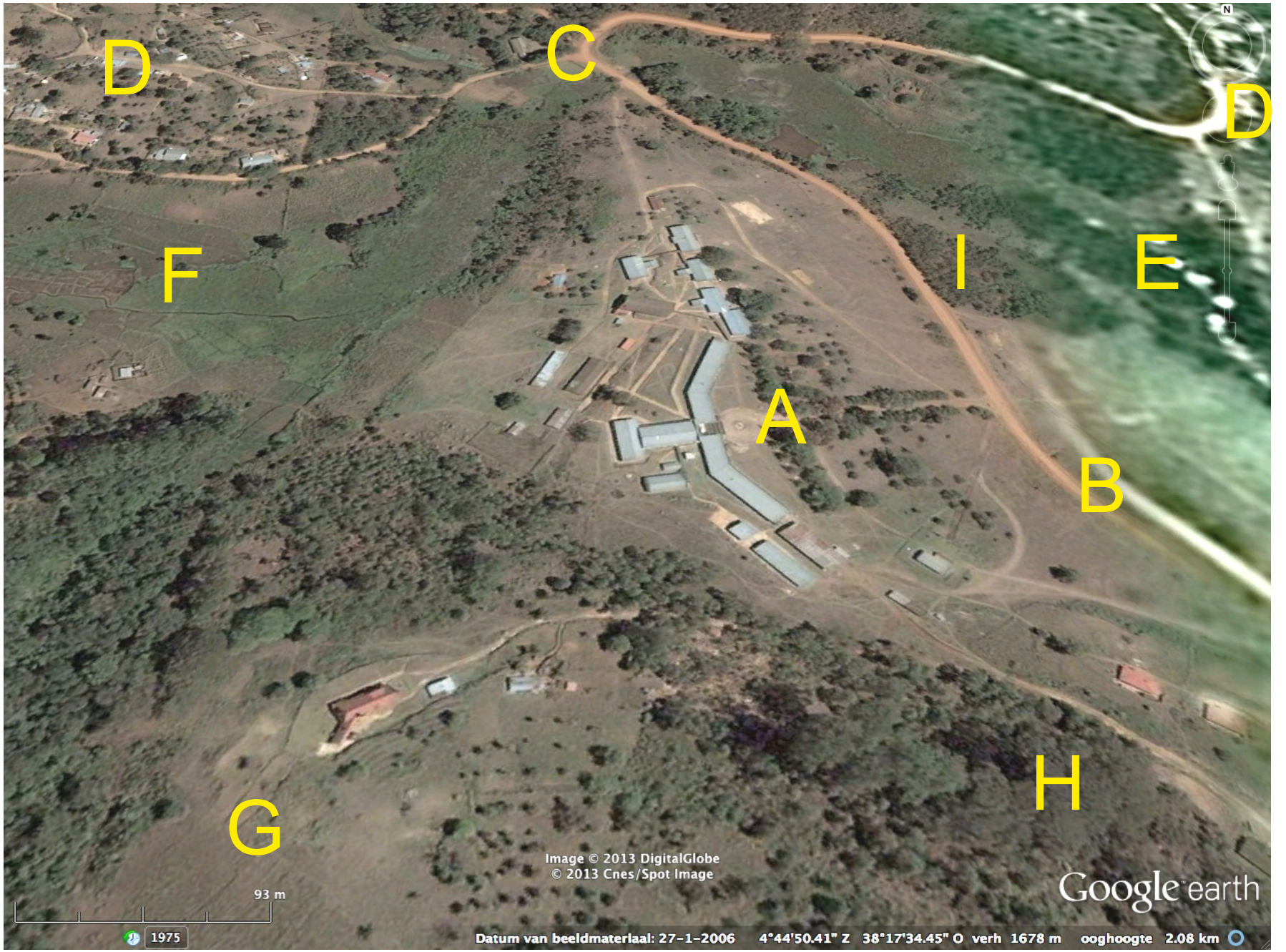
Proches Hieronimo, Joel Meliyo, Hubert Gulinck, Didas Kimaro, Balthasar Msanya, Loth Mulungu, N. Kihupi, Seppe Deckers, Herwig Leirs



This map displays the itineraries. During day one we will visit points 1 to X, during day two points Y to Z. We end both days back in point 0 (SEKOMU campus). The boxes with numbers 1 to Z are the key excursion stops; we will get out of the bus for explanation. Stops will take between ten minutes and one hour or more. The boxes without numbers are secondary places, we will slow down, stay in the bus and provide information while driving, but depending on interest we may want to leave the bus for few minutes.The background of this map is a false colour composite of a SPOT image of 2007 (copyright SPOT IMAGE). In this overview map vegetation is in red. This same image will be used for many of the consequent displays in this brochure, but in another colour scheme, with vegetation in green. When the Google Earth airphotos provide more detail, we will use the latter instead. Many of these displays will be oblique 3-D views generated through Google Earth.

0 SEKOMU Campus 1 Kibohelo 2 Magamba Ridge 3 Lukozi valley 4 Viti 5 Gologolo 6 Lokome 7 Nkungumizi 8 Malindi 9 Moa 10 Mwangoi 11 Mlalo

start: SEKOMU CAMPUS



Sebastian Kolowa Memorial University (SEKOMU) has been hosting LEPUS from the very start of the project. We could not have dreamed of a better headquarter, not only for the geographical location of the campus in between Lushoto town and the case study area, but also for the intellectual and human atmosphere of this young university, and for the quality of its campus ground and its infrastructure.

The picture above unfortunately does not cover the entire campus. You see central Campus B (label A in this picture), but Campus A south of this image is not covered neither by good Google Earth airphotos, nor by the SPOT image. But you will have plenty of opportunity to walk through this diversified landscape in the calm hours of the conference period.

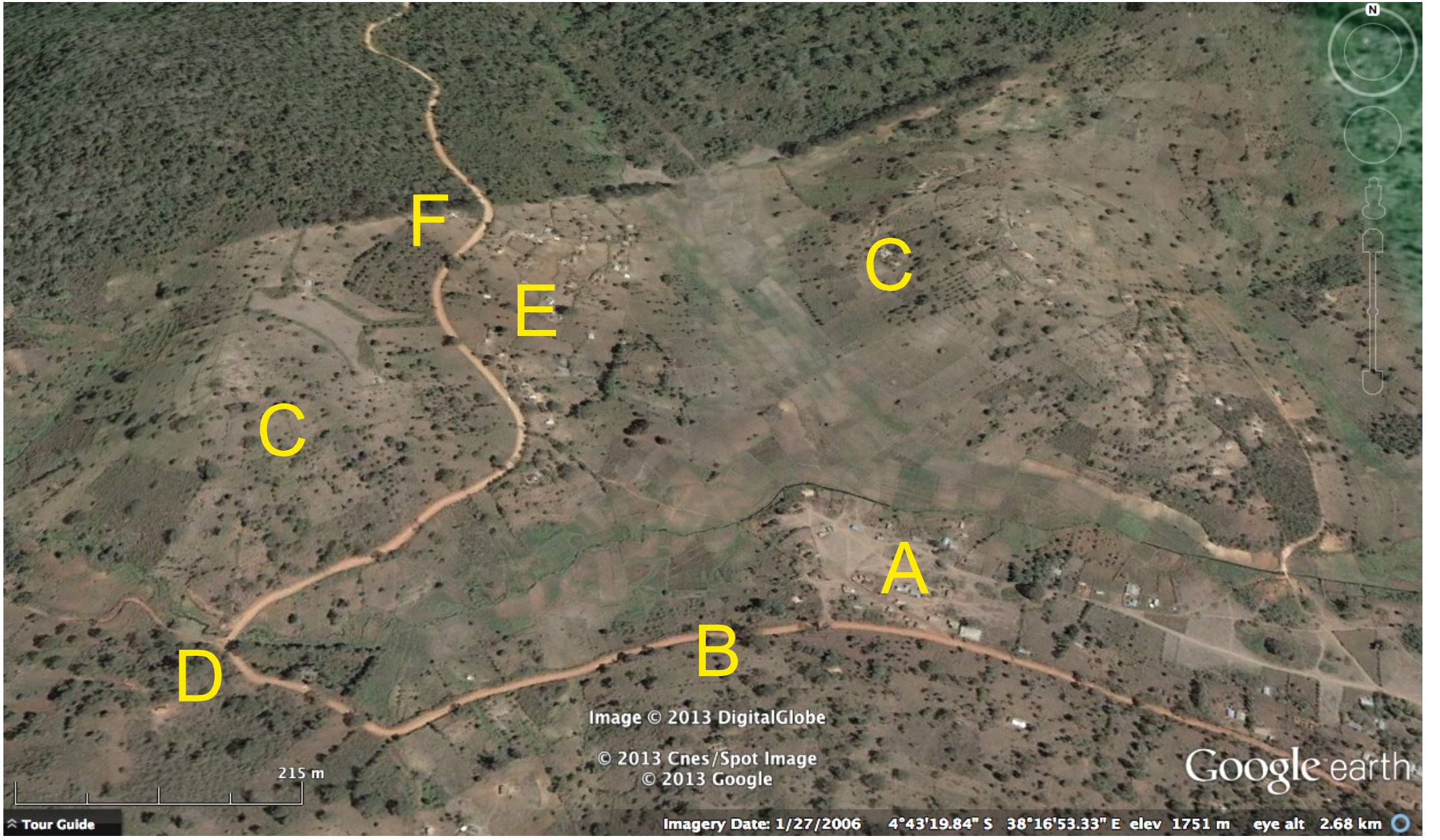
The campus is situated next the main road (B) coming from Mombo over Lushoto, and winding to the north (Malindi, Mtai). The T-junction (C) on the top of this picture is a lively place with small market stalls, and also a nodal point from where you can reach among other a secondary school for girls, a mission, and of course nearby villages (D)

Immediately east of the campus and the main road flows the Kibohelo river (E), and a tributary (F), with irrigated agriculture in its bottomland, joins this river just north of Campus B.

In and around the campus you see farmland, on slopes typical with terraces (G), as well as remnants of the natural forest vegetation (H), and wood plantations (I).

This campus is an ideal hub to start studies of the natural and cultural riches of West-Usambaras.

1 KIBOHELO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The site "Kibohelo" is not part of the LEPUS case study area, but it is a nice entrance into the many characteristics and the diversity of the West Usambara plateau and hills. It lays about 5 km north of SEKOMU campus, and is actually being used as case area in the SHEIRUDE project (VLIR South programme). After some winding road sections we see on our right side the hamlet Kibohelo (A) and a bit further we have a nice panoramic view on the Kibohelo valley (B), the s behind it and on the far end the former Shume-Magambe forest reserve (recently upgraded to Magamba Nature Reserve), and in background to the right the Magamba ridge as one ot the highest point in the West Usambaras.

It is obvious that the valley bottoms are plainly used for crops, but this is an open field (no obvious field boundaries), whether on slopes and on low hills we see plenty of small landscape elements and structures like low field edge strips, terraces, isolated trees and shrubs, and tree lines (C). These structures are suggestive as habitats for rodents. On the other hand they have a landscape stabilising role.

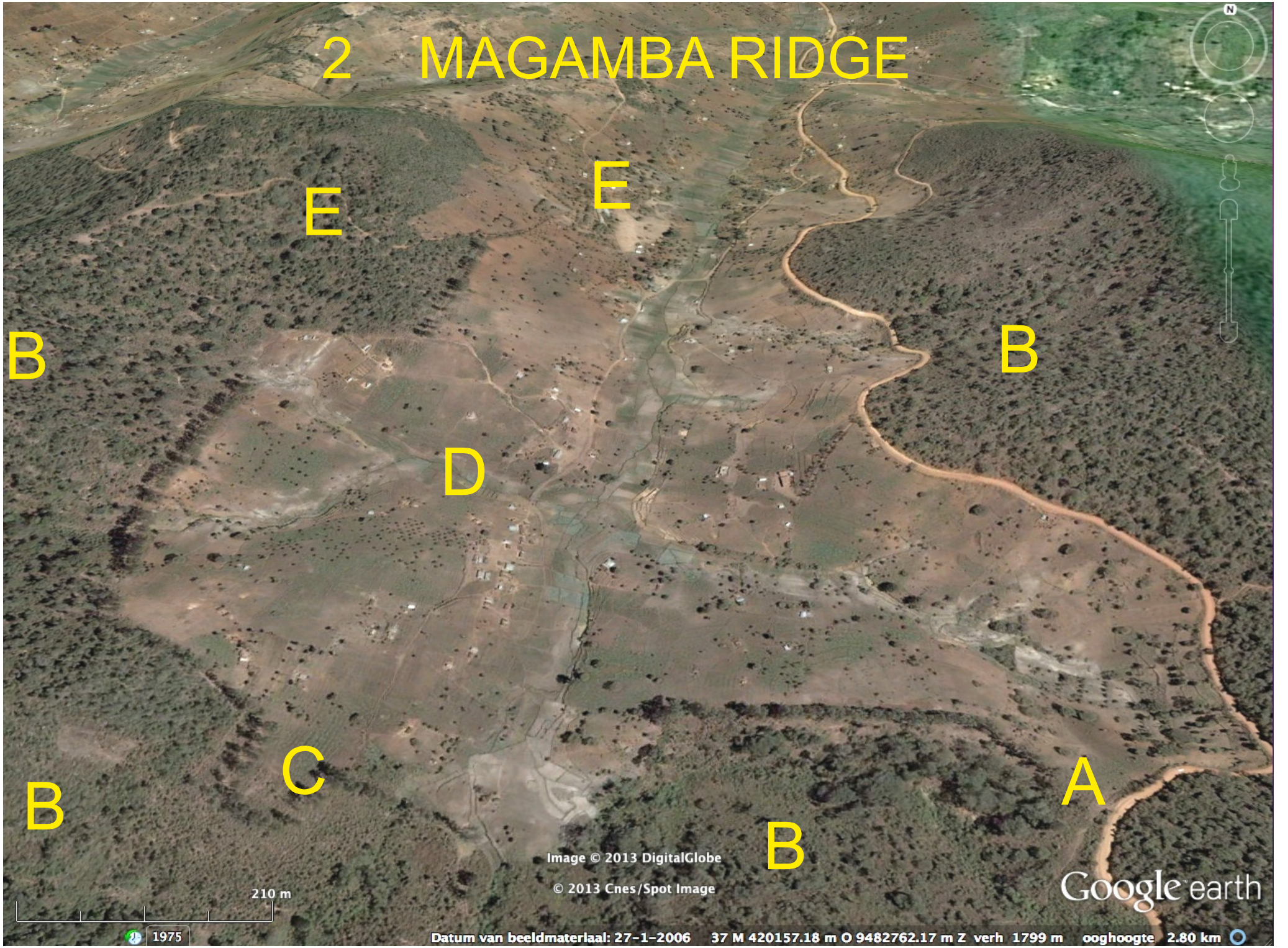
The Kibohelo area is populated by people of the Mbugu ethnic minority, descendants from 18th century migrants from the South Pare Mountains. They have an own language and own local traditions. Some of the landscape features do appear like *miraba* which we will see very clearly in the Lukozi and Mwangoi areas, but this word is not being used here. Instead the Mbugu have an apparently related word *mirobe* for a similar rectangular network, but not composed of tall grass but of shrubs.

We will have a brief stop at the waterfall site (D). *Kibohelo* or *kibohero* is the word for waterfall in Mbugu language. This is an interesting nodal point in the landscape: a bridge over the river and a very nice waterfall, a cloth washing place, the edge between cultivated and non cultivated land.

Now we continue upwards, we pass the hamlet Fyofyoi (E) and we cross the demarcation line (F) of the forest reserve (Magamba Nature Reserve). This line is still in many places visible as a solid line of Eucalyptus trees, but many segments of this border line have disappeared. Also it is obvious that there is a strong edge effect inwards to the forest with clearings and much thinned forest, suggestive of a strong interaction of humans with the natural habitat.

The Kibohelo area is being investigated more deeply in the SHEIRUDE project, for its rich landscape, land use and cultural features . Next to the mirobe mentioned above there are other locally acknowledged features not immediately obvious for the foreign eye. Also so far this valley appears to be just outside the current influence of the urbanising pressure from Lushoto and the SEKOMU campus.

Now and for a couple of kilometres we will cross the Magamba Nature Reserve towards the next stop at the watershed divide between Magamba ridge and Lukozi valley.


2 MAGAMBA RIDGE
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The stop (A) is on the border between Magamba Nature Reserve and Ndabwa village.

This site looks like a bowl-shaped peninsula of cultivated area surrounded by the Magamba Nature Reserve (B). The winding main road sharply divides forest from cleared area. Elsewhere, the remnants of the reserve demarcation line of Eucalyptus trees can clearly be seen (C). The stop position is on the watershed divide and provides a nice panoramic view on the upper part of the Lukozi valley (D). Ndabwa was the name of a hamlet in the outbreak period, now Ndabwa is the name of a village including this and other hamlets.

Ndabwa is inhabitated by Pare and Sambaa. Twelve plague cases were recorded between 1988 and 2003

Elevation at this stop is 1940 m. Slope ranges from 1 to 15 % on the ridge summits and can be over 100 % at shoulder, back slope and foot slope positions. The geological base is composed of a high level ferralitic red earths with intrusions of distinctive band predominated by hornblende, pyroxene granulites evidenced with hanging cliffs, or rocky ridges or rock outcrops particularly at the shoulder and back slopes.

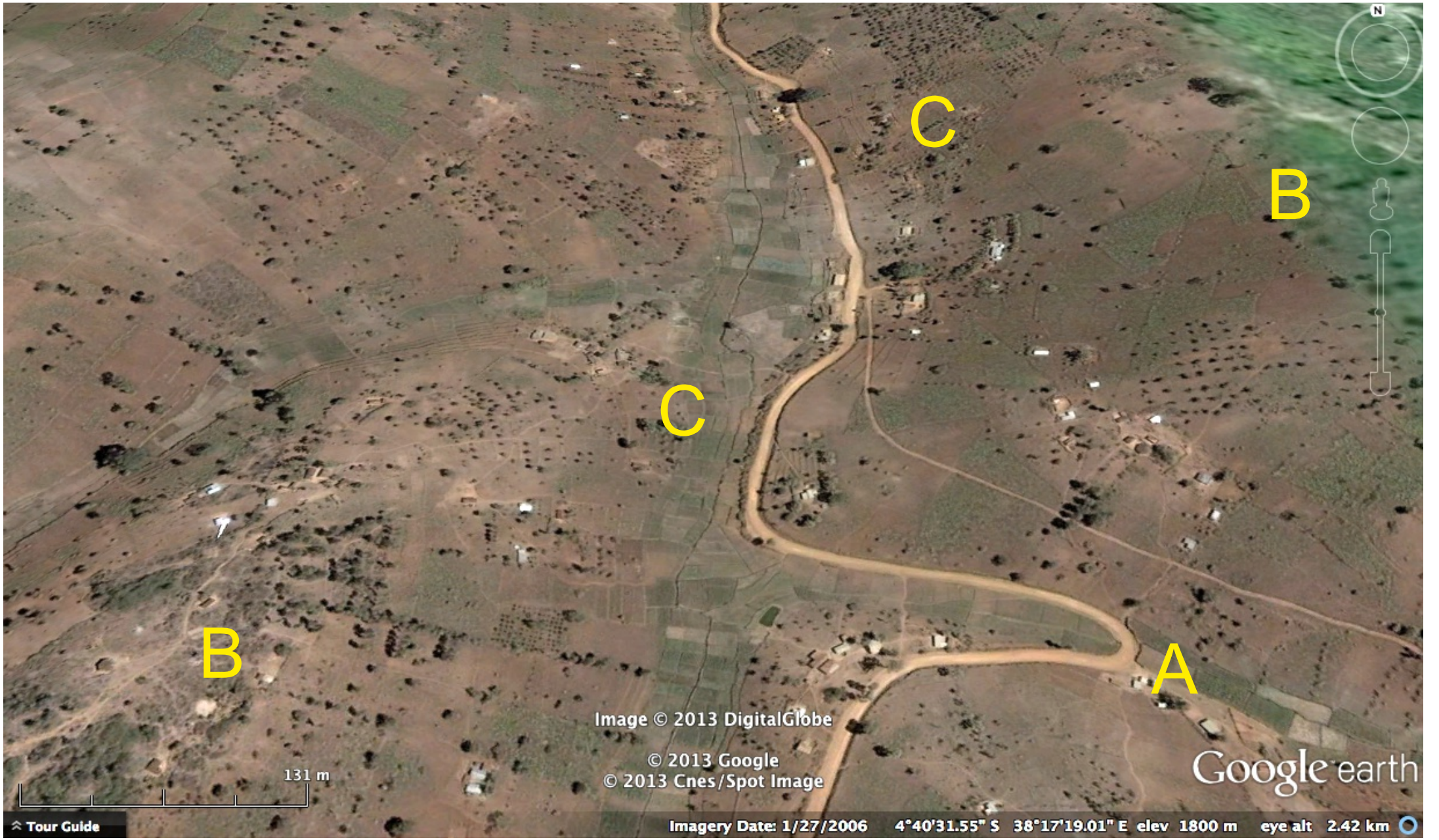
Soils were classified following World Reference Base (FAO, 2006). In most ridge summits soils are shallow or rocky to moderately deep, well drained yellowish and reddish sandy clay loams and sandy clays, often with more sandy topsoil, with weak structure and profile development, high in organic carbon, but general with low natural fertility and moderate to poor moisture storing properties. These soils classify mainly as Lithic Leptosols (Epieutric, Humic) and Regosols. Soils in the shoulder slopes are mainly Regosols whereas soils in the back slopes are mainly Alisols and Acrisols. The footslope soils are mainly Phaeozems and Luvisols, and valley soils are Fluvisols and Cambisols.

This is an agro-ecological zone boundary dividing the cold wet and cold dry zones. The average annual temperature for the eastern part is 12 – 170 C and average annual rainfall ranges between 790 and 2300 mm. The area has a bimodal rainfall pattern with reliable onset dates and two dependable growing period (DGP) lasting for 3-4.5 months, with a variation of 3-4 weeks. The most likely onset period is first half of March and mid-October.

The picture nicely displays the pattern of the valley bottoms, essentially used for irrigated agriculture, and with few trees and shrubs. The pattern of the settlement is dispersed with tendency to concentrate on the lower slopes. We observe terraces, contour strips and some miraba. Crops in the valley bottom are potatoes, tomatoes, onions, and many other vegetable species. On the slopes we find maize, patatoes and beans mainly. Some regular patterns of trees indicate plantation of of fruit trees. Overall the tree cover in the cultivated area is relatively thin. Dominant tree species area *Grevillia spps., Albizia spps., Eucalyptus spps., Pinus spps*., fruit trees. In the Magamba Nature Reserve dominant trees at an elevation more than 1500m amsl is *Albizia spps., Cassipaurea spps., Chrysophyllum spps., Entandrophragma spps., Ficalhoa laurifolia, Macaranga kilimandisharica, Ocotea usambarensis, Olea spps., Parinari excelsa, Podocarpus spps., Pygeum africanum and Syzygium guinense* (Kaoneka and Solberg, 1994).

Rodent trapping and flea collection was done both in the forest and in the valley (E).

3 LUKOZI VALLEY



This stop (A) provides a view on the Lukozi valley, before we arrive in Lukozi village
Lukozi the name of a ward and of a major village. It is an important market place. We can consider this area as a key area to observe different types of soil and water management conservation structures such as miraba, terraces, contour strips etc.
Demography and Plague incidence

The Lukozi area is inhabited by Pare and Sambaa
Lukozi village had plague occurrence for the first time in 1987 when 32 people were infected. It kept on occurring until 2003 with a worst scenario in 1991 when 66 people were infected. By the end of 2003, a total of 266 people had fallen sick of plague disease in 11 years of occurrences. The incidence at Lukozi and the neighbouring hamlets has been recorded to be 0.588 and plague incidence means is 3.17.
Landform and geology

The site topography is mainly strongly dissected plateau characterised by low relief intensity and broad summit ridges. The geology is the dominant one in the West Usambara Mountains composed of Leucocratic quartzo-feldspathic granulite, khondalites rocks.

Soils of the ridge summits are mainly Cutanic Alisols (Profondic Hyperdystric, Humic), those of shoulder and back slopes are Haplic Regosols; Cutanic Alisols (Chromic, Humic, Abruptic), while on the foot slopes soils are Luvic Ferralic Phaeozem for the convergent slopes and Cutanic Alisols (Chromic, Humic, Abruptic) and Cutanic Alisols (Profondic, Hyperdystric, Humic)) and Haplic and Gleyic Fluvisols (Humic, Eutric) occupy the valley bottoms.
Profile 1 (on page 26) shows dominant morphologic characteristics of back slopes and foot slope soils of Lukozi area.
Except for the Valley bottoms, soils in Lukozi are well to excessively well drained, and generally of poor fertility status, particularly deficient of available phosphorus and macronutrients.

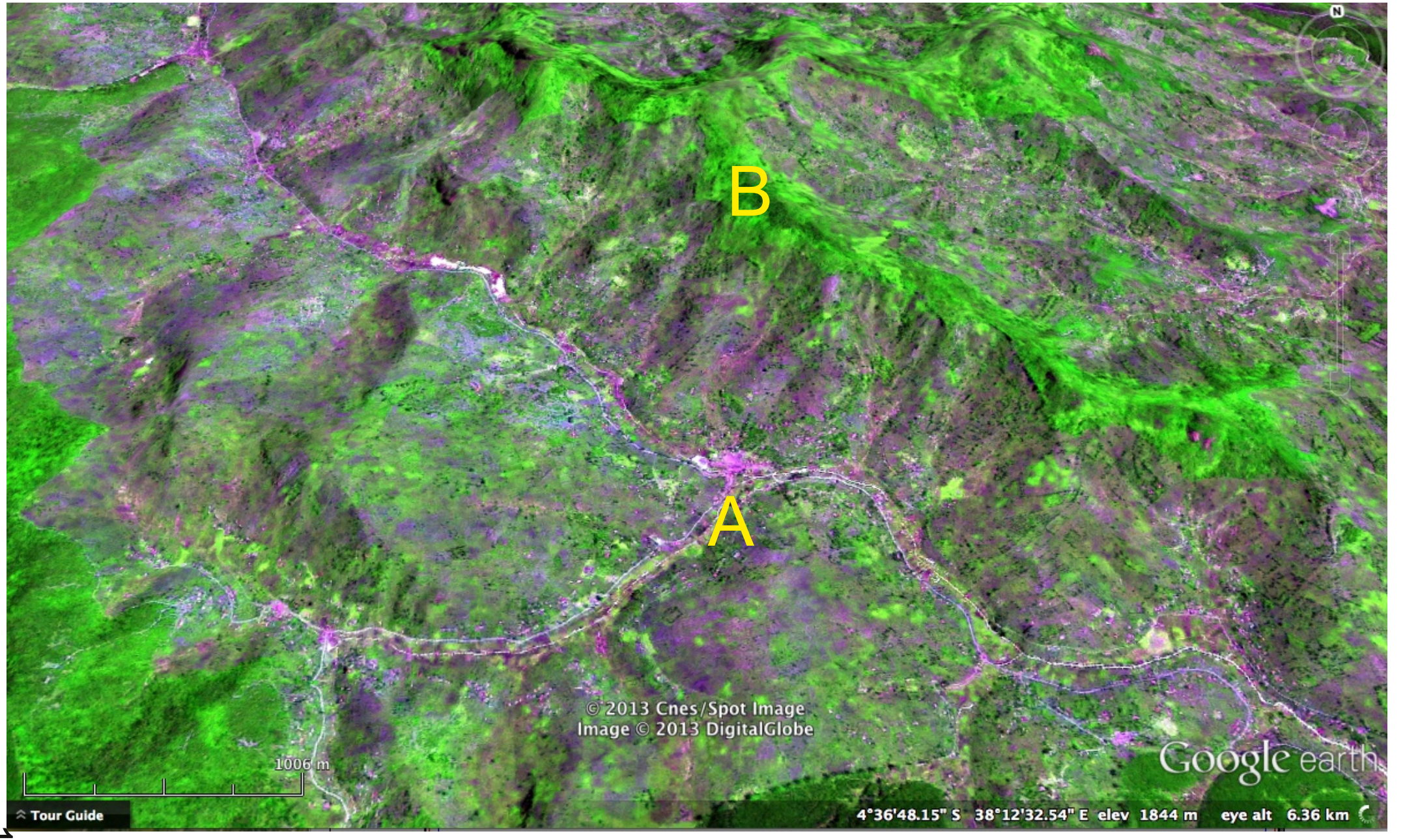
Lukozi area is located in the cold dry agro-ecological zone. The average annual temperature ranges between 17-19 0 C and average annual rainfall ranges between 600 and 1200 mm. The area has a weak bimodal rainfall pattern and unreliable onset dates and two slightly dependable growing period (DGP) lasting for 2.5 -3.5 months. The most likely onset period is end of March and mid-October.

The land use within the ward/village includes valley bottom irrigated agriculture, slope cultivation, woodlots and livestock keeping. Other land uses bordering the villages includes forestry (Magamba Nature Reserve) and Plantation forest. The dominant land management types practiced includes agroforestry, miraba, terrace, contour strips, other hedge-like structures for plots demarcation and house premise fencing. On the valley bottom we find a rich composition of crop species.

Daily activities range from those related to household food requirement, market activities, energy, social services, religious practices, etc. Mapping of activities were done and related to plague at three scales: a) Ward and village scale- completed MSc by Marianne Hubeau, b) Hamlet scale – completed MSc by Mattias Vandaele, c) Farm scale – ongoing PhD by Proches Hieronimo.

Rodents and fleas were collected in 24 quadrats and information concerning land use associated human activities and journeys were mapped through enquiries. This was done in both wet and dry season of 2012.

4 VITI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© 2013 Cnes/Spot Image
Image © 2013 DigitalGlobe
1006 m
Google earth
Tour Guide
4°36'48.15" S 38°12'32.54" E elev 1844 m eye alt 6.36 km

In terms of demography Viti is comparable to Lukozi.
Viti village was infested by plague for the first time in 1987 when 11 people succumbed. There were almost annual recurrences until 2003 with a worst scenario in 1997 of 64 people being infected. A total of 313 people have fallen sick of plague in 11 years of incidences. The plague frequency in Viti was 0.529 and mean incidence was 4.21.

Viti village is located in a valley amidst a strongly dissected plateau. Overall, the landscape is characterised by strong relief intensity. In the west we find low altitude, broad summit ridges, whilst in the north and south there are terraced ridges with high relief intensity ridges are characterised by terraced ridges with rock outcrops or cliffs at summit and shoulder slopes. The rocks are composed of Leucocratic quartzo-feldspathic granulite, khondalites rocks and at specific places there are distinctive bands of hornblende and of pyroxene granulites.

Soils are well drained, shallow to very deep in shoulder, back slopes and foot slopes. The valley bottom are moderately drained. Generally and because they are highly weathered they have poor fertility status with low cation exchange capacity, low available phosphorus but are high in iron, manganese and copper, leading to toxic conditions in low pH soils.

The dominant soils in the valley bottoms are Mollic Gleyic Fluvisols (Epiclayic, Orthoeutric, Humic), whereas in the foot slopes soils are Cutanic Alisols (Chromic, Humic, Abrupt) and Cutanic (Hyperdystric, Humic, Abruptic). Soils in the shoulder and back slopes are mainly Cutanic Acrisols, Haplic Regosols and Lixisols

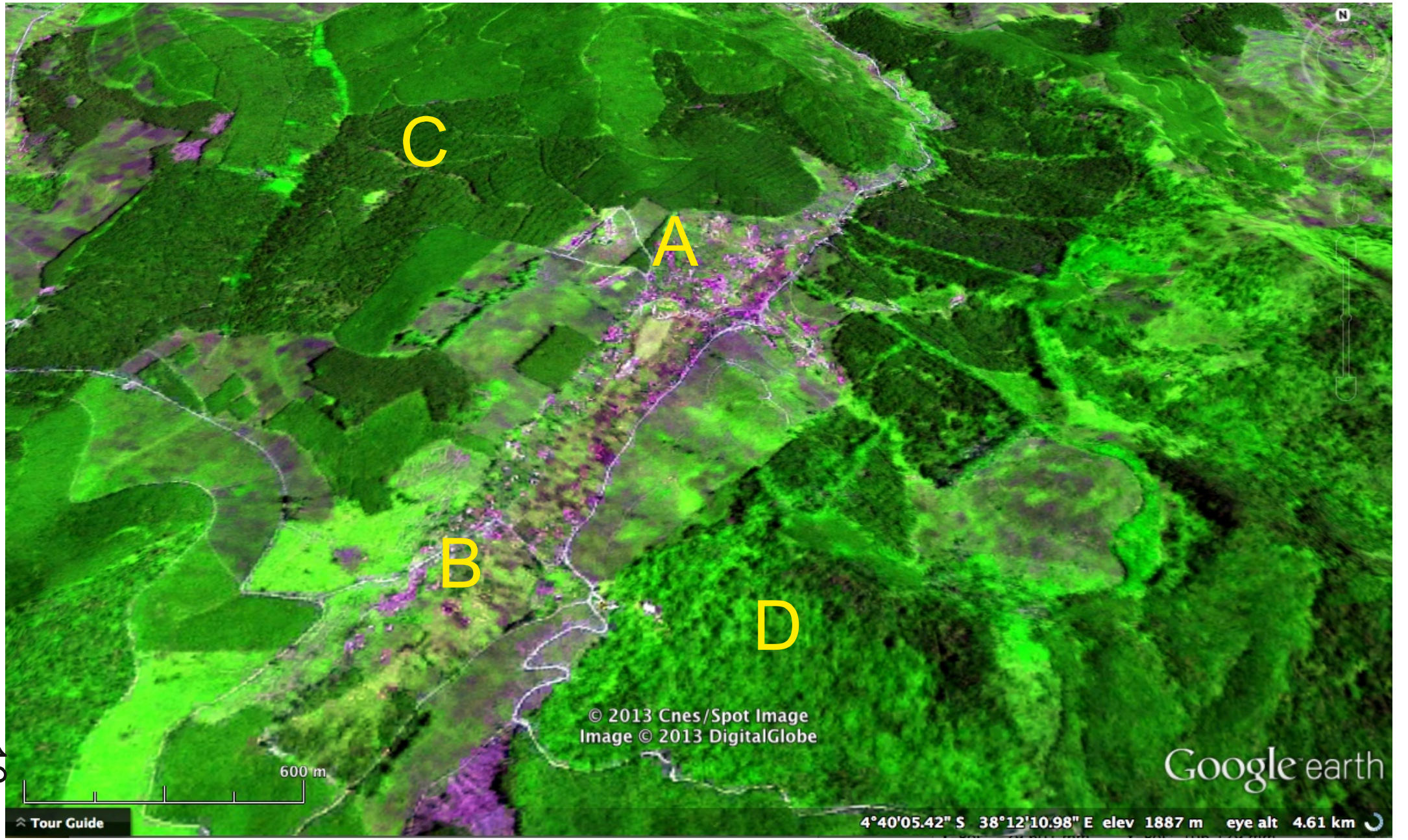
Like Lukozi area, Viti is located in the cold dry zone and has similar agro-ecological zone properties.

A characteristic feature is the branched ridge north and north-east of the village, between Viti and Malingo, capped with a relic fo natural forest, the Mkumbi Forest Reserve, in its edges altered for an Australian wattle (*Acacia sp.*) plantation, now this has become an invasive species.

The region around Viti was until about 50 years ago still under natural forest cover (see inset this page). So the current human landscape can be considered as young in comparison to the much older cultural landscape around a.o. Shume.

Agroforestry is much practiced and scattered all over this area, but it is difficult to point examples in this picture.

5 GOLOGOLO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© 2013 Cnes/Spot Image
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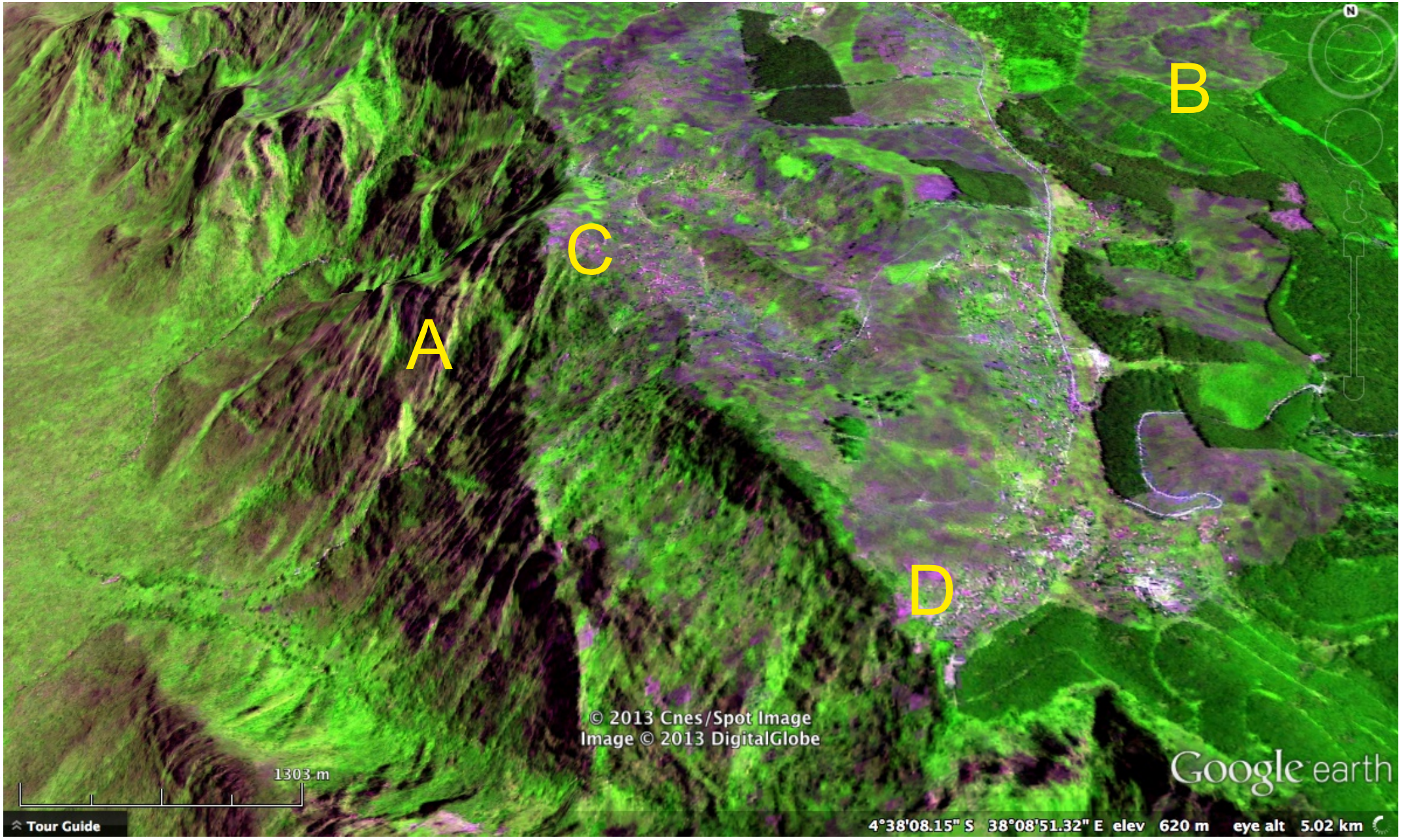
4°40'05.42" S 38°12'10.98" E elev 1887 m eye alt 4.61 km

The demographic composition in the Shume - Gologolo - Lokome area is similar to Lukozi and Viti. However, these are sites in the "high plague incidence" region of West-Usambara.

In the Shume, Gologolo and Lokome area plague was first recorded in 1987. Records show that Gologolo and Nywelo had plague frequencies of 0.765 and 0.647 and plague mean incidence of 18.54 and 10.46 respectively. The worst scenario was recorded in 1995 when 323 people were infected.

The dominant land uses within the Gologolo village (A) (part of Shume ward) includes valley bottom irrigated agriculture (B), and plantation forest (C) and livestock keeping. On the valley bottom we find a rich composition of crop species. Dominant tree species area *Grevillia spps, Albizia spps, Pinus spps*., fruit trees. The area is also bordering Magamba Nature Reserve. In the Magamba Nature Reserve (D) dominant trees are *Albizia spps., Cassipaurea spps., Chrysophyllum spps., Entandrophragma spps., Ficalhoa laurifolia, Macaranga kilimandisharica, Ocotea usambarensis, Olea spps., Parinari excelsa, Podocarpus spps., Pygeum africanum* and *Syzygium guinense* (Kaoneka and Solberg, 1994).

SHUME: 6 LOKOME 7 NKUNGUMIZE



The Lokome-Shume section seems to be like a peninsula squeezed between the 500m deep escarpment to the west (A), and forest plantations to the east (B). Being so close to both it certainly is in a highly specific landscape-ecological position in comparison to other parts of the study area.

Lokome-Shume area is located in the cold dry agroclimatic zone. The average annual temperature ranges between 15-19°C and the average annual rainfall ranges between 500 and 800 mm (DADP, 2010). The area has a weak bimodal rainfall pattern with unreliable onset dates and two slightly dependable growing period (DGP) lasting for 2.5 -3.5 months. The most likely onset periods are the end of March and mid-October.

The hamlets Lokome (C) and Nkungumize (D) (belonging to Nywelo village of Shume ward) lay on the escarpment shoulder and partly on the upper escarpment. Slope ranges from 1 in the valley bottoms to almost vertical in some areas in the escarpment. The site is characterised by strongly dissected ridges.
In geological terms the site is composed of Leucocratic quartzo-feldspathic granulite, khondalites rocks and at localised places distinctive band predominated by hornblende, pyroxene granulites, visible in vertical cliffs and hanging rock and rocky parts of the plateau.

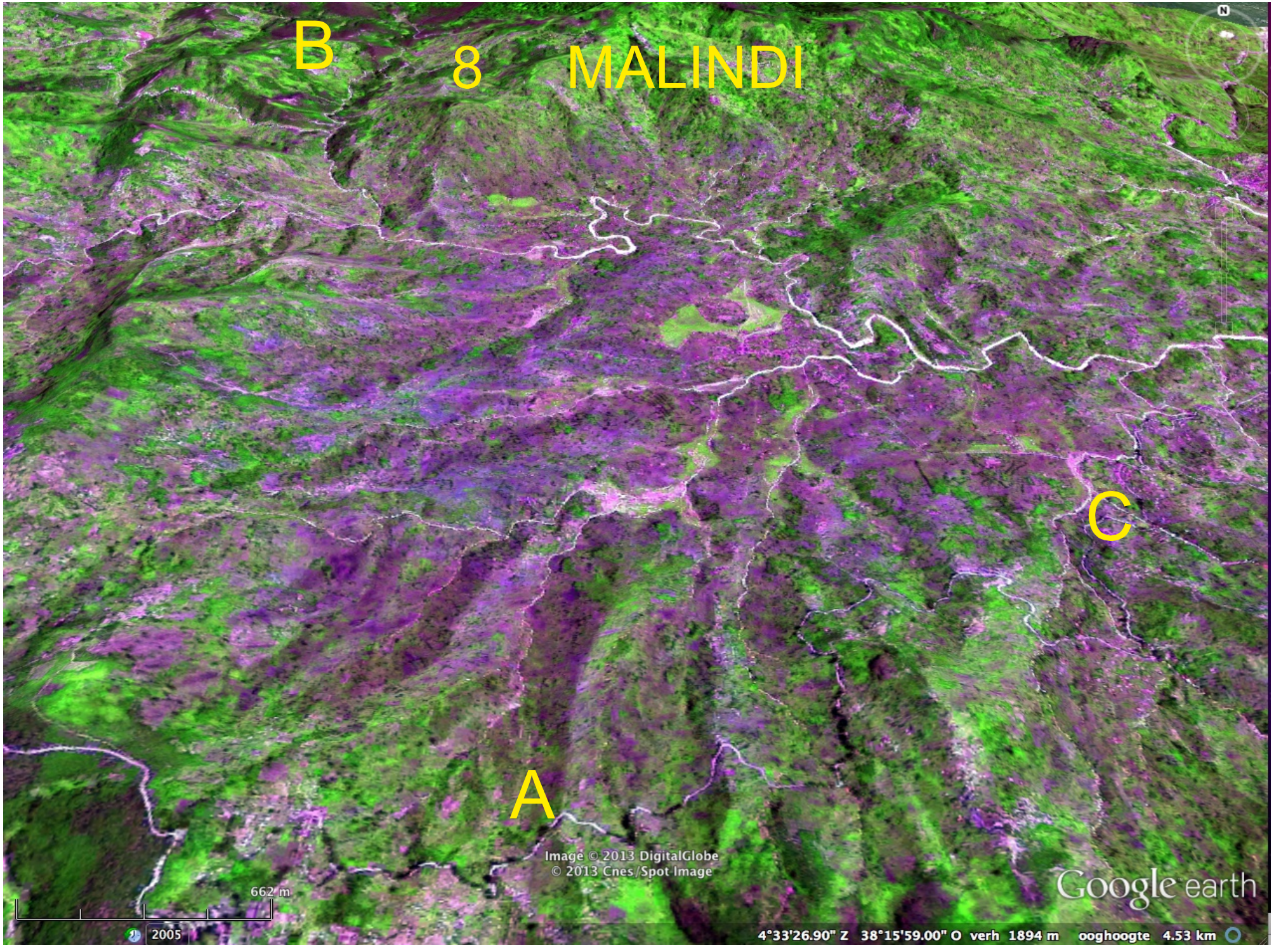
Profile 2 illustrates (p 26) the plateau soils, profile 3 soils in the upper escarpment. In the plateau part of Lokome, at the shoulder, back and footslopes the soils are shallow to very deep, well to excessively drained, highly weathered, with sandy clay textures. Dominant soils have pH(water) ranging from 5.3 to 6.7 in top soils and declining to 4.8 with depth. Organic carbon ranges from 2.7 to 3.7 % and declines with depth to 1.1%. Soil CEC ranges from 16 to 20 and declines with depth to 12 cmol(+)/kg soil. Available phosphorus ranges from 5 to 11 mgP/kg soil. Generally, these soils have moderate fertility status although they are severely P-deficient. Soils are classified as Cutanic Acrisols (Epiclayic, Profondic Humic), Cutanic Alisols (Hyperdystric, Humic), and Ferralic Cambisols (Hyperdystric, Chromic, Humic) for the shoulder, back slopes and foot slopes in complex pattern. pH(water) is 7.7. Total nitrogen content is low with 0.1 %, and the organic carbon content reaches 2.9 %. The soil CEC is 23cmol(+)/kg soil while available phosphorus is 23.2 mgP/kg soil. The soil is moderately fertile. The soils of escarpment are classified as Haplic Leptic Cambisols (colluvic, Eutric, Skeletic Humic) and Leptic Regosols (Colluvic, Eutric, Humic) and Mollic Leptosols (Epieutric, Humic)

The pseudo-valleys (convergent footslope) have moderately to poorly drained soils with topsoil pH(water) of 6, and organic carbon of 4.5 which declines slightly with depth. Soil textures are sandy clay loam to silty clay with low base saturation, and relatively high CEC of 32 cmol(+)/kg soil. Soils of the valley bottoms were classified as Haplic Fluvisols (Dystric) and Haplic Cambisols (Dystric). The soils on the escarpment are composed of shallow to very deep stony, well drained colluvial soils with mainly black profiles (Figure 6b).

Lokome hamlet is a subvillage of Nywelo village within Shume ward. The dominant land use within the village includes escarpment irrigated agriculture, slope rainfed agriculture, plantation forest (*Pinus sp.*), natural forest and livestock keeping (zero grazing for cows and free grazing for sheep). The dominant land management practices includes miraba, terrace, contour strips, other hedge-like structures for plots demarcation and fencing of house premises. Local communities area allowed to grow crops during the first years of forest plantation, until shade and other effects prevent this. After this stage some grazing (sheep) is allowed.

Land use and rodents and fleas information were collected in 24 observation sites (100x100m quadrats), separately in the wet and in the dry season. In the dry season the following land use/cover and management were identified and mapped: sugarcane, banana, cassava, fallow, tilled land, rock outcrop and miraba. Also 28 small mammals were captured and 40 fleas were collected. During the wet season all the above land use/cover types were present except tilled land. In addition, other crops include maize, beans and potato. In this season also 12 small mammals were captured and 2 fleas were collected.

Various daily human activities include: farming, collection of firewood, grazing, going to market, going to school, going to hospital, going to mosque, going to church, going to visit the *sangoma* (traditional healer). At hamlet scale 9 main activities were documented whereas at farm scale several activities associated with each land use inside the quadrat were documented. The journeys generated by those activities were also mapped and analysed.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This stop (A) along a much winding road is first of all intended to have a synoptic view over the Mwangoi depression. The depression is a bowl shaped relatively low laying area at about 1390 m, whilst the surrounding mountains go up to over 2270 m.

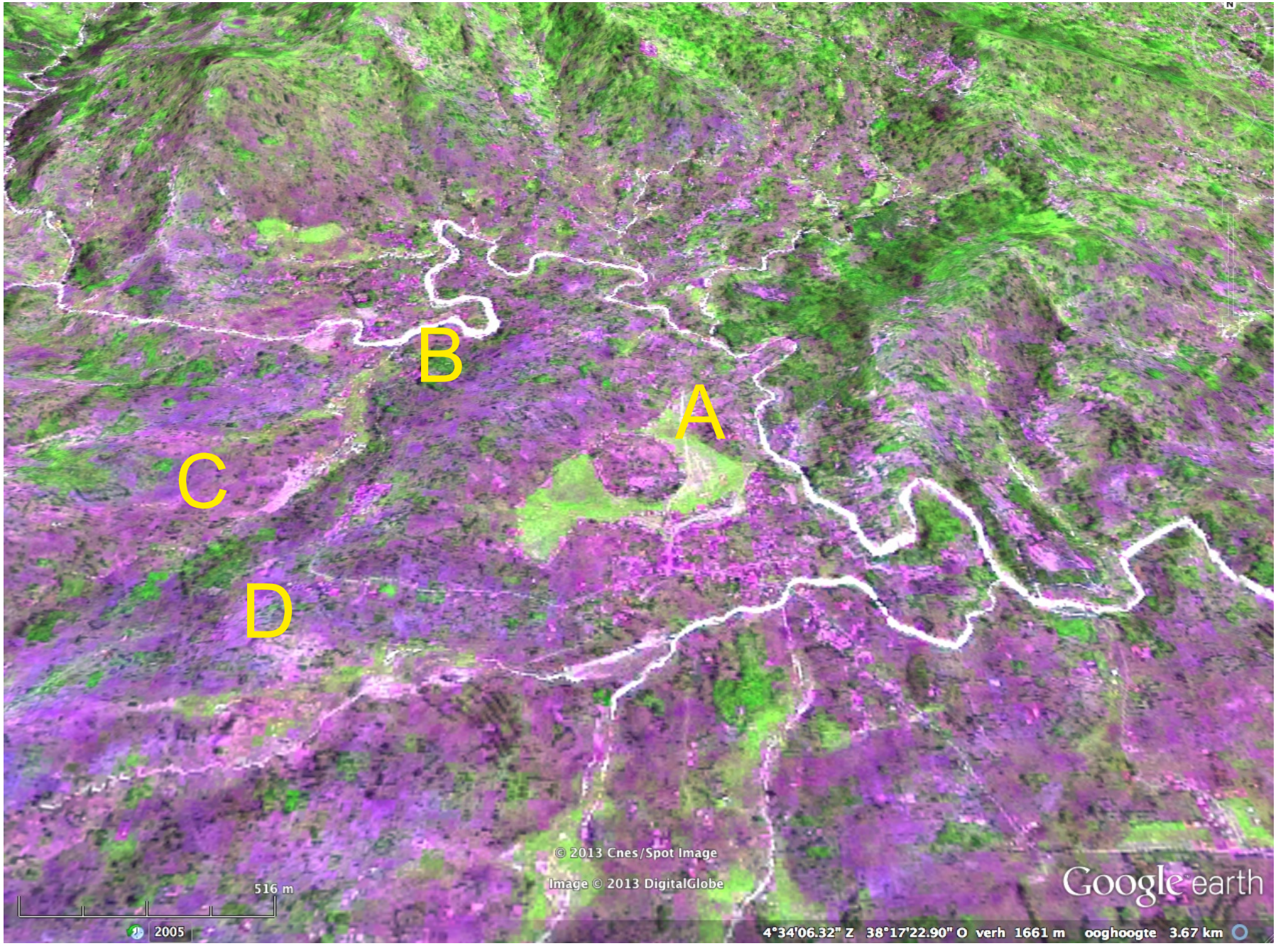
We have entered now the low-plage incidence area. In the north of the picture we see the southern rim of the Shaguyu Forest Reserve (B). (C) is Majulai, one of the research sites of Hildelitha Msita, about the erosion control impacts of *miraba*.

We stand on a shoulder/footslope of a strongly dissected plateau. The observed topography is the product of erosion and landsliding.

The geological bedrock is composed of Leucocratic quartzo-feldspathic granulite, khondalites rocks and at localised places there are distinctive bands with hornblende and with pyroxene granulites.

Soils in the area are variable well to excessively drained, shallow to very deep, very stony, rocky mainly depending on the position of the landform. Topsoil pH(water) is 4.9 to 5.9 values which declines to 4.8 values. Most soils have high toposoil organic carbon contents of 2.7 to 4.2 % which decline with depth to OC 1.9 %. The CEC of soils vary from 16 to 27 cmol(+)/kg soil without a clear trend with depth. Basically, these soils have low base saturation with values ranging 23 to 42.9 for topsoils and 5.9 to 23 in subsoils. The general soil fertility status is poor.
Soils were classified as Cutanic Acrisol (Hyperdystric, Profondic, Chromic) and Cutanic Acrisol (Humic, Hyperdystric, Profondic, Chromic)

9 and 10 MWANGOI - MOA



Mwangoi area had low (compared to other previous stops) plague frequency incidence of 0.11 and mean incidence of 0.49.

The landform at Moa (A), near the village green, is characterised by strongly dissected toe slopes (low altitude hills) of surrounding ridges. The genesis of this depression is still not clear but the several rivers traversing across it suggest it to be borne of mass wasting land forming processes. The geology is alluvium of Neogene materials of different textures. There is evidence of deposition of gravels and rocks of different sizes in different parts of the depression, including deeper centimetres of greying soil parent materials.

The river Umba (B) comes from the northern protected forest area (Shaguyu), and is a vital water source in this remote rural area.

The soils are variable but dominated by Mollic Gleyic Fluvisols (Epiclayic, Orthoeutric, Humic) and Haplic Fluvisol (Humic, Eutric) that extent following drainage lines (C) to Mlesa village just west of this picture. Profile 4 (p 27) shows dominant soils of valley bottoms (Haplic Fluvisol) The soils are very deep, poor to moderately well drained with alternative sandy and clayey textures.

Moa is located in the warm dry agro-ecological zone with average annual temperatures of 18 to 20 °C and average annual rainfall ranging from 500 to 800 mm although some years recorded 1700 mm/year.

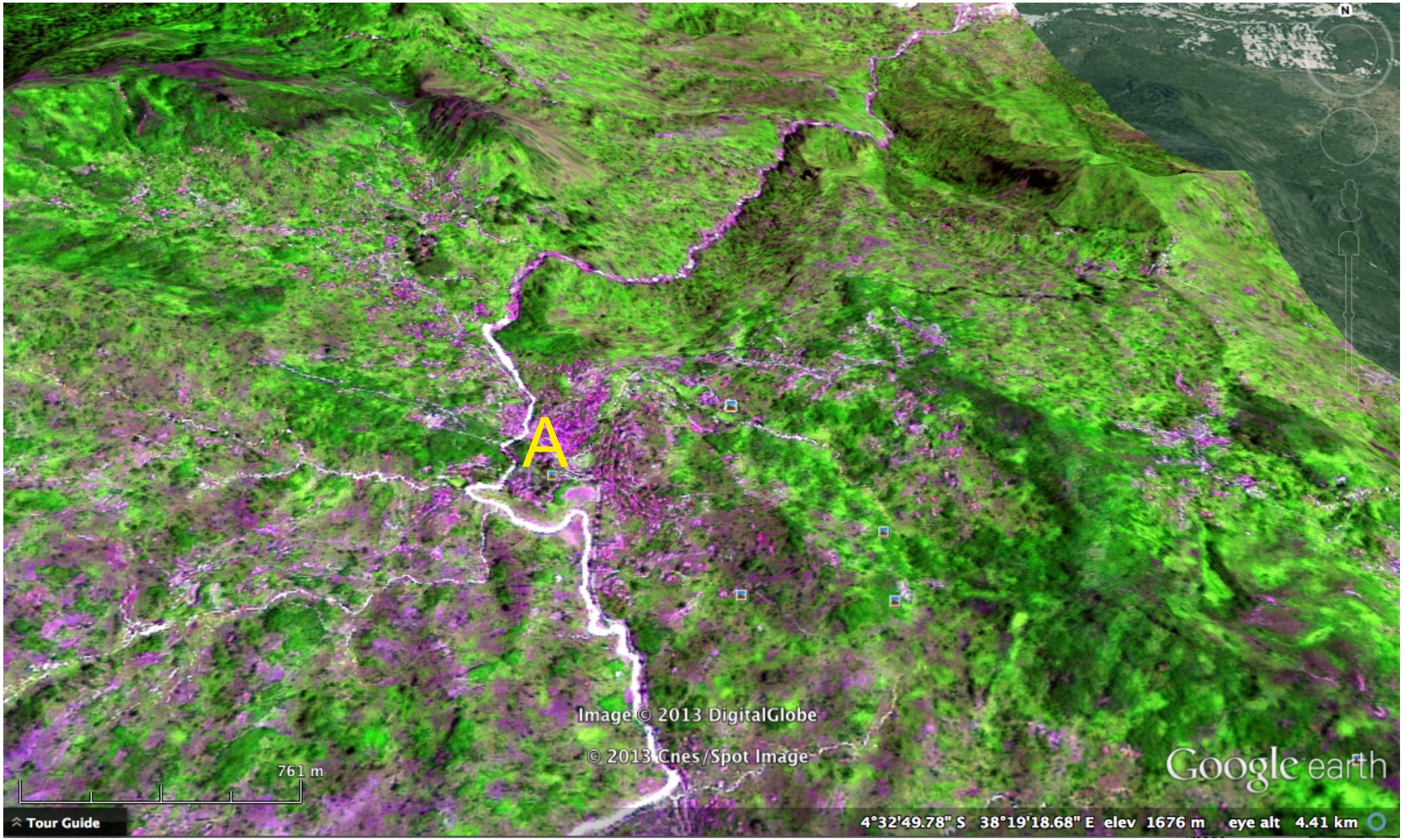
The land use includes valley bottom irrigated and rainfed agriculture, slope rainfed agriculture, woodlots, natural forest and livestock keeping (zero grazing). Dominant land management types includes miraba, terrace, contour strips, other hedge-like structures for plots demarcation and house premises fencing.

Land use and rodents and fleas information were collected in 24 observation sites (100x100m quadrats) located in various areas including natural forest, woodlots and agricultural areas with scattered houses. In the dry season the following land use/cover and management were identified and mapped: banana, cassava, settlement, tilled land and other hedge-like structures. Also one small mammal was captured but no fleas were found on it.

During the wet season all the above land use/cover types were present except tilled land. In addition, other crops included maize and beans. In this season also seven (7) small mammals were captured and no fleas were collected.

There is a stone quarry at Mwangoi hamlet (D). We stand on the summit of strongly dissected foot ridges. The rock material is composed of Leucocratic quartzo-fendspathic granulite. See also profile 5, p 27

11 MLALO

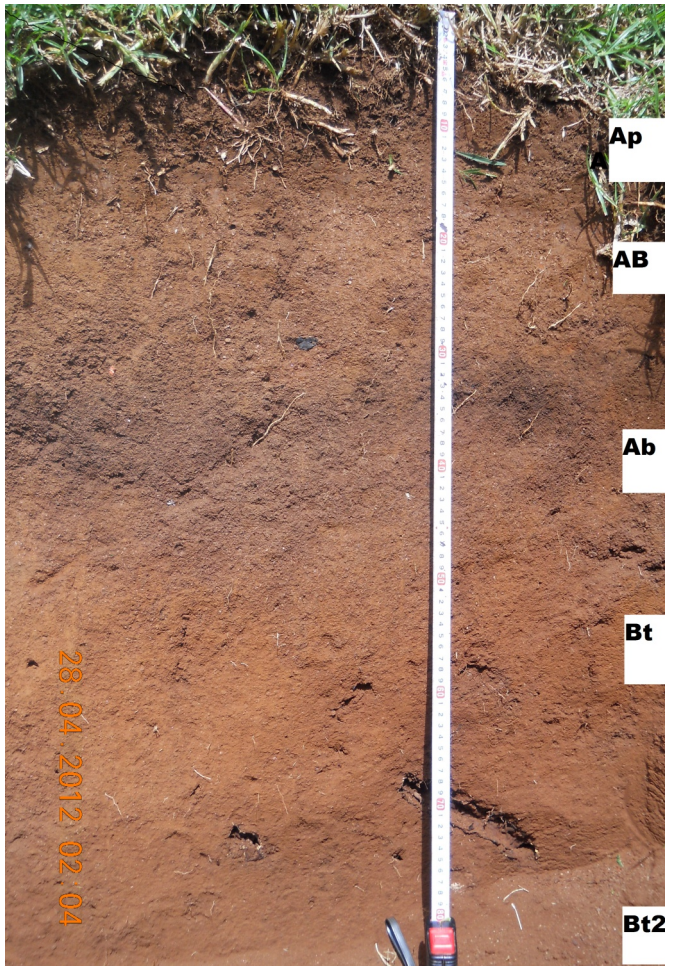

A
Image © 2013 DigitalGlobe
© 2013 Cnes/Spot Image
761 m
Tour Guide
4°32'49.78" S 38°19'18.68" E elev 1676 m eye alt 4.41 km
Google earth

Mlalo (A) is the farthest stop of the excursion. It is situated beyond the research perimeter, but we like to go to this site for its multiple qualities in terms of landscape and culture.

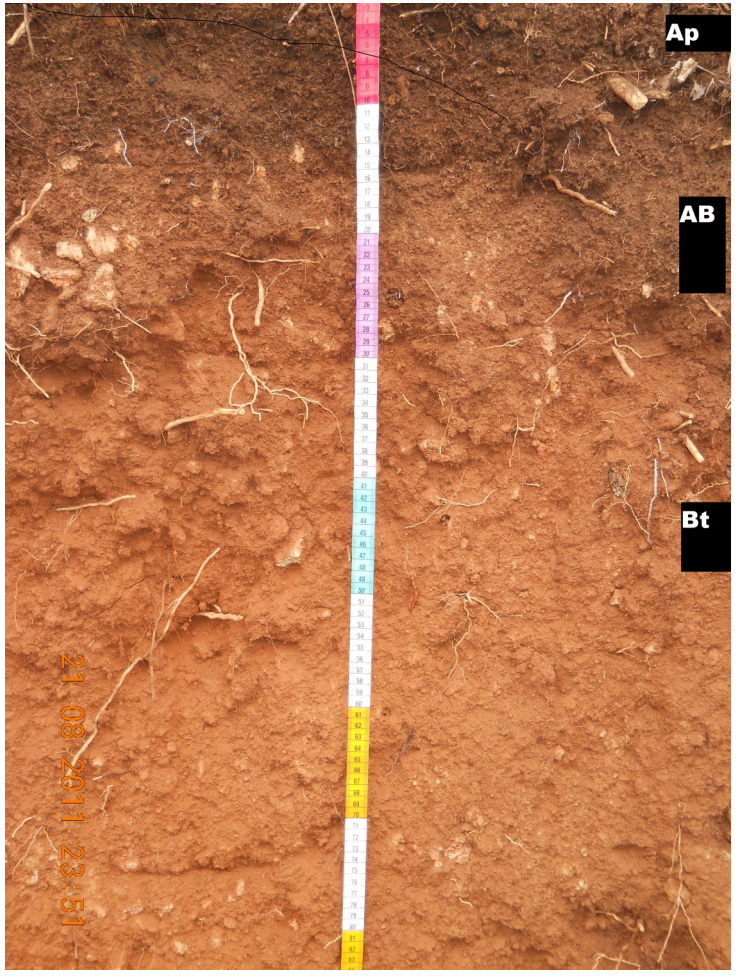
The Mlalo basin in source of water for a number of settlements. The area is remarkable by its lush vegetation, and for a number of horticultural products.

The Shambala people have lived in this region from around 1500. Since about 1820 the Germans have established one of their headquarters here. But the fame of Mlalo started with the Lutheran missionaries coming from Tanga in 1891.

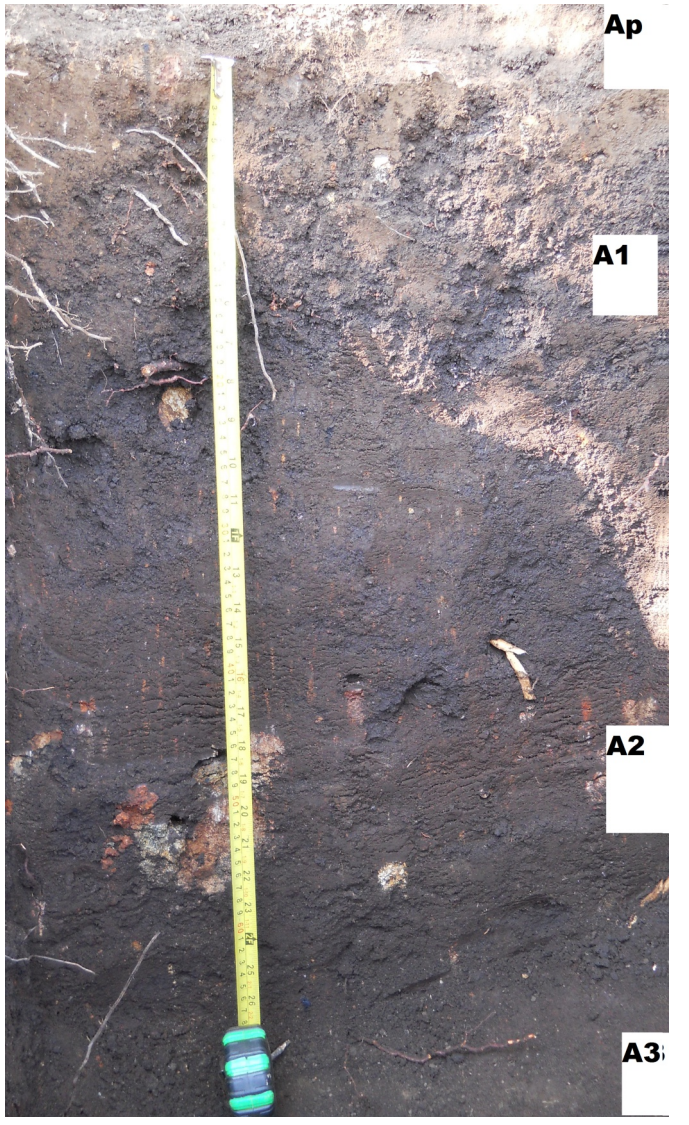
The area is rich in history of the Shambala people, the colonial period, the entry of Christianity, and a number of historical buildings and sites.



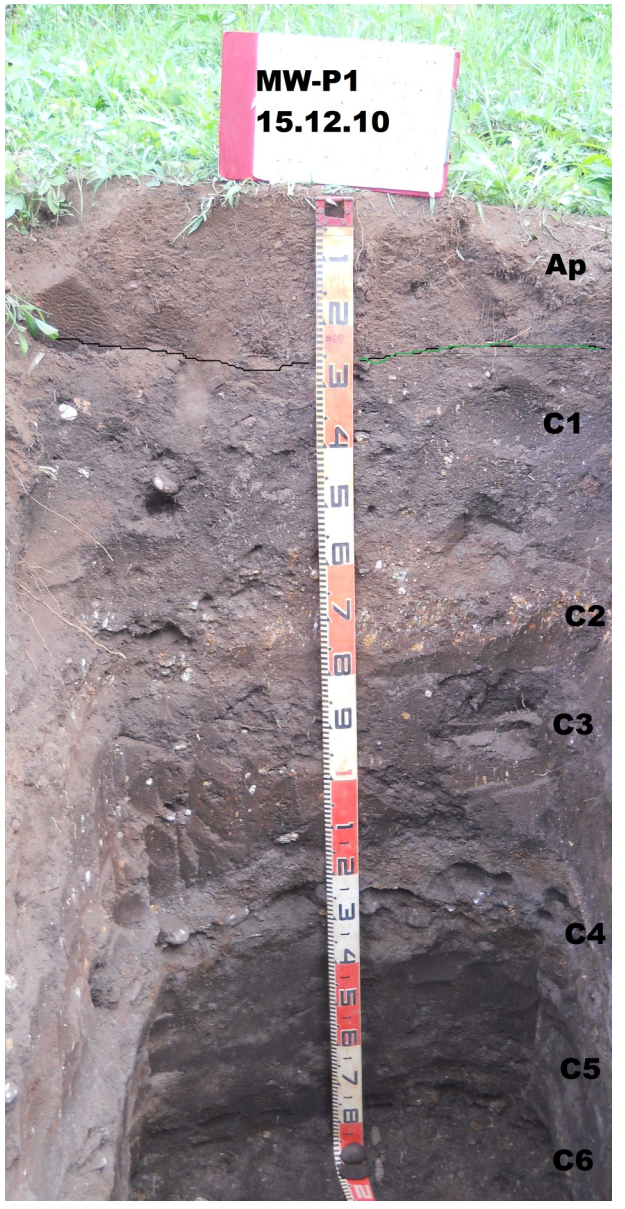
Profile 1
Typical profile of a Luvic Ferralic Phaeozem on backslopes and footslpes in the Lukozi area



Profile 2
Cutanic Acrisols (epiclayic, profondic, humic) in the plateau portion of Nywelo village



Profile 3
Haplic Leptic Cambisol (colluvic, eutric, skeletic, humic) on an escarpment in Nywelo village



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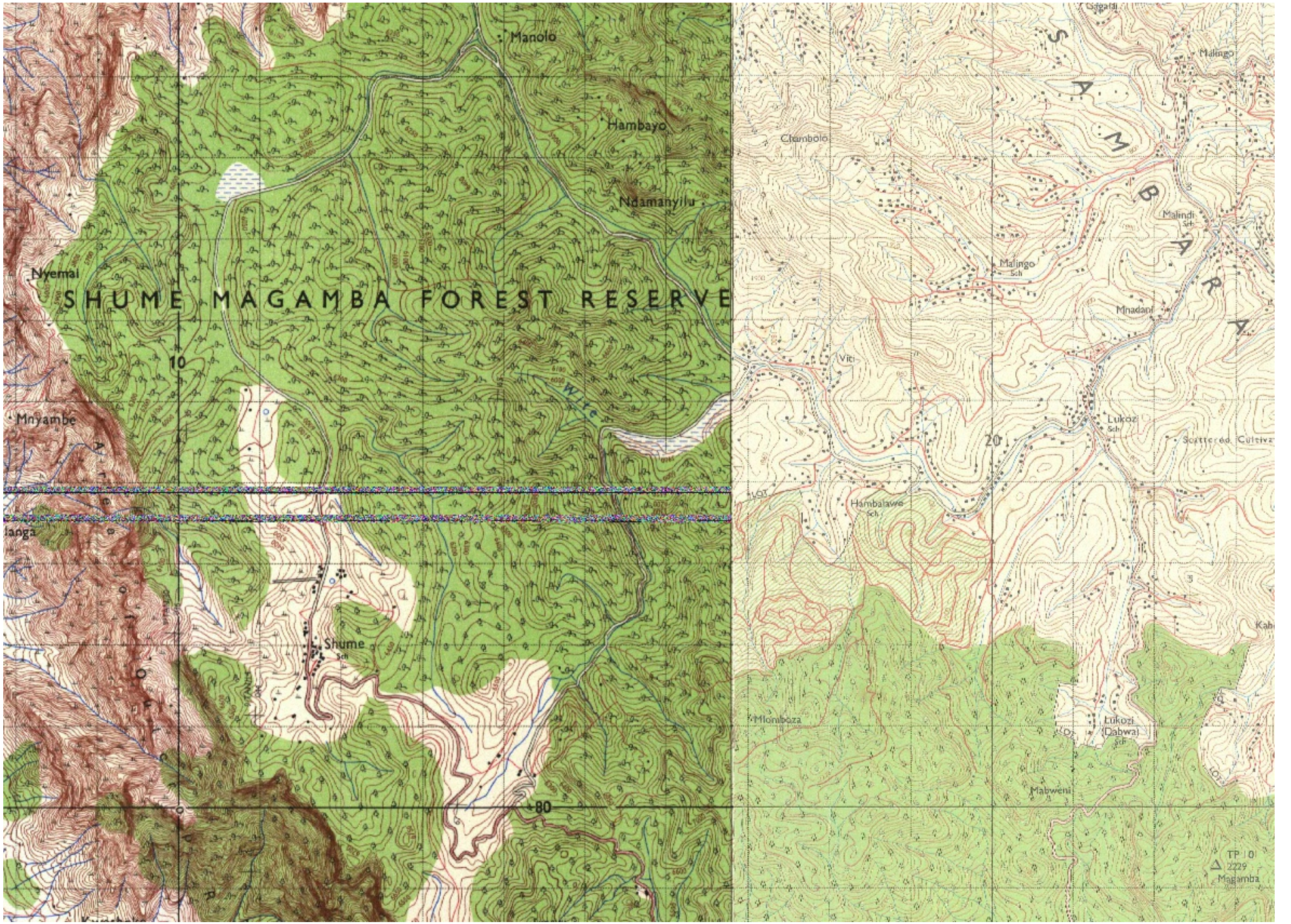
Profile 4
Typical soil in the valley bottom in Mwangoi area

Profile 5
A cross section showing a deep red profile with stone lines, in the quarry site of Mwangoi

Older (lef) and newer (right) topographical maps, illustrating the major deforestation in the 1960-ies



Miraba (in Lukozi valley)

Mirobe (in Kibohelo valley)

Acacia mearsnii (exotic)



Albizia gummifera


Chrysophyllum gorungosanum



Ocotea usambarensis



Podocarpus usambarensis

Syzygium guineense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