South Sudan Pilot Community Forestry Project

Forest cover mapping in Ifwoto and Lainya Payams: Technical report

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UNEP

NORSK FOLKEHJELP

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ACKNOWLEDGEMENTS

This piece of work was carried out by Norwegian People's Aid (NPA) - a Juba-based international NGO - on behalf of the United Nations Environment Programme South Sudan as part of the Small Scale Funding Agreement to conduct: a) full-scale participatory rural appraisal (PRA) covering the two selected payams and b) land use mapping of the two payams. The current report fulfills activity (b) of the agreement.

The mapping work and the report are funded by UK Department for International Development (DFID) support to UNEP, coordinated and facilitated by the UNEP Forestry Project Manager in Juba.

1. BACKGROUND

The forest resource mapping exercise covered Lainya Payam of Lainya County and Ifwoto Payam of Torit County in the states of Central Equatoria and Eastern Equatoria respectively. The two payams are the sites for the UNEP supported pilot community forestry project.

The primary aim of the exercise was to generate an overview of land use maps with special focus on the location and extent of major natural forest areas in the two payams.

The exercise adopted methodologies that have been applied elsewhere by NPA COREMAP (Community Resource Mapping) project. However, those methodologies were tailored for the exercise in order to facilitate a focus on forest areas and the human interface zones of settlement and agriculture fields. The communities in these areas rely heavily on the forests and on forest products for their livelihoods[1] so mapping was not limited to forest areas: a key aspect in the relationship between the communities and the forests - and therefore of the exercise - is *utilization*. Once the areas had been selected they were mapped according to the locally relevant strata that were enumerated during the PRA exercise and that are identifiable on the remote sensing maps.

At the end of the exercise land use maps of the two payams were generated. Those maps cover an estimated area of 167,327 ha (2026 km^2). However, the actual area under forest cover is less than that because the maps include other land uses and features. The maps were generated at the level of the *boma*, which is the smallest administrative unit in South Sudan. Although a finer subdivision of some of these forest categories was deemed feasible, required further field work that should be covered during the forest inventory exercise.[2] Therefore, for the purposes of forest categorization, it was decided that interpretation should proceed based on the classification presented in table 1.

[1] See PRA reports.

[2] A separate forest inventory will be conducted in the pilot community forestry sites which will help to further rectify and refine the forest maps.

2. MAPPING METHODOLOGY

The process of land use mapping involved holding a one day meeting in each of the bomas in the two payams in order that members of the community and stakeholders could disclose information and consult one another. During those meetings the local communities were informed about the project and the activities associated with it. Following a question and answer session community members were invited to draw a community map on the ground. The exercise was designed to offer a practical demonstration of the purpose, process and value of the project more vividly than perhaps a simple verbal explanation could. This improvised participatory map was designed to show not only the location of forests and forest resource endowments but also the pattern of ownership: which forest belongs to which clan, or is managed under which landlord. In addition the community members were asked to locate and depict any features of which they were aware - such as infrastructure facilities in the adjacent settlement areas - in order that the existing situation of each payam/forest could be represented accurately as possible.

Community members were then requested to nominate two or three people, with a range of local experience and knowledge, to form a team to work with the NPA/UNEP/MAF team during the forest resource mapping. The kind of knowledge required pertained to the forests: the trees therein, their uses, the historical or cultural sites found there, grazing areas, water points and wildlife, and in general the location of any other feature of interest. In Ifwoto Payam, the *Monyobiji (*young men) nominated the representatives and in Lainya Payam, the landlords selected them. The chosen community members guided the mapping team in the field.

The generation of the participatory map was the point of departure for the mapping process because that process provided the mapping team not only with immediate knowledge of the payam but also with information about forest profiles: vegetation cover types, forest features and so on.

The team used the following combination of methods to identify the categories of land use and vegetation cover:-

- During community meetings the mapping team gathered information on the nature and location of vegetation cover types. That information helped to direct their investigations. Similarly, the consultation process helped to identify different land cover types based on the physical features. Lastly, the field guides identified various species of trees and their uses to which those trees can be put to.
- The team built a knowledge base from topographic maps, and literature pertaining to South Sudan and its natural forest resources.
- The team acquired satellite images of 1:30m resolution of the area from the Regional Centre for Mapping of Resources for Development in Nairobi. They then interpreted those images by assigning false colors in order to help identify different forest cover types during analysis. That analysis was later verified on the ground using GPS: waypoints (GPS sampling points) for different land cover types were taken in all accessible areas.

- The team used ArcGIS software to generate thematic maps as well as to develop a digital terrain model, the (DTM)/elevation range of which was based on 1:50m contour interval.

Table 1: Categories of land use and vegetation cover

Vegetation Type	Appearance in images
Crop land	Appears light brown for green crop and whitish for dry crop ready for harvest. Area under cultivation and in most cases settlement area.
Fallow land	This is an area that was previously cultivated but left fallow for a period of not more than ten years. It appears dark yellow. Most species had already regenerated and hence the higher density as compared to the area under cultivation. This land is not well structured to reflect age of the land. The common indicator tree species of this kind of land use are *Combretum ssp*.
Grassland - areas of pure grass	Appears yellow with a uniformly fine texture. If burnt has a brownish color. Occurs over a wide altitudinal range. Distinctions between grassland types can probably be made on the basis of altitude after field work and review of literature.
Bush land Bush land - low : bush no higher than 2m Bush land - high: bush taller than 2m but less than 5m	Light red with uneven texture; typically intermingled with grassland. It comprises several tree species of multi-layered canopy. On average canopy is 2m-10m or less but can rise higher. Some common species include *Pterocarpus* and *Combretum* spp.
Woodland-Bush land - tree crown cover 30% or more of the area	Red, with texture varying depending on tree size, density and species. A variety of understoreys may be observed in moderately dense forest. This is a combination of tree layer and shrub understorey. The average woody canopy cover of this area is 58% and is dominated by *Combretum* spp. This area has a potential for thicker and richer woodland for harvesting of timber.
Woodland - Indigenous trees where crown cover < 30%	Deep pronounced red color, with texture varying depending on tree size and density, but with other vegetation visible beneath the trees. This is a one distinct not interlaced upper layer > 7m. Shrubs are <10% of the canopy cover. The woody cover is normally 41-80%.
Bamboo + woodland or Bush land	Light greyish when dry and reddish when green, bamboo is normally found together with either woodland or bush land. The white color is more pronounced than red for either woodland or Bush land.
Rocky area	Brown, Bare rock / ground/ hills almost all the hills are rocky

3. GEOGRAPHICAL LOCATION OF PILOT MAPPING AREAS

Lainya Payam and Ifwoto Payam are in Lainya and Torit Counties of Central and Eastern Equatoria states respectively. The two areas captured in this mapping exercise occupy a total area of approximately 2,026 square kilometers: Lainya Payam covers 1,541 km^2 and Ifwoto Payam, 485 km^2.

It should be noted however, that the respective geographical areas attributed to each of the payams should not be considered to be authoritative. The areas listed above were derived from consultations with members of the relevant communities and their respective landlords who indicated the extent of their clan land when drawing participatory community maps. To a large extent the accepted notional boundaries of clan land matched those of the bomas. Therefore, based on the indicated clan land boundaries, it was possible to delineate and calculate the area coverage in square kilometers (km^2).

4. GENERATED MAPS

The COREMAP-NPA/UNEP/MAF team generated thematic maps that represent the current status of vegetation cover in the two community forestry pilot project areas. In addition to depicting areas of forest, cropland and settlement, the maps also show infrastructure facilities.

Digital Terrain Models (DTM) for the two areas were developed using a 50 meter contour interval. The same algorithm was used to generate elevation range already depicted in two of the maps.

During the field visit members of the team established GPS sampling points and recorded descriptions of the vegetation, the names of trees, and the uses to which those trees are put. Seven boma maps were generated for the two payams (three for Lainya and four for Ifwoto). Colors derived from satellite imagery have been assigned to types of vegetation cover in the maps so that the areas of the different cover types could be calculated: that information has been added as a component in the legend (key).

4.1 Ifwoto Payam maps, tables and sample vegetation photos

Fig 1: Administrative units for Ifwoto Payam

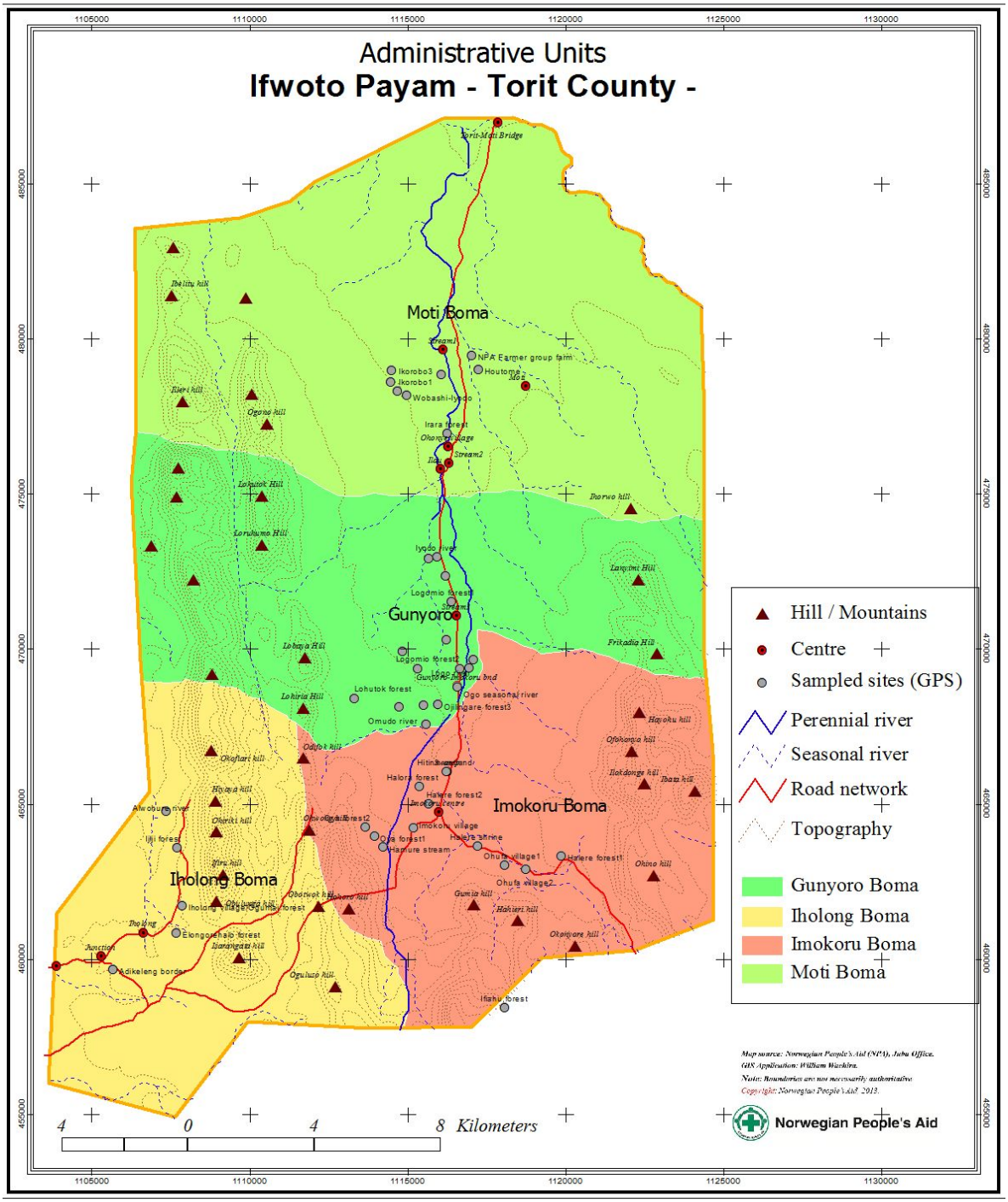


Fig 2: Digital Terrain Model for Ifwoto Payam

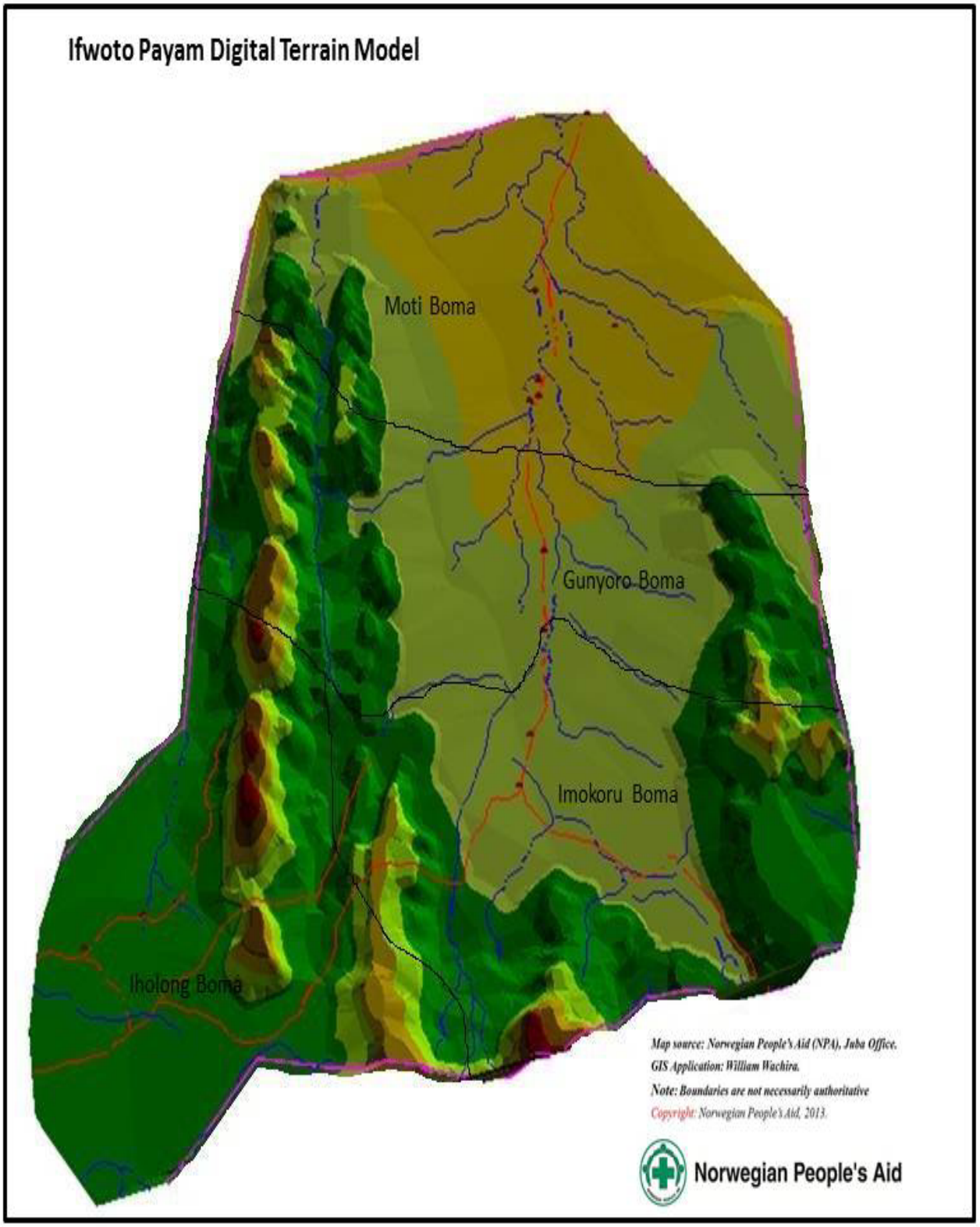


Fig 3: Elevation Range for Ifwoto Payam

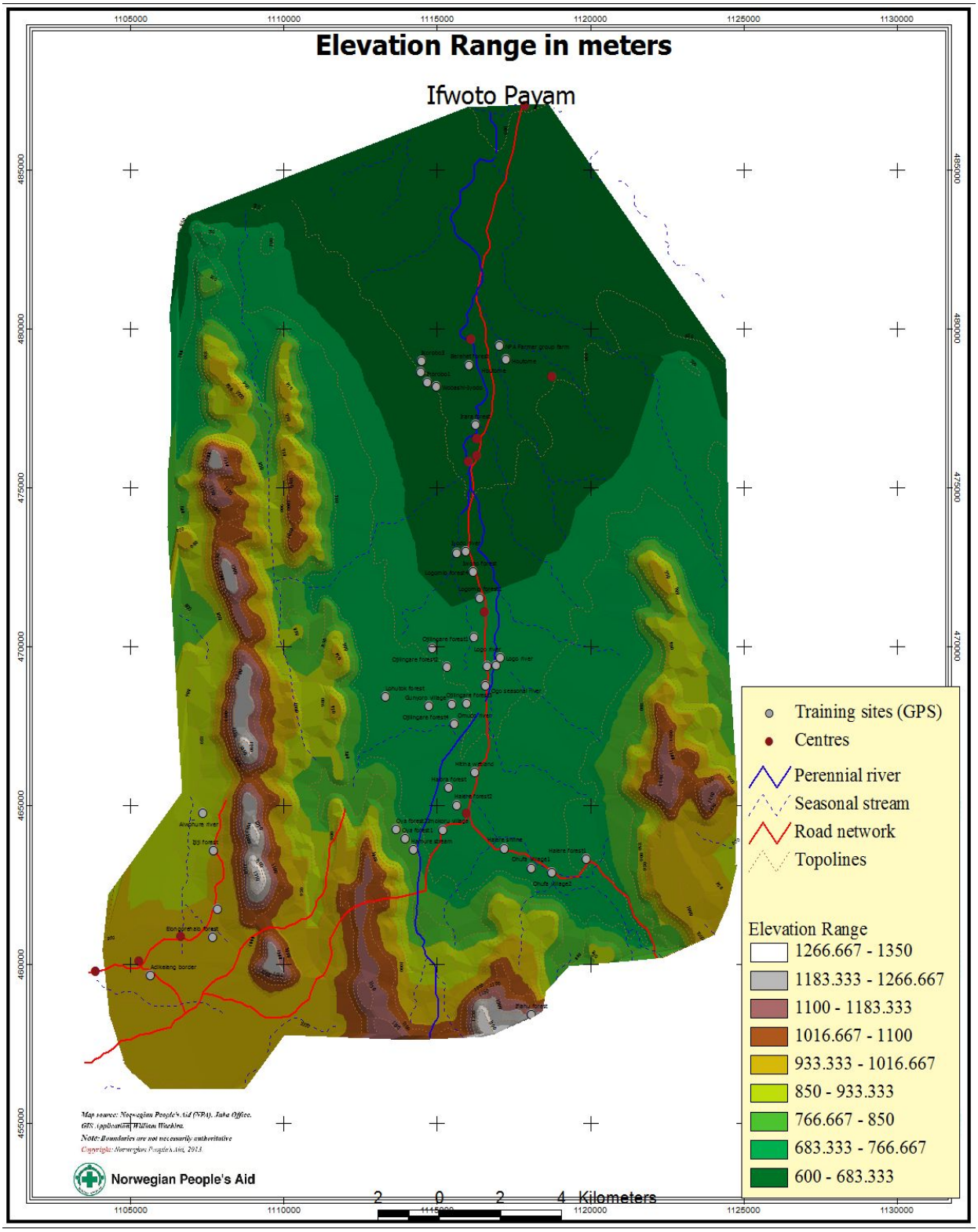


Fig 4: Vegetation cover, Ifwoto Payam

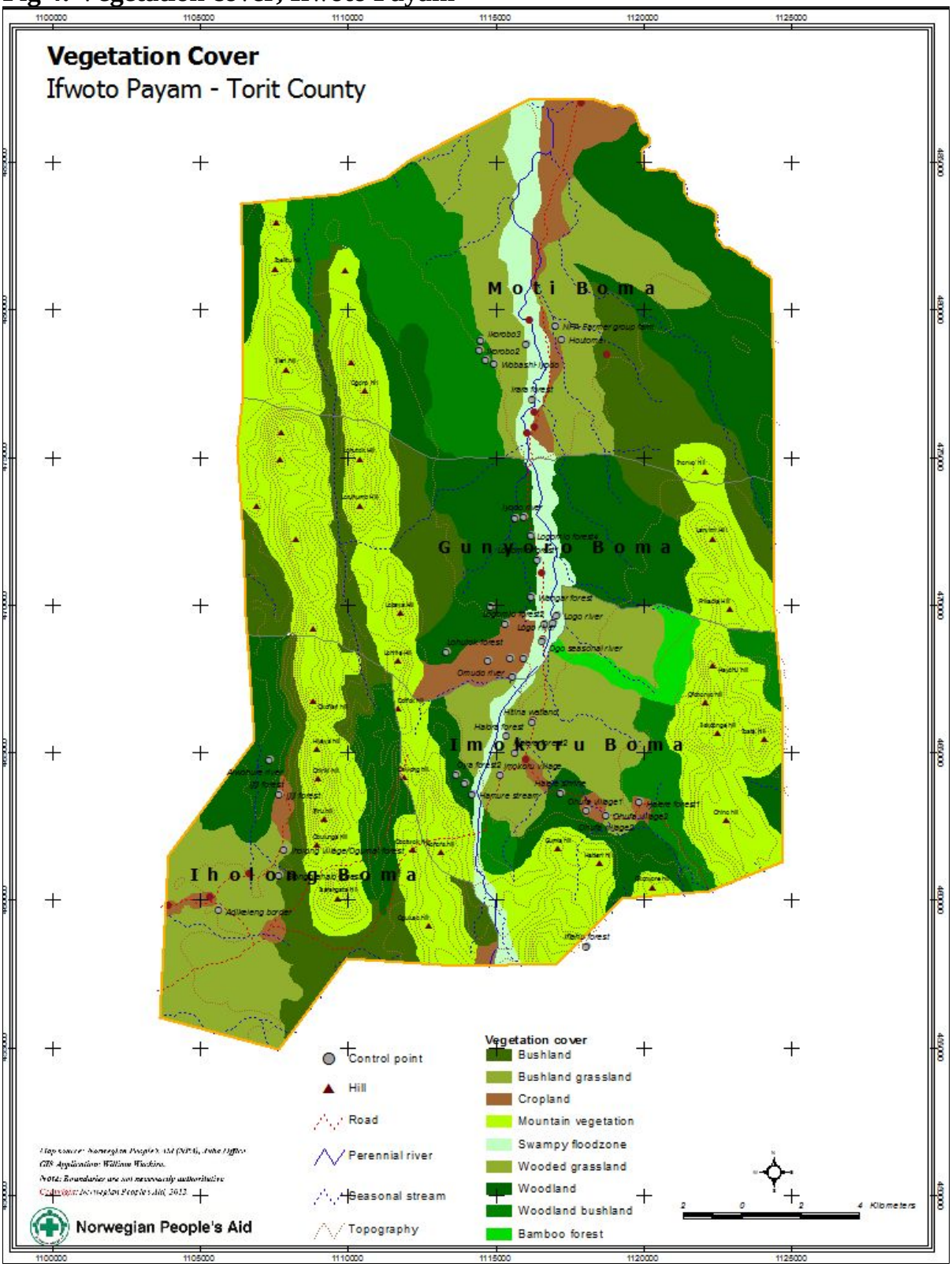
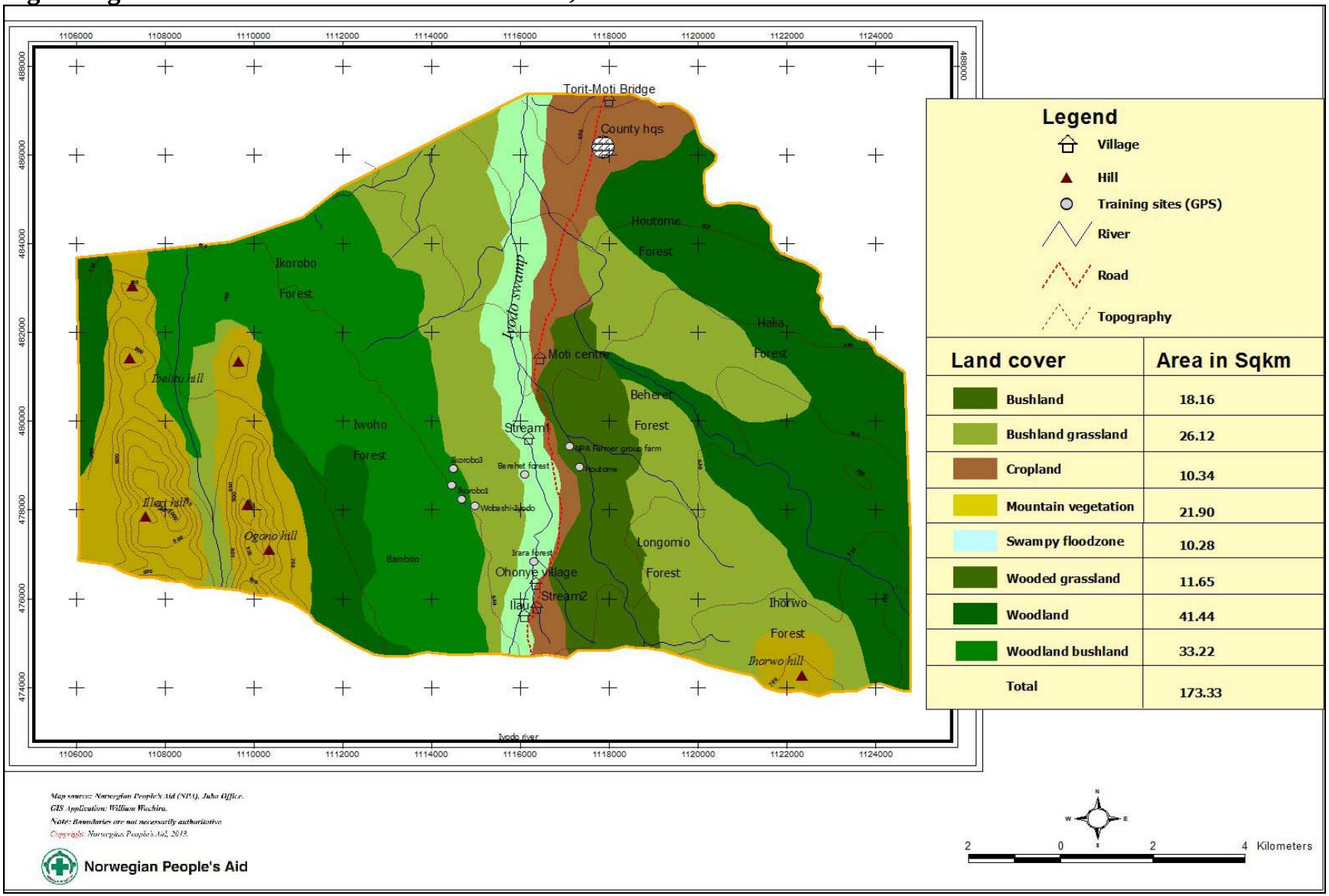


Fig 5: Vegetation cover & land cover sizes in km2, Moti Boma

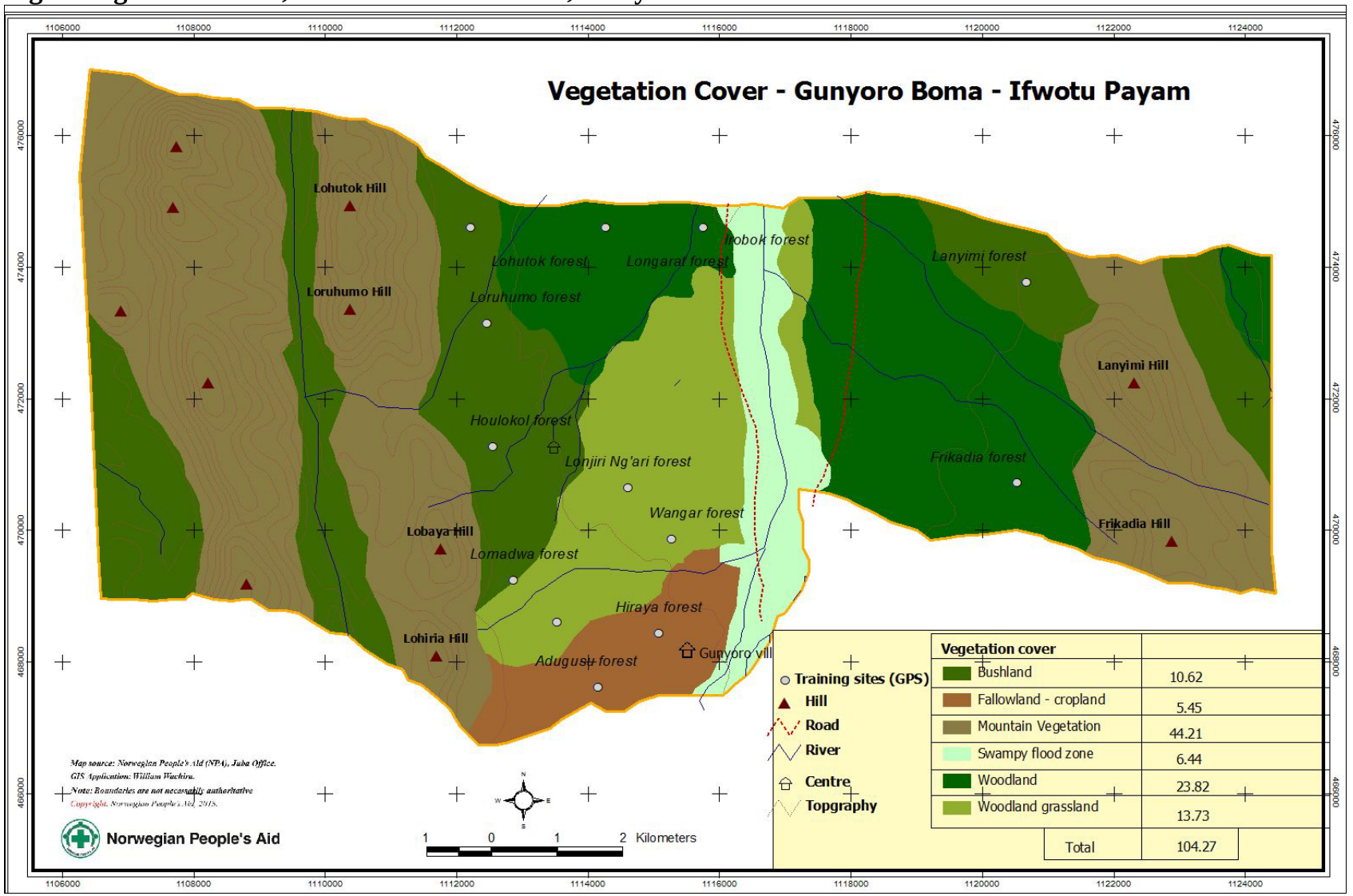


Woodland / Bushland in Moti Boma

Table 2: GPS sampling points (waypoints) in Moti Boma

Moti Boma – Ifwoto Payam - Date 23-24/1/2013						
Wpt	Northing	Easting	Location	Dominant trees	Vegetation cover type	Utilization
1	04°15.956	032°33.186	Logomie forest 1	Combretum spp	Bush land	Poles, Fuel wood
2	04°14.787	032°33.323	Logomie forest 2	Combretum spp	Bush land	Poles, Fuel wood
3	04°14.800	032°33.481	Logomie forest 3	Combretum spp	Woodland	Poles, Fuel wood
4	04°16.406	032°33.074	Logomie forest 4	Abezilia africana spp	Woodland/grassland	Poles, timber, firewood, hunting,
5	04°16.742	032°32.939	Iyodo river crossing point	Tamarindus indica spp	Woodland	Fruit, Charcoal
6	04°16.712	032°32.783	Iwoho forest	Acacia albida and Ficus spp	Woodland	Charcoal, fuel wood
7	04°18.909	032°33.106	Irara forest	Acacia spp and Zizyphus spp	Bush land/woodland	Charcoal, poles, medicine, fruit (Zizyphus)
8	04°19.929	032°33.000	Berehet forest	Acacia spp	Bush land/woodland	Charcoal, firewood
9	04°19.562	032°32.414	Obacye/Ikorobo	Acacia spp	Farm land	Food
10	04°19.641	032°32.257	Ikorobo forest	Acacia spp and Alucohi	Wooded savannah grassland	Hunting, thatching houses, fruit(alucohi)
11	04°19.803	032°32.144	Ikorobo forest	Combretum spp	Bush land	Poles, fuel wood, hunting
12	04°19.996	032°32.160	Ikorobo forest	Acacia albida spp	Woodland	poles, fuel wood, hunting
13	04°20.022	032°33.638	Houtome forest	Abezilia africana and Combretum spp	Bush land/woodland	Poles, timber, fuel wood, hunting
14	04°20.262	032°33.524	Farmer group farm in Houtome (NPA)	Planted teak and cassava	Farm land	Income generation and food
15	04°20.650	032°32.911	Igassa swamp	Many grass varieties	Swamp area	Fishing, vegetable garden

Fig 6: Vegetation cover, land cover sizes in km^2, Gunyoro Boma

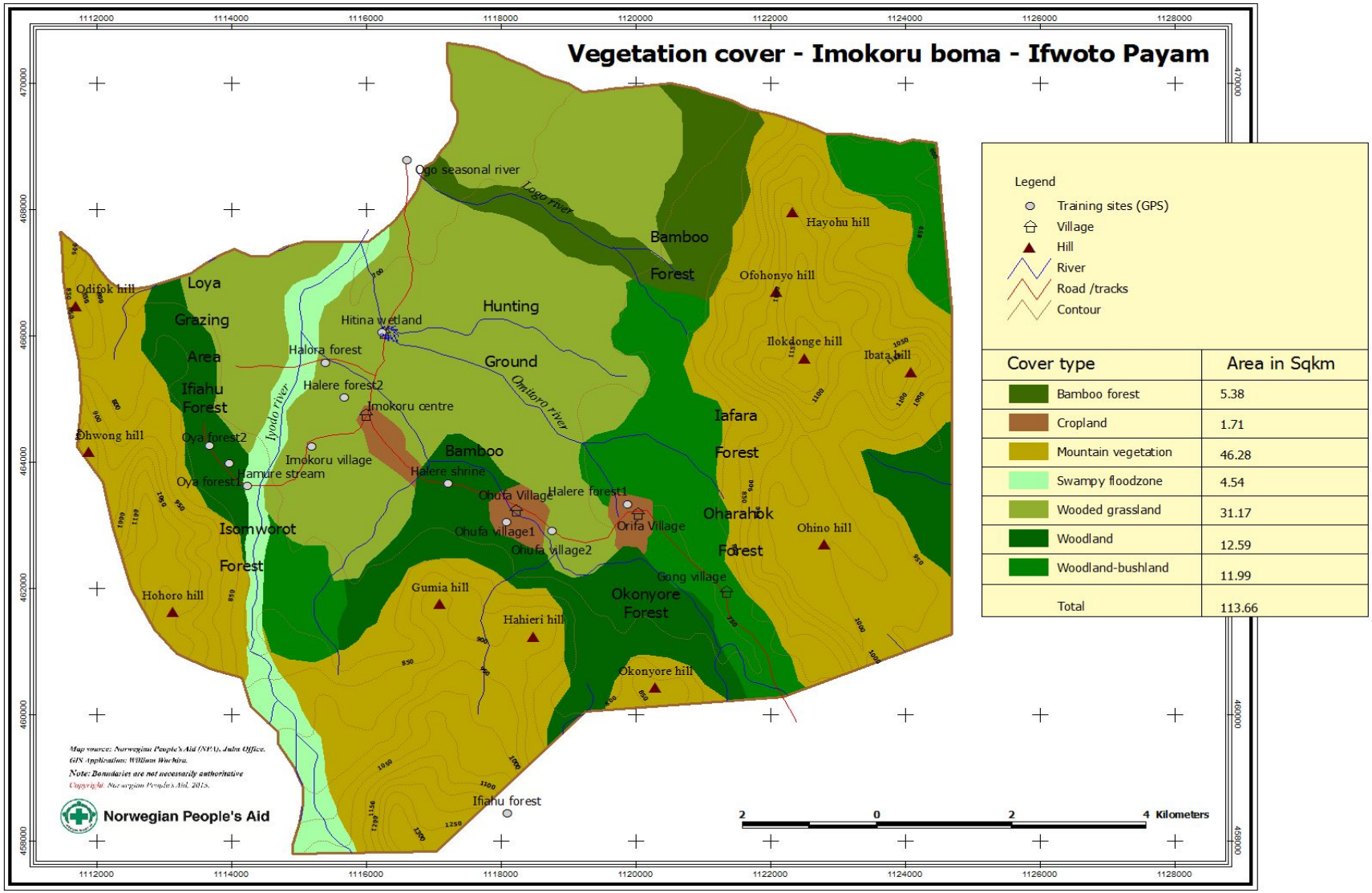


Forest in Gunyoro Boma

Table 3: GPS sampling points (waypoints) Gunyoro Boma

Gunyoro Boma – Ifwoto Payam - Date 27-28/1/2013						
Wpt	**Northing**	**Easting**	**Location**	**Dominant trees**	**Vegetation cover type**	**Utilization**
1	04°13.238	032°32.31.3	Lomudu seasonal river	Terminalia, Ficus, Combretum(12-15m)	Wooded savannah grassland	Poles, timber, hunting area
2	04°13.437	032°32.29	Gunyoro	Combretum ssp	Housing area	Housing area
3	04°14.219	032°32.23	Lojilingare forest1	Combretum, Acacia, Termilia spp	Grassland	Poles, timber, fuel wood, hunting area
4	04°14.409	032°32.08	Lojilingare forest2	Terminalia (10-15m)	Grassland/woodland	Poles, hunting and housing
5	04°14.526	032°32.52	Wangar forest	Acacia, Combretum,	Woodland	Poles, hunting and housing
6	04°13.726	032°32.726	Lojilingare forest3	Mango, Terminalia, Ficus spp (12-15m)	Woodland/grassland	Poles, timber, cultivation
7	04°13.699	032°32.065	Lojilingare forest4	Acacia, Combretum spp	Wooded savannah grass grassland	Poles, fuel wood, thatching grass
8	04°13.854	032°31.303	Lohutok forest	Combretum spp(12-15m)	Woodland	Hunting, poles, timber
9	04°14.531	032°33.324	Logo seasonal river	Bamboo, Terminalia, Combretum spp(15-17m)	Woodland	Poles, bamboo, timber

Fig 7 : Vegetation cover, landcover sizes in km^2, Imokoru Boma

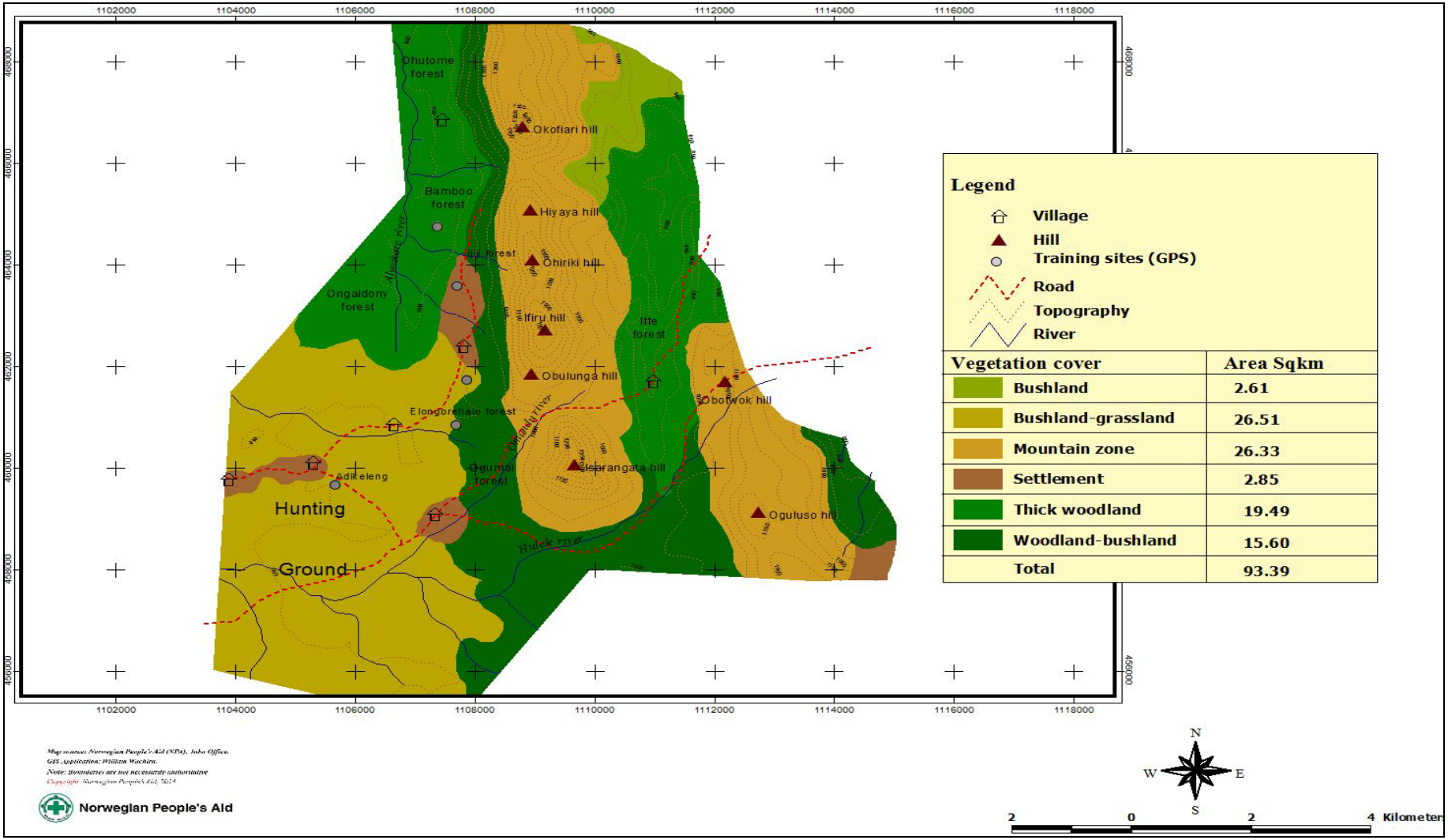


Forest in Imokoru Boma

Table 4: GPS sampling points (waypoints) Imokoru Boma

Imokoru Boma – Ifwoto Payam - Date 25-26/1/2013						
Wpt	Northing	Easting	Location	Dominant trees	Vegetation cover type	Utilization
1	04°11.678	032°33.627	Halereshrine	Combretum spp (10-15m)	Wooded savannah grassland	Fuel wood, performing ritual
2	04°11.092	032°34.092	Ahufa village	Acacia spp	Farm land	Wind belt
3	04°11.267	032°34.458	Ahufa shrine in Halere forest	Combretum spp (10-15m)	Shrine	Performing ritual
4	04°11.502	032°35.066	Halere forest	Mahogany(20-22m), Combretum spp	Wooded savannah grassland	Timber, poles, birth cloths
5	04°11.014	032°34.054	Ifiahu forest	Mahogany(20-22m), lulu tree, Olorai	Woodland/Bush land	Timber, poles, oil arts
6	04°12.416	032°32.788	Halere forest 2	Acacia and Combretum spp(15-20m)	Woodland and Bush land	Fuel wood, poles, cropland
7	04°12.715	032°32.641	Halere forest 3	Acacia spp (10-15m)	Wooded savannah grassland	Fuel wood, hedge/fencing
8	04°11.994	032°32.531	Imokoru abandoned village	Tamarind, mango, lulu trees(10-15m)	Woodland/Bush land	Poles, fruit, vegetation garden
9	04°11.654	032°32.011	Hamure river b/n ongulu /kunyiro	Grass, Acacia senegal/Gum Arabic (5-10m)	Swamp area	Vegetable garden, fuel wood,
10	04°11.847	032°31.866	Oya forest	Termnailia, Albezia, Acacia spp (12-15m)	Woodland	Poles, timber, medicine, hunting
11	04°12.004	032°31.711	Oya forest/village	Combretum, Mango, Terminalia spp (12-15m)	Woodland	Fruits, poles, hunting
12	04°12.975	032°33.109	Hitina swamp	Combretum spp (12-15m)	Savannah grass land	Timber and poles
13	04°14.458	032°33.289	Ogo seasonal river	Afzilia africana, Acacia spp, bamboo, Terminalia spp(12- 17m)	Woodland	Timber and poles

Fig 8 : Vegetation cover, land cover sizes in km^2, Iholong Boma



Forest vegetation in Iholong Boma

Table 5: GPS sampling points (waypoints) Iholong Boma

Iholong Boma – Ifwoto Payam - Date 29-30/1/2013						
Wpt	**Northing**	**Easting**	**Location**	**Dominant trees**	**Vegetation cover type**	**Utilization**
1	04°10.621	032°27.944	Iholong/ogumali forest	Melia excelsa (15-20m)	Woodland	Poles, timber, beehive
2	04°11.628	032°27.859	Ijiji forest	Melia excelsa, Combretum (15-20m)	Woodland	Poles, timber, hunting area
3	04°12.263	032°27.677	Alwahure river in Omiriwoloi forest	Combretum, Terminalia, (15-17m)	Woodland	Timber, poles, fuel wood, beehive, hunting
4	04°10.159	032°28.473	Elongorihailo forest	Terminalia, Combretum spp (15-20m)	Woodland	Poles, timber, fuel wood
5	04°09.510	032°27.388	Adikeleng (at boundary)	Acacia, Combretum spp	Grass land/woodland	Hunting ground, fuel wood, charcoal burning

4.2 Lainya Payam maps, tables and sample vegetation photos

Fig 9: Administrative units, Lainya Payam

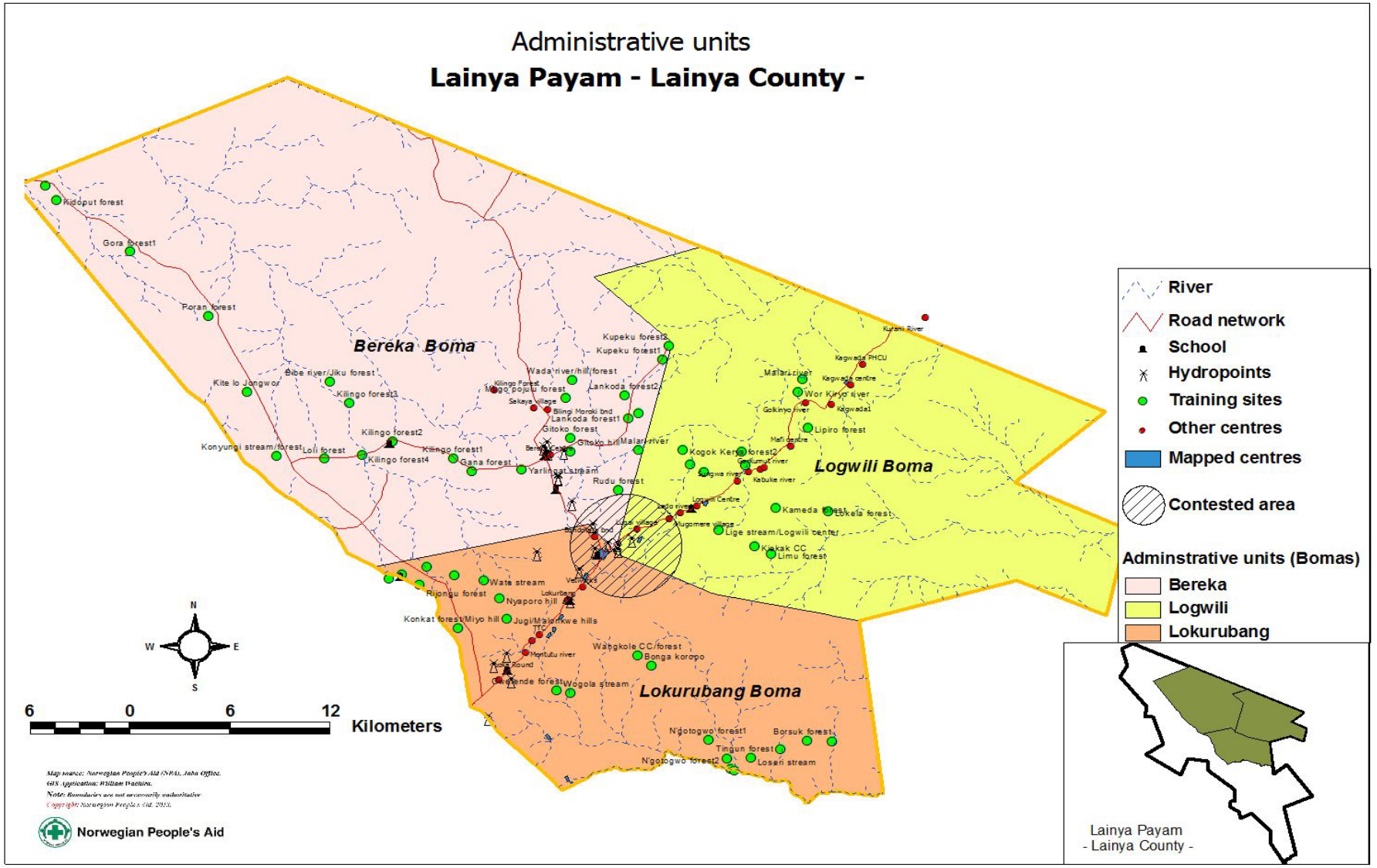


Fig 10: Digital Terrain Model, Lainya Payam

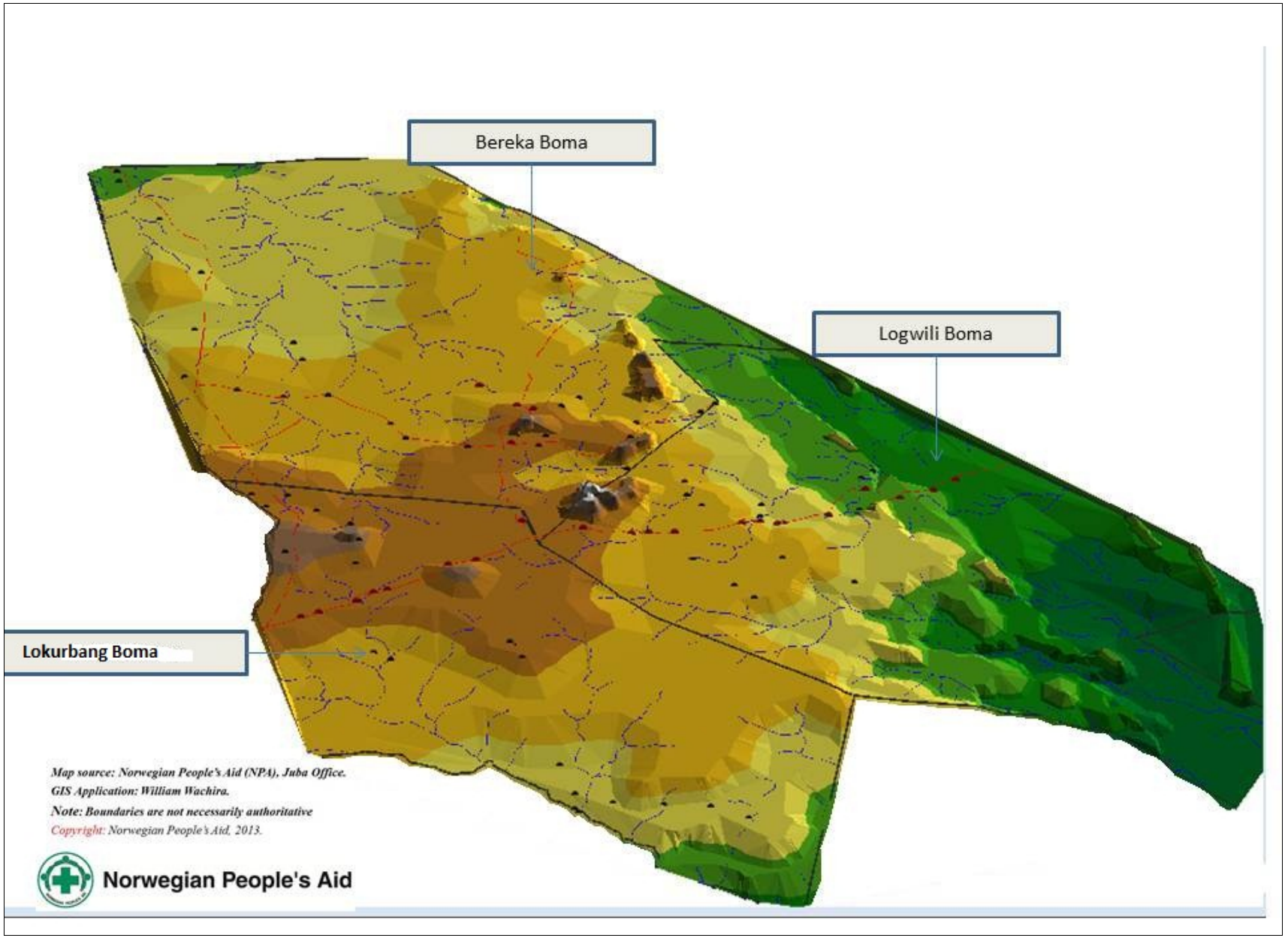


Fig 11: Elevation range, Lainya Payam

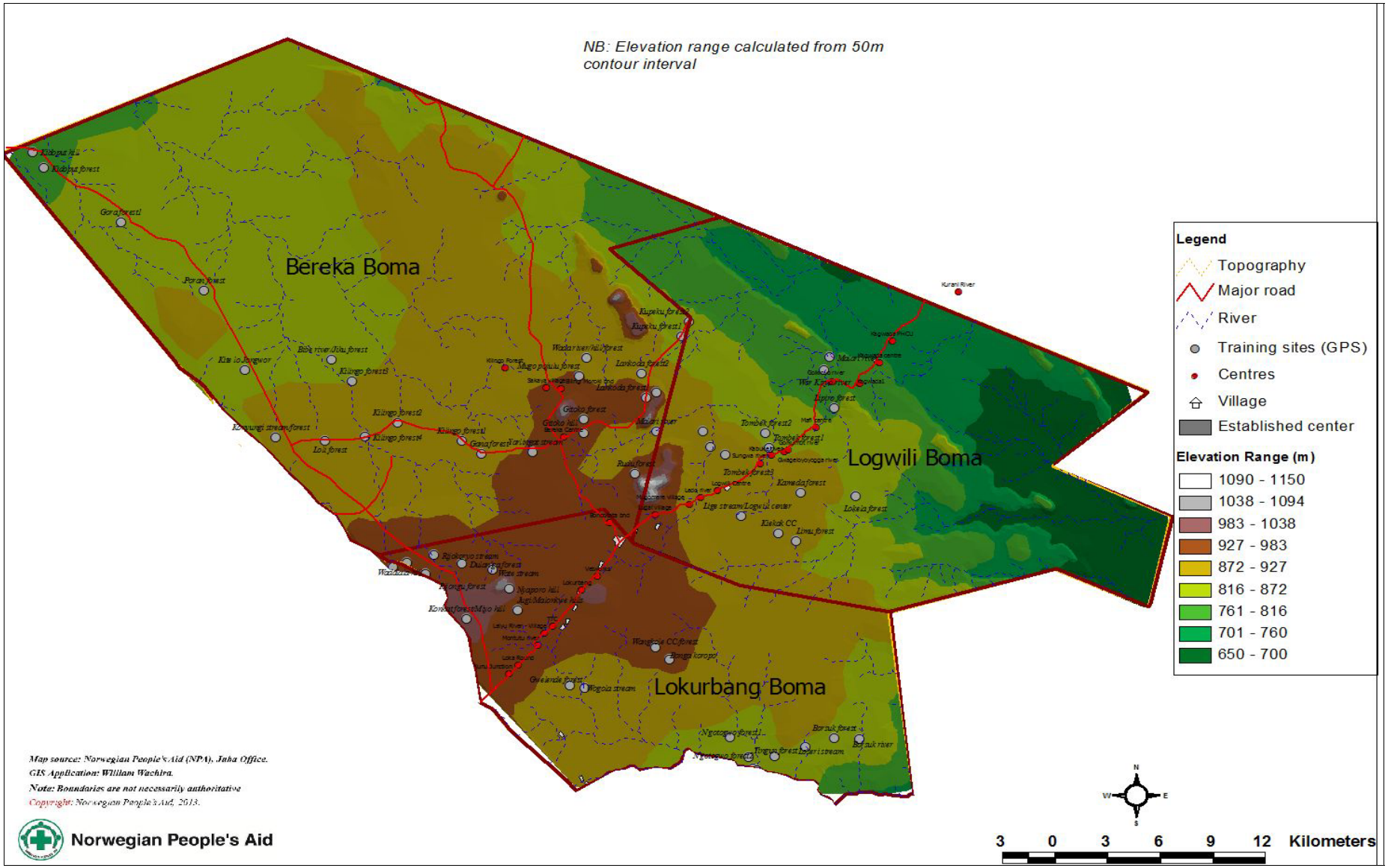
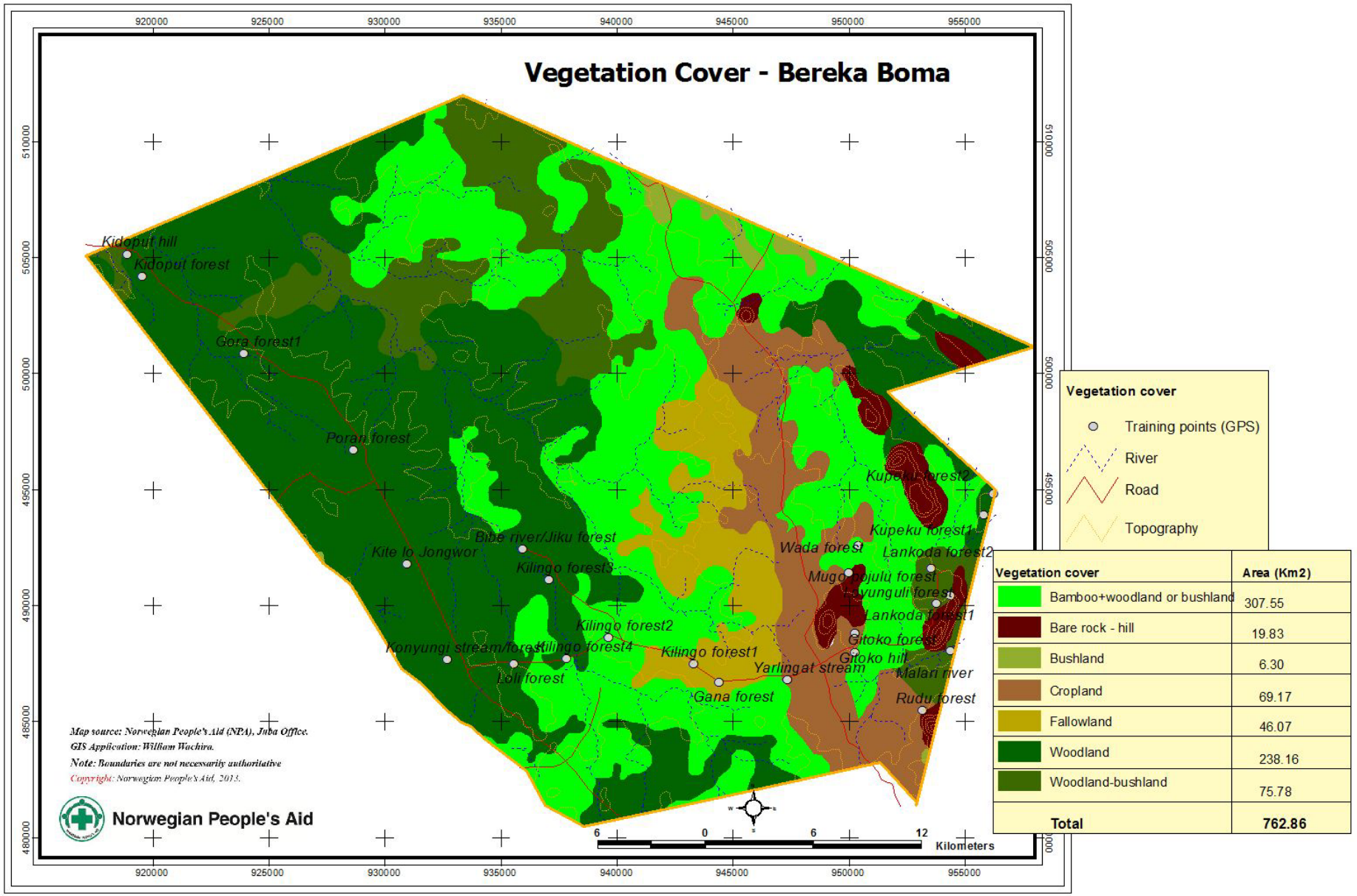


Fig 12: Vegetation cover, land cover sizes in km^2, Bereka Boma



Bamboo forest / harvesting in Bereka Boma

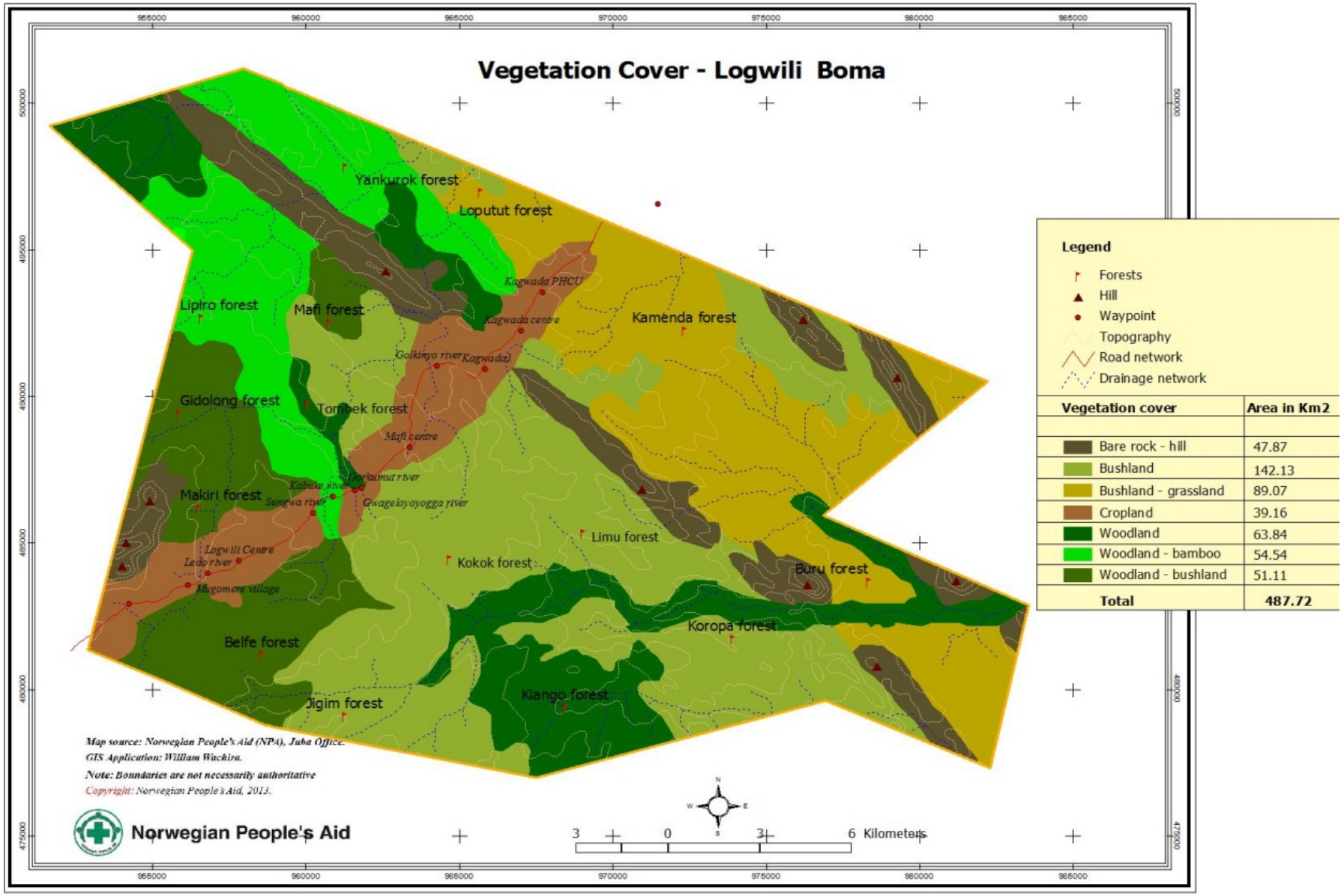
Table 6: GPS sampling points (waypoints) Bereka Boma

Bereka Boma – Lainya Payam - Date 7- 8/2/2013						
Wpt	Northing	Easting	Location	Dominant trees	Cover type	Utilization
1	04°23.549	031°01.614	Yerlingat stream	Bamboo	Bush land/ grassland	Sale, house construction
2	04°23.472	031°00.030	Gana forest(kiryo)	Bamboo	Bamboo forest	House construction, fence, sale
3	04°23.908	030°59.423	Kilingo forest 1	Terminalia spp, bamboo	Woodland/bush land/thick bamboo	Timber, poles, bamboo for sale
4	04°24.508	030°57.443	Kilingo forest 2	Bamboo and Afzelia africana	Bush land/fallow land	Poles, bamboo for income generation
5	04°25.862	030°56.049	Kilingo forest 3	Bamboo	Thick bamboo forest	For sale and construction
6	04°26.587	030°55.432	Bibe river in Jiku forest	Bamboo	Thick bamboo forest	For sale and construction
7	04°24.026	030°56.457	Kilingo forest 4	Isoberlinia doka (kobo)	Woodland	Timber and poles
8	04°23.892	030°55.240	Loli river in Jiku forest	Isoberlinia doka (kobo) and bamboo	Woodland /bamboo forest	Timber, poles, bamboo for sale and construction
9	04°23.992	030°53.699	Konyungi forest	Isoberlinia doka (kobo)	Woodland	Timber and poles
10	04°26.225	030°52.749	Jangwor lo kite forest	Combretum,Piliostigma reticulatum	Bush land/grassland	Poles and grass for thatching
11	04°28.890	030°51.494	Poran forest	Bamboo, Combretum, bito, kobo	Woodland/bamboo forest	Timber, poles, income
12	04°31.137	030°48.938	Gora forest	Terminalia spp, bamboo	Woodland/thick bamboo forest	Timber, poles, bamboo for construction and income
13	04°32.934	030°46.569	Kidoput forest	Isoberlinia doka /kobo spp	Woodland	Timber and poles
14	04°33.447	030°46.210	Kidoput hill	Isoberlinia doka /kobo spp	Woodland	Timber and poles

Table 6: Continued

Bereka Boma – Lainya Payam - Date 7- 8/2/2013						
Wpt	Northing	Easting	Location	Dominant trees	Cover type	Utilization
15	04°24.634	031°03.592	Gitoko forest	Bito spp	Bush land	Poles
16	04°25.342	031°05.087	Langkoda forest 1	Combretum spp	Bush and grassland	Poles and grass for thatching
17	04°25.525	031°05.408	Loyungulu pool	Bamboo, Jambula/kuji spp	Woodland and thick bamboo forest	Poles and bamboo for sale and construction
18	04°26.147	031°04.951	Langkoda forest 2	Bito and bamboo	Woodland and grassland	Timber, poles and bamboo for sale
19	04°27.392	031°06.175	Kupeku hill	Isoberlinia doka /kobo spp	Woodland	Timber and poles
20	04°27.894	031°06.391	Kupeku forest	Isoberlinia doka /kobo spp	Woodland	Timber and poles
21	04°24.187	031°03.182	Gitoko hill	Kele (Lophira alata), bamboo	Woodland	Timber and bamboo for sale
22	04°22.826	031°04.753	Rudu forest	Combretum spp	Bush land/grassland	Poles
23	04°24.239	031°05.411	Malari river	Bito, Terminalia, Acacia albida	Woodland	Timber, poles, charcoal, fuel wood
24	04°26.056	031°03.032	Mugopojulu forest	Lophira alata	Woodland	Timber and poles
25	04°26.678	031°03.252	Woda forest	Lophira alata and bamboo	Woodland and bamboo forest	Timber and bamboo for sale

Fig 13: Vegetation cover, land cover sizes in km^2, Logwili Boma

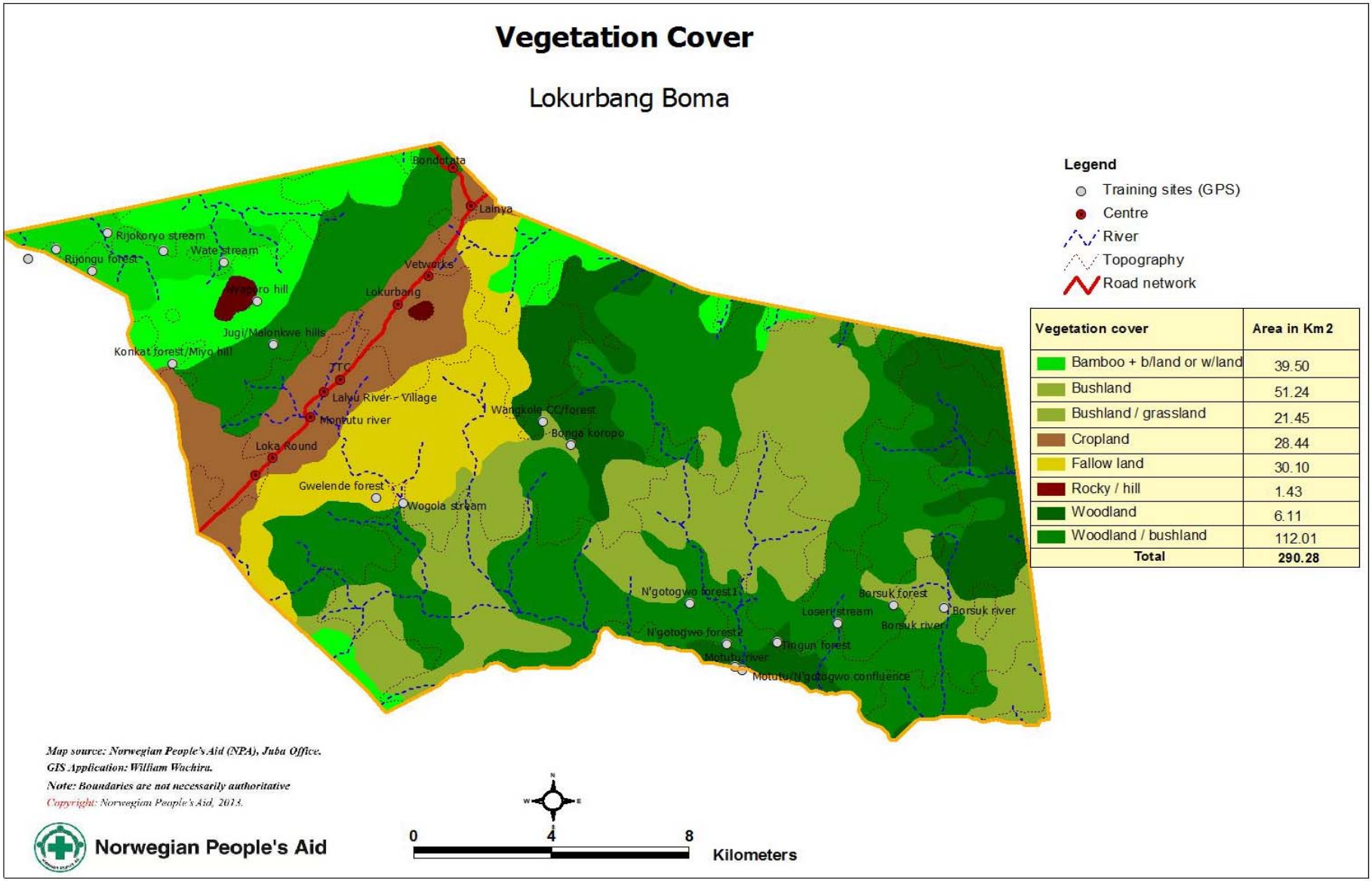


Forest resource harvesting in Logwili Boma

Table 7: GPS sampling points (waypoints) Logwili Boma

Logwili Boma – Lainya Payam - Date 9-11/1/2013						
Wpt	Northing	Easting	Location	Dominant trees	Cover type	Utilization
1	04°26.295	031°10.557	Mafi forest 1	Isoberlinia doka/kobo spp	Woodland	Timber and poles
2	04°26.721	031°10.709	Mafi forest 2	Isoberlinia doka/kobo spp and Acacia spp	Woodland	Timber, poles and fuel wood
3	04°23.694	031°08.871	Tombek forest 1	Afzelia spp and Logodo spp	Woodland	Poles and timber
4	04°24.171	031°08.751	Tombek forest 2	Kobo spp	Woodland	Poles and timber
5	04°23.463	031°07.528	Tombek forest 3	Combretum and bamboo	Bush land/woodland/bamboo forest	Poles and timber
6	04°25.019	031°07.627	Lipiro forest	Kobo and Mahogany	Woodland	Timber and poles
7	04°23.736	031°07.068	Kogokkerya forest 1	Combretum	Bush land	Poles and grass for thatching
8	04°24.240	031°06.843	Kogokkerya forest 2	Terminalia spp	Bush land	Poles and grass for thatching
9	04°22.220	031°09.848	Kameda forest	Terminalia spp	Bush land/woodland	Poles and timber
10	04°22.109	031°11.546	Lokela forest	Terminalia spp	Woodland	Timber and poles
11	04°21.416	031°08.008	Logwili stream	Isoberlinia doka (kobo)	Woodland	Timber
12	04°20.609	031°09.701	Limu forest/bokudu hill	Afzelia africana (bilingi), Terminalia	Bush land/woodland	Poles and timber
13	04°20.861	031°09.158	Kiekak cattle camp	Terminalia spp	Bush land/ woodland	Poles and timber

Fig 14: Vegetation cover, land cover sizes in km^2, Lokurbang Boma



Forest vegetation in Lokurbang Boma

Table 8: GPS sampling points (waypoints) Lokurbang Boma

Lokurbang Boma – Lainya Payam - Date 27-28/1/2013						
Wpt	Northing	Easting	Location	Dominant trees	Cover type	Utilization
1	04°18.293	031°01.173	Jugi/Malonkwe hill	Terminalia spp and bamboo	Bush land/woodland	Poles and timber
2	04°19.006	031°00.916	Nyaporo hill/forest	Bamboo	Bamboo forest	Construction and sale
3	04°19.641	031°00.402	Wate seasonal river	Bamboo and Terminalia spp	Bush land/woodland/bamboo forest	Poles and timber
4	04°19.812	030°59.452	Dulaang forest	Terminalia spp	Bush land/woodland	Poles and timber
5	04°20.110	030°58.572	Lujokoro stream	Bamboo and Terminalia spp	Bush land /woodland	poles and timber
6	04°19.491	030°58.332	Plantation(Rijangu forest)	Teak tree	Woodlot	Timber
7	04°19.839	030°57.768	Rijangu center	Teak and mango	Woodlot around housing	Timber and fruit(mango)
8	04°19.693	030°57.341	Lokedo stream	Teak tree	Woodlot	Timber
9	04°17.982	030°59.597	Kongkat forest	Bilingi and Terminalia	Bush land/woodland	Poles and timber
10	04°17.045	031°05.389	Wang kole cattle camp	Terminalia spp	Bush land/fallow	Poles
11	04°16.662	031°05.832	Bangkoropo forest	Hymenocadia (kirere), nyangilo	Bush land/grassland	Poles and grass for thatching
12	04°14.082	031°07.691	Ngotogwo forest 1	Duruba	Bush land	Poles
13	04°13.412	031°08.279	Ngotogwo forest 2	Kobo spp	Woodland	Timber
14	04°13.049	031°08.413	Mutu river	Duruba and Acacia spp	Woodland	Timber
15	04°12.994	031°08.515	Motutu/ngotogwo confluence	Kuruyu	Bush land	Poles, fishing
16	04°13.442	031°09.067	Tingun forest	Riangti, Acacia, Gwegwe	Bush land	Poles
17	04°13.758	031°10.008	Loseri stream	Terminalia, bamboo, kumii	Bush land	Poles, fruit, gum
18	04°14.060	031°10.882	Borsuk forest 1	Kobo spp and grass	Woodland/grassland	Timber
19	04°14.020	031°11.676	Borsuk forest 2	Kobo spp	Woodland	Timber
20	04°15.793	031°02.781	Gwelende forest	Piliostigma reticulatum	Bush land	Poles
21	04°15.717	031°03.214	Wogolo stream	Terminalia spp	Bush land/woodland	Poles

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