Forest mapping and pre-inventory of the Sudanese refugee hosting areas in Maban and Pariang counties, South Sudan (24 April – 12 May 2014)

Mission report part B

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List of abbreviations

CFM	Community forest management
FAO	Food and Agriculture Organization of the United Nations
MAFCRD	Ministry of Agriculture, Forestry, Cooperatives and Rural Development
NGO	Non-Governmental Organisation
NTFP	Non-Timber Forest Products
OCHA	Office for the Coordination of Humanitarian Affairs
RSL	Remote Sensing Laboratories (University of Zurich)
RSS	Republic of South Sudan
SDC	Swiss Agency for Development and Cooperation
UNEP	United Nations Environment Programme
UNHCR	United Nations High Commissioner for Refugees
WFP	World Food Programme

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Executive summary

A forest mapping and inventory, as part of the environmental action plan, has been recommended for the Sudanese refugee hosting areas in Maban County (Upper Nile) and Pariang County (Unity States) by both, the multi-party rapid environmental assessment in November 2012 and UNHCR's environmental inception mission in June 2013.

The reporting from the field verification and forest pre-inventory is split in two parts. Part A includes mainly the description of the vegetation and land cover sites and the planning of the next steps of the forest mapping/inventory. This report **(Part B)** presents the vegetation map which has been elaborated together with the Remote Sensing Laboratories of the University of Zurich.

The vegetation maps of Maban and Pariang counties are a solid basis for making a first estimation of the wood resources of a given area (woodshed) and they may serve as a basis for carrying out a full forest inventory for getting more detailed information about the stage and growing stock of the woody formations. The methodology applied for the vegetation mapping allowed to consider the four dominant tree species in the definition of the vegetation units. This information is pertinent to assess the spatial availability of different forest products including firewood and construction poles. In addition, the land cover/vegetation maps are an excellent tool for any land use planning activities in both counties.

According to a first estimation there is enough wood available in the vicinity of all camps provided that the size of the woodshed for a given camp/settlement is appropriate and a sustainable community forest management is implemented. Overall, the carrying capacity of the local ecosystems and the high resilience of the savanna landscape allow an additional influx of refugees without degrading the natural resources in the long-run if sustainably managed.

The average annual area burnt in South Sudan amounts to 52.8% while the average annual area burnt in Maban and Pariang amounts to 57.9% and 67.0%, respectively. The temporal fire distribution reveals a pattern of predominant early dry season fires (Nov./Dec.). In South Sudan certainly more than 90% of all fires are caused by man, whether deliberately or by accident or incidentally. The uncontrolled use of fire is a serious constraint for a sustainable forest management as the natural regeneration of woody formations (seedlings and saplings) is regularly set back by annual fires forest fires (especially by hot late dry season fires).

Key elements of a community forest management are presented and will be further discussed a 3-days-workshop organised by UNHCR in Juba early 2015. Finally, the planning of the next steps for the elaboration and implementation of a pilot community forest management project are outlined.

1. Introduction

A field mission has been carried out from 24 April – 12 May 2014. The first part of the mission report (Part A) included mainly (see Bloesch 2014):
a) The methodology of the forest pre-inventory;
b) The description of the vegetation (ground truthing and dendrometric measurements) and land cover sites;
c) Some thoughts about a community forest management (focussing on the fire regime and the shelter programme);
d) Some recommendations regarding further strengthening UNHCR's environmental unit and possible support by SDC;
e) The planning of the next steps of the forest mapping/inventory.

This report (Part B) presents the vegetation map which has been elaborated together with the Remote Sensing Laboratories of the University of Zurich. Each vegetation type is described regarding their geomorphic characteristic, vegetation physiognomy, forest data, and ecosystem services. For the methodology of the mapping we refer to the technical report from the RSL (Wulf et al. 2014) which includes also an analysis of the fire history. In addition, we present a first estimation of the wood resources in both counties and outline challenges and principles of a community forest management for a sustainable use of the natural resources. Finally, the next steps for the elaboration and implementation of a pilot community forest management project are outlined, including a 3-days workshop organised by UNHCR in Juba early 2015.

2. Vegetation map

Both Sudanese refugee-hosting areas are located in a typical savanna landscape on nearly flat terrain (see biogeographic description in Bloesch et al. 2013). The tree and shrub cover in Maban and Pariang counties varies mainly according to a) the soil moisture content (seasonally waterlogged areas are quasi free of woody plants) and b) extent of human disturbances including tree cutting for poles, woodfuel[1], and for gaining open rangeland and the use of fire which is of utmost importance. The current fire regime has widely shaped the physiognomy of the savanna landscape. The impact on forests (and forest policy) as well as on the land-use in general is tremendous (see chapter 3.4.1)!

The description of the 20 vegetation sites and 17 land cover sites for the ground truthing and for taking the dendrometric measurements has allowed defining the vegetation types following the classification of Yangambi (Scientific Council for Africa South of the Sahara 1956) considering crown cover of the woody plants and geomorphological characteristics (for the detailed description of the mapping methodology see Wulf et al. 2014):

- Grassland: ≤ 2% crown cover[2]
- Tree/shrub savanna: 2-30% crown cover
- Savanna woodland: 30-60% crown cover
- Woodland: ≥ 60% crown cover
- Riverine forest[3]: ≥ 60% crown cover

[1] "Woodfuel" is taken to cover both firewood and charcoal
[2] Percentage of the soil surface covered by vertically projected tree and shrubs crowns.
[3] In agreement with the Sudanese forest service the term riverine forests was used here.

Very narrow and often scattered gallery forests, consisting usually of just one tree row, occur along each side of riverbeds of seasonal watercourses. However, these formations are too narrow to be classified as a distinct unity on the map.

A major effort was made for further refining the denser vegetation types (at least 30% tree and shrub cover) with their dominant tree species including Red acacia, Desert date tree (*Balanites aegyptiacus*), Doum palm (*Hyphaene thebaica*) and Silak (*Anogeissus leiocarpus*). They are very common species of the Sahelo-Sudanian vegetation belt stretching from Senegal up to Ethiopia. All of them have high socio-economic values for the host and displaced communities. Red acacia, Desert date tree, and Doum palm may locally form virtually monospecific stands while Silak is often associated with Guok (*Combretum* spp.) and Piok (*Terminalia* spp). forming broad-leaved savannas/woodlands.

For the differentiation of the four dominant species on the satellite images we considered their phenology, i.e., deciduous[4] (seasonal variation of the foliation) versus evergreen (see species characteristics in chapter 2.1). The seasonal variation of the foliation was also considered for defining the tree and shrub cover using the NDVI[5]. To avoid the interference of the NDVI by the grass layer, Landsat satellite images from 4-6 weeks after the last significant rainfall at the end of the rainy season (October/November) were analysed, assuming that the deciduous trees and shrubs are still photosynthetically active at that time, while the grass layer has dried up (for detailed methodology see Wulf et al. 2014). Pixels (30x30m) having no dominant single species (less than 70% share in the canopy cover) have been classified as mixed stand.

Finally, 13 vegetation units out of the five vegetation types have been defined considering the four most dominant tree species (see Figs 1 and 2). We believe that in general the accuracy of the species distinction is quite satisfactory except for Silak whose leaves shoot late in the rainy season. Silak has a particular light foliation what renders the accurate determination of the canopy cover more difficult. Moreover, we have doubts concerning the correct classification of the vast wetlands along the river Bahr-el-Ghazal in southern Pariang County (mapped as woodlands with Date desert tree). Field verification and an additional description of vegetation sites would be required to further improve the validity of the vegetation map.

[4] No leaves during the dry season

[5] Normalized Difference Vegetation Index

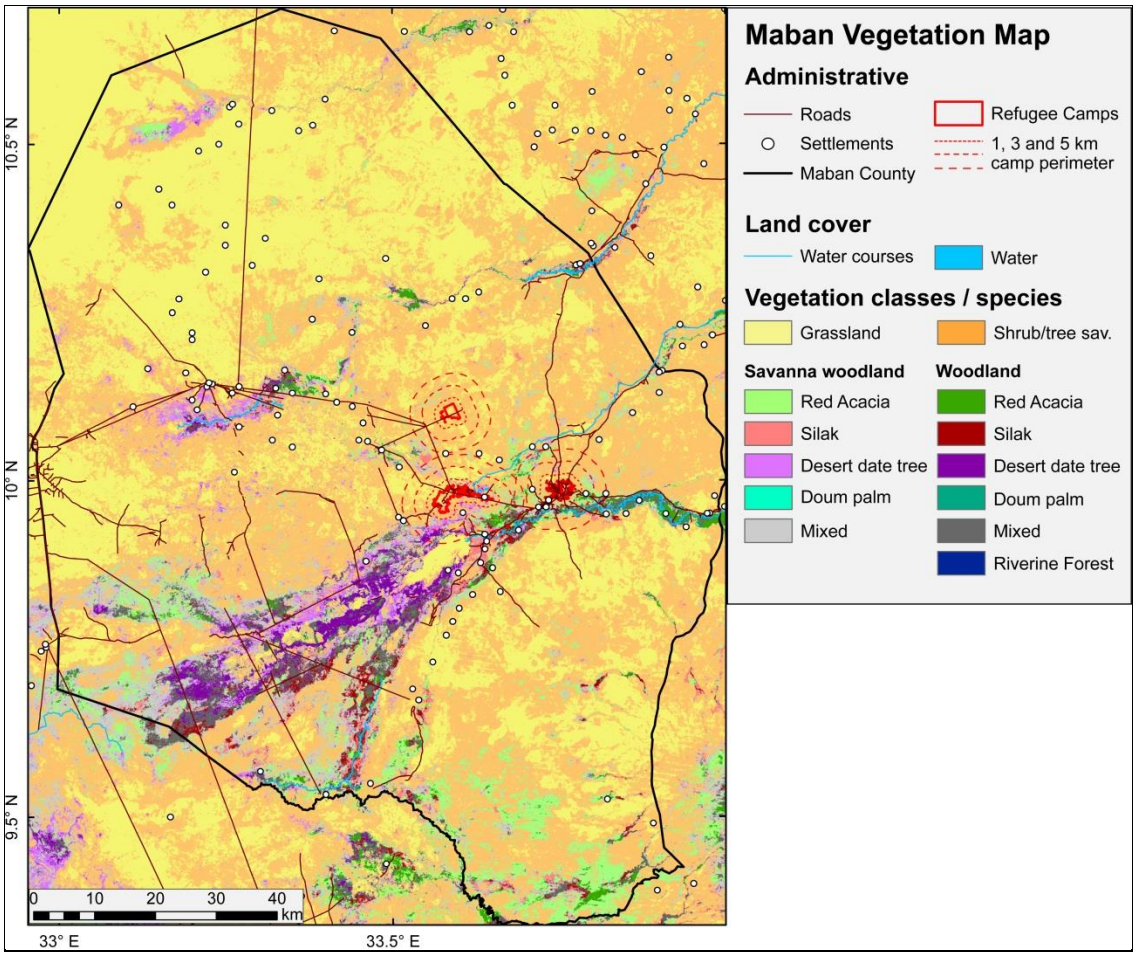

Fig. 1. Vegetation map of Maban County

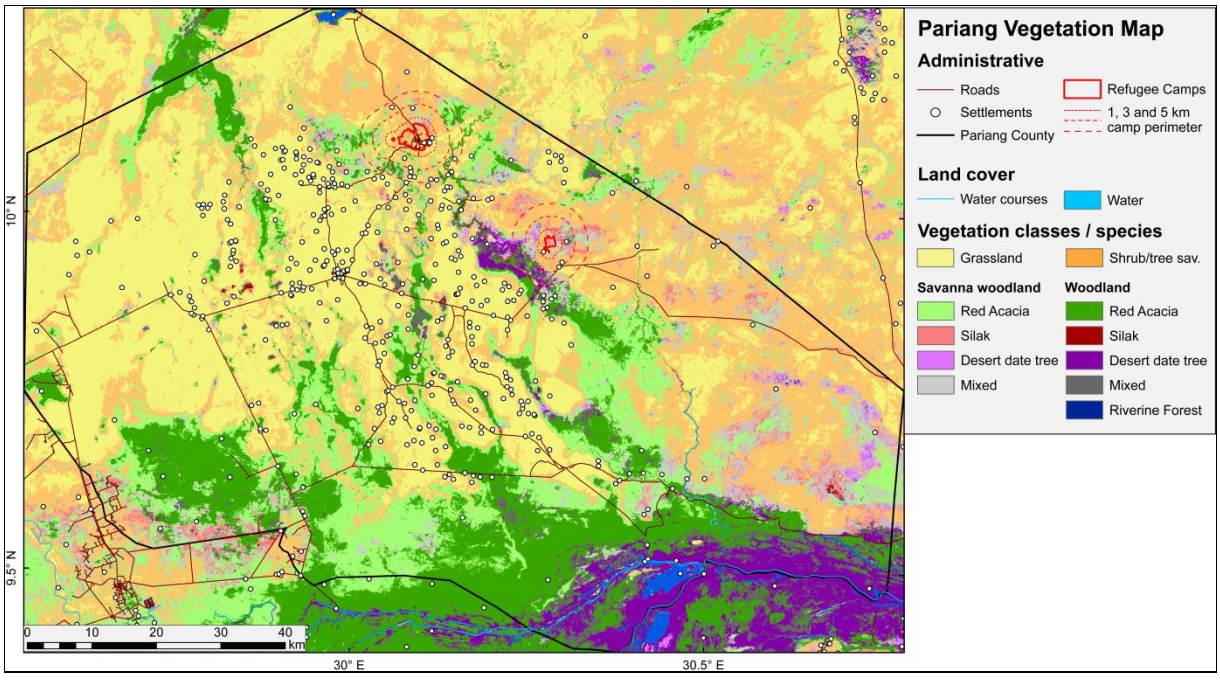

Fig. 2. Vegetation map of Pariang County

2.1 Characteristics of the dominant species

Red acacia (*Acacia seyal*)

This acacia is of outmost importance for charcoal making. The other acacias occurring in Maban and Pariang counties including *A. nilotica*, *A. polyacantha*, *A. senegal*, and *A. xanthophloea* are also good charcoal species much less frequent than the Red acacia. All acacias are deciduous.

Thanks to its high regeneration capacity by vegetative propagation (coppice shoots and/or root suckers after cutting) and by seeds, Red acacia stands can quickly recover after disturbances (cutting, fire). Poles (bifurcated) are used for shelter construction but their durability is rather low due to termite attacks. Young shoots and leaves as well as pods and the bark provide much valued tree fodder for livestock. Red acacia produces gum arabic (Talh) which is highly valued in Sudan (but is of lesser quality than that from *A. senegal*). Bark, root and gum are used for a variety of medicinal uses.

Desert date tree (*Balanites aegyptiacus*)

This evergreen protected tree has a wide range of uses including edible fruits, thorny branches and twigs for fencing, looping for fodder and young twigs and leaves serving as food especially in case of famine. Moreover, the Desert date tree has also a wide variety of applications as medicinal plant.

Doum palm (*Hyphaene thebaica*)

The evergreen Doum palm provides durable construction poles. The leaves are used as fodder and for thatching while their fibres are used for making mats, fans, baskets, ropes, and so on. The pulp of the fruit and the kernels after breaking the nut are eaten. Palm wine is produced from sap obtained by tapping the tip of the main stem. Doum palms do not occur in Pariang County.

Silak (*Anogeissus leiocarpus*)

The poles of Silak are most estimated by the users due to its durability (quite termite-resistant) and hardness of the wood. Silak is a protected tree species for the local communities. Silak is deciduous and has a wide variety of applications as medicinal plant.

2.2 Description of vegetation

In Table 1 and 2 the area as well as the mean canopy cover for each vegetation unit of Maban and Pariang counties are given. The tree/shrub cover is considerably higher in Pariang County than in Maban County with 31% and 16%, respectively. However, due to the likely misclassification of the wetlands (grasslands) along the Bahr el Ghazal River as woodlands with Desert date tree the mean canopy cover given for Pariang is certainly overestimated. The height of dominant trees of the savannas and woodlands varies little between 9 and 13m height. Exceptionally, some single trees may reach 14-16m (18m). Overall, the Red acacia is by far the most dominant tree species which may form vast quasi monospecific fine-leaved savannas/woodlands followed by the Desert date tree which is mostly abundant within and around settlements.

Tab. 1. Land cover classes/vegetation types of Maban County

County	Land cover class Vegetation type	Tree species Vegetation unit	Area [km^2]	Percent [%]	Subpercent [%]	Canopy cover [mean]
Maban			11861.1	100.00		16.08
	Water		0.0	0.00		
	Grassland		4382.5	36.95		0.12
	Tree/shrub savanna		5187.6	43.74		13.63
	Savanna woodland		1640.0	13.83		42.37
		Red Acacia	563.5	4.75	34.36	40.65
		Desert date tree	213.9	1.80	13.04	44.86
		Silak	155.1	1.31	9.46	42.53
		Doum palm	1.4	0.01	0.09	44.65
		Mixed	706.0	5.95	43.05	42.96
	Woodland		626.0	5.28		76.50
		Red Acacia	90.8	0.77	14.50	75.36
		Desert date tree	144.0	1.21	23.01	74.27
		Silak	91.4	0.77	14.61	79.58
		Doum palm	5.3	0.05	0.85	91.60
		Mixed	294.4	2.48	47.03	76.70
	Riverine forest		25.0	0.21		85.39

Tab. 2. Land cover classes/vegetation types of Pariang County

County	Land cover class Vegetation type	Tree species Vegetation unit	Area [km^2]	Percent [%]	Subpercent [%]	Canopy cover [mean]
Pariang			8925.6	100.00		30.73
	Water		50.0	0.56		
	Grassland		2890.5	32.38		1.70
	Tree/shrub savanna		2159.2	24.19		19.70
	Savanna woodland		2044.7	22.91		44.15
		Red Acacia	1334.4	14.95	65.26	45.04
		Desert date tree	44.8	0.50	2.19	39.13
		Silak	170.9	1.91	8.36	45.19
		Mixed	494.6	5.54	24.19	41.84
	Woodland		1771.5	19.85		76.60
		Red Acacia	1240.0	13.89	70.00	76.47
		Desert date tree	254.7	2.85	14.38	71.69
		Silak	12.4	0.14	0.70	93.28
		Mixed	264.3	2.96	14.92	81.20
	Riverine forest		9.7	0.11		92.85

Below, we give a general description for each vegetation type with its typical geomorphic characteristic, vegetation physiognomy, forest data, and ecosystem services.

Grassland

About one third of the total area of Maban and Pariang, respectively are covered by this vegetation type including natural grasslands (seasonally waterlogged areas), human-made pastures, cropping areas, and settlements (infrastructure). Probably the largest part is of made of man-made pastures as a result of extensive tree clearing of savannas especially in Pariang County where typically only a few protected Desert date trees remain. The vast pasture land is of great importance for livestock husbandry of the locals and for seasonal transhumance of nomads (see Bloesch et al. 2013). In addition, tall grasses are used for thatching the traditional Tukul houses. These areas are seasonally waterlogged (Black cotton soils) rendering access very difficult in the rainy season.

Fig. 3. Burnt grassland with tall grasses south of Yusuf Batil Camp (Maban County) including a prominent solitary Baobab tree (*Adansonia digitata*).

Tree/shrub savanna

This vegetation type is predominant in Maban County representing about 44% of the total area while in Pariang tree/shrub savannas cover only 24%. Tree/shrub savannas are also more open in Maban County having a mean canopy cover of about 14% (20% Pariang). Locally, large termitaria are a typical feature of tree/shrub savannas. This vegetation type is used for harvesting forest products and as pastures (including tree/shrub fodder).

Fig. 4. Tree/shrub savanna with termite mounds east of Doro Camp in Maban County.

Savanna woodland

Savanna woodlands still having a continuous grass layer are more widespread in Pariang County with about 23% of the total area (14% in Maban County) having vegetation units with a canopy cover between 39 and 45%. Red acacia units are particularly widespread in Pariang County covering about 15% of the total area and are of great importance for gaining fuelwood. Mixed stands are covering about 6% of the area in each county. These dense savannas are mainly used for collecting fuelwood and construction poles and wood pastures (grazing and browsing).

Fig. 5. Savanna woodland with Red Acacia (*Acacia seyal*) south of Yida settlement, Pariang County. Note the resprouting grasses after fire.

Fig. 6. Savanna woodland with Desert date tree (*Balanites aegyptiacus*) southwest of Adjuong Thok in Pariang County.

Woodland

Woodlands are widespread in Pariang County covering about 20% of the area (5% in Maban County) with a mean canopy cover in both counties of about 77%. Dense Red acacia stands are again widespread in Pariang County covering about 14% of the total area (see socio-economic importance under savanna woodland). Mixed stands cover about 3% of the area in each county and have in general a higher biodiversity not only in woody but also in herbaceous plants. Woodlands are mainly used for harvesting fuelwood and construction poles and for collecting Non-Timber Forest Products (NTFP) such as wild honey, vegetables, fruits, fibres and medicinal plants which are of great importance for the livelihoods of local and displaced communities.

Fig. 7. Woodland with Doum palm (*Hyphaene thebaica*) near Yabus River southeast of Doro Camp.

Fig. 8. Mixed woodland east of Doro Camp in Maban County.

Riverine forest

Patches of riverine forests mainly occur along the permanent Yabus River having a highly diversified structure and floristic composition. Landwards, they are often bordering woodlands with a broad ecotone. In both counties riverine forests cover less than 1% of the total area. The canopy cover is around 90% and most tree and shrub species are evergreen and some tree species may reach 25 m of height. Ficus trees are characteristic for this vegetation type.

Riverine forests fulfil a wide variety of ecosystem services including flood regulation (soil conservation thanks to an intact vegetation cover) and provisions services (food, raw materials and medicinal resources, NTFP) and have a relatively high biodiversity. As a result the conservation value of riverine forests is important.

Fig. 9. Riverine forest along Yabus River southeast of Doro Camp in Maban County.

3. Wood resources in the Sudanese refugee-hosting areas

3.1 Vegetation change within and around refugee sites

Vegetation changes that occurred after the Sudanese refugees arrived in South Sudan (July 2011 onwards) have been analysed based on multi-temporal analysis of Landsat data and comprises two approaches: a) using NDVI differences from data that cluster around the years 2002, 2008 and 2013, and b) NDVI differences from data acquired at the onset of the dry season during the years 2000 to 2013. Due to this acquisition timing the grass layer is mostly photosynthetically inactive while mainly trees and shrubs are depicted by the NDVI. According to both approaches distinctive reductions of the vegetation cover around the camps/settlement occurred after the refugee influx with a marked gradient of increasing tree/shrub cover from the camps/settlement outwards (for more details see Wulf et al. 2014).

3.2 Estimation of wood resources

The spatial distribution of wood resources is highly variable in both counties and depends on the vegetation type. Therefore, the situation is quite different for each Sudanese refugee camp (see detailed maps in Annexe A). Nevertheless, larger and denser woody formations (savanna woodlands and woodlands) do exist in the vicinity of all but the Kaya camp, i.e. within a radius of 5km outwards from the camp perimeter. According to the field visits, however, woodlands with a high percentage of Silak are quite abundant in the vicinity of

Kaya camp but we had difficulties to identify this species on the satellite images (see remarks in chapter 2).

The basal area[6] has been determined in the field at 17 sites and varies between 5 m^2 and 19 m^2/ha with an average of 10.2 m^2/ha per tree stand (see Bloesch 2014). As can be seen in Fig. 10 the basal area quite nicely correlates with the canopy cover estimated in the field.

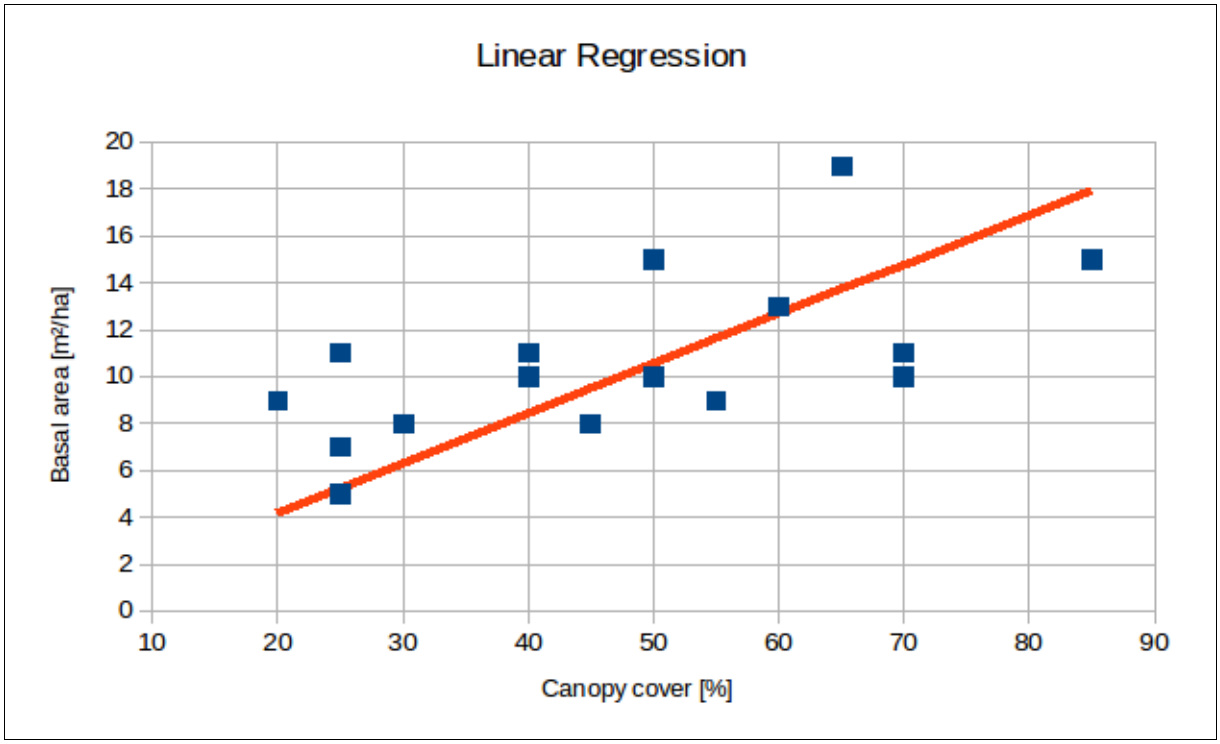

Fig. 10. Correlation between basal area and canopy cover estimated in the field; correlation coefficient = 0.6368; y = 0.2113 * x.

Since the mathematical correlation between basal area and canopy cover determined by satellite images is similar to the correlation coefficient based on the canopy cover estimated in the field (Fig. 10), this relation could be used for roughly estimating the total basal area for each vegetation unit and thereby the total growing stock for the woody formations (see Table 3). Note that riverine forests, because of their high conservation value are not considered in the estimation of the wood resources of potential wood supply areas. Moreover, these formations are insignificant in terms of their area and their growing stock.

The **growing stock**[7] can be calculated by the following formula:

Mean basal area x mean height of dominant trees x tree form coefficient

[6] Area occupied by the cross-section of all stems at DBH

[7] Volume of all living trees in a given area of forest or wooded land; it is usually measured in solid cubic meters (m^3).

Tab. 3. Mean basal area and mean growing stock

Vegetation type	N sites	Mean basal area (m^2/ha)	Mean height dom. trees (m)	Tree form coefficient	Mean growing stock (m^3/ha)
Tree/shrub savanna	4	8.0	11	0.4[8]	35.2
Savanna woodland	7	10.1	12	0.4	48.5
Woodland	6	13.5	12	0.4	64.8

The height of the dominant trees varies very little between the main woody formations (see Table 3). We define the tree form coefficient for all woody formations at 0.4 following a conservative assumption (although we assume that the tree form coefficient is most probably a little higher for woodlands). Following these assumptions, the growing stock is therefore mainly a function of the tree/shrub cover.

3.3 Demand for forest products

The Sudanese refugees as well as the local communities depend for their livelihoods on the availability of forest products including a) building materials for their shelter (construction poles and sticks, grasses for thatching), b) firewood primarily for cooking, but also for heating water (hygiene) and for lighting, and c) on other NTFP (e.g. wild honey, vegetables, tubers, fruits, fibres and medicinal plants).

a) Building material for shelter

The demand for building material highly depends on the type of shelter propagated by UNHCR and its implementing partners (see Bloesch et al. 2013). In this context, the durability of the construction poles is of utmost importance mainly depending on the termite resistance of the wood.

Poles are made of stems having usually a diameter of 15-20 (25) cm. We estimate that in average 1-2 poles can be made out of one tree. This general assumption has to be checked with the users in the field when preparing the pilot community forest management project.

b) Fuelwood

The firewood demand is permanently continuous and its impact on the vegetation will be progressively manifested with time. The firewood consumption of the Sudanese refugees is expected to be initially relatively high due to the readily available firewood in the vicinity of the camp/settlement. In a similar environment where biomass was initially abundant, the daily firewood consumption of Rwandan refugees in the refugee camp of Benaco in Kagera Region in Tanzania in 1994 was about 2.7 kg per person (Bloesch 2001). Two years later the daily consumption of firewood per person dropped significantly to 1.6 kg (Owen & Ruzicka 1997), due to the ever-decreasing wood resources in the vicinity of the camp, the use of fuel efficient clay stoves and the application of energy-saving practices.

According to De Montalbert, M.R. & Clements, J. (1983) minimal firewood consumption per person per year lies within a range of 1 m^3 to 1.5 m^3 (or 0.8 to 1.2 tons[9]) in developing countries under normal circumstances. During the Rwandan refugee crisis in the Kagera

[8] The tree form coefficient depends mainly on the age and growth characteristics of the tree species and the density of the stand.

[9] 1 m^3 ~ 800 kg

Region in Tanzania, the daily firewood consumption in Tanzanian villages was about 1.9 kg per person.

The joint environmental mission from 16 to 22 November 2012 (UNHCR, UNEP, OCHA & RSS 2012) estimated that the average firewood consumption was about 1.8 kg/person/day in the Sudanese refugee camps in Maban County. Virtually all households were using the open fire system at this time. Little effort was made since then for promoting energy saving methods including the use of appropriate improved cooking stoves, thus the current pattern of energy consumption by the Sudanese refugees has certainly not changed fundamentally.

Currently the Sudanese refugee population size in Upper Nile and Unity State is 131,207 and 86,570 persons, respectively (UNHCR 2014), meaning that their total annual domestic energy needs will be about 143,000 tons considering an average firewood consumption of about 1.8 kg/person/day. This figure does not consider a) the demand of the local communities and b) the high but unknown quantity of wood used for commercial charcoal making.

c) NTFP

The deforestation around the camps/settlement will also affect the availability of non-wood forest products. Both, refugees and local population, highly depend on non-wood forest products like honey, fruits, vegetables, ropes, and medicinal plants for their subsistence and income generating activities.

3.4 Sustainable use of forest products

A sustainable management of wood resources in the Sudanese refugee-hosting areas requires that a balance is reached between sustainable supply and consumption in a given area, so-called woodshed[10] (FAO 2012). Any imbalance between supply and demand will lead to further environmental degradation reducing the availability of forest products thereby affecting the livelihoods of locals and refugees what may increase the conflict potential between the two communities. Working towards a closer balance requires reliable data on both, the current potential sustainable supply (annual wood increment) and the annual demand for fuelwood and construction wood (refugees, locals, and commercial trade). According to a first estimation there is enough wood (fuelwood and construction wood) available in the vicinity of all refugee camps provided the woodshed is properly defined. The estimated total annual domestic energy needs of the Sudanese refugees of 143,000 tons corresponds to a total wood volume (growing stock) of 4500 ha of woody formations (average growing stock of 40m^3/ha or 32 tons/ha following a conservative estimation). However, as far as possible dry wood should be used for firewood by the Sudanese refugees what requires a strict implementation and supervision of a community forest management plan which should have been jointly agreed among all key stakeholder (locals, refugees, forest service, local authorities and traditional leaders).

The regrowth potential of the cut stems by coppice shoots and/or root suckers is considerable and has to be considered in the potential supply. However, an effective protection of the natural regeneration from uncontrolled fires and free roaming of livestock, especially goats (see Bloesch 2014) is absolutely necessary. In addition, the reproductive capacity of the soil seedbank is considerable.

[10] Portion of the territory necessary to supply on a sustainable basis the woody biomass needed by a specific consumption site

The carrying capacity of the local ecosystems and the high resilience of the savanna landscape allow an additional influx of refugees without degrading the natural resources in the long-run if sustainably managed.

3.4.1 Fire regime

The average annual area burnt in South Sudan amounts to 52.8% while the average annual area burnt in Maban and Pariang amounts to 57.9% and 67.0%, respectively (Wulf et al. 2014). The temporal fire distribution reveals a pattern of predominant early dry season fires (Nov./Dec.).

Fire is deeply rooted in the cultural practices of the rural communities in Africa south of the Sahara Desert. Nowadays, the fire regime in rural Africa has mostly a chaotic character, i.e., most firing is not in relation to the land-use and is widely uncontrolled including arson fires (see Bloesch 2002). In South Sudan certainly more than 90% of all fires are caused by man, whether deliberately or by accident or incidentally. Herders widely set fires for favouring the regrowth of grasses at the beginning of the dry season and for renewal and maintenance of pastures land by late dry season fires which keeps the savannas open and hinders bush encroachment. Peasants also frequently use fire to in order to prepare new crop fields. Charcoal making or harvesting of honey may also cause bushfire. Many other reasons exist for fires including hunting of game, protection of properties (housing, crops), lessening the danger of wild animals (in particular snakes hidden in the grasses).

As a consequence, the uncontrolled use of fire is a serious constraint for a sustainable forest management as the natural regeneration of woody formations (seedlings and saplings) is regularly set back by annual fires forest fires (especially by hot late dry season fires).

4. Community forest management

We believe that a strong participative approach is a prerequisite for successfully managing natural resources considering the overarching challenges of land tenure and silvicultural tending (see Bloesch et al. 2013). Community forest management allows strengthening local governance in ways that forest can be managed and accessed by different users peacefully, equitably and sustainably. A successful introduction of a community-based management of forests will also greatly contribute to appease the conflict potential over natural resources between host and displaced communities (Bloesch et al. 2013).

Natural forest formations on communal land in Maban and Pariang counties belong to the locals. A new forest policy has been approved on 8 February 2013 (RSS 2013). The new policy urges RSS and State Governments to enter into collaborative forest management agreements and arrangements with communities for sustainable management of forests, in ways that also ensure increased benefits to communities from forests. The communities may delineate and gazette forests in their communal land to be managed as Community Forests (Bloesch 2014). The forest service should technically support the local communities in the elaboration and implementation of a community forest management plan.

Community forest management offers additional revenue to the local communities. A collaborative forest management should define the allocation of the forest revenue between the forest service (royal fees, permits) and locals from the selling of their forest products. Major revenue should include the selling of poles for UNHCR's shelter programme and of Red acacia tree stands to business men for charcoal making.

A community-based management of forest resources is a prerequisite to organise and control wood harvesting and to protect the natural regeneration and tree plantation from free roaming livestock (mainly goats) and uncontrolled fires.

The approach of a pilot community forest management project as part of the environmental action plan will be discussed during a workshop in Juba and will serve as a guide for its implementation.

Elements of a community forest management plan (to be agreed upon and implemented by all relevant stakeholder including local communities, local authorities, traditional leaders, forest service and refugees):

- Selection of a camp for the elaboration and implementation of a pilot community forest management plan based on the interest and commitment of the local stakeholders;
- Define the local organisational structure for the elaboration, implementation and supervision of the pilot community forest management plan (role and responsibilities of local communities, forest service, and refugees); establishment of environmental committees;
- Delimitation and mapping of the potential woodshed (wood supply area) around the selected camp;
- Verification of vegetation map for the woodshed and survey of additional vegetation sites to refine the map;
- Estimation of wood resources (firewood and construction wood) based on the vegetation map and on transect walks for a qualitative assessment of the woodshed (tree species cut, cutting technique, regeneration of tree species, fire signs/traces, charcoal making);
- Assess the current wood harvesting pattern for fuelwood and construction wood by refugees, locals and business men (especially charcoal making) within the woodshed considering land tenure and traditional user rights;
- Carry out a fuelwood consumption study for the woodshed (refugees and locals);
- Estimation of quantity of building material needed by refugees and locals depending on shelter type;
- Identification and mapping of potential harvesting sites for firewood (collecting of dry wood) and construction wood for refugees and locals considering accessibility;
- Assess the potential for the use of cash and voucher activities in the environmental sector (Sudanese refugees and host population);
- Control of free roaming livestock and fire within the woodshed to protect the natural regeneration;
- Define the average number of poles made of one tree considering species and diameter;
- Training of locals in appropriate cutting techniques to favour the regrowth of straight single stems suitable for poles;
- Identification of income generating activities related to NTFP like bee-keeping or production of gum arabic (*Acacia senegal*, *A. seyal*);
- Assess the use of fire by the local communities and their reasons;
- Consider lessons learnt from the implementation of community forest management; good case studies are e.g. Nepal where participatory forest management contributed to restore forest resources or Tanzania where local communities can either declare – and ultimately gazette and manage their own forests or sign joint forest management agreements with government for state forests (Ministry of Natural Resources and Tourism 2015).

5. Next steps for the implementation of a pilot community forest management project

5.1 Forestry Workshop

The preliminary findings of the forest mapping/inventory of the Sudanese refugee-hosting area and the results of a fire study for South Sudan will be presented and discussed during the workshop. Moreover, the introduction of a Community Forest Management as a pilot project in the Sudanese refugee-hosting area will be discussed. Participants will come from both, humanitarian and development actors.

Aim of the workshop: The participants a) are aware of the extent of the fire occurrence and its impact on land use, b) know the methodology of forest mapping/inventory and are trained in forest measurements for the inventory, and c) contribute to define the methodology of a community forest management pilot project in the Sudanese refugee-hosting area.

The workshop will have a modular structure with three quite autonomous topics. The practical training part in forest measurements for the forest inventory is foreseen for the technicians only. Therefore, participants will not necessarily attend all sessions of the workshop.

Topics/agenda of the workshop:

A) **Fire occurrence in South Sudan:** Presentation of the fire history of the last 10 years (Modis satellite images) at national and county level (Maban and Pariang counties); impact on land use and forestry; **½ day**

   Result: The participants are aware of the extent of the annually burnt area in South Sudan and the Sudanese refugee-hosting area and its impact on forestry and land use in general.

B) **Forest inventory/mapping:** Presentation of vegetation map, first estimations of wood resources, discussion of methodology, practical training for field survey (application of devices for forest measurements); **1 ½ day**

   Result: The participants get acquainted with the methodology of forest mapping and inventory and they are able to take the forest measurements for the inventory.

C) **Community forest management:** Discussion of the approach, national forest policy, legal and socio-economic challenges, selection of zone within the Sudanese refugee-hosting area for pilot project; **1 day**

   Result: The participants agree on the methodology for a community forest management pilot project in the Sudanese refugee-hosting area.

Presentation of findings to senior management level (Ministries, Donors, UN, International organisations): **1.5 hours** at the last day before closing workshop

5.2 Tentative planning

Table 4. General time schedule (see also recommendations)

N°	Activities/ milestones	2015 (month)							Responsibility
		1	2	3	4	5	6	7	
1	3-days forestry workshop about forest inventory								UNHCR/SDC
2	Final selection of camp for pilot CFM project								MAFCRD/UNHCR
3	Elaboration of pilot CFM project								UNHCR /IP/ MAFCRD
4	Implementation of pilot CFM project							→	UNHCR /IP/ MAFCRD
5	Remote backstopping of CFM process							→	SDC
6	On-the-job training of UNHCR, IPs, MAFCRD staff							→	UNHCR

6. Conclusions and recommendations

The vegetation maps of Maban and Pariang counties are a solid basis for making a first estimation of the wood resources of a given area (woodshed) and they may serve as a basis for carrying out a full forest inventory for getting more detailed information about the stage and growing stock of the woody formations. According to a first estimation there is enough wood available in the vicinity of all camps provided that the size of the woodshed for a given camp/settlement is appropriate and a sustainable community forest management is implemented. Overall, the carrying capacity of the local ecosystems and the high resilience of the savanna landscape allow an additional influx of refugees without degrading the natural resources in the long-run if sustainably managed.

The methodology applied for the vegetation mapping allowed to consider the four dominant tree species in the definition of the vegetation units what is certainly of interest of a wider audience. This information is pertinent to assess the spatial availability of different forest products including firewood and construction poles. In addition, the land cover/vegetation maps are an excellent tool for any land use planning activities in both counties.

Key elements of a community forest management plan have been elaborated which have to be agreed by all relevant stakeholder. More than half of the area of Maban and Pariang counties is burnt annually by uncontrolled fires what has to be considered in the elaboration and implementation of a community forest management plan.

The following recommendations are put forward to UNHCR South Sudan, SDC and the forest service (see also recommendations in report A):

6.1 UNHCR

1) Organisation of a 3-days training workshop in Juba to present the preliminary findings of the forest mapping/inventory of the Sudanese refugee-hosting area, the results of the fire study for South Sudan, and to discuss the introduction of a pilot Community Forest Management project (participants from technical services from the line ministries, UNHCR, other UN organisations, international organisations, national NGOs);
2) Support the organisational and technical capacities of the refugees and locals (environmental committees) community-based forest management;

3) Regular on-the-job training/practical field exercises for the staff from UNHCR, IPs and forest service;
4) Field verification of the map including additional vegetation site (50) in Maban and Pariang counties (Silak stands, sites along Bahr-el-Ghazal in southern Pariang);
5) Plan and implement a pilot project on community-based forest management as part of the environmental action plan and as a starting point to strengthen the natural resource management in the refugee-hosting areas.

6.2 Possible support from SDC

1) Support the 3-days training workshop organised by UNHCR in Juba with technical expertise;
2) Assessment of the cash and voucher potential for the promotion of environmental activities in the Sudanese refugee-hosting areas considering similar approaches by WFP and FAO;
3) Assessment of the needs for additional transport means (motorbikes) of the forest service;
4) Upon demand of UNHCR, evaluation of further technical support of UNHCR's Environmental Unit either by the deployment of an environmental expert and/or a remote backstopping by the Expert Group Environment & DRR for specific topics;
5) Publication of the key findings and the methodology of the forest mapping and the fire study which are certainly of interest to a wider audience.

6.3 Forest service

1) Strengthening the forest patrols (control of permits) by involvement of the locals;
2) Determination of tree form coefficients by measuring cross sections of the stem for the calculation of wood volume;
3) Assessment/monitoring of charcoal making in both counties.

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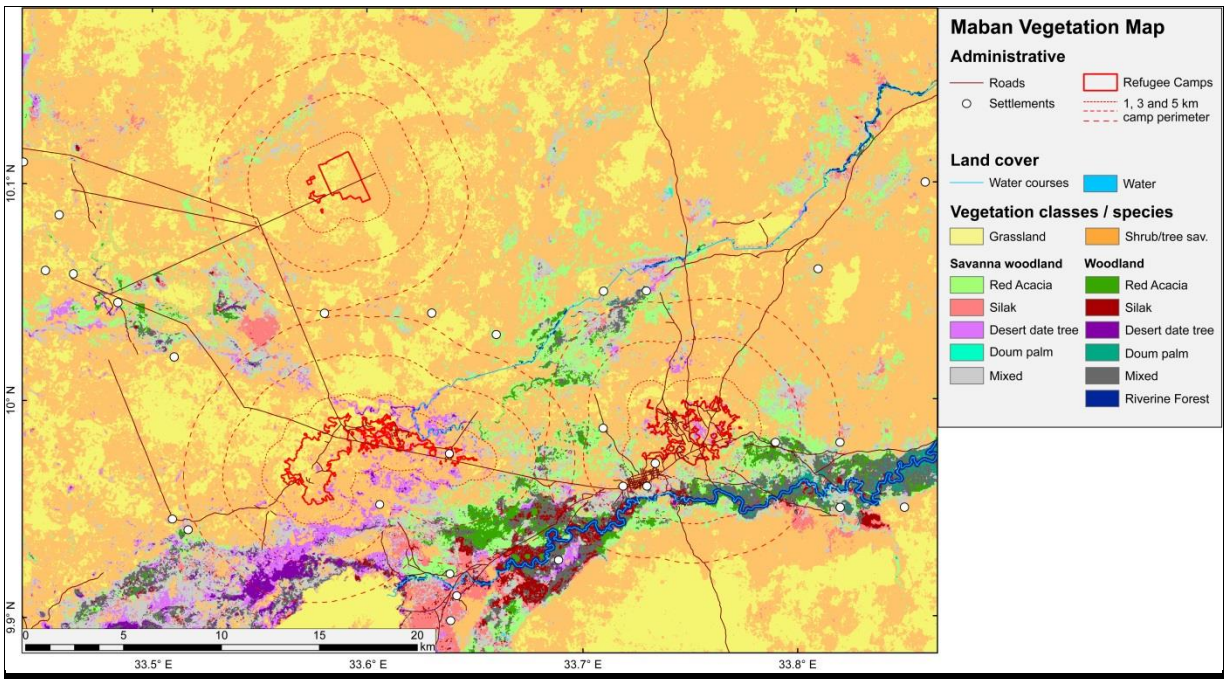
Annexe A: Detailed vegetation maps

Sudanese refugee-hosting area in Maban County



Sudanese refugee-hosting area in Pariang County