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Highlighting Threats of War on Biomass and Carbon Stocks Using Remote Sensing "Case Study of Darfur Crises"

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Introduction

Tropical forests are fragile and susceptible to depletion than is the case with temperate-zone countries (Norman, 1990). As Darfur's environment is particularly resource poor and suffers from very high natural variability and unpredictability that have been significantly exacerbated by the current crises and a high level of deforestation is taking place. Environmental resources are crucial to people's lives, livelihoods and cultural identity in Darfur region in Western Sudan (TEARFUND, 2007).

This conflict has led to the death of more than 100 000 people and displacement of ~2.7 million (UN OCHA, 2004). National and international efforts are intending to resettle the internal displaced peoples (IDPs) back to their home places. Most IDPs were from rural areas where houses are constructed from wood, straw and grass. Therefore, demands for forestry will be considerable at the time of reconstruction and some measures need to be taken in advance of resettlement. Accordingly, the study aims to assess and highlight the threats of expected reconstruction upon Darfur's biomass and carbon stocks using remote sensing, Geographical Information System, field surveys and documented reports.

Material and Methods

Fieldwork for the study was carried out in 2009/2010 to collect sufficient ground control points (GCPs) to be used for biomass classification using Global Positing System (GPS) with error less than 10 meter. The study used stratified sampling design based on unsupervised classification to locate the points and collected the biomass information. [1] To ensure that the particular groups within each population were adequately represented in the sample; and [2] To improve the

efficiency of sampling by gaining greater control on the composition of the sample. Therefore, firstly unsupervised classification outputs have been used to initially stratify the study area in to distinct number of strata depending on their spectral relativity. The sample plots were then been selected randomly from each stratum. The size of the sample in each stratum has been taken in proportion to the size of the stratum (which means that the sample plots in each of the stratum that is proportional to that of the total area). The area of sample plot has been calculated as 0.36 ha using the Townshend (1981b) equation. The equation indicates that a site dimension is estimated from image pixel size and the locational accuracy of image registration. The area of sample plot has been calculated as 0.36 ha using the Townshend (1981b) equation. The equation indicates that a site dimension is estimated from image pixel size and the locational accuracy of image registration.

$$A = P (1+2*L)$$

"Where: A = Minimum site dimension, P = Single pixel dimension and L = Estimated locational accuracy in number of pixels".

A Landsat 5 satellite data with a combination of band 2, 3 and 4 was used to discriminate the vegetation from non-vegetation using unsupervised classification algorithm. After that an NDVI maps were produced and overlay the GCPs over it to verify the discrimination and the total biomass area were estimated (Fig. 1).
Besides that secondary data were collected from Forest National Corporation, Sudan (FNC), FAO and the widest literatures about Darfur's environment and forest resources provided by numerous relief and development organizations working in the area. In addition to that direct interviews, surveys were made to villagers and markets to collect data for verifying estimation the amount of wood and grass/straw needed per household. Finally CarbonFix Standard and IPCC modules were used to convert biomass and estimate carbon dioxide (CarbonFix, 2010 and IPCC.org), (Table 1).

Table 1: IPCC Module for CO2 calculation

A	B	C	D	E
Area of Forest/Biomass Stocks	Annual Growth Rate	Annual Biomass Increment	Carbon Fraction of Dry Matter	Total Carbon Uptake Increment
(kha)	(t dm/ha)	(kt dm)		(kt C)
		C=(A x B)		E=(C x D)

Results and Discussion
Results showed that Darfur has a total area of 81.3 million ha, of which 22 million is a woody resource (including wooded grassland) with an annual wood depletion rate of 0.8 % (FAO, 1995) and annual allowable cut of 6 237 000 m^3 (FNC, 2010). The total population of Darfur is about 4.8 million, 70% from rural areas (2010 census). ~90% of the rural dwellers depend upon fuel wood as main source of fuel

which is 82% of it is free accessed and has no legislation (FAO, 1995). The annual wood consumption (fuel wood and building) was estimated to be 3 220 000 m³ (with average of 0.73 m³ per capita) of which 50 % accessed free of charge. The secondary data from Sudan Forest Products Consumption Survey (SFPCS, 1995) showed that Darfur states has the highest wood consumption among other states specially products used for fuel wood, buildings (Fig. 2).

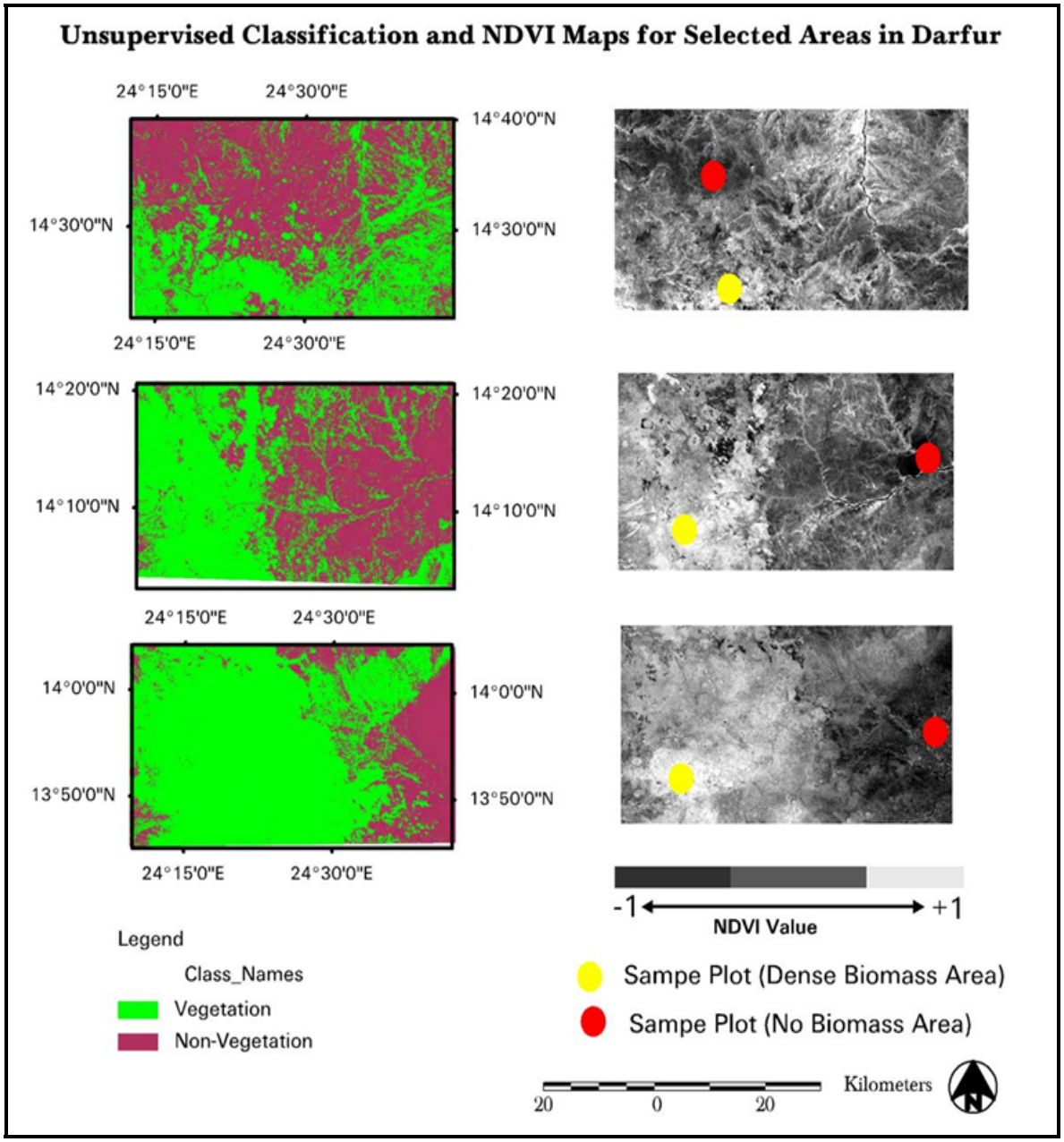

Fig. 1: Unsupervised Classification of Darfur Biomass and NDVI Maps

It has been calculate that each household needs about 0.5 m³ of wood and 0.45 ton of grass for building a house. Accordingly, the study found that the total wood expected to be removed is estimated at 155 000 m³ and this would release about

100 000 tons of CO_2. In the same way, about 138 000 tons of grass would be removed and this was estimated to release more than 638 000 tons of CO_2.

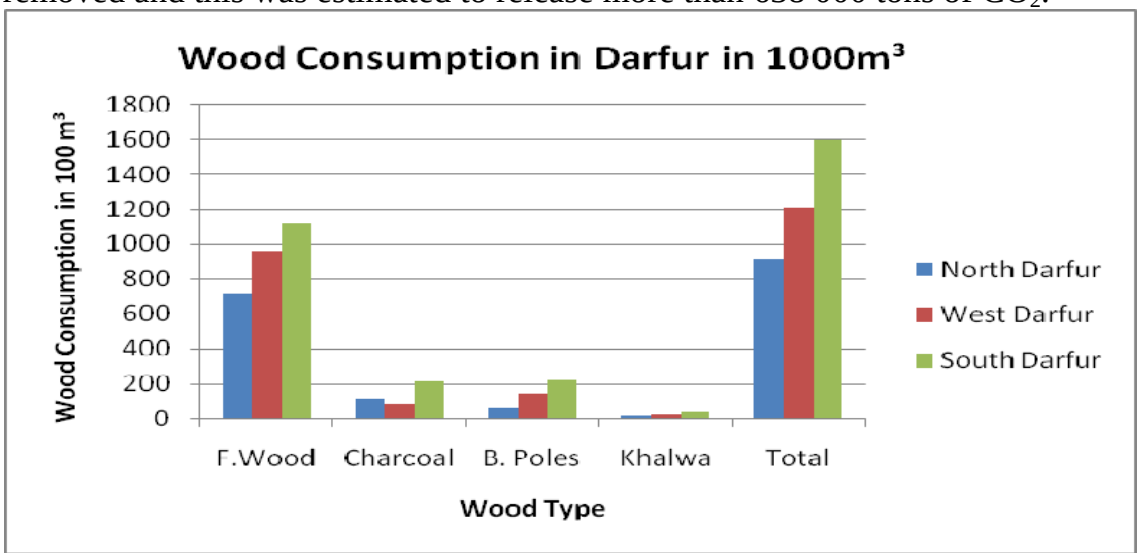

Fig. 2: Darfur Wood Consumption

Conclusions and Outlook

The study concludes that the planned resettlement is likely to create threats to Darfur's biomass and to a significant incremental CO_2 release; hence more research and environmental measures are needed before the resettlement takes place to avoid degradation and mitigate potential greenhouse gas emissions.

References

FNC, 2010. Forest National Corporation, Sudan, annual report 2010.

FOA, 1995. The Food and Agricultural Organization of the United Nation. FAO.GCP7SUD/047/NET, Sudan Forest Resources Survey.

Norman Myers , October 1990. Working paper 7; Forestry for Sustainable Development Program, Department of Forest Resources , College of Natural Resources -University of Minnesota ,St. Pa4 Minnesota 55108.

SFPCS, 1995. Sudan Forest Products Consumption Survey funded by FAO, 1995. FNC, Khartoum, Sudan.

Townshend, J. R., 1981b. Prospect: A comment on future role of remote sensing in integrated terrain analysis. Eds. Terrain analysis and remote sensing. George Allen & Unwin, London.

TEARFUND, 2007. Darfur: Relief in a vulnerable environment, TEARFUND; Darfur Office.

CarbonFix e.v. 2010. From www.carbonfix.inof. <Accessed date: 14.8.2010>.

http://un.org/depts/ocha/cap/sudan.html, <accessed date: 14.08.2010>.

http://free.vgt.vito.be/home.php <accessed date: 14.02.2010>.

http://glovis.usgs.gov, <accessed date: 11.02.2010>

http://ipcc.org, <accessed date: 11.02.2010>