Impacts of Displaced People on Vegetation Cover in Kass Locality, South Darfur, Sudan[*]

Abdalrahman Ahmed Abdalrhman Ahmed[1], Abdelnasir Ibrahim Ali Hano[2]

Desertification and Desert Cultivation Studies Institute, University of Khartoum, Shambat, Sudan

Abstract: This study focused on the detection and assessment of the impact of Internally Displaced Persons (IDPs) on vegetation cover in Kass locality- West Sudan. The study used three-cloud free images of different sensors (TM 1992, ETM+ 2002 and OLI 2017). The imageries were Geo-referenced and radiometrically corrected by using ERDAS Imagine software. Then, subsets of the study area were taken, about 874 Km^2. The study applied vegetation index (Soil Adjusted and Atmospheric Resistant Vegetation Index (SARVI) and hyper classification analysis. The results revealed that both vegetation cover (VC) and human activities of the study area witnessed remarkable changes during the study period, (1992-2002-2017). There were tremendous changes in the economic activities of the IDPs in the study area, where the majority of the IDPs lost their sources of income generation, which were mainly farming and private business. The trading on the forest products (fuel wood, charcoal and building materials) has become the source of income for a considerable proportion of the IDPs and that reflected in alarming vegetation degradation trend. The conclusions were, natural and reserved forests represented the main source of energy and building materials for the IDPs. It is possible to mobilize and sensitize IDPs to participate in a forestation programs that lead to rehabilitation of deteriorated habitat. The

[*]Part of thesis submitted by the author to the University of Khartoum, for the partial fulfillment of M.Sc. degree.

[1] Presently lecturer in the Department of Forest and Environment, Faculty of Forestry Science and Technology, University of Gezira, Sudan

[2] Assistant Professor of Forestry, Department of Forest Protection and Conservation, Faculty of Forestry, university of Khartoum, Sudan . Presently, Afforestation and Reforestation Coordinate in Desertification and Desert Cultivation Study Institute.

main recommendation of this study is to provide alternative energy source and encouraging IDPs through changing their attitudes to conserve the vegetation cover and rehabilitation of deteriorated environment.

INTRODUCTION

Vegetation degradation has resulted from various factors including human induced activities and severe prolonged drought under poor land resource management (Mustafa, 2007).Remotely-sensed data have showed a significant efficiency in assessing and monitoring the general vegetation cover (VC) in a long term in addition to provision of up-to-date maps and data sets of vegetation status which support decisions for sustainable management (Ralph, 2007).Indeed the remote sensing (RS), geographic information system (GIS) and global position system (GPS) provide desired technologies for land and environmental management (Leh *et al*., 2015; Seelan *et al*., 2003; Zucca *et al.,* 2015). Fuel wood comprises the main source of energy for the vast majority of people in Darfur, western Sudan. Its availability and accessibility has become a highly contentious issue in relation to human and environmental security. The current practice of harvesting this resource is Wholly unsustainable manner is resulting in a precarious situation in many parts of Darfur, some of which is likely to lead to increased conflict over already scarce and increasingly limited natural resources. The effects of this over-exploitation have already begun to manifest themselves in many parts of this region, with longer term impacts now imminent, (UNEP, 2007).The main objectives of the study aims to detect and assess forest degradation status in the Darfur region around the IDPs camps with the objective of suggesting future line of action to support development and sustainable forest management plans.

MATERIAL AND METHODS

The study area is located in Kass locality, in South Darfur state, approximately 86 km North West of Nyala, (CARE, 2004). It covers a total area of 874 Km^2. It lies between latitudes $12°.10 – 12°.55$ N and longitude $24°.8 –24°.27$ E (OCHA, 2009). Its elevation is 400 m above

2

sea level.(TEARFUND, 2007). The total population in the locality is 402.166 persons (HAC, 2017). The dominant tribe is Fur. The activities of the population are farms and trading. IDPs depend on collection of firewood, charcoal making, forest product gathering, and water selling, and labor in bricks making (TEARFUND, 2007).

Three cloud free images of different sensors (TM 1992, ETM+ 2002, and OLI 2017) were selected. All acquired in dry season (January) taking into account important factors, such as scale, spatial, temporal, and spectral resolution of the sensors, as well as atmospheric conditions and costs, for achieving the desired goals. The obtained images were available free-of-cost and could be downloaded. Landsat TM 1992, ETM$^+$ 2002 and OLI 2017 were downloaded from the United States Geological Survey (USGS) Global Visualization Viewer (GLOVIS), all images were geo-referenced to the WGS84 datum and Universal Transverse Mercator (UTM) projection. Field survey was carried out for image validation and field observation using Global Positioning System (GPS)to registered (x, y) observation points. Scene subset (874 Km^2) was taken for mapping and assessing the vegetation cover (VC).

Indices
The study attempted to integrate vegetation index (VI) and soil index (SI) to assess LD and VD to increase the accuracy of the information for assessing the impact of IDPs on vegetation and land degradation in the study area.

Soil Adjusted and Atmospheric Resistant Vegetation Index (SARVI) were tested with the aim of selecting an efficient VI for determining and assessing the vegetation status in the study area.

Computation of the indices:
SARVI = ((NIR – RB) / (NIR + RB + L))
$\times$ (1 + L), RB = R – γ (B – R), γ = 1 where B is blue wavelength included in the SAVI formula for reducing aerosol atmospheric noise; therefore, the SARVI formula can reduce aerosol atmosphere and soil noise. The blue band is not found in the wavelength spectrum of MSS; therefore for calculating SARVI, TM 1992, ETM+ 2002 and OLI 2017 were used.

3

Social Survey

The questionnaire and remote sensing data were integrated to determine the relationship between different factors, spatiotemporal changes of vegetation degradation patterns, and land degradation to analyze the reasons behind the changes of vegetation cover and its effect on land degradation. The data were collected through a questionnaire. In this study, 100questionnaires was used to collect socioeconomic data from internal displaced persons and forest national corporation staff to analyze the impact of IDPs on vegetation degradation and land degradation in the study area. Different methods of analysis were taken for analyzing, and correlating, was used for analyzing the relationship between vegetation degradation and impact of IDPs, using SPSS software. Two and three-dimensional pie charts were applied for analyzing the data by using Microsoft Office Excel 2013

RESULTS

Soil Adjusted and Atmospheric Resistant Vegetation Index (SARVI) was selected to assess the vegetation degradation status in the study area. It was used to show the recent spatial distribution of vegetation degradation and its trend. The vegetation degradation indicators can be seen in decreasing inan area of dense and moderate vegetation covers and increasing in the areas of bare and low dense vegetation lands.

The resulting maps of the geospatial distribution of vegetation show that the dense and moderate vegetation cover areas decreased through the last thirty years 1992-2017 and the bare land has increased in the study area, while the dense vegetation area has decreased (Figure. 1,2).
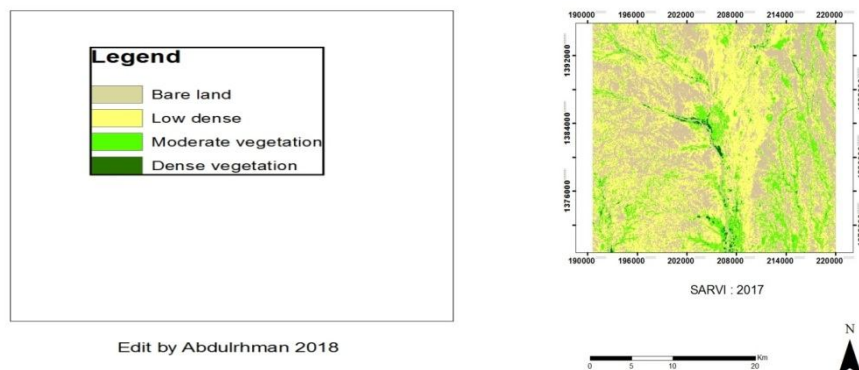

SARVI : 1992

SARVI : 2002

4

Edit by Abdulrhman 2018
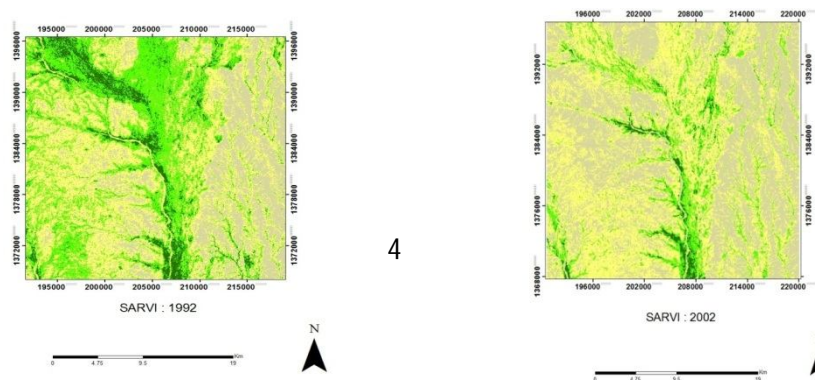
Fig: 1. Maps of the spatiotemporal trend of vegetation degradation for 1992, 2002, and 2017 respectively.(Source: Abdulrahman, 2018)

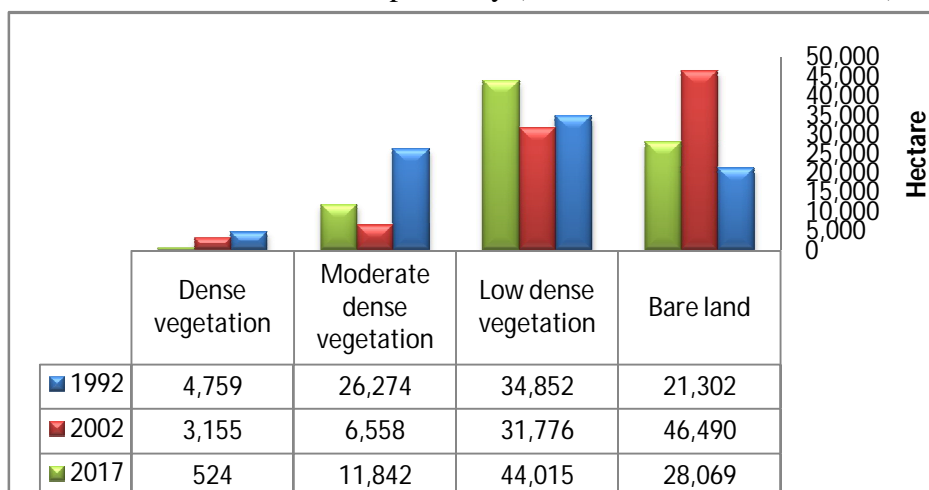|	Dense vegetation	Moderate dense vegetation	Low dense vegetation	Bare land
1992	4,759	26,274	34,852	21,302
2002	3,155	6,558	31,776	46,490
2017	524	11,842	44,015	28,069

Fig: 2. shows the trend of vegetation status throughout 1992 - 2002 – 2017.(Source: Abdulrahman, 2018)

The Soil Adjusted and Atmospheric Resistant Vegetation Index(SARVI) map 2017showed that the bare land covered 310.69 km^2, representing 36% of the total area, while it covered 464.90 km^2, representing 53% of

5

the total area in the map 2002, and it covered 215.65 km^2, representing 25% of the total area as in the map 1992 (Tables 1, 2, 3).

The Soil Adjusted and Atmospheric Resistant Vegetation Index (SARVI)map 2017 showed that the low dense vegetation area covered 440.15 km^2 representing 50% of the total area, map2002covered 317.76 km^2 representing 36% of the total area, and 1992 covered 348.52 km^2 representing 40% of the total area. (Tables 1,2 3).

The Soil Adjusted and Atmospheric Resistant Vegetation Index (SARVI) resulted map 2017 showed that the moderate dense vegetation covered 118.42 km^2 representing 14% of the total area, while it covered 65.58 km^2 representing 7% of the total area as it shown in map of 2002, and covered 262.74 km^2 representing 30% of the total area as shown in map of 1992 (Tables 1, 2, 3).

The resulted SARVI map 2017 showed that the dense vegetation (forest area) covered 5.24 km^2 representing 0.6% of the total area, while it covered 31.55 km^2 representing 4% of the total area as shown in the map of 2002 and it covered 47.59 km^2 representing 5% of the total area as shown in map of 1992. (Tables 1,2,3).

Table:1. Distribution of vegetation cover percentage in 2017 in Kass locality, Southern Darfur State – Sudan

Class name	Area (km^2)	%
Bare land	310.69	36
Low dense vegetation	440.15	50
Moderate dense vegetation	118.42	14
Dense vegetation	5.24	0.6
Total area	874	100%

Table: 2. Distribution of vegetation covers percentage in 2002 in Kass locality, Southern Darfur State – Sudan

Class name	Area (km^2)	%
Bare land	464.90	53
Low dense vegetation	317.76	36
Moderate dense vegetation	65.58	7
Dense vegetation	31.55	4
Total area	874	100%

6

Table:3. Distribution of vegetation cover percentage in 1992 in Kass locality, Southern Darfur State – Sudan

Class name	Area (km^2)	%
Bare land	215.65	25
Low dense vegetation	348.52	40
Moderate dense vegetation	262.74	30
Dense vegetation	47.59	5
Total area	874	100%

The study hypothesized that the main factors are probably to be responsible for, or have a relationship with vegetation degradation (VD) and/or land degradation (LD)in the research area such as the local population growth, in particular the IDPs population, and socioeconomic factors, such as the dominant human activities, dominant type of LU practices, regarding the methods of cooking food, and building houses and poverty. The results of questionnaires, records, and literature data on the study area show the relationship range of those factors with the VD and LD.

Analysis of proposed factors causing of vegetation degradation (VD) in the study are (social study):
The study hypothesized that the main factors are probably responsible for, or have a relationship with vegetation degradation (VD) and/or land degradation (LD)in the research area such as local population growth, in particular the IDPs population; and socioeconomic factors, such as the dominant human activities, dominant type of LU practices, regarding the methods of cooking food, and building houses and poverty. The results of questionnaires, records, and literature data on the study area show the relationship range of those factors with the VD and LD.

Figure (3) shows the distribution of respondents according to age. The majority of the sample were young's with an age ranging between 31 – 45. The number of Females was greater than the male and they represent 54% of the population (Figure 4). The level of education for the majority of population in the study area are Guranic schools(Kalwas) and they represent 37% , the University graduates represent 22% and illiterates represent about 19% of the population (Figure 5). More than 70% of the population are married in the study area (Figure 6).

7

The participation of the population in afforestation programs is small only 22% while the rest of them (About 78%) stated that they did not participate in afforestation programs because these programs took place during the rainy season when they are occupied in their farms (Figure 7).

It was stated that the vegetation cover was used for various purpose mainly on fire wood and charcoal for cooking which were the main reasons behind tree felling which resulted in the removal of vegetation cover. More than 40% stated that the current status of vegetation cover is very bad (Figure 8).
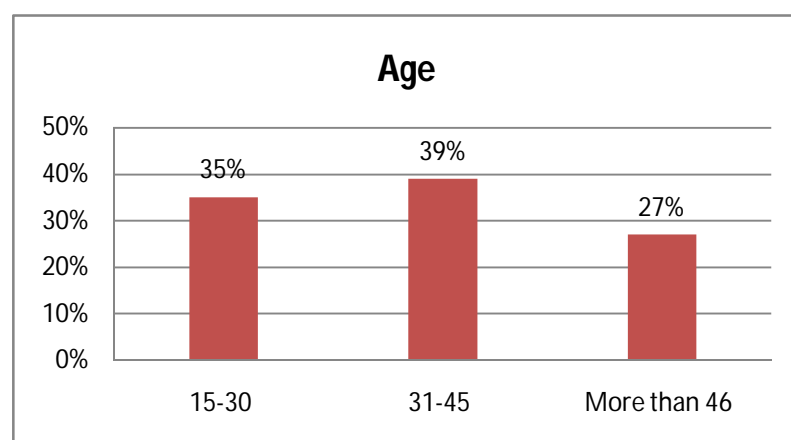
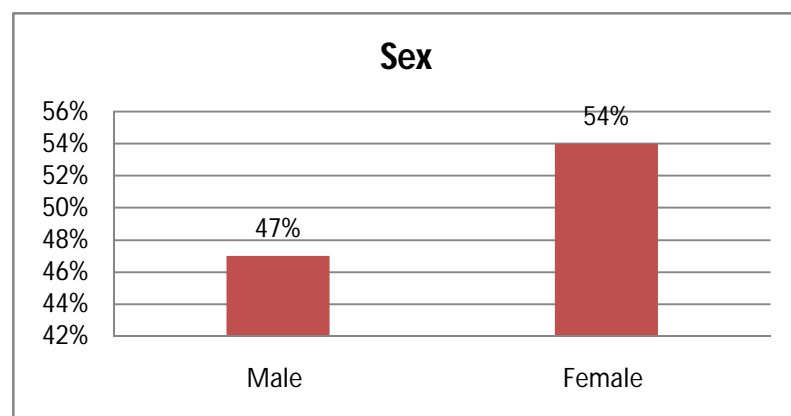
Fig: 3. Age of the respondent in the study area

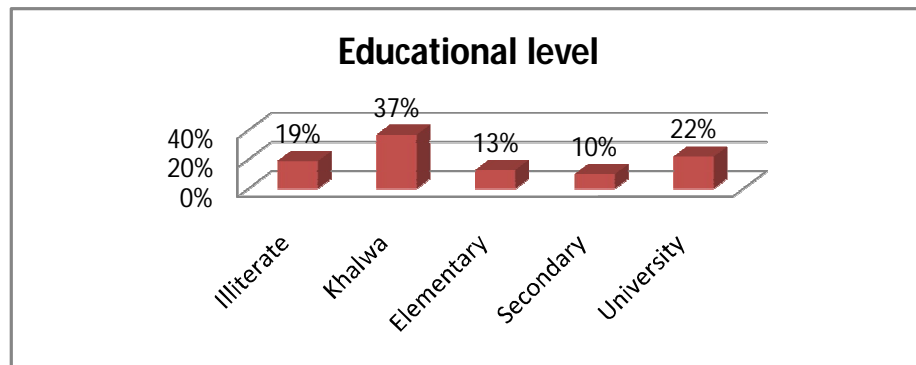Fig: 4. Gender of the respondent in the study area

8

Fig: 5. Frequency distribution of respondents according to educational level
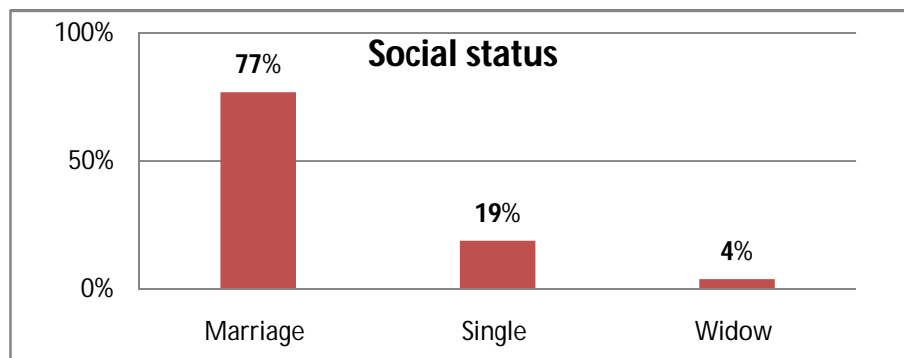

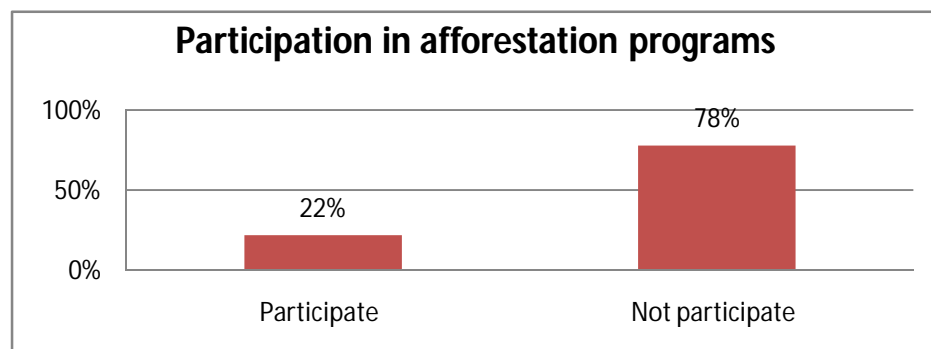Fig: 6. Social status of the respondent in the study area

Fig: 7. Frequency distribution of respondent by participation in a forestation programs
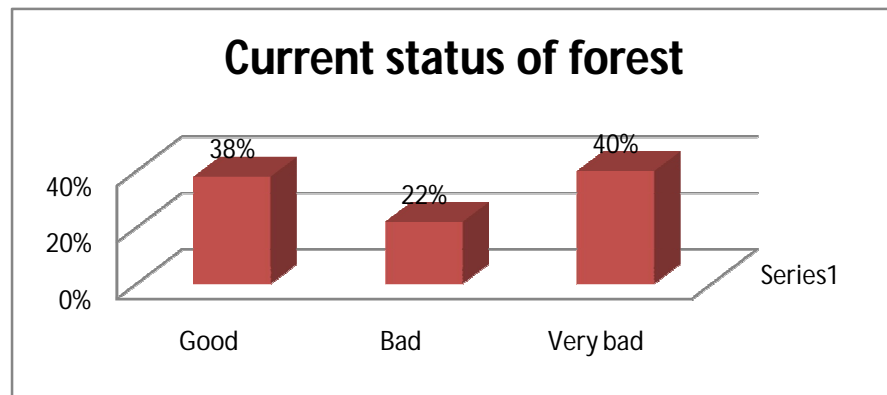
9

Fig: 8. Current status of forest in the study area

DISCUSSION

The produced map of SARVI indicated that the vegetation cover slightly corresponded to the ground truth of the study area where sparse annual and perennial vegetation dominates. The resulting SARVI map illustrated that severe vegetation degradation VD was widely spread during the period 2002 to 2017 which corresponds in the period when population displacement occurred, this may have been due to the fact that the area around the IDPs camps were used as farms and rangeland for livestock and hence overgrazing and tree felling had contributed to aggravating the status of vegetation degradation.

The important result of SARVI map showed that the trend of the vegetation cover degradation (VCD) increased faster during 2002 to 2017 (the period of war) more than it period 1992 to 2002 (pre-war), population displacement led to degradation of the herbaceous plant, shrubs, and forest area due to animal grazing and IDPs demand for firewood, charcoal, and building material, and also taking into account environmental factors that can affect the vegetation cover in the study area such as climate change and erratic rainfall.

The degradation of vegetation cover in the period 1992 to 2002 (before population displacements), was less than that during the period of displacement (2002 to 2017)because there was no big increase in

10

population density and therefore, was no great demand on natural resources particularly vegetation cover in the study area (dense and moderate dense vegetation).

(Mohamed, 2010) stated that the majority of the IDPs since they were practices marginal activities, relay on trading forest products for income generation. The bulk of the respondents collect firewood from the natural forests and reserved forests, this action reflects the degree of pressure exerted on the vegetation cover, the situation is much worse when the IDPs felled green trees as a source of energy.

(Ahmed, 2019)stated that there is link between displacements and natural resources depletion especially natural forest around Kass locality. The types of vegetation cover and density are influenced by large number of IDPs settled near the natural forests. It is observed that there is scarcity of trees around study area this problem is related to dependency of the IDPs and host community on the available forest resources for establishing temporary house, charcoal making and firewood as the source of income generation to their families. Generally, the result of the study explained that during the period 2002 to 2017 the study area had witnessed a significant deterioration of natural vegetation cover due to IDPs demands.

CONCLUTIONS

The trend of vegetation degradation in the study area has increased annually pre and after population displacements as assessment of vegetation degradation indicators illustrated in Soil Adjusted and Atmospheric Resistant Vegetation Index (SARVI). This results agrees with the hypotheses that Forest cover of the study area has been significantly reduced (degraded) during the period 1992-2017 which was caused mainly by human factor (displacements), particularly land clearance for agriculture, firewood, charcoal and over grazing. The majority of neighbored village population concentrated on the study area due to displacements which caused socioeconomic and demographic change these factors leads to sever vegetation degradation within the period of population displacements 2002-2017.

11

REFERENCES

Ahmed, M. A. 2019.Impact of Forest depletion on the Livelihood of Internally Displaced People in Kass Locality, South Darfur State, Sudan.M.Sc. thesis, Desertification and Desert. Cultivation Study Institute, University of Khartoum, Sudan.

CARE, 2004. International and Benfield hazard research center, Sudan. Rapids needs assessment report. South Darfur state locations of Kass, Kailek, Kabom, and Kalma camp 21PstP – 30PthP March, 2004.

HAC, 2017.Humanitarian Aid Commission kass office. High- resolution global maps of 21stcentury forest cover change. Science 342:850–3.

Leh, M., Bajwa, S., and Chaubey, I. 2015: Impact of land use change on erosion risk: and integrated remote sensing، geopraphic information system and modeling   methodology. Land Degrad. Dev. 24: 409–421.

Mustafa, M. A.2007. Desertification Processes. UNESCO Chair of Desertification. University of Khartoum. Pp. 111-128.

Mohamed, A. A. 2010. *Impact of Internal Displaced Persons on the Tree Cover at Al Genina Locality West Darfur State, Sudan*. M.Sc. thesis, Faculty of Forestry, University of Khartoum, Sudan.

OCHA, 2009. United Nation Office for the Coordination of Humanitarian Affairs Kass town and IDPs communities South Darfur – Sudan.

Ridder, M.,R. 2007. Global Forest Resources Assessment 2010; Options and Recommendations for a global remote sensing survey of forests. Rome, Italy.

Seelan, K. S., Laguette, S., Casady, G. M., and Seielstad, G. A. 2003. Remote sensing   applications for precision agriculture: A

12

learning community approach. Remote Sens Environ 88: 157–169.

TEARFUND. 2007.Darfur: Relief in a Vulnerable Environment. funded by Department for International Development, UK government (DFID), Office for Foreign Disaster Assistance, US government (OFDA) and United Nation High Commotion for Refugees (UNHCR).

UNEP. 2007.United Nations Environmental Programme. Destitution, Distortion and Deforestation: The impact of conflict on the timber and wood fuel trade in Darfur.Postal code 11111 Khartoum – Sudan.

Zucca, C., Wu, W., Dessena, L., and Mulas, M. 2015. Assessing the effectiveness of land restoration intervention in dry lands by multitemporal remote sensing – A case study in Ouled Dlim (Marrakesh, Morocco), Land Degrad. Dev. 26: 80–91.

تقييم أثر النازحين علي الغطاء النباتي لمحلية كاسب ولاية جنوب دارفور في السودان*

عبدالرحمن أحمد عبدالرحمن أحمد[1]، عبدالناصر ابراهيم علي هنو[2]

معهد دراسات التصحر واستزراع الصحراء، جامعة الخرطوم، شمبات السودان

مستخلص البحث: هذه الدراسة ركزت علي تقييم أثر النازحين علي تدهور الغطاء النباتي في غرب السودان من خلال متابعة وتخريط التغيرات التي حدثت في الغطاء النباتي بسبب التأثير السلبي للنازحين في تدهور الغطاء النباتي وإمكانية إستعادة البيئة الطبيعية التي تأثرت بالنزوح بمحلية كاس. إستخدمت الدراسة ثلاثة صور خالية من السحب لعدد من الأقمار الصناعية وهي:(TM 1992, ETM+ 2002, OLI 2017). تم تصحيح الصور جغرافيًا وطيفيًا بإستخدام برنامج ARDAS. تم تحديد منطقة الدراسة حوالي 874كم^2، الدراسة أستخدمت طرق جديدة وهي تكامل بين مؤشرالغطاء النباتي (SARVI) والتصنيف الإرتباطي (Hyper Classification). أهم النتائج التي توصلت إليها الدراسة هي: حدوث تغييرات هائلة في كل من الغطاء النباتي ونشاطات الإنسان في منطقة الدراسة في الفترة من1992-2002-2017. وهناك تغيرات كبيرة في النشاطات الإقتصادية للنازحين حيث أن غالبية النازحين فقدوا مصادر دخلهم المتمثلة بشكل أساسي في الزراعة والعمل الحر والتجارة في منتجات الغابات (حطب الحريق، الفحم النباتي، ومواد البناء) التي أصبحت مصدر دخل معتبرللنازحين، حيث إنعكست هذه النشاطات سريعا علي تدهور الغطاء النباتي. أهم الإستنتاجات التي توصلت إليها الدراسة هي: أن الغابات الطبيعية والمحجوزة تمثل المصدر الأساسي للطاقة ومواد البناء للنازحين وأنه من الممكن تفعيل دور النازحين للمشاركة في برامج التشجير التي تؤدي إلي إستعادة البيئة المتدهورة ، من أهم التوصيات التي توصلت إليها الدراسة توفير مصادر بديلة للطاقة وتشجيع النازحين من خلال تغيير سلوكياتهم للمحافظة علي الغطاء النباتي ومشاركتهم في إعادة تأهيل المناطق المتدهورة.