

**Reducing Deforestation and Improving Access of Women to Affordable Fuel Resource for Cooking in Sub- Saharan Africa -Case Study Sudan**

**By**

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**Abstract**

Firewood and charcoal are the main fuels used for cooking in Sub- Saharan Africa and for most women constitute a major item in the household budget. The increase in demand for woodfuels and the pattern of supply is adding to deforestation and impacting women in the region adversely. This paper investigates the problem at national level and by the geographical regions of Sudan according to the status of forest cover. A model is developed to assess the trend of the increasing demand for woodfuels and its impact on forest resource. Analysis of the associated socio- economic implications for women is conducted by assessing other household energy studies conducted at national and local levels. The model used for assessing the trends in demand revealed that with increasing population the level of demand for biomass sources in total at national levels is increasing under the current rate of uptake of gas as a fuel source. Policy measures should be introduced to increase the rate of penetration gas use. Analysis of information from other household studies showed that limited access of women to affordable energy sources for cooking has forced women to eat less cooked meals, or to resort to use other less efficient and more polluting biomass fuel. Scarcity in woodfuels is a result of the steady deforestation from the intensive use of land for agriculture and the commercial pattern of charcoal production. The process of deforestation is expected to accelerate, after the division of Sudan into two countries. It is recommended that more land is planted for forestry, community forestry is encouraged, and the resource is managed on a more sustainable basis. Studies cited show that increasing forest area for carbon projects would be more profitable if provision is made to include the woodfuels needs of communities to be met on a more sustainable basis.

**1. INTRODUCTION**

**1.1. Background and problem statement:**

Wood fuels constitute the main energy source for cooking in Sub- Saharan Africa. The pattern of firewood collection is more likely not a cause of deforestation compared to charcoal, which is claimed to be a factor contributing to deforestation. Charcoal produced using sustainably managed resources and improved technologies can be a low net emitter of greenhouse gases (FAO 2017). Charcoal is being produced from forests and woodlands and transported in most cases over long distances within the country or into a bordering country. In Zambia, because of higher prices paid in neighboring countries, charcoal is moving across borders in haulage trucks and through cross border traders (Gumbo, D. et al 2013). According to (Bafana, 2021), charcoal sold in urban centers of Zimbabwe is usually illegally imported from Mozambique and Zambia. The old Sudan before separation of South Sudan in 2011, was the largest country in Africa

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extending over five vegetational belts ranging from desert in the North to rich Savanna and mountain forests in the South. As a result of the separation of South Sudan, Sudan lost 25 per cent (619,745 km<sup>2</sup>) of its total land area, including 68 per cent of its forest and woodland (UNEP, 2020). A situation which is likely to cause a change in the pattern of land use for food production and energy provision for cooking. Policies on wood fuel also need to be integrated with climate-change and food-security strategies (FAO, 2017). Floor (1992) urged that charcoal adds more carbon dioxide into the atmosphere than any other fuel and therefore should be substituted to the extent possible based on environmental consideration. (Bailis et al, 2004) find that a transition from biomass fuels to kerosene and Liquefied Petroleum Gas (LPG) would be more desirable from a greenhouse gas and health point of view but cash constraints and lack of supply infrastructure often means that a transition from firewood to charcoal may be a necessary first step, as concentrations of particulate matter in households using charcoal were found to be 88 percent lower than households using open wood fires. An IPCC (2018) special report for limiting global warming to 1.5°C requires scaling existing technology for clean and efficient cooking. LPG constitutes a viable option of reducing the demand for wood fuels. Sudan started utilizing its locally refined petroleum products including LPG in the year 2000, giving an opportunity for making a breakthrough in substituting woodfuels. The Sudan experience represents a good case study to assess the degree to which the availability of LPG is making a reduction in the demand for woodfuels and allowing planning for the sustainable management of wood resources. This requires conducting surveys and assessments at national level, which may be expensive to do frequently. Models can be developed based on historical data to assess the trends on demands for woodfuels and the shift to alternatives.

## 1.2. Objectives

This study investigates the trends in wood fuel demand/ supply pattern the case of Sudan before and after the split of the one country in two countries (Sudan and South Sudan), addresses the socio- economic and environmental implications associated with the supply/ demand patterns, and recommends strategic policy measures and reforms. Specifically, the study investigates:

- A method to assess the change in the level of woodfuels demand/ supply brought in from current use of LPG in the last two decades.
- the environmental and socio- economic implications on the forest and communities associated with the trends in the supply/ demand patterns,
- and the required strategic policy measures for provision of woodfuel on a sustainable basis and restoring forest cover.

## 2. METHODOLOGY

The steps followed in the analysis were as follows:

1. Assessment period and study area: The year 2000 was taken as base year to study the trajectory of woodfuels demand in the last twenty years. At independence in 1956, Sudan was formed of nine administrative units (Regions). From 1973, a complicated series of administrative divisions led to several structural divisions, ending with the cessation of South Sudan in 2011. The frame of the study includes all the six regions constituting the present Sudan and the three regions that constitute the present South Sudan. Sudan had neither a complete nor a totally reliable forest inventory (FAO Report 2006). The FAO 2006 Report provided estimates of forests and wood land areas for the nine regions based on the Afri-Cover data for the year 2000. The regions were categorized according to forest resource situations into regions with deficiency, regions with prospective deficiency, and regions with sufficiency. Accordingly, the regions under each category were as follows: i) Regions with deficit (Nother, Khartoum); ii) Regions with

prospective deficit (Eastern, Central); iii) Regions with sufficient (Kordufan, Darfur); iv) Regions with Sufficient in South Sudan (Upper Nile, Bahr Elgazal, Equatoria).

2. Assessments of the trends of wood fuel demand: The information used included data on region’s per capita energy demand by fuel type and sector; and population data of the regions by sector. Modelling using spreadsheets was developed to assess the trends during the period of 2000 -2020, which follows the latest National Household Energy Assessment conducted in the year 2000. Data sources of Per capita energy were the General Directorate for Energy Affairs 2001 study, FAO Forest National Corporation 1994 Assessment, and the National Energy Administration 1983 Assessment. Sources of population data were the two population censuses conducted in 1983 and 1993.

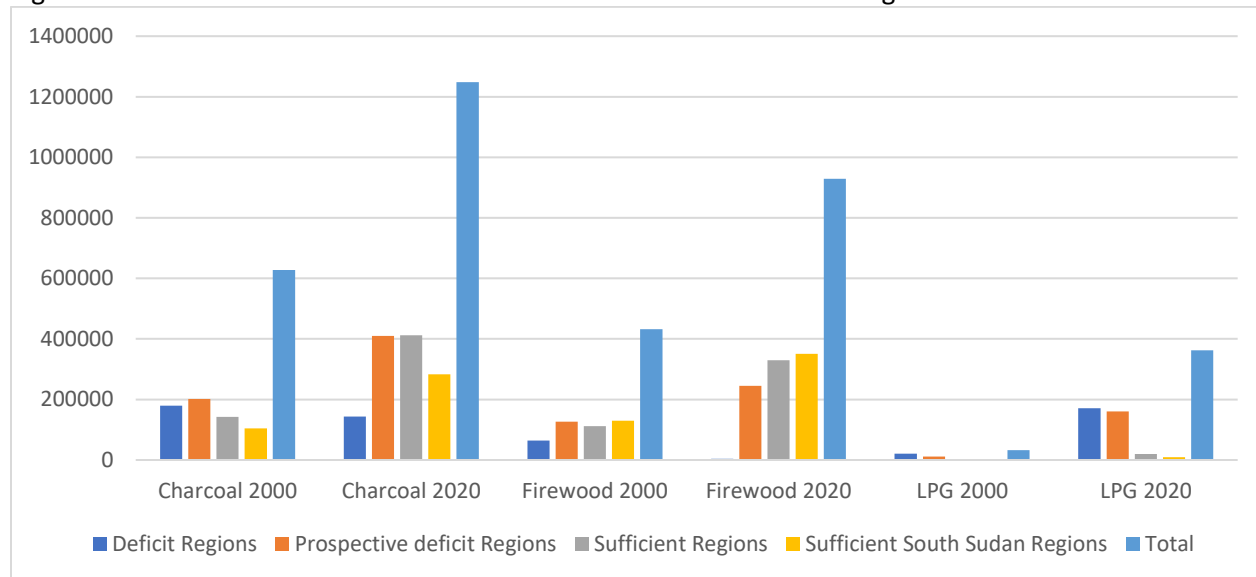
The EXCEL program was used to assess the trajectory of LPG and woodfuels demand by region and sector (urban/ rural) between 2000 and 2020 in five years intervals. Fuel demand was calculated by multiplying the per capita fuel in Ton Oil Equivalent (TOE) and population number. The per capita fuel use was calculated from per capita energy required for cooking and share of each fuel in the per capita energy. It is assumed that the share of LPG in per capita energy had increased annually by 10 % in urban sector and 5 % in rural in higher scenarios. The estimates projected for LPG demand were comparable to actual LPG quantities dispatched during the period under study. The method adopted by the United Nation 1985 for predicting urban population was used in predicting urban and rural ratios and population for the period in five years intervals.

3. Assessment of implications of woodfuels supply / demand patterns: The source of information were other studies conducted at national and local level.

### 3. RESULTS AND DISCUSSIONS

The development in the pattern of fuel demand for cooking by urban and rural sector is presented in Figures 1 and 2, respectively.

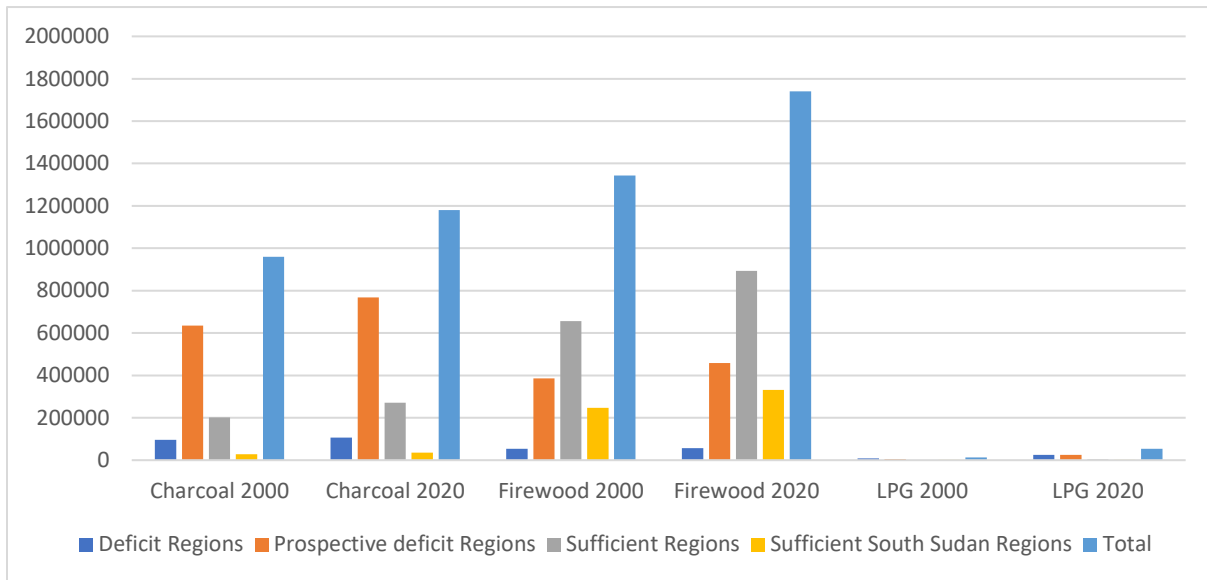
Figure 1: Estimates of woodfuels and LPG urban demand in TOE in the Regions of Sudan & South Sudan:



In general, use of gas is increasing in the urban centers compared to communities in rural sector. The regions with deficit and prospective deficit in wood resources are having the higher share in demand for LPG. The urban demand for both charcoal and firewood is continuing to increase in regions with sufficient wood resource as well as in regions with prospective deficit, and a decrease in level of urban demand for charcoal and firewood is only noticed in the regions with deficit wood resources. The demand for gas in rural sector is insignificant, and an increase is only noticeable in the regions with deficit and prospective

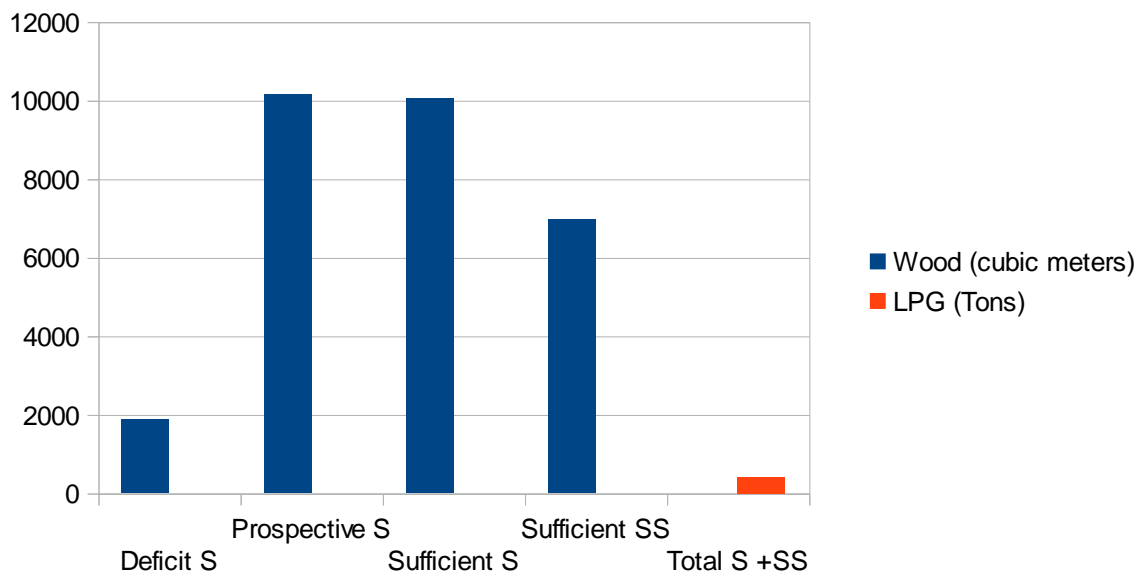
deficit in wood resources; and on the other hand, the demand for firewood and charcoal in rural situations is continuing to increase. The estimated total gas consumed for year 2020 of 400 thousand tons as from figure 3 is comparable with the actual quantities of LPG dispatched annually during the last decade.

Figure 2: Estimates of woodfuels and LPG rural demands in TOE in regions of Sudan & South Sudan:



According to the Energy Authority, 28,000 tons of gas were dispatched in 1999; the dispatch reached 118,176 tons after start of local production, and the level continued to increase and reached a maximum of 423,800 in 2011. Figure 3 shows that, the wood used in regions.

Figure: Estimates of region's thousands cubic meters wood used for firewood and charcoal and total tons of gas consumed in Sudan (S) and South Sudan (SS) in year 2020:



The assumed annual increase of 10% share gas in per capita energy requirement is not bringing significant change in woodfuels consumptions. This requires forest authorities to promote planting more forests and use existing resources efficiently and in sustainable basis to avoid further deforestation. The highest value of the regional wood volume used for meeting the region's local demands of 10 million cubic meters as in figure 3, is for regions in Sudan with prospective deficit as well as with sufficiency.

Earl (1984) reported: The demands of urban centers in the northern part of the country for charcoal during the 1920's used to be supplied from the adjacent near districts. With increasing demands, the production areas continued to shift southwards. In 1932, new sites southwards in Blue Nile of the Central Region, together with sites in the Eastern Region. Major factor contributing to the deforestation of those regions is the extensive use of the forest and woodlands for agriculture through the Mechanized Rainfed Farming (MRF). MRF in Sudan started in 1944 in the Eastern Region (Elsheikh, 1990). Area cultivated under mechanized farming in year 1983 was 2.00 million ha and reached 4.24 million ha in 1990 (Abdelsalam, 1992). Thirab, (2007) reported that areas of mechanized farming in Blue Nile of the Central Region only reached in total about 3.86 million ha in 2003. Area under MRF is expanding **at the expense of** forest cover, and more areas are planned to be brought under MRF. The African Development Bank Group 2013 reported that, a range of possible scenarios for the development of very large potential for expansion of cropland agriculture in South Sudan. One possible scenario total cultivated area would be increased from 2.7 million ha in 2010 to 4 million ha by 2020, and perhaps 6-7 million hectares by 2030. This extensive pattern of land use is producing scarcity in regions with prospective deficit in resource.

Scarcity in woodfuels and limited access to alternatives impacts poor women. Women in rural communities who used to collect free wood are being forced to shift to less efficient types of fuels or purchase charcoal, and the urban poor forced to reduce their cooked meals. A study by Elamin (2011) found that most rural women in Gezira of Central Region mainly use crop residues from cotton stalks in cooking. A study by Ahmed (2001) and by Elatahir (1999) in the outskirts of urban Khartoum indicated that the main fuel used by community is charcoal. Estimates from the latest two national energy assessments showed that, the average national per capita consumption from animal and crop wastes for 1995 was 0.010 tons, while the estimates for 2000 were 0.117; national average percent of rural population who use charcoal in 1994 was 32 % compared to 52 % in 2000; and the average national rural per capita was 0.029 tons in 1994 compared to 0.054 tons in 2000.

Much of the traded charcoal from the regions with prospective resource deficit comes from wood cleared in MRF. Charcoal industry is owned by entrepreneurs, who make charcoal by clearing trees in big land area which may go to hundreds of hectares. Traditional farmers are little involved in charcoal industry. However, charcoal have become the main cash crop for women in the conflict region of Darfur. While the land area under MRF is increasing, areas cultivated under traditional farming are continuously decreasing, (Abdelsalam 1992) reported that, Land area cultivated in traditional sector in year 1983 and 1990 was 5.17 million ha and 4.72 million ha, while areas cultivated under mechanized farming were 2.00 million and 4.24 million hectares, respectively.

The progressive shift of charcoal production sites further from consuming centers increased transport cost and charcoal prices. Rail transport by the early 1940's assumed a leading role in charcoal transportation. By 1960-70 all forms of transport were largely replaced by road (Abdelsalam, 1992). The study by Abdelsalam (2014) found that integrating rail and river transport in charcoal trade would contribute to stabilizing prices and enable sourcing from remote areas planned to be cleared for MRF. This should be of importance when considering border trade between the two countries.

The land area extent for forests is insufficient to provide for current and future levels of demand. The total area reserved for forestry constitutes only about 4 % of total land area in Sudan, and less than 1 % in South Sudan (FAO 2006). Securing meeting future demands on a sustainable basis hinge on allocating enough

areas for forestry to be managed sustainably, and the ability of the woody species to regenerate and grow. The main species used for charcoal is the Acacias. Vink 1987 used 20 years rotation for *Acacia seyal* and estimated yield of 4.2 and 4.3 m<sup>3</sup> / ha from thinning on age of 11 and 15 years, and 15.3 m<sup>3</sup> / ha from final felling. The estimated value of 10 million cubic meters of wood demand of categories of regions with highest demand, will require an approximate area of 47 thousand to be thinned and clear cut annually. This, will require an area of about 8.3 million ha to be reserved for forestry, if all all volume should come from forests in sustainable management. Carbon projects can provide an opportunity to expand on land areas reserved for forestry use. Abdelsalam 2012 found that including wood fuel as an additional value in carbon projects increases the profitability of the projects, contributes in solving wood fuel crisis, and reduces risk from leakage

#### 4. CONCLUSIONS

Forests and woodlands of Sudan as in most of countries in Sub- Saharan Africa are providing the main energy source used in households for cooking. A model was developed to assess the degree of reduction in dependency on woodfuels from current rate of provision of alternatives in form of LPG. The case of showed that there was no significant decrease in level of dependency on woodfuels, despite the boosting in production of LPG from local oil resources. Policy measures should be introduced to increase the rate of penetration of gas use. Plans need to be made to overcome the cash constraints and lack of supply infrastructure. The amount of wood-based biomass fuels consumed is still growing, and the levels will likely remain high in the future. Further, the demand for charcoal in rural communities is increasing as the access to firewood is decreasing. Deforestation is progressing in more regions of Sudan and South Sudan from the extensive use of land for agriculture and increasing demand for charcoal. Charcoal is being transported from further distant locations with increasing prices. The decrease in access to cooking energy sources from woodfuels is socially impacting the communities in particular the poor women. While there is need to improve access to modern fuels, it is of paramount importance to confront the wood fuel crises by investing in forestry and increasing land area reserved for forestry to be managed on a sustainable basis for meeting the future increasing demands for woodfuels. Investing in community forestry and involving local communities is good option. Plans in the short-term must give priority to the issue of making use of wood cleared from lands planned to be cleared for mechanized farming. Integrating rail and river transport in charcoal trade will enable sourcing from locations where land clearing for mechanized farming in new far distant regions is planned.

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