



**The Gum Acacia Production, Marketing and Food Security  
Research in Southern Sudan**

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**Compiled  
By**

**The Network for Natural Gums and Resins in Africa and SNV  
South Sudan**

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## List of Acronyms and Abbreviations

AIDGUM	Association for the Development of Natural Gums
AMURT	Ananda Marga Universal Relief Team International
BOSS	Bank of Southern Sudan
BRAC	Building Resources Across Communities
CBO	Community Based Organization
CES	Central Equatoria State
CFSAM	Crop and Food Security Assessment Mission
CNI	Colloides Naturels International
CPA	Comprehensive Peace Agreement
DBH	Diameter at Breast Height
DG	Director General
DOF	Directorate of Forestry
EES	Eastern Equatoria State
FAO	Food and Agriculture Organization of the United Nations
FOB	Freight on Board
GAC	Gum Arabic Company
GoSS	Government of Southern Sudan
GPS	Global Positioning System
IDPs	Internally Displaced Persons
IRD	International Relief and Development
ITC	International Trade Centre
KEFRI	Kenya Forestry Research Institute
KGAPC	Khartoum Gum Arabic Processing Company
LM	Live Mass
LU	Livestock Unit
MAF	Ministry of Agriculture and Forestry
MDTF-SS	Multi Donor Trust Fund-South Sudan
MOCRDR	Ministry of Cooperatives and Rural Development
MOFEP	Ministry of Finance and Economic Planning
MT	Metric Tones
NBGS	Northern Bahr El Gazal State
NGARA	Network for Natural Gums and Resins In Africa
NGOs	Non-Governmental Organizations
NPA	Norwegian People's Aid
NTFPs	Non Timber Forest Products
SAFDP	Support to Agriculture and Forestry Development Programme
SDG	Sudanese Pounds
SMoA	State Ministry of Agriculture
SNV	Netherlands Development Organization
SPSS	Statistical Package for Social Scientist
SSGCL	Southern Sudan Gum Company Ltd.
SSRRC	South Sudan Relief and Reconstruction Commission
SUMI	Sudan Microfinance

TDA	Toposa Development Association
UAE	United Arab Emirates
UNHCR	United Nations High Commissioner for Refugees
UNS	Upper Nile State
US-F	Under Secretary
US	Unity State
USAID	United States of America International Development
WFP	World Food Programme
WS	Warrap State
WTO	World Trade Organization

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## Executive Summary

Southern Sudan is endowed with vast quantities of natural resources including *Acacia senegal* and *Acacia seyal*. Though the gum belt in Southern Sudan runs across seven of the ten states, not much is known on the availability, potential production, use, marketing and contribution to food security of these resources hence the study. Although this study focused mainly on the key gum producing states namely: Upper Nile State (UNS), Eastern Equatoria State (EES) and Northern Bahr el Gazal State (NBGS), a rapid assessment was also carried out in Warrap State (WS). The objectives of the study were to carry out resource assessment and mapping of Gum Acacia resources and Marketing and value chain analysis of Gum Acacia subsector in the three states (UNS, NBGS and EES) and a rapid assessment in Warrap State. The exercise was also to strengthen the capacity of GoSS MAF, SMOA, directorate of Forestry (DOF) and universities team members on resource assessment and value chain analysis.

A total of 13 participants comprising mainly of staff from GOSS MAF-DOF staff were trained for one day including a half day practical session in Kapuri forest plantation, near Juba. The participants were exposed to the use of GPS, measurement of DBH, crown diameter and tree height. During the field trips, additional personnel from the states and counties and one university were engaged and involved in the resource assessment and value chain analysis, data collection exercises, which provided them with at least one week of hands on experience on these techniques. Two GOSS MAF staff were involved in the study for the whole 4 week period and gained valuable skills in sample plot determination, tree measurements, data collection, data coding, data entry, preliminary data analysis using micro soft excel and preparation of power point presentation.

Land Sat images (medium resolution) were acquired, processed and used to generate and identify relevant land cover classes. The identified classes were subjected to further interpretation and areas covered by *A. senegal* and *A. seyal* carefully mapped. Provisional resource maps were produced for each state and used for field verification and resource assessment before producing final maps. At least 3 sample plots were chosen in each selected county per state for the resource inventory exercise. Along selected transect routes, circular sample plots of 0.05 ha (radius of 12.6 m) were established in 82 plots with the acacia gum resources (32 for *A. senegal* and 50 for *A. seyal*). All the trees in the sample plots were counted and used in computing the stocking density. Tree height, diameter at breast height (DBH) and crown diameter were measured for at least 1/3 of the trees in the sample plot representing all the available diameter classes. The gum yield (MT ha<sup>-1</sup>) was computed based on stocking density, crown cover and estimated average gum yield per tree. The area under acacia gum resources was established using GIS software.

A marketing and value chain analysis of the gum acacia sub-sector was carried out in the three states (UNS, EES and NBGS) to help identify opportunities for its commercialization with a sustainable competitive advantage. The study

methodology involved four steps: identification of key players in the value chain through literature search and discussions with relevant stakeholders; review of strategic operations in the value chain tracing forms of value adding and associated costs through discussions and interviews; market characterization to establish opportunities for creation of sustainable competitive advantage through field surveys and observations; and identification of appropriate commercialization strategies for the sub-sector through discussions with relevant stakeholders. Multi-stage stratified random sampling procedures were applied to select all sample units for the exercise.

- The results indicate that most of the trees are in the diameter class 5.0-10 cm (50.0 % for *A. senegal* and 45.9 % for *A. seyal*) and very few (4.9 % for *A. senegal* and 8.5 % for *A. seyal*) with diameters over 20 cm. The quantity of juvenile trees (< 5 cm diameter) of either species is less than 20 % indicating that the populations are unhealthy with poor recruitment taking place.
- The mean stocking density *A. seyal* in Southern Sudan is 456 stems ha<sup>-1</sup>, UNS (519), NBGS (495), WS (427) and EES (200) ranging from 120 to 1940 stems ha<sup>-1</sup>. The mean stocking density of *A. senegal* in Southern Sudan is 337 stems ha<sup>-1</sup>, with Upper Nile State having the highest number (409) and Eastern Equatoria State the lowest (284). The range is 80 to 800 stems ha<sup>-1</sup>. Based on this information, it is estimated that *A. senegal* has a mean annual gum acacia yield of 15.0 Kg ha<sup>-1</sup> ranging from 3.6 to 35.6 Kg ha<sup>-1</sup> while *A. seyal* has 33.7 Kg ha<sup>-1</sup> ranging from 7.3 to 117.4 Kg ha<sup>-1</sup>.
- Results of the resource mapping and inventory show that the estimated area under gum acacia resources in the three states is 4,596,342.5 ha with an annual gum production potential of 25,721.9 MT, with *A. seyal* being more abundant and widespread. It was estimated to cover 2,709,117.7 ha (58.9 %) with an estimated production potential of 20,498.2 MT (79.7 %). *A. senegal* covers an estimated area of 1,887,224.8 ha (41.1 %) mainly in UNS and EES with a potential production of 5223.7 MT (20.3 %) per year. With adequate support and proper tapping, the potential yield of *A. senegal* can go up between 20 -74% depending on age. ( Wekesa,2010),
- It was also observed that commercial exploitation of Gum Acacia is at different stages in the four target states. The exploitation of the resources is explicit and well defined in the northern part of UNS for gum derived from *A. senegal* (gum hashab) and in eastern part of NBGS for gum from *A. seyal* (gum talha ) with the players in the value chain operating at three supply networks: local, national and international. However, the situation in EES is unclear and still in infancy stages of growth with undefined value chain.

The strategic operations carried out in the value chain including tapping, harvesting, cleaning, grading, packaging, transportation, marketing and making sales enhance value with cost implications. Opportunities for making costs manageable exist in form of collective actions and shared collection arrangements. However, there is low involvement of local communities and

value adding in the Gum Acacia value chain reducing levels of benefits realized. It was observed that spatial transfer of the product from production sites to the export auction market greatly enhances its value.

Prices of Gum Acacia increase substantially increasing the net benefits that accrue to the stakeholders involved. Producers who are able to market their collection up to the international supply network reap maximum benefits from their efforts. However, most Gum Acacia collectors/producers and local traders are constrained with inadequate capacities in the form of skills, finance, market information and intelligence, and poor transport arrangements. The sub-sector is still evolving from the era of monopoly system with most players having limited capacity to participate in a free economy system and reap benefits.

It is concluded that:

- The three key Gum Acacia production states in Southern Sudan (UNS, NBGS and EES) have about 4,596,342.5 ha with Gum Acacia resources, with an estimated annual gum production potential of 25,721.9 MT. This is about 32.2 % of the potential production in the whole of Sudan (80,000 MT). *A. seyal* is more widespread occupying 58.9 % with an annual potential production of 20,498.2 MT (79.7 %) while *A. senegal* occupies 41.1 % and has an annual production potential of 5223.7 MT (20.3 %). However, only a small quantity of this resource is currently being exploited and their full exploitation with proper tapping and post harvesting training has potential to make significant contributions in alleviating poverty and ensuring food security of the rural poor in many parts of Southern Sudan.
- There is also a general tendency in all the four states to cut *A. seyal* for fuel wood, fodder and building poles. This coupled with poor natural regeneration may threaten sustainable gum production in the long term.
- Commercial exploitation of Gum Acacia is at different stages in Upper Nile, Eastern Equatoria and Northern Bahr el Gazal States. Only players in UNS are organized into cooperative unions (brokers) for enhanced commercial exploitation of the resource with rest individually collecting and marketing.
- There are a number of players in the Gum Acacia subsector in Southern Sudan that include: resource owners, collectors, Cooperative Unions, Scouts or agents, fabricators, transporters, traders, government and non governmental agencies. All the players especially those in the local supply network have ventured into Gum Acacia activities to help enhance their income sources and improve their food security. Most of the incomes derived from sale of Gum Acacia were allocated by players (mostly those in the local supply network) in food (sorghum grain, salt, sugar, cooking oil etc) and other essential purchases (vet or human medicines, shoes, beads, clothes for children etc) indicating central role of the gum in the livelihoods of communities in Southern Sudan.
- Taxation and levying in the Gum Acacia sub-sector is quite high contributing about 32% (ranging from 25% to 38%) of the total cost in commercial exploitation of the gum, this is a great impediment to the exportation of gum.

- The northern part of UNS has clear land and resource ownership thereby making it easier to manage, control and commercialize gum acacia collection. This is unclear in other parts of the gum belt in Southern Sudan where access to the resource is open to everyone which can lead in the long term to “Tragedy of the Commons” and resource conflict should the full commercialization of gum acacia take off in these parts thereby affecting sustainability.

It is recommended that:

- The government enforces the management and conservation of *A. seyal*, which is threatened, through participatory approaches and that urgent considerations be made on establishment of Gum Acacia plantations to enhance sustainability of the supply of Gum Acacia in the long term thereby ensuring continued food security and incomes for participating households in Southern Sudan.
- Land and resource ownership in gum belt be revisited and addressed to ensure sustainable commercialization of the gum acacia in Southern Sudan
- Serious joint awareness and capacity building measures be undertaken to make the sub-sector competitive through formation and strengthening of collector groups and cooperatives, trainings (tapping and postharvest handling), financing, technical guidance, exchange visits etc..
- GOSS should consider reviewing taxation and levying regimes on exports at all levels of government and provide guidelines for unofficial levies in order to provide incentives that would encourage the trade in Gum Acacia.
- Reducing the number of middle men in the gum acacia through direct market linkages to ensure more benefits accrue to the key nodes on the chain.
- Government prioritizes infrastructure development such as roads, communication and water in the gum belt to increase production and marketing as the areas become accessible.
- More areas be visited during the medium and long term development of the Gum Acacia subsector in Southern Sudan and the data generated be used in updating the maps and inventory statistics.

## 1.0 Introduction

### 1.1 Background to Southern Sudan

Southern Sudan with an area of about 644,329.4 km<sup>2</sup> comprises 10 states namely: Eastern Equatoria, Central Equatoria, Western Equatoria, Northern Bahr El Ghazal, Western Bahr El Ghazal, Warrap, Unity, Jonglei, Lakes and Upper Nile. The Government of Southern Sudan (GoSS) was established by the Comprehensive Peace Agreement (CPA), which was signed in Naivasha, Kenya, in January 2005, after a prolonged period of civil war between the South of Sudan and the Northern government in Khartoum. GOSS has made considerable and tangible socio-economic progress in the five years of its existence, although major challenges to sustainable peace and economic development still remain. There is need to create a broad-based economy through focusing on other sources of revenue such as increased production and marketing of agricultural, livestock and forestry products.

Approximately eighty percent (80%) of Southern Sudan's population of estimated 8.26 million lives in rural areas and depends largely on forests, agriculture and livestock production for their livelihoods. These are among the poorest and most vulnerable communities by all standards. The Sudan is reported to be a low-income, food-deficit country, ranking 147<sup>th</sup> on the United Nations Development Programme's Human Development Index (2007/2008), among 177 countries (IFAD, 2009). A comprehensive approach to addressing economic development and rural development issues is therefore critical to reducing poverty in rural areas and increasing peace dividends to vulnerable groups. There is need for employment creation within and generation of income based on the available natural resources is of critical importance to stability, peace and poverty reduction.

Southern Sudan is endowed with vast quantities of natural resources. Many indigenous trees are valuable sources of timber, essential oils and food products such as Gum Acacia, Shea nut, honey and related bee products and others. Gum Acacia, a seasonal gum from the widely-growing *Acacia Gum* trees, in particular has the potential to make significant contributions to alleviating poverty in many parts of Southern Sudan. The gum belt in South Sudan runs across from Eastern Equatoria State (EES), Central Equatoria State (CES), Northern Bahr El Gazal State (NBGS), Warrap State (WS), Unity State (US), Jonglie State (JS) to Upper Nile State (UNS), (SNV, 2009).

## 1.2 Analysis of Gum Acacia Sub-sector in Southern Sudan

### 1.2.1 Description and uses of Gum Acacia

Gum Arabic (herein after referred to as Gum Acacia) is certainly the most ancient and the most well known of all gum types. The term 'Gum Arabic' was coined by European merchants who imported it from Arab ports such as Jeddah and Alexandria (ITC, 2008). Gum Acacia is a seasonal dried exudation obtained from the stems or branches of the widely-growing *A. senegal* and *A. seyal* (FAO, 1998). *A. senegal* (El-hashab in Arabic) produces gum hashab (also described as "hard gum") while *A. seyal* (El taleh in Arabic) produces the gum talha (also described as "flaky gum").

Gum Acacia is widely used in the food and pharmaceutical industry for its unrivalled technological properties: emulsifier for oil in water emulsion, carrier for encapsulation, stabilizer for colloidal systems, texturizer in sugar and polyols medium, film former avoiding fat, water and gas migration and binder for sugar and polyols compressed products (Mocak, *et al* 1998; Kravtchenko, 2005; Benech, 2006.). However, Gum talha is not listed as an approved food additive due to its properties (e.g. high tannin content of about 1.9 %) but has attractive properties for a binder for foundry moulding and a sizing agent in the textile industry (Anderson & Morrison, 1989). Unlike many other food ingredients that try to replace it, Gum Acacia, is natural, GMO free, and none chemically or enzymatically modified, filling completely the strong demand of consumers for natural products and bridging valuable labeling and image to the finished product.

### 1.2.2 Botanical sources and production areas

There are up to seventeen Acacia gum tree species that produce Gum Acacia of varying quality and quantity (Chikamai, 1997). Globally, close to 80% of Gum Acacia is produced by *A. senegal* while the rest is from *A. seyal* (10 %) or *A. laeta* (10 %) (ITC, 2009). In Sudan, 80 % of Gum Acacia production is from *A. senegal* and 20 % from *A. seyal*. Virtually all the Gum Acacia of commerce comes from Africa, with Sudan accounting for 35 % (in 2006) to 63 % (in 2002) of the world production followed by Chad and Nigeria (ITC, 2007; ITC, 2008). About 12 other countries in the Sahel, stretching from Senegal to Mauritania in West Africa to Somalia in the Horn of Africa and southwards to Tanzania are also producers.

Sudan has a potential annual gum production of 80,000 MT (but the average utilization of this capacity is under 25 % (Muller and Okoro, 2004). Despite this potential and Sudan's predominance in the world market, only about 10 % of the production is from Southern Sudan 2006 (SNV, 2009). However, it is recognized that due to the porous South-North borders and the fact that business is done informally by agents and middlemen from the north, Gum Acacia from the south is not clearly

recorded and hence, no accurate data exists. There is also a general lack of awareness by most of the local communities of the importance of the product at the international level and limited access to the market, (SNV, 2009).

### 1.2.3 Gum Acacia resources in Southern Sudan

The Sudanese gum belt is from latitude 10° to 14° extending across Central Sudan; accounting for about one fifth of the country's total area (520,000 km<sup>2</sup>) land is inhabited by over five million Sudanese people (Nour and Osman, 1997; Abdala, 2007). This belt only includes a small part of Southern Sudan (part of Upper Nile State). Based on the African gum belt and the probability map produced by SNV (2009) the gum belt in Southern Sudan is estimated at 300,740.6 Km<sup>2</sup> (30, 074,060 ha) and covers 7 states (Figure 1-1). The exact area of the belt covered by the gum producing resources, their distribution and densities and subsequently the potential annual production of Gum Acacia from Southern Sudan are yet to be established. There are also no maps showing the distribution of these resources in Southern Sudan except for the probability maps produced by NGARA (2005) and SNV, 2009. The provisional map requires further verification and refining before production of final maps (SNV, 2009).

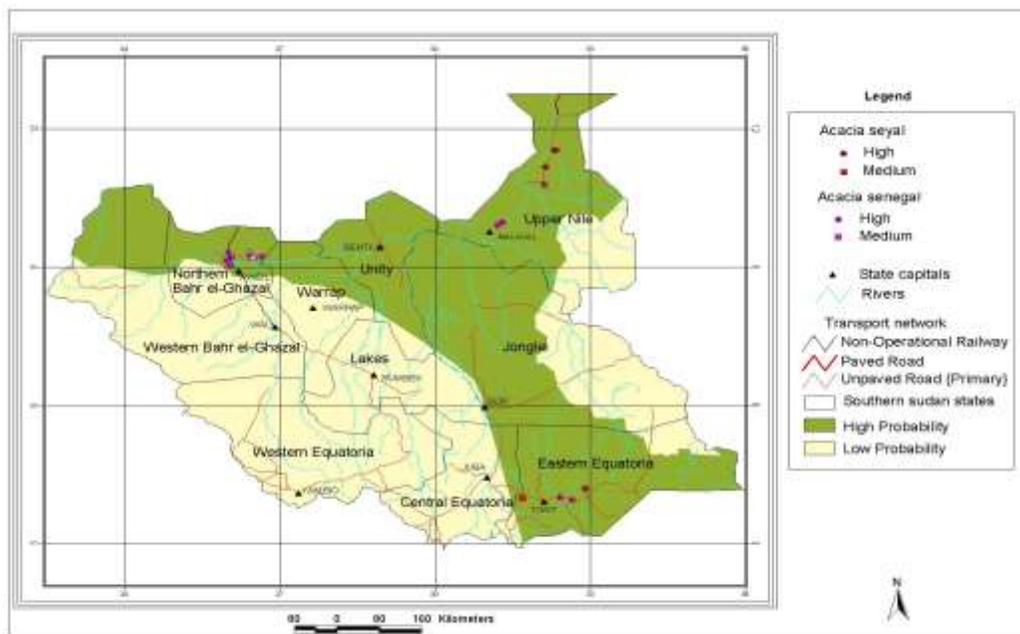


Figure 1-1: Probability map showing gum resources in Southern Sudan (SNV, 2009)

Gum Acacia from Southern Sudan is produced by two main species, *A. senegal* var. *senegal* and *A. seyal* var. *seyal* (SNV, 2009). *A. senegal* is a

tree of up to 15 m with a variable crown, flat and spreading or lax and rounded (Ross, 1979; Brenan, 1983). It is generally recognized by its three hooked prickles at the nodes, the two lateral ones pointing upwards or forward in the direction of growth and one central pointing downwards or backwards or else solitary, the two laterals being absent. The bark varies from greenish yellow to grey-brown, branches appearing white washed.

*A. seyal* var. *seyal* is a tree with irregularly flattened, spreading crown that grows to about 17 m in height (Ross, 1979, Hall and Mc Allan, 1993). It is easily recognized by its smooth or sparsely flaking bark, which is covered with whitish, greenish yellow or orange-red powdery layer. It has white, stout, sharp thorns about 8 cm long, arranged in diverging pairs.

Based on a classification by Harrison and Jackson (1958), *A. senegal* occurs in a number of vegetation types ranging from the semi-deserts and grassland zone in the north of Sudan to the *Terminalia-Sclerocarya-Anogeissus-Prosopis* savanna woodland in the south of the country. *A. seyal* occurs predominantly in grassland, wooded grassland and woodland on heavy alluvial or clay rich or volcanic loam soils prone to water logging, often as a dominant species sometimes to the virtual exclusion of others (Hall and Mc Allan, 1993).

In Upper Nile State, *A. senegal* var. *senegal* and *A. seyal* var. *seyal* are fairly well distributed in five counties, namely: Renk, Maban, Manyo, Melut and Fasoda (SNV, 2009). *A. senegal* grows best on clay sandy soils usually associated with *Balanites aegyptiaca* and also *A. seyal* var. *seyal*.

In Eastern Equatoria State *A. senegal* var. *senegal* belt extends from Lafon upto Kapoeta. The most important areas where *A. senegal* var. *senegal* is prevalent and some tapping currently taking place are Kidepo valley, Tagonyi, Kadiriha and Tiwolo (SNV, 2009). *A. senegal* var. *senegal* are rare in Northern Bahr El Ghazal state (SNV, 2009).

*A. seyal* var. *seyal* is also fairly well distributed in five counties in UNS (Renk, Maban, Manyo, Melut and Fasoda), (SNV, 2009). The *A. seyal* var. *seyal* occurs in almost pure stands in Melut County in wooded grassland, especially on seasonally flooded or wet flats of black cotton soils and along water courses in the entire Nile basin.

In Northern Bahr El Gazal State (NBGS), *A. seyal* var. *seyal* resources are especially abundant in Aweil East County particularly in Bach (around Warawar), Malualkon, Malualbai and Wanajok payams (SNV, 2009). There are also extensive resources in Aweil North, around Ariath Payam and Aweil West in Udhum Payam.

In Eastern Equatoria State (EES), both *A. seyal* var. *seyal* and *A. seyal* var. *fistula* are available (SNV, 2009). *A. seyal* var. *fistula* is particularly

abundant around Kiyala mixed with scattered *A. seyal* var. *seyal*, *A. nilotica*, *Balanites aegyptiaca* and *Ziziphus* sp. *A. seyal* var. *seyal* has also been observed in dense stands around Lobira (Ikotos County).

However, *A. seyal* resources in all the three states seem to be threatened due to excessive cutting by the local communities for fuelwood and building poles (SNV 2009; SSGCL, 2006).

#### 1.2.4 Resource ownership

Land ownership is not clearly defined in Southern Sudan and the land where the Gum Acacia trees are wildly growing is communal land. In Renk and Melut where the gum collection has been going on for at least more than 10 years, the community elders apportion land with the Gum Acacia tree resources to each clan, and each clan in turn divides their portion of land to the individual families (SNV, 2009). In NBGS, Aweil East and North, where collection of gum started fairly recently, the land is not apportioned and collectors can get gum from anywhere within the state (SNV, 2009). In Kimatong and Kapoeta North in EES, though the clans have been apportioned their land, there is no restriction on extraction of gum. Any tree can be tapped by any body provided the tree is not cut down (SNV, 2009).

#### 1.2.5 Harvesting of Gum Acacia

Gum emerges naturally from slits in tree barks; or by creating additional man-made slits, which yields larger quantities. The amount of gum produced varies, however, from 20g to 2000g depending on the tree species, age, site and season. Annual yields of Gum Acacia from young *A. senegal* trees are reported to range from 188 to 2856 g/tree (avg. 900 g) and from older trees, 379 to 6754 g/tree (average 2000 g) (Duke, 1983). Yield per ha per year ranges between 30 to 40 kg in case of open stands and as much as 100 kg in case of dense stands (ITC, 1983). The average annual gum yields range from 0.5-1 Kg in Sudan, 0.1-0.5 Kg in Nigeria (SSGCL, 2006), though studies on this are yet to be done in Southern Sudan. On average, a tree yields 250g per season (ITC, 2008, Boer, 2002), implying about 500 g annually. The age of the tree and ambient temperatures have been reported to affect the yield. The highest gum yields have been reported for trees between 7 and 15 years old in Nigeria and 10 to 15 years old in Sudan (SSGCL, 2006). Yields from cultivated trees are said to increase up to the age of 15 years, when they level off and then begin to decline after 20 years (Boer, 2002).

In Southern Sudan only *A. senegal* is tapped while gum from *A. seyal* exudes naturally. Tapping is reported to increase gum yield of *A. senegal* by 77.4 % (Wekesa et al, 2009) and the gum yield from *A. seyal* of about 27.9-76.7 % (Mohammed And Röhle, 2009). Tapping of *A. senegal* trees in Southern Sudan starts as early as 3 years (SNVI, 2009) similar to that reported by Nour and Osman (1997) for trees from seedlings grown in

plantations in the north, though others report 4 years (Duke, 1983) or 5 years (Abdala, 2007). Diameter of the *A. senegal* trees tapped ranges from 4 cm (SNV, 2009). Tapping of *A. senegal* trees for gum production varies from site to site and begins from as early as mid October to early November, usually after the long rains when the trees are just starting to shed their leaves (SNV, 2009). The main gum collection season is December-May. Tapping is done mainly using an axe or a knife or a machete but this varies with counties, only about 25 % of tappers in Renk use the recommended Sonke for tapping (SNV, 2009). SNV (2009) reported that the first collection of gum in Southern Sudan is done 1-2 months after the tapping and there are about 3-5 collections per tree per season though 3-6 weeks and 4-6 pickings have been report for the north ( Warrag and Abdelgadir 2006, ; Nour and Osman, 1997). Boer (2002) reports that after 4–6 weeks the skin of the gum nodule becomes too hard to expand any further, it ceases to grow and is ready for picking. Subsequent collections are done in 15-day intervals, the number of pickings being very much affected by tree yields in a particular year and the prevailing prices (FAO 2000a).

#### 1.2.6 Post harvest handling of Gum Acacia

The collectors only clean the gum but there is no grading at the producer level. Grading is done by the exporters. The gum is packaged mainly in jute bags in units of 50 kg (especially in UNS) and polythene bags (especially in EES) (SNV, 2009). The outputs of the cleaning and sorting are graded and sold according to five grades namely: Hand Picked Selected (HPS), Cleaned, Siftings, Dust and Red (Nour and Osman, 1997). Thorough controls are carried out before exportation.

#### 1.2.7 Marketing of Gum Acacia

The main importers of gum from Sudan are: USA, India, France, United Kingdom, Germany, Italy, Japan, China, Switzerland, Mexico, Sweden, Ireland and Brazil, (ITC, 2008). The export of gum from Sudan was being coordinated by the Gum Arabic Company (GAC) that collapsed in 2009. Since 2006, the production of gum in South Sudan has been dwindling due to low prices and both collectors and local traders have been left at the mercy of the Northern traders who come on adhoc basis and are the ones who set the prices (SNV, 2009). The prices have come down from US \$ 2.6-3.1 /kg (in 2005) to USD 0.5 for gum hashab and to, US \$ 0.3 for gum talha (in 2006-2008), SNVI, 2009. The gross income for the producer from the sale of gum talha is only 25-33.3 % of the export value.

According to SNV, 2009 rapid assessment study, there is only one, South Sudan Gum Company Ltd, permitted by GOSS to trade in Gum Acacia since 2007. This company markets the Gum to United States of America, United Arab Emirates (UAE) and India through Mombasa port in Kenya...

### 1.2.7 Gum Acacia and food security in Southern Sudan

Most gum collectors are resource poor agro-pastoralists with scanty resources and little or no education. SNV (2009) estimated the number of households of the local community members involved in tapping and collection of the gum in various Counties and States at about 11,630. Though the same study estimates that more than 50-75 % of the local communities in the key active gum producing areas in Southern Sudan depend on gum production as an alternative source of livelihood, especially during the drier months, data to support this claim and other related issues is scanty. It should be pointed out however that during the dry season, pastoralist communities and herders do depend on gum acacia as a source of food or snack. Collection of gum is therefore carried out as the livestock herders and communities are moving with their livestock in search of grazing and water sources.

### 1.3 Background to the study

As a build up to an SNV funded rapid assessment on South Sudan Gum Acacia Sub-Sector Situational Analysis in the three key gum producing states (UNS, EES and NBGS) in mid 2009, SNV secured further funding from UN FAO/SIFSIA Project and MDTF-SS SADP for a detailed gum acacia study in these states and a rapid assessment in Warrap State (WS). This study focused on gum acacia resource assessment and mapping to estimate the potential yields, abundance and distribution by species for the purpose of making management decisions and sustainable utilization and development. It also aimed at quantifying and mapping the two major Gum Acacia resources (*A. senegal* and *A. seyal*) in order to provide baseline information upon which future periodic regeneration surveys and harvesting assessments would be based to assist in decision making.

The study also focused at carrying out a marketing and value chain analysis of Gum Acacia. This aimed at establishing key players in the Gum Acacia value chain, identifying strategic operations and their associated costs and benefits along the value chain. The study was for determination of marketing characteristics and opportunities that create a sustainable competitive advantage of the sub-sector and establishment of appropriate strategies for engaging all players into sustainable commercial exploitation of Gum Acacia in Southern Sudan.

It was envisaged that conducting the research study would yield results, which would eventually lead to addressing gum subsector food security information gaps to inform policy and programme decisions in Southern Sudan. Availability of authentic information / data and development of clear strategies can lead to increased food security through increased gum production and marketing in Southern Sudan. This would therefore lead to increased income and benefits to participating individuals and communities, and helping in the building of a strong export market.

With that in mind, SNV hired 2 consultants in the framework of Network for Natural Gums in Africa (NGARA), to conduct this study on behalf of SNV with full participation of GoSS MAF staff and SNV. NGARA was chosen because it had been involved in the initial rapid assessment of 2009 and was conversant with the research theme and locations. The core research team comprising of SNV, NGARA consultants and GOSS-MAF was joined in the field by State Ministry of Agriculture and Forestry (SMOA) staff.

#### 1.4. Tasks Performed by the Research Team

The main tasks performed by the team were as follows:

- i. Strengthened the capacity of GoSS MAF and university team members on resource assessment, value chain analysis and marketing, data collection, data analysis and research report production;
- ii. Carried out a detailed resource assessment to establish the extent, distribution and potential yield of Gum Acacia resources by type in identified areas in the three key states and produced resource maps;
- iii. Determined the quantities/potentials for Gum Acacia commercialization in Southern Sudan;
- iv. Carried out a marketing and value chain analysis of the Gum Acacia sub-sector and established the key actors, current methods of harvesting, post harvest handling, utilization, management for sustainability and marketing of Gum Acacia in the producing states;
- v. Presented preliminary research findings to key stakeholders for discussion and development of national strategic plan for Gum Acacia production and marketing in Southern Sudan.

#### 1.5 Expected Outputs

- Well trained and equipped research team composed of 2 GoSS MAF staff, 1 University representative, and state level DoF staff.
- Well documented and packaged Gum Acacia research report with clearly analyzed issues, opportunities, challenges and recommendations for policy and programme development.
- Resource maps showing the distribution of gum acacia resource by type for the three states produced.
- Clear Gum Acacia value chain Analysis with key gaps along the chain requiring attention identified and clear recommendations for making the chain competitive.
- Clear contributions of gum acacia to food security in South Sudan articulated.
- Gum Acacia future research issues in Southern Sudan identified.

## 2.0 Methodology

### 2.1 Preliminary activities

#### 2.1.1 Capacity building for local partners

The overall objective of the capacity building exercise was on job training on resource assessment, value chain analysis, data collection and analysis and report writing. A two day training session was conducted before the field work began. The training comprised of 1 day of theory at GOSS MAF (Teak room) and a half day of practical's in Kapuri forest plantation (near Juba), followed by a practical session for core team members on data entry in GPS. Hands on training continued in the field for about four weeks.

#### 2.1.2 Theoretical and practical sessions in Juba

The main topics covered included: Overview of mapping techniques, data collection methods, Overview of GIS and GPS, Taxonomy and ecology of commercial gum resources, Tree Mensuration and marketing and forestry enterprise development. Practical sessions included: entering of data sets for field verification in GPS, sample plot selection/determination, tree diameter at breast height (DBH), height and crown diameter measurements.

#### 2.1.3 Hands on training during field work

The hands on capacity building exercise in the field included identification, selection, prioritization and mapping of the sample plots with the assistance of the SMOA officers, selection of transect routes, use of GPS to locate preselected sites for verification, tree identification and measurements at each site, identification of soil and terrain types at each plot, establishment of current uses of the acacia gum resources in the various sites among others. The study sites are recorded in Table 2-1 below.

Table 2-1: Study areas

State	Counties
Upper Nile	Renk, Melut, Baiet, Malakal
Eastern Equatoria	Lafon, Budi, Kapoeta North, Kapoeta East, Ikotos and Torit
Northern Bahr El Gazal	Aweil East, Aweil North (Gok Machar) and Aweil West (Nyamulel)
Warrap	Tonj North

## 2.2 Resource Mapping

An expert on resource mapping spearheaded this activity. The process involved the following activities:

- i. Land Sat images (of medium resolution) for the three states were acquired, processed and used to generate and identify relevant land cover classes.
- ii. The identified classes were subjected to further interpretation and areas covered by *A. senegal* and *A. seyal* carefully mapped. Provisional resource maps were produced for each state and used in the field verification and ground truthing exercise. The objective for field verification was to ascertain if mapped units had the resources as indicated in the provisional map before production of final resource maps.
- iii. A number of sample points were pre-selected prior to the field visit. Fieldwork was conducted to verify the preliminary interpretation. A number of crucial points (about 60 % of preselected points) were verified, however, some points could not be verified due to inaccessibility, insecurity, distance, logistics and short duration of the study. Additional points with the gum resources were also taken along the transect routes.
- iv. Based on the field measurements of stocking densities of each of the resources, polygons of *A. senegal* and *A. seyal* were delineated and further classified as Low, Medium and High densities. The findings of the field work and resource inventory were used to update the preliminary interpretation. The data was harmonized to establish the areas covered by each resource in each density class (low, medium and high density) in each state and county. Resource maps were produced showing the location, distribution and densities of the resources.

## 2.3 Resource Assessment

The main objective of resource inventory was to generate key data on the gum resources to be used in estimating the potential for commercial production of Gum Acacia in Southern Sudan and to form a data base for future reference and use. The provisional resource maps were used in carrying out this activity. The following procedure was followed:

- i. Information on geographic coordinates of the centroids of the polygons containing *A. senegal* and *A. seyal* was provided by the mapping expert. The points were marked on the provisional resource maps and also entered into a GPS.

- ii. The polygons were examined in terms of accessibility (roads) and security and those that were accessible and secure were marked for field verification and resource inventory. Consultations were also carried out with local authorities in each selected state prior to field work on the availability of the target resources (*A. senegal* and *A. seyal*) and Counties with the gum resources prioritized. The research team was accompanied by at least one local person with some knowledge on the resources. At least 3 sample plots were chosen in each selected county for the resource inventory exercise. Areas that were relatively accessible by car were selected as transect routes. Along each transect route circular sample plots of 0.05 ha (radius of 12.6 m) were established in areas with the acacia gum resources. A total of 82 sample plots (32 for *A. senegal* and 50 for *A. seyal*) were used in the study (Annex IV). A total of 608 trees ( 399 *A. seyal* and 209-*A. senegal* ) were used in the study.
- iii. Within each sampling plot, data was collected using data sheets (Annex III) on:
- GPS
  - Stocking density of young (juvenile < 5cm) and mature (DBH > 5 cm) Gum Acacia producing species
  - Local and botanical names of associated species
  - Diameter at breast height (DBH) –determined at 1.3 m using a diameter tape
  - Crown diameter-(determined by projecting the edges of the crown to the ground and measuring the length along one axis from edge to edge through the crown centre, the measurements from the two perpendicular directions were then averaged).
  - Approximate tree height-(measured using Suunto clinometer)
  - Terrain conditions
  - Soil conditions
  - Evidence of exploitation through tapping or harvesting
- iv. Solid crown cover was calculated using the following formula:  
Solid Crown cover (%) = Surface Area of Crown (m<sup>2</sup>) / Sample Plot Area;  
(m<sup>2</sup>) = [ $\pi D^2 * 100 / 2$ ] / 500 (Where  $\pi = 22/7$ ; D=crown diameter). The crowns of the *A. senegal* and *A. seyal* trees were assumed to take a hemispherical shapes.
- v. The collected data was put in an excel data base, cleaned and synchronized to ensure that data from the mapping and inventory exercises corresponded to the correct mapping units (State and counties)
- vi. Stocking density (stems per hectare) was calculated for each resource as follows:

Stocking Density (stems/ ha) = No. of trees in 0.05 ha sample plot / 0.05 =  
 No. of trees in 0.05 ha sample plot x 20

Table 2-2: Density Classification for *A. senegal* and *A. seyal* (stems/ha)

Density	Classification
< 500	Low
500-800	Medium
> 800	High

- vii. Stocking Density classes were then assigned based on the following criteria:

The stocking density was based on the optimal stocking density for a plantation of 625 stems per hectare and a spacing of 4m x 4m. Based on this criterion, the stocking density of each resource was then classified into low, medium and high (Table 2-2).

The data was analyzed using SPSS programme. The mean, standard deviation and coefficient of variation of stocking density, were calculated for the three diameter categories (low, medium and high) at State levels. Significant differences in these parameters among and within the three states were tested at 95 % confidence level using state and county means.

- viii. Correctional Factor

A correction factor was applied to account for the existence of other land uses such as farmlands, settlements or glades because the mapping units are not homogenous. The following correction factors were adopted for all the resources.

- High Density - 75%
- Medium Density - 50%
- Low Density - 25%

- ix. Yield Estimates Calculations

Assessment of area under acacia gum resources and yield of Gum Acacia was derived as follows;

- Estimated density of acacia gum resource for a given density class;
  - No. of stems = Mean Density x Area x correction factor (1)
- The yield of acacia gum was based on the formula:
  - Estimated Yield (MT)= Number of Stems x Crown Cover x Yield)/1,000,000 (2)

Where: Crown Cover for *A. seyal* = 12.1%

Crown Cover for *A. senegal* = 8.9%  
Estimated Gum Yield/ stem= 500 g

## 2.4 Gum Acacia Sub Sector Marketing and Value Chain Analysis

The study used both primary and secondary data. The secondary data was collected from prescriptive literature and electronic resources such as on-line catalogues, indices, study reports, and research papers. Visits and discussions were held with a variety of organizations and institutions involved in research and development work on Gum Acacia in Southern Sudan. Specifically, visits were made to National Forestry Corporation and private companies based in Khartoum to extract data on Gum Acacia produced and marketed from Sudan over the years from the commencement of GAC Ltd. Visits were also made to key government departments in Juba to get complementary statistics on Gum Acacia produced and marketed from Southern Sudan over the years. The departments covered included, *inter alia*, the Revenue, Customs and Statistics departments in the Ministry of Finance and Economic Planning; Ministry of Commerce and Industry; etc. In addition, visits and discussions were held with private companies to collect information/data on Gum Acacia marketed from Southern Sudan states, pricing and transportation costs road and water. It should be pointed out that no data was secured on contribution of South Sudan states to national production and marketing records due to the fact that all gum from South Sudan states like NBGS and UNS is bulked up either in El Obeid and Kosti by traders from north as gum from Kordofan or White Nile. As there was no separate data for the South Sudan on gum production and marketing, an estimate of 10 % (SNV, 2009), was used to derive the proportion of gum from the South based on data for the whole of Sudan.

The primary data was obtained through field interviews using semi-structured questionnaires (Annex III). Multi-stage stratified purposive sampling procedures were applied to select appropriate sample units for interviews and discussions (Table 2-3). At selection stage I, UNS, EES, NBGS and Warrap States were selected because of high amounts of Gum Acacia resources. At stage II, Renk and Melut Counties in UNS, Budi and Kapoeta North Counties in EES, Aweil East and Aweil North in NBGS, and Tonj North County in Warrap were selected. Payams with high levels of Gum Acacia resources were selected at stage III, and finally key stakeholders including resource owners/collectors (20), traders (18), community leaders (30), government officials (18) and development agencies (7) were selected purposively for interviews and discussions (List of stakeholders covered in Annex I). Sequential sampling (snowballing) was applied where priority information for purposive sampling was not readily available.

Interviews, focused group discussions and observations made explored

strategic operations in the Gum Acacia value chain tracing all forms of value adding and associated costs, and collected data for market characterization to establish opportunities that would contribute to the sub-sector's sustainable competitive advantage. In total, 14 focused group discussions were held in all the states during the field study.

Table 2-3: Multi-stage Stratified Sampling Procedure to select appropriate project sites

Sampling stage	Sampling frame	Description	Selected units						
			Upper Nile State		Eastern Equatoria State		North Bahr El Gazal State		Warrap
Stage I	List of states in Southern Sudan	Status of gum acacia resource	Upper Nile State		Eastern Equatoria State		North Bahr El Gazal State		Warrap
Stage II	List of all counties in selected state	Status of gum acacia resource	Renk	Melut	Kapoeta	Budi	Aweil East	Aweil West	Tonj
Stage III	List of all payams in selected counties	Selection of payams based on gum acacia resource status and commercialization	Jelahak	Melut	Kapoeta Riwoto	Kimatong Kidepo	Madhol Wanjok Malith	Udhum Ariath-North	Kwanjok Tonj North
Stage IV	All possible collectors and traders	Random selection of collectors and traders for interviews	Collectors Owners Traders	Collectors Owners Traders	Collectors Owners Traders	Collectors Owners CBO	Collectors Owners Traders	Owners	Owners

## 2.5 Data analysis for marketing and value chain study

Data was organized using Microsoft Excel programme and analyzed with SPSS computer package. Cost/benefit analyses were carried out using Gross Margins (GM). In addition, the study tried to make potential market projections spelling out their sizes, current supply chains, prices of the products, the level of anticipated demand and cost.

## 2.6 Constraints to the research study

- Inaccessibility and civil insecurity in some of the potential sample plots such as Manyo, Fasoda, some parts of EES (Napak, Kidepo Valley and the upper parts of EES bordering Jonglei state)
- Inadequate knowledge of relevant forestry and Gum Acacia issues by most SMOA officials
- Inadequate time for the field work as there were more sites for verification but couldn't all be covered due to limited budget and timeframe per state.
- Could not access higher resolution images e.g. quick bird or spot due to financial limitations

### 3.0 Results and Discussions

#### 3.1 Capacity building for local partners

A total of 13 participants comprising mainly of staff from GOSS MAF staff were trained. A one and half day's training was conducted followed by a half day practical session at Kapuri forest plantation, near Juba. The practical session comprised of setting up sample plots and collecting required data. The participants were exposed to the use of GPS to note the current position of the sample plots and also on the entry of the pre selected GPS points (that were to be used during the field verification exercise) in the GPS. The participants also had practical sessions on measurement of DBH, crown diameter and tree height using diameter, linear tapes and Suunto clinometer, respectively (Plate 3.1).

During the field trips, additional personnel from the states and counties and one university were engaged and involved in the resource assessment and marketing and value chain analysis and data collection exercises, providing them with at least one week experience on these (Plate 3.2).



Plate 3.1: Training in session at Kapuri forest plantation and at GOSS-MAF (Teak Room) GOSS



Plate 3.2: Practical on job training in the field

### 3.2 Resource Mapping and Inventory

The study generated a lot of important information. The information obtained included data on site factors e.g. soil type, terrain, current use of the resources and other vegetation associated with the gum resources, distribution of diameter classes for the mature trees, tree height, diameter and crown cover and their variations.

#### 3.2.1 Site factors

The data on soil type, terrain, and associated species for the two species in each state are summarized in Tables 3-1 to 3-4.

Both species are found in flat to gently sloping or gently sloping to moderately sloping terrain. Relationships with soils are also well-defined for the two species. *A. senegal* seems to prefer sandy clay or clay loam soils while, *A. seyal* is more adaptable to the deep, heavy soils prone to water logging such as black cotton, clay or alluvial soils. Both species also are closely associated with *Balanites aegyptiaca* in their habitats. A few other species that are associated with these resources are indicated in the tables 3-1 to 3-4. The current uses for *A. senegal* are mainly fodder, tapping of gum for sale, gum collection for eating and for *A. seyal* the key uses included firewood, building poles charcoal, and fodder.

Table 3-1: Data on soil type, terrain and associated tree species in WS

<b>Species</b>	<b>Soil type</b>	<b>Terrain</b>	<b>Current use</b>	<b>Most common tree in the same habitat</b>	<b>Other species in the same habitat</b>
<i>A. seyal</i>	Clay loam	Flat to gently sloping	Firewood, building poles, charcoal, fodder, and building poles	<i>Balanites aegyptiaca</i>	Amutach (Dinka), <i>Acacia polyacantha</i> , Pach (Dinka)

Table 3-2: Data on soil type, terrain and associated tree species in EES

Species	Soil type	Terrain	Current use	Most common tree in the same habitat	Other associated species
<i>A. senegal</i>	Sandy loam	Flat to gently sloping  Or gently sloping to moderately sloping	Gum collection for eating, fencing	<i>Balanites aegyptiaca</i> ,	<i>A. seyal</i> , <i>A. nilotica</i> , <i>A. mellifera</i> , <i>A. tortilis</i> , <i>A. nubica</i> , Vatinit (Boya), Bainyit (Boya), Lomach (Boya), Kuljo (Peri),
<i>A. seyal</i>	Black cotton soil	Flat to gently sloping  Or Gently sloping to moderately sloping	Firewood and Building poles	<i>Balanites aegyptiaca</i> ,	<i>A. seyal</i> var. <i>fistula</i> , <i>Salvadora persica</i> , <i>A. senegal</i> , <i>A. tortilis</i>

Table 3-3: Data on soil type, terrain and associated tree species in UNS

Species	Soil type	Terrain	Current use	Most common tree in the same habitat	Other species in the same habitat
<i>A. senegal</i>	Sandy clay	Flat to gently sloping	Fodder, Tapping of gum for sale, Gum collection for eating	<i>Balanites aegyptiaca</i> , <i>A. mellifera</i>	<i>A. seyal</i>
<i>A. seyal</i>	Black cotton and clay loam	Flat to gently sloping	Charcoal, building poles, firewood, fodder	<i>Balanites aegyptiaca</i>	<i>A. senegal</i> , , <i>Ziziphus spina-christi</i> ,

Table 3-4: Data on soil type, terrain and associated tree species in NB GS

Species	Soil type	Terrain	Current use	Most common tree in the same habitat	Other species in the same habitat
<i>A. seyal</i>	Black cotton and clay loam	Flat to gently sloping	Firewood, Charcoal, Firing bricks, Gum collected for Sale	<i>Balanites aegyptiaca</i>	Amutach (Dinka ), Amuth ( Dinka ), Jokan (Arabic), Adoth (Dinka), Wad arab (Arabic), <i>Tamarindus indica</i> , <i>Acacia polyacantha</i> , Adhot (Dinka), <i>A. seyal</i> var. <i>fistula</i> , Pach (Dinka)

### 3.2.2 Population Dynamics

The proportion of juvenile (< 5cm diameter) to mature Gum Acacia trees were as indicated in Figures 3-1 and 3-2.



Figure 3-1: Population dynamics of *A. senegal*

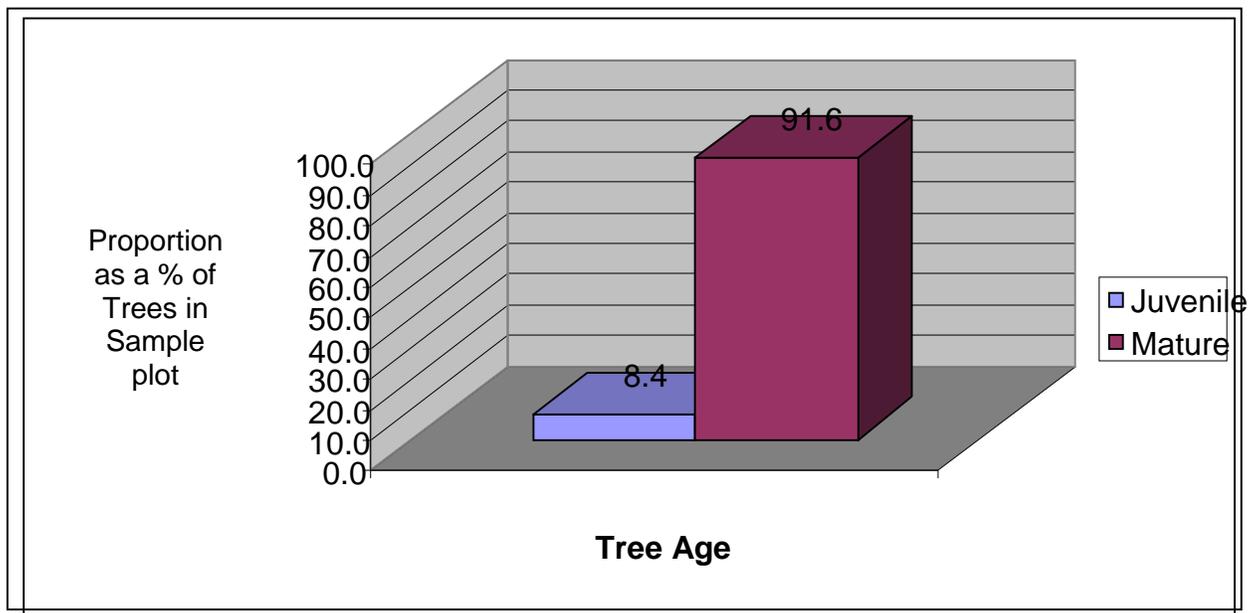


Figure 3-2: Population dynamics of *A. seyal*

The figures indicate that *A. senegal* had a higher proportion of juvenile trees (18.4 %) as compared to *A. seyal* (8.4 %) implying a lower natural regeneration for *A. seyal* as compared to *A. senegal*. However, the population of both species could be said to be unhealthy with poor recruitment taking place, as the proportion of the regenerants was much less than the threshold of 33 %. The low regeneration could be due to grazing, drought, human interference, pests attack, competition stress from the natural vegetation

and grass fires (Eisa *et al*, 2008, Warrag and Abdelgadir, 2006). This low natural regeneration may pose a challenge in the sustainability of the production and marketing of Gum Acacia in the long term leading to food insecurity.



**(a)**

**(b)**

Plate 3-3: *A. senegal* (a) and *A. seyal* (b) trees in sample plots depicting low natural regeneration

Further analysis on the data for distribution of the diameter of the mature trees indicate that most of the trees are in the diameter class 5.0-10 cm (50 % for *A. senegal* and 45.9 % for *A. seyal*) and only a small proportion have more than 20 cm diameter ( 4.9 % for *A. senegal* and 8.5 % for *A. seyal*), Figures 3-3 and 3-4. This is normal for stand dynamics indicates and indicates a substantial number of stems available for gum production in the short term-medium term.

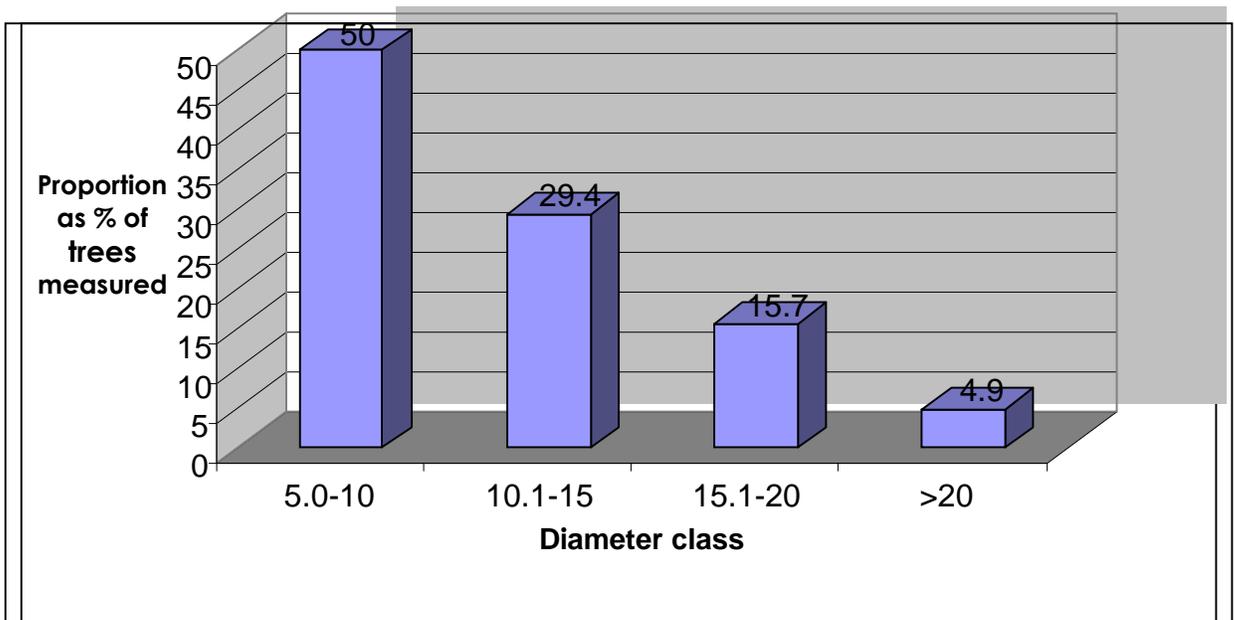


Figure 3-3: Distribution of diameter classes for *A. senegal*

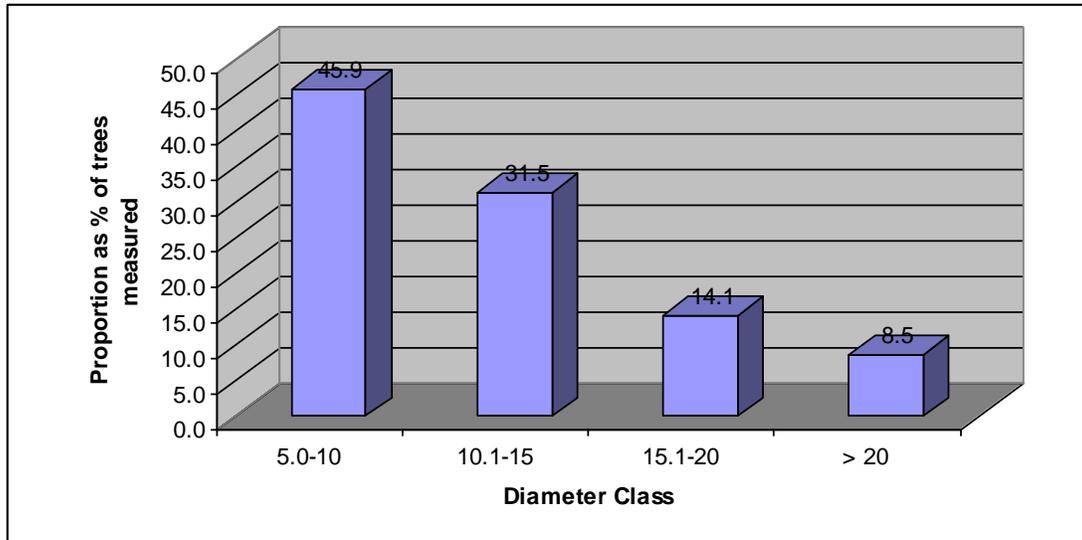


Figure 3-4: Distribution of diameter classes for *A. seyal*

### 3.2.3 Height, Diameter, Crown Diameter and Crown Cover for Gum Acacia

The means and the ranges for diameter, height, crown diameter and crown cover for the two species are summarized in Table 3-5.

Table 3-5: Mean and Range for height, diameter, crown diameter and crown cover for *A. Senegal* and *A. seyal*

Species	Height (m)		DBH (cm)		Crown diameter (m)		Crown cover (%)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
<i>A. senegal</i>	7.6	3-12	9.8	5-22.4	5.1	1.9-9.5	8.9	1.2-28.1
<i>A. seyal</i>	9.3	4-17	11.7	5-37	5.9	1.8-12.5	12.1	1.0-48.7

*A. seyal* trees were significantly ( $P < 0.001$ ) taller, larger in diameter and wider in crown size as compared to *A. senegal*. The results on the height of *A. seyal* are consistent with those of Tackolm (1974), 9-10 m, Thomas (1943), 15 m and Ross (1979), 17 m. Diameters of 20 cm (Keay, 1989), 30 cm (Jackson, 1973) and 60 cm (ITC, 2009) have also been reported for *A. seyal*. *A. senegal* is also reported to grow to 2-6 m (occasionally to 15 m) (Duke, 1983).

#### 3.2.3.1 Variations in height, diameter, crown diameter and crown cover for Gum Acacia resources with states.

The variations in these parameters for each species with states are illustrated in Figures 3-5 to 3-12.

i. Diameter at Breast Height (DBH)

Figure 3-5 indicates that EES and UNS have similar mean DBH (9 cm) for *A. senegal*. However, the mean DBH for *A. seyal* varied significantly ( $P < 0.001$ ) with state, with trees from EES having the largest mean DBH (17.2 cm) and UNS the least (9.2 cm) (Figure 3-6 and Annex IV).

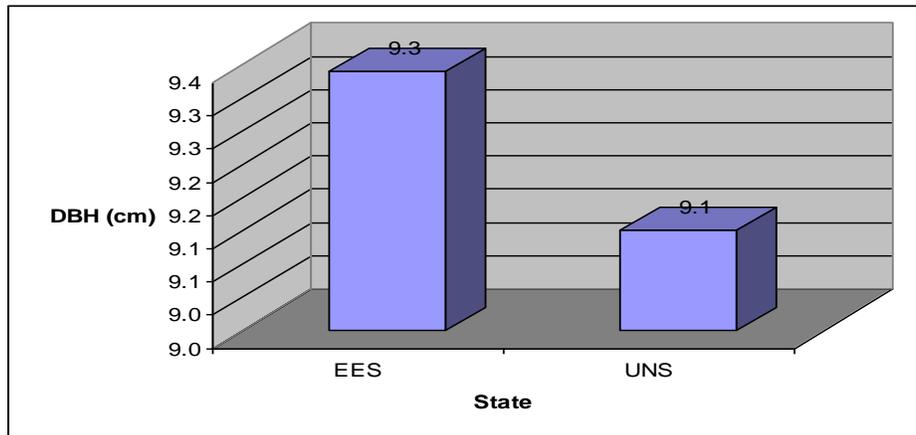


Figure 3-5: Comparison of mean DBH for *A. senegal* in EES and UNS

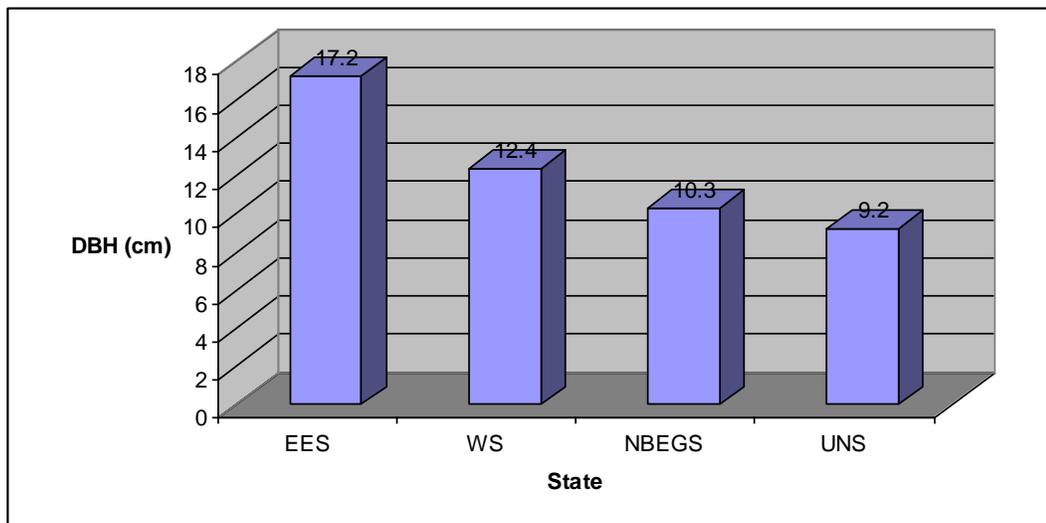


Figure 3-6: Comparison of mean DBH for *A. seyal* in the four states

ii. Tree height

Mean height of *A. senegal* trees in UNS (9.34 m) was similar to that in EES (9.29 m) while height varied significantly ( $P < 0.001$ ) with state in the case of *A. seyal*. *A. seyal* trees in EES were the tallest (13.2 m) and those from WS being the shortest (7.9 m) (Figures 3-7 and 3-8). Gum yield is reported to be significantly correlated with tree height in natural stands (**Rahman, 2001**).

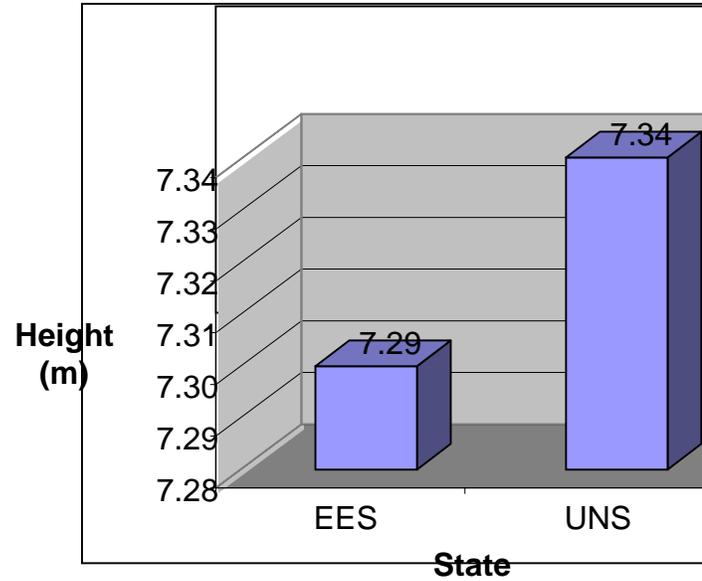
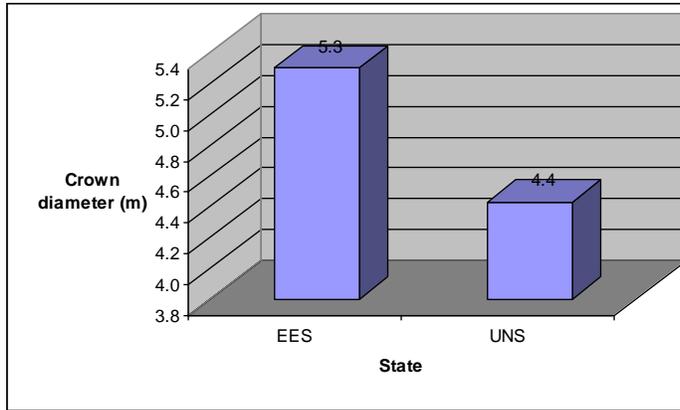


Figure 3-7: Comparison of mean height of *A. senegal* in EES and UNS

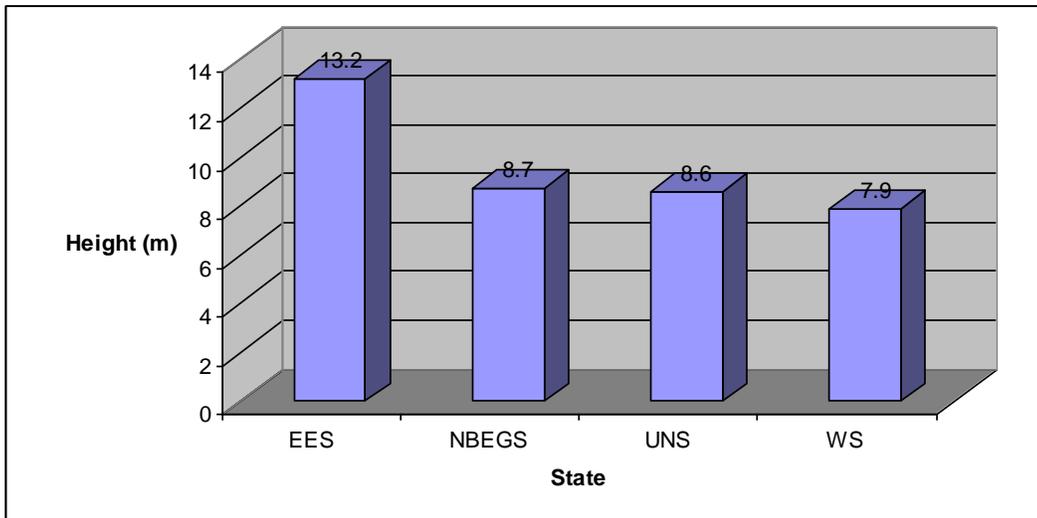


Figure 3-8: Comparison of mean height of *A. seyal* in EES, WS, NBGS and UNS

iii. Tree crown size and cover

*A. senegal* and *A. seyal* trees from EES had larger crown diameter and crown cover than those from the other states as illustrated in Figures 3-9 to 3-12).

Figure 3-9: Comparison of crown diameter of *A. senegal* in EES and UNS

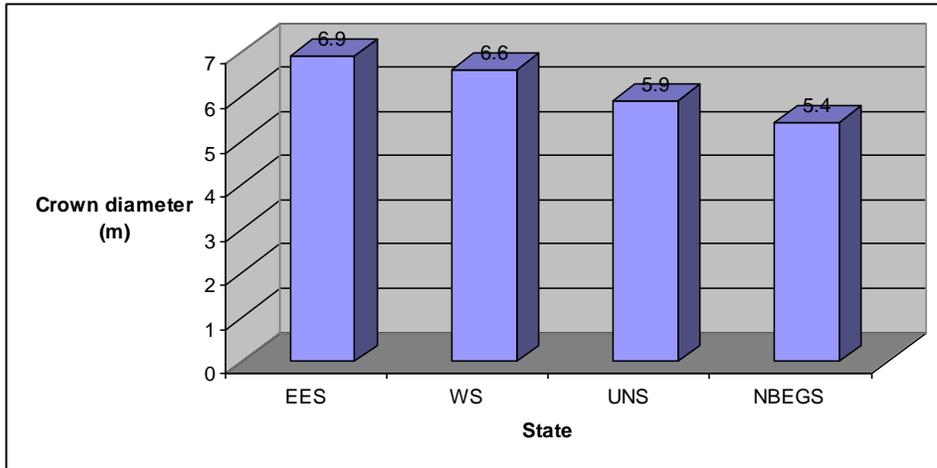


Figure 3-10: Comparison of crown diameter of *A. seyal* in EES, WS, NBGS and UNS

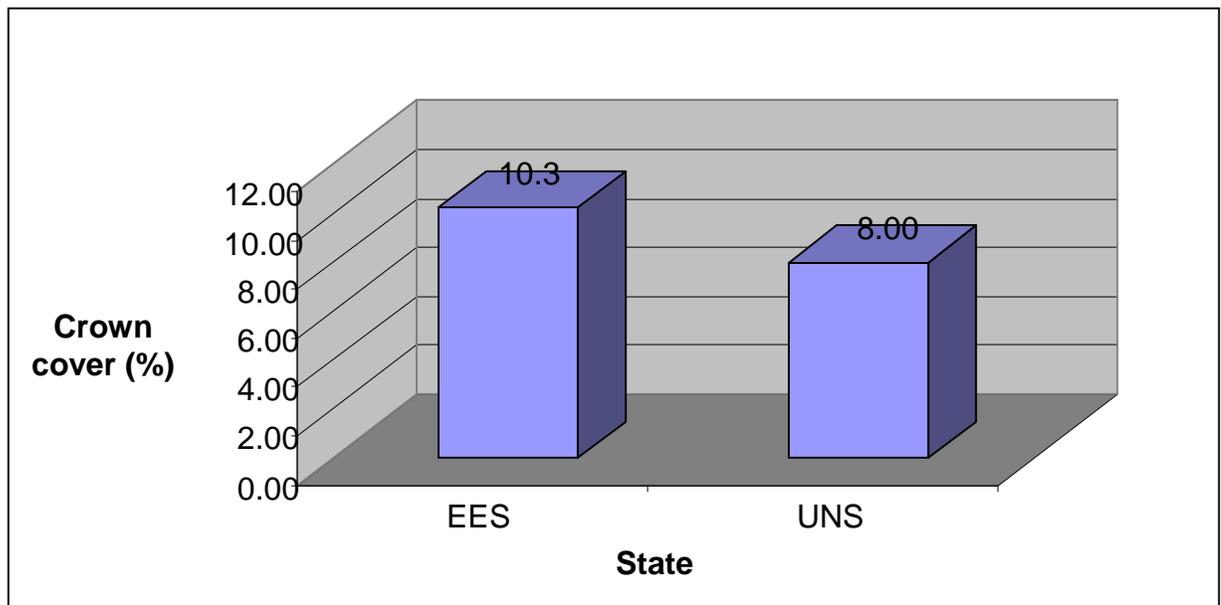


Figure 3-11: Comparison of crown cover of *A. senegal* EES and UNS

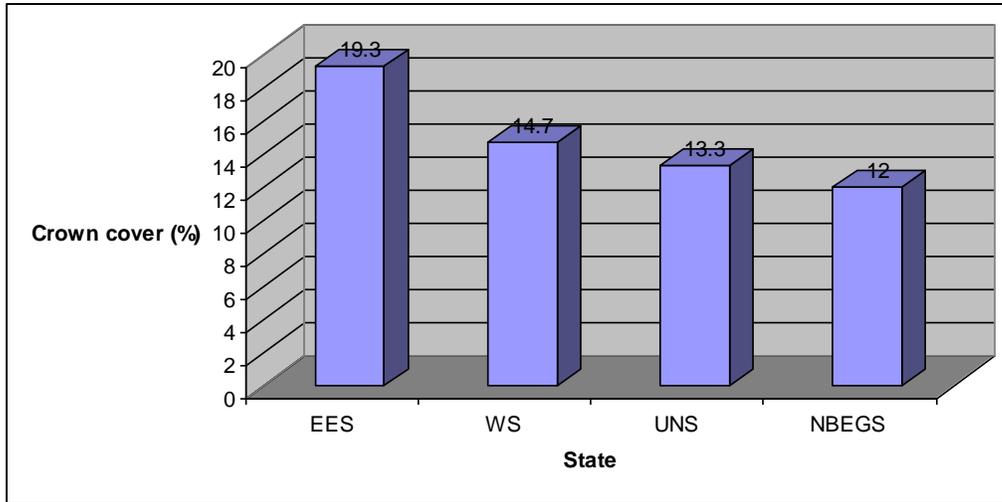


Figure 3-12: Comparison of crown cover of *A. seyal* in EES, WS, NBGS and UNS

### 3.2.4 Stocking Density

The mean stocking density for *A. senegal* was 337 stems ha<sup>-1</sup> ranging from 80 to 800 stems ha<sup>-1</sup>. UNS had a higher mean stocking density (409 stems ha<sup>-1</sup>) than EES (284 stems ha<sup>-1</sup>), Figure 3-13. This implies an overall potential gum yield from *A. senegal* of 15.0 Kg ha<sup>-1</sup> (ranging from 3.6 to 35.6 Kg ha<sup>-1</sup>) and a potential gum production of 18.2 Kg ha<sup>-1</sup> in UNS and 12.6 Kg ha<sup>-1</sup> in EES. It is envisaged that with improved tapping and post harvest handling, yields and returns to collectors would also increase. No stems of *A. senegal* were observed in the sample plots in NBGS.

The mean stocking density for *A. seyal* was 456 stems ha<sup>-1</sup> ranging from 120 to 1940 stems ha<sup>-1</sup>. UNS had mean stocking density (519 stems ha<sup>-1</sup>) that was significantly ( $P < 0.005$ ) higher (than that for EES (200 stems ha<sup>-1</sup>) but only slightly higher than to that of NBGS (495 stems ha<sup>-1</sup>) and WS (427 stems ha<sup>-1</sup>), Figure 3-14. This translates to an overall mean potential gum yield from *A. seyal* of 27.6 Kg ha<sup>-1</sup> ranging from 7.3 to 117.4 Kg ha<sup>-1</sup>) and a potential gum production of 31.4 Kg ha<sup>-1</sup> in UNS, 29.9 Kg ha<sup>-1</sup> in NBEGS, 25.8 Kg ha<sup>-1</sup> in WS and 12.1 Kg ha<sup>-1</sup> in EES. The mean stocking densities seem to be influenced mostly by growing conditions (soils, terrain) and also anthropogenic factors (Chikamai, 1997). The current uses of these resources and the soils where they occur are summarized in Tables 3-1-3-3. The disparities in stocking density within the three density classes (low, medium and high) as measured by the coefficient of variation was within acceptable limits (between 6.5 to 44 %) for *A. senegal* and (between 14.2 to 37.2 %) for *A. seyal*.

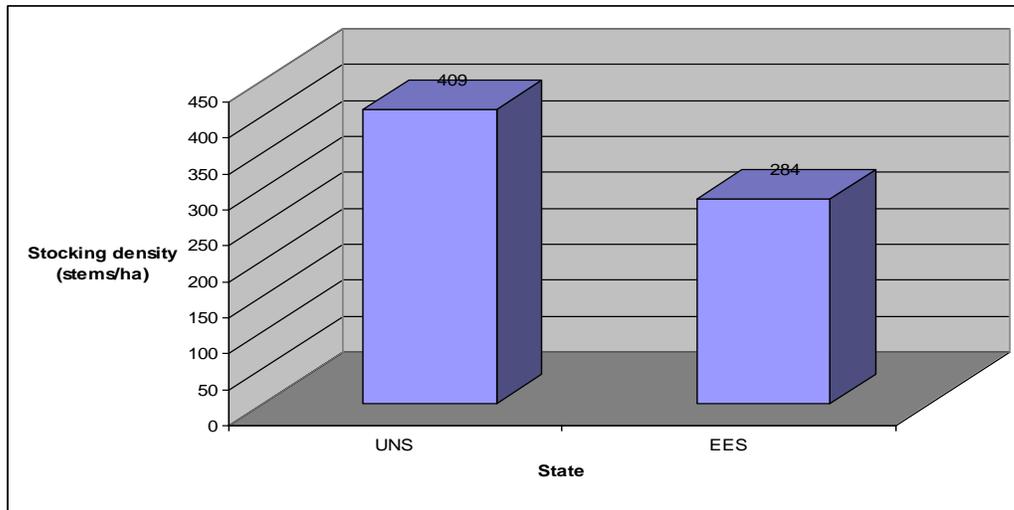


Figure 3-13: Mean stocking density for *A. senegal* in UNS and EES

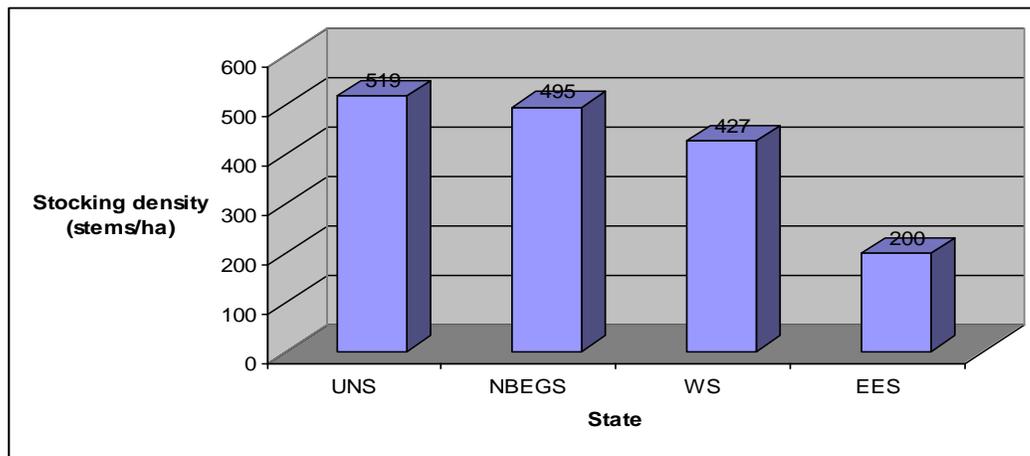


Figure 3-14: Mean stocking density for *A. seyal* in the four states

### 3.2.5 Areas Covered by Acacia Resources and Potential Gum Yield

The area covered by Gum Acacia resources (both *A. senegal* and *A. seyal*) in the three states, laid between latitude 4 and 11 and are shown in Figures 3-15 to 3-17 and Annex IV. The areas covered by these resources, the stem populations and estimated gum production potential are summarized in Tables 3-6 to 3-8.

Results of the resource mapping and inventory show that the estimated area under Gum Acacia resources in the three states (UNS, NBGS and EES) is 4,596,342.5 ha with an annual gum production potential of 25,721.9 MT. Between the two species, *A. seyal* is more abundant and widespread. It was estimated to cover 2,709,117.7 ha (58.9 %) with an estimated production potential of 20,072.2 MT (79.7 %). *A. senegal* covers an estimated area of 1,887,224.8 ha (41.1 %) mainly in UNS and EES with a potential production of 5,223.7 MT (20.3 %) per year. This is about 2.3 times the annual production of gum hashab in 2006/7 (2245 MT), SNV (2009).

*A. senegal* is currently being tapped to some extent in UNS but not in EES which does affect the quantities collected and marketed by individuals, thereby affecting their household incomes and food security. With proper training and timely tapping, yield from *A. senegal* in UNS and EES can go up significantly as it is estimated to increase production to upto 74% (Wekesa, 2010)

#### Potential for South Sudan Gum

The estimated total potential Gum Acacia production from Southern Sudan (25,721.9 MT) is about 36.7 % of the global annual production (70,000 MT), about 75.3 % of the highest annual export from the whole of Sudan in the last 15 years (34,162 MT) and about 32.2 % of the potential production in the whole of Sudan (80,000 MT).

This translates to an export value of about US \$ 43,806,550 (US \$ 13,059,250 for gum hashab and US \$30,747,300 for gum talha<sup>1</sup>, and a total income of about US\$ 8,761,310 to the collectors (US \$ 2,611,850 from gum hashab and US \$6,149,460 from gum talha). Assuming that in the short-term, 80 % of gum hashab annual production potential (5,014.44 MT) and 20 % of gum talha production potential (4,358.8 MT) can be collected and sold, an estimated total annual income to the local collectors from the sale of Gum Acacia of about US \$ 3,319,372 (US \$ 2,089,480 from gum hashab and US \$ 1,229,892 from gum talha) would be realized. The total export value could be about US \$ 16,596,860 (US \$ 10,447,400 (gum hashab) and US \$ 6,149,460 (gum talha) which is about 30.8 % of the export value from the whole of Sudan)<sup>2</sup>.

By state, UNS contains the highest amount of the Gum Acacia resources having 196,496,806 stems in 2,305,434.2 ha of land with a potential production of 11,011.7 MT. *A. seyal* resources are more abundant (1,651,344.6 ha) and widespread accounting for 8,544.20 (77.6 %) per year than *A. senegal* which covers approximately 654,640.84 ha with an annual production potential of 2,467.5 MT (22.4 %). The resources are most abundant in Renk, Maban, Manyo, Melut and Fasoda counties. *A. senegal* is more abundant in Renk county (especially in Jelihak) Wadacon, Kaka and Melut counties while *A. seyal* is quite widespread in all the five counties.

NBGS has an area of 936,131.5 ha with about 191,505,232 stems of *A. seyal* and having a potential gum production of 11,586 MT per annum. The higher potential gum production in NBGS with a lower area under the resources could be attributed to presence of sites with high density (> 800 stems/ha<sup>-1</sup>) stands.

EES has an area of 1,354,225.6 ha with gum resources with a potential annual production of 3124.2 MT. *A. senegal* resources are more abundant (1,232,584 ha) in EES accounting for 2756.5 MT (88.2 %) per year than *A. seyal* which covers approximately 121,641.6 ha with a production potential of only 368 MT (11.8 %) per annum.

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<sup>1</sup>International prices of about US \$ 2500 for grade 1 (gum hashab from *A. senegal*) and US \$ 1500 for grade 2 (gum Talha from *A. seyal*); (ITC, 2009) and local prices of US \$ 0.5 (gum hashab) and US \$ 0.3 (gum talha), (SNV 2009).

<sup>2</sup> Based on an export value of US \$53,978,036 (2005)

Table 3-6: Areas, stem populations and estimated gum production potential for *A. senegal*

State	Density class	Mean stocking density (stems $\text{ha}^{-1}$ )	Area (ha)	Population (stems)	Estimated yield (MT)
EES	Low	201	1,232,584	61,937,346	<b>2756.2</b>
UNS	Low	338	654,089.6	55,270,569	2459.5
	Medium	647	551.3	178,330	7.9
<b>Sub-total</b>			<b>654,640.8</b>	<b>55,448,899</b>	<b>2467.5</b>
<b>Grand total</b>			<b>1,887,224.8</b>	<b>117,386,245.2</b>	<b>5223.7</b>

Table 3-7: Areas, stem populations and estimated gum production potential for *A. seyal*

State	Density class	Mean stocking density (stems $\text{ha}^{-1}$ )	Area (ha)	Population (stems)	Estimated yield (MT)
EES	Low	200	<b>121,641.6</b>	<b>6,082,080</b>	<b>368.0</b>
NBGS	Low	249	795,887.0	125,153,223	7571.8
	Medium	629	104,771.5	44,004,050	2,662.2
	High	840	35,473.0	22,347,959	1,352.1
<b>Sub-total</b>			<b>936,131.4</b>	<b>191,505,232</b>	<b>11,586.1</b>
UNS	Low	327	1,628,124.4	133,099,172	8,052.5
	Medium	700	23,220.2	8,127,065	491.7
<b>Sub-total</b>			<b>1,651,344.6</b>	<b>141,226,237</b>	<b>8,544.2</b>
<b>Grand total</b>			<b>2,709,117.7</b>	<b>338,813,549</b>	<b>20,498.2</b>

Table 3-8: Total area, stem populations and estimated gum production potential for *Acacia* gum resources in EES, UNS and NBGS

	Area (ha)	Population (stems)	Estimated yield (MT)
EES	1,354,225.6	68,019,426	3,124.2
NBGS	936,131.5	191,505,232	11,586.0
UNS	2,305,434.2	196,496,806	11,011.7
<b>Totals</b>	<b>4,596,342.5</b>	<b>456,199,794</b>	<b>25,721.9</b>

### 3.2.6 Warrap State Rapid Assessment

The rapid assessment of Gum *Acacia* resources in Warrap State indicated that there were two main counties with these tree resources namely: Tonj North (mainly in Rual bet, Akop and Mariodlou Payams), and Twik (mainly in areas neighbouring Abyei). Current exploitation of the resource is in Twik County, close to Abyei. Though accessibility to this area is poor, it has good quantities of the gum resources and some Gum *Acacia* are collected and taken to Elobeid in the North.

Due to limitations of time, a visit was only made to Tonj North County and the data collected indicate that the county has a potential annual gum talha production of  $25.8 \text{ Kg ha}^{-1}$  ( $25.8 \times 10^{-3} \text{ MTha}^{-1}$ ). The actual area under gum resources in Warrap State could not be established due to limited data. However, from the probability map showing gum resources in Southern Sudan (SNV, 2009), it was estimated that the area of Warrap State with a high probability of Gum Acacia resources (i.e. area under the gum belt) was about 1,400,000 ha (38.9 % of total area of WS). The actual area with Gum Acacia resources needs to be established through a more detailed study.

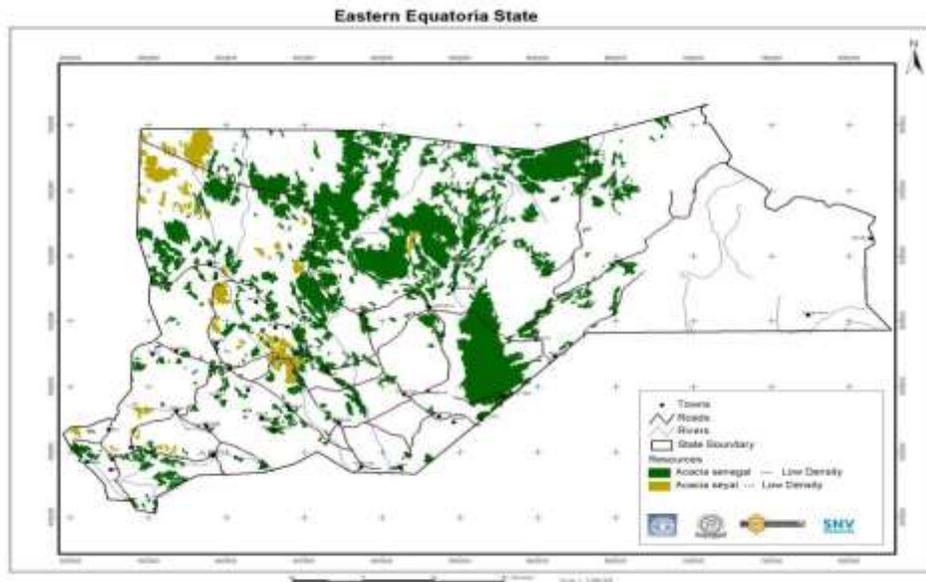


Figure 3-15: Map Showing the Distribution and Density of *A. senegal* and *A. seyal* in EES

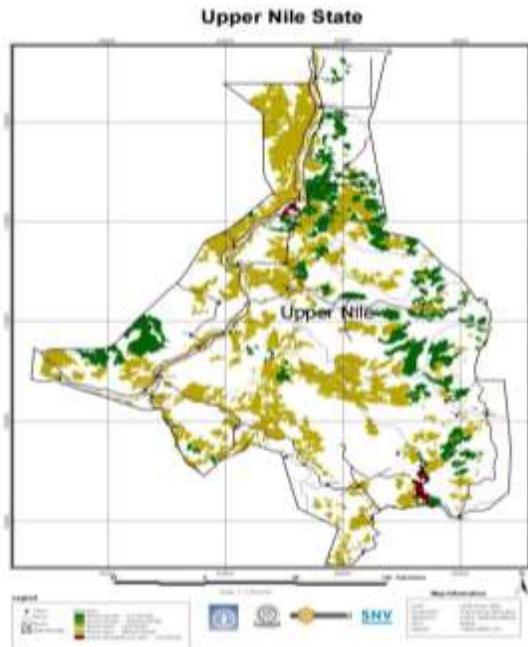


Figure 3-16: Map Showing the Distribution and Density of *A. senegal* and *A. seyal* in UNS

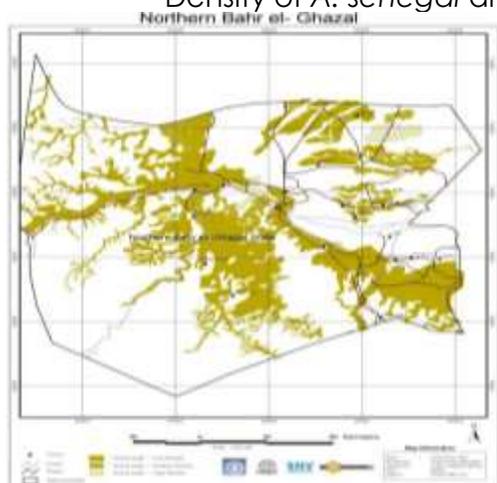


Figure 3-17: Map Showing the Distribution and Density of *A. seyal* in NBGS

### 3.2.7 Conclusions

The three states under study showed that they have abundant gum acacia resources with potential for commercial gum harvesting, collection and marketing in the near to medium term, if properly managed and tapped. The potential yield of 25,000MT from the three states can be increased with tapping and improved post harvest handling.

The available resources can be commercialized for the benefit of the rural poor which would lead to increased food security in the normally food insecure areas of Southern Sudan. For sustainability, regeneration needs to

be enhanced through seedling planting, seed broadcasting and plantation setting up. Policies for sustainable resource commercialization, utilization and management need to be put in place and enforced. GoSS MAF at all levels needs to be better equipped with resources to ensure sustainability of the sub sector. More studies in gum yields, regeneration and the other four states needs to be done so that the full potential of Southern Sudan is known for planning and decision making.

### 3.3 Marketing and Value Chain Analysis

#### 3.3.1 Players in the Gum Acacia Value Chain

A number of players are involved in the commercial exploitation of Gum Acacia resources in Southern Sudan. However, differences in resource distribution and commercialization in UNS, NBGS and EES, had an influence on their levels of involvement in the value chain. Regression analysis of the number of players against level of abundance and quantity of gum sold indicated a positive relationship, ( $R^2=0.38$ ) (Table 3-9). The level of abundance and quantity of gum sold positively influenced the number of players in the value chain implying that the higher the abundance and quantity of Gum Acacia sold, the larger the number of players in the value chain. The influence of quantity of gum sold on the number of players was significant ( $P<0.05$ ), implying that the level of commercialization of Gum Acacia measured by the number of players in a given site relies on quantities of Gum Acacia extracted and traded.

Table 3-9: Factors influencing number of players in Gum Acacia value chain

Parameter	Regression coefficients
Constant	3.157 (0.998)*
Quantity of gum sold	0.00114 (1.499)*
Level of Gum Acacia abundance	0.0837
$R^2$	0.38

The t-statistics are indicated in the parenthesis and \* denotes significance at 0.05 level

UNS and NBGS had more players in the Gum Acacia value chain than EES due to higher level of commercial exploitation. More needs to be done to bring EES and other remaining states to the same commercialization levels which will lead to increased production and marketing of gum. On average, players within value chain in the three States operated within three supply networks: local, national and export (Figure 3-18). The high number of players in UNS and NBGS demonstrates some level of

competition in the exploitation of gum in the two states making collection and marketing competitive.

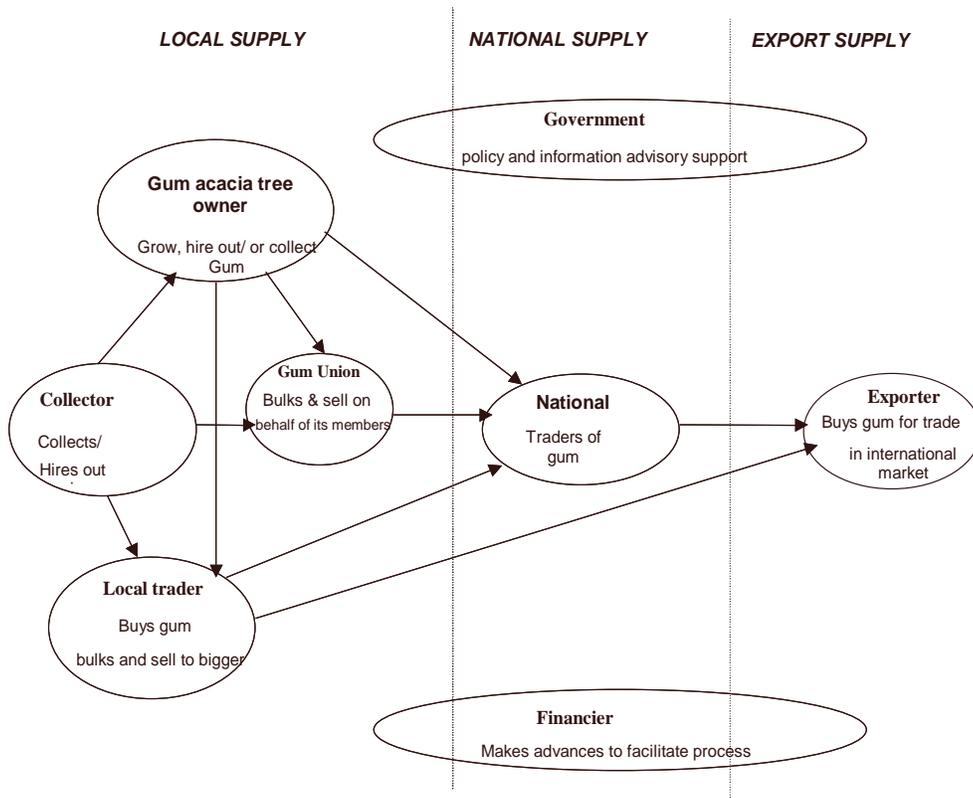


Figure 3-18: Gum Acacia Product Value Chain in Southern Sudan

### 3.3.1.1 Local Supply Network Players

The local supply network is a system whereby all players operate within a production site and are close geographically as well as culturally (Dyer and Ouchi, 1993). Players in Gum Acacia value chain within a County in Southern Sudan were observed to be operating in a local supply network and were closely knitted together culturally and in their practices. The key players included collectors, traders, fabricators, processors, transporters, financiers, and government and development agencies. The key players in each state are summarized in Table 3-10.

Table 3-10: Key players in the Gum Acacia value chain in UNS, NBGS and EES

Key Players	UNS	NBGS	EES
Gum Acacia Resource Owners	√		
Collectors	√	√	√
The Union	√		
Scouts	√		
Fabricators	√	√	
Transporters	√	√	
Traders	√	√	
Government	√	√	√
Development Agencies		√	√

In UNS the players were organized into marketing cooperative societies culminating into a cooperative union at the county level such as the Renk and Melut Gum Acacia Unions. Players in the local supply network of counties in NBGS were fewer than those in UNS. Group dynamics in NBGS was weak and majority of players in the local supply chain operated individually in their pursuit to commercially exploit Gum Acacia. In counties in EES, local players were few and the value chain was relatively simple with collectors selling their Gum Acacia through developmental organizations like the Galcholo Community Based Rehabilitation Organization (CBO).

Though Gum Acacia resource occurs naturally on communally owned land in most parts of Southern Sudan and the local community members have free access to the resources, it was observed that in UNS, some community members had individual ownership rights and either hired labour to collect the gum or leased out Gum Acacia garden(s) for collection in a season. There was a distinct difference between a collector and Gum Acacia garden owner in UNS. Therefore, the analysis drew a distinction between resource owners and collectors in UNS and reviewed them separately. Essentially, 20 resource owners and 10 collectors were identified and interviewed from UNS.

### 3.3.1.2 Gum Acacia Resource Owners

Gum Acacia tree owners were managers of gum resources occurring under private ownership arrangements. However, land ownership arrangement was not well defined. In all the three states land was communally owned but in Renk and Melut Counties of UNS community elders apportioned land with Gum Acacia resources to each clan. Each

clan in turn apportioned their share in portions of land known as "gardens" to their individual members.

Sizes of the gardens varied depending on status and ability of an individual allottee. In Renk County, for example, Gum Acacia 'garden' varied in size and averaged about 150 acres. Most of the gardens were located away from Bomas (up to 100 km away). Though, individual rights were exercised with exploitation of tree resources including gum collection, no restrictions were exercised on communal grazing. The allottee also had a responsibility of managing and conserving Gum Acacia trees within his/her garden for sustained collection.

The individual garden owners, would either collect gum acacia or lease out their gum acacia collection rights to outsiders for payment in cash or in kind. In Renk, the allottee either gets 50% of the workers collecting gum for him/her as payment or the leaser would pay about 100SDG (2004) / 50SDG (2009) for every worker brought to the allottee's garden.

Gum resources in EES and NBGS were found on communally owned land with no restrictions in accessing the resources by any party. Responsibilities for issuing directions on land use rested with traditional leaders and landlords, who were revered community members. Any tree could be tapped by anybody provided the tree was not cut down.

### 3.3.1.3 Gum Acacia Collectors

Gum Acacia collectors formed majority of players in the value chain. Communities in areas where Gum Acacia trees existed ventured in collecting gum from the wild in communally owned portions. However, hired workers, mostly from Southern Kordofan and Darfur States, were involved in gum collection in UNS where some form of individual resource ownership existed, at a fee. Locals were said to have limited skills and knowledge in gum tapping and collection hence hired outside workers were mostly used. In September – October, as a practice, scouts were sent out to look for those with skills and willing to collect gum. On average, a trader or resource owner can hire upto 150 workers in a season depending on size of garden and season. It is estimated that between 1500 to 150,000 collectors / workers collect gum in a good season.

Once recruited, collectors operated in groups of 10 to 20 to enhance their security in the forest. Collectors were transported to collection sites by tractors or pick-ups in October/November to start tapping and collection. They camp in the bush for 20-30 days working before being replaced by another team. In a season, four to five collections are made at one to three weeks interval in a season. Payment of workers is mixed cash and in kind such as sharing 1:3 for gum harvested with a down payment of 200-250SDG and then water and food provision when in the field.

Although most collectors were men, women, youths and children were also involved but this varied with sites covered, culture or religion. Collectors in Renk and Melut Counties of UNS State were mostly men. The collectors were all male (herders)(Figure 3-19). However, in NBGS, both male (57%) and female (43%) were involved. The involvement of female collectors, who are also the bread winners in most households in NBGS was also observed by SNV. (2009)

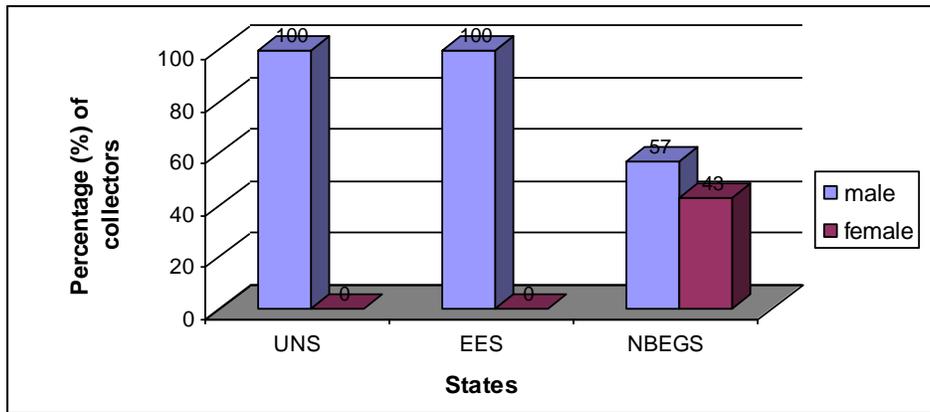


Figure 3-19: Collectors (%) in the States covered

#### 3.3.1.4 Local Traders

Local traders in local supply network operate at stores located at local market centers in the Bomas, Payams and local county towns and mostly agents for the national traders. From the study , it is evident that UNS and NBGS had the highest concentration of active gum traders who are located in virtually every centre within active production sites.. However, EES had very few local traders involved in buying gum despite having high concentration of Gum Acacia producing trees. For example:

##### NBGS

- Warawar – 6 traders; Malith market – 10 traders; Raildit Village – 1 Trader; Leith & Arieu – 1 trader

##### UNS

- Kaka – 10 traders; Melut – 1 big trader and 100 small village traders; Jelahak – 6 traders; Renk town market – 6 traders

##### EES

- Kapoeta – 1 trader; Kimatong – 1 development organisation (CBO)

Local traders often got Gum Acacia from collectors in small quantities and bulked it up for sale to national dealers/ brokers or exporters. The average quantity transacted by a single trader in a year varied across states. Traders in UNS transacted the highest quantities of gum (46,950Kg/trader) whereas traders in EES transacted the least averaging a paltry 2000Kg/trader (Figure 3-20). Local traders in NBGS where gum

derived from *A. seyal* is produced transacted an average of 11,984Kg annually.

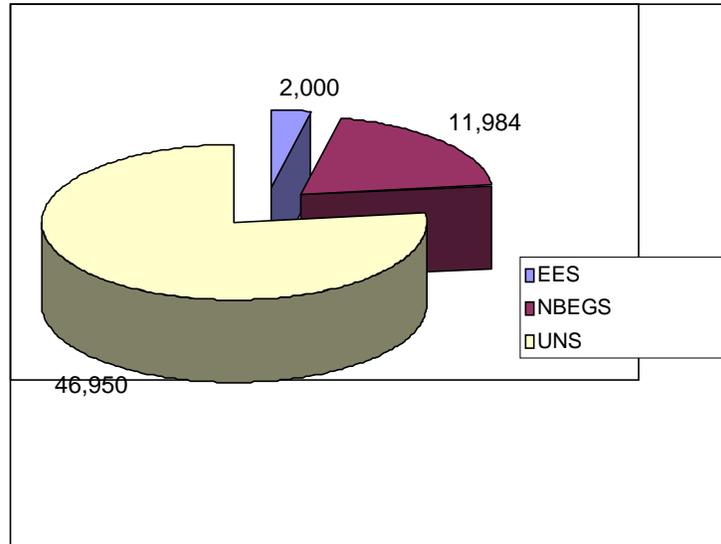


Figure 3-20: Average annual quantities of Gum Acacia transacted by local traders

Local traders buy gum either brought over to their stores by collectors and/or go over to the collection points to scout for the gum to buy. Apart from buying gum at the stores located in market centers and local towns, majority of traders (80%) in UNS also went out to buy gum from collection points (Figure 3-21). Only 10 % of traders bought gum from collection points in NBGS.

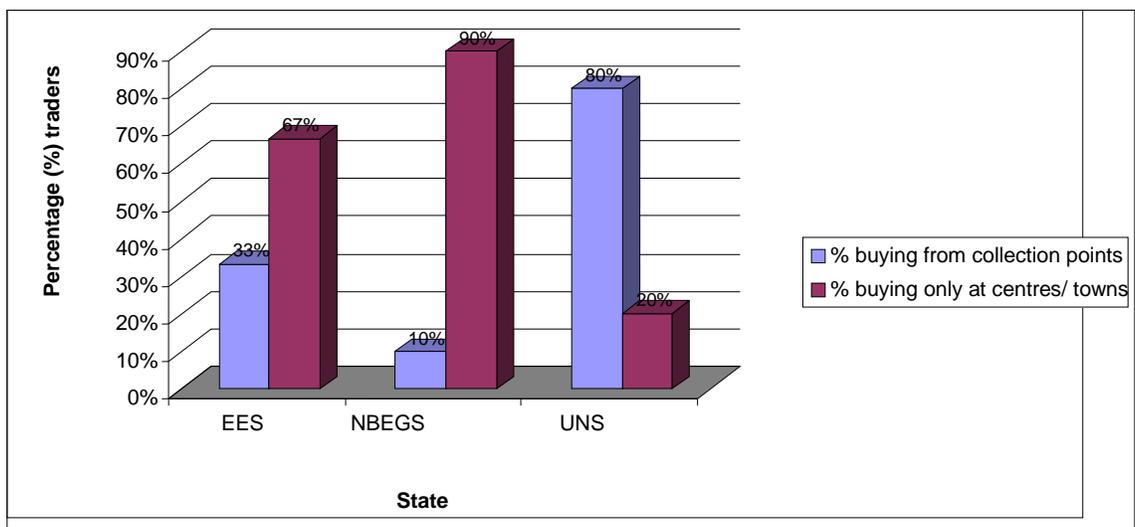


Figure 3-21: Traders buying gum at collection points and centers/towns

Gum prices by local traders were varied over the sites and years. Unit prices for gum at collection points were lower than those in centers/towns. Traders in UNS bought gum from collectors at the sites and centers/towns at average prices of SDG 1.8 /Kg and SDG 2/Kg, respectively in 2010 (Figure 3-22). During the same period, traders in NBGS bought gum at 1.25SDG to 1.5 SDG/Kg from collectors at collection points and at their stores located either in centers or town respectively. Local trade in EES was low and collectors sold gum through the support of local development agencies or sold directly to national dealers at stores located in local market centres in Kimatong or Kapoeta town.

The local traders sell their gum to town/centre traders at a slight higher prices such as : in UNS the price ranges between 2.25SDG/kg to 3.75SDG/kg while in NBGS the traders sold at 2SDG/kg to 4SDG/kg depending on who bought or where they sale the gum.

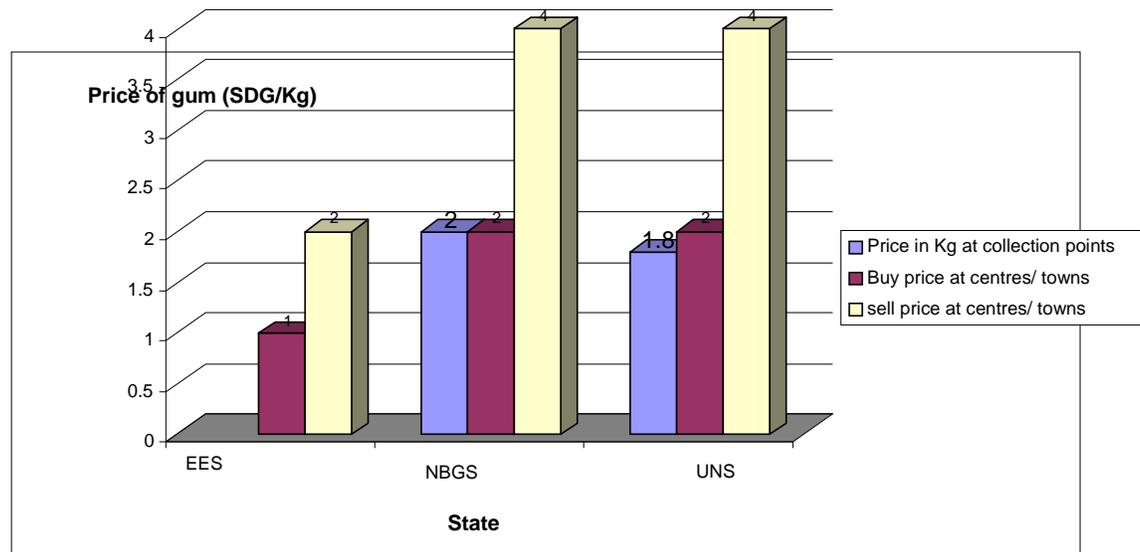


Figure 3-22: Buying and selling prices (SDG/Kg) for gum at collection points and centers/towns

The prices were unsteady over the last 8 years with highest prices realized in 2005 (Figure 3-23). The least prices were in EES covering only two years (2009 to 2010). However, it was not possible to get good time series data covering unit prices over a longer period of time.

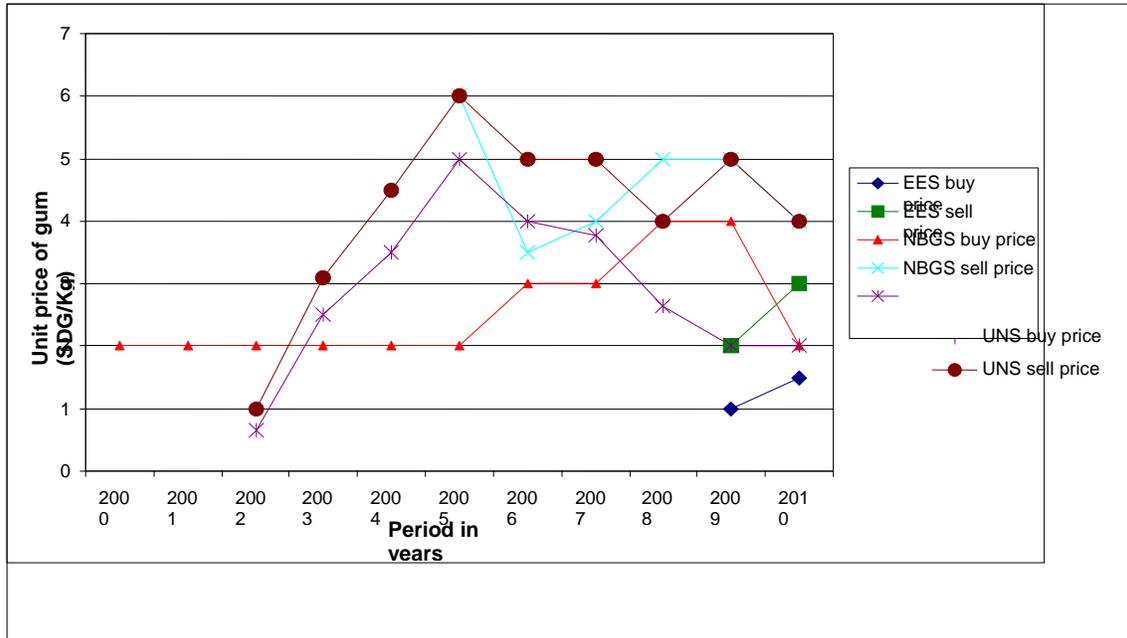


Figure 3-23: Time series unit prices (SDG/Kg) for Gum Acacia traded by local traders in Southern Sudan

### 3.3.1.5 Transporters

Transporters operating with different modes of transport were involved in transportation of gum from collection points to the stores. These included human portorage, donkeys, bicycles, tractors and trucks. Human portorage was commonly applied during collection whereby collectors carried their collections on their backs and head to bulking sites before transportation to the market using donkeys, bicycles, tractors or trucks. Tractors and trucks were mainly used by Gum Acacia resource owners who owned gum 'gardens' or brokers and owned such transport facilities and this no easily accessible to collectors because of the cost of hiring and that there are very few available tractors or trucks .

In UNS, tractor owners charges about 2SDG per 100kg bag of gum from the collectors point to the local stores while in NBGS, bicycle owners are engaged by traders and are paid on commission basis. In EES, collectors rely on donkeys or human portorage, with local traders hiring motorcycles or trucks to haul the gum from collection points.

### 3.3.1.6 Materials suppliers and fabricators

Most centres and towns within Gum Acacia producing sites had dealers who acted as suppliers of materials for the collection, packing, transportation and marketing of the gum. The materials included: new and used sacks (bags), food rations, medicines, clothing, beddings, water, and collection kitty. Prices of sack differ depending whether new or old or by type , in UNS and NBGS 100 kg jute sacks costs 2SDG/old bag and 4SDG/ new bag while in EES 50kg polythene sacks are normally bought

from Juba or Kenya .

Fabricators of tools used in tapping and collection of gum were found in most centres within production sites of UNS. Among these fabricators were metal smiths who fabricated farm tools for sale to producers, collectors and retail traders just before and during the gum acacia tapping and collection season. As a common practice with most artisans and craft-persons in rural environments, metal smiths practiced their craft in many different metals, with most using iron.

### 3.3.1.7 Players in the National Supply Network

The national supply network is regarded as that system whereby all players operate within boundaries of a Country (Dyer and Ouchi, 1993). In such a situation, the systems, processes, cultures, products, descriptions and languages are diverse. However, the rules of play are same and all players are required to conform to similar regulatory frameworks. Field observations showed that players within the national supply network in Southern Sudan were diverse and included national Gum Acacia dealers, transporters, financiers and regulatory agencies. At this level, governmental, financial and development agencies were observed to be more active.

### 3.3.1.8 National Gum Acacia dealers

National Gum Acacia dealers were the large traders and transporters involved in buying, transporting and bulking the gum for sale to exporters. It was observed that large dealers were few and mostly operated from Northern Sudan. This is historical in that for along time gum trade was concentrated in the north with most of the establishments and dealers located in Khartoum and Port Sudan. The Gum Arabic Company Ltd. (GAC), which held a monopoly position for export of crude Gum Acacia from Sudan until 2008 when it was wound up operated from Khartoum. During its operation, GAC exerted monopoly in Gum Acacia sub-sector and was involved in facilitating collection and trade in Gum Acacia in the whole Republic of Sudan. All gum traders were supposed to pay royalty on all their sales. However, the operation was a mess and traders who traded gum through GAC often had great difficulty in obtaining payment leading to cross-border smuggling.

After the signing of the CPA in 2005, GOSS mandated the Nile Commercial Bank to support the producers in Southern Sudan financially. The bank was to work in partnership with GOSS-MAF, Counties and producer associations. As prices of Gum Acacia were being fixed without due consideration of production costs, world prices, taxes etc, thus bank was therefore unable to promptly facilitate the collectors and traders. This resulted in the dwindling of the production and trade in gum in the South making the arrangement not to hold. Since then, collectors and local traders were left at the mercy of the Northern traders who could come on

ad hoc basis. In 2007, GOSS permitted South Sudan Gum Company Ltd. to trade in Gum Acacia. Since then, the company markets the Gum to United States of America, United Arab Emirates (UAE) and India through Mombasa port in Kenya.

During the survey, it was pointed out that most national gum dealers (80%) bought gum delivered to their stores in major urban centers such as in UNS – Renk town, in NGBS – Warawar town or Elo Beid in North Kordfan while in EES – Kapoeta town. The rest went over to centers within production points to buy from local dealers. Unit prices offered for gum by national dealers were higher than those by local traders ranging from 2.75SDG/kg to 4SDG/kg. Some local traders in NGBS preferred to take their gum to Elo Beid where they fetch higher prices (upto 4SDG/kg) than selling to national traders who come to Malith or Warawar (2- 3SDG/kg).

An example of the national traders' costs in order to haul their gum from main towns in gum producing site to major towns in preparation for export:

Costs	UNS
Forest office	12SDG/100kg bag
Transport	5-10SDG/bag
Weighing Bags	1.5SDG/bag
Zakat or Christian Tithe	10% of total value of 1 bag
Tax	% of value of 100kg bag
Gum Union	1.5SDG/bag
Bag	2-4SDG/bag
Loading Porters	1.5SDG/bag
Form 15 and Form 47	15% of value of 1 bag
Payam levy ( if national buyer goes to collectors)	2SDG/bag
County	6 SDG/100kg bag
Cleaning, sorting and grading	1SDG/kg

### 3.3.1.10 Players in the Export Supply Network

Export supply network involve operations with global supply dimensions. This involves networks within regional and international markets. Key players within the export supply network included exporters, transporters, financiers and regulatory organizations. It was observed that exporters of gum originating from Southern Sudan operate at two levels: regional and international markets. Regional traders involved those who operate within the Eastern Africa Region including Ethiopia, Kenya, and Uganda. Some Gum Acacia, especially from Eastern Equatoria State is sold to traders from East Africa (Kenya and Uganda). However, these cases were minimal. Smuggling of gum was reported to

occur through some borders especially with Northern Sudan and Ethiopia.

#### 3.3.1.11 International Market Dealers

International market dealers involve export traders (exporters) and transporters who operate within the international supply network. The main operation bases for exporters and transporters are the ports of exit including Port Sudan and Mombasa. For a long time, most of the gum originating from Southern Sudan was exported through Khartoum and Port Sudan where most of the international market dealers are located. Marketing through Mombasa and Djibouti is a recent practice and the number of dealers in them is comparatively lower. A few international dealers (3 companies) are also directly establishing themselves in major urban centers in Southern Sudan including Juba, Malakal and Renk.

#### 3.3.1.12 Other players in the Gum Acacia value chain

At all levels, the governmental, non-governmental (NGOs), community and faith based (CBO/FBO), financiers (banks and micro-financiers) and different development agencies exist. The governmental organizations include ministry departments that offer policy, advisory, regulatory, management and conservation functions in the Gum Acacia sub-sector. The government departments include those in Ministries of Agriculture and Forestry, Transport and Communication, Finance and Trade. The most crucial is the Forestry Department in the Ministry of Agriculture and Forestry whose mandate includes management and conservation of the Gum Acacia sub-sector for the good of the country.

During the field surveys, it was observed that the Directorate of Forestry had offices in every County and most Payams that produce Gum Acacia. The staff at County level were facilitated with office space and inadequate transport. However, such facilitation was inadequate in Payams. In addition, most of the staff charged with responsibilities of ensuring the management and conservation of Gum Acacia resources were inadequately equipped with necessary theoretical and practical capacities to effectively and efficiently discharge their duties. Some of the Payams were also in remote areas with poor roads, prone to floods and had no mobile telephone network coverage. These pose a challenge to effective and extensive extension services.

There were many NGOs (local and International) and CBOs in Southern Sudan either directly or indirectly involved in the promotion and development of Gum Acacia sub-sector. Most worked in the food security and livelihood sub-sector in partnership with international development agencies including Food and Agriculture Organization of the United Nations (FAO), World Food Programme (WFP) and

Netherlands Development organization (SNV). SNV (2009) identified various organizations, current activities, and potential roles in the Gum Acacia sub sector as elucidated in Table 3-11.

Table 3-11: Key potential Players in Gum Acacia sub-sector

<b>Organization</b>	<b>Counties covered</b>	<b>Roles and Potential role in Gum Acacia sub sector development</b>
GOSS MAF	All	Policy development; Resource development, management and conservation; Licensing and certification ; Resource mobilization; coordination of all actors
SNV	Counties in UNS, EES, Abye, Jonglei	Championing the gum subsector development activities; Public policy dialogue; Market intelligence and linkages; Capacity building at different levels; Resource mobilization; Multi stakeholder forum; Knowledge development ,brokering and Networking
NGARA	N/A	Capacity building; Networking; Resource assessment and mapping; Research; Information and Knowledge sharing, Resource Mobilization
FAO	All the 12 Counties in UNS, All Counties in NBEGS, All counties in WS	Support mapping of gum resources; Resource mobilization; Coordination of implementing partners; Logistics; Monitoring and evaluation system
USAID Winrock Int & ACDI AVOCA	Aweil E, Aweil W and Aweil N in NBGS, WS and US	Value chain analysis; Support to producer groups; Capacity building; Resource mobilization
IRD	Malakal, Bailliet, Ulang and Nasir in UNS	Mobilization of resources; Capacity building & information sharing; Linking producers to markets
Consortium (Mercy Corps)	Renk in UNS and Aweil East in NBEGS	Gum Acacia can be an activity in economic recovery and development programme
CARE International	Malakal, Bailliet and Maiut in UNS	Capacity building on Village savings and loans programmes
Wildlife Conservation Society	JS, CS and EES	Resource management planning, mobilization of resources, Strengthening of the NRMG at GoSS level.
NPA	Bailliet, Nasir, Maiut, in UNS Lunguchuk, Maban in EES	Local and international advocacy; Have interest in promoting Gum Acacia related activities
Galcholo CRO	Budi (Kimatong')	Facilitation of producers to collect Gum

Sources: SNV (2009) and GoSS MAF/ FAO SIFSIA 2010

Financial institutions have been involved in supporting commercial exploitation of Gum Acacia in Southern Sudan. The key financial institute involved has been the Nile Commercial Bank in 2007/2008 after being approached by GOSS to help develop the Gum Acacia sub-sector. The bank was required to facilitate the buying of gum from producers in Upper Nile State while GOSS committed itself in looking for appropriate export market. The bank too provided vehicles to protect the sub-sector from smugglers. Using cereal stores and shops in Renk County, the bank was able to buy 800 to 1000 metric tons of gum from Renk, Wadokona, Jelahak, Maban and Kaka in 2007/2008 at SDG 3/Kg. The gum was cleaned, and transported by ferry to Juba but faced challenges in marketing . Finally the bank exported the gum to Canada and ever since it has not ventured into that form of business again.

Micro-finance is still in its infancy stages of growth in Southern Sudan..SNV (2009) observed that GOSS had taken steps to support and promote micro-finance in Southern Sudan. The Central Bank (Bank of Southern Sudan) in partnership with the private sector was in the process of transforming the micro-finance sector. This would result in enhanced opportunities for the creation of more micro-finance schemes in the Gum Acacia producing States in order to help producers and traders acquire financial resources for increased exploitation of the gum. There are about four key micro-finance companies that could be approached: Sudan Micro-Finance Institution (SUMI), Building Resources Across Communities (BRAC), Finance Sudan Co. Ltd., and AMURT International.

### 3.3.2 Strategic Operations and their associated Costs and Benefits in the Gum Acacia Value Chain

#### 3.3.2.1 Management and conservation of the Gum Acacia trees

Gum Acacia production begins with the resource owner, who tends and protects the trees throughout the year. The land use system for gum production is a bush, which doubles up as grazing land. Some sites especially in UNS practiced a system similar to bush fallow practiced commonly in Gum Acacia producing sites in the north. In this system, the bush is alternated with crop cultivation under shifting cultivation. In this case each plot of land is used to cultivate crops for some successive years then is left for some years to be under regenerating Gum Acacia trees. When crop (mostly sorghum) production declines, the plot is let to be fallow to allow Gum Acacia trees to coppice and regenerate naturally. Such bush fallow system is quite beneficial in that the tree offers a number of environmental benefits, the most important are that its extensive lateral root system reduces soil erosion and run off and as a leguminous tree it fixes nitrogen which improves soil fertility (Pearce 1988; Barbier 2000). Deans *et al.* (1999) predict nutrient and organic matter accumulation in

*A. senegal* fallow over 18 years in Northern Senegal and recorded a substantial increase of Nitrogen (N) and Potassium (K) in surface soil with plantation age. Their study concluded that N accumulated in 15 years of fallow provided good sorghum yields for at least four cropping cycles. Based on these benefits, *A. senegal* is a preferred species in the semi-arid areas of the Sahel and is used on a large scale as a buffer zone against desertification.

Gum Acacia is primarily collected by resource poor community members. Barbier (2000) observed that such members of the community give priority to food crop production (usually sorghum) to secure family nutritional needs but seek other sources of income to meet the household's basic needs other than grains. They harvest Gum Acacia because this activity constitutes a crop diversification strategy to mitigate crop failure. In addition, the acacia tree's long lateral root system reduces soil and wind erosion. It has a regenerating impact on the land. However, Barbier (2000) acknowledges that Gum Acacia production does compete with food and cash crops in resource allocation especially labor and land.

During the study, it was noted that in EES, gum collection is done mostly by livestock herders or pastoralist communities as they move with their livestock in search of grazing and water. Gum provides alternative source of income to pastoral communities especially to meet the immediate household needs such as grain, salt, medication, books, beads for women, shoes etc, when there is no other source for income. Gum is also normally mixed with milk and given to children or youth as they herd livestock. During the drought years, gum plays an important role in food security as it is harvested for family consumption. It was also noted that gum is used for medicinal purposes.

One of the key challenges on resource conservation observed during the study was the cutting of *A. seyal* for the more lucrative charcoal production (Plate 3-3). Fuel wood has a greater demand than gum Talha, probably due to the lower prices offered for gum Talha as compared to gum Hashab. In UNS, charcoal from gum Talha is sold in Khartoum and later exported to Middle East. In NBGS where gum is produced mainly from *A. seyal*, these trees are threatened due to excessive felling for sale as fuel wood for firing bricks and baking bread (Plate 3-4). *A. seyal* is considered one of the best firewood (Duke, 1983).



Plate 3-3. Charcoal from *A. seyal* in UNS



Plate 3-4. Firewood from *A. seyal* for firing brick making plants in NBECS

### 3.3.2.2 Gum Acacia tapping

The tapping together with collection of gum is done seasonally. Tapping for gum production is done only for *A. senegal* trees beginning as early as mid October to early November, usually after the long rains when the trees are just starting to shed their leaves. The tapping periods for the gum are summarized in Table 3-12.

Table 3-12: Tapping periods for Gum Acacia in Southern Sudan

State	County	Type of gum	Tapping period
UNS	Renk	<i>A. senegal</i>	October-November
	Melut	<i>A. senegal</i>	November
EES	Budi	<i>A. senegal</i>	December
	Kapoeta North	<i>A. senegal</i>	December

At exactly the right time of year, determined by their knowledge, local conditions and expertise acquired over many years (usually by end of October), Gum Acacia tree owners/collectors “tap” their trees. Tapping is done mainly using a sonke, an axe, a knife or a machete. SNV (2009) observed that at least 25% of tappers in Renk used a sonke, which is the recommended tool for tapping. However, usage of sonke in other sites was limited or none. It was observed that a sonke is expensive and beyond reach of most tappers who are resource poor. A sonke costs SDG 20-25 (US\$ 8-10) per piece. This made most tappers to use inappropriate

tools like an axe, a machette or knife, which were readily available in homesteads.

Tapping is done on mature *A. senegal* trees. Tapping is done by making incisions in the branches and stripping away the bark to accelerate exudation (Plate 3-6). SNV (2009) observed some inappropriate tapping in UNS that require to be rectified for sustainable exploitation of the resource. Tapping was done on the whole tree trunk and on all branches. It was done using hired labour or by tree owners themselves. Resource poor tappers often got financial facilitation from local traders or local gum dealers for advances to facilitate the process.



Plate 3-4: Tapping of *A. senegal* trees in UNS

Most agricultural operations, including Gum Acacia harvesting, are primarily financed by village traders who are mostly agents to big national buyers . Typically, the traders provide cash, seeds, tools but also basic commodities (water, sugar, and food) for the households to get by during the “hunger gap”. Tappers pay back in kind at prices determined early in the season and usually integrating important credit charges. In Upper Nile State, a collector is required to get a permit to tap or collect gum from the forest department by paying SDG 2 (US \$ 0.8) per season.

### 3.3.2.3 Gum Acacia collection

According to SNV (2009), more than 150,000 resource poor agro-pastoralists are involved in tapping and collection of gum in Southern Sudan. Collection of the gum is carried out between December and May. The collection period of gum in each state is summarized in Table 3-13. Collection period for gum from *A. senegal* (4 months) is relatively shorter than that of gum from *A. seyal* (5 months). Usually collection is done in 4 to 5 phases depending on the site and rains. Second harvest phase takes most days mostly lasting 15 to 20 days (Table 3-14). The last phase takes least number of days lasting only 3 -4 days.

Table 3-13: Collection periods for Gum Acacia in Southern Sudan

State	Country	Type of gum	Collection season
Upper Nile	Renk	<i>A. senegal</i>	December - March
	Melut	<i>A. senegal</i>	December - March
Eastern Equatoria	Budi	<i>A. senegal</i>	January - April
	Kapoeta North	<i>A. senegal</i>	January - March
Northern Bahr El Ghazal	Aweil East	<i>A. seyal</i>	January - May

Table 3-14: Collection/harvesting days in normal season

Harvest Phase	Period	Number of days
1 <sup>st</sup> Harvest	45/50 days after tapping	8-10 days
2 <sup>nd</sup> Harvest	15 days after 1 <sup>st</sup> Harvest	15-20 days
3 <sup>rd</sup> Harvest	15 days after 2 <sup>nd</sup> harvest	10 -12 days
4 <sup>th</sup> Harvest	15 days after 3 <sup>rd</sup> harvest	6-8 days
5 <sup>th</sup> Harvest	8 days after 4 <sup>th</sup> harvest	3-4 days
Total Days in a season		42- 54 days/ season

Gum Acacia collection was either done by tree owners and their household members or by hired labour (in UNS). Workers were given an advance payment of SDG 200 each and on delivery of the gum, the income is shared in a ratio of 3:1, (owner: worker). In EES, collection was done by local communities who sold it to Galcholo CBO at an average price of SDG 1/Kg. However, collection of the gum in Counties in EES was inconsistent over the years largely because of lack of consistent market outlets despite the willingness of most of the community members interviewed.

Average annual collection of Gum Acacia realized by an individual collector was highest in UNS (29.2Kg/day) were tapping was done and least in NBGS (13.5Kg/day) on natural exudates. Collections realized generally rose from first collection to highest during the second collection and then declines till the last collection (Table 3-15; Figure 3-24). Average yields per collector in a season ranged from 650 kgs (NBGS) to 1,400kgs (UNS) depending on season – temperatures, rainfall and start of next season, collector’s ability and distant to acacia forests.

Table 3-15: Quantities of gum realized by a collector per collection phase

State	County	Phase 1 (Kg)/day	Phase 2 (Kg)/day	Phase 3 (Kg)/day	Phase 4 (Kg)/day	Phase 5 (Kg)/day	Mean
UNS	Renk	15.9	49.8	27.7	22.5	-	29.0
	Melut	32.9	27.6	34.5	22.3	-	29.3
	Mean	24.4	38.7	31.1	22.4	-	29.2
EES	Budi	25.4	32.5	29	22.4	-	27.3
	Aweil	12	12	12	12	-	12.0
NBE	East	15	15	15	15	12	15.0
GS	Wanjok	15	15	15	15	12	15.0
	Mean	13.5	13.5	13.5	13.5	12.0	13.5
TOTAL MEAN		21.1	28.2	24.5	19.4	12.0	23.3

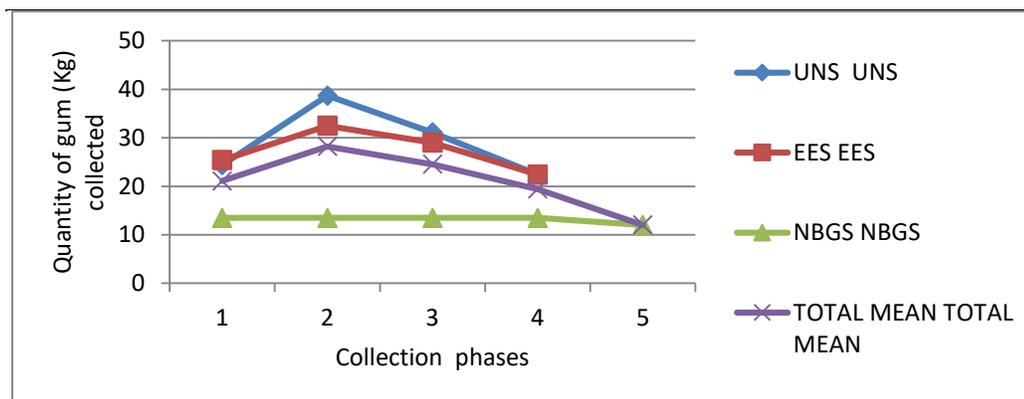


Figure 3-24: Quantity of gum (Kg) per collection phase in a season in UNS, NBEGS and EES

### 3.3.2.4 Cleaning, sorting and grading

The producers only cleaned the gum but there was no grading at the producer level. Collected gum was cleaned by removing debris, packed in gunny bags (either 50 or 100 Kg) and stored in structures that acted as store houses to await the sale to gum dealers. All the gum was bought as one with no grading or classification done. Grading was done by the exporters. Efforts to cleaning of gum at Kimatong' was not up to the required standards as there were still some traces of bark on the gum. Generally producers in the study states require further training on this if the gum is to fetch a higher price in the market thereby ensuring increased incomes to collectors.

### 3.3.2.5 Storage

In UNS, it was reported that the gum collected is stored buried in large holes dug on the ground, wrapped in polythene sheets and covered with soil. As Gum Acacia is sold on weight basis, this method is considered by the collectors as an appropriate and effective way of controlling moisture loss from the gum in order to maintain weight of gum until a trader purchases it. In Kimatong' the gum collected was sold and taken to a

store owned by Galcholo community rehabilitation organization for storage and sale. In NGBS, gum was packed into sacks and then brought to the village market or centre market on weekly basis. The gum is stored in mud and dagga or tented storage facilities in village markets and more durable structures in towns and big centres. In some villages or payam centres rent space to store gum for a rental fee of upto 200SDG/month depending on size and location. Well ventilated grading and storage facilities need to be constructed in the gum producing areas so that post harvest losses are reduced and quality of gum increased.

#### 3.3.2.6 Packaging, loading and off-loading

Gum Acacia being a natural product must be packaged carefully 'in a manner that allows aeration' so as to facilitate polymerization in the course of its transportation. It should be packed in natural weaved or synthetic fibre bags. Gum Acacia was mostly packaged in 50 kg bags unlike in the past when it was packaged in units of 100 Kg. It was reported that most collectors in UNS and NGBS use jute bags for packaging gum. However, a few were observed to be using polythene bags mainly because they were cheaper and occasionally due to lack of knowledge. In EES, collectors use traditional bags or coconut leaves to package gum as they transport this to the central store where it then packed into polythene and jute bags depending on availability. In NGBS, gum was mostly transported to market in polythene bags and the repackaged by bulking traders into 50 or 100kg jute bags. Prices of jute bags is 2SDG/bag if old and 4SDG/ bag if new. Polythene bags are 1SDG/50kg bag.

Once gum is bagged , manual loading to trucks or containers costs between 1.5 - 3SDG/bag depending on size. It was learnt that if one is using Nile river transport, offloading port charges is 15USD/MT while other international ports charge only 5-6USD/MT. Where mobile cranes is used it costs about 150- 250SDG/hr. It was however noted that there are fewer mobile cranes in Southern Sudan and this is found in Juba only making it difficult to load a 20 or 40ft container in Renk or Malakal due to poor port facilities. Loading has to be done manually.

#### 3.3.2.7 Trade of Gum Acacia

Trade of the gum is the major operation carried out by players in the value chain. Annual quantities of Gum Acacia traded over time in each state could not be computed from the data obtained from the surveys as the data was incomplete and not representative enough for making inferences. In addition, record keeping by gum producers and dealers was poor. Most of the interviewees relied on their memories to give information, which made it harder for giving quantitative answers. Data from prescriptive literature show that annual Gum Acacia traded from Southern Sudan is about 10% of total Gum Acacia produced and traded in the whole Republic of Sudan (SNV., 2009). Therefore, this percentage was applied in quantifying the quantities of Gum Acacia traded from Southern Sudan.

In general, there was a declining trend in quantities of Gum Acacia produced and traded over years from 1970 in Southern Sudan. A declining trend line fitted the data with a coefficient of determination ( $R^2$ ) value of 0.315 implying that about 32% of variability in quantities transacted was explained by a declining trend line (Figure 3-25). The estimated equation was  $Y = 121341 - 59.695X$  with Y as gum quantity and X as period in years. The estimates were statistically significant at 1% level and variable X had a negative coefficient indicating a negative relationship between quantities transacted and period i.e. a decline by 59.7 MT of gum quantities transacted with each increase in the year period.

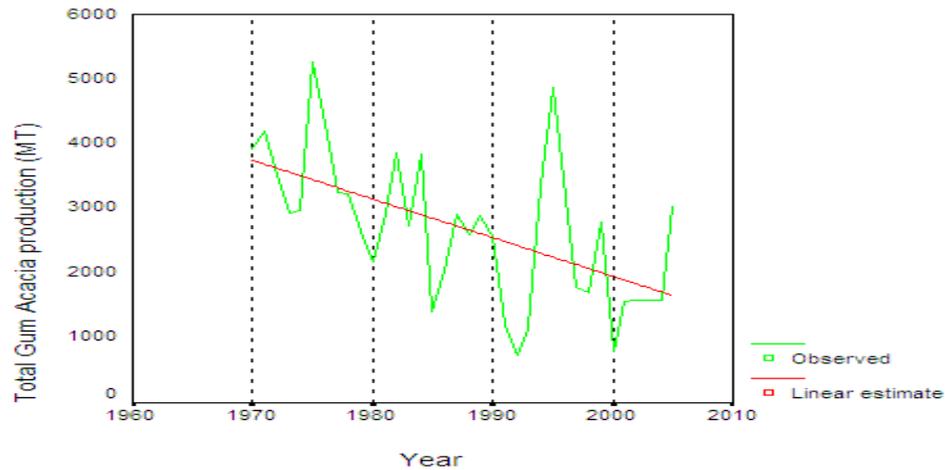


Figure 3-25: Total Gum Acacia production in Southern Sudan

Comparing the two types of gum produced in Southern Sudan, the *A. senegal* gum (Hashab) that forms bulk of the quantities transacted showed a declining trend over the years from 1970 (Figure 3-26). The declining trend line had a  $R^2$  of 0.435 implying that about 45% of variability in quantities of gum transacted was explained by a declining trend line. The equation for the trend line was  $Y = 133665 - 66.088X$  with estimates statistically significant at 1% implying that each year increase would result to a decline in gum quantities transacted by 66 MT.

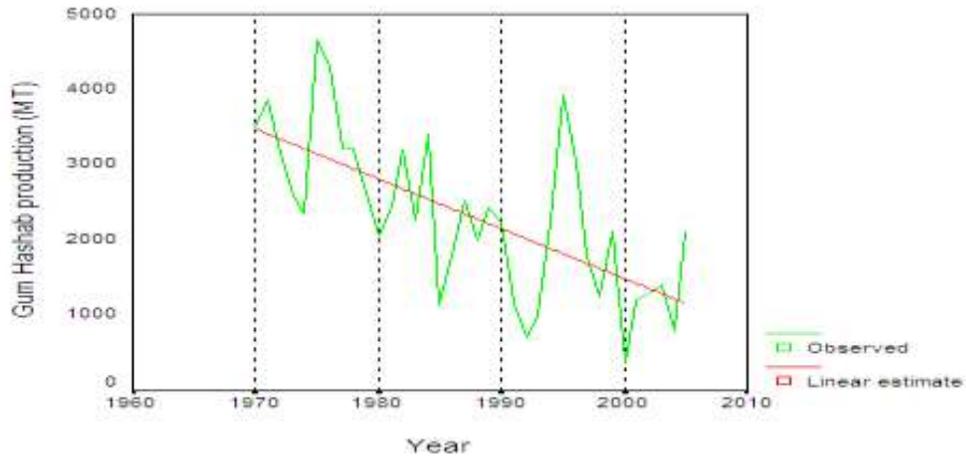


Figure 3-26: *A. senegal* (Hashab) production in Southern Sudan

The *A. seyal* gum (Talha) on the other hand had an increasing trend in quantities of gum transacted over the years (Figure 3-27). However, the  $R^2$  value for increasing trend line was low (0.056) implying that increasing trend line only explained a paltry 6% of variability. The equation for trend line was  $Y = 12320 + 6.3918X$  with estimates statistically significant at over 10% implying that each year increase would result to quantities decline by 6 MT.

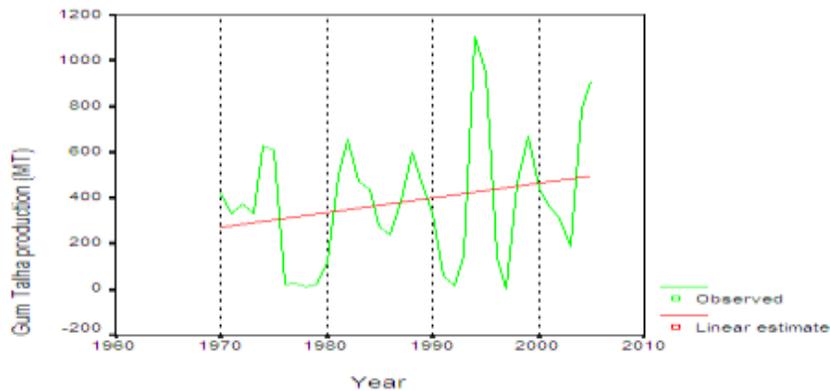


Figure 3-27: *A. seyal* (Talha) production in Southern Sudan

To explain variability in Gum Acacia transacted over the years, a ratio method was applied by measuring standard deviation of  $\log(Q_t/Q_{t-1})$  over a year, where  $Q_t$  is quantity in year 't' and  $Q_{t-1}$  is quantity in year t-1. This is, in other words, same as standard deviation of growth rates (ratio method). The average inter-year variability of annual quantities for the decade is then calculated as standard deviation of all the annual growth rates in the decade.

The inter-year variability in Gum Acacia quantities transacted was high in the 1990s and 2000s, and least in the 1970s. The inter year variability for *A. senegal* gum (Hashab) was highest in 2000s while the variability for *A. seyal* (Talha) was highest in the 1990s (Table 3-16).

Table 3-16: Inter year variability for Gum Acacia transacted in Southern Sudan

Period	Std. Deviation (%)		
	Hashab	Talha	Total
1970-1979	13	53	11
1980-1989	21	32	19
1990-1999	23	124	26
2000-2005	47	31	30
Total	26	60	22

The variability in quantities of Gum Acacia transacted by Sudan has been captured in various studies. Rahim *et al.* (2005) observed that production of Gum Acacia in Sudan was characterized with alarming signs of overall decrease and also a substantial year-to-year variation during the past 30 years as a result of years of the Sahel drought (1970s-1980s), and increased competition from other producing countries. Similar observations were made by Couteaudier (2007) who noted that production and consequently exports for Gum Acacia from Sudan had been declining for the past forty years at an average rate of 2.2 percent per annum as a result of severe Sahalian droughts (mid-70s and mid-80s), political unrest and inadequate marketing arrangements leading to low prices received by farmers for Gum Acacia pushing them to favor crop cultivation. Similar observations were made by Macrae and Merlin (2002).

### 3.3.2.8 Pricing Patterns of Gum Acacia

Both producer prices (floor and delivery prices) and export prices (FOB Port Sudan) were unstable over the years from 1970 (Figure 3-28). Comparatively, variability was visibly higher with the export prices for over the years than with floor prices. The floor prices (and delivery prices) were comparatively stable over the years unlike export prices. Floor prices (and delivery prices) rose rapidly from 1992 when GAC concession was withdrawn for sometime before re-introduction.

During this short period, traders and banks bought Gum Acacia from auction markets driving up prices (Couteaudier, 2007). The inter-year variability in the floor prices and export prices for Gum Acacia during the GAC era were high in the 1980s and 1990 (Table 3-17).

Table 3-17: Inter-year fluctuation in prices for gum

Period	Standard deviation (%)		
	Floor price	Delivery price	Fob P/Sudan
1970s	15	13	10
1980s	14	46	16

1990s	34	33	12
2000s	12	7	15

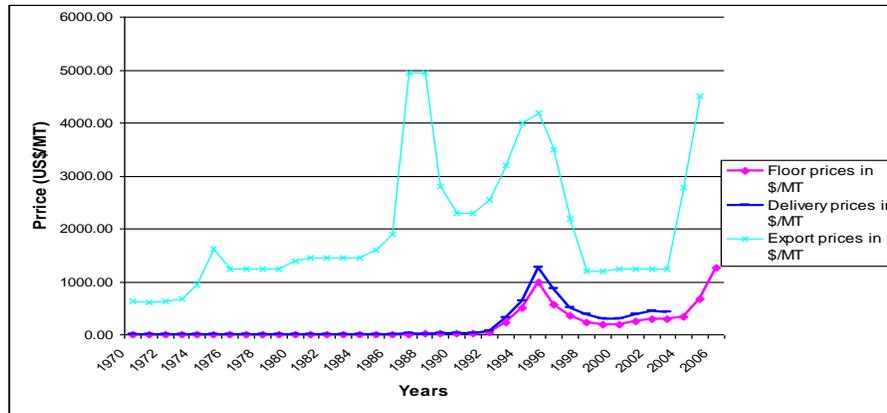


Figure 3-28: Price trends for Gum Acacia in Sudan

This is attributed to the fluctuations in the supplies of Gum Acacia over that period of time. Rahim *et al.* (2005) attributed the fluctuation from 1980 to 1992 to be as a result of years of shortage and years of surpluses from US\$ 1500 (1980) to US\$ 5000 (1983–1984) and US\$ 2300 (1988–1991) to US\$ 7000–9000 in 1992. The 1994–1995 prices (FOB, Port Sudan) of the best quality ‘gum hashab’ were US\$ 5000/MT.

The prices of Gum Acacia in the post-GAC era were set by the traders and were observed to be very low. Collectors had limited capacity in terms of information and market intelligence to leverage fair prices for their gum. The prices exhibited high volatility, for gum Hashab, with the highest prices being in 2009 (SDG 5.2/Kg in UNS), after another peak in 2005 realized during GAC era (Figure 3-29). On the other hand, the prices for gum Talha in NBGS were fairly stable with a steady increase over the years. The mean unit price for the gum Talha ranged from SDG 1 in 2005 to SDG 3.5 (2008-2010). Gum Talha was sold at the same price

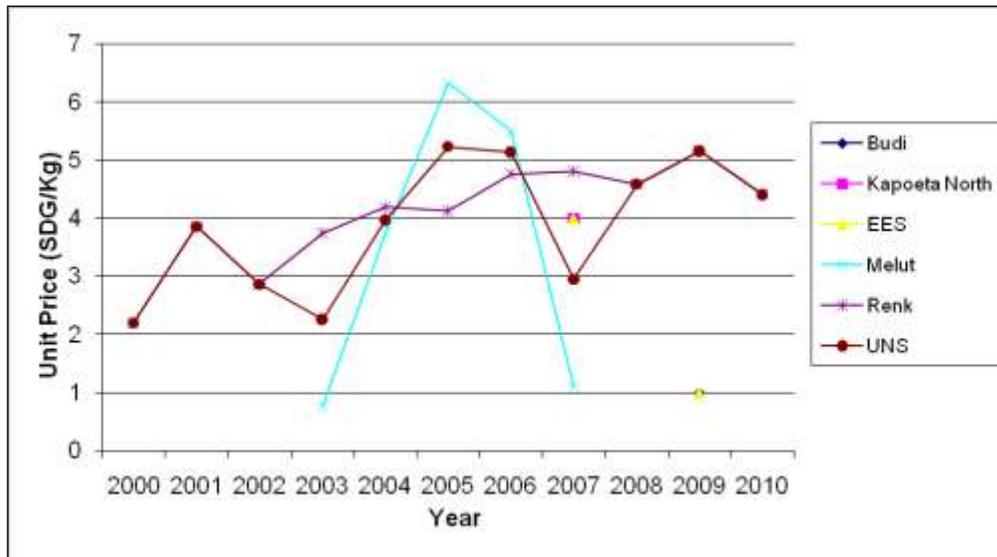


Figure 3-29: Price (SDG/Kg) for gum Hashab in target Counties in UNS and EES

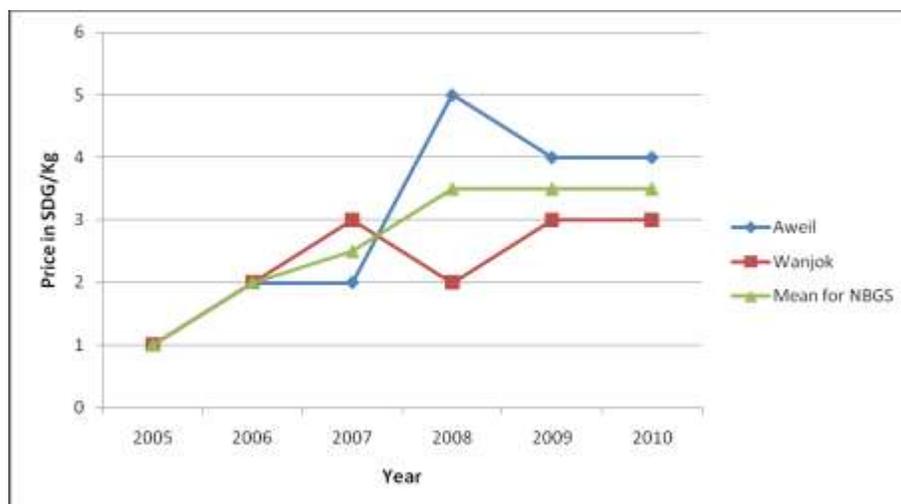


Figure 3-30: Price (SDG/Kg) for gum Talha (*A. seyal*) in target Counties in NBEGS

(SDG 2/Kg) in 2006 in both Aweil East and Wanjok but the price was higher in Aweil East between 2008-2010. The highest price per kilogram being SDG 5/Kg in 2008 at Aweil East, (Figure 3-30).

### 3.3.2.9 Gum Acacia supply chain from Collector to consumer

Gum Acacia does not follow a defined path from the collector to the consumer. This path follows rules laid down by each producer country. For a long time (especially before 2005), the trade in Gum Acacia in Sudan had been monopolized by the Gum Acacia Company (GAC)

which collapsed in 2009. GAC had been facilitating the collection and trade in Gum Acacia in the whole Republic of Sudan before the signing of the Comprehensive Peace Agreement (CPA) in 2005. While the gum market in Sudan was supposed to be controlled by GAC, and traders were supposed to pay royalty on all sales, it had not worked effectively, and was considered to be a mess. Traders who marketed the gum through GAC often had great difficulty in obtaining payment. Cross-border smuggling was, therefore, rife.

Large traders usually bought the gum from producers, and or from small traders, and did the cleaning and sorting prior to selling it. Cleaning and sorting is done by hand, usually by women, who sort it out on the ground into piles of whole tears and smaller pieces, separating any excessively dark gum and removing pieces of bark and other foreign matter. It is then bagged and transported to the port warehouse. Once here, every consignment of gum is re-cleaned, sorted and graded in preparation for export. The outputs of the cleaning and sorting are graded and sold according to five grades namely: Hand Picked Selected (HPS), Cleaned, Siftings, Dust and Red. Thorough controls are carried out before exportation. Export gum is packaged in new 50- Kg jute bags. The gum is then placed on palletes before being put into containers for exportation. The importer receives the product, inspects it visually, then samples it for analysis and it's only then that authority is granted for the bank to pay the exporter at the agreed price. Final processing of gum is carried out at the export destination to produce high quality spray dried products.

Gum is destined for export market in different parts of the world through Port Sudan with little through Djibouti and Mombasa. Buyers are organized at different levels of the supply chain. At local supply chain level, local traders buy gum in their stores located in local trading centres at the Boma, Payam or County level. Per capita gum volumes traded was low. At national supply chain level, traders originated from the north and bought gum through agents or established stores in major urban centres within production sites. Per capita gum volumes traded were colossal and required substantial capital investments. Outlets were established in UNS and NBGS but almost none-existent in EES. Gum transportation was by road and very expensive.

About 80% of Gum Acacia is consumed by 13 countries (USA, India, France, United Kingdom, Germany, Italy, Japan, China, Switzerland, Mexico, Sweden, Ireland and Brazil) three of which are responsible for 70% of re-exports (France, United Kingdom, and Germany)(ITC, 2008). According to 2006 data, between 2003 and 2007, these 13 countries consumed 80% of the annual global Gum Acacia supply (about 5,000 MT each). Some 23 emerging countries consumed another 17% (about 200 MT each), the remaining 3% represent some 70 countries whose annual consumption is less than 175 MT. European commission consumed more than one third of available gum, between 2003 and 2007. The prices of

Gum Acacia in the three major producing countries (Sudan, Chad and Nigeria) followed a downward trend in 2009 as a result of large stocks and low demand. The price of 'hard' gum varied between 2.3-2.5 per US \$/Kg in Sudan, 2-5-2.6 US \$/Kg in Chad and 1.9-2.1 US \$/Kg in Nigeria (ITC, 2009). At the start of 2009-2010 harvesting season, the price for 'flaky' gum lied between 1.5 and 1.7 US \$/Kg. The global imports of crude gum and price trends indicate that unit prices were generally on the decline except for Switzerland and Chinese Taipei (Taiwan). This is because most of the EU countries (the major importers) were still struggling to merge out of recession during the period of review.

#### 3.3.2.10 Transportation of Gum Acacia in Southern Sudan

The gum in Southern Sudan is transported by either road or river transport. The gum is rarely transported by river leaving most of it to be transported by road. As a common practice, collectors transport the gums (using donkeys, horses and camels or bicycles) to the village market (an open market) where it is sold to local traders, who are agents for traders from the North. Traders buy the gum from the collectors at this point and then transport the gum to their stores (own premises or rented) using own or hired transport. The gum is then transported to either Port Sudan or Djibouti or Mombasa using contracted trucks. River transport is also occasionally used in the transportation of gum from the states to Juba. It would cost about 400SDG/MT from Renk to Juba by steamer which can carry upto 200-400MT/ steamer. This takes about 7-9 days .

Three companies offer river transport services and these are : Keer Transport (Juba Port - have 4 steamers & mobile cranes), River Coop Company ( Kosti , North Sudan) and South Sudan Transport Company ( Sunflower Hotel, Juba) .

#### 3.3.2.11 Road transport

The road infrastructure in Southern Sudan is in poor state. By 2009, the country had a road network estimated at 12,642 km consisting of 7,369 km of interstate roads, 1,451 km of state primary roads and 3,822 km of state secondary roads. Tarmac is only less than 200km and mostly in Juba and other urban areas. The study observed that the opening up of the Juba – Uganda road via Nimule by 2011 funded by USAID is going to lower transport cost significantly between Southern Sudan and its neighbours including the port Mombasa.

Large international transport companies together with small private companies, chiefly owner-operated trucks, provide road freight transport services. About 10 established private companies were observed to be offering road freight transport services in Southern Sudan. These include, *inter alia* SDV Tranintra Sudan, Kuehne and Nagel Ltd, Sudanese-Kuwaiti Transport Company and Kalzac Consolidated Services (Table 3-18).

Table 3-18: List of road freight transport services providers

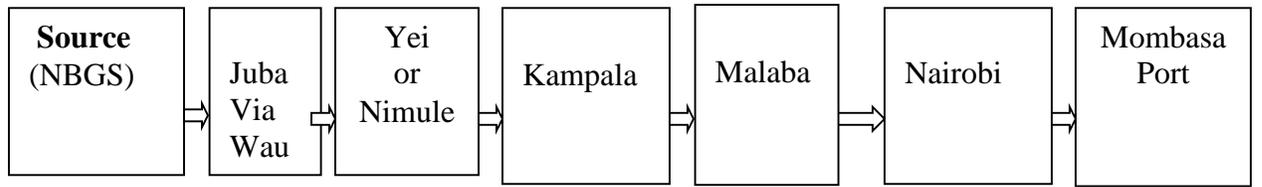
<b>Freight Company</b>	<b>Location</b>	<b>Route</b>	<b>Contact</b>
SDV Traninfra Sudan	Juba	Juba - Mombasa	+249 0183 489231
Southpole Logistics Co	Nairobi	Juba - Mombasa	
Kuehne and Nagel Ltd	Juba	Juba – Mombasa Juba - Khartoum Juba – Port Sudan	+249 955205375
Kalzac Consolidated Services	Port Sudan Khartoum	Juba - Khartoum Juba – Port Sudan	+2490183781339
Worldwide Movers South Sudan	Juba		+249 0129030115
Clear Case Logistics Ltd	Nairobi	Juba - Mombasa	+254 20 2680503
Interfreight East Africa	Juba, Mombasa Khartoum	Juba – Mombasa Juba - Khartoum Juba – Port Sudan	+249 1220990320
MHM Clearing & Forwarding Agencies	Port Sudan	Juba - Khartoum Juba – Port Sudan	+249 0183473930
Nrtc-Keer Co. Ltd, Keer Marine	Juba	Juba - Khartoum Juba – Port Sudan	+249 92202066
RH & S Transporting & Investment Co. Ltd	Juba	Juba – Mombasa Juba - Khartoum Juba – Port Sudan	+249 912834319
Trady and Construction Ltd	Juba	Khartoum	+249 955035665
Uranus Transportation		Juba - Khartoum Juba – Port Sudan	+249 912158836

Some gum was transported through passenger transport system. However this was minimal and was limited in the local networks serving port points and centre. There is potential for its utilization to transportation of gum in small quantities by collectors from production points to the market as passenger's luggage or as delivery luggage.

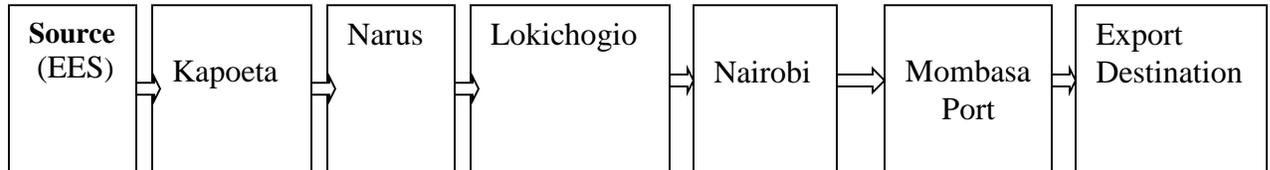
### 3.3.2.12 Road Freight costs to several destinations in Southern Sudan

Southern Sudan is a land locked country with possible exit points at Port Sudan through Northern Sudan, Djibouti port via Ethiopia and Mombasa through Uganda and Kenya where international link roads exist. Two main routes connect Southern Sudan with Uganda: Juba-Yei-Kaya and Juba-Nimule roads. Yei-Kaya link has become the main corridor on the west bank of the White Nile radiating westwards towards Maridi – Yambio-Tambura and northwards towards Mundri-Mvolo-Rumbek-Tonj-Thiet-Aweil. The route is a major lifeline as it connects various markets with that of Kenya and Uganda. The other international road link is Juba-Kapoeta-Narus to Lokichogio in Kenya but rarely used because of poor state of road and infrastructure.

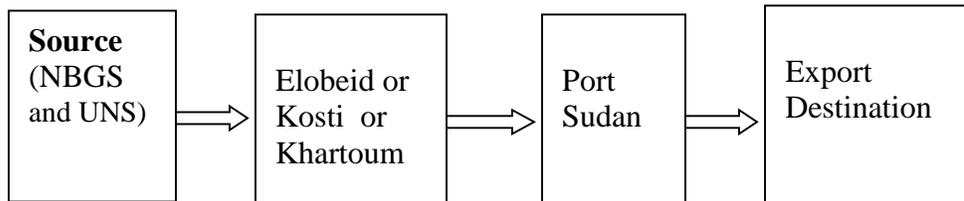
The possible transport corridors/routes that could be utilized for the transportation of Gum Acacia are illustrated in Figure 3-31. In between Mombasa and Kampala, there is an option of using Railway transport, which could reduce freight costs.



(a)



(b)



(c)

Figure 3-31: Transport channels for Gum acacia from NBEGS

### 3.3.2.13 Road and rail tariff charges

Road freight transport costs per metric ton are summarized in Table 3-14. Road freight transport charges were varied between different routes used. The most expensive route to transport goods were the sections between Arua – Koboko (SDG 2.17 /MT/km) and Yambio- Rumbek (SDG 2.08 /MT/km) (Table 3.19, Fig 3-32). The least expensive sections were the route sections in Kenya: Mombasa– Nairobi (SDG 0.18 /MT/km) and Nairobi – Lokichoggio (SDG 0.33 SDG/MT/km).

Local distribution by road in the area of Koboko stood at 1.05 to 1.25 SGD per MT/km (Table 3-17). Prices increase substantially during rainy seasons due to limited local transport capacity. The average road freight transport costs on all routes used by goods from and to Southern Sudan is SDG 1.32 /MT/km.

Table 3-19: Road freight transport costs per metric ton (MT) in SDG

Origin	Destination	Freight type	Travel days	Km traveled	Cost (SDG /MT/km)
Mombasa	Nairobi	Container truck	2	490	0.18
Nairobi	Lokichoggio	Container truck	4	880	0.33
Lokichoggio	Kapoeta	Small trucks		125	1.88
Kapoeta	Torit	Small trucks			1.88
Torit	Juba	Route not plied		144	
Juba	Rumbek	Container truck		530	1.88
Rumbek	Wau	Container truck		210	1.88
Nairobi	Malaba	Rail		435	
Malaba	Kampala	Rail		210	0.57
Malaba	Kampala	Road	1	210	0.95
Nairobi	Kampala	Container truck	3	658	0.47
Kampala	Arua	Container truck	0	520	0.63
Kampala	Adjumani	Container truck	0	500	0.37
Adjumani	Arua	Container truck	1	187	0.90
Arua	Kobok	Container truck	1	100	2.17
Kobok	Yambio	Container truck	7	457	1.77
Yambio	Rumbek	Container truck	10	493	2.08
Nimule	Juba	Container truck		193	1.88
Arua	Nimule	Container truck		40	1.88

The study observed that the costs of transport between Juba – Kampala via Nimule are likely to drastically drop as the new tarmac road under construction is expected to be operational by early 2011. This will open up Southern Sudan and make goods cheaper to and from Mombasa.

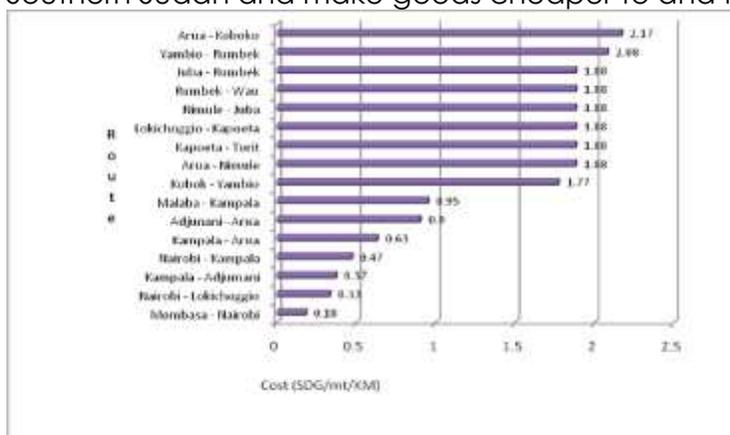


Figure 3-32: Cost of road freight transport between different towns

The disparities in the freight costs are largely due to the state of the road plied, security and how competitive it is. The most expensive routes

(Yambio – Koboko- Rumbek Juba) are largely due to the poor state of the road and insecurity on the way. Where the road is good i.e tarmaced and in good state, vehicles are able to move freely and fast resulting in lower costs. However, more days are required to cover routes with poor roads. Although the route between Koboko and Yambio is about 490 km and is equivalent to the road distance between Mombasa and Nairobi, a truck takes 10 days to cover the former route and only 1 day for the latter (Figure 3-33).

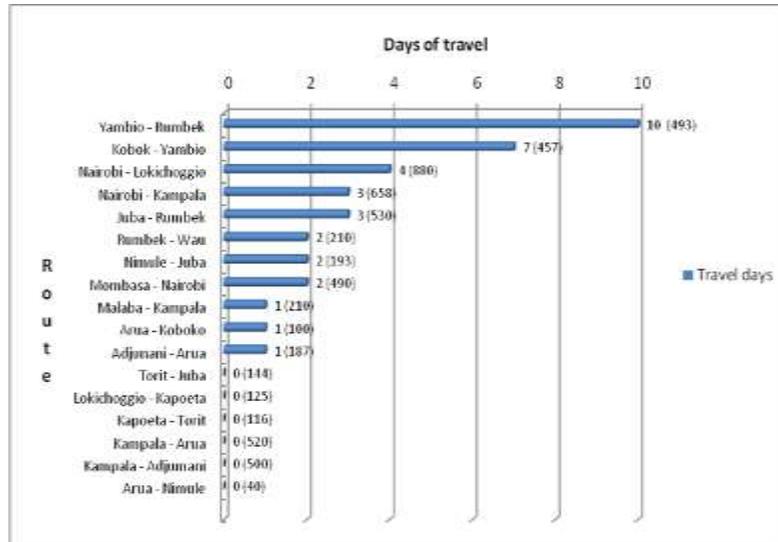


Figure 3-33: Days of road freight transport between different towns (Km travelled are in brackets; 0 implying less than 1 full day)

The road sections that link up Upper Nile and the rest of the country especially with Juba and other key gum acacia producing states are in intolerable state and currently not frequently plied. Some sections either have limiting bridge sizes or altogether are not connected with bridges to allow flow of traffic throughout.

### 3.3.2.14 Comparison of Road and Rail transport costs

An analysis of the road and rail tariff charges (for a 30 ton general cargo consignment) shows that road tariff rates are generally higher than rail rates as goods move through different countries to and from Mombasa Port, Table 3-20. The Table illustrates that it costs between 65.9 and 151.4 % % more to transport goods by road as compared to rail within Kenya and Uganda in some selected routes.

Table 3-20: Comparison of Road and Rail tariff rates

Country	Destination	Cost (US cents/ton/km)		% of Tariff rates of road as compared to rail transport
		Road	Rail	
Kenya	Mombasa-Kisumu	9.3	3.7	151.4
	Mombasa-Nairobi	9.5	4.2	126.2
Uganda	Kampala-Gulu	13.6	8.2	65.9
	Kampala-Kasese	16.6	6.7	147.8

### 3.3.2.15 River Transport

The Nile River, traversing Sudan from south to north, provides an important inland transportation route with 5,310 km navigable. Its overall usefulness, however, has been limited by natural features (e.g. a number of cataracts in Khartoum and the Egyptian border, shallow stretches) and sharp bends and man made features (dams with locks that do not operate well). Other impediment is the spread of the water hyacinth, which impedes traffic flow.

Currently, the GOSS is putting a lot of priority to the river transport as the air transport is expensive and its road network is in deplorable state. The Juba Port is being re-constructed and new cranes being acquired through the support of the Japanese government.

Businessmen already using the river route said it is expensive and time-consuming. Handling the few barges was one reason why the river remains largely empty of traffic despite a demand to transport goods from North Sudan and neighbouring countries. The key transport cost components are barge charge and loading and off-loading expenses. The "On the barge" cost is SDG 500 (\$200) per ton from Kosti to Juba (a 1,435 km river route). However, the loading and offloading is SDG 37.5 to 50 (\$15 to \$20) per ton by hand (comparatively quite expensive).

### 3.3.2.16 Ports serving Southern Sudan

Southern Sudan has options of using ports in Northern Sudan, Eriteria, Djibouti or Kenya. Ships using Port Sudan face the highest port charges in the region, and imports arriving at the port are subject to lengthy delays. The opportunity cost of locking up capital in inventories is considered as 20 per cent with each ten days of avoided delay equivalent to about 0.6 per cent of the value of goods in avoided inventory costs. Hummels (2001) estimates the cost to be 0.8 per cent of ad valorem value *per day*, based on a study of what exporters are willing to pay for reducing transit time of manufactured goods. In addition, there are greater hindrances by Southerners accessing the port due to rivalry and suspicion that exist between the south and the north. The Port of Mombasa is the largest in the East African region and is well bestowed with equipment and facilities, and has a natural

harbour whose berths do not require constant dredging while the quays are firmly established.

### 3.3.3 Cost/Benefit Analysis of Gum Acacia production and marketing

During the field surveys a number of scenarios under which Gum Acacia resources were commercially exploited in Southern Sudan emerged. Three scenarios were observed and used in cost benefit analysis as elucidated hereunder.

Firstly, there was a scenario whereby owners of Gum Acacia trees made their own collections and sold out gum to a local trader in a local supply network. In this scenario, owners managed and conserved Gum Acacia trees for own gum collection. Under these arrangements, gum collection was done using own labour i.e. using members of the household or hiring workers to do the collection.

The second scenario had similar gum collection arrangements like the first scenario case but sales were instead made to the national dealer. Thirdly, it was observed that Gum Acacia tree owners entered into sharing deals with collectors especially in Upper Nile State. In this scenario, the tree owner provided finance and materials to facilitate collectors carry out the job. The collections realized were then shared out with the owner taking 3 kg out of 4 kg of gum collected i.e. applied a sharing ratio of 3:1. There were also situations whereby owners leased out their Gum Acacia trees for collection in a season. This too was reviewed as a possible scenario for Gum Acacia commercial exploitation in Southern Sudan.

Once the gum was collected, it was sold out to various gum dealers in different supply systems ranging from local supply network to export supply network. Thus marketing of the gum involved spatial transfers from points of collection to different market outlets. Based on this, five analytical scenarios for transportation and marketing of gum emerged as elucidated in Table 3-21.

**Table 3-21: Five analytical scenarios for Gum Acacia transportation to market by the collector/producer as supplier**

Scenario	Means of transport	Supplier	Origin	Destination
1	River transport	Producer/ collector	Collection site	Juba
2	Road transport			Juba
3	Combination of river and road transport			Port Sudan
4	Road transport			Port Sudan
5	Road transport			Mombasa

From all possible scenarios for Gum Acacia commercial exploitation, the highest net profit margins were realized with marketing in export supply system through Port Sudan. The highest returns were realized when gum was transported from Renk to Port Sudan using a combination of both river and road (SDG 4243.5), and road alone (SDG 4065.6) as elucidated in Figures 3-34 & 3-35 Table 3-22. The least returns were realized with marketing of gum in the local supply system with sales made to local traders of gum that was leased out (SDG 100), own collection (SDG 420.7) and under shared arrangement between owner of garden and collectors (SDG 606.2).

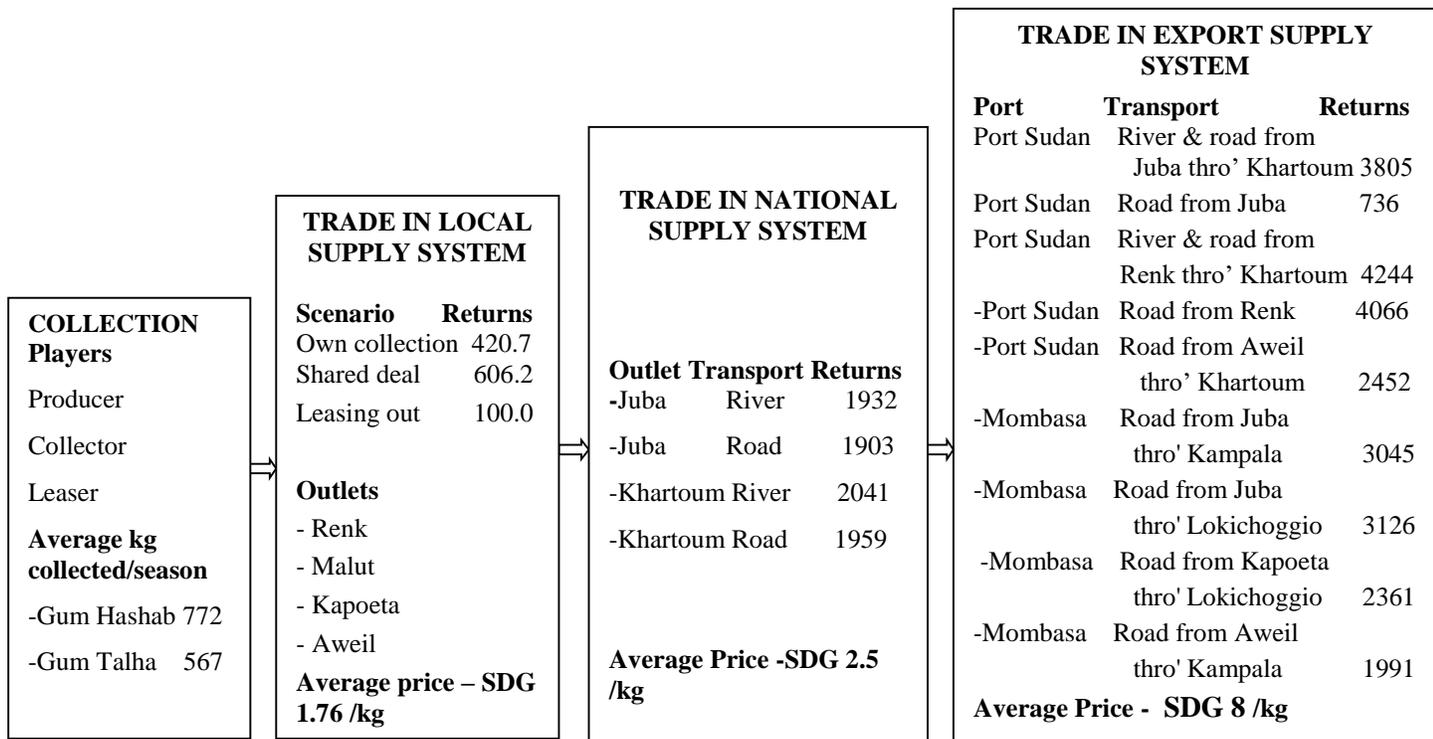


Fig 3-34: Summary of the outlets, transportation and net earnings in the Gum Acacia value chain in Southern Sudan

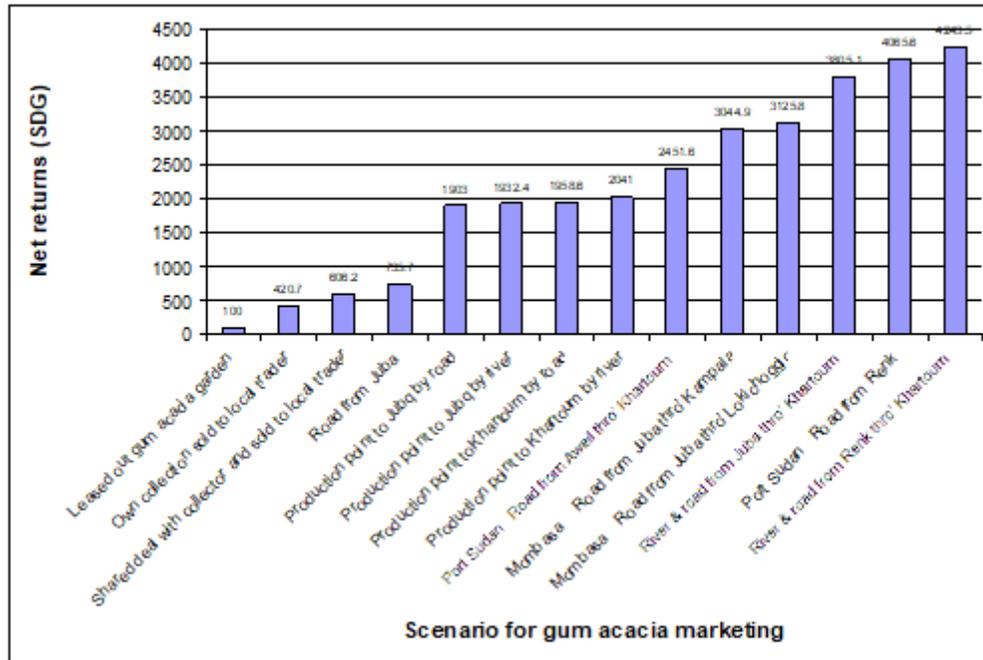


Fig 3-35: Net returns (in SDG) realized from gum acacia marketing under different scenarios

Export marketing of the gum through Mombasa Port resulted in returns that were 26% lower than those realized when using Port Sudan. Although net earnings from its usage are lower, advantages of using Mombasa Port are manifested in form of anticipated benefits of Southern Sudan joining the East African Community if the referendum results favour its cessation from the north. Southern Sudan easily identifies itself with East Africa and goodwill exists for it marketing its commodities through the East African community. The transport infrastructure in the region is being improved for the anticipated expansion of the community to cover Southern Sudan. Currently, the Nimule – Juba road is being tarred as well as the Lokichoggio – Juba road is being upgraded. The Kenyan Government is also developing a new port in Lamu with a railway link to Southern Sudan. All these developments are aimed at reducing transportation costs and help yield long term sustainable benefits to Southern Sudan. Thus the long term benefits of using Mombasa Port outweighs those of using Port Sudan which currently has the highest port charges in the region coupled with lengthy delays translating to about 0.6 per cent of value of goods in avoided inventory costs with each ten days of delay.

**Table 3-22: Net Profit Earnings from different Scenarios for commercial exploitation of Gum Acacia in Southern Sudan**

Item	Trade in local supply system			Trade in national supply system				Trade in export market supply system								
	Own collection	Sharing with collectors	Leasing out	Juba by river	Juba by road	Khartoum by river	Khartoum by road	Mombasa by road from Juba thro' Kampala	Mombasa by road from Juba thro' Loki	Port Sudan through Khartoum by road <sup>1</sup>	Port Sudan by road from Juba	Port Sudan thro' Khartoum from Renk <sup>1</sup>	Port Sudan by road from Renk	Mombasa by road from Kapoeta thro' Loki	Port Sudan by road from Aweil thro' Khartoum	Mombasa by road from Aweil thro' Kampala
Tools axe	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2
panga	2	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2
spear	3	3	0	3	3	3	3	3	3	3	3	3	3	3	3	3
stick	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
tapper tool	4	4	0	4	4	4	4	4	4	4	4	4	4	4	4	4
<b>Total</b>	<b>12</b>	<b>12</b>	<b>0</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>
Materials Food ration	100.6	0	0	100.6	100.6	100.6	100.6	100.6	100.6	100.6	100.6	100.6	100.6	100.6	100.6	100.6
Water	54	0	0	54	54	54	54	54	54	54	54	54	54	54	54	54
Medical	23.50	0	0	23.50	23.50	23.50	23.50	23.50	23.50	23.50	23.50	23.50	23.50	23.50	23.50	23.50
<b>Total</b>	<b>178.10</b>	<b>0.00<sup>a</sup></b>	<b>0.0</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>	<b>178.1</b>
Transport Pdt - store	38.6	38.6	0	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	28.35	28.35
To national markets	0	0	0	245.4	290.3	152.2	234.7	290.3	290.3	234.7	290.3	0.0	0.0	0.0	0.0	0.0
To export port	0	0	0	0	0	0	0	1174.1	1093.2	469.5	3483.3	265.8	443.7	2148.0	705.7	1166.2
<b>Transport Total</b>	<b>38.6</b>	<b>38.6</b>	<b>0</b>	<b>284.0</b>	<b>328.9</b>	<b>190.8</b>	<b>273.3</b>	<b>1502.9</b>	<b>1422.0</b>	<b>742.8</b>	<b>3812.1</b>	<b>304.4</b>	<b>482.3</b>	<b>2186.6</b>	<b>734.1</b>	<b>1194.6</b>
Package (Jute bags)	30.88	30.88	0	30.88	30.88	30.88	30.88	30.88	30.88	30.88	30.88	30.88	30.88	30.88	22.68	22.68
Store (rental fee)	0	0	0	308.8	308.8	308.8	308.8	308.8	308.8	308.8	308.8	308.8	308.8	308.8	226.8	226.8
Labour Tapping	61.25	0	0	61.25	61.25	61.25	61.25	61.25	61.25	61.25	61.25	61.25	61.25	61.25	61.25	61.25
Collection	330.75	0	0	330.75	330.8	330.75	330.75	330.75	330.75	330.75	330.75	330.75	330.75	330.75	330.75	330.75
Loading <sup>2</sup>	0	0	0	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58	8.505	8.505
Off-loading <sup>2</sup>	0	0	0	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58	8.505	8.505
Cleaning	0	0	0	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	5.67	5.67
<b>Labour total</b>	<b>392</b>	<b>0</b>	<b>0</b>	<b>422.88</b>	<b>422.9</b>	<b>422.88</b>	<b>422.88</b>	<b>422.88</b>	<b>422.88</b>	<b>422.88</b>	<b>422.88</b>	<b>422.88</b>	<b>422.88</b>	<b>422.88</b>	<b>414.68</b>	<b>414.68</b>
Taxes GOSS tax	0.0	0.0	0.0	185.3	185.3	185.3	185.3	185.3	185.3	185.3	185.3	185.3	185.3	185.3	136.1	136.1
Forest levy	92.6	62.1	0.0	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.6	68.0	68.0
County levy	46.3	46.3	0.0	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	34.0	34.0
Zakat/tithe	135.9	91.0	0.0	135.9	135.9	135.9	135.9	135.9	135.9	135.9	135.9	135.9	135.9	135.9	99.8	99.8
Transport permit	0.0	0.0	0.0	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	149.7	149.7
Union fee	11.6	7.8	0.0	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	8.5	8.5
Payam levy	0.0	15.4	0.0	15.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Taxes &amp; levies total</b>	<b>286.4</b>	<b>222.6</b>	<b>0.0</b>	<b>690.9</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>675.5</b>	<b>496.1</b>
<b>Total costs</b>	<b>938.0</b>	<b>304.1</b>	<b>0.0</b>	<b>1927.6</b>	<b>1957.0</b>	<b>1819.0</b>	<b>1901.4</b>	<b>3131.1</b>	<b>3050.2</b>	<b>2370.9</b>	<b>5440.3</b>	<b>1932.5</b>	<b>2110.4</b>	<b>3814.8</b>	<b>2084.4</b>	<b>2544.9</b>
Product Gum collected	772	1000	0	772	772	772	772	772	772	772	772	772	772	772	567 <sup>3</sup>	567 <sup>3</sup>
Gum sold (value)	1358.72	910.3424	0	1930	3860	3860	3860	6176	6176	6176	6176	6176	6176	6176	4536	4536
Leasing payments	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Product value</b>	<b>1358.72</b>	<b>910.3424</b>	<b>0</b>	<b>3860</b>	<b>3860</b>	<b>3860</b>	<b>3860</b>	<b>6176</b>	<b>6176</b>	<b>6176</b>	<b>6176</b>	<b>6176</b>	<b>6176</b>	<b>6176</b>	<b>4536</b>	<b>4536</b>
<b>Net Profit</b>	<b>420.7</b>	<b>606.2</b>	<b>100.0</b>	<b>1932.4</b>	<b>1903.0</b>	<b>2041.0</b>	<b>1958.6</b>	<b>3044.9</b>	<b>3125.8</b>	<b>3805.1</b>	<b>735.7</b>	<b>4243.5</b>	<b>4065.6</b>	<b>2361.2</b>	<b>2451.6</b>	<b>1991.1</b>

**NOTES**

Buy price/local traders SDG 1.76 /kg; Buy price/national trader SDG 2.5 /kg

<sup>a</sup>Materials including food ration, water etc not incurred because collection done by collectors under sharing arrangements

<sup>1</sup>Gum transported to Kosti by River and thereafter by road

<sup>2</sup>Labour applied in loading and off-loading because of lack of cranes

<sup>3</sup>Sites in NBSGS produce Gum Talha with lower collections realized (567kg/season) unlike Gum Hashab (772kg/season)

**Observations**

Highest returns with (i) Port Sudan through Khartoum from Renk at SDG 4243.5 and SDG 4065.6 (ii) Port Sudan through Khartoum by road from Juba at SDG 3805.1 (iii) Mombasa by road through Loki from Juba at SDG 3125.8 (iv) Mombasa by road through Kampala from Juba at SDG 3044.9 (v) Port Sudan for Gum Talha by road from NBSGS through Khartoum at SDG 2451.6, and (vi) Mombasa for Gum Talha by road from NBSGS through Kampala at SDG 1991.1.

### 3.3.4 Utilization of Gum Acacia and its impact on food security in Southern Sudan

#### 3.3.4.1 Utilization of Gum Acacia

Utilization of Gum Acacia by local communities was found to be limited. It was reported that in some instances gum was mixed with milk and eaten as food. Some communities also chewed gum with a belief that it enhances body immune level and clears stomach ailments. It was also reported that local communities utilized Gum Acacia powder as a cement substitute while plastering the inside of houses, and was traded in most parts of Southern Sudan for that purpose. The gum acacia powder is sold in Juba for 6SDG/kg upto 10SDG/kg in other non gum producing states centres. The powder currently is coming from North Sudan .

As gum collection takes place once in a year during the dry season when there are limited agricultural activities, the income from the gum collection is used to supplement other incomes. Gum production is therefore an alternative source of livelihood especially during the drier months when no income may be expected from agricultural produce.

#### 3.3.4.2 Utilization of income derived from Gum Acacia

From the responses on utilization of income derived from sale of Gum Acacia, all collectors/producers in the three States allocated over 70% of gum income in food ( grain , cooking oil, sugar and salt) and other essentials purchases. Collectors in EES had the highest percentage (95%) of gum income allocated for food and other essential purchases while those from UNS had the least (72%) (Figure 3-35). Comparatively, local traders (who are the major players in the local economy) allocated smaller percentages of gum income to food and other essential purchases (30-65 %) as compared with collectors. The biggest percentage allocation of gum income was by traders from EES (65%) and least by those from UNS (30%). Quantities of gum collected and traded in EES were low explaining why allocations by collectors and traders for food and other essentials from the State were higher than the other states. Collectors/producers in all States allocated most of the gum income to food and other essential purchases because of limited livelihood options. Apart from involvement in livestock production as main activity, there was limited cultivation of food crops (such as sorghum).

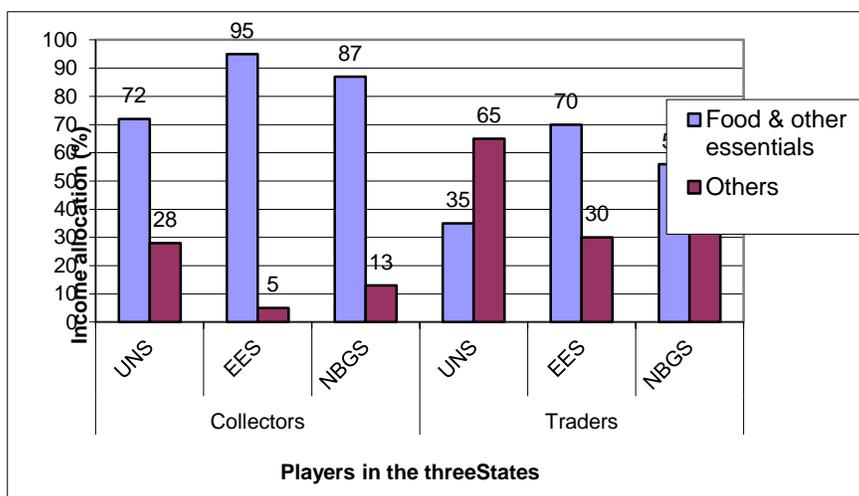


Figure 3-35: Allocation (%) of income derived from sale of Gum Acacia



Studies done show that poverty is rampant in Southern Sudan (Gathuma, 2009; FAO, 2008, Couteaudier, 2007). Estimates by FAO (2008) on food consumption showed that about 43 percent were potentially food insecure households (18 percent in the poor food consumption group and 25 percent borderline) and 57 percent in the good food consumption group in the six assessed states. At least 30 percent of households assessed were observed to be applying severe coping mechanisms like dietary adjustments (fewer meals, reduced food intake and switch to less preferred food items), which could affect households' ability to meet their future needs. All these findings demonstrate the gravel situation of food security in Southern Sudan.

The rural communities of Southern Sudan are involved in a number of activities as sources of livelihoods. The key ones include crop cultivation and livestock rearing. As alternative livelihoods, communities have been observed to be involved in fishing, hunting, gathering of wild fruits and honey, collection of commercial gums, charcoal making and selling timber, building-poles and firewood (Gathuma, 2009, FAO, 2008).

Among these activities great potential lies with Gum Acacia because of its location in marginal areas where livelihood options are limiting. Equally, collection is done during the dry spell when it is off-season for main farming activities. The income from the gum collection is used to supplement other incomes. Gum production is therefore an alternative source of livelihood especially during the drier months when no income may be expected from agricultural produce. SNV. (2009) estimated that more than 75 % of the local communities in gum producing areas in UNS depended on gum production as an alternative source of livelihood. The study (SNV, 2009) concluded that with some bit of promotion and price incentive, more than 50 % of the population in areas with gum resources in EES and NBGS could have gum production as an alternative source of livelihood. FAO (2008) estimated about 1,500 Tones of Gum Acacia to have been exported in 2008 from Southern Sudan, mostly coming from Upper Nile. Couteaudier (2007) observed that Gum Acacia was mostly produced

by small-scale farmers in traditional rain-fed farming areas who represented up to 20 percent of Sudan's population and were among the poorest. The study by Couteaudier (2007) concluded that decontrol of the Gum Acacia export market could increase export revenues for Sudan and raise significantly the income of small-scale farmers.

### 3.3.4.3 Comparative Cost/Benefit Analyses

Rural communities in Southern Sudan were involved in a number of on-farm economic activities that put gum collection to competition. These activities include livestock production, sorghum cultivation and production of fuelwood (charcoal) for sale. Field observations showed that there was higher preference of crop cultivation, livestock and charcoal burning than gum collection. The three highly preferred activities have immediate benefits to the communities in form of food and immediate incomes. It was observed during the study that livestock are a sign of wealth and rarely are they sold in pastoral communities unless there is very big need. Livestock therefore provide the households with milk and security but women and children have no access to income from livestock easily than from gum acacia, which gives them the freedom and ability to buy basic household needs and items considered luxuries such as beads for women but important for woman and young men. As a common practice, the average area under sorghum cultivation is 1 ha. Therefore, 1 ha was applied in quantifying the benefits realized from each activity under an average household in Southern Sudan.

The highest benefits are realized from sorghum cultivation with gross benefit of 3,200 SDG and then charcoal making at 2,880 SDG (Table 3-23). The least is livestock rearing at 400 SDG. Such observation was made by SNV. (2009) in NBGS where local communities indicated preferring to cut *A. seyal* trees for charcoal burning because it was observed to be lucrative. SNV (2009) observed that fuel wood had a greater demand than gum talha, probably due to the lower prices offered for the gum. This perception by local communities in NBGS had resulted in excessive felling of *A. seyal* trees for sale as fuel wood for firing bricks and baking bread. *A. seyal* is considered one of the best firewood (Duke, 1983).

Table 3-23: Gross benefits earned from four key economic activities in rural Southern Sudan

<b>Activity</b>	<b>Average scale/household</b>	<b>Incremental Physical output realized/household/season</b>	<b>Gross benefit earned (SDG)</b>
Sorghum cultivation	1 ha	800 kg	3,200
Livestock	0.1 Livestock Unit (50kgs)	2 shoats	400
Charcoal burning	625 acacia trees/ha	104 bags	3,120
Gum collection	120 stems/ha	620 kg	1,240

To be able to derive the net benefits realized for assessing economic viability of the four on-farm activities, a comparative costs/benefit analysis was done using a fixed bundle of inputs necessary for the production of the activities. The bundle given contains:

- 100 man-day labour (is provided by one labourer in a period of 4 months)
- Food rations amounting to 154.6 SDG (containing food and water)
- Medicinal care kit amounting to 23.50 (basic medicines and first aid inputs)
- Tools amounting to 12 SDG

The assumptions made for the analysis included:

- That the person (labourer) is required to camp out in the bush for sometime working on the earmarked activity
- That given bundle of inputs can only be allocated to one activity at a time
- Possible activities to engage in can be either collection of gum, rearing goat (fattening goats for sale), charcoal burning for sale or sorghum cultivation for sale
- Additional funds necessary for goat rearing to buy small sized goats for fattening
- The sales are made at end of the 4 months period with time for marketing inclusive.
- All products produced are for market sale
- The production period is fixed at 4 months within suitable times of the year
- Amount of Gum Acacia collected by a person is 15 kg/day
- One person is comfortably able to take care of 2 shoats ( estimated to be 50kgs LM) out grazing in the 1ha grazing bush at 10ha/1Livestock Unit ( LU) which is 500kg Live Mass ( LM)
- No transportation costs incurred since product sale done at farm gate
- Average yield of sorghum production in the targeted states is 800kg/ha

From the analysis, the most profit economic activity on-farm activity in rural parts of the Southern Sudan within Gum Acacia belt is sorghum cultivation at 3,200 SDG (Table 3-24) followed with charcoal making at 2,880SDG. The least economically viable activity among the four is livestock rearing with gross margin of 222 SDG. In this case the number of charcoal bags realized is lower because labour amount has been fixed unlike the above computation. This clearly demonstrates that Gum Acacia is still competitive but due to marketing difficulties and desire for quicker benefits, local communities are compelled to go for easier options like charcoal burning that has detrimental environmental impacts.

Table 3-24: Gross margins (in SDG) of four commonly undertaken on-farm economic activities in Southern Sudan

<b>Operation</b>	<b>Sorghum</b>	<b>Shoats rearing</b>	<b>Charcoal</b>	<b>Gum collection</b>
Tools	12	0	12	12
Medical kit	23.5	23.5	23.5	23.5
Food rations	154.6	154.6	154.6	154.6
Total variable costs	190.1	178.1	190.1	190.1

<b>Total Physical output</b>	<b>800kg</b>	<b>2 shoats</b>	<b>96 bags</b>	<b>750 kgs</b>
Producer unit price	4	200	30	2
Value of total physical product	3,200	400	2880	1,500
Gross margins	3,010	222	2690	1,310

## 4.0 Conclusions and Recommendations

### 4.1 Conclusions

- i. The three key Gum Acacia production states in Southern Sudan (UNS, NBEGS and EES) have about 4,596,342.5 ha with Gum Acacia resources, with an estimated annual gum production potential of 25,721.9 MT. This is about 32.2 % of the potential production in the whole of Sudan (80,000 MT).  
Out of this 2,709,117.7 ha (58.9 %) is occupied by *A. seyal* and 1,887,224.8 ha (41.1 %) by *A. senegal* with an annual production potential of 20,498.2 MT (79.7 %) and 5223.7 MT (20.3 %), respectively. *A. seyal* with a mean stocking density of 456 stems ha<sup>-1</sup> (ranging from 120 to 1940 stems ha<sup>-1</sup>) is more abundant and widespread (in all the three states) than *A. senegal* (mainly in UNS and EES) with a mean of 328 stems ha<sup>-1</sup> (ranging from 80 to 800 stems ha<sup>-1</sup>). NBEGS tends to have only *A. seyal* resources. UNS tends to have the highest stocking density of *A. seyal* (519 stems ha<sup>-1</sup>), followed by NBEGS (495 stems ha<sup>-1</sup>) and EES has the least (200 stems ha<sup>-1</sup>). UNS also tends to have a higher stocking density of *A. senegal* (384 stems ha<sup>-1</sup>) than EES (284 stems ha<sup>-1</sup>). Only a small quantity of this resource is currently being exploited and its exploitation has a potential to make significant contributions in alleviating poverty in many parts of Southern Sudan. However, there is a general tendency in all the four states to cut *A. seyal* for fuel wood, fodder and building poles. This coupled with poor natural regeneration may threaten the resources.
- ii. *seyal* trees in EES tend to have larger diameter at breast height (17.2 cm) and crown cover ( 19.3 %) than those from WS (12.4 cm & 14.7 %), UNS (9.2 cm & 13.3 %), and NBEGS (10.3 cm &12 %). *A. senegal* trees from EES also tend to have larger crown cover than those from UNS but are similar in height and diameter.
- iii. Commercial exploitation of Gum Acacia is at different stages in the various states. Collection and marketing of Gum Acacia in UNS (due to proximity to the North) is well advanced involving a number of players in the value chain operating at three supply networks: local, national and international. The players in UNS are organized into cooperatives for enhanced commercial exploitation of the resource. In NBGS (also due to proximity to the North), there are a number of players in the value chain though it is less advanced as compared to UNS and without cooperatives. The situation in Eastern Equatoria is unclear and still in infancy stages of growth while in Warrap State, commercial exploitation of gum is only in Twik County, close to Abyei.
- iv. The key actors in the Gum Acacia value chain include producers/collectors, cooperative societies, fabricators, suppliers of various materials (local shop owners), traders, transporters, financiers, regulatory agencies, exporters, community based organizations and Non governmental organizations.

- v. Gum Acacia plays a crucial role in the income and food security of the vulnerable and resource poor collectors/producers in all the states as they allocated more than 70 % of the income from gum to food and other essential purchases because of limited livelihood options. Even the less vulnerable local traders allocated 30-65 % of the income from gum to the essential basic needs.
- vi. There is minimal value adding in the Gum Acacia industry in Southern Sudan with most of the product marketed as crude gum. Value adding increases dramatically along the value chain (outside Southern Sudan) as the gum moves up the supply system from production level to the international supply network, with most benefits accruing to exporters where most value adding is realized than rest of the players in the value chain.
- vii. Most Gum Acacia producers and local traders are constrained with inadequate capacities, skills, finance, market information and intelligence, and poor transport arrangements. The sub-sector is still evolving from the era of monopoly by the defunct Gum Arabic Company. The level of entrepreneurship coupled with value addition is low.
- viii. Levels of awareness on value, prices and outlets by local communities are low especially in EES. Engagement of local communities in different operations of the gum sub-sector is low leaving most operations to outsiders.
- ix. Taxation and levying in the Gum Acacia sub-sector is quite high contributing about 32% (25% to 38%) of the total cost in commercial exploitation of the gum. The charges include the official government taxes and unofficial levies like those paid to various religious organizations.
- x. Although higher returns are realized with gum export through the current exit port, the long term benefits coupled with efficiency of other potential ports in the neighbourhood and the anticipated developments after the 2011 Referendum outweighs those returns.

## 4.2 Recommendations

It is recommended that:

### Shortterm

- i. GOSS MAF enforces the conservation of *A. seyal* which is threatened
- ii. GOSS MAF and GOSS RDC to mobilize communities and build capacity of gum producer /collectors especially on production, marketing and entrepreneurship and organize them into producer associations or unions for collective action and lobbying in order to penetrate and expand into existing and emerging markets for the product.
- iii. GOSS MAF and GOSS MC through support from development partners build the capacity of key actors in gum subsector through financial support by linkages to micro-financing institutions, technical guidance and and organized training sessions.
- iv. GOSS MAF encourages increased participation of local communities in the sub-sector, especially the youth who are unemployed, through appropriate policy frameworks and other incentives for enhanced food security.
- v. GOSS reviews taxation and levying regimes on gum exports at all levels of government and provides guidelines for unofficial levies in order to provide incentives that would encourage the trade in Gum Acacia.

## Medium term- Long term

- i. GOSS MAF establishes effective market information capturing, management, sharing and dissemination at all levels to boost local and international trade
- ii. GOSS MAF to establish agriculture/ forestry development financial support services
- iii. GOSS MAF and GOSS MC through support from development partners build the capacity of key actors through construction of warehouses for value addition and storage of gum, relevant exchange visits and study tours
- iv. GOSS MAF to put in place regulatory systems to meet export standards in-terms of gum quality control and verification systems at all levels – e.g Certificate of Origin
- v. The Government of Southern Sudan to negotiate with the neighbouring governments on concessions over usage of the potential exit ports for exporting the gum to optimize returns.
- vi. GOSS pilots Acacia gum plantation development in at least three of the gum producing states
- vii. GOSS MAF to work with the GOSS Ministry of transport on issues of infrastructure in gum producing areas where there is greatest potential for impact
- viii. GOSS MAF establishes large scale Gum Acacia plantations, using superior seed sources and borrowing from experiences in the North, to enhance sustainability of the supply of Gum Acacia.
- ix. Higher resolution images such as quick bird and spot and Aerial surveys should be used in future mapping for improved degree of accuracy.

### 4.3 Main Areas for Further Research

- i. GOSS MAF in collaboration with relevant development partners to carry out a detailed resource assessment and mapping in the remaining four states (Warrap, Jonglei, Unity and Central Equatoria ) with gum production potential.
- ii. GOSS/MAF in collaboration with relevant development partners should carry out a study on Gum characterization, certification, quality and quantity variations within and among producing states for the two types of gum.
- iii. GOSS in collaboration with relevant forestry research bodies to investigate the causes of poor natural regeneration of Acacia gum resources
- iv. GOSS pilots Acacia gum plantation development in at least three of the gum producing states
- v. GOSS in collaboration with relevant forestry research bodies and development partners to initiate research on Acacia gum tree improvement
- vi. GOSS to carry out further regular field verification of sites with the Gum Acacia and the data generated be used in updating the maps and inventory statistics.

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## 6.0 Annexes

### Annex I: List of people met and interviewed

Name	State	County	Position	Contact
Celestino Oryem	EES	Lafon	Administrator –Burgilo Payam	
Ukal Kawang' Julu	EES	Lafon	Chief Administrator –Burgilo Payam	
Angelo Okeny Ilngalanga	EES	Torit	Director for Forestry-SMOALFE & RD	0919790599
Andrew Lopua	EES	Kimatong	Finance-Galcholo CBO	
David Lokwam Lokingi	EES		D. head teacher at Loryok Payam Primary School	
Samwel Ohitai	EES	Torit	Forest Officer	
Lawrence Otika Joseph	EES	Torit	Director General -SMOA	
David Obong'o	NBEGS	Aweil	FAO Area Emergency Coordinator	256-477145374/249-919660197 <a href="mailto:david.obongo@fao.org">david.obongo@fao.org</a> <a href="mailto:david_obongo@yahoo.com">david_obongo@yahoo.com</a>
Buli Stanley	NBEGS	Aweil		0927745193 <a href="mailto:bulimurye@yahoo.com">bulimurye@yahoo.com</a> Bulimurye@fieldwinrock.org
Nofl Abdalla	NBEGS	Aweil	DG-SMOA	0191722973 noflabdalla@ yahoo.com
Ahou Deng Kuot	NBEGS	Aweil	Asst. Director Forestry	
John Leon Lollis	NBEGS	Aweil	Director Forestry	0909828325
Nafisa Abdelrhman	Warrap	Kuajok	Assistant Conservator Of Forests	<a href="mailto:nafisa.abdelrhman@yahoo.com">nafisa.abdelrhman@yahoo.com</a> 00429926615316
Gabriel Malek	Warrap	Tonj North	Director Vetinary Dept	
Martin Akok Anei	Warrap	Tonj North	Deputy Director Forestry	
William Malith Thokriel	Warrap	Tonj North	Acting Director for Forestry	
Chirillo Chier Paduol	Warrap	Tonj North	County Extension Officer	
Albino Garang' Abwok@yahoo.com	NBEGS	Aweil	FAO logistician	0914157841
Kamilo Gabriel			FAO Aweil-Fisheries Section	<a href="mailto:kamilofao@yahoo.com">kamilofao@yahoo.com</a> <a href="mailto:kamiliogabriel@yahoo.co.uk">kamiliogabriel@yahoo.co.uk</a> 0913231511; 0122428149
Peter Majur Ador	UNS	Malakal	Project Officer-Support to Agriculture and Forestry Development Project, Small grant management by NPA	0918928799; 0955045001 0128868145 <a href="mailto:pador@npaid.org">pador@npaid.org</a> or majurador@yahoo.co.uk
Joseph Okoth	UNS	Malakal	Director Forestry	
Samwel Jonawok	UNS	Malakal	D. Director Forestry	

### Producers/Collectors

Name	Gender	Age Group	Telephone	State	County	Payam	Boma
Mayik Achmil Ajuot	Male	Middle	919,822,200	UNS	Renk	Jalahak	Jalahak

Sebin Ali	Male	Middle		UNS	Renk	Jalahak	40kilo
Ahoch Yuot Awuol	Male	Middle	914092628/ 923285148	UNS	Malut	Malut	Malut
Daw Deng Daw	Male	Middle	912,407,731	UNS	Malut	Malut	Malut
Bier Dour Nyog	Male	Old	919,884,605	UNS	Renk	Jalahak	Jalahak
Ayik Ayei Kak Akwei	Male	Middle	9,101,300,284	UNS	Renk	Renk	Renk
Sheekh Pal Padiit Pal	Male	Old	914,272,418	UNS	Renk	Jalahak	Jalahak
Hakim Ajak Baping	Male	Middle	913,159,229	UNS	Renk	Jalahak	Jalahak
Alukor Iko	Male	Middle	922,957,551	EES	Kapoeta North	Kapoeta	Kapoeta
John Lokuu	Male	Middle		EES	Budi	Kimatong	Komou
Lokayi Kolonj	Male	Youth		EES	Budi	Kimatong	Tataman
Andrew Eponyo	Male	Middle		EES	Budi	K	Kimou
Abuk Yor	Male			NBEGS	Wanjok	Madhol	Malowe
Deng Yor	Male	Youth		NBEGS	Aweil	Madhol	Rialdit
Akok Ngoni	Male	Youth		NBEGS	Aweil	Madhol	Marollic
Village Meet				NBEGS	Aweil	Madhol	Rialdit
Adeng Luol	Female	Middle		NBEGS			
Marco Yor	Male	Middle		NBEGS	Aweil	Madhol	Rialdit
Adut Akeen	Female	Youth		NBEGS	Wanjok	Madhol	Malith

### Traders

Name	Gender	Age Group	Business Type	State	County	Centre
Joseph Komyo	Male	Youth	Producer	EES	Budi	Barack
Rose Nakiwu	Female	Middle Age	Gum Buyer	EES	Budi	Kimatong
Adam Albuor	Male			NBEGS	Aweil East	Aweil
Deng Deng	Male	Youth	Big Dealers Agent	NBEGS	Aweil East	Lienth
Geng Ayan	Male	Middle Age	Broker	NBEGS	Aweil East	Lenth
Fodhol Jabor	Male			NBEGS	Aweil East	Madhoul
Kuol Kuol	Male	Middle Age	Buling	NBEGS	Aweil East	Malith
Luka Dulajat	Male	Middle Age		NBEGS	Aweil East	Wanjok
Adam Ralmdalb	Male	Middle Age	Medium Trader	NBEGS	Aweil East	Warwar
Kalifa Mod	Male	Middle Age	Wholsaler	NBEGS	Wanjok	Warwar
Augustino N. Deng	Male	Middle Age	Centre Trader	NBEGS	Wanjok	Malith
Abdalla Abdire	Male	Middle Age	Wholesaler	NBEGS	Wanjok	Malith
Ayik Akwei Ayeuikak	Male	Middle Age	Union	UNS	Renk	Renk
Suleiman Ahmed Adedelkhales	Male	Middle Age	Assorted Goods	UNS	Renk	Renk
Saliman Ahmed Abdul Kali	Male	Middle Age	Mixed Sales	UNS	Renk	Renk
Gum Arabic Union Officials			Gum Buyer	UNS	Renk	Renk

**Annex II: Data collection sheet**

**Inventory of Acacia gum resources in Southern Sudan**

Data collected by :..... Date:.....  
 Sample plot No: -----GPS readings: N----- E----- Alt: .....  
 State: .....County: .....Payam: .....Boma.....  
 Tree species assessed: ..... Local Names.....  
 Total No. of mature trees: ..... Mean DBH.....Average Ht (m).....  
 Total No. of juvenile trees: ..... Mean DBH..... Average Ht (m).....  
 Soil type:.....  
 Terrain conditions: .....  
 Current use of resource: .....  
 Extent of resource: From: .....to.....  
 Other vegetation in the neighbourhood.....

Tree age category	Tree No	Tree Height (m)	Tree diameter (cm)	Crown diameter (m)		
				A	B	Mean
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					
	11					
	12					
Mean						

**Annex III: Questionnaires**

**COLLECTOR'S QUESTIONNAIRE ON STATUS, COLLECTION, MARKETING AND UTILIZATION OF GUM ACACIA IN SOUTHERN SUDAN**

**Identification**

1. Collector's name: ..... Gender: ..... Age group: (child/youth/middle age/old) (tick)  
Te: .....

2. Where situated State: ..... County: ..... Payam: ..... Boma: .....

**B. Collection of Gum Acacia resource products**

3. What is the source of the gum acacia you collect? (tick) (a) communal land (b) own plot

4. Are there any traditional management rules and regulations that pertain to gum harvesting and marketing? Yes/no

5. Please indicate in the table below details on gum acacia resource products you collect.

Type of gum acacia product	Place and distance covered when sourcing product		*Product abundance level (low/medium/high)	Who collects (wife, girls, children, boys, men, salaried workers, hired labour)	Quantity collected (Kg/unit time)				Time spent in collecting in 1 day		Collection Cost (SDG/Kg)				Transport mode and cost			
	Place	Distance (km)			Day	week	Month	year	Start time	End time	Labour	Food	Packs	Equipment	Mode	Distance in km	Cost (SDG)	

\*Levels of abundance: Low = not easily available; medium = moderately available; high = readily available

**C. Marketing of products**

6. Fill in the table below concerning quantities of gum acacia products you sell per month.

Type of gum acacia product	Quantities sold/month in Kg												Outlet where sold	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

7. Do buyers consider gum grades or they just buy anything and everything? (tick) (a) buy anything (b) buy graded gum

8. How much gum acacia did you sell annually and at what price between 2000 and now?

Type of gum	Item	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Quantity											
	Price/Kg											
	Quantity (Kg)											
	Price/Kg (SDG/Kg)											

**D. Pricing mechanism**

9. Who determines price for gum acacia products you sell? (tick) (a) Self (b) Traders (c) Market forces (d) Others (specify .....

10. How do you get information on where to sell and price of your gum acacia products?

11. How is payment done by buyer of your gum? (tick) (a) cash on delivery (b) advance payment before collection (C) barter trade

**E. Marketing challenges for gum acacia products**

12. What challenges do you face while marketing your gum acacia resource products?

**F. Group dynamics in production and marketing of gum acacia resource products**

13. Are there established groups for collection and marketing of gum products you deal with in this locality? (tick) (a) Yes (b) No

14. If yes (12) above, give following information on groups in the locality

Name of group	Whether member	Membership	How group governed	Year formed	Gum product deal wi	Problems faced	Quantity collected/ marketed/year					
							2006	2007	2008	2009	2010	

15. Why do you opt to use groups for the collection and marketing of the gum acacia resource products?



9. What are the prices for the Gum acacia over the years (SDG/Kg)?

Price/year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Buying price (SDG/Kg)											
Quantities bought (Kg)											
Selling price (SDG/Kg)											

10. How do you pay the gum collectors? (tick) advance purchase/ barter/ collect and pay after sale/ cash on delivery

11. Who are the buyers of these products and their preferences

Gum acacia product	Type of buyer	Preference ranking

12. What value addition do you carry out on your gum acacia resource products before selling?

### Annex IV: Summary of data collected in each sample plot

No.	Species	Local names	Sample plot No.	State	County	Payam	GPS	Altitude (m)	Accessibility	No. of stems per ha	Density classification
1	<i>A. senegal</i>	Kor (Peri)	LAF03	EES	Lafon	Marguna	5.0413632.47498	487	Good	140	Low
2	<i>A. senegal</i>	Kor (Peri)	LAF 05	EES	Lafon	Burgilo		487	Good	160	Low
3	<i>A. senegal</i>	Kor (Peri)	LAF 06	EES	Lafon	Burgilo	5.0300432.46284	488	Good	140	Low
4	<i>A. senegal</i>	(Peri)	LAF07	EES	Lafon	Kurumi	5.0327532.46333	492	Good	680	Medium
5	<i>A. senegal</i>	Todoch (Boya)	Budi 01	EES	Budi	Kimatong	4.4715433.20768	686	Good	180	Low
6	<i>A. senegal</i>	Todoch (Boya)	Budi 02	EES	Budi	Kimatong	4.4658433.21089	682	Good	260	Low
7	<i>A. senegal</i>	Todoch (Boya)	Budi 03	EES	Budi	Kimatong	4.4482 33.2126	683	Good	240	Low
8	<i>A. senegal</i>	Todoch (Boya)	Budi 04	EES	Budi	Kimatong	4.6328533.27356	637	Very Good	800	High
9	<i>A. senegal</i>	Todoch (Boya)	Budi 05	EES	Budi	Kimatong	4.6308533.27466	637	Very Good	320	Low
10	<i>A. senegal</i>	Todoch (Boya)	Budi 06	EES	Budi	Napak	4.7445633.25721	621	Good	200	Low
11	<i>A. senegal</i>	Todoch (Boya)	Budi 07	EES	Budi	Napak	4.7438933.25771	613	Good	420	Low
12	<i>A. senegal</i>	Todoch (Boya)	Budi 08	EES	Budi	Napak	4.7403733.25694	630	Good	240	Low
13	<i>A. senegal</i>	Eminai (Toposa)	KAPN01	EES	Kapoeta North	Paringa	4.836233.55189	627	Good	80	Low
14	<i>A. senegal</i>	Eminai (Toposa)	KAPN02	EES	Kapoeta North	Korkamuge	5.1573533.51005	500	Good	140	Low
15	<i>A. senegal</i>	Nyokoromuech (Toposa)	KAPN03	EES	Kapoeta North	Korkamuge	5.2112533.51442	485	Good	100	Low
16	<i>A. senegal</i>	Eminai (Toposa)	KAPS01	EES	Kapoeta South	Machil	4.7124733.47216	648	Good	240	Low
17	<i>A. senegal</i>	Angariati (Lotuho)	Ikotos 01	EES	Ikotos	Lobira	4.416633.08904		Very Good	160	Low
18	<i>A. senegal</i>	Angariati (Lotuho)	Torit 04	EES	Torit	Hiyala	4.4871632.90974		Very Good	620	Medium
19	<i>A. senegal</i>	Hashab, Ongir ( )	MaL 02	UNS	Malakal	Malakal	9.4969131.63287	390	Good	740	Medium
20	<i>A. senegal</i>	Hashab	Mel02	UNS	Melut	Melut	10.4377232.20218	394	Very Good	460	Low
21	<i>A. senegal</i>	Hashab	Mel03	UNS	Melut	Melut	10.4377232.20218	394	Very Good	440	Low
22	<i>A. senegal</i>	Hashab	Renk01	UNS	Renk	Jelahak	10.9523332.70763	386	Good	460	Low
23	<i>A. senegal</i>	Hashab	Renk02	UNS	Renk	Jelahak	11.0992932.78584	393	Very Good	300	Low
24	<i>A. senegal</i>	Hashab	Renk03	UNS	Renk	Jelahak	11.0843532.78322	393	Very Good	460	Low
25	<i>A. senegal</i>	Hashab	Renk04	UNS	Renk	Jelahak	11.0770732.75408	389	Good	560	Medium
26	<i>A. senegal</i>	Hashab	Renk05	UNS	Renk	Jelahak	11.0761332.74365	390	Good	380	Low
27	<i>A. senegal</i>	Hashab	Renk06	UNS	Renk	Jelahak	10.8897732.67211	386	Good	160	Low
28	<i>A. senegal</i>	Hashab	Renk07	UNS	Renk	Jelahak	11.2998732.82088	389	Medium	360	Low
29	<i>A. senegal</i>	Hashab	Renk13	UNS	Renk	Shomadi	11.6228732.79403	382	Very Good	60	Low
30	<i>A. senegal</i>	Hashab	Renk14	UNS	Renk	Shomadi	11.5759332.78671	389	Very Good	640	Medium
31	<i>A. senegal</i>	Hashab	Renk15	UNS	Renk	Shomadi	11.62569 32.8315	376	Good	160	Low
32	<i>A. senegal</i>	Hashab	Renk16	UNS	Renk	Shomadi	11.9630932.89905	397	Good	200	Low

33	<i>A.seyal</i>	Alando (Pari)	LAF01	EES	Lafon	Burgilo	4.994232.53008	489Good	180Low
34	<i>A.seyal</i>	Alando (Pari)	LAF02	EES	Lafon	Burgilo	4.9901832.53292	489Good	200Low
35	<i>A.seyal</i>	Alando (Pari)	LAF 04	EES	Lafon	Burgilo	5.0539532.46912	473Good	140Low
36	<i>A.seyal</i>		Torit 01	EES	Torit		4.4732.84583	Very Good	200Low
37	<i>A.seyal</i>		Torit 01	EES	Torit		4.4732.84583	Very Good	320Low
38	<i>A.seyal</i>		Torit 02	EES	Torit		4.4732.84583	Very Good	240Low
39	<i>A.seyal</i>		Torit 03	EES	Torit		4.4732.84583	Very Good	120Low
40	<i>A.seyal</i>	Talha	MAL 03	UNS	Malakal	Lelo	9.4914431.62775	390Good	400Low
41	<i>A.seyal</i>	Talha	MAL 04	UNS	Malakal	Lelo	9.5224431.60056	396Good	780Medium
42	<i>A.seyal</i>	Talha	BAL 01	UNS	Baliet	Adong'	9.2672232.11786	393Good	220Low
43	<i>A.seyal</i>	Talha	BAL 02	UNS	Baliet	Baliet	9.948932.28523	Good	740Medium
44	<i>A.seyal</i>	Talha	BAL 03	UNS	Baliet	Adong'	9.96532.29519	Good	340Low
45	<i>A.seyal</i>	Talha	Mel01	UNS	Melut	Melut	10.43772 32.2028	394Good	580Medium
46	<i>A.seyal</i>	Talha	Mel04	UNS	Melut	Melut	10.4377232.20218	394Very Good	1940Very High
47	<i>A.seyal</i>	Talha	Mel05	UNS	Melut	Melut	10.4377232.20218	394Very Good	340Low
48	<i>A.seyal</i>	Talha	Mel06	UNS	Melut	Melut	10.4377232.20218	394Very Good	420Low
49	<i>A.seyal</i>	Talha	Mel07	UNS	Melut	Faloij	10.378732.53698	394Very Good	460Low
50	<i>A.seyal</i>	Talha	Renk08	UNS	Renk	Jelahak	11.3182 32.6974	389Very Good	340Low
51	<i>A.seyal</i>	Talha	Renk09	UNS	Renk	Jelahak	11.414232.72738	376Very Good	140Low
52	<i>A.seyal</i>	Talha	Renk10	UNS	Renk	Jelahak	10.9341132.69876	384Very Good	300Low
53	<i>A.seyal</i>	Talha	Renk11	UNS	Renk	Shomadi	11.5875 32.8739	386Very Good	40Low
54	<i>A.seyal</i>	Talha	Renk12	UNS	Renk	Jelahak	11.51541 32.7617	385Very Good	260Low
56	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 01	NBEGS	Aweil East	Malwal Bai	9.0737527.82043	385Very Good	160Low
57	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 02	NBEGS	Aweil East	Malwal Bai	9.0595927.79833	430Very Good	580medium
58	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 03	NBEGS	Aweil East	Malwal Kon	9.0322227.66209	419Very Good	260medium
59	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 04	NBEGS	Aweil East	Malwal Kon	9.0272727.63951	426 Good	500medium
60	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 05	NBEGS	Aweil East	Madhol	9.0376227.72456	423Very Good	700medium
61	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 06	NBEGS	Aweil East	Baac	9.1158127.59863	430Very Good	360Low
62	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 07	NBEGS	Aweil East	Baac	9.1115327.59491	423Very Good	720Medium
63	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 08	NBEGS	Aweil East	Rumdier	9.2337127.61511	428Very Good	500Medium
64	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 09	NBEGS	Aweil East	Dakun	9.5440727.70453	425Very Good	760Medium
65	<i>A.seyal</i>	Talha (Arabic) , Peny	AWE 10	NBEGS	Aweil East	Dakun	9.5437927.70294	425Very Good	560Medium

	(Dinka)							
66	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 11	NBEGSAweil East	Melith	9.4489827.70263	426Very Good	840High
67	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 12	NBEGSAweil East	Melith	9.4361427.69551	431Very Good	640Medium
68	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 13	NBEGSAweil East	War Awar	9.2929827.61877	428Very Good	600Medium
69	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWE 14	NBEGSAweil East	War Awar	9.2262127.61504	428Very Good	360Low
70	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWW 01	NBEGSNyamulel	Riang angong	9.2719 27.4549	Very Good	280Low
71	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWW 02	NBEGSNyamulel	Wedweil	9.039 27.1607	438 Good	720Medium
722	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWW 03	NBEGSNyamulel	Maduany	8.82564 27.3048	438Very Good	160Low
73	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWW 04	NBEGSNyamulel	Wedwell	8.98325 27.1907	438Very Good	360Low
74	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWW 05	NBEGSNyamulel	Wedwell	8.9994627.21525	438 Good	420Low
75	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWN 01	NBEGSAweil North	Mayen ulem	9.0283327.26349	440Good	320Low
76	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWN 02	NBEGSAweil North	Ariath	9.0944 27.2125	443 Good	420Low
77	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWN 03	NBEGSAweil North	Ariath	9.1803627.10885	450Very Good	840High
78	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWN 04	NBEGSAweil North	Gok Machar	9.2132426.87982	445 Good	260Low
79	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWN 05	NBEGSAweil North	Mayen ulem	9.037827.26099	444 Good	640Medium
80	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	AWN 06	NBEGSAweil North	Gok Machar	9.03071327.12507	453Medium	420Low
81	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	TNC01	WS Tonj North	Rual bet	8.2856828.83892	411Good	420Low
82	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	TNC02	WS Tonj North		8.2168828.76585	411Good	280Low
83	<i>A.seyal</i>	Talha (Arabic) , Peny (Dinka)	TNC03	WS Tonj North		8.2168828.76585	411Good	580Medium

## Annex V. ANOVA Tables

Table A4-1: Variation of Height, DBH and Crown Diameter with tree species

Variables		df	F	Sig.
Height * Species	Between Groups	1	9.2	0.003
	Within Groups	606		
	Total	607		
DBH* Species	Between Groups	1	72.0	0.000
	Within Groups	606		
	Total	607		
Crown Diameter*Species	Between Groups	1	25.5	0.000
	Within Groups	606		
	Total	607		

Table A4-3: Variation of Height, DBH and Crown Diameter of *A. senegal* with State

Variables		df	F	Sig.
Height * State	Between Groups	1	.634	.427
	Within Groups	212		
	Total	213		
DBH * State	Between Groups	1	.037	.848
	Within Groups	212		
	Total	213		
Crown diameter * State	Between Groups	1	19.00	.000***
	Within Groups	208		
	Total	209		

A

Table A4-3: Variation of Height, DBH and Crown Diameter of *A. seyal* with State

Variables		df	F	Sig.
Height* State	Between Groups	2	35.529	.000***
	Within Groups	397		
	Total	399		
DBH * State	Between Groups	2	58.201	.000***
	Within Groups	397		
	Total	399		
Crown diameter * State	Between Groups	2	8.575	.000***
	Within Groups	397		
	Total	399		
	Total	336		

**Table A4-4: Mean number of *A. senegal* stems per hectare in each county**

County	Mean	N	Std. Deviation	CV (%)	Minimum	Maximum
Budi	333	8	203.4	61.1	180	800
Ikotos	160	1	.		160	160
Kapoeta	140	4	71.2	50.9	80	240
Lafon	280	4	266.8	95.3	140	680
Malakal	740	1	.		740	740
Melut	450	2	14.1	3.1	440	460
Renk	340	11	182.7	53.7	60	640
Torit	620	1	.		620	620
<b>Total</b>	<b>383.</b>	<b>32</b>	<b>206.2</b>	<b>53.9</b>	<b>60</b>	<b>800</b>

**Table A4-5: Mean number *A seyal* stems per hectare in each county**

County	Mean	N	Std. Deviation	CV (%)	Minimum	Maximum
Lafon	173	3	30.6	17.6	140	200
Torit	220	4	83.3	37.8	120	320
Malakal	590	2	268.7	45.5	400	780
Baliet	433	3	272.3	62.8	220	740
Melut	748	5	672.0	89.8	340	1940
Renk	260	4	86.4	33.2	140	340
Aweil East	539	14	196.7	36.5	160	840
Aweil West	388	5	209.6	54.0	160	720
Aweil North	483	6	217.4	45.0	260	840
Tonj North	427	3	150.1	35.2	280	580
<b>Total</b>	<b>456</b>	<b>49</b>	<b>297.1</b>	<b>65.2</b>	<b>120</b>	<b>1940</b>

**Table A4-6: Mean Stocking Density (stems/ha) of stems for *A. senegal* in UNS and EES**

State	Mean	N	Std. Deviation	CV (%)	Minimum	Maximum
UNS	409	13	177.3	43.3	160	740
EES	284	18	209.8	73.8	80	800
<b>Total</b>	<b>337</b>	<b>31</b>	<b>203.6</b>	<b>60.4</b>	<b>80</b>	<b>800</b>

**Table A4-7: Mean Stocking Density (stems/ha) of stems for *A. seyal* in the three states**

State	Mean	N	Std. Deviation	CV (%)	Minimum	Maximum
UNS	519	14	448.2	86.4	140	1940
NBEGS	495	25	204.1	41.2	160	840
EES	200	7	66.3	33.2	120	320
WS	427	3	150.1	35.2	280	580
<b>Total</b>	<b>456</b>	<b>49</b>	<b>217..2</b>	<b>49</b>	<b>120</b>	<b>1940</b>

## About SNV Netherlands Development Organisation

### Brief Profile of SNV

SNV Netherlands Development Organisation is an international development organisation with over 40 years of experience in international development cooperation. SNV currently works in 33 countries in Africa, Asia, Latin America and the Balkans. Nine (9) of these countries are in the East and Southern Africa (ESA) region which are South Sudan, Kenya, Ethiopia, Uganda, Zambia, Zimbabwe, Mozambique, Rwanda and Tanzania . SNV globally employs over 850 professional advisors across the 33 countries. Our advisors are a diverse mix of professionals with varied expertise, and different cultural and professional backgrounds. SNV Sudan has employed a diverse team of seventeen (17) highly qualified and experienced technical professionals in all the above sectors.

### What we do.

SNV is dedicated to a society where all people enjoy the freedom to pursue their own sustainable development. We stimulate and set the framework for the poor to strengthen their capacities and improve their livelihood. We do this by providing capacity development services, facilitating knowledge development, brokering, networking and advocacy at national and international levels. Partnerships with other development agencies and the private sector are key to our approach. The approach is to support local actors to increase their capacities to solve their socio-economic development challenges, pursue their development goals, and contribute to the reduction of poverty and the promotion of good governance

SNV has been working in South Sudan since 2005 with its first program base in Eastern Equatoria State of South Sudan. In 2008 it opened a country office in Juba, and started to expand its programmes to Upper Nile, Jonglei and Central Equatoria States, as well as the Abyei area. It works in two main areas - **Basic Services** and **Economic Development**.

In Economic Development SNV works to support the development of the agricultural sector through value chain development approach in Livestock, Horticulture, Non Timber Forest Products (NTFP), particularly gum arabic and Shea nuts. VCD seeks to address the systemic bottlenecks in selected value chains through an integrated set of services. It is designed to contribute to improvements in the competitiveness and performance of enterprises in the value chain and impact on small producers in the form of increased incomes, productivity and employment.

In Gum Acacia, SNV Sudan is supporting GoSS MAF in the development of the subsector through facilitating knowledge development, brokering and networking; market intelligence and linkages; strengthening producers and service provider organisations as well as encouraging public policy dialogue in NTFP and gum specifically. As part of knowledge development and brokering under gum acacia, SNV Sudan secured funding from UN FAO/SIFSIA and MDTF-SS SAFDP to conduct a detailed gum acacia resource assessment and value chain analysis study in three key states, namely UNS, NGBS and EES. SNV with support from expertise in Network for Gums and Resins in Africa (NGARA) and GoSS MAF staff have since conducted the study and have produced this report. The details of this report will be shared with stakeholders as part of knowledge brokering.