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Prospects for Kenaf Textiles Production in Nigeria

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Abstract
Textile fibres are the predominant fibres used for textiles production in Nigeria since the 1960's. However, the number of textiles industries in the country has reduced drastically as a result of drastic reduction in cotton production, old and absolute technology predominant in the sector and lack of basic infrastructures. Efforts to increase cotton production have not met with adequate success despite the development of improved long fibre varieties. To increase textiles production, textile experts have been studying the properties of Kenaf bast fibres for textiles production. The research on Kenaf fibres are being programmed to include softening of Kenaf fibres, characterisation of woven fabrics, production of non-woven fabrics and development of products such as furniture underlays, carpet backing and wall covering. To boost production, there is increasing interest in natural fibre composites utilisation in the textiles sector globally in view of their potentials to replace synthetic fibres and their sustainability. Experts are increasingly concentrating on Kenaf/cotton fibres utilisation. Several studies indicated that mercerisation drastically improved softness of hand for both fabrics industry. Blending cotton fibres with kenaf with proper treatment results in higher value end products, making kenaf a viable textile fashion fibre. The sustainable development of Kenaf/cotton textiles will impact significantly on the textiles industry in Nigeria in view of the huge potentials the nation has in Kenaf production.
Keywords: Bast fibre, Kenaf, cotton, mercerisation, alkali treatment, degumming.

1.0 Introduction

Textile fibres are mainly produced from cotton in Nigeria. In the 1960's to the 1970's, textiles production was one of the major industrial activities in Nigeria, contributing more than 25% of the Gross Domestic Product (GDP). During this period, the textiles sector employed more than 700,000 people and catered for more than 2 million family members (RMRDC, 2003). More recently however, most especially in the 1990's, the sector experienced serious downturn leading to the closure of textile mills in various parts of the country. The mills, which were about 250 in number in the 1970's had less than 25 operational processing outfits in 2016 (RMRDC, 2017). The declined of the industry is particularly lamentable as cotton turnover between dwindled from 8.2 billion naira in 1980 to 300 million naira in 2012. The ginning capacity of existing ginneries also diminished from 78% to 33% (Awolehin *et al.*, 2016). Among the major problems that led to the demise of the sector include the turning of farming into a lacklustre activity as a result of availability of petrodollars occasioned by exploitation and export of oil in substantial quantities, the drop in the national production of cotton and general decrease in the investment in processing activities in Nigeria (Ogunwusi, 2013). Most of the pioneer investors which consists mostly of the Lebanese and the Chinese citizens lost interest in the sector and instead of upgrading the equipment and facilities within the industry, allowed the old installed facilities to deteriorate (FMITI, 2015). Today, most of the mills are old and the technology of textiles production remains obsolete (RMRDC, 2015). The problem is further compounded by importation of inferior textile materials at low prices into the country (FMITI, 2015). As a result, the current domestic market size or cotton fabric which is 1,200 million meters is mostly dominated by imports.

To promote increased production of cotton locally, the Federal Government of Nigeria through its agencies, among which are the Federal Ministry of Agriculture and Natural Resources, and Federal Ministry of Industry, Trade and Investment have been promoting increasing cotton production by distributing cotton seeds to farmers (FMITI, 2015). Also, the Raw Materials Research and Development Council (RMRDC) in collaboration with the Institute of Agricultural, Zaria developed long fibre cotton varieties (SAMCOT 11, 12 and 13) in 2003 which are also distributed to farmers on annual basis to boost productivity and to increase farmers profit within the sector. However, as a result of increasing production costs in the textile industries, the prices offered to farmers by the ginneries are generally low. This made majority of the farmers to opt for the export of their produce, despite assiduous efforts by the Federal Government through the Presidential Committee to boost cotton production in Nigeria.

In view of the above, to promote increased activity with the sector, it has become expedient to investigate the prospects and challenges of Kenaf fibres utilisation for textiles production in Nigeria. This paper examines the status of Kenaf utilization for textiles fibre production globally and the possibility of developing Kenaf yarn for apparel applications in Nigeria. The problems and the challenges of the initiative are also outlined. This is important as one of the major approaches being sought globally by textiles manufacturers who are seeking new approaches to producing environmentally friendly products, such as recyclable and biodegradable textile materials are critically focusing on Kenaf utilization in the industry (Zheng, 2003).

2.0 The Concept of Textile Fibres Production from Kenaf

Cotton fibre is the traditional raw materials for Textile production in most part of the world. However, efforts are currently made to use Kenaf for textile in view of its attributes. A lot of works have been done in the direction. It is hoped that soon Kenaf will become a virile raw material in the industry.

2.1 Kenaf Fibre Utilisation in the Textiles Industry

Traditionally, bast and leaf fibres have been used for various products such as ropes, twine or burlap (Oloruntoba *et al*., 2016). Bast is a group of fibre that includes hemp, flax, jute, nettles and Kenaf. The plants in this group are characterised by an outer bark that contains strong, cellulosic fibres and Kenaf is quickly becoming a sustainable favourite among textile innovators (Fibre watch, 2017). Bast fibres have been around since early civilisations as they were the simplest fibres to process before mechanisation (Fibre Watch, 2017). The use of Kenaf as a textiles fibre plant had been documented by the Egyptians as early as 1000BC (Fibre Watch, 2017). Kenaf fibres are produced when the core is separated from the outer layers as the fibres are stiff as a result of its lignin content. The research on Kenaf fibres are being programmed to include softening of Kenaf fibres, characterisation of woven fabrics, production of non-woven fabrics, development of products such as furniture under-lays, carpet backing and wall covering (Ramaswany *et al.,* 1995; and Kalaor, 1990). However, due to the coarseness and stiffness of fibre bundles, Kenaf processing remains problematic (Zang, 2003). Also, Kenaf single fibres are too short for textiles processing, thus; inhibiting production of high quality yarns and fabrics that contain Kenaf (Zang, 2003). Another problem was that raw Kenaf bast fibre bundles are too coarse and brittle to process through conventional textiles equipment (Zang, 2003). Despite these however, there have been rapid growth in research and innovation on Kenaf fibres utilisation in the sector in the natural fibre composites (NBC's) area. The interest warranted by advantages of these materials compared to others such as synthetic fibre composites includes low environment impact, low cost and support for their potentials across the wide range of applications (Pickering, 2016). The most current research areas on Kenaf Textile fibre utilization are on fibre characterisation, fabric performance and consumer acceptability. In a series of studies carried out at the southern university, USA Namwamba and Dixon (2003, 2004) reported that Kenaf fibre was extracted by bacterial retting and chemical retting. Yarns were spun from Kenaf/Cotton blends using the ring and rotor spinning methods. Yarns were spun from test methods of the American Association for Testing and Materials (ASTM). Results showed that application of NaOH caused fibres to swell and become rounder without changing fibre bundle diameter significantly. Fibre bundle shape varied greatly for chemically retted fibres, which also showed sign of deterioration. Examination of longitudinal shape fibre bundle of chemically retted fibre were more separated, uneven and appeared more brittle than the bacterially retted fibre. Under cross-polarized light, bacterially retted fibre showed a higher degree of anisotropy, birefringence, and pleochroism than chemically retted fibre. Fibre diameter increased with chemical treatment. Based on the findings of this study, it can be concluded that NaOH improved fibre regularity of kenaf fibre but caused weakening off the fibres. Excessive chemical treatment damages fibre bundle integrity, loosening short kenaf fibres, resulting in rougher yarn of fabric. Everglades' variety has finer fibres and bundles and could be more suited for apparel applications.

Nevertheless, Kenacitv a multi-national company currently produce Kenaf yarn in India, where it is used for apparel and accessories. The process adopted in India involves a bath soaking of the plant stalks, after which the long fibres are stripped and dried. The company doesn't currently work with designers or apparel companies within the U.S., as their production facilities in the U.S don't have the proper equipment for extracting and processing long fibre (Ecosalon, 2017). However the company continues to develop new technologies for processing and diversifying the use of Kenaf fibres, with the aim to create a viable market for Kenaf textiles in the U.S. by bringing the first bast fibre production and spinning plant to country. Although the company is proprietary in regard to their processing methods, they are prepared to share their knowledge about sustainable and intelligent methods for processing bast fibres (Ecosalon, 2017).

2.2 Kenaf/Cotton Utilization in the Textile Industry

Interest in Natural Fibre Composites (NCF's) is growing for many reasons including their potential to replace synthetic fibre with improved sustainability. Their advantages and disadvantages according to Pickering *et al* (2016) include high specific strength, stiffness and renewability as shown in Table 1. According to Pickering *et al*., (2016) the main factors affecting mechanical performance of NFCs include matrix and fibre selection, fibre dispersion, fibre orientation, composite manufacturing process and porosity.

To remove the clogs occasioned by Kenaf fibres processing into textile materials and hence promote its industrial use, Kenaf is now being blended with cotton and carded and spun into yarns that are made into woven or knitted fabrics. This development has increased the utilisation of cotton blend fabrics in recent years as they combine the best properties of each component (Bel-Belgrade *et al.,* 1999). According to Belgrade *et al.,* (1999), natural fibres have become more prevalent in fashion over the last 10 years. Ramie, also a bast fibre, has found acceptance. Blending cotton with milkweed fibres produces a fabric that has high moisture content, rendering the fabric more comfortable for apparel that has high absorbent properties (Lois and Aneruws, 1987). Bast fibres such as ramie are typically blended to improve fabric hand (Cheek and Roudsel, 1989).

To promote effective industrial utilization of Kenaf in the textile industry, a number of studies have been carried out on cotton/Kenaf blends. Tao et al (1999) reported that treated fibre bundles are blended with pima cotton and spun on a cotton processing system to yield blended 30/70 kenaf/cotton yarns. For comparison, 100% cotton yarn, 30/70 jute/cotton yarn, and 30/70 flax/cotton blended yarn are also prepared. The study observed that the kenaf blende yarns are comparable to the jute/cotton yarn and flax/cotton blends. Experimental woven fabrics made from 100% cotton yarn and from the blended yarns reveal that the breaking strength of kenaf/cotton blended fabric is similar to that of other blends, but lower than that of 100% cotton fabric. The kenaf blended fabric displays the highest air permeability. When the Kawabata Evaluations System was used to evaluate the fabrics, the result show that the blends are stiffer and less recoverable after deformation than the 100% cotton fabric, but the measure surface properties of the blended fabrics are comparable to those of 100% cotton. Also, Bel-Berger *et al.,* (1999) observed that softening the fibres invers the nep count for the chemically and the bacterially retted samples and improved yarn uniformity. Cotton/Kenaf fabrics can further be improved in softness and hand. Bel-Belgrade *et al*., (1999) reported that different fabric treatments such as enzymes, bleaching and mercerization resulted in softness of hand to the study. Two types of fabric were treated, a light weight plain weave and a twill. The report indicated that mercerization dramatically improved the softness and hand for both fabrics, indicating that blending cotton fibres with Kenaf fibres with proper fabric treatment results in higher value end products, making Kenaf a viable textile fashion fibre. It was observed that the initial plain weave fabric had aesthetically pleasing look of linen but was too scratchy for apparel. Bel-Belgrade *et al.,* (1999) surmised that although the untreated fabrics were too rough, Kenaf good tensile property and resistance to mildew and rot may open markets for industrial textiles. Treated samples were reported to result in softer, thicker fabrics with higher weaves due to shrinkage and had the look and feel of heavy upholstery fabrics. Enzyme and mercerization treatments improved the hand of the Kenaf/cotton blended fabrics, compared to untreated fabrics and the softness to the fabrics was much improved to the touch. Treatment with xylenes enzyme followed by mercerization and bleaching produced the most significant results (Bel-Belgrade *et al*., 1999). With the use of the xylenes enzymes, Kenaf fibres separated and conform to yarn and fabric structure. Based on the observation, Bel-Belgrade *et al* (1999) observed that prior to the research; Kenaf was not a viable fibre for apparel and upholstery fabrics. However using cotton as the support system for Kenaf, combined with vetting and finishing techniques, the research resulted in optimal Kenaf/cotton blended fabrics for apparel and upholstery use that are aesthetically appealing and a soft hand. The lightweight fabrics have linen look, and after treatment, are suitable for apparel without any type of lining. Such cotton/Kenaf blending were inexpensive natural fibre alternative to linen. The heavy twill fabrics are excellent upholstery fabrics that have a soft hand and meet the industry's soft requirements. In both cases, the collaborative effort resulted in high value fabrics made with Kenaf, an inexpensive fibre (Bel-Belgrade *et al.*, 1999).

In separate studies, Lewin (1984) and Taylor and Kugler (1992) reported that the bleaching and dyeing of Kenaf bundles leads to loss of tensile strength of the fibres due to partial removal of non-cellulosic component that basically constitute intercellular binding materials. However, Taylor and Kugler (1992) observed no reduction in linear density of Kenaf fibre bundle as a result of bleaching. Zheng (2003) observed the need to develop the technology for processing Kenaf blended with cotton fibre spinnability. Zheng (2003) also observed that after chemical treatment, fibre fitness, softness and elongation at break were improved, but fibre bundle strength and length were decreased. Increasing concentration of sodium hydroxide was however observed to weaken fibre strength considerably. Also, yarn with lower Kenaf blending ratio spun more easily with rotor spun yarns with high Kenaf content requiring high level of twist, resulting in high elongation break. Open and rotor spun yarns were observed to appear more uniform than ring spun yarns and exhibited less hairy appearance. Likewise fabrics were observed to become stiffer when Kenaf blending ratio was increased with knitted fabrics from ring spun yarns, softer but weaker than those from open and rotor spun yarns and had more hairy appearance. According to Ramaswamy *et al.,* (1995), bast fibre quality depends on both physical (crystallinity, crystallite size and orientation) and chemical (lignin, gum and hemicellulose) properties. Therefore it is imperative to determine fibre uniformity, evaluate the effect of processing on tenacity, crystallinity, crystal size and chemical composite of extracted fibre from base to the tip of the stalk. The report of the study using decorticated Kenaf fibres (variety E41) retted chemically and with bacteria showed fibre bundle strength to range from 22-30g/tex. The gum content also decreased from 20 - 10% with initial chemical processing. However, further degumming does not reduce gum level. The initial gum removal increased crystallinity by 3 - 5% and crystal size by 20 - 25%. Physical and chemical properties of Kenaf were observed to be uniform along the whole length of the stalk. The report also observed alkali treatment with 1% NaOH not to impact the stretch noticeably, while enzyme and degumming treatment weaken the fibre significantly (30 - 45%). Commercial softener employed made the fibre too sticky on the carding equipment. Bending rigidity and hysteresis also does not significantly improve the softened fibres. Degummed fibres are the strongest, most pliable, with least hysteresis and lower residual gum content and are spinable.

In all, it can be summarised that while research and development are ongoing on Kenaf fibres utilisation in the textile industry, the era of industrial application of Kenaf/cotton composite fibres utilisation in the textile sector is near. Successes have been recorded and textiles are already being produced from them, although not on large scale commercial basis. As innovation continues in this area as a result of the attributes of both Kenaf and cotton as individual fibres and as composites, the era of cotton domination of the textile sector may generally be coming to an end. This may be a way out for tropical countries such as Nigeria that have optimal potentials for Kenaf production and processing as subsequently discussed.

3.0 The Prospects for Kenaf Production and Utilisation in Nigeria

The prospects challenges of industrial production and processing of Kenaf in Nigeria have been reviewed (Ogunwusi, 2003). Kenaf cultivation dated back to the pre-colonial days when peasant farmers used it for cord making. The plant assumed a national significant in the 1960's when government established two cottage industries for jute bag production in Lagos and Badagry with hope that the crop will be cheaply grown and the raw materials sourced locally (RMRDC, 2002). The Nigeria Fibre Company (NIFINCO) at Badagry that manufactures jute bag operated on 100% imported fibre until 1970/71 after which it was finally closed down while the Nigerian Fibre Product Ltd, Jos (NNFPL) operated until 1992 (Ogunwusi, 2003). The demise of the two plants leads to the switching over to synthetic fibre for packaging agricultural products in the country. Before the closure of the plant however, the Nigeria Fibre Company started commercial cultivation of Kenaf in 1965. As at then, Kenaf was extensively cultivated in the western region, most especially Odeda, Ado Odo, Ijebu Ode, Saki, Wasimi, Sepeteri, Igbemo-Ekiti, etc., while NNFPL sourced its fibre through the northern Nigeria development corporation's plantation at Jama's (Ogunremi, 2000). While the two factories had a total processing capacity of about 20,000 metric tonnes of retted fibre per annum, less than 10% of the raw materials could only be obtained from local sources, leading to closure of the plants (Ogunremi, 2000).

Since this development, various organisations including the Ministry of Agriculture and Natural Resources, Federal Ministry of Investment, Trade and Industry have been at the vanguard of promoting increased Kenaf cultivation locally. In recognition of enormous industrial potentials of Kenaf, the Raw Material Research And Development Council (RMRDC) sponsored the Institute of Agricultural Research and Training (IAR&T) to produce five tonnes of foundation seeds that were distributed to Kenaf Growers, Processors and Marketers Association in 2017 for planting (RMRDC, 2017).

Despite the initial failure of Kenaf development initiative in the 60's, a number of factors made the development of Kenaf as an industrial raw material attractive in the country. Among these include its ability to adapt to various ecological zones in the country, its environmental friendliness, low gestation period, etc.

Several studies have indicated that Kenaf is well adapted to a variety of soil conditions in the tropics and sub tropics. The plant thrives well in drained, sandy-loam soil. In Nigeria, production of breeder, foundation and certified seed are being handled by the Institute of Agricultural Research and Training (IAR&T), National Seed Service (NSS) and the Agricultural Development Project's (ADP's) in some of the States in the country. Land evaluation for Kenaf cultivation indicated that the country has over 1 million (1,000,000) hectare of land which are distributed in over 16 States of the Federation, that are suitable for Kenaf cultivation. The total certified Kenaf seed required to cultivate the one million hectare of land is 30,000 metric tonnes, and to produce this quantity of certified seed, 1.1 metric tonnes of breeder seed is required, passing through 1,000 metric tonnes of foundation seed and 33.3 metric tonnes of foundation seed. This constitutes a major imperative of the RMRDC Kenaf development programme (Ogazi *et al.,* 1995).

RMRDC intervened in promoting Kenaf seed development in 1992 by sponsoring multi-location trials of available Kenaf seed varieties through IAR&T, Ibadan. The Council also supported the Kenaf Association of Nigeria to undertake seed multiplication at Ilorin, in Kwara State. Result of field trials carried out through the programme showed that Kenaf can successfully be planted in Oyo, Osun, Ondo, Kwara, Niger, Ogun, Lagos, Kano, Kaduna, Taraba, Benue, and Plateau States (Aribisala, 1993). The locations that should be avoided for Kenaf cultivation in these areas are those prone to strong winds and stormy heavy rains which may constitute hazards resulting in lodging and difficulty in harvesting (Ogunremi, 2000). The plant is also more tolerant of poor soil conditions than jute and requires little care during its growing period (Wison and Menzal, 1964).

Result of field studies carried out in the more humid parts of the Nigerian Savanna and forest zone showed that overall yields of fibre increased up till mid-April and thereafter decreased (Baker 1970). It also indicated that planting should be done by hand operated planter. To facilitate planting of the crop in Nigeria, simple hand operated planters were fabricated and tested at IAR&T, Ibadan. According to Ogunremi (2000), efforts are on to improve, modify and perfect the planters before distribution to farmers. In addition, studies at IAR&T, Ibadan, on yields of fibre during the inter-cropping of Kenaf with cassava, okro, maize, and other grains have reached advanced stage of completion for final and definite recommendation on optimum sowing date, population and pattern of arrangement for crop components of intercrop combinations (Ogunremi, 2000). This will facilitate its cultivation by subsistence farmers, who in most cases, depend on the aforementioned crops for sustenance. In line with the Federal Government diversification plans, Kenaf when fully developed would also be employed for long fibre pulp production (RMRDC, 2003) and for production of jute bags locally (RMRDC, 2017).

According to Ogunwusi (2013), apart from its industrial potentials, other properties that give Kenaf supremacy over wood fibre in the area of environmental conservation are its:

- *High Yield:* Kenaf yields 6-10 tons of dry fibre per acre. This is 3 - 5 times greater than the yield of southern pines which may take from 7 - 40 year to reach harvestable size.
- *Rapid Growth:* Kenaf reaches 5 metres in 150 days.
- *Papermaking Characteristics:* Production of bleachable grade of pulp from Kenaf requires less chemicals, energy and pulping time. This is made possible by the relatively low lignin content of Kenaf compared to wood. An average Kenaf plant contains 9% lignin while wood in most cases contains more than 29% of the same material. Consequently, energy consumption is about 25% lower in Kenaf pulp production than wood pulp.
- *Bleaching:* Commercial scale bleaching of Kenaf pulp could be done with hydrogen peroxide, a relatively harmless chemical, compared to chlorine used for wood pulp.
- *Carbon dioxide, Nitrogen and Phosphorus Fixing Potentials:* Kenaf has high ability to fix CO_2, absorb nitrogen, phosphorus and heavy metals from the soil and consequently can be used for soil rehabilitation purposes.
- *Other Bioremediation Applications:* Apart from its nitrogen, carbon dioxide, phosphorus and heavy metals fixation potentials, Kenaf has proved effective in water purification and pollution control. It is salt tolerant, and, as a rapidly growing crop, utilizes large amount of water.
- Kenaf can be produced at about half the cost of pulpwood, especially, under suitable growing conditions (Vargas, 1997).

While research and development activities have shown Kenaf to grow faster than wood in temperate countries, the growth rate of tropical varieties indicate a volumetric yield up to 2.5 times that of temperate climes, as the crop responds positively to high solar radiation, rainfall or irrigation regimes. The potentials of Nigeria in the production of Kenaf textile fibres locally can however only be fully realised if all hands are on deck. The Institute of Agricultural Research, Zaria may need to link up with IART, Ibadan to further the on-going research on Kenaf utilization for textiles production. A plus for Kenaf textiles fibres production in Nigeria is that retting technology has been developed locally. Also, the design and fabrication of Kenaf decorticators has been perfected. This equipment is required in Kenaf fibre processing.

4.0 Problems of Kenaf Production and Processing in Nigeria

While, the desirability of a virile Kenaf agro industry in Nigeria cannot be over emphasized; there are some problems that may militate against the sustainable development of such an industry. One of this is the production of Kenaf which is still subsistence level with average annual production of about of about 1,000 tonnes since the previous decade and the highest production was recorded in 2010/2011 (Table 2) according to Food and Agriculture Organization (2015). Production has been declining from 2012 to date and this could be attributed to lack of utilization of this crop which made the farmers to deviate from planting it (Oloruntoba *et al.*, 2016; Ogunwusi, 2003).

While the issue of Kenaf production for industrial use can be approached from three levels; which include utilization of small scale farm holders; employment of independent large scale farmers/contractors; and, or establishment of large scale plantations by Kenaf processing industries; the problems of logistics, economies of scale and the need to develop a structure of harvesting, storage and delivery system is yet to be adequately considered (Ogunwusi, 2003). However, research on methods for harvesting Kenaf is being conducted in other economies. Since 1988, Kenaf International and Natural Fibres in Louisiana have harvested approximately 1,000 acres (40ha) of Kenaf in Texas and Louisiana (Taylor, 1993).

Apart from problems that are related to harvesting and storage, the issue of monoculture development of Kenaf has been a topic of serious consideration by environmentalists who observed that as Kenaf industry expands, it is most likely that chemical usage will increase. Research on the development of pest tolerant Kenaf varieties and rotation with other pest resistant crops may have to be initiated locally to combat this problem. Another major problem that may constrain the development of a virile Kenaf agro-industry in Nigeria is , as the cost of building new textile mills in bound to be beyond the investment capability of most entrepreneurs government intervention may become necessary. Thus, need for a consortium may be necessary.

Closely allied with the above is the lack of market for kenaf fibre as kenaf is not being used at industrial scale presently. There is also lack of awareness on the potentials at the local level. This necessitates the need for the general public and investors to be sensitized on the potentials of this important agro commodity.

5.0 Conclusion

NCF's are fast becoming important in the global textiles industry. Although production of Kenaf/cotton textiles are not currently being practiced at industrial level in most countries across the globe, the current state of research indicated that this is bound to become a reality soon. It is evidenced that if the textiles industry in Nigeria are to be working optimally, the present level of cotton production may not be suffice for the raw materials required in the industry. As a result, sustainable development and utilisation of Kenaf fibres as substitute or complementary raw material may be required in the sector may be a way out.

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Table 1: Advantages and Disadvantages of NFC's

Advantages	Disadvantages
Low density and high specific strength and stiffness	Low durability then for synthetic fibre composite but can be improved considerably with treatment.
Fibre are a renewable resources, for which production requires little energy, involves CO_2 absorption, whilst returning oxygen to the environment.	High moisture absorption, which results in swelling.
Fibre can be produced at a lower cost than synthetic fibre.	The lower strength, in particular impact strength compared to synthetic fibre composites.
Low hazard manufacturing processes	Greater variability of properties
Low emission of toxic fumes when subjected to heat and during incineration at end of life.	Lower processing temperatures limiting matrix options.
Less abrasive damage to processing equipment compared with that of synthetic fibre composites.	

Table 2: Shows Data on Kenaf Production in Nigeria from 2006 - 2015

Year	Hectarage (Ha)	Yield Kg/Ha	Production (Tones)
2006	1000	10160	1016
2007	1000	11160	1116
2008	1000	12270	1227
2009	1000	11300	1130
2010	1000	13200	1320
2011	1000	12990	1299
2012	1000	8380	838
2013	1000	6920	693
2014	1000	7340	734
2015	965	6945	565

Source: Food and Agriculture Organization, 2015