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# **Sericulture as a Tool for Sustainable National Development in Nigeria- The Way Forward**

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### **Author's contribution**

*The sole author designed, analyzed and interpreted and prepared the manuscript.*

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## **ABSTRACT**

The present review article proposed sericulture as a viable, sustainable development plan for Nigeria and as a path to diversifying the Nigerian economy away from an oil-based economy to that which is more balanced and stable. The paper identified poverty alleviation as the foremost Sustainable Development Goal for Nigeria. The reasons for Nigeria's failure at getting rid of abject poverty in spite of decades of oil wealth were advanced. Sericulture, the agro-based business of silk production and processing was presented as a model that fits into the UNDP-identified components of a robust agribusiness plan for Nigeria. The paper concluded that a renaissance of silk production in Nigeria is possible and that while the focus on *Bombyx mori* sericulture should be given priority, research into the development of African wild silk moths of the indigenous (Nigerian) *Anaphe* sp. should be encouraged. It was recommended that collaborative efforts between government, the private sector and the academia should be actively pursued in order to develop Nigerian Sericulture. Furthermore, policies focused on the local utilization of silk and integration of this into the development of the entire textile industry was recommended.

**Keywords:** *Sericulture; agribusiness; sustainable development; sustainable development goals.*

## 1. SERICULTURE IN HISTORY

Natural silk and its means of production, that is, sericulture are believed to have been discovered by Chinese Empress Xi-Ling-Shi in the year 2640 B.C., during the reign of Emperor Chin Shih Huang Ti [1]. Thousands of years after this discovery, sericulture remained a hidden treasure of China because the death penalty was the lawful punishment for exporting silk out of China during that time. Subsequently, sericulture entered Europe when two European monks smuggled it by way of carrying the silkworm eggs and mulberry seeds in their walking sticks. Several years later, Marco Polo, the renowned traveller from the West, came through the Silk Road to the South-East Asian countries, the longest commercial route of the ancient world. Thus sericulture became widespread all over the world [2].

Sericulture has since remained an excellent agro-based cottage industry, the end product being raw silk, the most precious textile fiber produced by the silk gland of the silkworm, a fabric so exquisite that even today; no other fabric can match its lustre, softness and exquisite natural colour. Presently, 58 countries (Table 1) are listed as sericulture countries, where the citizens engage in some form of sericultural activities [3]. As shown in Table 1, China maintains its glorious position as the foremost mulberry silk producing country in the world followed by India [4]. The other major silk producing countries of the world are Uzbekistan, Brazil, Japan, Republic of Korea, Thailand, Vietnam, DPR Korea, Iran. On the other hand, The major silk consumers of the world are; USA, Italy, Japan, India, France, China, United Kingdom, Switzerland, Germany, UAE, Korea, Viet Nam [4]. Due to its capacity to complement poverty alleviation and job creation programmes in many under-developed and developing countries, many countries in Asia, Africa and South Africa have shown interest in the development of sericulture in recent times [5]. Conversely, in the developed and industrialized countries such as France, Italy, Spain, Japan and South Korea, demand for raw silk and silk finished products continues to increase on a daily basis, due to the excellent features of the natural silk in comparison to the synthetic fibres. With the foregoing, it may in fact be concluded that the future of the global silk industry is indeed very bright.

## 2. SERICULTURE IN NIGERIA

The International Sericultural Commission lists Nigeria among the minor sericulture countries of the world engaged in the production of cocoons and raw silk in "negligible quantities", other countries listed in this category are Kenya, Botswana, Zambia, Zimbabwe, Bangladesh, Colombia, Egypt, Nepal, Bulgaria, Turkey, Uganda, Malaysia, Romania and Bolivia [4]. For centuries, traditional silk fabrics called *Sanyan* were made from silk harvested from the wild and undomesticated silk moth species by the Yoruba people in south-west Nigeria [6]. In other words, and without any evidence of technology transfer, while the Chinese were making silk from domesticated silkworms, the Yoruba people in Nigeria were also making silk from wild silkworms. However, the wild silkworms are different from their domesticated cousins available in China and elsewhere as they are not commercially viable in the production of silk. As populations grew and demands for silk increased amidst the cutting down of trees on which those wild silkworms thrive by loggers, the demise of the traditional silk industry in Yoruba land was just a question of time. In anticipation of this scenario, the Forestry Research Institute of Nigeria (FRIN), Ibadan in an attempt to fill the gap, introduced mulberry sericulture to Nigeria in 1962 to prop-up the fledgeling sericulture industry [7]. The venture failed as sericulture could not reach its potential as an Agro-Industrial enterprise in Nigeria due mainly to the insufficient Government – Private sector collaborative participation among several other reasons [8]. Mulberry sericulture was re-introduced in Nigeria in 1992 by the old Ondo State Government under the leadership of the then Governor Bamidele Olumilua and in collaboration with Professor Musiliu Ashiru of the Forestry Research Institute, to explore mulberry sericulture as a panacea for unemployment and poverty alleviation among rural dwellers. This effort was supported by the Raw Materials Development Council (RMRDC) and today, lawyers' wigs and other clothing items made from silk produced in Ekiti and Ondo States are available in the Nigerian market which means mulberry sericulture venture can actually prosper in Nigeria.

## 3. STATE OF NIGERIA IN TERMS OF DEVELOPMENT

Nigeria is presently at crossroads as it tackles the arduous task of diversifying her economy away from a more than 90% oil-based economy

to one which is more balanced and stable, even in the face of ever-dwindling oil prices [9]. Today, there are more people from diverse backgrounds talking about sustainable development of the country. Everest Rogers (1976) defined development as a widely participatory process of social change in the society, intended to bring both social and material advancement (including greater equality, freedom and other valued qualities) for the majority of the people through gaining control over their environment [10]. With the foregoing, it is evident that development may mean different things to different people and that, its meaning may vary according to the changes occurring in the social, economic, political, cultural, ethical, scientific and technological value of a given society. Regardless of the focus of development, it is the ability of a people to have greater control over their environment and the increased realization of the values of their society; whatever those values may be, ranging from poverty alleviation, and women empowerment to global recognition and so on.

For Nigeria and other developing countries in the world, poverty alleviation is perhaps the most important focal point of developmental efforts. This fact is well articulated in the Millennium Development Goals (MDGs) targeted at eradicating extreme hunger and poverty in 189 member countries of the United Nations (UN). In order to achieve more success in the global developmental imperatives, in the year 2015 (fifteen years after the MGDs were established) the MDGs were further crystallized into seventeen (17) measurable, universally-agreed objectives, tagged "Sustainable Development Goals" (SDGs), yet again, poverty eradication came up on top as the first of the seventeen goals [11]. However, the scourge of poverty is still being felt by the majority of the citizens of the countries who do not have access to primary health care, water and food. According to Fred Agwu (2011), poverty is a condition in which income is insufficient to meet subsistence needs [12]. For example, about 92% of Nigerians survive on less than \$2 per day while about 71% survive on less than \$1 a day [13]. This means that the income of two Nigerians per day is equal to the daily feeding of a cow in Europe [14]. The situation is that damning and serious. To further compound the situation, the rate of unemployment in Nigeria is about 6.4% [15] and has been identified as one of the major causes of poverty [16].

Moreover, Nigeria's Human Development Index ranks 158 in the world and this is the last in the 'Medium Human Development' category (Table 2). Also in the same vein, the Global Hunger Report (GHR) in 2008, placed Nigeria in the 20<sup>th</sup> position among the 118 hungriest nations in the world [17,18]. From the foregoing, Nigeria cannot be said to be developing; at best, Nigeria can be said to be "maintaining or managing" to wobble along.

#### 4. NIGERIA'S ECONOMIC GROWTH

From the perspective of economic growth, oil has been the most important factor in Nigeria's economic growth plan for over 40 years. Nigeria is not alone among the countries of the world with this predicament; however, studies have shown that in the last decades of the 20th century, there was a counter-intuitive relationship between natural resource abundance and economic development [19]. Developing countries with abundant natural resources underperformed compared with those that are deficient in natural resources [19,20]. Specifically, the per capita income of countries with poor resources increased at rates two or three times faster than those of the resource-abundant countries (like Nigeria) and the growth rate has widened significantly since the 1970s. This apparent paradox between natural resource abundance and economic growth, as well as development, has led to increasing research works into the so called resource curse phenomenon. This is probably why many Nigerians have referred to the abundance of crude oil in the country as a curse rather than a blessing.

There is an urgent need, more than ever before, for Nigeria to revamp its agricultural sector. This sector was instrumental to the development of highly industrialized countries like China, Japan, Korea, India and Malaysia, just to mention a few. Agriculture used to be the mainstay of Nigeria's economy, particularly before Independence and in the First Republic (1960-1966), but the discovery of crude oil succeeded in displacing agriculture and consigning it almost into oblivion. Harris and Heyer (2010), presenting this similar orthodoxy on Sub-Saharan Africa, posited that "Most of poor in Africa live in rural areas but why poverty rate is high is due to Africa's failure to replicate the Asian Green Revolution" [21].

Perhaps, in an attempt to revert to its 'golden' past, the Nigerian government has over the years pursued several agricultural and rural

development policies in a bid to reconstruct a self-reliant nation and a dynamic economy. These include: National Accelerated Food Production Programme (NAFPP), River Basin Development Authority (RBDA), Agricultural Development Programme (ADP), Operation Feed the Nation (OFN), Green Revolution (GR), Directorate of Food, Roads and Rural Infrastructure (DFRRI) etc. Surprisingly, no policy was ever articulated to promote Agribusiness in order to exploit the value chain embedded in it. So, all the poorly contrived policies failed to achieve their set objectives.

As identified by the United Nations Development Programme (UNDP), in Nigeria, Agribusiness can be divided into four components as follows [22]:

(a) Farm Input Supply Business: This encompasses agricultural chemical inputs, suppliers of fuels, fertilizers, pesticides and herbicides, seed and feed concentrate suppliers; agricultural machinery and equipment suppliers; automobile, tube, tires, and foam manufacturers; credit and veterinary services suppliers. This supply component extends to supplies of containers, sacks, crates needed in the packaging activities. Quite important as well, are utilities like water, power, telephone, hospital insurance etc.

(b) The Producing Farm Business: These are crop and livestock producers who are farmers scattered all over the country. The growth of this component depends on an effective use of the available large expanse of land leading to improved productive forces and complementarity with industry that absorbs excess agricultural labor.

(c) Food Processing Agribusiness: This includes food and fruit juice canners; manufacturers of beer, soft drinks, cocoa drinks, coffee, and tea; producers of confectionary, sugar, sweets, chocolate, cakes, biscuits; tobacco processors and/or manufacturers; meat processors; wood processors and furniture makers and distributors, paper millers and tissue paper manufacturers; leather and footwear manufacturers; food packaging and cartons manufacturers; cotton processing, spinning, weaving and textile companies; food processors of cornflakes, jam, bread, butter, milk, margarine, and tomato puree; oils, soap, and toothpaste manufacturers, fishing companies, fish processors, packers and distributors.

(d) Food Marketing and Distribution Agribusiness: Companies in this category include private food stores; wholesalers and retailers of frozen foods including super markets, etc. These agribusiness firms are scattered all over the country but are concentrated in three main industrial clusters in Nigeria, Kano, Kaduna, Jos in the north; Lagos, Ota Ibadan in the south-west and Port Harcourt, Aba, Nnewi, Onitsha in the south-east. A survey of a few include: Taraku Oil Mills Ltd, Abakiliki Rice Processors, Sorghum Outgrower Scheme with Guinness Plc, Fuman Agriculture and Agricultural Products, Fruit Juice Manufacturers and Cocoa Exporters.

In a nutshell, harnessing bio-resources for economic growth and national development refers to the deployment of biological resources such as germplasms of highly valued living organisms and developing these into viable industry by fully exploiting their value-chain in the four main agribusiness areas as outlined earlier. Such germplasms may be the fermenting bacteria of locust bean, "iru" that produces a particular flavour that is the relish of the majority of the people and building an agribusiness around it, in order to meet the Nigerian developmental goals particularly in the areas of poverty alleviation, employment generation, closing the inequality gap in gender, earning capacity in the urban and rural areas and so on. On the other hand, it may be the deployment of a particular variety of maize that fits into a bio-fuel initiative, just to cite a couple of examples.

## 5. THE RELEVANCE OF SERICULTURE TO NIGERIA'S ECONOMIC DEVELOPMENT

The present article proposes sericulture as a viable solution to the earlier characterized moribund nature of Nigeria's socio-economic development. Sericulture fits squarely into all the four components of the National Agribusiness Development Model enumerated above. According to Ayoade (2014), sericulture may be broken into three different processes, namely: (a) cultivation of mulberry plants otherwise called "Moriculture" which provides food for the silkworm larvae; (b) rearing of silkworms (Sericulture); and (c) reeling of cocoons which are the products of sericulture preparatory to silk reeling [8]. While the first two parts of the process are purely agricultural in nature, reeling of cocoons to spin yarn is distinctly industrial and it is carried out either in cottage-type establishments or in large-scale factories called

'filature'. The main areas of employment generation in the silk production venture include: mulberry cultivation, silkworm rearing, production and sale of silkworm eggs, silk reeling, threading and weaving, and fabrication of machines for both the small scale filature and/or big time miller.

In addition to providing direct employment to sericulturists, every part of the mulberry plant from the root to the leaves is medicinal which drug designers, pharmaceutical companies and herbal medicine practitioners have taken advantage of, to create tens of thousands of more jobs in the silk production industry.

Silk business is, without doubt, a good candidate for poverty alleviation in a developing country such as Nigeria due to its high employment potential. It is estimated that Sericulture can generate employment at 11-man days per kg of raw silk production (in on-farm and off-farm activities) throughout the year [8]. This potential to generate employment, especially in rural areas, makes sericulture an excellent tool for rural reconstruction and development. For example, in China, about 1 million workers are employed in the silk reeling sector alone, excluding tens of millions of workers employed in moriculture and sericulture segments of silk production. In India, about 10 million workers are employed in the silk industry. The industry also provides employment for 20,000 weaving families in Thailand [23]. In addition to creating gainful employment for their rural populations, China and India, the first and second most populous countries in the world which are also the two largest silk producers, respectively, derive about \$2 billion and \$450 million worth of revenue annually from the Sericulture enterprise [24].

Furthermore, sericulture presents a great opportunity in closing the gap between the rich and the poor. Since the end-product users are mostly from the higher economic groups, money flows mostly from the high-end groups to the low-end groups as the majority of the financial benefits of this industry goes directly to the rural households. According to Gangopadhyay (2009), about 57% of the gross value of silk fabrics flows back to the cocoon growers with share of income to different groups as follows: 56.8% to cocoon grower, 6.8% to the reeler, 9.1% to the twister, 16.6% to the trader [25]. Moreover, sericulture has a low gestation period and high returns on investment. Mulberry takes only six months to grow in order to commence

silkworm rearing. Mulberry, once planted, will go on supporting silkworm rearing year after year for about 15 – 20 years depending on inputs and management provided. The cost per benefit ratio of investment in sericulture is 1.5 to 2.0.

From the foregoing, sericulture can easily be incorporated into most women empowerment programmes since most sericulture activities, starting from mulberry garden management, such as leaf harvesting and silkworm rearing, are more effectively taken up by women. There have been success stories on this venture from many countries which include China, India, Japan, Brazil, Thailand, Vietnam, Indonesia, Iran, Sri-Lanka, Philippines, Bangladesh, Nepal, Myanmar, Turkey, Papua New Guinea, Mexico and Uzbekistan [26].

Some Latin American countries have also taken up sericulture to provide employment, including financial benefits to the people in rural areas. Countries in Africa, where some silk production is taking place or where there are attempts to revive the old industry, include: Botswana, Egypt, Ethiopia, Ghana, Kenya, Madagasca, Rwanda, South Africa and Nigeria [24].

## 5.1 Indigenous Wild Silk

Globally, sericulture, the process of silk production, is a term describing the modern process of cultivating mulberry plants, rearing of silkworms and reeling of cocoons for the manufacture of fabrics. On the other hand, traditionally, the history of textile production from silk in West Africa dates back from the 10<sup>th</sup> century AD, particularly in south-west Nigeria among the Yoruba people where it is the men that weave the silk [27]. Unlike the mulberry silk which is derived from *Bombyx mori* and of Chinese origin, silkmths belonging to the genera *Anaphe* and *Epanaphe* are the species used in traditional silk production in Africa. The fibres from these insects are processed and hand-spun into silk threads that are used in producing fabrics of high cultural significance. These fabrics may be classified into three (3) major categories, namely, *sányán*, *etù* and *alāri*. *Sányán*, also known as the king of cloths is usually derived from hand-spun fibres from the silkmth and the silk threads washed and soaked in cornstarch with the fabric coming out as beige and is particularly associated with chiefs and kings, while the *alāri* is *sányán* dyed in red camwood solution. *Etù* is *sányán* dyed into blue, black or shades of these colors. It would be impossible to find these fabrics in contemporary

Africa but for their cultural significance, however, these fabrics are found wherever Africans are found in the diaspora where they are worn at weddings and other ceremonies by Africans and non-Africans alike by members of the elite class. The expensive silk yarn has, however, been substituted for cotton and in many cases synthetic fiber dyed in the traditional color of the silk fabric since according to the Yoruba aesthetics, the purpose of something is more important than its actual form [28]. In spite of these substitutions, the glory of the cloths remains.

Despite the fact that the cultivation of African wild silk appears to be much simpler than that of the exotic mulberry silkworm [29], the African wild silk is scarcely found in Africa today for a variety of reasons such as deforestation due to uncontrolled land development, which has been a major bane to the survival of the indigenous silkmths in Africa including members of the *Anaphe* and the *Epanaphe* species, particularly *Anaphe venata* (which is perhaps the most studied species of silk-producing moth from Africa). Other factors responsible for the failure of African silk production are the unprecedented socio-economic change that came upon many African countries, particularly Nigeria as a result of the discovery of crude oil [30], poverty and the consumption of silkmths as food by humans and livestock due to their high nutritive content. Other factors militating against development of the sericulture industry in Nigeria include lack of commitment of research efforts to developing sustainable rearing regime for local breeds of silkworm and high yielding races outside the forest environment (i.e. domestication). Lack of effective research and training programmes and the unavailability of adequate commitment by government and other stakeholders to build Nigeria's sericulture as an industry, are other factors militating against silk production in Nigeria. This review is focused on analyzing these problems and proffering solutions to the outlined problems.

## 5.2 The Oil Boom

In 1962, two years after the Nigerian independence, when mulberry sericulture was introduced to Nigeria by the Forestry Research Institute of Nigeria, Ibadan [7], Nigeria was poised to become a leading world economy within two decades, given the vast natural resources particularly agricultural resources. Nigeria was not only agriculturally self-sufficient

and food secure, but it thrived in global markets as the world's largest producer of groundnuts and palm oil and as a significant producer of cotton and cocoa. Agriculture was the nation's main source of employment and income. In 1965, the agricultural sector employed over 70 percent of the labor force. Export cash crops were responsible for 62.2 percent of the young nation's foreign exchange and 66.4 percent of its GDP [31]. Northern cities like Kano, with its towering groundnut pyramids, employed large swathes of the population and became regional economic hubs, emblematic of the nation's agricultural wealth. These northern cities were linked to southern ports like Lagos through extensive and reliable rail networks that fostered economic interdependence and regional integration [32].

However, the oil boom era of the 1970s truncated the steady growth and the promising future of the Nigerian economy [30]. The resultant oil-based economy made other sectors of the economy, particularly the agricultural and agro-allied sector unsustainable. The oil boom in hindsight is now assessed as a curse. This is because it injected so much money suddenly into the economy. As a result of the sudden wealth, government and citizens developed such hedonistic tendency and a weird taste for comfort and expression of wealth and class that government failed to plan and work for other sectors of Nigeria's economy. Consequently, other sectors such as agriculture and agro-allied sectors were actually crippled as Nigeria became an importer of every item she consumes.

In an attempt to substitute for the waning indigenous silk production in Nigeria, the Forestry Research Institute of Nigeria (FRIN) imported accessions of mulberry trees and races of the Chinese *Bombyx mori* silkworms into Nigeria in the year 1962 but this endeavor failed to take off as a viable project. This was due to the lack of desire by government or private investors to fund projects that are not linked to petroleum because such require planning, follow-through and the fact that the returns may not necessarily come as quickly and rapidly, unlike the quick cash available from petroleum.

On the other hand, sericulture being a cottage business requires minimal capital outlay, and is a better candidate than petroleum oil when considering poverty alleviation and job creation in a developing country such as Nigeria. Other reasons advanced for sericulture as a viable tool

for national development includes its high employment potential (since agro-based businesses do not require as much technological know-how and training as petroleum business), wealth redistribution potential (since major portion of the share of income goes to the cocoon farmers, unlike oil production where the refiners and dealers make the bulk of the profit), low gestation and high returns [8].

The Raw Materials Research Development Council (RMRDC) is one of the government parastatals of the Federal Republic of Nigeria with the mandate to formulate and assist government in executing appropriate policies for domestic raw materials exploitation, development, utilization and investment. Moreover, the RMRDC's mandate includes reduction of the nation's dependence and expenditure on raw material imports by serving the interests of the private sector as it facilitates the sourcing, development, and utilization of domestic raw materials in manufacturing [33]. Several attempts by the RMRDC at resuscitating Nigerian silk production started since the 1990s did not yield any dividends till date. All these because of lack of focus on the part of the government and other stakeholders to forge a sustainable system of developing other sectors of the economy apart from the "get-rich-quick" oil sector. In the 1990s, the RMRDC in collaboration with the Forestry Research Institute of Nigeria and some state governments such as the Ondo and Ekiti States with International organizations such as Japan International Cooperation Agency (JAICA) funded the establishment of model sericulture projects such as the ones at Ado-Ekiti and Akure but these initiatives were stymied by lack of funding, inadequate involvement of the private sector, lack of market for the cocoons, yarn and finished products.

### 5.3 Deforestation

The Nigerian oil boom era witnessed an unprecedented increase in capital projects and uncontrolled deforestation in Nigeria. Deforestation is defined as the permanent destruction of forests (without any simultaneous replanting) in order to make the land available for other uses. The general deforestation rate for Nigeria is estimated to be about 350,000 hectares per year, which is equivalent to 3.6% of the present area of forests and woodlands, whereas reforestation is only at about 10% of the deforestation rate [34]. On the other hand, the rate of deforestation is higher in some cases. For

example, when land use/land cover changes in the Wilberforce Island, Bayelsa State (South-South Nigeria) was studied for the purposes of determining the causes of deforestation and changes in the vegetation cover for a 13 – year period. The results showed that forest and sparse vegetation/grassland decreased from 73.34% and 10.32% to 51.34% and 8.08% between 2002 and 2015 respectively, while farmland and residential area increased from 10.71% and 0.44% to 30.575 and 1.72% respectively for the same period. It was concluded that land use/cover changes were due to deforestation to provide raw materials for wood industries, and space for agriculture and building of houses for the increasing population in the area [35]. These kinds of statistics have a direct impact on indigenous silk production in Nigeria since the main indigenous silk-producing silkmoth, *Anaphe venata* is known to thrive only on the African whitewood (*Triplochiton scleroxylon*), known as *arère* in Yoruba, *Okpobo* in Igbo and *Obeche* in Edo. This tree has been a major victim of the deforestation scourge that accompanied the Nigerian oil boom. *Arère* has been a major target for deforestation because of its use for timber as the wood from it is in great demand for furniture, shingles, frames, beams, crates, boxes, veneers and plywood. The wood from *arère* is soft, easily worked, and takes stains well and it is also used for paper pulp. Due to these and other uses, the *arère* tree has been a victim of over-exploitation and the trees are scarce in many areas or locally extinct. More recent efforts at reforestation of these species by the International Institute for Tropical Agriculture (IITA) Forest Project have experienced limited success due to insect damage although other strategies such as restoration of degraded forests are being considered [36].

### 5.4 Competition for Silkmths from Human and Livestock as a Nutritive Source

When it's nutritional value is considered and as a protein source, the larvae of *Anaphe* have been compared to that of chicken eggs, and mass rearing as an alternative protein source has been advocated [37-39]. The attempt to substitute the rearing of silkmths for silk to that of livestock and human nutrition is another major factor militating against the development of sericulture in Nigeria. There are numerous reports showing that there is a direct competition for silk-producing insects by farmers of livestock producing farmers for replacing the dietary fish

meal in feeding animals (specifically poultry) and for incorporation into human diet, particularly in the North-Central and South-Western part of Nigeria respectively. Reports by Ijaiya and Eko showed that the replacement of the fish meal with silkworm caterpillar meal (from the *Anaphe* African silkworm) fed to anak broiler chicks produced higher growth performance and higher economic benefit [40]. These kinds of data further discouraged farmers from focusing on the goal of increasing the production of cocoons and their processing into silk as they would rather grow the insects to larval stage, kill and feed to their poultry birds in a rather simpler process, albeit with less economic benefit and in direct competition with raising silkworms for sericulture.

Moreover, various reports [37,39] show that a seasonal ataxic syndrome known to be highly prevalent among the Ijesha people living in and around Ilesha, Ikare among other locations in south-west Nigeria where the syndrome was first described as "Ijesha shakes" is as a result of feeding on meals of stew from the African silkworm, *Anaphe venata* and a monotonous high carbohydrate meal of pounded yam. The decomposition of thiamine due to the consumption of the larvae of these insects and the resulting acute shortage of this physiologically important amino acid has been cited as the cause for "Ijesha shakes". In summation, there is ample evidence to show that there is a stiff competition for silkworms that would otherwise be more economically significant if grown for silk than when consumed by incorporation into the diet of livestock or into the meals of humans.

### 5.5 Lack of Market Structure, Research and Extension Support Services

The cultivation of African wild silk is considered to be much simpler than that of the exotic mulberry-cultivated *Bombyx mori* because the worms do not need to be killed before leaving the cocoons [29]. This is because the African non-mulberry wild silk cannot be wound and can only be used in the schappe silk industry perhaps in the manufacture of rugs, mats and other less refined final products where it does not matter that the cocoons have been bored through by the moth. This is traditionally counted as the advantage of cultivating silk from the African silkworm over the exotic *Bombyx mori*, although, in reality, this is indicative of minimal usefulness for the silk obtained from the African silkworm

particularly in the global silk markets due to the lack of versatility in applicable uses.

Furthermore, with the advent of the introduction of mulberry silk into Nigeria, there has been no structure in place for sorting and standardizing the quality of cocoons produced. This is a major drawback to silk production in Nigeria because oftentimes the cocoon producers are unable to find buyers for their products due to low quality and a structured buying system to ensure that cocoon producer are able to trade their products. Due to the fact that presently, only one sericulture project site is functioning in Nigeria. Nigeria's lone functioning sericulture project site was set up as a collaborative project between the RMRDC and the Ondo State of Nigeria in the city of Akure. This center, apart from guaranteeing the disease-free *Bombyx mori* eggs to silk farmers and assisting them to establish mulberry plantation and training them in early and late stage larval insect rearing including, extension services in the other pertinent areas of quality control of cocoons. However, support in the areas of buying/ trading of cocoons, silk reeling and the making of finished are abysmally minimized or non-existent.

## 6. THE WAY FORWARD- CONCLUSIONS AND RECOMMENDATIONS

From the foregoing, it can be seen that in spite of great potentials, the sericulture project failed in Nigeria. A turn-around is however possible if the following ideas are considered.

### 6.1 Focus on Local Utilization

Most policies and projects hitherto on sericulture in Nigeria have so far been focused on encouraging farmers to produce large amounts of cocoons for export. This flaw in policy has plagued sericulture in Nigeria and elsewhere in Africa. This is because the production of high-grade cocoon and the processing of the same into high-quality yarn/fabric that would be well assessed for export requires high technical skill, on the other hand, technical know-how of Nigerian farmers in the area of *Bombyx mori* sericulture is still very low, hence, most Nigerian farmers are unable to attract buyers even when they are able to produce cocoons. Even when these farmers attract buyers, the low-grade silk products fetch little or nothing on the global market. It is recommended that a silk purchase board be set up to evaluate cocoons for quality



**Table 1. Global silk production (In metric tonnes)**

Countries	Year						
	2010	2011	2012	2013	2014	2015	2016
Bangladesh	40	38	43	43	45	44	44
Brazil	770	558	614	550	560	600	650
Bulgaria	9.4	6	8.5	8.5	8	8	9
China	1,15,000	1,04,000	1,26,000	1,30,000	1,46,000	1,70,000	1,58,400
Colombia	0.6	0.6	0.6	0.6	0.5	0.5	-
Egypt	0.3	0.7	0.7	0.7	0.82	0.83	1.2
India	21,005	23,060	23,679	26,840	28,708	28,523	30,348
Indonesia	20	20	20	16	10	8	4
Iran	75	120	123	123	110	120	125
Japan	54	42	30	30	30	30	32
North Korea	-	300	300	300	320	350	365
South Korea	3	3	1.5	1.6	1.2	1	1
Phillipines	1.00	1.00	0.89	1.00	1.10	1.20	182
Syria	0.6	0.50	0.50	0.70	0.50	0.30	0.25
Thailand	655	655	655	680	692	698	712
Tunisia	0.12	3	3.95	4	4	3	2
Turkey	18	22	22	25	32	30	32
Uzbekistan	940	940	940	980	1,100	1,200	1,256
Vietnam	550	500	450	475	420	450	523
Madagascar	16	16	18	18	15	5	6
<b>Total</b>	<b>139158.02</b>	<b>139285.80</b>	<b>152910.14</b>	<b>1597371.10</b>	<b>178057.62</b>	<b>202072.83</b>	<b>192692.45</b>

Source: International Sericultural Commission (2018)

and buy such from farmers, thereby encouraging farmers who otherwise would have nothing to show for their efforts. The activities of such a purchasing board may be further expanded to help facilitate exporting of cocoons and other locally produced finished silk products.

**Table 2. Human development index (Medium category)**

Country	index
*Equatorial Guinea	118
*Namibia	128
*South Africa	129
*Congo	136
*Kenya	147
*Sudan	150
*Ghana	151
*Tanzania	152
*Cameroon	153
*Uganda	157
Nigeria	158

\* Countries in Africa above Nigeria in this category.

Source: World Bank Data Bank (2017)

### 6.2 Deliberate Effort to Encourage Government-private Collaborative Participation in Sericulture Sector

Up to date Government agencies have been the driving force behind sericulture in Nigeria, however, in order to fully exploit the benefits of sericulture throughout its value chain, more private sector participation including the academia is required to promote sericulture in Nigeria. This is required particularly in the area of policy formulation and the allocation of resources to farmers and investors in sericulture.

In spite of the fact that the indigenous *aso oke*, the local garments has evolved to the point that it is presently being made with imported synthetic fabric shows that there is a market for the locally made silk. With proper coordination, the stakeholders in Nigerian sericulture can stir up a renaissance in this traditionally entrenched agri-business enterprise. The involvement of the academia is recommended for the sake of stability in policy and promotion of research activities focused on developing *Bombyx mori* sericulture vis-à-vis local sericulture of the *Anaphe* species. This is suggested due to the fact that the ivory towers are the least affected by institutional breakdown that has consistently

prevented continuity of policies in Nigeria. The educational and research institutions are better positioned to offer the necessary research backing and extension services required to support the general public that may be interested in sericulture. Moreover, research output due to the collaborative research between government, industry and the ivory towers may help to develop indigenous African silkmoths to the point of global acceptance as in the case of *Eri* and *Tussah* silkmoths that are indigenous to India.

### 6.3 Formulation of Government Policies that Lead to Increasing in the Local Content of Materials Used in the Textile Industry

The Nigerian textile industry is said to be worth 4.7 Billion Nigerian nairas [41] and this number is bound to increase as we witness more importation of textile materials from China. Already, it is estimated that more than 80% of the textiles in the Nigerian market are from China [42]. Moreover, even the local fabrics such as the traditional *aso-òkè* are presently woven with synthetic fibers from China. It is recommended that targets are set for a systematic increase in the local content of raw materials in the textile industry with a view to developing the local textile-affiliated industry such as sericulture. This is expected to alleviate poverty as jobs are created; from the farmers that produce the silk, cotton and other raw materials to the textile workers that process these into finished products and the traders that trade in the products.

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### COMPETING INTERESTS

Author has declared that no competing interests exist.

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