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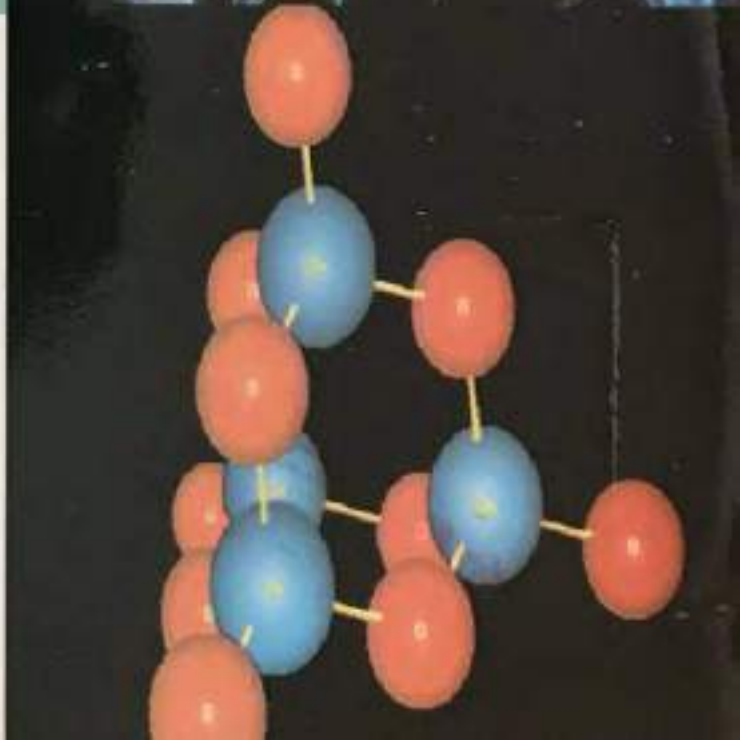

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Relative Efficiency of Innovated Traps in Small Scale Fishing Industry in Lagos Lagoon, Nigeria

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ABSTRACT

The use of two innovated fishing traps in parts of Lagos lagoon namely; Badore, Makoko, Ilaje and Agboyi was investigated to determine their level of efficiency. These revealed various degrees of efficiency and selectivity in catching of fish resources from the lagoon. The local fishermen set their traps in the evening between 5pm and 6pm and retrieve it at 6am to 7am the following morning. The long hours of setting was believed to yield greater catch. The result of this work showed that fishing traps in Badore has increased the living standard of the fisher folks compared to other sampled fishing communities such as Makoko, Ilaje and Agboyi. From [the thirty questionnaires—ministered in each fishing community, the mean weight of fishes caught per canoe between May to September with the cylindrical basket traps (Igun) for fishes in Agboyi, Badore, Ilaje and Makoko were 203.6±5.89kg, 591.2±9.48kg, 110.4±12.39kg and 202.2±7.02kg respectively. For the wire made trap (Iyanmo), the mean weight of fish caught per canoe in Agboyi, Badore, llaje and Makoko were 216.8±5.09kg, 523.2±8.02kg, 107. 7±18.93kg, and 190.4S ±82kg respectively between May and September. In females of Tilapia guineensis the K-values varied from 0.12 to 30.73 as against 0.62 to 14.97 in the males. Male, Chrysichthys nigrodigitatus has a higher condition factor than the females and the K-values ranged from 0.71 to 0.97 while the females K-value range from 0.46 to 0.57. The lowest K-value was observed in the females of Chrysichthys nigrodigitatus with the largest body weight of 80.5. In Liza falcipinus, the females had a higher condition factor than the males. In females the K values varied from 0.10 to 0.21 as against 0.04 to 0.08 in the males. The lowest K-value was observed in the male that had the longest length of 35cm and corresponding largest body weight of 17.5g. Study revealed that the cylindrical basket traps for fish were more effective in Badore Lagos lagoon while the wire made traps were very efficient in catching fishes among Ilaje fisherfolks.

Keywords: *Catch per Unit Effort, Cylindrical basket trap, Fisher-folks, wire made trap, K-Value*

INTRODUCTION

Fish is a major and growing part of the diet of Nigerians; consumption is growing even faster than that of meat. According to a FAO (2007) project, in the year 2000, fish production in Nigeria grew by 22 percent while meat production grew by 6 percent. Between 2002 and 2009, fish production in Nigeria increased by 50 perhowever increased supply has not been able to match increased demand and Nigeria still remains Africa's largest importer with 620,000 MT in 2007. The high volume of fish importation constituted a large drain in the nation's foreign exchange reserve while the pressure of demand on the limited supply translates to high prices of fish and its products in the country (Adeyemi, 2011). Lamenting the shortfall of fish supply in the country, Adesina (2011) estimated the animal fish demand in Nigeria to be 2.66 million as against the annual domestic production of about 0.78 million, giving a gap of about 1.8 million metric tons. He expressed regret that the shortfall of fish supply in the country had led to a low annual per capital fish consumption rate of only 7.5 kilogrammes as against 15 kilogrammes per annum as recommended by

the Food and Agriculture Organization (FAO 2007). Oyemomi (2011) affirmed that increase in national fish production would not only diversify the country's resources base but also complement efforts aimed at achieving the Millennium Development Goals (MDG). He disclosed that an estimate of 10 million Nigerians were actively engaged in the upstream and downstream areas of fisheries operations, he said the contribution of the fisheries sub-sector to the nation's economy was significant ranging from employment creation to provision of raw materials for the animal feed industry. Nigeria is a Marine state of about 140 million people, with a coastline measuring approximately 853 kilometers. With this, the expectation is that Nigeria should be an exporter of aquatic foods. Sadly, however, Nigeria imports between 700,000 and a 900,000 metric tons of fish annually to partially meet a shortfall of 1,800,000 metric tons (Uba, 2012). Aquaculture experts in Nigeria has consistently reported an under-performance in meeting the targeted fish production quota, they note a huge gap in the demand and supply of fish. This huge gap between supply and demand forced Nigeria to import fish, making Nigeria one of the largest importers of frozen fish in West Africa (Ayinla, 2011). If situation will change, large and small scale fishing industries need improvement but research has concentrated more on large scale fishing thus living behind small scale fishing enterprise which is a major occupation and means of livelihood in developing countries such as Nigeria. It is on this note that this study focuses on improvement of fish productivity in Nigeria small scale fishing. To increase fish production in Nigeria, some factors come into play such as the improvement of the productivity of the aquatic environment and a review of methods used in catching the fishes.

The productivity of the aquatic environment can be increased by the construction and installation of artificial reefs and fish aggregating devices. These manmade structures provide shelters, food and breeding grounds for both fin and shell fish. Fish catching involves the use of different fishing gears which include the trawl net, cast net, lift net and traps among others. Traps are any form of semi-permanent staked net designed to intercept and hold fish during their daily or annual migrations within natural or artificial water bodies (Brandt, 1964). It is usually fitted with a device that deters the fish from leaving once they have entered. Trap fishing is a simple fishing method that has been used traditionally by fishermen all over the world to lure and catch aquatic animals (Brandt 1964). Traps have several advantages compared to other fishing gears; they do not need to be hauled. Brandt (1964) reported that each trap is provided with a mouth opening or entrance (with or without a non-return valve) and chamber(s) for fish collection, irrespective of the shape or the design or the material used in the construction. Traps have proven to be one of the most versatile types of fishing gear and have been modified to catch particular species and size ranges (NAFO 2016) and to exclude or reduce the entry of animals very similar to the target species. Traps used as sampling gears for stock assessment and biological studies, have originated from these designs in most cases. An effective trap should be one that filter out debris and catch fish unharmed. Trap catches are influenced by the season. Fagade and Olaniyan (1974) reported higher fish species diversity in the Lagos lagoon in the dry season (December to May) than in the wet season (June to November). A similar observation has also been reported by Solarin (1998) for the Lagos lagoon. Catch efficiency depends on the size, mouth opening, bait type, leaching time, tidal current and other factors.

Such gear retains the high quality of fish caught. Brandt (1964) reported that pots or the closely knit basket traps do not allow small fish to escape. Traps are highly selective for species and size of fish. The mesh size determines the lower length limit of fish trapped by Craig (1974) found wire-mesh traps with 0.64cm mesh trapped perch from 5cm and those of 1.28cm mesh caught fish from 9.5cm. The upper limit depends on the size of the funnel entrance. The funnel entrance can be round (winder mere perch trap) or vertical slit (carlander" trap, Swedish perch' trap). Within a species, the traps can also be selective for sex (Craig, 1974). The trap entrance, or funnel, can be regulated to control the maximum size of fish that enters. The trap mesh / hole size regulates the species size that will be caught. This is also a function of the type, model and characteristics of the trap being used. Sustainability of commercial fishes is best achieved when fishing gears are selective and have low impacts on bottom habitats (Philip et al. 2018). The efficiency of four different trap designs were tested in a serial collapsible fish trap in the south west coast of India. The oval shaped funnel design was discovered to be of better efficiency (Arun et al.). According to Ovegard and Lunneryd (2011), floating pots were not only specie selective but also reduced the proportion of undersized catch by more than 90% in a study that was carried out on the Atlantic. Different fishing traps were used in Nigerian fishing communities thus studies are needed that will assess the catching characteristics of these traps and also compare their efficiency across communities, fish species and condition factor of fishes caught. This gap is what the present study seeks to fill.

MATERIALS AND METHODS

After identifying the traps used in selected parts of the Lagos Lagoon, two of them based on similarity in their catches such as cylindrical basket traps for fishes (big) and wire made traps for fishes (medium) were monitored and studied to determine the frequency of the catches, investigate the fish species composition in relation to fishing gear selectivity.

Study Area

Lagos Lagoon is the largest lagoon along the West African coastline (Awosika and Dublin-Green, 1992). It is separated from the ocean by a narrow strip of barrier bar complex of the western Nigeria coastline. It lies approximately between longitudes 3024'E and 4000'E and latitude 60 26' 37'N with an aerial extent of 350km2. It has a rectangular shape with its longer axis running almost parallel with the orientation of the coastline. The longer west-east axis is about 60km long while the widest area along the north-South axis is almost 17km long. The lagoon has two arms; one connects it with the Lekki lagoon in the east while the second leads northwards into the hinterland. The Lagos Lagoon opens to the sea only through the commodore channel. This channel also serves as the only entrance to Nigeria's largest seaport of Apapa and Tin can ports. The Lagoon is drained by four main rivers, Ogun, Majidun, Agboyi and Aje with some other smaller rivers some of which are ephemeral. The origin and evolution of the Lagos lagoon is closely linked with the origin and evolution of the West African coastal geosynclines and classical theories of barrier- Lagoon origin. The fauna is composed of fresh, marine and brackish water species depending on the season. Among the fauna exploited for commercial purpose are; prawns, shrimps,

crabs, oysters and fishes. The Lagos lagoon had been primarily used for fishing as far back as early in the century. With increasing population along the shores and in the mainland it became a major waterway for commercial and private ferry and boat transportation, naval operations and lately for recreation.

Description of Study Sites

Four fishing communities were sampled, Ilaje, Makoko, Agboyi and Badore all in Lagos Lagoon. Agboyi represents the northern part, Ilaje represents the western part, Makoko represents south of west, while Badore represents the eastern part just to have a fair coverage of the Lagoon.

llaje

Ilaje area of Lagos lagoon is part of a series of fishing communities which is located within latitude 60 29' 36.6"N and longitude 30 22154.2' 'E. Ilaje is one of the fishing villages with a population estimate of about one thousand people. It is under Shomolu Local Government Area in Bariga, Lagos State. Ilaje is popularly known for its fishing activities in Lagos state with many developed fishing gears and traps that helped in fishing. Fishing activity is the major occupation practiced in Ilaje village and this does not exempt male and female both young and old ones. Most of the fisherfolks at Ilaje fishing community migrated majorly from Ilaje in Ondo State to settle down for fishing activities while some came from Badagry, they are called the "Eguns". These set of people comes and leaves to Badagry for business transactions.

Agboyi

Agboyi community is under Agboyi-Ketu Local Council Development Area of Lagos state situated within latitude 60 34' 57.2"N and longitude 30 24'26.5"E. It has a population of almost one million people with a ratio of 40:60 male to female (Internet Geography). Agboyi community is classified into three segments by the inhabitants namely Agboyi one, two and three. The three segments follows each other linearly while Ogun River and Lagos lagoon water intercepts at Agboyi. River Ogun flows in from different towns in Ogun State; namely Iganhun, Ibaraku, Abeokuta and others while the Lagos lagoon water flows from the towns within Lagos State. Fishing activities is well practiced all through the year in Agboyi community with the aid of different fishing gears that includes: the cast net, gill nets, circular lift nets which is locally known as "Garawa" for crabs, and traps of different types and sizes. Fisherfolks from Agboyi are majorly from Ogun state with the exception of few that are indigenes of Lagos State.

Makoko

Makoko is under Yaba Local Government Area situated within latitude 60 29' 36.6' 'N and longitude 30 2254.2' 'E, Lagos State. Over one million people mostly from Ilaje, Egun and Ijaw reside in Makoko but the greater population lives on water. Fishing is the major occupation practiced by both sexes in Makoko with the exception of few ones that dredges sand and mould blocks for building purposes. Makoko is popularly known for its productivity of fresh fishes which include both the shrimps and the crabs all through the year. Presently there is construction of bore-hole at

the newly built market called "Asejere market". These has really helped the fisher women to process the fishes in good form, either as fresh or smoked. It is reported that people also bring fresh fishes from Ijora-Olopa, Ido, Lagos state and takes it to "Agbami" which is the major fishing site for processing.

Badore

Badore is under Eti-Osa Local Government Area situated within latitude 60 30' 37.8' 'N and longitude 30 36129.9" E in Lagos State. It has a population of over one thousand people at fishing site. The major occupation of the people living in Badore is fishing but few are into quarrying and dredging of sand, boat carpentry and fetching of fire wood from the wild for fish smoking. It is reported that most of the sand dredgers are fishermen. Ministry of works and infrastructure are constructing jetty with terminal building at Badore to enhance the fishing activities in the community. Ministry of transportation, Lagos State Waterways are presently dredging ferry route from Ikorodu to Badore, this is to reduce the stress faced by the people in the community and also to reduce the cost of transportation.

Field Survey

In studying the efficiency of fishing traps in Lagos lagoon system, a combination of interview and field experiment was conducted. Thirty fisherfolks were randomly selected in each location and each fisherfolk was interviewed using structured questionnaire. These questions were meant to collect information on different traps and their efficiencies. This survey lasted for five months (May-September, 2009). Information collected were analyzed using statistical package for social scientists (SPSS).

Field Experiment: Setting of Fishing Traps at llaje and Badore Lagos Lagoon

The second phase of the study was based on collection of samples fortnightly with the use of two different fishing traps namely: the cylindrical basket traps for fishes (Igun), and the wire made traps (Iyanmo) and this lasted between February to April 2010. The cylindrical basket traps for fishes (Igun) and the wire made traps (Iyanmo) were set at Ilaje and Badore lagoon to be able to compare the two fishing villages that have the highest catches as reported by the fisherfolks.

Condition Factor of the catches at Ilaje and Badore Lagos lagoon

This indicate the state of well-being or the condition of fish species caught at Ilaje fishing community during the period of this study, that is, how lean or healthy (fat) the species are. It is represented with the formula below:

K=IOOW/L3

Where: W = Weight in Grams

L = Total Length

3 = Growth Exponent

K = Condition Factor

Catch per Unit Effort and Production Estimates of the Fishing Operation

Catch per Unit Effort (CPUE) is expressed as the average catch per day of a gear of a certain boat/gear type. Total fish production was estimated according to Solarin (1998) using this formula:

T= h x n x c.p.u.e

Where T = total fish production

h= average number of fishing days per month

n= estimated number of active or functional canoe units

c.p.u.e = catch per unit effort (kilogram per canoe per day per trip).

The Fishing Traps

The cylindrical basket traps for fishes and the wire made trap that are used in the fishing villages were examined and set to collect catches from Agboyi, Badore, Ilaje and Makoko. These traps, designed to catch fish are in form of cages or baskets made with various materials (raffia palms, wood, metal rods and wire netting). They are usually set on the bottom, with or without bait, singly or in rows, connected by ropes (buoy-lines) to buoys on the surface to show their locations.

Cylindrical Basket Trap for Fishes

This is the commonest trap used in rivers, lagoons, lakes and estuaries. It is cylindrical conical structure made from mid rib of palm fronds cane with two valves. The trap usually has two non— return valves with openings ranging between 35 to 40cm inward leaving only a narrow entrance. The length of the trap ranges between 70 and 90cm. It is used in catching both shellfish and finfish mostly by women and children. The basket trap is the commonest traps used in lagoons, rivers, lakes and estuaries. The materials for the trap are derived solely from the raffia palm. They consist of solid strands for the body of the trap and fibres for holding the strands in place. The strands are obtained from the midrib of the compound leaf (frond). This is scraped and split into long strands according to the size of the traps. Strands of about 0.5 mm wide and 100 cm long are used for medium to large traps. The strands are smoothed with sharp knives and bundled in readiness for use. Fibres for tying are extracted from the base of young raffia palm fronds and arranged in pairs in readiness for use. Actual trap-making involves twisting pairs of fibers over the raffia strands at regular intervals. When enough strands have been linked to form a sizeable mat, the mat is folded so that the two ends join up to make a cylindrical shape. The frond of a young raffia palm can also be used as a tying fibre if it is split lengthwise into four parts. The flexible stem of a climber plant is used to make a circular frame, which is slipped into the cylindrical trap and tied firmly to the trap using the same fibre. This gives the trap a firm shape. A conical door is made from tied strands and attached to the trap as an entrance. Another such door is placed midway into the cylindrical trap. The door has its base at an entrance to the trap and its apex inside the trap. With this design, the door allows fish to enter but prevent them from getting out again. The rear end of the trap is tied with the same fibre. The tying gives the trap its characteristic conical shape. It is commonly known as "Ogun" among the Yorubas.

Wire Basket Trap

This is a basket trap made of wire with stick at the frame of the mouth to form its shape. It has one entrance and can expand as the catches increases. It has been noticed for its effectiveness in catching fishes most especially *Chrysichthys nigrodigitatus* (cat fish) and *Clarias lazera* (mud catfish) and the crabs. It can harvest hundred fishes at a time

during the high peak of fishing. In Ilaje fishing village it's called "Iyanmo" and it is used without bait yet very effective. It is mostly constructed by the men and operated throughout the year.

RESULTS

Response from the fisherfolks at the four fishing communities sampled shows that the most prevailing fishes caught with the cylindrical basket trap made from the frond of raffia palm "Igun" and the wire made traps "Iyanmo" include tilapia, *Clarias nigrodigitatus*, barracuda, mullet, sardine, bonga, and shad among others. Traps are used in conjunction with baits, there are several baits used in the visited sites namely; worm, garri (mixed with cold water), maize shaft, shrimps, crabs, fish, beef/chicken, soap and termites, but usage varies from location to location. The most used traps were the cylindrical basket traps mainly by the women at Makoko, Ilaje and Badore fishing communities.

The Use of Fishing Traps in the Sampled Fishing Communities

Agboyi Fishing Community

Thirty-three percent of the fisherfolks in Agboyi fishing community use traps of different types, 30% use traps with acadja while others use the set net, cast net and the trawl net. Two traps are mostly used, they are the cylindrical basket traps (big and small) and the wire made trap (Iyanmo). At the locations visited, various traps are used but not with the same frequency, in Agboyi, the two traps in use are cylindrical basket traps (big and small) and the wire made trap (Iyanmo) and they are almost in the same proportion in terms of usage, 46.67% to 40% respectively while the remaining percentage (13.33%) use other fishing gears mostly among the women fisherfolks. The traps used are based on the fact that they record high percentage of catches, locally available and are cost effective. In Agboyi the species caught with cylindrical basket traps (big and small) and the wire made trap (Iyanmo) are *Chrysichthys nigrodigitatus, Elops lacerta, Tilapia guineensis, Channomuraena vitata, Liza falcipinus, and Arius gigas*. Though fishes were the major targets of the traps, crabs and rare cases clams find their way into them, baits used with the cylindrical basket traps (big and small) and the wire made traps (Iyanmo) are maize shaft, tiles, worms, crabs, fish and garri in little proportion which cost 300 naira per day. Sixty-three point six percent of the fishing traps are made by the women whereas 36.4% are made by men. The average cost of making big trap is 10,000 naira, medium size fishing trap costs 1,500 naira and the small size fishing trap is constructed at the rate of 150 naira each. The big trap lasts for 2 years, the medium size trap lasts for 8 months and the small size fishing trap lasts for three months. 62.07% of the fisherfolks set their fishing traps in shallow waters whereas 37.93% set their traps against the current. 66.67% set their fishing traps in the evenings and 33.33% set their traps in the morning. 63.33% of the fisherfolks collects their catches in the morning while 33.33% of the fisherfolks collects their catches in the evenings.

Ilaje Fishing Community

Ilaje fisherfolks uses traps of different types, 33% of the fisherfolks are engaged with the use of traps of different types only, 30% use traps with acadja, while others use the set net, cast net and the trawl net. Among the different fishing traps used in Ilaje, records shows that the cylindrical basket traps and the wire made trap has the percentage ratios of usage as 6.67 and 40 respectively. The women fisherfolks reported to value the fishing traps as being efficient and effective in carrying out successful fishing operation and the materials are locally available and are affordable by all. The fish species caught with the cylindrical basket traps and the wire made trap are *Chrysichthys nigrodigitatus, Elops lacerta, Tilapia guineensis, Channomuraena vitata, and Liza falcipinus*. Baits used with the cylindrical basket traps and the wire made traps are termites, shrimps, crabs, soap, eba and fish and these cost them 150 naira per day. Sixty three point thirty three percent of the traps are constructed by the women while 36.67% are constructed by the men. The big trap lasts for 2 years in Ilaje, the medium trap lasts for 8 months and the small size fishing trap lasts for 3 months. At Ilaje, 62.07% of the fishing traps are set in shallow waters while 37.93% are set against the current. 66.67% of the traps are set in the evening, 33.33% are set in the morning. 65.33% of the fisherfolks collects their catches in the morning.

Badore Fishing Community

Three traps are in use in Badore fishing community namely; the cylindrical basket traps (big and small), wire made trap and the bamboo trap with the percentage ratios of usage as follows: 17, 65 and 82.35 respectively. Species caught with cylindrical basket traps (big and small), wire made trap and the bamboo made traps are *Tilapia guineensis, Chrysichthys senegalensis, Chrysichthys nigrodigitatus, Elops lacerta, and Mugil cephalus*. The baits used with cylindrical basket traps (big and small), wire made trap and bamboo made traps are garri, fish, maize shaft and worms in little proportion which cost 100 naira per day. 60% of the fishing traps are made by men and 40% of it is made by the women. Ten thousand naira is the amount been used to construct the big trap, 1,000 naira is used to construct the medium size fishing trap and 500 is used to construct small size fishing trap. The big trap lasts for I year, the medium size fishing trap lasts for 6 months while the small size fishing trap do last for 3 months. Badore fisherfolks set their fishing traps in shallow waters. 96.43% of the fisherfolks set their traps in the morning and 3.57% of the fisherfolks set their traps at night. 96.43% of the fisherfolks collects their catches in the evenings and 3.57% collects their catches at night.

Makoko Fishing Community

Traps of different types are used in Makoko fishing community, 61% of the fisherfolks in Makoko use traps of different types, 33% use of Acadja while 6% use the lift net. Makoko records three types of traps namely; cylindrical basket traps, lift net and the wire made trap with the percentage ratios of usage as follows: 51.85, 25.93 and 22.22 respectively. Species caught with cylindrical

basket traps (big and small), wire made trap and the bamboo made traps are *Tilapia guineensis , Sarocentron hastatus, Arius gigas, Scarus hoefleri, and Cynoglossus browni* while the baits used with cylindrical basket traps (big and small) is acadja, liftnet for crabs and for the wire made traps are worms, garri and beef/chicken in little proportion which cost 200 naira per day. Traps in Makoko are made by both male and female. 72.73% are made by women whereas 27.27% are made by men this is because the men preferred to use other fishing gears to traps while the women finds the fishing traps to be easily handled by them. Big trap is constructed for 12,000 naira each, medium size fishing trap is constructed for 2,000 naira and the small size fishing trap is constructed for 700 naira each. The big trap lasts for I year and 2 months; the medium will last for 6 months while the small fishing trap lasts for 3 months. 55.6% of the fisher-folks set their fishing traps in the evenings whereas 44.4% set their fishing traps in the morning. 56.67% of the fisher-folks collects their catches in the evenings and about 43.33% collects their catches in the morning.

Catch per Unit Effort of Fishing Traps at the Fishing Communities Sampled

Catch per Unit Effort with Cylindrical Basket Traps

The mean weight of fish caught per canoe for five months with cylindrical basket trap (Igun) in Agboyi fishing community was 203.6±5.89kg while in Badore, the mean weight of fish caught per canoe between May to September, 2009 was 591.2±9.48kg. Also the fisher-folks in Ilaje fishing community used the cylindrical basket trap (Igun) within the study period and the mean weight of fish caught per canoe is 110.4±12.39kg and lastly, the mean weight of fishes caught per canoe for five months at Makoko fishing community is 202.2±7.02kg with Igun.

Catch per Unit Effort of the Wire Made Trap

In Agboyi, the mean weight of fish caught with wire traps was 216.8±5.09kg between May and September, 2009. In Badore, the mean weight of fish caught per canoe during the same period was 523.2±8.02kg. The fisher-folks in Ilaje fishing community using the wire made trap within the same period recorded 107.7±18.93kg while fisher-folks in Makoko recorded 190.45.±82kg.

DISCUSSION Efficiency of Artisanal Fisheries in Lagos Lagoon

The use of fishing gear (traps) in Lagos lagoon reveals various degrees of efficiency and selectivity in catching of fish resources. This study was conducted to provide information on the efficiency of fishing traps and their possible effect on the fish fauna in Lagos lagoon. The most used traps were the cylindrical basket traps mainly by the women at Makoko, Ilaje and Badore fishing communities. The wide use of fishing traps in lagoon was because of its versatility, low cost and ease of operation. The entrance / valve of no return mouth aperture prevent fish escape and also determine the size of fish that would be caught. The bait used in the study areas were maize shaft, worms, garri, crabs, fish,

termite, shrimp, beef, chicken and soap depending on the most preferred by the individual. However, from interviews conducted the traps could be baited or unbaited. The local fishermen set their traps in the evening between five and six o' clock and retrieve it at six to seven o' clock the following morning. The long hours of setting was believed to yield greater catch (Emmanuel, 2009). Women in the studied areas show some levels of competence in the area of basket trap operation. The involvement of women in the basket trap operations contrast with the general beliefs that women are responsible for the collection of the invertebrate only; or, that women only occasionally perform men's fishing (Matthew, 1991). A well-constructed big trap can last for a year or more if properly handled and kept after use. The site of the setting should be where there is low current velocity or not close to navigable area which could disturb the efficiency of the traps and the stakes should be constantly checked to see that it is strong enough and still holding tight to the soil.

Efficiency of fishing traps set at Ilaje and Badore Lagos lagoon

Thirty-five samples of *Tilapia guineensis* caught from Ilaje Lagos lagoon ranges between 4.5cm to 35cm and the ratio of male to female was 16:19 . Tilapia guineensis shows a direct relationship between length and body weight, length of 35.0 cm has a body weight of 50.2g while length of 4.5cm has a body weight of 28.0g which indicates an increase in length corresponds with an increase in body weight. The seven samples of Chrysichthys nigrodigitatus caught from llaje Lagos lagoon was three males and four females. The length of these samples ranges between 18.0 cm to 26.0 cm and it shows a direct relationship between length and body weight, length of 26.0g has a body weight of 80.5g while length of 18.0cm has a body weight of 56.0g which indicates an increase in length corresponds with an increase in body weight. Also five samples of Liza falcipinus was caught from Ilaje Lagos lagoon. The ratio of male to female was 2:3. The length of Liza falcipinus ranges between 25.0cm to 35.0 cm and it shows a direct relationship between length and body weight, length of 35g has a body weight of 17.5g while length of 25.0cm has a body weight of 12.5g which indicates an increase in length corresponds with an increase in body weight. This agrees with the earlier studies involving fish species from different water bodies by Fagade and Olaniyan (1974). Females Tilapia guineensis had a higher

condition factor than the males. In females the K-values ranged from 0.12 to 30.73 as against 0.62 to 14.97 in the males though the lowest K-value was observed in the female. Male Chrysichthys nigrodigitatus had a higher condition factor than the females and the K-values ranged from 0.71 to 0.97 while the females K-value ranged from 0.46 to 0.57. The lowest K-value was observed in the female that had the largest body weight of 80.5kg. In Liza falcipinus, the females had a higher condition factor than the males. In females the K- values ranged from 0.10 to 0.21 as against 0.04 to 0.08 in the males. The lowest K-value was observed in the male that had the longest length of 35cm and corresponding largest weight of 17.5g. This study identified that the use of all the fishing traps in Badore yielded value and has increased the living standard of the fisher-

folks. The Catch per Unit Effort (CPUE) of all the fishing traps in Badore fishing community is higher compared to Makoko, Agboyi and Ilaje fishing community. Based on the Catch per Unit Effort of fishing traps experimented at Badore and Ilaje fishing communities, this study agrees with the response of the fisherfolks that the cylindrical basket trap for fish is more effective in Badore Lagos lagoon while the wire made traps are very efficient in catching fishes among Ilaje fisher-folks.

CONCLUSION

It is suggested therefore that each community be encouraged to use such fishing methods that are more cost effective, and have greater yield in other to boost productivity to meet up with the demand for fishes and reduce the high volume of fish importation in Nigeria.

REFERENCES

Adesina A (2011). The fish site. *Available on http://www/hcfishsite.com/fishnews/15698 n100billion-spent-on-fish-imp00rtation-annually.*

Adeyeni A. (2011). The fish site. *Available on http://www/hcfishsite.com/fishnews/15698 n100billion-spent-on-fish-imp00rtation-annually.*

Arun J., Neethiselvan N., Sundara Moorthy B., Paulraj J., & Ravikumar Thangaraji (2017). Comparative Efficiency of fish trap with different funnel designs. *Indian Journal of Fisheries. Vol 64 (4).*

Awosika, L.F. and Dublin-Green, C.O. (1994). Sand mining in the Lagos and Lekki Lagoons and strategies for effective management. *Journal of Mining and Geology. Vol. 30, No. 11. P. 137-139.*

Ayinla O. (2011) aquaculture experts say Nigerian fishing in the Doldruns. *Available at http://www. Cable gate search.net/cablegatesearch.net/cable .php7id=05 Lagos 1961*

Brandt, A. (1964). Fish catching methods of the world. In: EIFAC consultation of e e l fishing gear and techniques. (McGarth, C. *EIFAC Tech. Pap.* (14): 16-25. 15

Craig, J.F. (1974). Population dynamics of perch, Perca fluviatilis. In: Slapton Ley, Devon. 1. Trapping behaviour, reproduction, migration, population estimates mortality and food. Freshwater. *Biol.4*: 417—31.

Emmanuel, B.E. (2009). The artisanal fishing gears, crafts technology and their efficiency in the Lekki lagoon, Nigeria. Ph.D Thesis. University of Lagos. 256pp.

Fagade, S.O. and Olaniyan, C.I.O. (1974). Seasonal distribution of the fish fauna of Lagos Lagoon. Bull. *Inst. Fr. April Noire, ser.* A.36 244-252.

FAO (2007). The Micro, Small and Medium Enterprise (msme) Project (2005-2011) *Available on http://msme-Nigeria-o-y/downloads/catfish%20.*

Mattew, E. (1991). Women and fishing in traditional Pacific island cultures. *South Pacific Commission Fisheries Information Paper.* 14: 23pp.

Miller, J.M., Pietrafes, L.J. and Smith, N. (1990). Principles of hydraulic management of coastal lagoons for aquaculture and fisheries. *FAO Fisheries Technical Paper.* 3 14:

88pp.

Oyemomi A. (2011) — The fish site. *Available on http://www/hc fishsite@com/fishnews/15698n 100billion-spent-on-fish-importation-annually.*

Ovegard M. & Lunneryd S. (2011). Size Selective Capture of Atlantic Cod (Gadus Morhua) in floating pots. *Fisheries Research. Vol 107 (1-3). Pg. 239-244.*

Philip M., Philip W., Fararo B. (2018) Comparing Catch Efficiency of five models of pot for use in a newfound land and Labrador cod fishery. Vol. 13 (6).

Solarin, B.B. (1998). The hydrobiology, fishes and fisheries of the Lagos lagoon, Nigeria. Ph.D Thesis. University of Lagos. 235pp. cent,

Proximate Composition and Organoleptic Properties of Chin-Chin from Flour Blends of Wheat, Orange Fleshed Sweet-Potato Enriched with Pigeon- Pea

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ABSTRACT

The consumption of snacks developed from composite flours is increasing steadily due to their potential health benefits. Chin-chin produced from wheat flour (WF), Orange fleshed sweet-potato flour (OFSPF) and Pigeon pea flour (PPF) blends at different ratios of 5:80:15%; 10:70:20%; 15:60:25% and 20:50:30% WF-OFSPF-PPF, were investigated for their proximate composition. Chin-chin samples prepared from the flour blends were subjected to proximate analysis and organoleptic evaluation using standard laboratory methods. Wheat chin-chin (100%WF) serves as a control sample. The data generated were statistically analyzed by One-way Analysis of Variance (ANOVA) using SPSS (version 21). The proximate composition of the flour blends ranged from 7.03- 9.82% moisture, 0.79- 2.89% ash, 6.40- 21.34% protein, 1.84-16.36% fat, 0.17-2.47% fiber, 59.96- 78.04% carbohydrate and 370.08-442.12 kcal/100g energy value. The composite chin-chin have composition range of 1.62- 2.71% moisture, 0.88- 1.92% ash, 15.59-16.23% fat, 2.34-2.54% fiber, 9.45-13.50% protein, 64.18-67.52% carbohydrate and 447.41- 459.92 kcal/100g energy value respectively. The mean sensory scores for the chin-chin samples ranged from 5.35-7.67 taste, 5.05-7.25 colour, 5.15-6.45 aroma, 6.05-7.95 crunchiness and 5.25-7.75 overall acceptability, respectively. In conclusion, the inclusion of pigeon pea and OFSPF significantly improved the nutritional quality of the chin-chin samples. However, the control sample had higher sensory scores compared to the composite chin-chin samples, but they were all accepted.

Keywords: *Wheat flour, Pigeon pea flour, Chin-chin, Proximate composition, Organoleptic properties*

INTRODUCTION

Chin-chin is a golden- brownish crispy snack that is usually prepared from wheat flour, butter, milk, sugar, egg and other customary baking ingredients (Akubor, 2004) by baking or frying process. It is a popular snack consumed in West Africa by wide range of people, especially school going children, adolescent girls and high mobility groups (Singh *et al.,* 2011). Most of the bakery products (doughnuts, pies, cookies, cakes and buns) which are cereal-based (usually produced from wheat flour) have low nutritional values, with poor sources of protein (Lasekan and Akintola, 2002; Brink and Belay, 2006). Consequently, high competition in markets, increased demand for natural, healthy and functional products has prompted an intense search to improve the nutritive value and functionality of these bakery products by modifying their nutritive compositions. This effect have been achieved by incorporating an increasing ratios of enriched materials from plant sources other than wheat in basic recipes with the attempts to increase chin-chin's protein and mineral

contents for quality and availability (Tyagi *et al.*, 2006) or increase dietary fiber and improve the prebiotic characteristics of the product (Gallagher *et al.*, 2003). Composite flour is desirable in this regard because it improves the nutritional value of food products, such as bakery products.

However, several studies have established the possibility of producing chin-chin from different locally available composite flour with tremendous success recorded in their sensory, physical and chemical properties. Adebayo-Oyetoro *et al.* (2017) and Emelike and Ebere (2016) reported the quality of chin-chin enriched with tigernut and moringa leaf powder respectively. Moreover, maize-wheat flour blends enriched with edible palm weevils (*Rhynchophorus phoenicis*) (Ojinnaka *et al.,* (2016), wheat flour - modified cocoyam starch blends (Falola *et al.*, 2014) and composite millet-wheat flour (Adegunwa *et al.*, 2014) were used for the production of chin-chin respectively with the aim of contributing to nutrition security and healthy life of current and future generations.
Orange fleshed sweet-potato (OFSP) is a naturally bio-fortified crop with a great potential to be used in food- based intervention programs to address vitamin A deficiency (VAD) owing to its richness in carotene. Compared to other sweet-potato varieties, OFSP has some additional advantages, such as orange colour, sweet taste and high vitamin A. It is also a rich source of vitamin, calcium, dietary fiber, protein and as well offers numerous health benefits including stronger bones and teeth, lower cholesterol levels, prevention of cardiovascular disease and reduction of mammary and prostrate cancers. The incorporation of OFSP into wheat-based products, such as chapattis and mandazis (Bechoff *et al.*, 2011), bread and biscuits (Low and Van Jaarsveld, 2008) or to prepare a soft porridge have been promoted. OFSP are mainly eaten boiled, steamed or processed into products, such as sun-dried OFSP flour or chips. Orange-fleshed sweet potato (OFSP) flour serve as a source of energy and nutrients, β-carotene (pro-vitamin A), minerals (Ca, P, Fe, Zn and K) and also add natural sweetness, color, flavor and dietary fiber to processed food products (Woolfe, 1992). Processing of OFSP into flour can make it more accepted as a traditionally processed food and possibility of incorporating β-carotene in cookies. The high fiber contents of sweet-potato flour increases its utility in various new food product developments. Addition of various proportion of OFSP flour in wheat can increase the fiber and carotenoids contents that help in the lowering of wheat gluten level and as well prevent celiac disease (Tilman *et al.,* 2003).

Pigeon peas (*Cajanus cajan*) is an underutilized legume that is commonly referred to as ?Otili' in South-West, Nigeria (Adebowala and Maliki, 2011). Pigeon pea has been reported to contain 20-22% protein, 1.2% fat, 65% carbohydrate and 3.8% ash (FAO, 1982). The seeds are not widely consumed in Nigeria because of its hard- to-cook phenomenon and dearth of information on its utilization.

However, since emphasis has recently been shifted from the use of wheat flour exclusively to the utilization of indigenous and affordable food raw materials for baked products production (Apata and Ologhobo, 1994; Osagie, 1998). Composite flour blends can be an adequate complementary base for such formulation. The research work therefore evaluates the proximate composition and organoleptic properties of chin-chin produced

from flour blends of wheat, orange fleshed sweet-potato and pigeon pea.

MATERIALS AND METHODS

Source of Materials

Orange fleshed sweet-potato tubers were obtained from Joseph Ayo Babalola University teaching and research farm in Ikeji-Arakeji, Nigeria. Pigeon-pea, wheat flour, granulated sugar, powdered milk, baking fat, salt, spice and baking powder were procured from Ilesa market, Osun state, Nigeria.

Production of Orange Fleshed Sweet-Potato Flour (OFSPF) and Pigeon-pea Flour

Orange fleshed sweet-potato tubers are sorted, washed, peeled, sliced into chips of about 4-5 mm thickness with knife and then blanched in hot water (98oC for3 min.) (Omah and Okaka, 2015). The blanched chips are dried in a cabinet drier (65oC for 9 h), milled to achieve flour of 100 µm particle size. The resulting flour was packaged in high density polyethylene and stored in an air-tight container at 4oC prior to further analysis.

Pigeon-pea flour was produced according to the method described by Omah and Okafor (2015) with slight modification. The peas were sorted and soaked in water (95oC for 30 min.), dehulled, dried in a cabinet drier (60oC for 8 h), cooled, milled with an attrition mill, packed in high density polyethylene and stored for further analysis.

Composite Flour Formulation

The blends of Wheat flour (WF), Orange-fleshed sweet-potato flour (OFSPF) and pigeon pea flour (PPF) were mixed at the ratio of 5:80:15%, 10:70:20%, 15:60 25%, 20:50:30% and coded as WOP_1, WOP_2, WOP_3 and WOP_4 respectively as shown in Table 1. Wheat flour (WF-100%) serves as the control sample.

Table 1: Composition of the flour blends

Sample codes	Wheat flour (WF) (g) :	OFSPF (g)	: Pigeon pea flour (PPF) (g)
WF	100	0	0
WOP_1	5	80	15
WOP_2	10	70	20
WOP_3	15	60	25
WOP_4	20	50	30

WF- Wheat flour, OFSPF – orange-fleshed sweet potato flour, PPF- Pigeon pea flour

WF – 100% Wheat flour, WOP_1– 5% WF: 80% OFSPF: 15% PPF, WOP_2 – 10% WF: 70% OFSPF: 20% PPF, WOP_3 – 15% WF: 60% OFSPF: 25% PPF, WOP_4 – 20% WF: 50% OFSPF: 30% PPF

Preparation of Chin-Chin Samples

The method described by Emelike (2006) was adopted for the production of chin-chin with slight modification, which was the addition of suya spice. Table 2 shows the recipes for chin-chin production. The composite flour was weighed into clean bowls separately and other dry ingredients, such as baking powder, salt, spice and sugar were weighed, sieved into the bowls and hand-mixed thoroughly to ensure uniformity. After mixing, the baking fat was rubbed-in and a milk solution was turned in and mixed to form dough. The dough was placed on a floured surface and kneaded until smooth and elastic. The kneaded dough was rolled out and then cut into small squares of about 2 cm by 2 cm in size. Frying of the dough (cubes) was done in an electrically heated deep fryer (Michaki model, 2.5L) containing vegetable oil, that was

preheated to temperature of 180oC prior to frying of the chin-chin for 7 minuntil golden brown. The chin-chin were allowed to cool, then packaged and stored at room temperature prior to further analysis

Table 2: Recipes for chin-chin production from flour blends of Wheat – Orange fleshed Sweet- potato – Pigeon pea

Sample code	Wheat flour (%)	OFSPF (%)	PPF (%)	Sugar (g)	Baking fat (g)	Baking powder (g)	Baking powder	Water L	Salt (g)	Spice (g)
WF	100	0	0	13	10	5	1	1	3	
WOP_1	5	80	15	13	10	5	1	1	3	
WOP_2	10	70	20	13	10	5	1	1	3	
WOP_3	15	60	25	13	10	5	1	1	3	
WOP_4	20	50	30	13	10	5	1	1	3	

OFSPF: orange - fleshed sweet potato flour, PPF: Pigeon - pea flour
WF – 100% Wheat flour, WOP_1 – 5% WF: 80% OFSPF: 15% PPF, WOP_2 – 10% WF: 70% OFSPF: 20% PPF, WOP_3 – 15% WF: 60% OFSPF: 25% PPF, WOP_4 – 20% WF: 50% OFSPF: 30% PPF

Proximate Composition of Fours and Chin-Chin Samples

The proximate composition of the flours and the chin-chin samples were analyzed for moisture, protein, fat, crude fibre and ash contents according to the methods described in AOAC (2010). The carbohydrate (CHO) content was calculated by difference as: CHO= 100- (% moisture + %protein + %fat + % ash). Food energy value (Kcal/100g) was determined according to the method of Marero *et al.* (1998) using the factor [(4 × % Protein) + (4 × % Carbohydrate) + (9× % Fat).

Sensory Evaluation of Chin-Chin Samples

A preference test was conducted to evaluate and differentiate the sensory properties of the composite chin-chin from the control sample (Retapol and Hooker, 2006). Ten panelists made of students and members of staff in Food Science and Technology Department, Joseph Ayo Babalola University, Nigeria were chosen based on their familiarity and experience with wheat-based chin-chin to compare each coded sample on basis of some specified attributes (taste, colour, aroma and crunchiness). The chin-chin samples were presented in coded form on white plastic plates and randomly presented to the panelists. The panelists were provided with portable water to rinse their mouth between evaluations. Each sensory attribute was rated on a 9-point hedonic scale, where points 1 and 9 denote poor and excellent attributes respectively. Each panelist assigned scores for each attribute as against the maximum score of 9 and their responses were analyzed statistically.

Data obtained were analyzed using analysis of variance (ANOVA) (Steel and Torrie, 1980), using a statistical package for the Social Sciences, SPSS (version 21). Mean separation was done using Duncan multiple range test and significance difference was accepted at 5% probability level.

RESULTS AND DISCUSSION

Proximate Composition of the Composite Flours

The results of the proximate compositions of

wheat flour (WF), pigeon-pea flour (PPF), orange fleshed sweet-potato flour (OFSPF) and their blends at different proportions are depicted in Table 3. The moisture content of the flour samples ranged from 7.03% (100% PPF) to 9.82% (100% OFSPF). There was no significant ($p>0.05\%$) difference in the moisture content of the composite flour. The increase in the moisture content of the composite flour may be attributed to the increasing substitution levels of OFSPF. This implies that the composite flour may be susceptible to spoilage by microbial invasion especially by mold and fungi (Ihekoronye and Ngoddy, 1985). These results were in agreement with the values reported by Ezeocha and Onwuneme (2016) for the moisture content of composite flour prepared from sweet-potato and tigernut. A similar finding was observed by Adebowale *et al.* (2009) for increasing moisture content in sweet-potato-wheat composite flour. The moisture content of flour determines its storage stability. Moreover, Sanni *et al.* (2006) reported that the lower the moisture contents of a flour to be stored, the higher the storage-stability. The ash content ranged between 0.79% and 2.89% with OFSPP (100%) and pigeon pea flour (100%) having the lowest and highest values respectively. The result showed that the composite flours had comparable ash values, with the exception of sample WOP_1, which have the least value among the flour blends. Ash content is a reflection of the mineral matter in a food product. However, it is evident from the result that, the ash content of the composite flour increased with the increasing substitution level of pigeon-pea flour and as well with the decreasing level of OFSPF respectively. This may be attributed to the fact that pigeon- pea flour contains the highest percentage of ash (2.89%) than wheat flour and OFSPF respectively. The protein content of the flour samples ranged from 6.40 to 21.34%, with OFSPP (100%) having the least value, while sample WOP_5 (20% WF: 50%OFSPF: 30% PPF) had the highest protein content as was expected. There was significant ($p<0.05\%$) differences among the composite flour. The protein content of the composite flours increased with increasing pigeon- pea flour substitution levels. This is expected since pigeon- pea is a rich source of protein, when compared with wheat and OFSP flours. Moreover, it was obvious from the results that pigeon-pea flour and wheat flour contributed higher protein content in the composite flour, thus reflecting them as better sources of protein compared to OFSPF. Similarly, Ezeocha and Onwuneme (2016) reported a decrease in the protein content of wheat - sweet-potato- tigernut composite flour due to low protein contents in sweet-potato and tigernut flour. The fat content ranged from 1.84 to 16.36% for the flour samples. The control sample (100%WF) and 100% PPF had the lowest and highest values respectively. It was evident from the results that, the fat content of the composite flours increased with increasing pigeon- pea flour substitution levels. Fasisi (2009) reported that low fat content in flour samples increased the shelf-life of the material by decreasing the chances of rancidity and also contribute to low energy value. The flber content of the flour samples ranged between 0.17 and 2.47% in which 100% PPF and 100% OFSPP had the lowest and highest values respectively. The significant ($p<0.05\%$) variation in the fiber content of the composite flour may be attributed to the increasing inclusion level of

OFSPF, as was expected. The low fiber content observed in pigeon pea flour could be attributed to the removal of the pea coats which are known as rich sources of fiber. Dietary fiber intake is essential in human diet because of its numerous health benefits in the reduction of the risk of several developing diseases, such as coronary heart disease, hypertension, diabetes, obesity, stroke and gastro-intestinal disorders (Anderson *et al.,* 2009). The carbohydrate content of the flour samples ranged from 59.96 to 78.04%, with sample WOP_5 (20% WF: 50% OFSPF: 30% PPF) and the control sample (100%WF) having the lowest and highest values respectively. Significant differences ($p<0.05$) exist among the flour samples. The carbohydrate content of the composite flour decreased with pigeon pea flour addition in the blends, and this could be attributed to the fact that flours from leguminous plants are poor sources of carbohydrate. Pigeon pea flour had lower carbohydrate values compared to other flours in the study, thus indicating that OFSP tubers and cereals are good sources of carbohydrate. The energy value of the flour samples ranged between 370.08 in the control sample (100% WF) and 444.12 kcal/100g in PPF (100%). The energy values of the flour samples WOP_1 and WOP_2; WOP_3 and WOP_4 were comparable respectively, but differed significantly ($p<0.05\%$) from other flour blends. The increase in the energy value of the composite flour could be attributed to increase in both carbohydrate and protein values of the samples (Adebowale and Maliki, 2011).

Table 3: Proximate Compositions of Flour Blends of Wheat- Orange fleshed Sweet Potato - Pigeon-pea

Samples Code	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Fiber (%)	CHO (%)	Energy value (Kcal/100g)
WF	8.53^{c}	1.25^{b}	10.34^{f}	1.84^{g}	1.13^{e}	78.04^{a}	370.08^{e}
WOP_1	9.55^{b}	1.10^{d}	19.66^{d}	7.12^{e}	1.01^{e}	62.57^{e}	393.00^{e}
WOP_2	9.56^{b}	1.20^{c}	19.89^{c}	7.22^{d}	1.56^{d}	62.13^{d}	393.06^{c}
WOP_3	9.54^{b}	1.25^{b}	20.33^{b}	7.76^{c}	1.66^{c}	61.12^{e}	395.64^{b}
WOP_4	9.53^{b}	1.26^{b}	21.34^{a}	7.91^{b}	1.84^{b}	59.96^{f}	396.39^{b}
OFSPF	9.82^{a}	0.79^{d}	6.40^{g}	5.36^{f}	2.47^{a}	77.63^{b}	384.36^{d}
PPF	7.03^{d}	2.89^{a}	12.86^{e}	16.36^{a}	0.17^{f}	60.86^{e}	442.12^{a}

Means in the same column with the same superscript are not significantly different ($p>0.05$)
Values are means of duplicate determinations.
WF 100% Wheat flour, WOP_1 5% WF: 80% OFSPF: 15% PPF, WOP_2 10% WF: 70% OFSPF: 20% PPF, WOP_3 15% WF: 60% OFSPF: 25% PPF, WOP_4 20% WF: 50% OFSPF: 30% PPF

Proximate Composition of Chin-Chin Samples

The results of the proximate compositions and energy values of chin-chin samples produced from the composite flour are presented in Table 4. The moisture content of the chin-chin samples was significantly ($p<0.05$) different, ranging from 1.62 to 2.71%; control sample (100% WF) and WOP_4 (20% WF: 50% OFSPF: 30% PPF) had the lowest and highest values respectively.

Generally, the moisture content of the composite chin-chin increased with increasing substitution level of PPF and decreasing inclusion level of OFSPF. It was also observed from the results that the composite chin-chin had higher moisture contents compared to the control sample.

However, the moisture of the chin-chin samples was low (<10%) to reduce the chances of spoilage by micro-organisms and consequently guarantee good storage stability (Ayo *et al.*, 2007). The results obtained in the study converse with the moisture content of chin-chin produced from flour blends of wheat-tigernut (3.00-5.29%; Adebayo-Oyetoro *et al.*, 2017), millet-wheat (3.98-5.04%; Adegunwa *et al.*, 2014), modified cocoyam- wheat (1.41-5.05%; Falola *et al.,* 2011) respectively. Chin-chin with low moisture content generally have prolonged shelf-life.

Chin-chin samples had significant ($p<0.05\%$) different ash content which ranged from 0.88 to 1.92%; control sample (100%WF) and sample WOP_4 (20% WF: 50% OFSPF: 30% PPF) had the lowest and highest values respectively. Generally, the composite chin-chin samples had higher ash contents than the control sample, which is directly related to the mineral compositions of the flour blends. The high ash content in the composite chin-chin could be attributed to the increasing substitution levels of pigeon-pea flour. Adegunwa, *et al.* (2014) and Falola *et al.* (2011) reported higher ash contents (4.97-6.10%) and (1.16- 4.00%) for chin-chin samples produced from flour blends of millet-wheat and modified cocoyam-wheat respectively. Conversely, low ash content (0.47-1.08%) is obtained in chin-chin samples produced from flour blends of wheat- and tigernut (Adebayo-Oyetoro *et al.*, 2017). The fat content of the chin-chin samples ranged from 15.59 to 16.23%, with the control sample (100% WF) and WOP_4 (20% WF: 50% OFSPF: 30% PPF) having the lowest and highest values respectively. The fat content of the chin-chin samples increased with the increasing substitution level of PPF and decreasing inclusion level of OFSPF. The high fat content of the chin-chin may be attributed to the high amount of fat added and absorbed during preparation and frying respectively.

The range in the study was significantly lower than those reported by Adebayo-Oyetoro *et al.* (2017) for the fat content (21.05-36.67%) of chin-chin produced from wheat and tigernut flour blends, but higher than those produced from flour blends of millet-wheat (7.56 - 8.13%; Adegunwa *et al.*, 2014) and modified cocoyam-wheat (7.81-8.27%; Falola *et al.,* 2011) respectively. The presence of high fat content in the chin-chin indicates high calorific value and could serve as a lubricant that improves product quality in terms of texture. In addition, fat is a rich source of energy and is essential as carriers of fat soluble vitamins; A, D, E and K. The crude fiber content of the chin-chin samples ranged between 2.34% in the control sample (100%WF) and 2.54% (WOP_4-20% WF: 50% OFSPF: 30% PPF). These values were higher than chin-chin samples produced from flour blends of modified cocoyam-wheat (0.77-2.15% ; Falola *et al.,* 2011) and wheat- tigernut blends (0.28- 0.66% ; Adebayo-Oyetoro *et al.*, 2017) respectively, but lower than those produced from blends of millet-wheat (4.56-5.23%; Adegunwa *et al.*, 2014).

The composite chin-chin samples were not significantly different ($p>0.05$) from one another, but significantly different ($p<0.05$) from the control sample. OFSPF is relatively a good source of dietary fiber, which explains the higher values reported in the study. Crude fiber is an indication of roughage/bulkiness of a sample and its presence in food products

serves in reducing constipation by facilitating bowel movement (peristalsis) and preventing many gastrointestinal diseases in man (Abiodun *et al*., 2012). The protein content of the chin-chin samples ranged from 9.45 to 13.50%; control sample and sample WOP_4 (20% WF: 50% OFSPF: 30% PPF) had the lowest and highest values respectively.

The composite chin-chin samples were significantly ($p<0.05$) different from the control sample. However, increase in the protein content of the composite chin-chin could be attributed to the increase in the proportion of pigeon-peas in the chin-chin formulation recipe. Pigeon pea flour is a richer source of protein compared to other flours in the study. The protein content of the composite chin-chin samples in the study is higher than values reported in other studies for composite chin-chin (7.66-11.58, Adebayo-Oyetoro *et al*., 2017; 6.80- 9.25%, Falola *et al.,* 2011) respectively, but lower than those produced from flour blends of millet-wheat (12.63-19.90%; Adegunwa *et al*., 2014). Food products rich in protein content are of great nutritional importance in developing countries, such as Nigeria, where protein malnutrition prevails (Anuonye *et al*., 2012; Okpala and Okoli, 2011). Most children require protein for growth, repair and maintenance of the body. Protein is an essential building material necessary for the maintenance of all body parts, such as blood, hair, bones, brain, nails, skin muscles and body fluid (Mahan and Escott-Stump, 2008). The carbohydrate content of the chin-chin samples ranged from 64.18 to 67.52% and significant ($p<0.05$) difference exists among the samples. Chin-chin made from 100%WF and 20%WF: 50%OFSPF: 30%PPF (WOP_4) had the highest and lowest values respectively.

The high carbohydrate contents of the chin-chin could be attributed to the inclusion of WF and OFSPF in the formulation. The values were higher compared with 49.7-52.0%, for biscuits produced from carrot pomace powder and germinated chicken peas blends (Baljeet *et al*., 2014). The energy value of the chin-chin samples ranged between 447.411 and 459.92 Kcal/100g. Samples made from 100% WF (control sample) had the highest value while sample WOP_2 had the least value. Significant ($p<0.05$) differences exist among the composite chin-chin. The fat, protein and carbohydrate values contributed to the energy value of the chin-chin. Chin-chin are energy-giving foods which are consumed by both young and old, especially in-between or after meals

Table 4: Proximate composition of chin-chin samples produced from composite flour blends

Sample Codes	Moisture (%)	Ash (%)	Fat (%)	Fiber (%)	Protein (%)	CHO (%)	Energy value (Kcal/100g)
WF (100%)	1.62^{d}	0.88^{d}	15.59^{d}	2.34^{b}	9.45^{e}	67.46^{a}	459.92^{a}
WOP_1 (5:80:15)	2.48^{c}	1.43^{d}	15.65^{c}	2.49^{a}	11.73^{d}	66.73^{b}	454.78^{c}
WOP_2 (10:70:20)	2.51^{c}	1.72^{c}	15.69^{c}	2.50^{a}	12.37^{c}	64.62^{c}	447.41^{d}
WOP_3 (15:60:25)	2.62^{b}	1.84^{b}	15.82^{b}	2.52^{a}	12.58^{b}	67.52^{a}	455.22^{c}
WOP_4 (20:50:30)	2.71^{a}	1.92^{a}	16.23^{a}	2.54^{a}	13.50^{a}	64.18^{d}	456.84^{b}

Means in the same column with the same superscript are not significantly different ($p>0.05$)
Values are means of duplicate determinations.
WF 100% Wheat flour, WOP_1 5% WF: 80% OFSPF: 15% PPF, WOP_2 10% WF: 70% OFSPF: 20% PPF, WOP_3 15% WF: 60% OFSPF: 25% PPF, WOP_4 20% WF: 50% OFSPF: 30% PPF

Sensory Evaluation of Chin-Chin Samples

The results of the sensory evaluation of the chin-chin samples are presented in Table 5. The mean scores for the taste of the chin-chin samples ranged between 5.35 for sample WOP_4 (20% WF: 50% OFSPF: 30% PPF) and 7.67 for the control sample. Significant ($p<0.05$) difference exist among the chin-chin samples and this could be attributed to the unfamiliarity and unpreparedness of the panelists to explore new chin-chin samples with suya spice. The scores in the study is comparable with those reported for composite chin-chin made from flour blends of millet-wheat and modified cocoyam-wheat (4.94 -7.72; Adegunwa *et al.*, 2014) and (5.60-7.12; Falola *et al.,* 2011) respectively, but higher than 4.0-5.5 as recorded by Hussein *et al.*, (2015).

Colour is an important sensory attribute of any food because of its acceptability. With regard to the colour of the chin-chin samples, the mean scores ranged from 5.05 to 7.25, with sample WOP_3 (15%WF: 60% OFSPF: 25% PPF) and 100% WF having the least and highest scores respectively. However, there was significant ($p<0.05$) difference between the control sample and the composite chin-chin samples. The composite chin-chin samples had deep-brown colouration, as this may be attributed to the reaction between sugar in OFSPF and amino acids in PPF (known as Maillard reaction). Obviously, the inclusion levels of OFSPF and PPF greatly influenced the colour of the chin-chin as evident in the scores recorded by the panelists. Similar color mean scores were recorded for composite chin-chin made from modified cocoyam-wheat flour blends (5.20- 7.40; Falola *et al.,* 2011) but higher than those prepared from composite wheat-sweat potato flour (3.6-5.6; Hussein *et al.*, 2015). The aroma of the chin-chin samples had mean sensory scores ranging between 5.15 and 6.45. Chin-chin samples made from 100% WF (control) and sample WOP_1 are not significantly different from each, but different from others. The high aroma score of sample WOP_1 could be attributed to the slight beany flavor compared to others with low scores, owing to the noticeable high proportion of

PPF. Conversely, Hussein *et al.* (2015) reported a low aroma scores for chin-chin samples made from flour blends of wheat and sweat potato. The mean scores for the crunchiness of the chin-chin samples were significantly different from each other with the increasing substitution level of PPF and decreasing inclusion level of OFSPF. The scores ranged from 6.05 to 7.95 for 100%WF (control) and WOP_1 respectively. This result disagrees with the scores obtained for composite chin-chin samples made from flour blends of wheat- tigernut blends (3.67-7.61; Adebayo-Oyetoro *et al.*, 2017), wheat-sweat potato and modified cocoyam-wheat (5.52-6.88; Hussein *et al.*, 2015) respectively. Crunchiness is another important criterion perceived when snacks are chewed between the molars and is usually expressed in terms of hardness and factorability.

The mean scores for the overall acceptability of the chin-chin samples ranged between 5.25 for sample WOP_4 (20%WF: 50%OFSPF: 30%PPF) and 7.75 for the control sample (100%WF). Significant ($p<0.05$) difference exist among the composite chin-chin samples. The scores decreased as the substitution level of PPF increased and with decreasing inclusion level of OFSPF. It is worth-noting that the composite chin-chin samples were generally acceptable, since higher ratings of more than 4.5 was obtained, which is the minimum acceptable values on the nine point hedonic scale.

Table 5: Mean sensory scores of chin-chin produced from flour blends of wheat- Orange fleshed sweet-potato- Pigeon-pea

Sample codes	Taste	Colour	Aroma	Crunchiness	Overall acceptability
WF	7.67^a	7.25^a	6.45^a	7.95^a	7.75^a
WOP_1	5.75^c	6.65^b	6.35^a	6.05^e	6.55^b
WOP_2	6.05^b	5.85^c	5.15^d	6.75^d	6.25^c
WOP_3	5.55^d	5.05^e	5.35^c	6.85^c	5.75^d
WOP_4	5.35^e	5.65^d	5.55^b	7.25^b	5.25^e

Mean values with the same superscript within the same column are not significantly different ($p>0.0$ are means of duplicate determinations.
WF – 100% Wheat flour, WOP_1 – 5% WF: 80% OFSPF: 15% PPF, WOP_2 – 10% WF: 70% OFSPF: WOP_3 – 15% WF: 60% OFSPF: 25% PPF, WOP_4 – 20% WF: 50% OFSPF: 30% PPF

CONCLUSIONS

The study shows that chin-chin samples with improved nutritional and sensory properties can be produced from composite flour blends of wheat, orange fleshed sweet-potato and pigeon peas and will assist Food processors to realize local and affordable raw materials for chin-chin production. The study revealed that chin-chin samples produced from 5%WF: 80% OFSPF: 15% PPF compares favorably with the control sample and they were most acceptable among others, in terms of colour and aroma.

REFERENCES

Adebowale, O. J. & Maliki, K. (2011). Effect of fermentation period on the chemical composition and functional properties of pigeon - pea (*Cajanus cajan*) seed flour. *International Food Research*

Journal, 18(4): 1329-1333.

Adebayo-Oyetoro, A. O., Ogundipe, O. O, Lofinmakin, F. K., Akinwande, F. F., Aina, D.O. & Adeyeye, S. A.O. (2017). Production and acceptability of chin-chin snack made from wheat and tigernut (*Cyperus esculentus*) flour. *Journal of Cogent Food and Agriculture*, 3:1282185. Http://dx.doi.org/10.1080/23311932.2017.1282185.

Adegunwa, M. O., Ganiyu, A. A., Bakare, H. A. & Adebowale, A. A. (2014). Quality evaluation of composite millet-wheat chin-chin. *Agriculture and Biology Journal of North America*, 5, 3339.

Aiyesanmi, A. F. & Oguntokun, M. O. (1996). Nutrient composition of *Dioclearеflexa* seedan underutilized edible legume. *La Rivista Italiana Delle Sostanze Grasse*, LXXIII, 521-523.

Akonor, P. T., Dziedzoave, N. T., Buckman, E. S., Essel, E. M., Lavoe, F. & Tomlins, K. I. (2016). Sensory optimization of crackers developed from high-quality cassava flour, starch and prawn powder. *Journal of Food Science and Nutrition*, 1: 6.

Akubor, P. I. (2004). Protein contents, physical and sensory properties of Nigerian snack foods (cake, chin-chin, puff-puff) prepared from cowpea-wheat flour blends. *International Journal of Food Science and Technology,* 39: 419-424. Http://dx.doi.org/10.1111/j.1365-2621.2004.00771.x

Anuonye, J.C. Onu, J. O., Egwin, E. & Adeyemo, S.O. (2009). Nutrients and antinutrients composition of extruded acha and soyabeans blend. *Journal of Food Processing and Preservation*, 34: 680-691.

AOAC (2010). Official methods of analysis. 17th edition. Association of Official Analytical Chemists, Washington, D.C.

Apata, D.F. & Ologhobo, A.D.D. (1994). Biochemical evaluation of some Nigerian Legume seeds. *Journal of Food Chemistry*, 49: 333-338.

Baljeet, S.Y., Ritika, B.Y. & Reena, K. (2014). Effect of incorporation of carrot pomace powder and germinated chickpea flour on the quality characteristics of biscuits. *International Food Research Journal*, 21(1): 217-222.

Bechoff, A., Poulaert, M., Tomlins, K. I., Westby, A., Menya, G., Young, S. & Dhuique-Mayer, C. (2011). Retention and bioaccessibility of *β*-Carotene in blended foods containing orange-fleshed sweet potato flour. *Journal of Agriculture and Food Chemistry*, 59:10373-10380. http://dx.doi.org/10.1021/jf201205y

Brink, M. & Belay, G. (2006). Plant Resources of Tropical Africa, Cereals and Pulses. Prota Foundation/Backhuys Publishers/CTA, Wageningen, 129-133.

Emelike, N.J.T & Ebere, C.O. (2016). Effect of drying techniques of Moringa leaf on the quality of chin-chin enriched with Moringa leaf powder. *IOSR Journal of Environmental Sciences, Toxicology and Food Technology*, 1(4): 65-70.

Falola, A. O., Olatidoye, O. P., Adesala, S.O. & Amusan, M. (2014). Modification and quality characteristics of cocoyam starch and its potential for chin-chin production, *Pakistan Journal of Nutrition,* 13(12):768-773.

FAO, (1982). Legumes in Human Nutrition. Food and Agriculture Organization of the United Nations. Food and Nutrition series, No.20 Rome.

Fasasi, O. S. (2009). Proximate, anti-nutritional factors and functional properties of processed pear millet. *Journal of Food Technology,* 7: 92-97.

Gallagher, P. R. Flatt, G. Duffy, Y.H.A. & Abdel-Wahab (2003). The effects of traditional antidiabetic plants on in-

vitro glucose diffusion. *Journal of Nutrition Research*, 23: 413424.

Hussein, A. E., Emmanuel, O. Chinyere, A. & Majekodunmi, R.O. (2015). Utilization of sweet-potato starches and flours as composite with wheat flours in the preparation of confectioneries. *African Journal of Biotechnology*, 14(1):17-22.

Ihekoronye, A. I. & Ngoddy, P. O. (1985). Integrated Food Science and Technology for the Tropics. London: Macmillan Publisher.

Lasekan, O.O. & Akintola, A.M. (2002). Production and nutritional evaluation of puffed soy-maize snack. *Nigerian Food Journal*, 20: 15-19.

Low, J. W. & Van Jaarsveld, P. J. (2008). The Potential contribution of bread buns fortified with beta-carotene-rich sweet- potato in central Mozambiqu. *European Food and Nutrition Bulletin*, 29: 98-107.

Mahan, K. & Escott-Stump, S. (2008). Krause"s Food and Nutrition therapy, 12th edition. Canada: Saunders Elsevier.

Ojinnaka, M.C., Emeh, T.C. & Okorie, S.U. (2016). Evaluation of quality of composite maize-wheat chin-chin enriched with *Rhynchophorous phoenicis*. *Journal of Food Research*, 5(4): 26-35.

Omah, E.C. & Okafor, G.I. (2015). Production and quality evaluation of cookies from blends of millet-pigeon pea composite flour and cassava cortex. *Journal of Food Resource Science*, 4 (2): 23-32.

Osagie, A.U. (1998). Antinutritional factors. In: A.U. Osagie and O.U. Eka (ed). Nutritional quality of plant foods, Published by Post harvest Research Unit, Department of Biochemistry, University of Benin, Nigeria, 53-83.

Retapol, T. N. & Hooker, H. (2006). Consumer evaluation and preference heterogeneity for a novel functional food. *Journal of Food Science,* 71: 4146.

Sanni, L.O., Adebowale, A. A. & Tafa, S.O. (2006). Proximate, functional, pasting and sensory qualities of Instant yam flour. A Paper Presented at the 14th ISTRC Symposium, Central Tuber Crops the Research Institute, Trivandrum, Kerala State, India

Singh, V. P., Sanyal, M. K., Dubey, P. C & Mendirtta, S. K. (2011). Quality Assessment of vacuum packaged chicken snacks stored at room temperature. *Journal of Stored Products and Postharvest Research,* 2(6): 120-126.

Tyagi, M. R. Manikantan, Harinder Singh Oberoi (2006). Effect of mustard flour incorporation on nutritional, textural and organoleptic characteristics of biscuit. *Journal of Food Engineering*, 80(4):10431050.

Woolfe, J. A. (1992). Post-harvest procedures: Sweet potato an untapped food source. Cambridge, UK: Cambridge University Press, 643.

Data Mining Approach to Coronary Artery Disease Diagnosis

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ABSTRACT

The prevalence of coronary artery disease (CAD) is on high increase all over the world. The disease often results to death and has been categorized as one of the world's most predominant cause of death. The high mortality rate from CAD is as a result of many factors which include lack of accurate diagnosis, shortage of medical specialists and services, poor interpretation of laboratory results and late diagnosis. These inadequacies have prompted the development of computer aided diagnostic systems for CAD using data mining approach. Data mining is an advanced technology, which is used to analyze large volumes of datasets and extracts patterns that can be converted to useful knowledge. Two filter-based feature selection methods namely Information Gain and Chi-Square methods were used to identify the most relevant features for the diagnosis. After which two data mining techniques - K-Nearest Neighbor (KNN) and Support Vector Machine (SVM) were used. The implementation of the models was carried out in Python environment. The highest accuracy obtained from the resulting models on test dataset was 88.2% for SVM as against the highest accuracy of KNN which is 85.3%. The result shows that the proposed system performs well on the test dataset. Thus, the system is good for diagnosis of CAD and could be of immense benefits to the health sector and every individual.

Keywords: *Coronary Artery Disease, Data Mining, Diagnosis, Predictive Model*

INTRODUCTION

In every fields of human endeavor, data are being generated and collected and accumulated at a huge pace. There is a pressing necessity for a new generation of computational tools that can be of assistance in extracting relevant information from the rapidly increasing volumes of data. The essential part of this process is the application of explicit data mining methods for discovery and extraction of patterns from data (Bhatla and Jyoti, 2015). Data mining is an interdisciplinary field of computer science which involves the computational process of discovering patterns in large dataset. It cut across artificial intelligence, machine learning, statistics and database systems (Kumar and Sonia, 2017). The main objective of data mining process is to extract relevant information from a dataset and then transform it into a better and understandable form for further use. In healthcare, data mining entail steps that allows the extraction of patterns from preprocessed data by the application of specific algorithms.(or by basically applying specific algorithms).

The most vital and hardest - working muscle in human body is the heart. The heart with blood vessels makes up the cardiovascular

system. The basic function of the heart is to pumps blood into every cell of the human body. It can be stated that heart muscle is the engine of the human body (Palaniappan and Awang, 2008). One of the most predominant health issues is coronary artery disease. This disease develops when the major blood vessels that supply human heart with blood, oxygen and nutrients (coronary arteries) become diseased or damaged. The arteries usually get blocked with cholesterol-containing deposits (plaque). Hence, it is very essential to predict such diseases through appropriate symptoms.

There are many types of algorithms presently being used for disease prediction which includes Decision Trees, Naïve Bayes, Multilayer perceptron and Support vector machine. Unfortunately, all medical personnel do not possess proficiency in every area of specialty and likewise there is a shortage of specialist especially in other area of cardiology. Therefore, an automatic medical diagnosis system would possibly be remarkably beneficial for bringing the efficient and accurate result. Appropriate computer-based information and decision support systems can help to minimize the negative effect of heart disease. In this work a performance comparison of heart disease diagnosis is executed with the help of two feature selection methods, K- Nearest Neighbor (KNN) and Support Vector Machine (SVM).

REVIEW OF RELATED WORKS

Several researchers have been exploring the use of data mining techniques to diagnose heart disease. Some factors related to heart disease includes and not limited age, sex, blood sugar, chest pain, blood pressure, cholesterol. These are some of the factors used in the diagnosis of heart disease in patients. Soni, (2011) did a survey of current techniques of extraction from databases using data mining techniques for diagnosis of heart disease. The authors used Naive Bayes, Decision Trees and K-Nearest Neighbor. The limitation of the work was that the classification based on clustering did not perform well. Deepika (2011) used pruning classification association rule (PCAR) derived from Apriori algorithm. The proposed method deletes minimum frequency item with minimum frequency item sets and removes infrequent instances from sets of instances then the frequent item set was revealed and used.

Jabbar *et al.* (2012) presented an efficient associative classification based genetic algorithm for heart disease prediction. The goal for using genetic algorithm to predict disease from large dataset was to get the best attribute set. As revealed in the work, there are limitations in the prediction of the disease using data mining approach. Reducing in the set of attributes (features) can make it less complex with better accuracy. Anooj *et al.*, (2012) worked on diagnosis of heart disease using a weighted fuzzy rule-based system. The system was designed to automatically retrieve knowledge from the patient's data. Mamdani fuzzy inference system was used to build the weighted fuzzy rules. Bhatla *et al.*, (2012) in their work also proposed to evaluate various data mining techniques used for heart disease prediction. Findings from the work revealed that SVM outperformed other data mining techniques used. Another observation from the work is that decision tree also gave a

fairly good accuracy with the help of genetic algorithm and feature subset selection. (Anbarasi, *et al.*, 2010). Sethukkarasi and Kannan (2012) designed a novel neuro fuzzy technique with genetic algorithm for feature extraction. A radial basic function neural network was constructed in the work with five input, training and normalization in hidden layer and output layer with one node.

Khaleel *et al.* (2013) presented an approach to diagnose heart diseases with Apriori data mining technique. A graphical representation was also used to visualize the techniques. A prototype was developed to validate the efficiency of the approach. It was observed that the prototype can be suitable in real world. Methaila *et al.*, (2014) in their work applied three data mining classification modeling techniques in addition to weighted association Apriori algorithm and MAFIA algorithm for heart disease prediction. However, the performance evaluation of the work was not explicitly stated. Goyal and Chhillar (2015) present a work on heart disease prediction using K-means and apriori algorithm. The work also presented the issues in diagnosing the diseases and analyzed the results. Bahrami and Shirvani (2015) also studied different classification techniques for diagnosis heart disease. Classifiers such as Decision Tree, KNN, and Naive Bayes were used for the classification. The result revealed that Decision tree outperformed others in terms of classification accuracy.

METHODOLOGY

The main objective of this work is to design predictive models for coronary artery disease using data mining technique. The predictive models were designed using two different data mining algorithms which are K-Nearest Neighbor (KNN) and Support Vector Machine (SVM). It was implemented in Python environment. Dataset used in this work was obtained from University of California, Irvine (UCI) online repository (https://archive.ics.uci.edu).

Two experiments were conducted in this study and for the two experiments, three scenarios were considered per experiment. The first scenario contains all the attributes in the dataset, the second scenario contained attributes selected with information gain feature selection method, while the third scenario contained attributes selected with chi-square feature selection method. With two experiments and three different scenarios a total of six predictive models were designed. The selected features were fed to the classifiers. The models were evaluated based on five criteria described below

I. Accuracy: Accuracy is the ratio of correct predictions to the total predictions given as

$$ACC = \frac{TP + TN}{TP + TN + FP + FN} \quad (1)$$

ii. Precision: The ratio of True positives to the Overall positive predictions. It is otherwise referred to as precision or positive predictive value given as:

$$Precision = \frac{TP}{TP + FP} \quad (2)$$

iii. False Alarm Rate (FAR): This is simply the ratio of false positives (false alarms) to the total negatives. It is otherwise known as the false positive rate given as:

$$FAR = \frac{FP}{TN + FP} \quad (3)$$

iv. Recall: Also known as the Sensitivity or true positive rate is the ratio of True

positives to the total Positives i.e.

$$Recall = \frac{TP}{FN + TP} \quad (4)$$

In order to evaluate the performance of the algorithms used, there was need to plot the results of the classification on a confusion matrix (Figure 1).

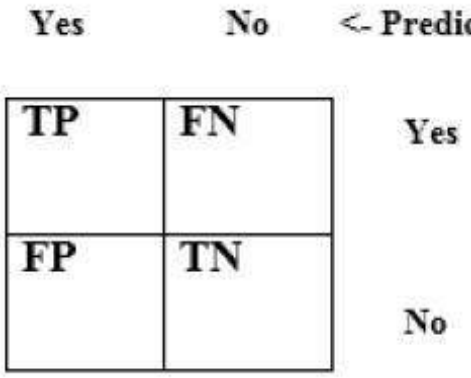

Figure 1: Diagram of a Confusion Matrix

True positives (TP) are the correctly classified Yes cases, False positives (FP) are incorrectly classified No cases, True negatives (TN) are correctly classified No cases; and False negatives (FN) are incorrectly classified Yes cases. The true positive/negative and false positive/negative values recorded from the confusion matrix can then be used to evaluate the performance of the prediction model. To determine most relevant features of the dataset, the ranked features were grouped into 3 groups. The first group contain the first top 5 features, the second group contain the first top 10, and the last group contain all 13 features (without feature selection). The grouped features passed to each classifier for classification, and the group whose performance is best during classification was chosen as most relevant features. The Machine Learning Algorithms used in this work are discussed below:

(a) K-Nearest Neighbor (KNN)

KNN is a learning classifier that classifies unlabeled examples based on their resemblance to examples in the training set. The records were represented as a point in a *i*-dimensional space where *i* is the number of attributes. To find a class label for a test data sample, the nearest CAD training data point from the test sample in the *i*-dimensional space is located using a proximity measure and the target class label of the nearest training data point is assigned as the predicted target class for the test data point. However, when the data points are in between the boundaries of two different CAD instances, an algorithm with a majority voting method is used to measure the nearness of the data points with more than two dimensions and assign a class label. The number of neighbors used to assign the target class of the instance query is identified by the value of *n*. KNN is based on Euclidean distance between the training set and the testing set. Given that is the instance to be classified ranging from 1 to *n*, is the total number of instances in a data set ranging from 1 to *k* with same number of features. The Euclidean distance between two tuples, $X_1 = (x_{11}, x_{12}, \ldots, x_{1n})$ and $X_2 = (x_{2i}, x_{22}, \ldots, x_{2n})$ is defined as:

$$dist(X_1, X_2) = \sqrt{\sum_{i=1}^{n} (x_{1i} - x_{2i})^2} \quad (5)$$

(b) Support Vector Machines (SVM)

SVM is a one of the data mining methods. It recognizes patters and data in a classification

task. SVM classifies and separates similar data by finding the best hyper plane that separates all data points of one class from other class. From the perspective of statistical learning theory, the motivation for considering a binary classifier SVM comes from the theoretical bounds on the generalization error. These generalization bounds have two important features: upper bound is independent of size of the input space, and the bound is minimized by maximizing the margin between the hyperplane separating the two classes and the closest data point to each class – called support vectors. Closest points are called support vectors because they support where the hyperplane should be located. That is, moving the non-support vectors will not shift the hyperplane, whereas moving the support vectors will shift the hyperplane. Given a training dataset: θ, containing data feature vectors x_i and the corresponding data labels y_i, in the form of

$$\theta = \{(x_1, y_1), (x_2, y_2), \ldots (x_n, y_n) \quad (6)$$

where $x_1 \in$ ^{m}, m is a dimension of the feature (real) vector, $y_1 \in \{0,1\}$ and n is the number of instances in the dataset. We assume (x) is some unknown function to classify the feature vector xi.

$$g(x): \ ^m \rightarrow \{0,1\} \quad (7)$$

In SVM method, optimal margin classification for linearly separable patterns is achieved by finding a hyperplane in m dimensional space. The linear classifier is based on a linear discriminant function of the form,

$$f(x) = \sum_i wi\, xi + b \quad (8)$$

RESULTS AND DISCUSSION

The predictive models were designed using two different data mining techniques (KNN and SVM) and the performance was evaluated. Three scenarios were considered as earlier mentioned. The intention here is to investigate the effect of feature selection on the performance of the models. In the first scenario, the algorithms were run on a full training set containing 802 instances with 13 attributes. In the second scenario, the two algorithms were run with features selected with information gain feature selection method. While the third scenario, the algorithms were run with attributes selected via chi-square feature selection method. The confusion matrixes and the detailed performance measures of the developed model is presented in Table 1 and Table 2 respectively. Figure 3 shows the performance evaluation chart of the developed models.

Table 1: Confusion Matrixes for Experiments

Models	Actual	Predicted	
		Yes	No
KNN with all attributes	Yes	318 (39.7%)	78 (9.7%)
	No	79 (9.8%)	327 (40.8%)
KNN with Information Gain Feature Selection	Yes	332 (41.4%)	64 (8%)
	No	62 (7.7%)	344 (42.9%)
KNN with Chi-Square Feature Selection	Yes	335 (41.8%)	61 (7.6%)
	No	57 (7.1%)	349 (43.5%)
SVM with all attributes	Yes	318 (39.7%)	78 (9.7%)
	No	72 (9%)	334 (41.7%)
SVM with Information Gain Feature Selection	Yes	344 (42.9%)	52 (6.5%)
	No	50 (6.2%)	356 (44.4%)
SVM with Chi - Square Feature Selection	Yes	347 (43.4%)	49 (6.1%)
	No	46 (5.7%)	360 (44.9%)

Table 2 Detailed Performance Measures for Experiments

MODEL	Correct Classification	Accuracy (%)	Precision (%)	TP Rate (%)	FP Rate (%)	FAR (%)
KNN with all attributes	645 (80.4%)	80.4	80.1	80.3	80.7	19.3
KNN with Information Gain Feature Selection	676 (84.3%)	84.3	84.3	83.8	84.3	15.7
KNN with Chi-Square Feature Selection	684 (85.3%)	85.3	85.5	84.6	85.1	14.9
SVM with all attributes	653 (81.4%)	81.3	81.5	80.3	81.1	18.9
SVM with Information Gain Feature Selection	700 (87.3%)	87.3	87.3	86.9	87.3	12.7
SVM with Chi-Square Feature Selection	707 (88.2%)	88.2	88.3	87.6	88	12

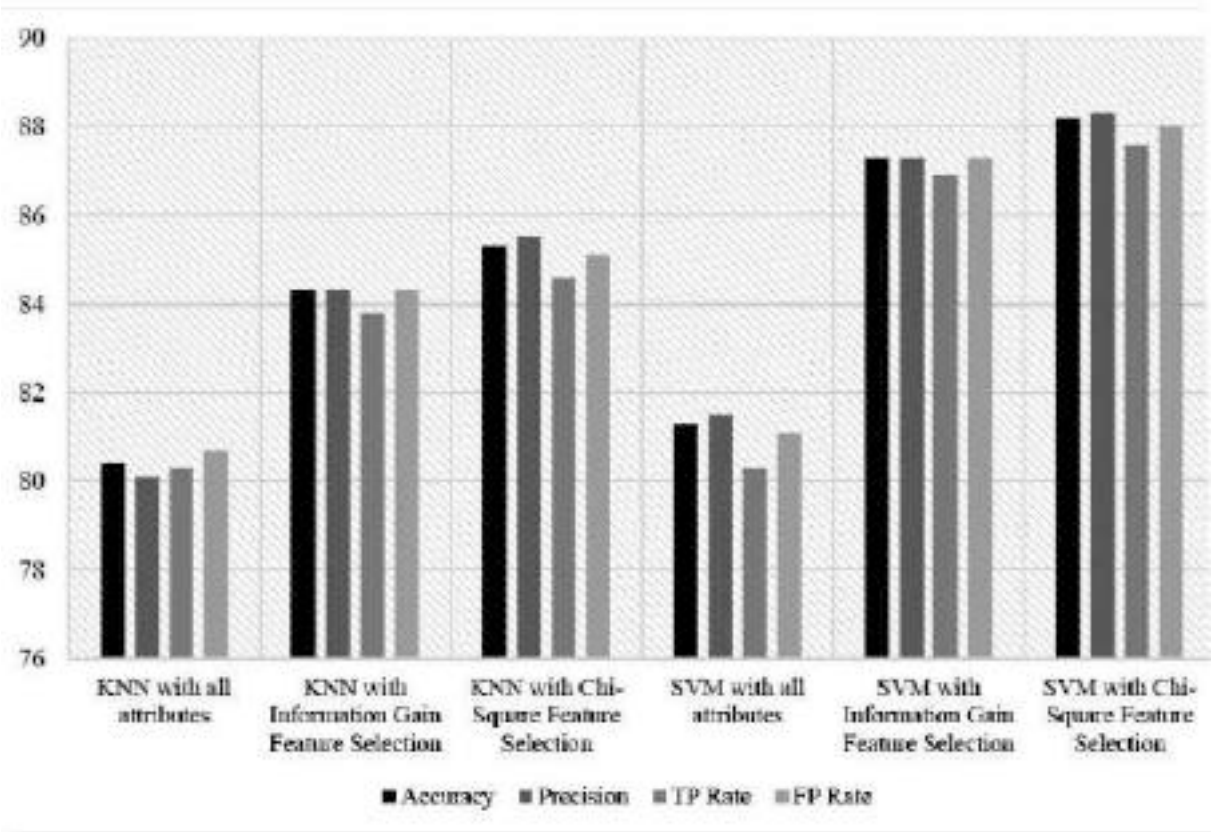

Figure 3: Performance evaluation Chart of the Predictive Models

From the performance evaluation of the developed model, it was revealed that Chi-Square features selection method is better with SVM model gave the highest accuracy and least False Alarm Rate (FAR) of 88.2% and 12% as against that of KNN models which was 85.3% and 14.9%. The variables identified by the predictive model using the feature selection algorithms can help to provide and handle the relationship that exist between the attributes with respect to the diagnosis of CAD.

CONCLUSION

The models trained and classified well on testing dataset with SVM model attaining a very good accuracy as well as low false alarm rate of roughly (7.3%). The features selected via two features selection techniques were considered as the most relevant features when tested with SVM model as the model produced a prediction accuracy of 88.2 % on Chi- Square and 87.3% on information gain. Conclusively, SVM model performed better on the dataset compared to that of KNN. Sequel to the performance of the prediction models for CAD diagnosis, a better perception of the relationship between the variables relevant to CAD diagnosis was estimated. The models can be integrated into the available Health Information System (HIS) which covers and manages clinical information that can be fed to the diagnosis classification model thus improving clinical decisions. It is recommended that a continual evaluation of attributes monitored during diagnosis of CAD be made in order to increase the number of information relevant to developing an improved prediction model for the disease using the feature selection method and data mining approach.

REFERENCES

Anbarasi, M. Anupriya, E. and Iyengar, N, (2010). Enhanced Prediction of Heart Disease with Feature Subset Selection using Genetic Algorithm. International Journal of Engineering Science and Technology, vol. 2(10)

Anooj, P. (2012). Clinical decision support system: Risk level prediction of heart disease using weighted fuzzy rules. *Journal of King Saud University – Computer and Information Sciences* vol. 24, page 27 – 40.

Bahrami, B. and Shirvani, M. (2015). Prediction and Diagnosis of Heart Disease by Data Mining Techniques. *Journal of Multidisciplinary Engineering Science and Technology* (JMEST), vol. 2(2).

Bhatla, N. and Jyoti, K. (2012). An Analysis of Heart Disease Prediction Using Data Mining Technique. *International Journal of Engineering Research and Technology (IJERT),* vol 1 (8).

Deepika, N. (2011). Association Rules for Classification of Heart Attack Patients. *International Journal of Advanced Engineering Sciences and Technologies (IJAEST)*, vol. 11(2), pp 253-257.

Goyal, S. and Chhillar, R. (2015). A Literature Survey on Applications of Data Mining Techniques to Predict Heart Diseases, International Journal of Engineering Sciences Paradigms and Researches (IJESPR), vol. 20(01)

Jabbar, M., Chandra, P. and Deekshatulu, P. (2012). Heart Disease Prediction System using Associative Classification and Genetic Algorithm. *International Conference on Emerging Trends in Electrical, Electronics and Communication Technologies.*

Methaila, A. Kansal, P. Arya, H. and Kumar, P. (2014). Early Heart Disease Prediction Using Data Mining Techniques. *Journal of Computer Science and Information Technology,* pp. 53–59.

Palaniappan, S. and Awang, R. (2008). Intelligent Heart Disease Prediction System Using Data Mining Techniques. *International Journal of*

Computer Science and Network Security, vol.8(8).

Sethukkarasi, R. and Kannan, P. (2012). An Intelligent System for Mining Temporal rules in Clinical database using Fuzzy neural network. *European Journal of Scientific Research*, vol. 70(3), pp. 386 – 395.

Soni, J. (2011). Predictive Data Mining for Medical Diagnosis: An Overview of Heart Disease Prediction. *International Journal of Computer Applications*, vol. 17 (8),

Spectroscopic Study of the Impedance of Biosynthesized Zinc Oxide Nanoparticles

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ABSTRACT

Zinc Oxide nanorods (ZnO NRs) were bio-synthesized by co-precipitation and bacterial inoculation. Fourier Transform Infra-Red (FTIR) spectroscopy analysis was carried out to identify the elemental constituents of the ZnONRs, the composition of which were analyzed using Energy Dispersive Spectroscopy (EDX). Its structural and morphological properties were studied using X-ray Powder Diffractometer (XRD) pattern and Scanning Electron Microscopy (SEM) images respectively. Impedance Spectroscopy studies were carried out on the ZnONRs for frequency domain responses (10 Hz – 13MHz), impedance related functions, admittance, Immittance and modulus functions. From the results obtained, the dielectric constant, ε/ of the biosynthesized ZnONRs is very high (750), it decreases with increasing frequency and then reaches a constant value. The dielectric loss Ɛ// also decreases with increasing frequency. The dielectric loss angle, σ for the sample decreases continuously with increase in frequency. Finally, it was observed that the resistance and capacitance values depend on temperature and frequency.

Keywords: *Nanorods, FTIR, XRD, EDX, Dielectric constant, Dielectric loss, Dielectric loss angle*

INTRODUCTION

Impedance Spectroscopy (IS) is becoming a popular analytical tool in materials research and development because it involves a relatively simple electrical measurement that can readily be automated and whose results may often be correlated with many complex materials variables: from mass transport, rates of chemical reactions, corrosion, and dielectric properties, to defects, microstructure, and compositional influences on the conductance of solids. IS can predict electrons behavior of the performance of chemical sensors and fuel cells, and it has been used extensively to investigate membrane behavior in living cells. It is useful as an empirical quality control procedure, yet it can contribute to the interpretation of fundamental electrochemical and electronic processes. (Evgenij and Macdonald, 2005)

A lot of factors contribute to the experimental value of dielectric constant of a sample. These include method of synthesis, macroscopic quantities – bulk resistance, capacitance, dielectric effect and a few microscopic quantities such as ion/charge effect - homogeneous reactions associated with dissociation and recombination of charges present, electronic effects usually at high frequency range while different polarization, interfacial, atomic, ionic etc usually occur at low frequency range. ZnO is one of the most promising materials for electrical devices,

including transparent conductive films, light emitting diodes and photocatalyst, flat panel displays, photodetectors, gas sensors and solar cells. (Latif, 2012, Amrut, et al. 2013)

Although extensive work has been done on doped or hybrid ZnO NRs, much work has not been done on dielectric performance of bio-synthesized ZnO NRs. Moreover, synthesis method could have significant effect on dielectric performances of ZnO NRs. Hence, this work presents impedance spectroscopic (IS) studies on biosynthesized ZnO NRs considering its responses in frequency domain, impedance related functions, admittance, immittances and modulus functions.

EXPERIMENTAL

Zinc acetate dihydrate, sodium hydroxide, were purchased from HiMedia Laboratories Private Limited, 23 Vadhani Industrial Estate, LBS Rd, Mumbai, India. All other reagents are of analytical purity grade and have been received from commercial sources. ZnO nanostructures were prepared by co-precipitation method. 0.02 M aqueous solution of zinc acetate dihydrate was put into 50 ml of distilled water under vigorous stirring. After 10 min stirring, 1.0 ml of Bacterial Inoculum (prepared from Bacto Yeast Nitrogen Base and glucose in demineralized water by a method of broth culture until turbid) was added into the above solution. After addition of Inoculum, 2.0 M NaOH aqueous solution was introduced into the above aqueous solution, resulting in a white aqueous solution at pH 12, which were then placed on magnetic stirrer for stirring for 2 hr. The precipitate was then taken out and washed repeatedly with distilled water followed by ethanol to remove the impurities for the final products. Then a white powder (of ZnONRs) was obtained after drying at a constant 60 0C overnight in a Mophorn Vacuum Drying Oven 0.9 Cu Ft.

The elemental composition of the ZnO NRs was analyzed using Energy Dispersive Spectroscopy (EDX) - BRUKER-X Flash 6130, and Fourier Transform Infra-Red (FTIR) spectroscopy - by SHIMADZU - IR TRACER 100 using KBr pellet method at room temperature through the wave range 400 - 4000 cm-1. The structural properties were characterized using X-Ray Diffraction (XRD) machine - D8 advance ECO XRD systems with SSD160 1D Detector, with Cu-Kα1 and Kα2 radiation of wavelength 1.5406 and 1.54438Å. The Scanning electron microscope (SEM) - ZEISS-EVO 18 Research was used to investigate the surface morphology of the samples while the optical properties of the samples were studied using VISIONlite 061408 UV – VIS (1600 series) spectrophotometer. For dielectric studies, ZnO NRs powdered sample was compressed into pellets of 13.01 mm diameter and 0.082 mm thickness by using a very high pressure (5 Ton). The pelletized ZnO NRs was characterized by an alternating current (AC) Impedance Spectroscopy (HIOKI 3532 – 50 LRCHiTESTER model) measurements were obtained in the 40 Hz to 10 MHz frequency range, a constant voltage (1.0V) and different temperatures 100 - 155 °C.

RESULTS AND DISCUSSION

Energy Dispersive X-ray Spectroscopy

Energy dispersive X-ray spectroscopy (EDX) was used for the elemental analysis of the sample. The EDX spectrum in fig.1revealed that only zinc (Zn), and oxygen (O) signals were detected and no other signal of secondary phase or impurity was detected. This implies the high purity chemical composition of the ZnO NRs

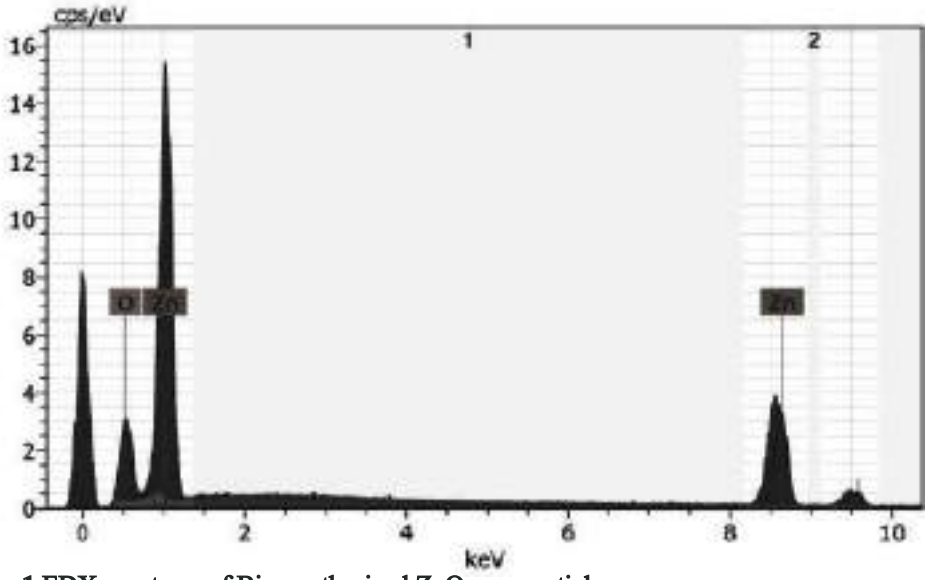


Fig. 1 EDX spectrum of Bio-synthesized ZnO nanoparticles

Fourier Transform Infrared Spectroscopy (FTIR)

The FTIR measurement was carried out using KBr pellet method at room temperature through the wave range 400 - 4000 cm-1 as shown in Fig. 2. This was done to identify the possible biomolecules responsible for capping and stabilization of the bio-synthesized zinc oxide nanoparticles. It is also to indicate the reduction of metal (zinc) ions by the used bacteria. The spectral peaks observed are 871.82 cm^{-1}, 987.55 cm^{-1}, 1097.50 cm^{-1}, 1529.55 cm-1, 1550.77 cm^{-1}, 2358.94 cm^{-1}, 2881.66 cm^{-1}, 3664.75 cm^{-1}, 3701.40 cm^{-1} and 3726.47 cm^{-1}. The stretch for ZnO nanoparticles was at 871 cm^{-1} which was found to be around 860 - 900 cm^{-1} aromatic ring -1,3- distribution of metal. (Coates, 2000, David, 2011). The peak around 925 – 1005cm^{-1} gives C-C vibration from methyne, The peaks around 1050 – 1260cm^{-1}leads to C-O stretching alcohols, carboxylic acids, esters, ethers. Here the C-O stretching alcohols, carboxylic acids, esters, ethers show the peak at 1097.5 cm^{-1}. The peaks between 1485-1555cm^{-1}leads to -C=N- stretch and –NH bend of aromatics nitro compounds. Here, the -C=N- stretch and –NH bend primary amines show peaks at 1529.55 and 1550.77 cm^{-1}. The peak at 2358.94 cm^{-1} indicates aromatic combination bands of methyl group $–CH_3$ and aliphatic nitrile of =C=O. (David, 2011). The peak 2881.66 indicates Sp^3 C-H stretching vibration from aldehydes.

The peaks observed around 3000 - 3700 are at 3664.75, 3701.40 and 3726.47 cm^{-1} leading -OH and -NH stretching for primary, secondary amines, amides. Hence, the FTIR analysis of the bio-synthesized ZnO nanorods confirmed the participation of biological molecules in bio-reduction reactions, formation, capping and stabilization of ZnO nanoparticles.

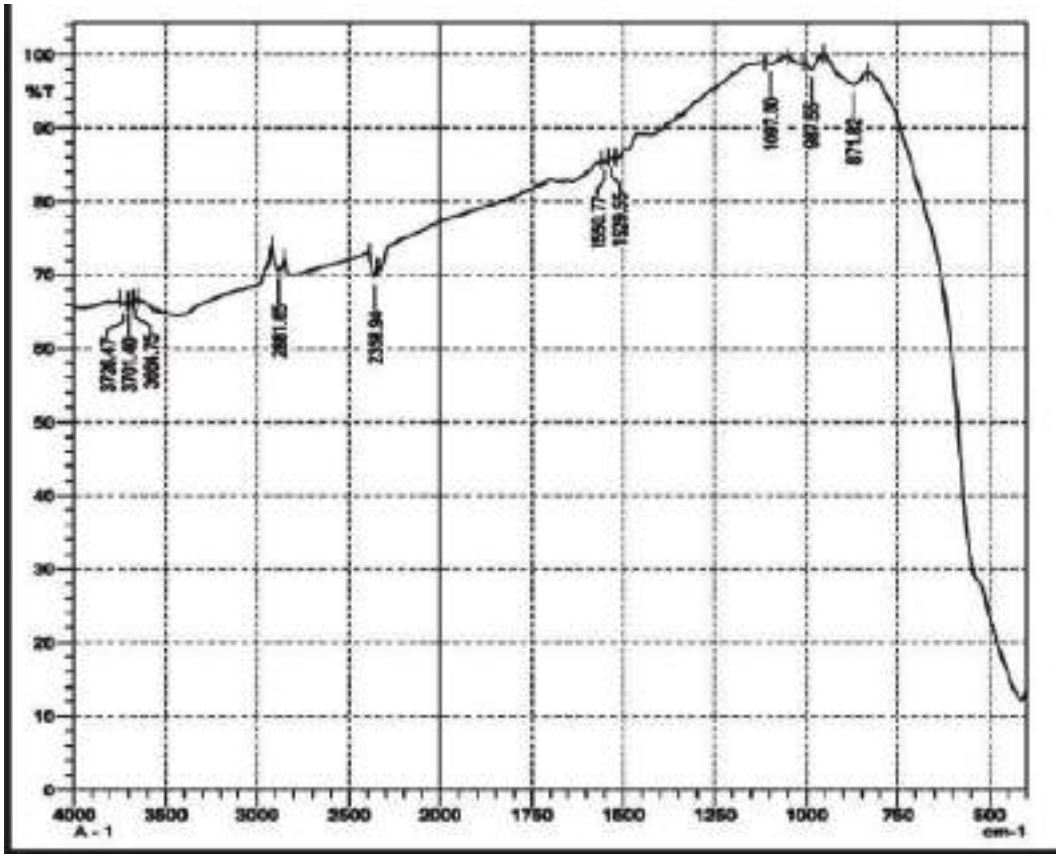


Fig 2. FTIR spectra of ZnO nanoparticles synthesized by biological method

X-Ray Diffraction Analysis

Fig.3 shows the X-ray Diffraction (XRD) pattern of the bio-synthesized ZnO nanorods. The ZnO NRs diffraction peaks shows highly oriented and crystalline structure of zinc oxide nanorods. The sharp and narrow diffraction peak positions with 2θ values of 31.84, 34.50, 36.34, 47.65, 56.73, 63.02, 66.54, 68.12, 69.26, 72.76, 77.16, 81.61, 89.87 were indexed as (100), (002), (101), (102), (110), (103), (200), (112), (201), (004), (202), (104) and (203) hkl crystal planes. The peak intensity profiles were in good agreement with those of powder ZnO obtained from the International Center of Diffraction Data card (JCPDS) card No. 75-0576 (from ICDD 12 Campus Boulevard Newtown Square, PA. 19073-3273). This confirmed the formation of a crystalline hexagonal wurtzite structure of the ZnO NRs. It is also observed that there is no extra diffraction peaks of other phases, which implies its phase purity. The average grain size of the synthesized ZnO NRs was calculated to be 6.67 nm by using Debye-Scherrer's Eq. (1).

$$D = \frac{K\lambda}{\beta Cos\theta}\mathring{A} \quad \text{---------- (1)}$$

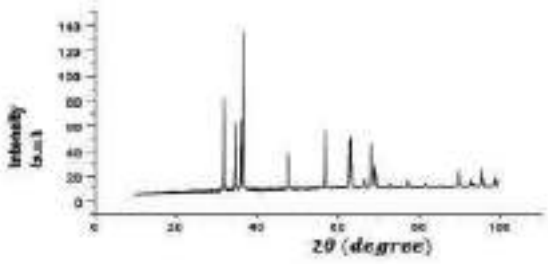


Fig. 3: The XRD Spectral of Bio ZnO NRs

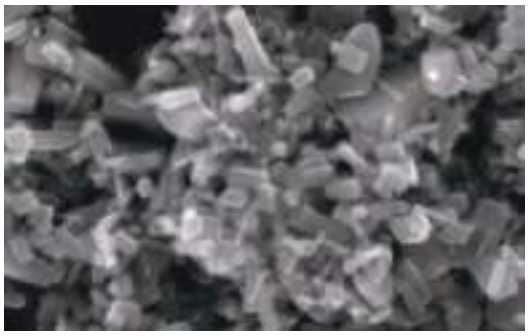


Fig. 4: The SEM Micrograph Image of Bio ZnO NRs

Frequency Domain Responses

The applied ac voltage signal is given by

$$V(t) = V_0 e^{i\omega t} \quad (1)$$

for a single frequency $f = {}^{\omega}/_{2\pi}$. The resulting steady state current in the electrical network is given by

$$I(t) = I_0 e^{(i\omega t + \emptyset)} \quad (2)$$

Where $\omega = 2\pi f$ and $\emptyset$ is the phase angle – phase difference between the applied voltage and the current. The implication of this is that for a purely resistive substance, $\emptyset = 0$ that is $Z(\omega) = Z'(\omega)$. In such case, the impedance is completely independent of frequency. In this IS study, our ZnO NPs proved not completely resistive over a range of frequency as shown by its Cole-Cole plot in Fig.5.

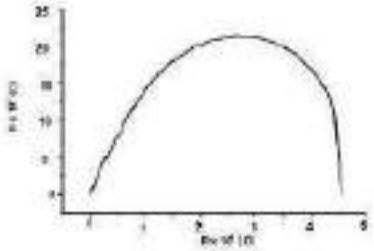


Fig.5. The Cole-Cole plot of bio-synthesized ZnO NPs

This is in support of Kronig-Kramer's relation which connects the real and imaginary parts, ensuring that Z'' and θ cannot be zero over all frequencies (Barsoukov and Macdonald, 2005). The frequency dependent spectroscopic plots of our biosynthesized ZnO NPs are shown in **Fig.6**

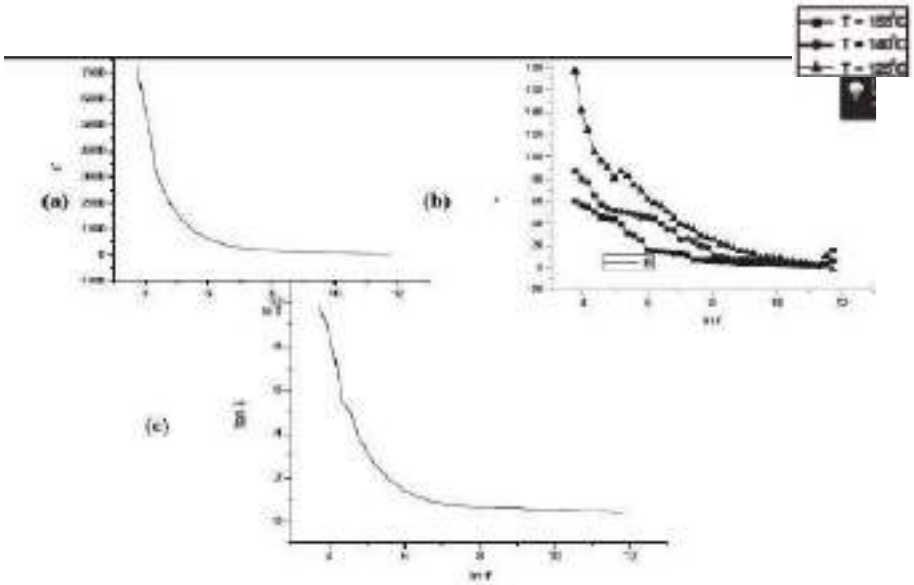


Fig. 6 (a) A plot of Z' against ln f. (b) A plot of Z' at different temperatures against ln f and (c) A plot of tan δ against ln f.

From fig. 6 (a), it is observed that dielectric constant ($Z^{/}$) decreases with increase in frequency (f). The decrease in the value of dielectric constant on increasing frequency may be attributed to a combined contribution due to electronic, ionic, and interfacial polarization. The large value of the dielectric constant $\varepsilon^{/}$ obtained at lower frequencies is caused by the oxygen vacancies, and grain boundary defects. The observed dielectric dispersion at low frequencies can be explained on the basis of the Maxwell-Wagner theory of interfacial polarization (Muhammad et al, 2010, Geethalakshmi et al, 2014).When frequency increases, polarization decreases until it disappears except ionic and electronic polarization, which makes dielectric constant decrease rapidly. (Baljinder, et al. 2016)

The dielectric loss ($Z^{//}$) decreases as frequency increases. When frequency increases, the increase in hopping electrons results in local displacement in the direction of the extent electric field. This leads to an increase in electric polarization and therefore aids dielectric loss. (Hassouna et al. 2012, Aparna, et al. 2016)

The behaviour of tangent of dielectric loss angle (Tan δ) as a function of frequency for ZnO NRs is shown in fig. 6(c). For this sample, Tan δ is also observed to be decreasing with increasing frequency. This occurred when the jumping rate of charge carriers lags behind the alternating electric field beyond a certain critical frequency. At low frequencies, more energy is required for electron transfer or ion exchange, while small energy is required at high frequency for ion exchange. Low dielectric losses are desirable being the energy dissipation in the dielectric system. (Muhammad, et al. 2009)

A.C. Conductivity and Time Domain Responses

In the time domain, the relationship between the properties of the material sample and response to alternating voltage $v(t)$ or current $i(t)$ is complex. Evgenij and Macdonald (2005) established that response of capacitive element is

$$i(t) = \left(\frac{dv(t)}{dt}\right)C \qquad \text{(where C is the capacitance of the material sample)} \quad (3)$$

That of inductive element is

$$v(t) = \left(\frac{di(t)}{dt}\right)L \quad \text{(where L is the inductance of the material sample)} \quad (4)$$

The equations transform into

$$I(j\omega) = C.\omega.j.v(j\omega)$$

$$I(j\omega) = -\frac{v(j\omega)}{L.\omega.j} \quad \{j = square\ root\ (-)\}$$

$$\text{Thus, } v(j\omega) = V_m\pi$$

$$I(j\omega) = I_m\pi.\exp(\theta j)$$

This is a form of Ohm's law

$$I(j\omega) = -\frac{V(j\omega)}{Z\,(j\omega)}$$

For capacitance,

$$Z(j\omega) = -\frac{1}{(c.\omega.j)} \qquad (5)$$

For inductance,

$$Z(j\omega) = L.\omega.j \qquad (6)$$

The complex quantity $Z(j\omega)$ is the impedance function. From Fourier Transform,

$$Z(j\omega) = -\frac{F[V(t)]}{F[i(t)]}$$

Thus the complex number, $Z = a + jb$

$j \equiv \sqrt{-} \equiv \exp\left[\frac{i\pi}{2}\right]$

The impedance vector is $Z(\omega) = Z^{/} + Z^{//}$

The relaxation time also called time constant, τ, of a 'parallel *RC* element' is given by

$$\tau = RC$$

At maximum frequency,

$$\omega_{max} RC = 1$$

The Cole–Cole plot shown in fig.5 confirms the distribution of relaxation time. Also, the periodic conductivity σ in our ZnONRs is observed to increase with increasing frequency. The relaxation is equally observed in the whole frequency range as a gradual increase in conductivity with increasing frequency as shown in fig. 7. This is supported by the report of Tripathi, et al. 2009 and Ziaul, et al. 2011.

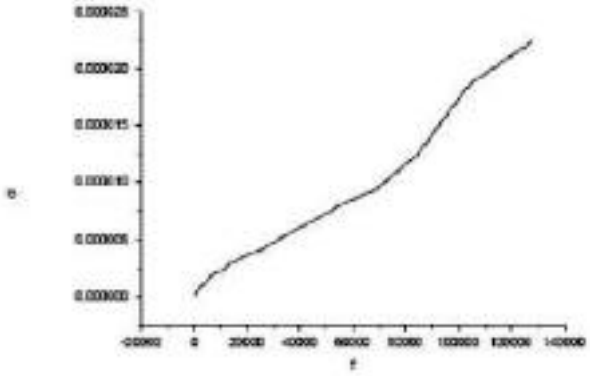


Fig 7 A plot of electrical conductivity against frequency

Impedance Domain

Impedance is defined as a complex quantity which is only real at $\theta = 0$ and therefore, $Z(\omega) = Z^{/}(\omega)$ for a purely resistive behavior.

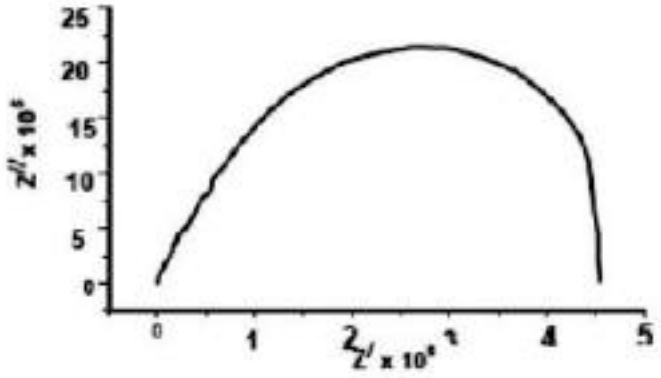
$$Z(\omega) = |Z|\exp(-i\emptyset)$$

$$Z(\omega) = |Z|cos\emptyset - i|Z|stn\emptyset$$

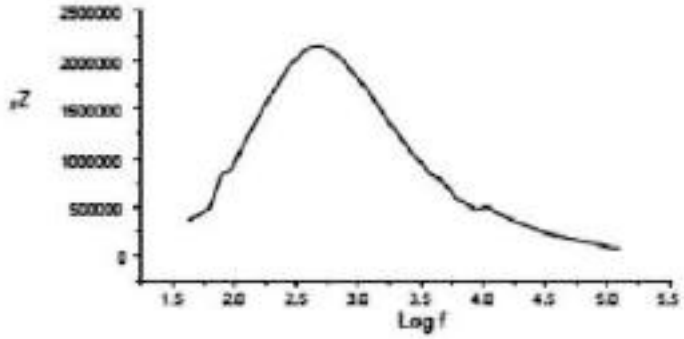
$$Z(\omega) = z^{/}(\omega) - iZ^{//}(\omega)$$

$Z^{/}$ is the real while $Z^{//}$ is the imaginary part of the complex impedance. It is only when $Z(\omega) = z^{/}(\omega)$ that $Z^{/} = R$ which is an ordinary linear resistance, that $Z(\omega)$ is purely real. Here, the relaxation time is given by $\tau = RC$ Where at maximum frequency of loss, $\omega_{max} RC = 1$

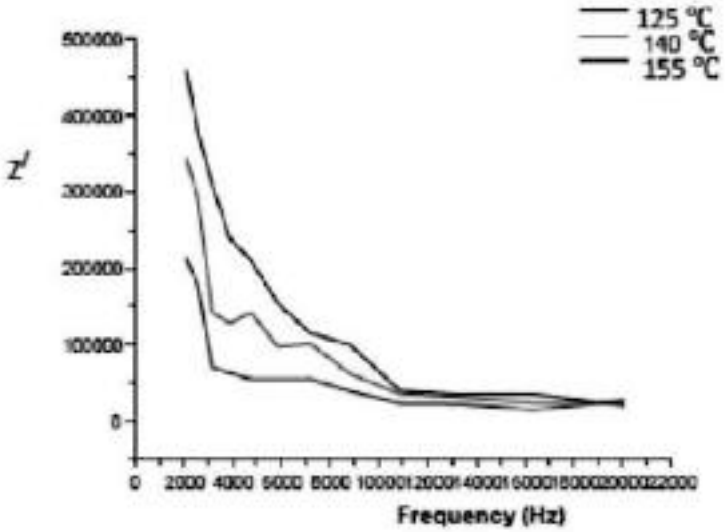
These impedance responses help to give information on the nature of the conducting species, within the sample itself and whether conduction is by ions or electrons. (John, *et al.* 2009).The spectroscopic plots of some impedance responses of the ZnO NRs are shown in **Fig.4**



(a)



(b)



(c)

Fig.8 (a) Imaginary impedance Z'' versus real impedance Z' (b) Imaginary impedance Z'' versus log f (c) Variation of real part of impedance of ZnONRs with frequency at different temperatures.

From fig. 8 (a) the imaginary Impedance, Z'' plotted against real Z' shows a semicircle from which the resistance R and capacitance C values may be obtained. The intercepts on the Z' axis give the value of R, while the value of C can be calculated by applying equation $\omega_{max} RC = 1$ to the frequency at the peak of the semicircle. In this sample – ZnO NRs, the value of the resistance is 4.125 (MΩ) as shown in the characteristic graph Fig. 5. The capacitance value is calculated to be 7.79 x 10^{-11} or 0.78 p^F. This value is for the bulk capacitance of a sample. Hence, this may be interpreted in terms of the bulk response of the sample and a single parallel R*C* element. There is no 'electrode spike' in the curve at low frequency. Therefore, there was no impedance barrier to charge transfer between the metal electrode and the sample, so the conducting species were electrons. (John, et al. 1990; Ziaul, et al. 2011)

The variation of the real part of impedance Z with frequency at different temperatures is shown in **fig. 8 (c).** The curves show that Z' becomes independent' value of about 50,000 (add units). In particular, at 155o, Z' decreased most rapidly from 200,000 to 50,000 (add units) between corresponding frequencies of about 2000 Hz to 3000 Hz (Tripathi, et al. 2009, Baljinder, et al. 2016).

CONCLUSION

In this study, zinc oxide nanoparticles have been successfully synthesized by co-precipitation and bacterial inoculation. The crystallite size of the ZnO NRs was calculated to be 6.7 nm by using Debye-Scherrer's formula. The SEM and XRD spectrum confirmed the formation of a crystalline hexagonal wurtzite structure of the ZnO NPs while the EDX spectrum revealed its purity. It is observed that dielectric constant (Z') decreases with increase in frequency (f), indicating its enhancement by polarization due to oxygen vacancy. Dielectric loss (Z'') reduced drastically in this sample which makes it desirable for applications as inductive and capacitive materials as well as microwave absorbers. The alternating current (a.c.) conductivity (σ) increases with increase in frequency as well as increase in temperature. This shows that hopping electrons are responsible for electronic polarization in the biosynthesized ZnO NPs. The relaxation is observed as an increase in conductivity as frequency increases within the whole range of frequency.

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REFERENCES

Amrut S. Lanje, Satish J. Sharma, Raghumani S. Ningthoujam, Ramchandra B. Pode (2013): "Low temperature dielectric studies of zinc oxide (ZnO) nanoparticles prepared by precipitation method" Advanced Powder Technology 24(1):331–335

Aparna, P. U. Divya N. K., Pradyumnan P. P. (2016): "Structural and Dielectric Studies of Gd Doped ZnO Nanocrystals at Room Temperature". Journal of Materials Science and Chemical Engineering, 4, 79-88

Baljinder Kaur, Lakhbir Singh, V. Annapu Reddy , Dae-Yong Jeong, Navneet Dabra, Jasbir S. Hundal (2016): "AC Impedance Spectroscopy, Conductivity and Optical Studies of Sr doped Bismuth Ferrite Nanocomposites". Int. J. Electrochem. Sci., 11 4120 – 4135

Coates J. (2000): "Interpretation of Infrared Spectral, A practical approach in Encyclopedia of JABU Journal of Science and Technology (2019, Vol 4:4) Analytical Chemistry" – R.A. Meyers (Ed) O John Wiley and Sons Ltd., pp 10815-10837.

Cullity, B.D. (1978): "The Elements of X-Ray Diffraction". Addison-Wesley, p.102.

David Cameron (2011): "Baltic Sea Region programme" Advanced Surface technology Research Laboratory (ASTRaL) University of

Lappeenranta Finland

Evgenij Barsoukov, J. Ross Macdonald (2005): "Impedance Spectroscopy: Theory, Experiment, and Applications" 2nd Edition, John Wiley & Sons, Inc.:Hoboken, NJ. ISBN 0471-64749-7.

Geethalakshmi, K., Prabhakaran T. and Hemalatha J. (2012): "Dielectric Studies on Nano Zirconium Dioxide Synthesized through Co-Precipitation Process". Materials and Metallurgical Engineering Vol:6, No:4, 2012

Hassouna Dhaouadi, Ouassim Ghodbane, Faouzi Hosni, and Fathi Touati (2012): "Mn3O4 Nanoparticles: Synthesis, Characterization, and Dielectric Properties." HINDAWI.ISRN Spectroscopy Volume 2012, Article ID 706398, 8 pages

John T. Irvine S., Derek C. Sinclair, and Anthony R. (2009): "West Electroceramics: Characterization by Impedance Spectroscopy" P RAMANA © Indian Academy of Sciences journal physics. Vol. 72, No. 6 pp. 969–978

Lanje A. S. , Sharma S. J., Pode, R. B. and Ningthoujam R. S. (2010): "Dielectric study of Tin oxide nanoparticles at low temperature". Applied Science Research, 2010, 2 (2): 127-135

Latif I., Entisar E. AL-Abodi, Dhefaf H. Badri, Jawad Al Khafagi (2012): "Preparation, Characterization and Electrical Study of (Carboxymethylated Polyvinyl Alcohol/ZnO) Nanocomposites" American Journal of Polymer Science 2(6): 135-140

Muhammad NaeemAshiqa, Muhammad Javed Iqbalb, Iftikhar Hussain Gulc (2010): "Structural, magnetic and dielectric properties of Zr–Cd substituted strontium hexaferrite (SrFe12O19) nanoparticles" Journal of Alloys and Compounds. Vol. 487, pp 341-345.

Tripathi R. A Kumar, and Sinha T P (2009): "Dielectric properties of CdS nanoparticles synthesized by soft chemical route". PRAMANA °c Indian Academy of Sciences Vol. 72, No. 6

Ziaul Raza Khan, M. Zulfequar, Mohd. Shahid Khan (2011): Chemical synthesis of CdS nanoparticles and their optical and dielectric studies. J Mater Sci 46:5412–5416

Developing an Integrated Portal Management System for Artisans and Technicians in Nigeria: A Prototype System Development Approach

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ABSTRACT

Artisans and technicians play critical roles in major economies of the world. Unfortunately, Nigeria as a developing economy has fallen short in tapping into this large group of professionals in her desire to drive infrastructural and economic development through job and wealth creation. Coincidentally too, there is an absence of information on technicians and artisans in Nigeria as they hang around different parts of cities and rural areas in search for job while potential employers look for them. Through a rapid prototyping methodology, this study developed a web based information system for technicians and artisans in Nigeria using Nyanya area in the Federal Capital Territory as a pilot. The interfaces are user-friendly and simple. Built using PHP and MySQL database management system, the portal have supports for technicians and artisans' registration, job poster advertisement, interfaces for searching and applying for available jobs. It equally provide prospective customers access to a database of skilled personnel for specific need based on location, qualification, specialization, relevant experience and other criteria as the case may be.

Keywords: Portal, *Information system, artisans, craftsmen, technician, prototype.*

INTRODUCTION

Technicians and artisans also referred to as handymen or craftsmen have been in existence from time immemorial. They are responsible for the creation or crafting of quality items for either household or industrial use. These professional groups have been identified to have had a sizable contribution to the technological and industrial advancement of countries and make up a global economy averaging $32 billion.

In Nigeria the informal sector which makes up an estimated 30% of the populace is largely made up of technicians and artisans. This professional group is made up of a heterogeneous mix of disciplines which possess skills developed either via informal learning such as apprenticeship or by undergoing formal vocational or technical trainings in various public and private institutions.

The economic slowdown which necessitated a drive by the Nigerian government for infrastructural development and advances in Information technology necessitates the identification and registration of technicians and artisans to aid in the identification of available skillset and skill shortages.

The advances in Information Technology and rapid changes in the work environment has also lead to the appearance of new skillsets which have become critical to economic development leading to a widening gap in skillset supply and demand.

Unfortunately, there is a complete absence of an integrated information system that serves as database for the supply and demand of the artisans and technicians in Nigeria. The search for qualified labour force is usually through the referral system. This approach is time consuming, risky and provides insufficient options for the selection of qualified and competent professionals for specialized tasks.

In the Federal Capital Territory and in most towns in Nigeria, artisans converge on daily basis in certain locations, waste useful hours waiting for prospective employers in different unorganized ways. Identifying available skillsets and implementing skill acquisition and vocational training programs has been close to impossible due to the absence of centralized and detailed information on artisans. Efforts by government agencies are often targeted at the formal sectors of the economy often leaving the informal sector despite their critical nature and contributions to national gross domestic product.

This work developed a web-based technician and artisan's registration and information system. The developed system would serve as a centralized location for electronically accessible information for skilled technicians and artisans, their employers and the government in Nigeria. The system would provide a user-friendly interface for technician and artisan registration, credential verification and also serve as a reliable source of information for the general public on availability of skilled and verified technicians and artisans.

RELATED WORKS

Research by (Palei, 2015) and (Nedozi, Obasanmi, & Ighata, 2014) established the importance of infrastructure to economic development. Although Infrastructure is not the main indicator of economic development, it is one of the tools for regional development, as it affects directly or indirectly, socio-economic activities and creates the necessary conditions for achieving economic growth and development.

Artisans and technicians play a critical role in industry and, therefore, in facilitating infrastructure development and economic growth. As stated in (Artisan Alliance, n.d.) and (The Artisan As An Engine Of Economic Growth, 2015), the artisan economy is the second largest employer of labor after agriculture with an average annual earnings of approximately $32 billion. If it were a country it would have the fourth largest economy in the world, with the fourth-largest workforce. As explained by The Former U.S. Secretary of State John Kerry. While speaking at a forum at the State Department about the impact that artisans have on communities and on the global economy, artisans are widely acknowledged as an engine for poverty reduction and economic development (Foote, 2015).

Artisanal Training in precolonial times involved the transfer of skills through apprenticeship system. New entrants into the systems were accepted based on personal relationships including kinship, friendship and philanthropy, this is still obtainable today (Osasona 2005).

Various departments of the Federal Civil Services by setting up training schools initiated the formal capacity development of skilled workers. Training programs provided by these schools, while been tailored to the needs of the departments were also run by the departments that established them including among others Public Works, Post and Telegraphs Department, and Nigerian Railways. In a bid to make the training programs offered by some of the civil service departments more economical, The Yaba Technical Institute was established in 1948. Thereafter, Yaba College of Technology, Kaduna Polytechnic, Auchi Polytechnic, The Polytechnic, Ibadan among others were established, this was acting upon a recommendation for the expansion and upgrade of the Technical Institutes by The Ashby Commission in 1959.

Worried by the high rate of youth employment, the Presidency in 2006 in a bid to redirect the youths to technical and entrepreneurial skills for self-employment,

introduced through the NBTE, the inclusion of compulsory entrepreneurship education in all the polytechnics and monotechnics. Under this scheme students are made to undergo in addition to core technical courses of study, training in any other skill. This is expected to produce enough high-quality technical skills needed in the country if the students enroll in the skills that are essential for economic and social development in the country. (Esene, 2015)

Other youth empowerment programs Introduced by the government which have been designed as short term technical and vocational skills programs include; carpentry, iron bending, furniture youth training programs established by The National Directorate of Employment, National Poverty Alleviation Programme (NAPEP), National Youth Service Corps (NYSC), Industrial Training Fund (ITF) amongst others. These are programs with the objectives of providing the teeming population of youths with opportunities to acquire marketable and applied skills outside the school system (Gumbari, 2009).

All these programs have unfortunately been plagued with inability to make any significant impact, because these programs have been marred by high levels of corruption and politicization, they have failed consistently to meet the objectives set from inception. Little progress has also been made in the formal technical educational sector. As at 2012, there were only 159 recognized Technical Colleges in the country made up of 19 Federal, 137 State and 3 Private with a total enrolment of 92,216 as against 610,000 in secondary schools. As observed by (Gumbari, 2009), most of these technical colleges which are over twenty-nine years in age are made up of technical laboratories and workshops that are mostly ill-equipped and incapable of providing the requisite traying for the rapidly increasing population. There are 140 polytechnics/monotechnics to date, producing about 32,292 diplomats.

Due to the introduction of non-technical programs in the polytechnics / monotechnics, a high percentage (over 60%) of students who eventually graduate major in the Humanities and the Social Sciences (Gasper, 2011). The has ultimately led to slow industrialization which is caused by the dearth of artisans in the economy arising inability of these institutions to provide the much-needed high-quality technical skills (Okereocha, 2017).

Responding to this dearth of artisans, various state government and private organizations have initiated programs to breach the gap, such as the Lagos state annual training and retraining of artisans which make up more than half of jobs and business opportunities in the State (Bello, 2016), (Essiet, 2017), (The Vanguard, 2018) and the Dangote Group plan to spend about ₦30billion in the next five years in training 500,000 artisans in the construction industry (Gbonegun, 2018).

Different countries have put in place different techniques aimed at identifying and collating information regarding specific skillsets in their climes.

In the United State of America, there exist a sophisticated dataset and statistical infrastructural institutional design of labour market information systems (Sparreboom 1999). With this infrastructure, the government is able to have first-hand information on the number of Americans who are out of job at any given time, their qualifications, specialties, location etc.

In the Netherlands, deliberate policies have been put in place to identify and control the labour market. The system ensures that government institutions present only courses with sufficient opportunity for gainful employment. Courses are tied to workplaces. Through internship programmes, students identify and access prospective workplaces where their career progresses after graduation. In that country, the up-to-date labour related information including qualification structure, guidance for vocational labour force, regional policies are developed by the Netherland's National Centres for Expertise (Cras 2011).

The approach is different in New Zealand as reported by Baker (2011). Information JABU Journal of Science and Technology (2019, Vol 4:4) is accessed from official statistics like census. Consequently, census is carried out every five years to ensure accuracy. Household Labour Force Survey (HLFS) takes place quarterly to act as additional data gathering avenues. The organ of government responsible for compiling official statistics, present the report in tables and chart for use by the Industry Training Organisations is the IndustryTraining Federation in New Zealand. Australia employs multidimensional techniques. These include structured on-line telephone surveys, interactions with companies, focus group discussions, feedback which emanates from registers of industry skills councils, government planning information etc. Information accessed through these techniques is used in initiatives associated with workforce development, determination of skill shortage, provision of country-wide database and serves the need of labour market Paton (2011).

In 2009, India developed a labour market information system. The portal was built by collating information from government agencies and developing a model suitable to integrate all the data. Sector skill councils were required to build a portal that links all stakeholders in order to have an integrated system that cut across different sectors, ministries, states, sector skills among others Chenoy (2011).

In Canada the sector councils are responsible for tracking information on their labour market on a sector by sector basis using different techniques. While some councils adopt macroeconomic models, other make use of committees comprising of government stakeholders as well as the industry. Systems that make use of surveys, interviews for employers of labour and educational institutions are already in place. Some council carries out sector studies and other types of intelligence Cardozo (2011).

In South Africa, the development of frameworks for standardization and cooperation as it concerns the demand and supply of skill labour as well as the development of the development of systems and system interfaces had been put in place Roodt (2012).

From the forgoing, there is an absence of an artisan and technicians information system hence the gap.

MATERIALS AND METHODS

This work adopted the prototyping approach. The approach entails interactions with the intended users of application and the researcher. The users of the application software were involved in the development process of the application by making contributions to the requirements, specification document and prototype presented to their umbrella association leadership in such an iterative manner until the final application emerged. The more times the validation of the application takes place, the more the proof-of-concept becomes the final application. To ensure the information system is accessible to end users and to verify its functionality, a working copy of the information system was hosted temporarily on an online website "http://enigma.com.ng/taris" and feedback collected from test users. The rationale for the selection of the rapid prototype model is its support for early gathering of clients feedback, functionality, avoidance of re-design cost as well as the focus on the end product instead of its evolution,

HTML and PHP were used for the design of the Web Application. Oracle MySQL was selected as the database management system, due to its seamless integration with PHP. A database named "taris" was created and tables for the various entities of the information system were equally created as shown in Table 1.

Table 1: Database Objects Created

Object	Type	Description
admin	Table	Stores details about system administrators
User	Table	Stores records about Technicians and Artisans
company	Table	Stores records about job-posters (companies)
State	Table	Provides a list of States in Nigeria
Lga	Table	Provides a list of Local Government areas in Nigeria
Area	Table	Provides a list of Districts or Area in Nigeria
qualification	Table	Provides a list of Qualifications related to Technicians and Artisans in Nigeria
discipline	Table	Provides a list of disciplines related to Technicians and Artisans in Nigeria
specialty	Table	Provides a list of
		Specialties related to Technicians and Artisans in Nigeria
job_post	Table	Stores records of job posts created by the Job posters.
apply_job_post	Table	Stores records of jobs that have been applied for.
mailbox	Table	Stores mailbox for mails created by Technicians and Artisans
reply_mailbox	Table	Stores mailbox for mails replied to by Job posters.
vjob_post	View	A view created to join records from job_post and company tables

System Design

The Database Entity Relationship Model diagrams are shown in figures 1 and 2.

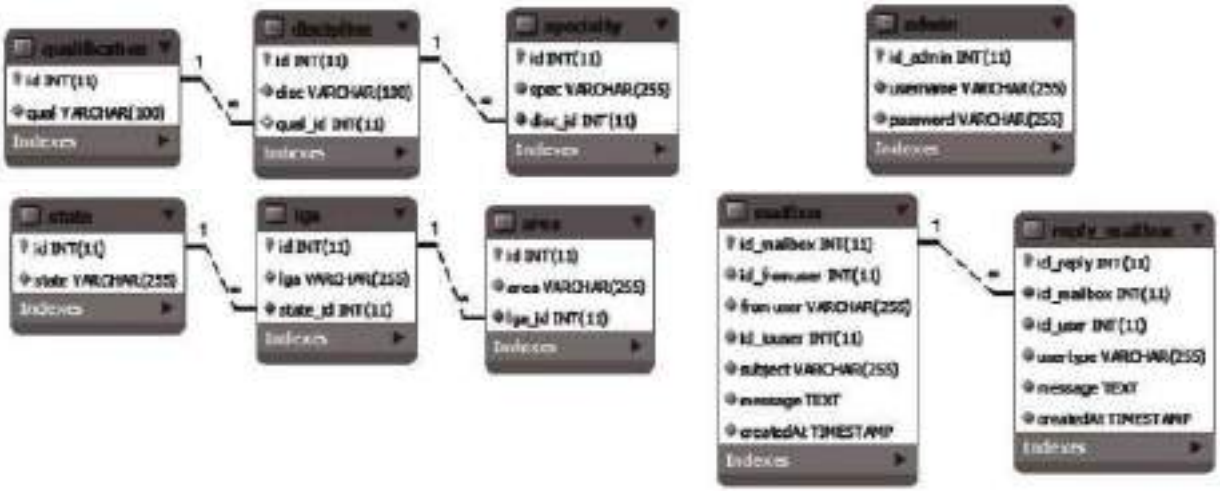

Figure 1: Database Entity Relationship Model diagrams

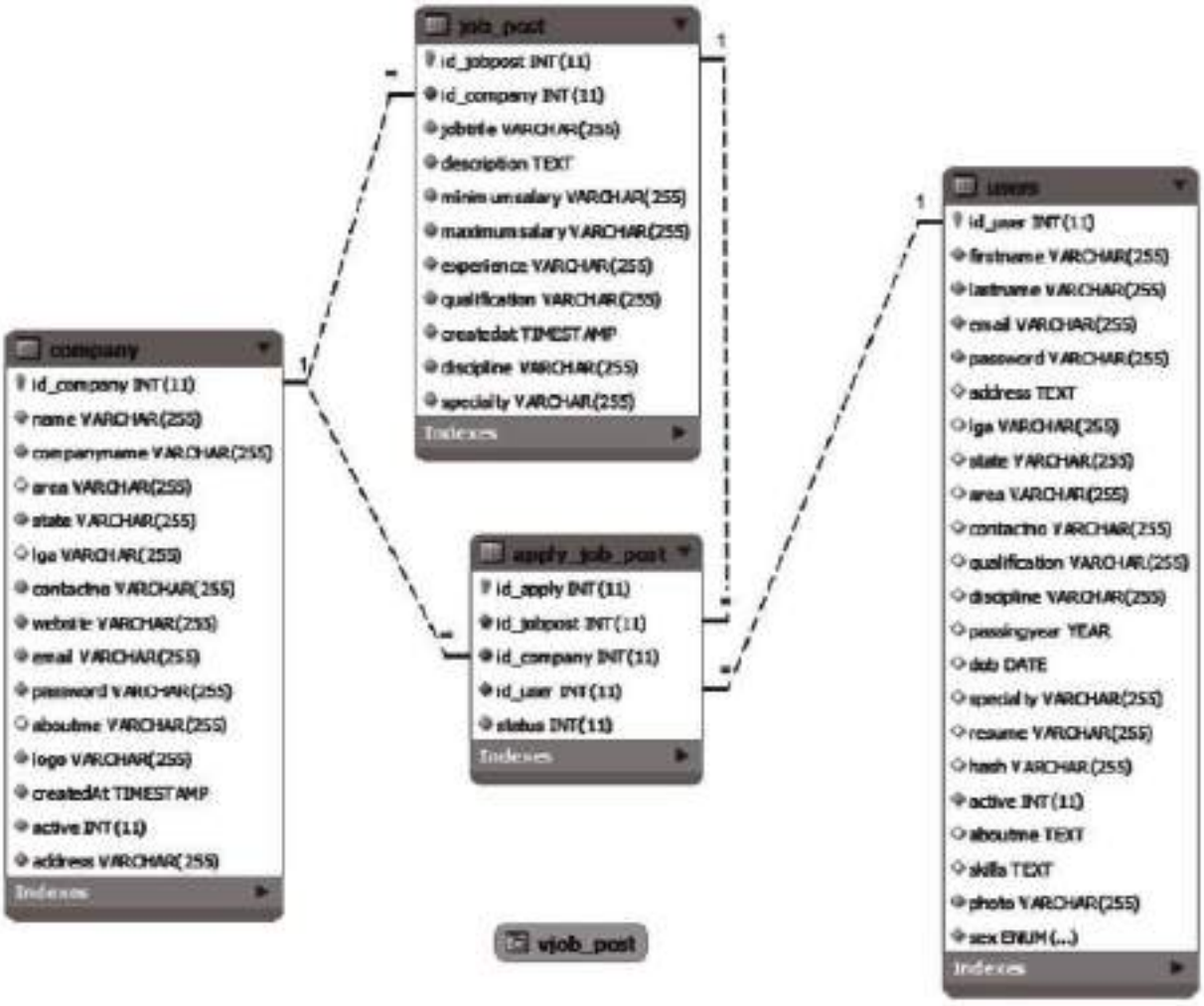

Figure 2: Database Entity Relationship Model diagrams

Modules and Interfaces

Six broad categories of modules were designed for this information system with several submodules. These are listed thus:

i. Authentication Management Module
ii. Registration / Signup Module
iii. Technicians and Artisans Information Module
iv. Job Poster Information Module
v. Administrative Module
vi. Search module

The Technicians and Artisans Information Systems being a web-based information system can either be deployed on premises on owned severs or hosted online on commercial hosting platforms. The System software and hardware requirements would therefore be determined by the platform of choice. Notwithstanding, there are certain minimum requirements for effective and efficient functioning of the system which have been identified below.

The Server Systems would have the following minimum requirements as shown in Table 2 while the client system's requirements are stated in Table 3.

Table 2: Server System Minimum Requirement

Table 2: Server System Minimum Requirement

Item	Recommended Minimum
Memory	4GB RAM or Higher
Processor	2.4 GHz (32 or 64 bit)
Storage	200GB Storage for Database and Application Files
Network	100Mbps Ethernet or

Table 3: Client System Minimum Requirement

Item	Recommended Minimum
Memory	4GB RAM or Higher for PCs and Laptops 1GB RAM or Higher for Mobile Devices
Processor	2.4 GHz (32 or 64 bit)
Network	High Speed Network Connectivity. Local Area Network for On premises hosting and Internet for Online hosting

TARIS is a web-based Information system which was designed using PHP (PHP: Hypertext Preprocessor). Table 3 provides a summary of the server software requirements for the two main operating systems used for hosting PHP based web applications.

Table 4: Server Software Minimum Requirement

Operating System	Software Requirement
Windows	Internet Information Services (IIS 7.0) with the PHP 5.6 installed using the Web Platform Installer and MySQL OR WAMMP Server Application
Linux	Apache Server running PHP 5.0 or higher with MySQL Support

The only software required by client devices to connect to the System is any compatible web browser that supports HTML5.

RESULTS

Snapshots of the implemented system are presented in figures 3 to figures 11:

Figure 3: Admin: Login Page

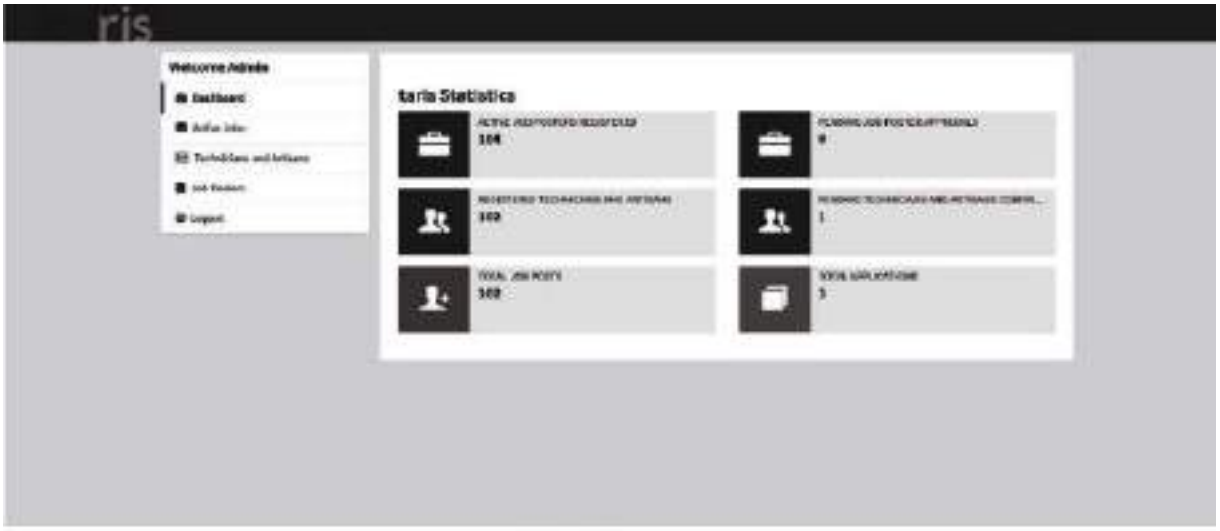

Figure 4: Admin: Dashboard

Figure 5 Admin: Technician & Artisans Database

Figure 6: Technician & Artisan Registration /Signup

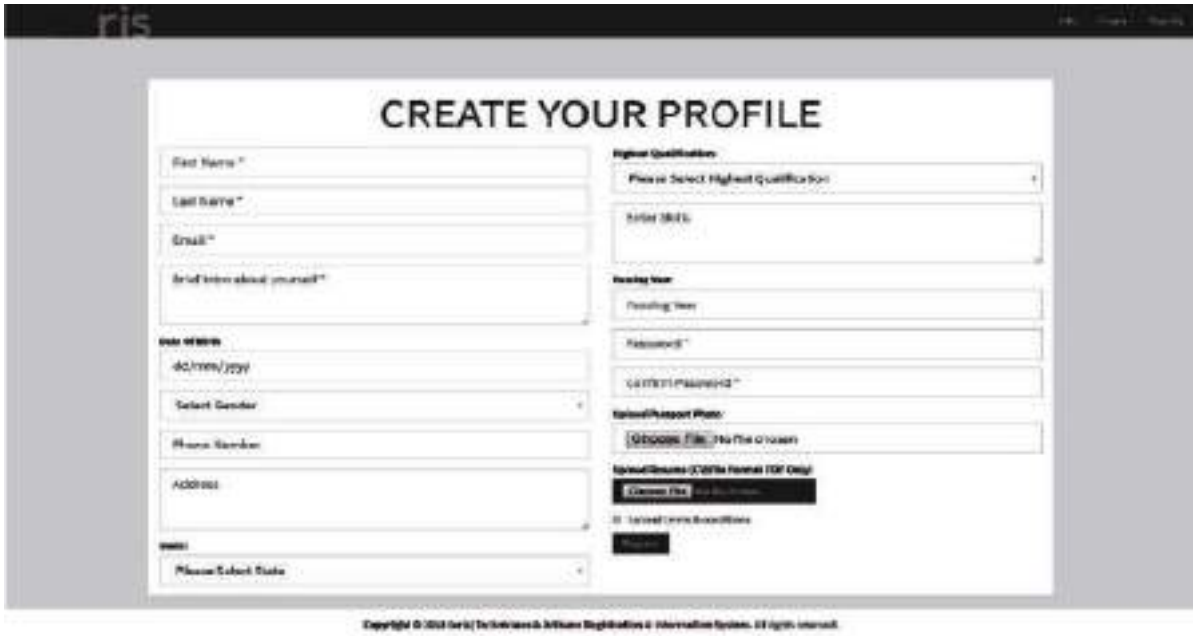

Figure 7: Blank Technician & Artisan Signup Page

Figure 8: Job advertisement

Figure 9: Technicians, Artisans and Job Poster Information Section

Figure 10: View Technician & Artisan Profile

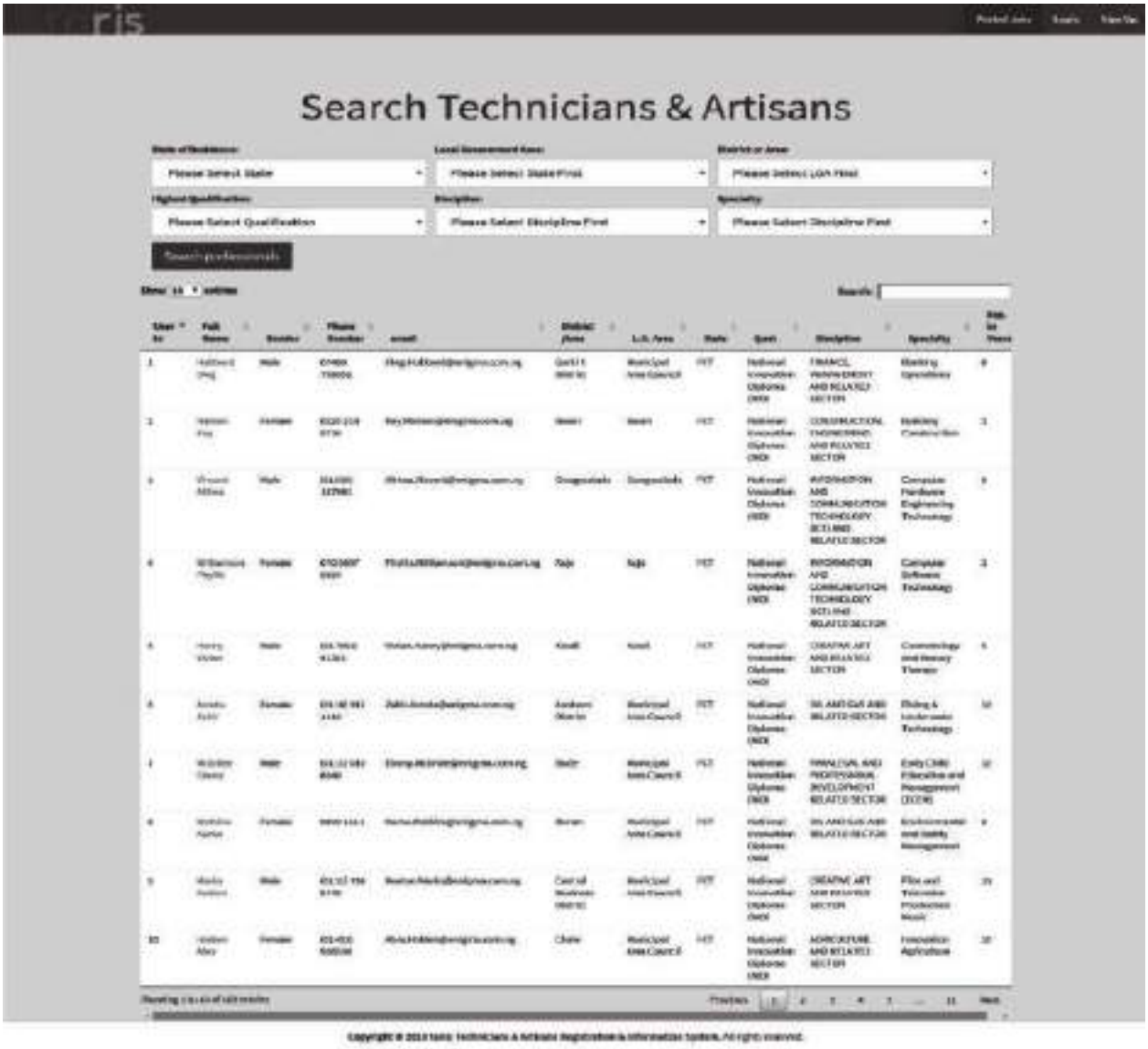

Figure 11: Search Technicians & Artisans Page

DISCUSSIONS

This work identified the role of technician and artisans in infrastructural development and economic growth, and went further to develop an information system for the identification and registration of Technicians and Artisans named TARIS. This system would be useful in aiding the identification of available skillsets in various locations of the country. It would also serve as an authoritative source of information for developing capacity building and training initiative in line with both the Federal Government and various State Governments drive for economic growth through industrialization and youth empowerment.

TARIS would provide the following facilities to professionals (technicians and artisans), the Job Posters', researchers and the government.

Centralization of Data: With the current situation of an almost total lack of information of skilled technicians and artisans in Nigeria,

when fully implemented the system would serve as the "go-to" portal for information on availability, competency and experience of technicians and artisans in Nigeria thereby providing the necessary public and private agencies and the general public with reliable information of technicians and artisans based in different locations of the country. This can also be used by relevant agencies for technical education in determining skillset availability and shortage levels when designing and implementing skills acquisition and vocational or technical training programs.

Identification of Technicians and Artisans based on Location: The system provides a user-friendly interface for Technician and Artisan Registration. It would also serve as a reliable source of identification of available skillset per location by simply assessing the portal, viewing and selecting the need skills at any given time and location. Such database must be regularly populated and updated regularly to ensure accuracy of information.

Improved quality of service: The implementation of technicians and artisan's registration and information system will help improve the quality of service provided by the technicians and artisans. Artisans registered on the system are rated by verified clients for whom they have work and ranked based on their average percentage rating, and number of jobs successfully completed.

Job Board: The System also serves as a job board where job posters and companies can post vacancies and get qualified professionals to fill such vacancies.

ICT Researchers: The existence and usage of such an information system by both customers and the skilled workforce would showcase ICT as playing a pivotal role in the identification and utilization of skilled resources within an economy. Centralized collection and management of skillset offers researchers the opportunity to study trends, analytics and evaluation of interactions among workers and how such interactions has resulted to economic growth and development..

Government: The creation and management of such an information system offers the government the opportunity to understand the professional competencies of artisans in both the formal and informal sectors of the economy. This to a large extent can serve as the framework for relevant policy direction and best ways of harnessing and channeling of such skillset to achieve national growth and development.

CONCLUSION

Technicians and Artisans Information system was designed in response to an almost lack of information on Technicians and Artisans in the country. Although various associations of artisans and technicians have in the past attempted to identify their members, this Information system is a single centralized tool for Technician and Artisan Registration. Its implementation would not only serves the artisans and technicians but also provide the general populace with a means of interfacing with professionals in their various localities.

Future Research

Future research should evaluate the performance of the implemented system with the view to making comparison between results of the designed system vis-à-vis the

existing system. Analysis of the designed system can also be carried out with a view to recommending features that would result to increased usability, performance impacts and higher rates of employments especially in developing economies.

REFERENCES

Artisan Alliance. (2018). ARTISAN ALLIANCE Support for the world's most untapped start-upcommunity. Retrieved April 12, 2018, from Artisan Alliance: http://www.artisanalliance.org/

Artisan. (2018). Retrieved July 10, 2018, from Merriam-Webster.com, Merriam-Webster: www.merriam webster.com/dictionary/artisan

Baker, J. (2011) New Zealand: Industry Training Federation. In International Network of Sector Skills Organisations (INSSO), International Perspectives on Labour Market Intelligence. A development for INSSO by funding member, The Alliance of Sector Councils, Canada.

Bello, U. A. (2016). NIOB to certify artisans. Retrieved from Daily Trust: Retrieved March 10, 2018 from https://www.dailytrust.com.ng/news/property/niob-to-certify-artisans/146838.html

Cardozo, A. (2011). Canada: The Alliance of Sector Councils. In INSSO, International Perspectives on Labour Market Intelligence. A development for INSSO by funding member, The Alliance of Sector Councils, Canada.

Chenoy, D. (2011) India: National Skill Development Corporation. In INSSO, International Perspectives on Labour Market Intelligence. A development for INSSO by funding member, The Alliance of Sector Councils, Canada.

Cras, P. (2011) Nederland: Colo and Kennicentrum. In INSSO, International Perspectives on Labour Market Intelligence. A development for INSSO by funding member, The Alliance of Sector Councils, Canada

Esene, D. R. (2015). Implementation of entrepreneurship development education curriculum of polytechnic education towards unemployment reduction among graduates of office technology and management in the Nigerian south-south zone. European Journal of Research and Reflection in Management Sciences, 3(1), 33-45.

Essiet, D. (2017). Empowering artisans to spur economic growth. Retrieved from The Nation Nigeria: http://thenationonlineng.net/empowering-artisans-spur-economic-growth/

Foote, W. (2015). Tapping the Potential of The Artisan Economy. Retrieved from

Forbes:https://www.forbes.com/sites/willyfoote/2015/09/29/tapping-the potential-of-the-worlds-fourth largest-economy/#20a81021aa28

Gasper, O. A. (2011). Entrepreneurial Polytechnic: A Catalyst for Nigeria's Attainment of Vision 20:2020. Convocation Lecture delivered at the Federal Polytechnic. Ado Ekiti.

Gbonegun, V. (2018). Dangote plans N30 billion institute for local artisans. Retrieved from The Guardian Nigeria:https://guardian.ng/property/dangote-plans-n30-billion-institute-for-local-artisans/

Gumbari, J. (2009). The Importance of Skills Acquisition: Challenge to Nigerians. Legislative Digest, 1(2), 62.

Nedozi, F. O., Obasanmi, J. O., & Ighata, J. A. (2014). Infrastructural Development and Economic Growth in Nigeria: Using Simultaneous Equation. Journal of Economics, 5(3), 325-332.

Nwanoruo, C. C. (2004). Towards the Improvement of Informal Apprenticeship Scheme for Self-reliance in Nigeria. Journal of Technology and Education in Nigeria, 9(1), 65-70.

Okereocha, C. (2017). How Dearth of skilled artisans hurts industrialization. Retrieved from The Nation: http://thenationonlineng.net/dearth-skilled-artisans-hurts-industrialisation/

Osasona, C. O., & Hyland, A. D. (2006). Colonial Architecture in Ile-Ife. Ibadan: Bookbuilders, Editions Africa.

Osasona., C. O. (2005). Ornamentation in Yoruba Folk Architecture. BookBuilders Editions Africa.

Palei, T. (2015). Assessing the Impact of Infrastructure on Economic Growth and Global Competitiveness. Procedia Economics and Finance, 23, pp. 168-175.

Paton, B. (2011). Australia: Industry Skills Councils. In INSSO, International Perspectives on Labour Market Intelligence. A development for INSSO by funding member, The Alliance of Sector Councils, Canada. 5-12

Roodt, J. (2012). National Database Sets and Research on Labour Market Demand, Labour market intelligence, 1-34.

Sparreboom, T. (1999). Improving Labour Market Information in Southern Africa. Harare: ILO

Technician. (2018). Retrieved July 10, 2018, from Merriam-Webster.com, Merriam-Webster,: https://www.merriam webster.com/dictionary/technician

The Changing Role of the Artist in Society. (2018). Retrieved May 10, 2018, from The Artist and Society: http://www.uwgb.edu/malloyk/lecture_6.htm

The Vanguard. (2018). Manpower deficit: Lagos targets training 1,000 artisans in 2018.Retrieved from The Vanguard: https://www.vanguardngr.com/2018/03/manpower-deficit-lagos-targets-training-1000-artisans-2018 commissioner/

Vocational Enterprise Institutions (VEIs) and

Prediction of Osteoarthritis using Data Mining Classification Techniques

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ABSTRACT

Osteoarthritis is the most common reason of disability among the ageing population. The awareness of machine learning as a tool in medicine is growing rapidly and has provided new avenues for research into a number of diseases and infections. Creating better predictive models for these diseases could provide opportunities for better care, which we have applied to osteoarthritis, a degenerative disease that affects a large number of both genders in older population. A number of studies have been undertaken in order to understand the prediction of osteoarthritis risks using data mining techniques. Hence, this study is focused at using two different types of s data mining techniques to predict osteoarthritis risks in Nigerian patients using the Naïve Bayes' and the K-nearest neighbour algorithms. The performances of these two classification techniques was evaluated in order to determine the most efficient and effective model. To achieve this, a dataset containing patients who have participated in an osteoarthritis treatment program was used and analysed. The Naïve Bayes' showed a higher accuracy with lower error rates compared to that of the KNN method while the evaluation criteria proved the Naïve Bayes' to be a more effective and efficient classification techniques for the prediction of osteoarthritis risks among patients of the study location. Our results show that it is possible to predict an efficient and effective classifier for Osteoarthritis

Keywords: *Osteoarthritis, classification, prediction, risk factors, Naïve Bayes, K-nearest neighbour*

INTRODUCTION

Osteoarthritis (OA) is a deteriorating sickness that usually affects the human knee joints. OA is the most common form of arthritis and one of the leading causes of disability globally, affecting 3.8% of the global population (Cross *et al*, 2014). It causes painful joint locking. This breakdown usually affects the daily functional activities of an affected individual. This type of health breakdown challenge frequently happens to middle-aged and elderly person due to breakdown of cartilage. It is one of the leading causes of disability among the elderly people (Heidera, 2011). It was estimated that more than 27 million Americans have this condition, which primarily affects people who are 60 years of age or older Osteoarthritis often times involves the joints that bear most of the body weight (weight-bearing joints), such as the knees or hips. In many cases, only one joint aches. OA can also occur in any other joint, such as the middle and lower spine or the joints in the hands and fingers. (Cross *et al*, 2014). It has been estimated by the Centre for Disease Control that nearly 1 in every 2 people develop symptoms of OA of the knee by age 85. The symptoms may vary from person to person. In most people, the joint damage occurs gradually over many years, and as it does, the pain usually increases. At times, the pain may progress rapidly. In some people, OA is relatively mild and does not interfere much with daily life. Others may experience significant pain and disability. It ranks as the fifth highest cause of years lost to disability in the whole population in high-income countries, and the ninth highest cause in low- and middle-income countries (Teitel and Zieve, 2013). It accounts for 50% of the entire musculoskeletal disease burden, and thus is considered the highest-burden condition within the musculoskeletal group of

diseases, which also includes rheumatoid arthritis and osteoporosis. Radiographic evidence of knee osteoarthritis is present in approximately 30% of men and women over the age of 65.2. Worldwide estimates are that 9.6% of men and 18.0% of women over the age of 60 years have symptomatic osteoarthritis. Approximately 80% of those with OA will have limitations in movement, and 25% cannot perform their major activities of daily life (WHO, 2014)

The various ways of early detecting of Osteoarthritis is by identifying the risk factors and guiding against those ones that can be guided. Some of the factors that increases the risk of Osteoarthritis are, older age; because this disease increases with age, sex; women are more likely to develop osteoarthritis according to (WHO, 2014) Obesity, joint pains and joint injuries, repeated stress on the joint, Genetics, bone deformities, certain metabolic diseases etc. (Web 1, 2019). Osteoarthritis conditions can usually be managed, although the damage to joints can't be reversed. Staying active, maintaining a healthy weight and some treatments might slow progression of the disease and help improve pain and joint function. Osteoarthritis symptoms often develop slowly and worsen over time. Signs and symptoms of osteoarthritis are, Pains: affected joints might hurt during or after movement. Stiffness; Joint stiffness might be most noticeable upon awakening or after being inactive. Tenderness, loss of flexibility, Grating sensation, Bone spurs, swelling, etc. (Web 1, 2019).

Data mining can be a useful tool in the health sector and healthcare. Organizations that perform data mining are better positioned to meet their long-term needs. Data can be a great advantage to healthcare organizations, but they have to be first changed into information. Predicting the outcome of a disease is one of the most interesting and challenging tasks in which to develop data mining applications. Classification is a data mining technique used to predict group membership for data instances Benko, and Wilson, (2003). This study aims at using data mining techniques to classify Osteoarthritis risks using datasets of patients' information from Federal teaching hospital, Ido-Ekiti, Ekiti State, which contains the risk factors of Osteoarthritis and Osteoarthritis classes (yes and no). Naïve Bayes' and KNN classification of Osteoarthritis was performed using the WEKA software.

RELATED WORKS

A number of papers have been documented and published on the use of data mining techniques in the classification of Osteoarthritis risks. Some of such works are reviewed in the following paragraphs.

Sheng *et al* (2019) presented a paper titled Identification of knee Osteoarthritis based on Bayesian Network: Pilot study. The aim of the paper was to propose a Bayesian network (BN)-based classification model to classify people with knee OA. A total of 249 elderly people between ages 60 and 80 years living in the Konggiang community were recruited for the research work. 157 patients were later adopted for the osteoarthritis research work after the data pre-processing. The results after the evaluation show that their proposed model gave a higher result than the existing models in use.

Teitel and Zieve, (2013) worked on Predicting and Analysing Osteoarthritis Patient Outcomes with Machine Learning. The aim of their work was to answer two questions. The questions are; "Is it possible to predict Osteoarthritis patient outcomes?" and "What factors contribute to the Osteoarthritis patient outcome?" In their work, construction and evaluation of machine learning models was done. The dataset containing 75,366 patients who have participated in an osteoarthritis treatment program was used and analysed. The selection of models used in the work included neural networks, logistic regression and gradient boosting machines among others in order to capture the performance of several types of machine learning models. Their results show that it is possible to predict patient outcomes on a test set with 60% accuracy. Future enhancement of the work will require the improvisation of algorithm to improve classification rate to achieve greater accuracy.

Adebusoye *et al* (2013) worked on Magnitude of knee osteoarthritis and associated risk factors among adult patients presented in a family practice clinic in Nigeria. The study used a semi-structured questionnaire to interview four-hundred (400) respondents. Knee osteoarthritis was diagnosed clinically using the American College of Rheumatology (ACR) criteria. The Four-hundred patients were aged 18 years and above. Only those who gave their informed consent were included, while those who were too ill to participate in the study were excluded. Descriptive statistics were employed for the socio-demographic, lifestyle, and self-reported health status of the respondents. Chi-square statistics was used to assess the association between categorical variables. The *P*-value of significance was set at < 0.05. Logistic regression was used to explore the relationship between the socio-demographic, lifestyle and other risk factors associated with knee OA. The result shows that, the point prevalence of knee osteoarthritis was 11.5%. Increasing age, female gender, marital status, low educational status, financial dependency, poor income, obesity, previous knee injury, epigastric pain, peptic ulcer disease, varus deformity of the knee, and poor health status were significantly associated with knee osteoarthritis. Data mining technique was not used for classification in the study.

Takahashi et al (2010) presented a paper titled" Prediction model for knee osteoarthritis based on genetic and clinical information". The aim of the paper was that, the current association studies have revealed the hereditary factors behind OA, with its susceptibility inheritable factors. This will enable the researchers to predict disease occurrence based on genotype knowledge. The method used was that the genotyped risk alleles of the three susceptibility genes were statistically analysed with their effects. They later constructed prediction models by using the logistic regression analysis. The result of this work shows that Individuals with five or six risk alleles showed significantly higher susceptibility when compared with those with zero or one risk alleles.

MATERIAL AND METHODS

Data Mining Techniques

Data mining is the process of extracting patterns from data; these patterns may be discovered depending on the data mining tasks that are applied on the dataset. The two types of data mining tasks are: descriptive and predictive data mining task. The descriptive data mining task help to understand the characteristic properties of dataset and predictive data mining tasks are used to perform predictions based on available dataset. Predictive data mining is the chosen data mining task for this study. According to data mining applications can used for different parameters to examine data which includes; association (patterns that define the relationship between data), sequence/pattern analysis (patterns where one event leads to another), classification (identification of new patterns with predefined targets) and clustering (grouping of identical of smaller objects).

Methods

So as to classify the Osteoarthritis data collected form Federal Medical Centre (FMC) Ido, with the aim of achieving high accuracy and precision; two supervised learning algorithms i.e., Naïve Bayes' are K-Nearest Neighbour (KNN) were used. The data pre-processing was performed in order to remove inconsistent data and the data converted into a format that is useful in the simulation environment. WEKA data mining software was the environment used for simulating the Osteoarthritis risk prediction model; which is an open-source data mining software used for academic purposes.

Training Dataset Description

Following the identification of the risk factors of Osteoarthritis from the review of literature and expert medical physicians, the case files of patients were used to collect information about the distribution of the risk factors of OA patients coming for treatment at the Federal medical Centre Ido Ekiti, Ekiti State, in the

south-western Nigeria. The datasets collected from the patients' records contains 102 instances with 15 attributes. The class distribution is framed as Yes or No. Hence there are 14 independent variables and 1 dependent variable. The nominal values are set for the independent variables and the dependent variable. A description of the attributes contained in the dataset is presented in Table 1: below, Gender is either male or female, Age; the ages of the patients included in the study ranges from twenty one (21) years to eighty five years (85), Family History is either yes or no, Hip ratio depends on the size of the hips of the patient, BMI is the Body Mass Index (BMI) which is the weight of the patient, it is Abnormal for the obsessed patients, Hypertensive Heart Disease (HHD) is whether the patient is having high blood pressure or not ,to just mention a few. The non- modifiable factors are the first seven variables while the modifiable variables are the next seven variables in the table. The Osteoarthritis is the last variable.

Table1: Distribution of Identified Features in the Original Dataset

Types	Variable Names	Attribute Values
Input Variables	Gender	Male, Female
	Age (years)	Above 21 to 85 years
	Family History	Yes, No
	Waist Hip Ratio	Low, Normal
	BMI	Normal, Abnormal
	HHD	Yes, No
	Joint pains	Yes, No
	Cellulitis of Leg	Yes, No
	Seizure Disorder	Yes, No
	Ulcer of L/R. Limb	Yes, No
	Septic Arthritis	Yes, No
	Repeated stress on Joint	Yes, No
	Bone Deformities	Yes, No
	Joint Injuries	Yes, No
	Osteoarthritis	Yes, No

Naïve Bayes' (NB) Classification

Naive Bayes' Classifier is a probabilistic model that depends on Bayes' theorem. It is known as a statistical classifier. It is one of the habitually used methods for supervised learning. It provides a capable way of dealing with any number of attributes or classes which is purely based on probabilistic theory. Bayesian classification provides practical learning algorithms and prior knowledge on observed data. Let X_{ij} be a dataset sample containing records (or instances) of i number of risks factors (attributes/features) alongside their respective Osteoarthritis, C (target class) collected for j number of records/patients and

$H_k = \{H_1 = \text{Yes}, H_2 = \text{No}\}$ be a hypothesis that X_{ij} belongs to class C. For the classification of the diagnosis of (OA) given the values of the risk factor of the jth record, Naïve Bayes' classification required the determination of the following Rupali Patil (2014)

a. $P(H_k|X_{ij})$ – Posterior probability: is the probability that the hypothesis H_k holds given the observed data sample X_{ij} for $1 \leq k \leq 2$.

b. $P(H_k)$ - Prior probability: is the initial probability of the target class $1 \leq k \leq 2$.

c. $P(X_{ij})$ is the probability that the sample data is observed for each risk factor (or attribute), i.

d. $P(|X_{ij}|H_k)$ is the probability of observing the sample's attribute, X_i given that the hypothesis holds in the training data X_{ij}.

Therefore, the posterior probability of an hypothesis H_k is defined according to Bayes' theorem as shown in equation (1) while the determination of OA class is in equation (2).

$$P(H_k|X_{ij}) = \frac{\prod_{i=1}^{n} P(X_{ij}|H_k)P(X_i)}{P(H_k)} \quad for\ k,2 \quad (1)$$

$$max.\left[P(H_1|X_{ij}), P(H_2|X_{ij})\right] \quad (2)$$

K-Nearest Neighbour (KNN)

This can be described as learning by similarity; it is learnt by comparing a specific test tuple with a set of training tuples that are similar to it. It is classified based on the class of their closest neighbours, most times, more than one neighbour is taken into consideration hence, the name K-Nearest Neighbour (K-NN), the "K" indicates the number of neighbours taken into account in determining the class (Jiawei and Micheline, 2006) In this work, our data tuples are restricted to a patients with OA symptoms. The Euclidean distance between a training tuple and a test tuple can be derived as follows:

let p_i be an input turple with p features of OA $(p_{i1}p_{i2}p_{i3})$

let n be the total numberof input tuples of OA $i = 1.2 \ldots . n)$

let k be the total number of features of OA $(j = 1,2, \ldots, k)$

The euclidean distance between turple p_i and p_t $(t = 1,2, \ldots, n)$ can be defined as:

$$d(p_i p_t) = \sqrt{(p_{i1} - p_{t1})^2 + (p_{i2} - p_{t2})^2 + \cdots + (p_{in} - p_{tn})^2} \quad (3)$$

in general term: the euclidean diatance between two tuples for instances are

$$p_1 = (p_{11}, p_{12}, \ldots p_{1n}) and\ p_2 = (p_{21}, p_{22}, \ldots, p_{2n}) will\ then\ be:$$

$$distp_1 p_2 = \sqrt{\sum_{i=1}^{n} (p_{1i} - p_{2i})^2} \quad (4)$$

Equation (3) is applicable to numeric attribute of OA, in which we take the difference between each corresponding values of attributes tuple P_1 and P_2, square the result and add them together to get the square root of the accumulated result ,this gives us the distance between the two points P_1 and P_2. From equation (4), diagnosis of the input instance is based on the closest n neighbour

In order to evaluate the performance of the supervised machine learning algorithms used for the risk factor classification of the OA, there was the need to plot the results of the classification on a confusion matrix (Figure 1). The four parameters used to formulate the metrics are as follows:

a. True positives (TP) are correctly classified Yes cases;
b. False positives (FP) are incorrectly classified No cases;

c. **True negatives (TN) are correctly classified No cases; and**

d. **False negatives (FN) are incorrectly classified Yes cases.**

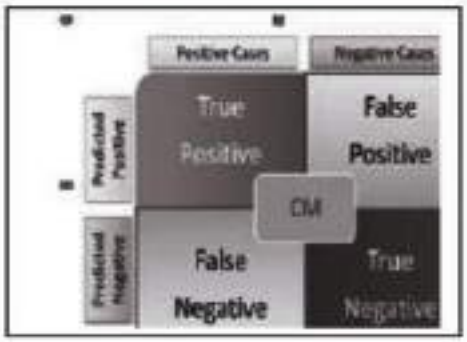

Figure 1: Diagram of a Confusion Matrix

The true positive/negative and false positive/negative values recorded from the confusion matrix can then be used to evaluate the performance of the prediction model. A description of the definition and expressions of the metrics are presented as follows:

a. **True Positive (TP) rates (sensitivity/recall) – proportion of positive cases correctly classified.**

$$TP\ rate_{Yes} = \frac{TP}{TP + FN} - \quad (5)$$

$$TP\ rate_{No} = \frac{TN}{FP+TN} \quad (6)$$

b. **False Positive (FP) rates (1-specificity/false alarms) – proportion of negative cases incorrectly classified as positives.**

$$FP\ rate_{Yes} = \frac{FP}{FP+TN} \quad (7)$$

$$FP\ rate_{No} = \frac{FN}{TP+FN} \quad (8)$$

c. **Precision – proportion of predicted positive/negative cases that is correct.**

$$Precision_{Yes} = \frac{TP}{TP + FN} \quad (9)$$

$$Precision_{No} = \frac{TN}{TN + FP} \quad (10)$$

d. **Accuracy – proportion of the total predictions that was correct**

RESULTS AND DISCUSSION

The results of the data mining process for the prediction of Osteoarthritis risk using NB classifier and KNN technique as discussed above was implemented using the WEKA software data mining tool. The 102 datasets that were collected from FMC, Ido in Ekiti State were divided into 70% for training sets and 30% for testing sets. The two techniques were used to evaluate the models using the testing data. From the results on Table 2 of the analysis made on the dataset using Naïve Bayes', It shows that Naïve Bayes' recorded the highest correctly classification of 81 instances and 21 incorrectly classified instances with accuracy of 93.14% while KNN recorded the least performance of 88.24% with the correctly and incorrectly classified instances respectively. From the Confusion matrix, the True Positive (TP) rate/recall which is the percentage of the actual number of positive that were classified as positive cases has an average of 93.14% and 88.24% for the Naïve Bayes' and KNN respectively. The False Positive (FP) rate which is the percentage actual number of positive cases that were

misclassified also called false alarm has an average of 2.5% and 4.0% for the Naïve Bayes' and KNN respectively. From the results in Table 2 and graph in figure 2 it shows very clearly that data mining techniques can be used in predicting Osteoarthritis risks and that the Naïve Bayes' classifier has a better accuracy than the KNN algorithm.

Table 2: Results of the Correct and Incorrect Classification of Testing Datasets

Supervised machine Learning	Confusion Matrix		Classification Accuracy (%)	False Alarm Rate (%)
NB	TP =76 FP = 2	TN=19 FN = 5	93.14	2.5
KNN	TP = 72 FP =3	TN=18 FN=9	88.24	4.0

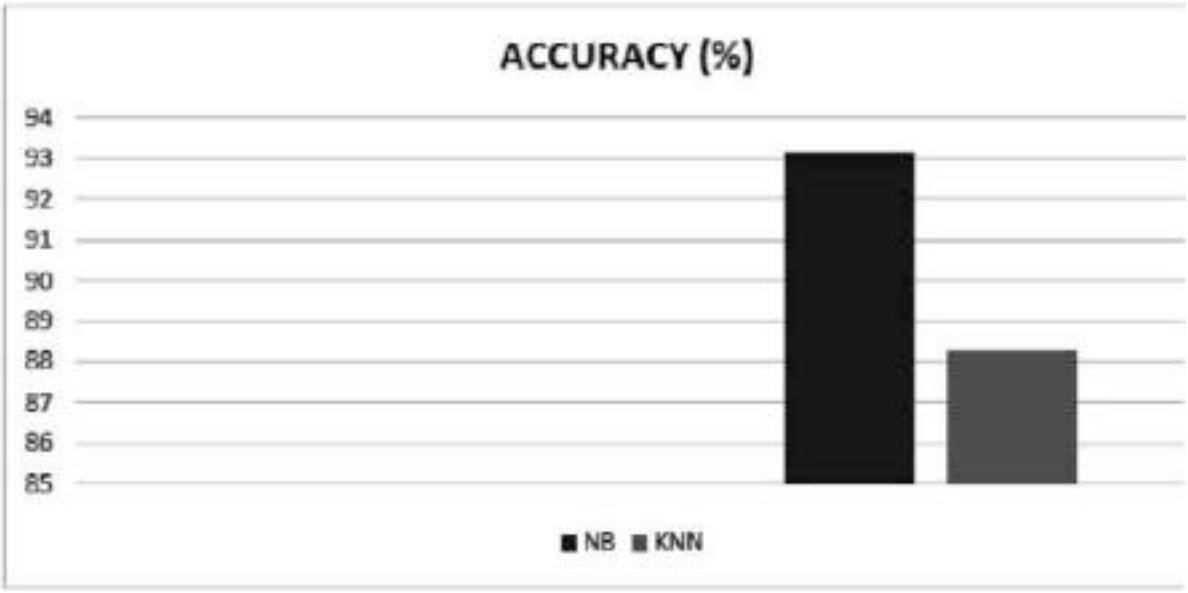

Figure 2: Performance Evaluation Chart for Naïve Bayes' and KNN

CONCLUSION

In this study two different data mining classification techniques were used for the prediction of Osteoarthritis risk in adult population and their performances was compared in order to evaluate the best classifier. Experimental results show that the Naïve Bayes' classifier is a better model for the prediction of Osteoarthritis risks for the value of accuracy, recall, precision and error rates recorded for both models. Hence, an efficient and effective classifier for Osteoarthritis risks has been identified while the number of attributes covered by the classifier can be increased by increasing the sample size of the training set and hence the development of a more accurate model.

REFERENCES

Adebusoye LA, Ogunbode A.M, Alonge T.O

(2013) "Magnitude of knee osteoarthritis and associated risk factors among adult patients presenting in a family clinic in Nigeria". J, Med Trop 2013; 15; 144-50

Benko, A and Wilson, B. (2003) Online decision support gives plans an edge. Managed Healthcare Executive, Vol. 13 No. 5, p. 20.

Cross, E. Smith, D. Hoy, S. Nolte, I. Ackerman, M. Fransen, L. Bridgett, S. Williams, F. Guillemin, C. L. (2014) The global burden of hip and knee Osteoarthritis: estimates from the global burden of disease 2010 study. Annals of the Rheumatic Diseases, pages annrheumdis–2013, .

Heidera B. (2011) Knee osteoarthritis prevalence, risk factors, pathogenesis and features: Part I. Caspian J Intern Med 2011;2:205-12.

Jiawei, H. and Micheline, K. (2006) Data Mining: Concepts and Techniques, Second Edition, Elsevier Inc.

Rupali R Patil (2014) "Heart Disease Prediction System Using Naïve Bayes and Jelinek mercer Smoothing"

Sheng B, Huang L, Wang X, Zhuang J, Tang L, Deng C, Zhang Y (2019) "Identification of Knee Osteoarthritis Based on Bayesian Network: Pilot Study" JMIR Med Inform;7(3): e13562 URL: http://medinform.jmir.org/2019/3/e13562/ doi: 10.2196/13562 PMID: 31322132

Takahashi Hiroshi, Masahiro Nakajima, Kouichi Ozaki, Toshihiro Tanaka, Naoyuki Kamatani1, Shiro Ikegawa (2010).: Prediction model for knee osteoarthritis based on genetic and clinical information. Arthritis Research & Therapy 2010 12:R187.

Teitel A.D, Zieve D (2013). MedlinePlud Medical Encycolpedia. National Institutes of Health. "Osteoarthritis." Last updated: Sept 26, 2013. http://www.nlm.nih.gov/medlineplus/ency/article/000423.htm

World Health Organization (WHO). "Chronic Rheumatic Conditions." Chronic diseases and health promotion. 2014. http://www.who.int/chp/topics/rheumatic/en/

Web 1 https://www.mayoclinic.org/diseases-conditions/osteoarthritis/symptoms-causes/syc-20351925 Accessed 17th Oct, 2019

Implementing Channels Optimization Strategies for Efficient E-Banking Operations

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ABSTRACT

In this age where customers enjoy best possible services across all industries, banks have to concentrate on and optimize their channel management strategies so that they are able to ensure customer satisfaction and loyalty. The adoption of the internet for banking services in the world economies serves as the basic motivational factors for banks to consolidate on the internet banking channel to reach out to millions of their customers. The merits associated with this technological innovation are enormous and has revolutionized the banking sector. However, despite the numerous benefits, they are discernible challenges and problems associated with this form of banking such as identity theft, internet fraud, and network issues among others. The core of this research is to explore strategies for efficient channel optimization to plug loopholes in banking operations. This research adopted Innovation Diffusion Theory for the study. The primary and secondary methods of data collection were used with the adoption of questionnaires and personal interviews as the major research instruments for randomly selected staff and customers of Access/Diamond Bank Plc. Chi square was the statistical tool for the analysis and testing of responses. The study revealed that despite challenges associated with virtual channels, efficient channel optimization strategies will lead to efficient banking activities and services, cost-reduction in banks, and reduction of waiting time experienced in the banking halls. This paper further established a closer study of the key aspects of channel optimization strategy and brings into focus the concept of analytics. Analyzing data and discovering meaningful patterns helps the banks take sound decisions.

Keywords: *analytics, banking services, channel, optimization strategies, virtual channel*

INTRODUCTION

The banking sector like other sectors of the economy has experienced rapid transformation in all its activities through technological innovations. These have made it possible for banks to offer various services independent of the conventional banking halls and beyond its official working hours via alternative delivery channels such as Automated Teller Machines, electronic banking and internet banking, credit/debit cards and the execution of payments through electronic funds transfer at the point of sale etc. Many banks have installed modern computer interconnectivity backbone that would enable them achieve communications of data and multimedia over internets and extranets. Channels are fast becoming an integral part of banking activities. In this century where customers enjoy best possible services across all industries, banks have to concentrate on and optimize their channel strategies so that they are able to guarantee customers satisfaction and loyalty, that is, with particular attention given to 24/7 operational services, reference data, security management, integrated workflow management, integrated business intelligence, solutions for credit administration and loans, integrated delivery channel amongst others.

Available statistic indicates that in the period between 2012 and 2017, branch banking had declined by 6% while online banking witnessed an increase by 7%, indicating a paradigm shift from the traditional channels like the branch to online. At present, customers are presented with various

alternatives for choices and will not hesitate to switch to banks which give them better services, hence this constant innovation and increased competition makes it pertinent for banks to manage their channels more effectively for efficient service delivery. The traditional banking system which focuses on transactions through a physical branch is fast diminishing; with the seeming unending competition in the banking sector, banks are exploiting channels like mobile and social media to reach out to their customers and ensure that they have an enhanced, effective and seamless banking experience. With online banking, individuals can obtain account balance information; make withdrawals and even payments without having to visit the banking hall.

With the convergence of internet and telecommunication services into the form of hand-held devices, banks have to upgrade their channel management strategies to capitalize on this trend. Channel optimization has a plethora of benefits to offer. On one hand it helps in cost reduction by getting accurate information about customer perceptions and needs and accordingly shifting from high cost to low cost channels. On the other hand it helps the banks in customer acquisition through a thorough understanding of the customer life time value by segmenting customers on the basis of channel usage information. This work seeks to assess the successes recorded in virtual banking channels and challenges that have impeded efforts in the implementation of efficient channel delivery in banking operations in Nigeria, which thus raise concern for strategies for its optimization. It conveys reduction in operational cost than the traditional banking, and with its high potentiality.

The research recommended that banks should align themselves with the government and other private sectors to provide required infrastructures, follow the stipulated electronic banking guidelines of the Central Bank of Nigeria, develop new products to meet the needs of the Nigerian banking customers, reinvigorate and refresh the bank's web assets to prioritize ease of use, navigation and visual design, enhance customers awareness and online literacy by promoting greater awareness of online security through the various online banking touch points, improve response time to fraud complaints, generate a robust customers information database for overall optimization in bank service delivery.

Electronic banking is faced with problems such as insecurity and congestion of internet; the existing business environment also poses some challenges to the smooth operation of e-banking in Nigeria which are epileptic power supply, dominance of cash transactions in the economy, and low level of awareness among Nigerians and its impact on the operations of financial institutions. Thus, it is this problem that put the banking sector in seemingly perpetual strategies towards the efficient channel optimization for optimum customers' satisfaction and accounts security.

Therefore this research seeks to address the following problems:

I. How to best protect the vulnerability of banks to potential risks of virus attacks; unauthorized access, fraudulent transactions and theft in the adoption of virtual banking channels in the Nigeria.
ii. How to tackle the challenges associated with congestion of internet in the smooth operation of e-banking in Nigeria.
iii. How the old, the poor and illiterate category of persons in the society who do not have the knowledge of computer/ internet or e-banking in accessing financial services will be catered for.
iv. How to solve the problem of epileptic power supply, dominance of cash transactions in the economy and the low level of awareness among Nigerians.

RELATED WORKS

Rose et al. (2005) considered that customers are attracted to these technologies because of convenience, increasing ease of use, and in some instances cost savings. The use of paper cheques has been supplemented step-by-step with e-cheques (i.e., electronic images) allowing banks to have more storage capacity, reduce costs and improve customer services.

A more recent e-banking development is wireless internet applications of banking sometimes called m-banking (mobile banking).

Laukkanen and Lauronen (2005) believe that due to the widespread use of computer technologies in almost all aspects of life, organizations that are connected to the Internet started extending their services to their customers to include new applications and services that satisfy their customers' desires to make better businesses. One of these emerging applications is mobile banking.
Ayadi (2005) admits that the employment of electronic banking comes with unique challenges. He listed instances of ATMs not disbursing cash despite reflecting otherwise on the bank account, ATMs not returning bank cards and wobbly internet connectivity preventing or disrupting transactions done with mobile phones.

Meltzer (2006) maintains that revenue is a very significant indicator of the effect of alternative channels on the profitability of commercial banks. Due to the novel avenues of revenue, the commercial banks have achieved higher profits from the alternative banking channels. The convenience associated with alternative banking channels in accessing and delivery of financial services is noteworthy in the profitability of commercial banks. Alternative banking channels have made it so easy to access financial services thus motivating more clients to subscribe and use of banking services. The enhanced access and subscription to commercial banks has led to higher profitability. To him, one very significant feature of alternative banking channels is the reduced costs associated with banking. This is achieved by the reduction of staff through self-service channels since the number of staff is drastically reduced. The diminished cost impacts on the profitability of banks since it erases the avenues of expenditure and creates fresh fields of revenue.

Porteous (2006) identifies one of the main challenges to offering financial services to the underprivileged through branches in addition to other bank-based delivery channels to be the high costs involved in these conventional banking methods. The cost to the financial service providers to serve a poor client with a small balance in addition to conducting small transactions is just too great to make such accounts viable. In addition, when financial service providers do not have branches that are close to the customer, the client is less likely to use and transact with their service Dzaja (2007).

Servon and Kaestner (2008) believe E-banking has revolutionized the way business is transacted by globalizing the business enterprise. They maintain that e-banking technologies have proliferated in recent years, and the availability of a wide range of products has led to increasing adoption among customers. These technologies include direct deposit, computer banking, stored value cards, and debit cards. Culled from www.marketresearch.com, factors impacting online banking include the trend within the industry and the socioeconomic forces behind changing demographics.

Ian (2009) posit that, since banking services are commonly similar between the institutions, the approach must guarantee that each channel is shrewdly positioned to optimize its contribution to the bank's differentiation from the competition. Andrew (2009) holds the view that virtual banking channels offers users access to services with a mobile phone all day, at all times. So, to effectively achieve a truly convenient banking mode, a truly mobile mode of banking has to be explored, hence the need for m-banking. The convergence of the Internet and mobile networks creates new opportunities and applications. Treating mobile business as simply an extension to the traditional web could result in missing out unique differentiated qualities for new value-added possibilities. Mobile Banking is considered to be one of the most value-added and important mobile service available.

Sultana (2009), reveals however that the

outstanding growth of mobile sector worldwide has created a unique opportunity to provide social and financial services over the mobile network. With over 4 billion mobile cellular subscriptions worldwide, mobile network has the ability to immediately offer mobile banking to 61% of the world population. Eze (2009) stressed that the epileptic electricity supply initially dissuaded many from purchasing mobile phones and other technological appliances.

Saxena (2010) reveals that in an endeavour to optimize services and diminish costs, banks are regularly migrating towards a 24-7 service where clients are enjoying the superior sense of independence that this creates. Accessibility is the central pillar as customers demand instant access to deposits, loans and status of their account. Al-Akhrasand Qwasmi (2011) considered the term mobile banking (or m-banking) as the alternative banking services that the user can perform via a mobile device ubiquitously at any time and from anywhere.

Kohali and Sheleg, (2011) established that alternative banking delivery channels are new conduits and techniques for providing banking services directly to customers. Recent economic crisis along with increasing market intricacy has placed extraordinary pressure on financial institutions. The demand for a digital lifestyle in addition to the technological insurrection it brings to residences and places of work, as well as the momentous demographic shift and a regulatory structure, are subjecting the finance sector to significant challenges in a time of rigorous market uncertainty. Conversely, times like this present opportunities for commercial banks to embrace change resulting in innovation over the delivery of financial services.

MATERIALS AND METHODS

There are several methods of collecting this basic information. Both primary and secondary sources were used for this research purpose. Primary data was collected through survey by using appropriate research instrument, with the use of a questionnaire and interview. Secondary data were used for providing the theoretical background to the research problem. The secondary data sources were journal, books, internet materials etc.

The nature of this study requires the collection of both primary and secondary data. Primary data is of paramount importance as there are little published literatures in Nigeria on the current issues on internet banking adoption. Therefore, it was essential to gain first-hand insight knowledge, hence, individual interviews were very important tools used in the collection of qualitative data for this study from customers, bank managers, staff and other stakeholders.

Data Presentation

Table 4.1 Positional Considerations

S/N	ITEM	SA	A	D	SD
1.	Banks should give consideration to the segmentation of customers according to their preferences.				
2.	Customers should be addressed with regards to their required channels for optimum satisfaction.				
3.	Banks should design easy interfaces in their online platforms to suit customers choice platform.				
4.	Banks should make efforts to balance offline with online transactions for customers convenience.				

Data Analysis

Table 4.2. Data Analysis (Age of Respondents)

Scoring interval	Respondents	% of respondents
20-29	32	21.3
30-39	69	46
40-49	34	22.7
50 and above	15	10
	150	**100**

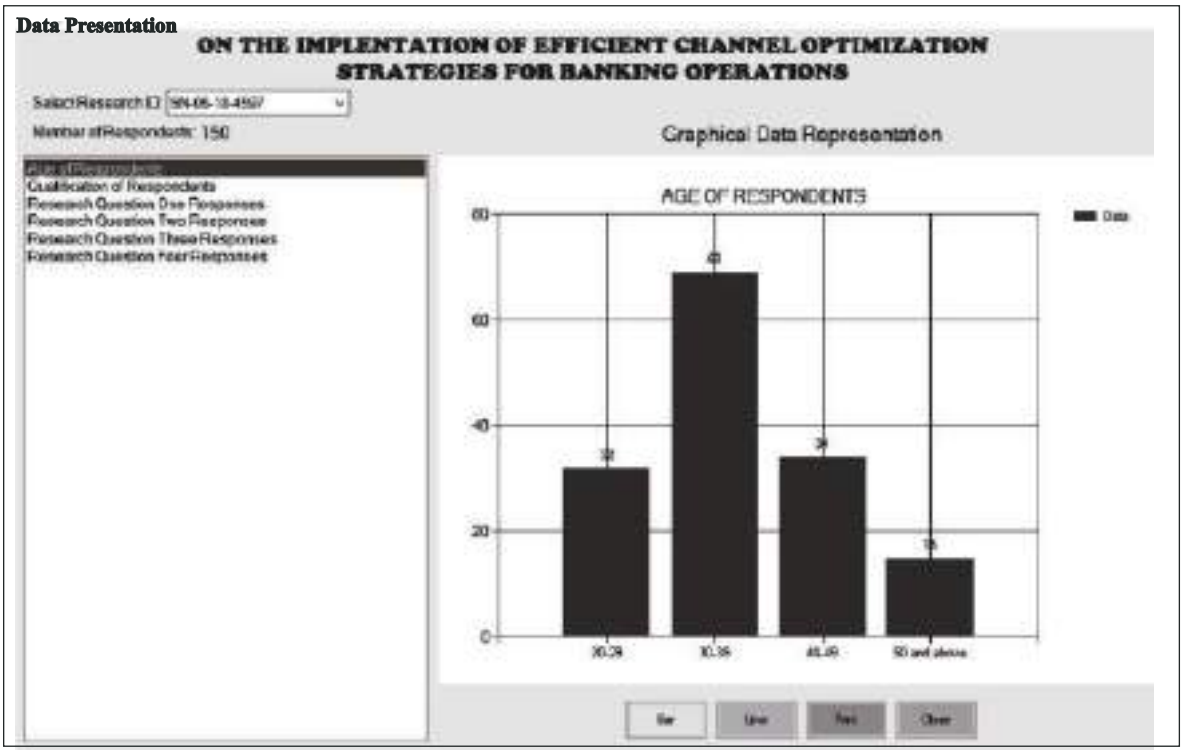

Fig. 4.1: Graphical Representation of Data on Respondents Ages

Table 4.3. Data Analysis (Educational Qualification of Respondents)

Qualification	Respondents	% of respondents
FSLC	5	3.33
SSCE	33	22
OND	47	31.3
B.Sc and above	65	43.3
	150	100

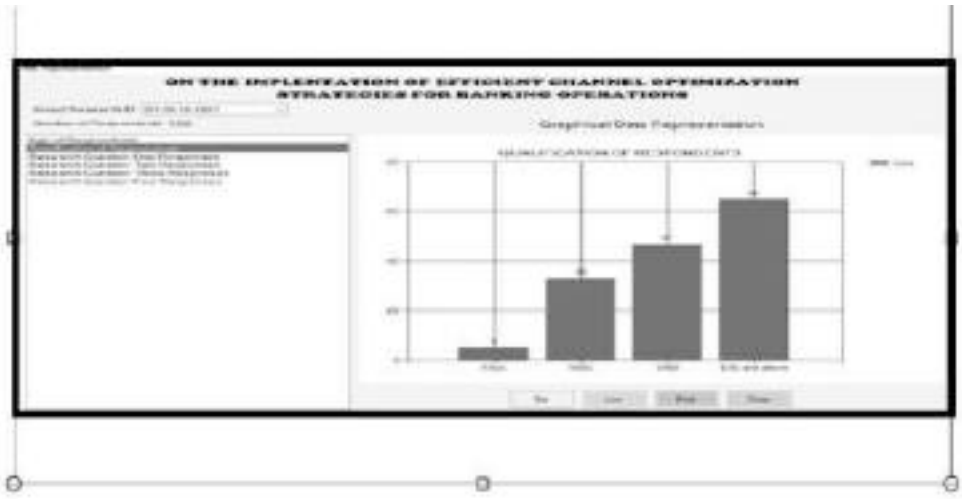

Fig. 4.2: Graphical Representation of Data on Respondents Qualifications

Table 4.4. Data Analysis of Respondents' RESPONSES

S/N	SA	A	D	SD	TOTAL
1	135	12	3	0	150
2	115	35	0	0	150
3	120	20	8	2	150
4	140	10	0	0	150
TOTAL	510	77	11	2	600

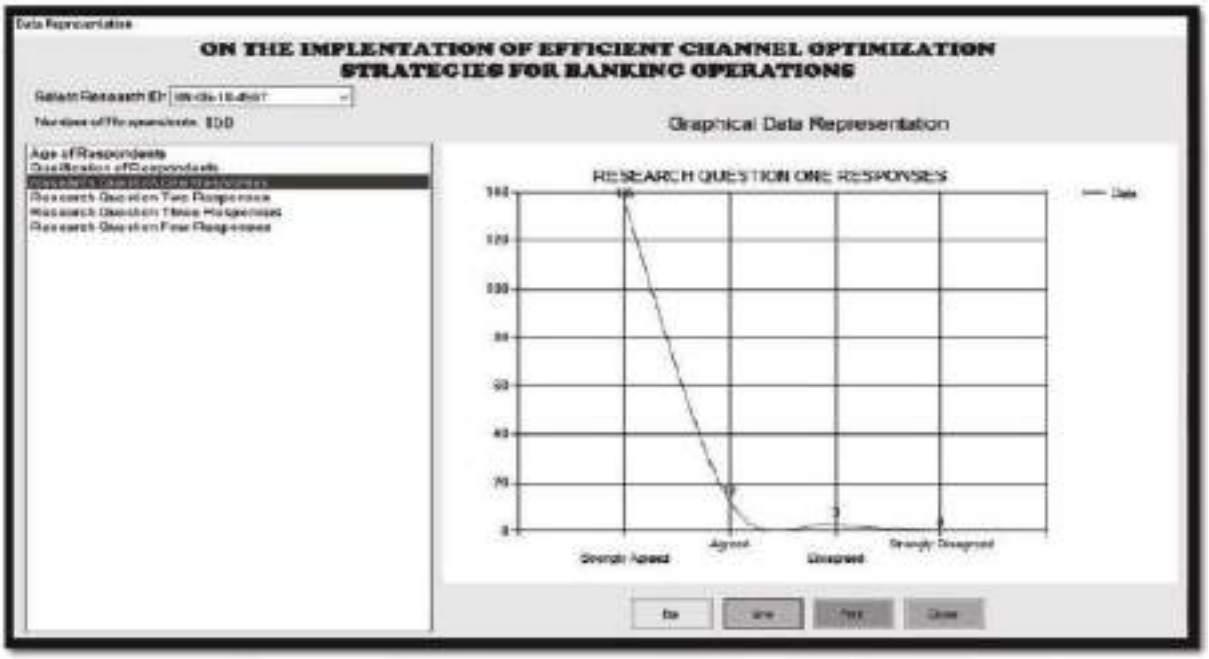

Fig. 4.3: Graphical Representation of Data on Research Questions Responses

Rating Scale:

Respondents Opinion / Rating

SA – Strongly Agree	- 4 points
A – Agree	- 3 points
D – Disagree	- 2 points
SD – Strongly Disagree	- 1 point

Chi Square formula

$$\textit{Chi Square formula} = \sum_{E}^{df} \frac{E(O-E)^2}{E} \qquad (1)$$

Where X^2 – Chi Square
E = Expected data
O – Observed data

The result of $(O-E)^2$= Square root of expected data subtracted from observed data is presented in Table 4.5.

Table 4.5. Data Analysis Results

	SA	A	D	SD
Question 1	127.5	19.3	2.8	0.5
QUESTION 1	4.43	2.76	0.01	0.5
QUESTION 2	1.23	12.8	2.8	0.5
QUESTION 3	0.44	0.03	9.66	4.5
QUESTION 4	1.23	4.5	2.8	0.5

The values are applicable to questions 2, 3 and 4. Therefore from Table 4.5. we have

4.43+2.76+0.01+0.5+1.23+12.8+2.8+0.5+0.44+0.03+9.66+4.5+1.23+4.5+2.8+0.5= 48.24.

RESULTS AND DISCUSSION

The calculated value of X^2= 48.24 and the D/F: (Number of Rows - 1) + (Number of Columns - 1) = (4-1) + (4-1) = 6. The table value of 6 at 0.5 = 12.592 at X^2 Distribution.

Since the calculated value is greater than the X2 table value, we conclude that although alternative bank channels are quite innovative, but are plagued with few challenges of fraudulent activities by scammers. But however, banks should give consideration to segmentation of customers according to their preferences, design easy interfaces in their online platforms to suit customers choice platform, make efforts to balance offline with online transactions for customers convenience and above all, individual customer should be addressed with regards to their required channels for optimum satisfaction.

Out of the total of 150 questionnaires retrieved from respondents, a greater percentage tilted toward efficient optimization strategies to be devised by the banking industry on the existing bank channels for improved services to customers and overall banking operations. This would reduce the hitherto identified insecurity that instills fear in bank customers in their attempt to use online channels.

CONCLUSION

Channels are fast becoming an integral part of banking activities. In this age where customers enjoy best possible services across all industries, banks have to concentrate on and optimise their channel management strategies so that they are able to ensure customer satisfaction and loyalty. Indeed, it makes good sense for banks to remain abreast of the changes happening in the technological setting and align their operations efficiently to service customers. This would make the difference between success and failure in times ahead. Nevertheless, it helps in cost reduction by getting accurate information about customer perceptions and needs and accordingly shifting from high cost to low cost channels.

This paper established a closer study of the key aspects of channel optimization strategy and brings into focus the concept of analytics that help the banks take sound decisions.

When used effectively, analytics can help banks identify the channel usage pattern, identify lesser used channels and supplement extensively used channels to arrive at appropriate and competent customer focus initiatives. Generally, this work revealed that banks should give consideration to segmentation of customers according to their preferences, design easy interfaces in their online platforms to suit customers' choice platform, make efforts to balance offline with online transactions for customers' convenience and above all, individual customer should be addressed with regards to their required channels for optimum satisfaction.

REFERENCES

Al-Akhras, T. M. and Qwasmi, D. (2011), Innovative Secure Mobile Banking Services. p. 195.

Andrew, W. (2009), Mobile Banking in Developing Countries: A Case Study on Kenya. pp. 132-139.

Ayadi, A. (2005), "Value Creation in Mobile Banking". Lagos, LIB Publishers.

Dzaja, S. (2007), Legal Aspects of Internet Banking Related to International Business Transactions. Washington.

Eze, A. S. (2009), Regulating Internet Banking in Nigeria: Problems and Challenges Part 1, Journal of Internet Banking and Commerce, vol. 10, no: 3, Feb. 2006, Retrieved 9th of July, 2010 from JIBC December 2012, Vol. 17, No. 3 – 19.

Ian, S. (2009), Online Banking and the Role of CRM: The Impact of the Internet as Online Business Platform on CRM (Study of Online Banking in the UK). Washington.

Kohali, A. and Sheleg, A. (2011), Alternative Banking Channels: Creating Differentiation, Israel, Tefen Associate Partners.

Kondabagil, J. (2007), Risk Management in Electronic Banking: Concepts and Best Practices. Washington: John Wiley & Sons.

Laukkanen, T. (2007), Internet versus Mobile Banking: Comparing consumer value perceptions. Business Process Management Journal; vol. 13 No. 6, pp. 788-797.

Journal of Electronic Commerce Research, Vol. 7, No. 2, pp.50-66.

Meltzer, I. (2006), Access to Savings in LSM1-5. Fin Mark Trust and SA Savings.

Saxena, D. (2010), Alternate Banking Delivery Channels, Accounting Education.

Schofield, E. and Klubin, S. (2004), — banking Services in Japan: A Strategic Perspective, International Journal of Mobile Communications, Volume 2, (1/2004), 51-66.

Sultana, R. (2009), Mobile Banking: Overview of Regulatory Framework in Emerging Markets, pp.124-131. J

The Influence of Students' Perception and Teachers' Attitude towards Agriculture as a Career Choice in Akure South Local Government Area, Ondo State, Nigeria

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ABSTRACT
The study examined the influence of perception of students and attitude of teachers towards Agriculture as a Career Choice in Akure South Local Government Area, Ondo State, Nigeria. The multi-stage sampling technique was used in selecting the respondents for the study. At the first stage, 10% of registered secondary schools (12 schools) in Akure South Local government area of Ondo State (6 privates and 6 public secondary schools) were purposively selected based on the accessibility. Thereafter, proportionate random sampling was used to select fifteen (15) students offering agriculture as a subject from each of the selected schools, making a total of one hundred and eighty (180) respondents. Data was collected through the use of a well-structured questionnaire and the objectives were analyzed using descriptive and inferential statistics. Findings from the study showed that 97.8% of parents supported their children on their intended study subject and only 2.8% of the students indicated to take up a career in agricultural field. However, 88.3% of the students had a positive perception of agriculture as a career choice while the agricultural teachers' attitude was adjudged favourable by the students. There was a positive relationship between teacher's attitudinal influence and student's perception of agriculture as a career choice and also a positive association between gender and subject base of the students and their perception of agriculture as a career choice. Based on the above findings, educational policy implementation should make agricultural subject at secondary school level to be compulsory for all categories of students where student will be exposed to agriculture as a career and as an important tool for economic development as well as a nation's advancement.

Keywords: *Agriculture, Career choice, Student perception, Teachers' attitude, Ondo State*

INTRODUCTION
Globally, agriculture is a pivotal sector as it stimulates in achieving economic growth, alleviate hunger and reduces poverty as well as provides space for employment. Several developed countries have recorded huge success of economic prosperity and development through agricultural investment, which is a major contributor to any nation's gross domestic product (GDP) alongside with other sectors and industrial services (Nwankpa, 2017). In Nigeria, an estimated 20.9% of the country's GDP in 2017 came from agricultural activities, which revealed an indication of its promising potentials for Nigeria's economic growth and its development (NBS, 2017; Statista, 2018).

According to Sertoglu *et al.* (2017), agriculture determines the outcomes of Nigeria's battle for the long-run economic growth attainment. Apart from the huge potential of the sector to boost economic development, the teeming fast-growing population's food need is partly buoyed through agriculture, birthing the quotidian quote that "no farmer (agriculturist), no nation".

With the abundant arable land, which is about 37.3% of the total land area (World Bank, 2016) and water resources capacity of 260

billion and 92 billion cubic meters of surface and ground waters respectively (Federal Ministry of Water Resources, 2011), Nigeria is yet to leverage the very many favourable conditions for agriculture to transform its economy and a substantial part of its foreign reserves covers the importation of staple food such as rice, wheat, sugar, and fish (Adesina, 2012; Awoniyi *et al*, 2018; Popoola, 2018). There is a huge economic burden caused by high food importation cost because Nigeria agriculture cannot meet up with the food demand of its growing population.

There is a huge youth population which is about half of the entire population (Pelzom and Katel, 2017). Many of them are not interested in agriculture because a very large percentage (about 70%) of Nigerian farmers are into subsistence farming (Adebayo & Olagunju, 2015; Nwankpa, 2017) using crude implements. Also, poor access to: land, credit, and other agricultural inputs make agriculture unappealing to the Nigerian youth (FAO, 2014). However, in Nigeria, there are several agricultural youth empowerment programmes implemented at the Federal, State and Local government levels. These are: The Agricultural Transformation Agenda (ATASP-Phase 1, 2015), The Youth Employment in Agriculture Program (YEAP), The Youth Initiative for Sustainable Agriculture (YISA), Graduate Farmer's Scheme of the Federal Government in collaboration with the Songhai Nigeria Farms (Federal Ministry of Agriculture and Rural Development (2016), and Agriculture Promotion Policy (APP). The Agricultural Transformation Agenda was initiated to address rural youths' poor access to job opportunities {ATASP-Phase1, 2015). The Youth Employment in Agriculture Program (YEAP) and the Youth Initiative for Sustainable Agriculture (YISA) were also designed by the Federal government to produce young commercial farmers and agribusiness leaders in Nigeria (Africa Agriculture Status Report, 2015) while the Graduate Farmer's Scheme of the Federal Government in collaboration with the Songhai Nigeria Farms (Federal Ministry of Agriculture and Rural Development (2016) were created to enhance youth engagement in agriculture. Besides, the Agriculture Promotion Policy (APP) which addresses the creation of a pathway for youth to enter the agribusiness economy. However, over five decades of policies on agriculture and youth empowerment are yet to improve youth engagement and participation in agriculture to a noteworthy notch as evidenced by the high levels of hunger, rising food import bills and youth unemployment in the country (PGDA, 2010; Filmer and Louise, 2014; FAO, 2015).
Fabiyi et al. (2015) posited that inconsistency in policy and neglect of agriculture by the government among other reasons, contributed to the problem.
Agriculture is not synonymous with a job in the Nigerian youth context because the use of crude implements and methods have misshapen their perception and ill-proportioned their level of participation in agriculture. Also, agriculture job looks monstrous and unappealing to the majority of them (Abdu-Lateef and Sharifah, 2015). This explain the increase in rural-urban migration because rural youths seek white-collar jobs in the city leading to a decline in manpower in agriculture and consequently, a decline in agricultural productivity. (Abbass, 2012; Baliyan and Nenty 2015).

Training and development amidst growing complexity of work environment cannot be overemphasised, and the need for professionalism, knowledge, and skills possession to effectively perform tasks in advancing/changing technology cannot be pushed aside (Akanbi and Adetunji, 2016). Despite the introduction of the 6-3-3-4 education system about four decades ago, which is to stimulate and sustain students' interest in agriculture, enable students to acquire useful knowledge and practical skills in agriculture, and prepare them for further studies and occupation in agriculture (National Policy on Education, 2004; Obi, 2005), the agricultural sector is still lacking the required level of personnel who needs to work with the rural dwellers and food producers are lacking in quantity but the

youths have no inclination to associate themselves with farming (FAO, 2014).

The aging farmers, forecast of a swelling national population and perceived food scarcity due to the Covid-19 pandemic, have further steered the need to transfer food production activities to younger, more energetic and productive society members (Pinnado and Sanchez, 2017) and this can only be gotten if the young school leavers decide to seek professionalism in this sector and choose it as a career choice. However, lesser students venture into agriculture as a field of study or as an occupation after their secondary education.
The dislike for this profession is taking a wider spread and alarming dimension. The agricultural productive capacity of the nation dwindles as reflected by high food insecurity status, unemployment, and poverty (UNESCO, 2016; UNCTAD, 2016).

THEORETICAL FRAMEWORK

Considering the social learning theory of career decision making, Mitchell and Krumboltz, (1990), posited that there could be a lot of factors interplaying to determine one's career choice such as genetic factors, environmental factors, and cognition/ perception and learning experiences. This implies that the perception and learning experience (tutor/ teachers attitude inclusive) can influence the career choice of students. Hence, this accentuates the imperativeness for this study as it majorly seeks to investigate the perception of the students and the influence of agricultural teachers' attitude on agriculture as a career choice on same in Nigeria using Akure South Local Government Area of Ondo State. The demographic characteristics of some secondary school students in Akure South Local Government were examined to do justice to the study. Likewise, the perception of the students on agriculture as a career choice and the teacher's attitudinal influence on the choice of agriculture as a career were determined.

METHODOLOGY

The study was carried out in Akure South local government area of Ondo State, Nigeria. Akure south local government area is located between latitude 700'Nand 7030'N of the equator and longitude 500'Eand 50301E of the Greenwich Meridian. The Local Government has an area of 331 square kilometres with population of 353,211 (NPC, 2006), and having 121 registered public and private secondary schools (Ondo State Ministry of Education, 2016).

A Multi-stage technique was used to select respondents from a population consisting of all Secondary School students offering agriculture in the Local Government Area. At the first stage, 10% of registered secondary schools (12 schools) in Akure South Local Government Area of Ondo State (6 privates and 6 public secondary schools) were purposively selected based on accessibility. Thereafter, random sampling was used to select fifteen (15) students offering agriculture as a course from each of the selected schools (9 SS3 students and 6 SS2 students) making one hundred and eight (108) SS3 students and seventy-two (72) SS2 students. In all, a total of one hundred and eighty (180) students were used for the study. Data were collected through the use of a well-structured questionnaire and the objectives were analysed using descriptive statistics and inferential statistics. The questionnaire elicited information on demographic on demographic characteristics of the students, perception and attitude to agriculture as a subject.

The perception of the students on agriculture as a career choice was measured by asking the students to show their level of agreement to some statements on a 5 point Likert-type scale with 5 = strongly agree, 4 = agree, 3 = undecided, 2 = disagree and 1 = strongly disagree, and reversed for negative statements in accordance with Chepllogoi et al. (2015). The mean cut off 3.0 was gotten and the perception index was done using descriptive statistics and mean statistic.

Similarly, in line with Ingram et al. (2018), the attitude of the teachers was determined by asking the students to affirm their agreement to various statements regarding their agricultural teacher's attitude to the course on a 5 point Likert-type scale with 5 = strongly agree, 4= agree, 3= undecided, 2 = disagree and 1 = strongly disagree, and reversed for negative statements. The mean cut off 3.0 was obtained and was used to judge if their attitude was favourable (≥ 3.0) or not favourable (<3.0) and vice versa for negative statements. The study also came up with two hypotheses:

H_{01} - There is no significant relationship between teacher's attitudinal influence and student's perception of agriculture as a career choice.

H_{02}: There is significant relationship between teacher's attitudinal influence and student's perception of agriculture as a career choice.

Hypothesis 1 was tested using Pearson product-moment correlation (PPMC) while hypothesis 2 was tested using chi-square analysis. Under hypothesis 1, the mean score for the attitudinal statements was computed and obtained in ratio level of measurement likewise the perception score. Accordingly, Pearson Product Moment Correlation (PPMC) was utilized to determine the relationship between the two variables for relationship testing at that level of measurement. Chi-square was used to test the relationship or association between the variables of interest in hypothesis 2 because variables were measured at the lowest level of measurement (nominal level).

RESULTS

A. Demographic Characteristics of Respondents

Table 1 shows that 56.7% of the respondents were male, which implies that there were more males offering agriculture as a course in secondary schools in the study area. The mean age of the students was 15 years. An indication that majority of the students will be in secondary school at that point. Also, the average number of children per family was 3 with 65.0% of them being the first or second child. This could influence a child's choice of career and parental consent to career choice (Liu, McMahon & Watson, 2015; Godleski & Ostrov, 2020).

Furthermore, the result in Table 1 reveals that majority (83.3%) of the respondents practiced Christianity as their religious belief. Also, 60.6% of the students were science-based students while the remaining 39.4% of students were non-science based. Many of the students offering agriculture as a course in the schools were science-based, while the non-science based (commercial and art students) were fairly represented in the course offering. This could be as a result of the influence of the school through the guidance and counseling unit. The result shows that only 50.6% of the students were willing to register or had registered agriculture as a course in the West African Senior School Certificate Examination (WASSCE). This implies that significant proportions of the students were offering the course for knowledge sake and not for certification. The majority (97.8%) of the students had parental support for their intended course of study in the tertiary institutions. This implies that most of the parents were satisfied with the career choice made by their children, this implies that there was no parental constraint/disagreement with the career choice of the students.

Table 1: Demographic characteristics of the respondent (N=180)

Variables	Frequency	Percentage	Mean
Gender			
Female	78	43.3	
Male	102	56.7	
Age			
13 – 14 years	36	20.1	
15 – 16 years	123	68.2	
17 - 18 years	21	11.7	15.3 years
Number of Children in family			
1 – 4	142	78.9	
5 – 8	38	21.1	3 children
Position in the family			
1st – 3rd position	145	80.6	
4th – 6th position	35	19.4	
Religion			
Christianity	149	83.3	
Islam	30	16.1	
Traditional	1	0.6	
Subject base			
Sciences	109	60.6	
Non-sciences	71	39.4	
Agriculture as a chosen course in SSCE			
No	89	49.4	
Yes	91	50.6	
Father's Occupation			
Teacher / Civil servant	70	38.9	
Trader / Artisan	54	30.0	
Private worker/self employed	56	31.1	
Mother's Occupation			
Teacher / Civil Servant	76	42.2	
Trader / Artisan	60	33.2	
Private worker/self employed	44	24.4	
Parent's support for the intended course of study			
No	4	2.2	
Yes	176	97.8	

Source: *field survey, 2016*

B. Students Intended Course of Study in the Higher Institution

The result shown in Figure 1 reveals that a higher percentage of the students had the intention of studying medicine and surgery (25.0%), engineering (11.1%), and law (10.6%) at higher institutions. However, a very low percentage (2.8%) intended for studying agriculture (agricultural-related fields) in higher institutions. This shows that the number of students interested in non-agricultural courses far outweighed those interested in agriculture. This implies that lesser young school leavers would opt-in for agricultural-related courses as a chosen course in the higher institutions which has serious implications for food security efforts of the government. This result is in tandem with the findings of Obayelu and Fadele (2019), who found that there was low percentage (4.6%) that showed willingness pursue agriculture in university among the student relative to other professional courses like medicine, engineering, and several others.

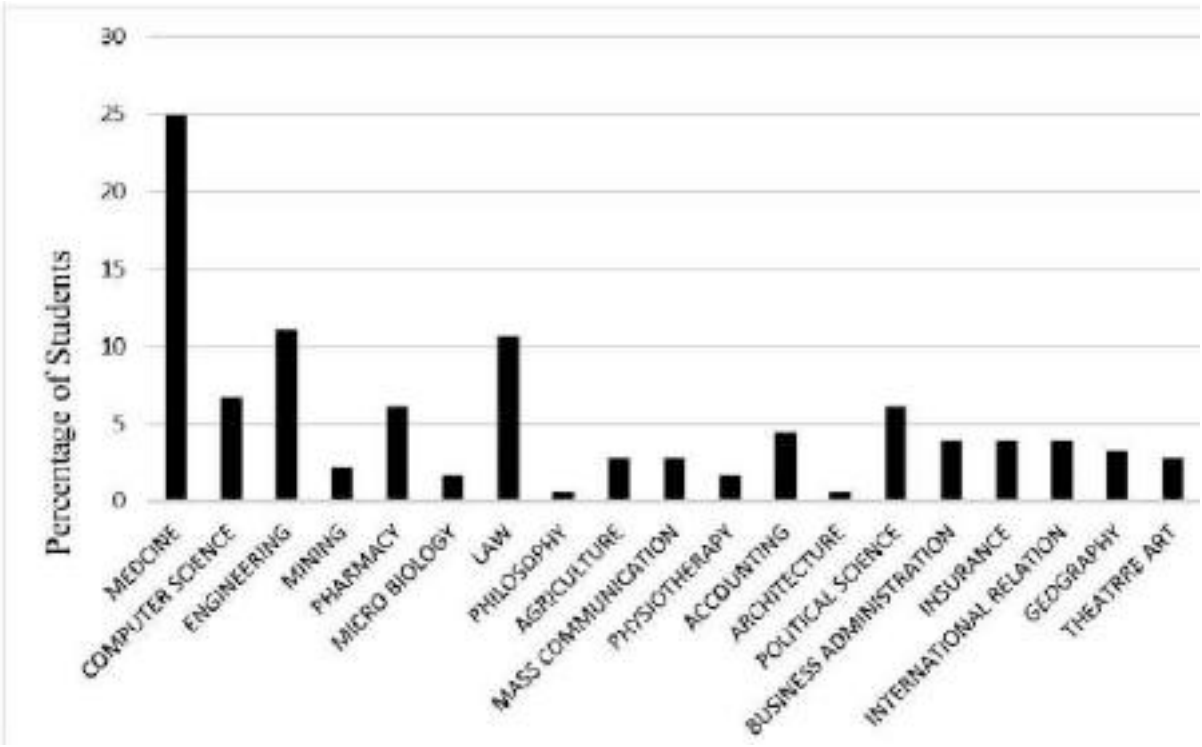

Figure 1: Percentage distribution of respondents according to the intended course of study in the higher institution (N=180)

C. Perception of Students on Agriculture as a Career Choice

The result in Table 2 shows the perception of the students about choosing agriculture as a career. The Perception was measured by asking the students to show their level of agreement to some statements on a 5-point Likert-type scale in accordance with Chepllogoi et al. (2015). The mean cut off 3.0 was gotten and the perception index was obtained. From Table 2, the students disagreed that agriculture is a poor man's job ($\bar{x} = 1.62$), choosing agriculture as a career is

the same as choosing to be poor ($\bar{x}$ = 1.67) and also disagreed with the statement 'agriculture should be left to the illiterate/ rural dwellers' ($\bar{x}$ = 1.50). The implication of this is that the students do not link this career with poverty or wretchedness and also do not hold the belief that only the less privileged and uneducated fellows should be left with the profession.

Moreover, the students have a positive disposition to agriculture as a career choice, as they disagreed with the fact that 'studying agriculture in the university is a waste of time' ($\bar{x}$ = 1.73). Similarly, the students disagreed that they could only study agriculture as a course ($\bar{x}$ = 2.60). This implies that the students were not only willing to offer it as a course but also could take it as a career. This was consolidated with their agreement to the statement that if agriculture becomes mechanized, they will take it up as a full-time career ($\bar{x}$ = 3.28). The implication of this is that the students are aware of the drudgery nature accrued to peasant farming and rather would prefer the mechanized system of farming which comes with ease.

Succinctly, the results shown in figure 2 shows that majority (88.3%) of the students were positively disposed towards agriculture as a career choice while only a few (11.7%) of the students had a negative perception about agriculture as a career choice. This indicates that the students could take up agriculture and its embedded disciplines as a career and course of choice in higher institutions because according to Balyan and Nenly (2015) and Johnson *et al.* (2015) perception of agriculture as a course and exposure to the sector determines the willingness to pursue agriculture as a career choice.

Table 2: Perception of students on agriculture as a career choice (N=180)

Statements	SA	A	U	D	SD	Mean
	%	%	%	%	%	
Agriculture is a poor man's job	3.9	3.3	3.9	28.9	60.0	1.62
Agriculture should be left to the illiterate, rural dwellers	-	4.4	4.6	23.3	65.6	1.50
Agriculture is all about farming	3.9	12.2	15.6	33.9	34.4	2.17
I can only study Agriculture as a course	6.7	6.1	36.1	33.9	17.2	2.51
Agriculture has too many risk involved	3.9	21.7	22.8	33.9	17.8	2.60
If Agriculture becomes mechanized, I will take it up as a full time career	21.7	27.8	18.9	20.6	11.1	3.28
Agriculture as a business is not very lucrative	8.3	10.6	30.6	23.9	28.7	2.50
Choosing agriculture as a career is the same as choosing to be poor	6.7	4.4	3.9	19.4	65.6	1.67
The future of the nation depends on the development of the agricultural sector	51.1	27.2	6.1	7.8	7.8	4.06
Studying Agriculture at university is a waste of time.	5.0	2.8	8.9	27.2	56.1	1.73

Source: *field survey, 2016* **SA**= Strongly agree, **A**= agree, **U**= undecided, **D**= disagree, **SD**= strongly disagree

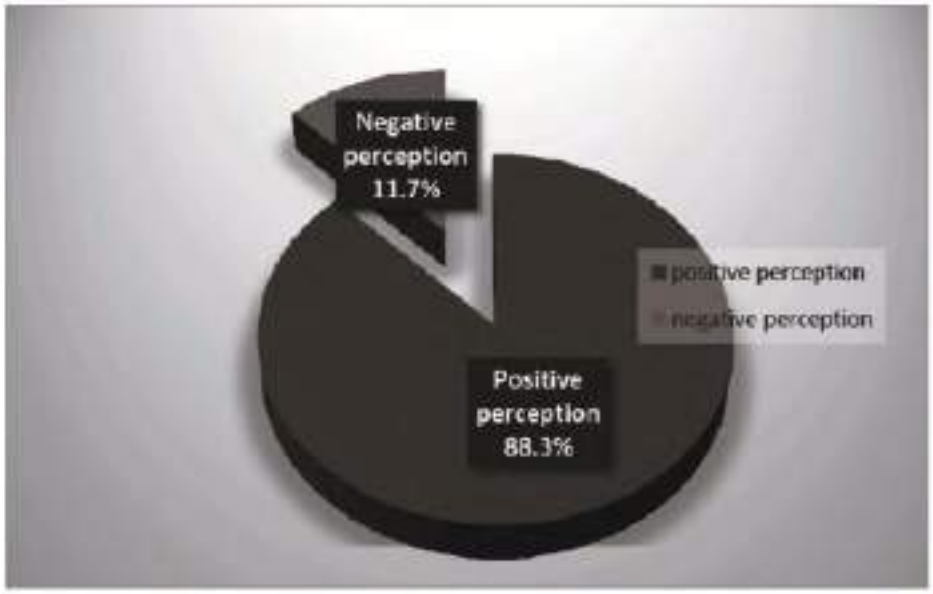

Figure 2: Perception Index of students about agriculture as a career choice (N=180)

D. Teacher's Attitudinal Influence on the Choice of Agriculture as a Career

Table 3 presents information about agricultural teacher's attitude influence on the choice of agriculture as a career. The result shows that the students judged their agricultural science teachers attitude favourable. About 82.3% of the students agree that friendly and good working relationships exist between the agricultural science teacher and students in their school. Also, 76.7% disagree that their agricultural science teacher is not effective in his/her teaching of the subject. This implies that the student's evaluation of their agricultural science teacher in terms of social interaction, mastery and delivery, and teaching effectiveness, were excellent and hence could influence their interest and decisions as regards the course, even to the extent of its choice as a career/course of study in the higher institution.

Furthermore, 80.5% of the students agreed that their agricultural science teachers expose them to career opportunities in agriculture by exposing them to several areas where they could specialize and be gainfully employed in the sector. This implies that their teachers stimulate and arouse their interest for a career in agriculture. This could be the reason for the positive perception towards agriculture as a career choice as seen in figure 2 above. The mean scores above the set cut off 3.0 for positive statements and the reverse for negative statements showed that the teachers' attitudes towards the students and towards the course through their approaches were perceived favourable by the students. Hence this could influence their choice of a career in agriculture.

Table 3: Percentage distribution of teacher's attitude influence on the choice of agriculture as a career (N=180)

Statement	SA (%)	A (%)	U (%)	D (%)	SD (%)	Mean
A friendly and good working relationship exists between the Agricultural science teacher and students in my school	51.7	30.6	7.8	6.7	3.3	4.21*
My Agricultural science teacher is not effective in his teaching	6.1	7.8	9.4	26.7	50.0	1.93*
My Agricultural science teacher is too strict and does not encourage interaction in class	6.7	6.1	12.2	20.0	55.0	1.89*
Communicates to us simply and fluently during the teaching in my school	54.4	20.0	13.3	5.0	7.2	4.09*
My Agricultural science teacher exposes us to career opportunities in agriculture	56.1	24.4	7.2	6.1	6.1	4.18*
My Agricultural science teacher is lazy and motivate to teach	6.1	4.4	8.9	22.8	57.8	1.78*
My Agricultural science teacher makes study of agricultural science boring and uninteresting	5.6	7.7	3.3	27.8	55.6	1.83*
My Agricultural science teacher is usually interested in solving any problem I have in the subject	45.6	29.4	14.4	2.8	7.8	4.02*
My Agricultural science teacher usually ask us questions that stimulate our thought or make us reason well in class	44.4	34.4	7.2	5.6	8.3	4.01*
All we do in my agricultural science class is to write notes	13.9	6.1	4.4	36.1	39.4	2.19*

Source: *field survey, 2016*

SA= Strongly agree, **A**= agree, **U**= undecided, **D**= disagree, **SD**= strongly disagree * = favourable attitude

E. Test of Hypotheses

H_{01}: There is no significant relationship between teacher's attitudinal influence and student's perception of agriculture as a career choice.

The result of the Pearson Product Moment Correlation in Table 4 shows that there was low, positive but significant relationship ($r = 0.245$, $p < 0.05$) between the teacher's attitudinal influence and student's perception of agriculture as a career choice. This implies that students' perception of agriculture as a career choice is influenced by the agricultural science teachers' approach to the subject and attitude to students. The positive relationship connotes that the stronger their perception about their agriculture teacher's attitudes, the more the students' interest in agriculture as a career choice. This result supports the assertion of Adedapo *et al.* (2014) who asserted that guidance/ teacher's role highly ranked (second) among factors influencing career choice of agriculture in their study in India.

Table 4: Correlation between teacher's attitudinal influence and student's perception of agriculture as a career choice (n=180).

Variables	r-value	p-value
Teacher's attitudinal influence vs. student perception of agriculture as a career choice	0.245	0.001*

Source: *field survey, 2016*

* Significant at 0.05 level (5%)

H_{02}: There is no significant association between the demographic characteristics of the students and perception of the students about agriculture as a career choice.

Result of the chi-square relationship in Table 5 shows that there was significant association between religion ($\chi 2 = 8.040$, $p < 0.05$), subject base ($\chi 2 = 4.050$, $p < 0.05$) and perception of the students about agriculture as a career choice. This implies that religion and the subject base (that is whether a science student or non-science students) can influence students' perception about agriculture as a

career choice. Religion could serve as an influence because some individuals contact their religious leaders or deity on the choice of actions and careers of choice, a position supported by Stark and Bainbridge (1985) who believe that religion is an important and influential factor for individuals and society. Also, the subject base of the student could shape the perception of the students about agriculture as a career choice because of the other choices available in their subject base and the linkages with other courses they offer. Fabiyi *et al.* (2015) found that the class of students/subject base had a significant association with students' choice of agriculture as a career. Other selected demographic characteristics have no significant association with students' perception about agriculture as shown in Table 5.

Table 5: Association between demographic characteristics of students and their about agriculture as a career choice.

Variables	χ^2 value	Df	Sig. (p-value)
Gender	0.046	1	0.830
Religion	8.040	2	0.018*
Subject base	4.050	1	0.044*
Interest for registration for agriculture at WASSCE	0.261	1	0.610
Father's occupation	4.731	4	0.316
Mother's occupation	5.640	4	0.228
Parental support for the intended course of study	0.623	1	0.430

Source: *field survey, 2016* * Significant at 0.05 level (5%)

DISCUSSIONS

The study assessed the perception of secondary school students in Akure South Local government area about agriculture as a career choice, and also determined the influence of teachers' attitudes on such perception. The mean age of the students was 15 years and very few (2.8%) of the students have the intention of choosing agriculture as a course of study in the higher institution. Obayelu and Fadele's (2019) and Fadeyi et al. (2015) supported the findings. Majority of the students opted for agriculture as the last resort because agriculture has been undignified with decades of neglect by the various arms of government. Also, many of the students offering agriculture as a course in the schools were science-based, while the non-science based were fairly represented. This could be as a result of the influence of the school through the guidance and counseling unit which has implication for food self-sufficiency in the country. The more youth in agriculture in the country, the better for the economy as agricultural productivity would be enhanced. Growing youth unemployment in the country, ageing farmers and diminishing crop yield under subsistence farming approach indicate that youth engagement in agriculture should be prioritized.

The study also reveals that the students judged their agricultural science teachers' attitude and approach to the course favourable and hence, it was found to have a positive correlation with their perception. Religion and subject base were identified as the demographic characteristics that could influence students' perception of agriculture as a career choice. However, the students had a positive perception of agriculture as a career option, although majority of them were not intending to pick up a career in this field. Other factors such as gender, parents' occupation, and parental support were not significant.

Hence this study recommends that collaborative and concise efforts should be made by educational bodies, agricultural experts, the media and Non-governmental organization (NGOs) to stimulate the choice of agriculture as a career by students, leveraging on their positive perception of agriculture as a career choice. Tertiary

institutions should engage in routine sensitization on the need to be food secure as a country and building interest in agriculture as the pathway to food security. Religious leaders also could be sensitised on the importance of agriculture in the development of a nation. In addition, government should connect young entrepreneurs with investors, local and international organisations such as the IFAD and Global Youth Business Incubator to enhance their productivity. The IFAD has many different projects that establish and strengthen micro-lending institutions that give young men and women the jump-start they need for their business. Government should intensify efforts on the Youth Employment in Agriculture Program (YEAP), The Youth Initiative for Sustainable Agriculture (YISA), and Graduate Farmer's Scheme.

CONCLUSION

The influence of perception of students and attitude of teachers towards Agriculture as a Career Choice in Akure South Local Government Area, Ondo State is the focus of this study. One hundred and eighty (180) respondents from twelve secondary schools were involved in the study. About 97.8% students had parental support on their intended study subject while only 2.8% of the students indicated to take up a career in agricultural field. The agricultural teachers' attitude was adjudged favourable by the students and there was a positive relationship between teacher's attitudinal influence and student's perception of agriculture as a career choice. Also, a positive association between gender, subject base of the students and their perception of agriculture as a career choice existed. Stimulation of the youth on the choice of agriculture as a career, youth sensitization on the need for the country to be food secure and an enhanced youth participation and engagement in agriculture are the recommended pathways to food security. Establishment of linkages between young entrepreneurs, investors, local and international organisations are germane as well as intensifying efforts on youth empowerment programmes in the country.

REFERENCES

Abdul-Lateef, A.L. and Sharifah, N.A. (2015) The Impacts of Integrated Youth Training Farm as a Capacity Building Center for Youth Agric. Empowerment in Kwara State, Nigeria. *Mediterranean Journal of Social Science* 6(5)

Adebayo, O. and Olagunju, K. (2015) "Impact of Agricultural innovation on improved livelihood and productivity outcomes among smallholder farmers in Rural Nigeria. A paper prepared for presentation at the 5th MSM Annual Research conference. Managing African Agriculture: Markets, Linkages and Rural Economic Development. 4th September. MSM, Maastricht. The Netherlands.

Adebo, G.M and Sekunmade A. B. (2013). Determinants of career choice of agricultural profession among the students of the faculty of Agricultural Sciences in Ekiti State University, Nigeria, *Journal of Agricultural Extension and Rural Development,* 5(11): 249-255.

Adedapo, A. O., Sawant, P. A., Kobba, F. and Bhise, R. N. (2014). Determinants of Career Choice of Agricultural Profession among the Students of College of Agriculture in Maharashtra State, India, *IOSR Journal of Agriculture and Veterinary Science*, 7(9): 12-18.

Adesina, A. (2012). Transforming Agriculture to Grow Nigeria's Economy. Convocation Lecture delivered at the Obafemi Awolowo University, Ile-Ife by Honourable Minister of Agriculture and Rural Development. December 13.

Akanbi, F. E and Adetunji, A. T. (2016) Importance of Manpower Training to Enhance Productivity of Staff Performance, *International Research Journal of Management, IT and Social Sciences*, 3(3): 123-131.

ATASP-Phase1(2015) Outreach programme

Awoniyi, S.O.M., T. G. Apata, O. A. Igbalajobi, S. Fakayode, R. Sanusi, B.

Olorunfemi and S. Ogunjimi (2018): Malaria and Agriculture: Evidence of relationship and labour/income loss among rural rice-farming households in Nigeria. *Research on Crops Journal* Vol. 19, (2) 353 – 364.

Baliyan, S. P., and Nenty, H. J. (2015). Factors Underlying Attitudes Towards Agriculture as Predictors of Willingness to Enrol in the Subject by Senior Secondary Students in Botswana, *Journal of Educational and Social Research*, 5: 377-387.

Baliyan SP, Nenty HJ. (2015). Factors underlying attitude towards agriculture as predictors of willingness to enrol in the subject by senior secondary students in Botswana. Journal of Educational and Social Research; 5 (1): 377-386

Berazneva, J. and Lee, D.R. (2013). Explaining the African Food Riots of 2007-2008: An Empirical Analysis. *Food Policy,* 39: 28-39.

Baliyan SP, Nenty HJ. (2015). Factors underlying attitude towards agriculture as predictors of willingness to enrol in the subject by senior secondary students in Botswana. Journal of Educational and Social Research; 5 (1): 377-386.

Fabiyi, E. F., Obaniyi, K. S., Olukosi, J. O. and Oyawoye, E. O. (2015). Assessment of Secondary School Student's Perception and Attitude to the Study of Agriculture, Omu- Aran, Kwara State, Nigeria. *Case Studies Journal,* 4(8): 96-101.

FAO (2014). Youth and agriculture: Key challenges and concrete solutions. Published by the Food and Agriculture Organization of the United Nations (FAO) in collaboration with the Technical Centre for Agricultural and Rural Cooperation (CTA) and the International Fund for Agricultural Development (IFAD).

FAO (2015). Global Hunger Index, (2015). An IFPRI Initiative. http://ghi.ifpri.org/countries/NGA Filmer, D. and Louise, F. (2014). Youth Employment in Sub-Saharan Africa. Africa Development Series. Washington, DC: World Bank. doi:10.1596/978-1-4648-0107-5.

FMARD (2016) The Agriculture Promotion Policy (2016-2020): Building on the success of the Agricultural Transformation Agenda, Closing key gaps. Federal ministry of Agriculture and Rural Development.

Federal Ministry of Water Resources (2011) The Nigeria Water Sector Roadmap. Federal Government of Nigeria.

Godleski, S.A and Ostrov, J.M. (2020). Parental Influences on Child Report of relational Attribution Biases During Early Childhood. *Journal of Experimental Child Psychology*, 192 (2020) 04775 pp 1-17 https://doi.org/10.1016/j.jecp.2019.104775

PGDA (2010). Nigeria: The Next Generation Report. Havard Program on the Global Demography of Aging, Working Paper Series No 62. October 2010.

Johnson, A. O., Johnson, A. and Macauley, A. (2015). Agriculture as a Career Option for Senior Secondary School Students in the Southern Province of Sierra Leone, *Journal of Education and Review,* 3: 194-199.

Liu, J., McMahon, M., and Watson, M. (2015). Parental Influence on Child Career Development in Mainland China: A Qualitative Study. *The Career Development Quarterly*. Vol 63 (2) pp 74 – 87.

Mitchell, L. K., and J. D. Krumboltz. 1990. "Social Learning Approach to Career

UNCTAD (2016). Development and Globalization: Facts and Figures. United Nations Conference on trade and Development

World Bank (2020) World Bank collection of development indicators, accessed on 16/05/2020

National Bureau Statistics (NBS) (2017). Annual Abstracts of Statistics; 2017.

Nwankpa, N. N (2017) Sustainable Agricultural Development in Nigeria: A Way Out of Hunger and Poverty, *European Journal of Sustainable Development* 6 (4): 175-184.

Nwozor, A., Olanrewaju, J. S. and Ake M. B. (2019). National Insecurity and the Challenges of Food Security in Nigeria, *Academic Journal of Interdisciplinary Studies,* 8(4): 9-20.

Obayelu, O. A., and Fadele, I. O. (2019). Choosing a Career Path in Agriculture: A Tough Calling for Youths in Ibadan Metropolis, Nigeria, *Agricultura Tropica et Subtropica*, 52 (1): 27-37.

Obi, C. J. (2005). A Critique of vocational Agricultural Education in Nigeria senior Secondary Schools. *Journal of Home Economics Research,* 6(2): 57-61.

Pelzom T., Katel O. (2017). Youth Perception of Agriculture and Potential for Employment in the context of rural development in Bhutan. Development, Environment and Foresight; 3 (2): 92-107. (ISSN: 2336-6621).

Pindado, E., and M. Sánchez. (2017). Researching the Entrepreneurial Behavior of new and Existing Ventures in European Agriculture, *Small Business Economics*, 49: 421–444.

Popoola, N. (2018). Nigeria Cut Food Imports, Saved $21bn in 34 months-Emefiele, Punch. https://punchng.com/nigeria-cut-food-imports-saved-21bn-in-34-months-emefiele/, accessed on March, 23rd 2020.

Sertoglu, K., Vigiral S., and Bekun F. S. (2017). The Contribution of Agricultural Section on Economic Growth of Nigeria. *International Journal of Economics and Financial Issues,* 7(1), 547-552.

Stark, R. & Bainbridge, W.S. (1985).*The future of religion: Secularization, revival and cult formation.* Berkeley, CA: University of California Press.

Statista. (2018). Nigeria: Sectoral distribution of GDP, 2007-2017. Retrieved from http://www.statista.com, accessed on 4th April, 2019.

UNESCO (2016). Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators. Note by the Secretary-General. Forty-seventh session of the Statistical Commission. United Nations Economic and Social Council. E/CN.3/2016/2/Rev.1.Available at http://unstats.un.org/unsd/statcom/47th-session/documents/

Decision Making: Krumboltz's Theory," In Career Choice and Development: Applying Contemporary Theories to Practice, edited by D. Brown and L. Brooks, 26-43. Washington, DC: Jossey-Bass.

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