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(6) Results.

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CONTENTS

Developing a Portable Reading Machine for the Blinds

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Abstract: Prevalence of the causes of blindness, especially cataract, is alarming and most sighted people may get it in their old age. Most blind do not have access to readily transliterated documents such as instructions on food packaging, medication and newspapers. Hitherto existing touch-based methods of Moon and Braille for text cognition by the blind and visually impaired are no longer acceptable technologically. In this work, a reading machine for the blind and visually impaired has been developed enabling them to read novels, newspapers, books and letters. In the development, scanner, optical character recognition, and text-to-speech technologies were employed. The Fourier Transform was involved in signal and image processing. Software implementation made use of XML-based speech synthesis markup language. Orientation of the document/paper does not matter during the scanning process. The SSML (Natural reader software) can still identify the right position of words and read them in a natural sounding voice. Li-Ion batteries used give high energy density and higher voltage ensuring reliability. With the implementation of the reading machine developed, information should be carried indiscriminately to the blind and visually impaired [The Journal of American Science. 2010;6(1):1-14]. (ISSN: 1545-1003).

Key words: the blind; portable reading machine; natural reader software; Fourier transformation; visually impaired.

1. Introduction

Blindness is particularly devastating in the developing world where it has a profound impact on the quality of life for the blind person and his or her community. Life expectancy of the blind is usually less than half that of someone with eyesight the same age. The desperateness of this situation is augmented by the fact that a blind person is unable to contribute to the family income. Not only does blindness mean a father is unable to work, or a mother cannot collect water or go to market, but someone with eyesight must care for him or her. Effectively two income producing individuals are lost. This creates a devastating economic impact on the family and the community. Restored eyesight allows the individual to return to a normal life of work and a traditional role in the family.

In Ghana, about 4.4% of the population is blind and people above the age of 50 years experience low vision. Pitifully enough, many novels, newspapers, books and letters are not readily transliterated into Braille to convey the information to the blind. Means of communication between the sighted and the blind is chiefly vocal. Therefore, the need for a reading machine is paramount. Out of the 20 million people living in Ghana, it is estimated that 200,000 are blind and over 600,000 more people are visually impaired. Thus, blindness is affecting about 4.4 % of the Ghanaian population and people beyond the age of 50 years experience low vision (Dogbe, 2004). A cross-sectional drawing of the eye is given in Figure 1.

Blindness is the total or partial inability to see due to disease or disorder of the eye, optic nerve, or brain (Microsoft Encarta, 2007). The term blindness typically refers to vision loss that is not correctable with eyeglasses or contact lenses (Microsoft Encarta, 2007). Blindness may not mean a total absence of sight, because, some people who are considered blind may be able to perceive slowly moving lights or colors. The term low vision is used for moderately impaired vision. People with low vision may have a visual impairment that affects only central vision (the area directly in front of the eyes) or peripheral vision (the area to either side of and slightly behind the eyes). Some people with low vision are able to function with their remaining sight while others need help to learn to use their sight more efficiently with training and special tools

Color blindness, for example, does not reduce visual acuity and should more accurately be called color-perception deficiency. Color blindness occurs almost exclusively in males, and the most common form is the inability to differentiate between certain shades of red and green. Night blindness, the inability to see in low levels of light, is commonly associated with a lack of vitamin A in the diet or with inherited diseases such as retinitis pigmentosa, a condition involving progressive degeneration of the eye's retina and abnormal deposits of pigment. In Ghana about a million people are blind (Dogbe, 2004).

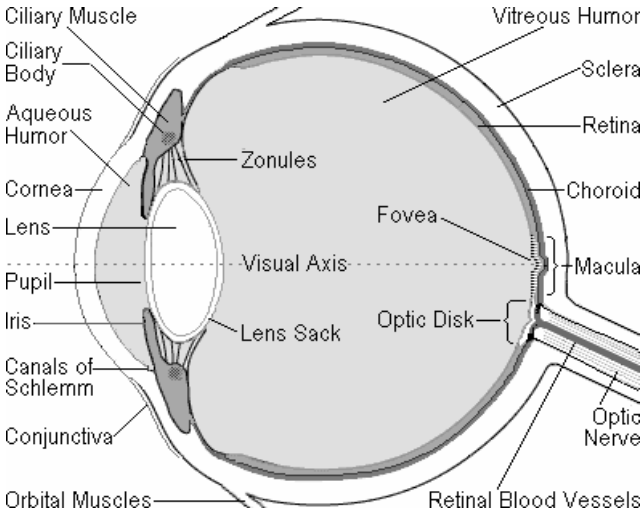

Figure 1. Cross sectional drawing of the eye (side view)

In spite of the progress made in surgical techniques in many countries during the last ten years, cataract (47.9 %) remains the leading cause of visual impairment in all areas of the world, except for developed countries (WHO, 2009a). With the exception of age-related macular degeneration (AMD), the rest are the causes of avoidable visual impairment worldwide. However, in developed countries, AMD is the leading cause of blindness, due to the high life expectancy of over 70 years of age. In the least-developed countries, and in particular Sub-Saharan Africa, the causes of avoidable blindness are primarily, cataract (50 %), glaucoma (15 %), corneal opacities (10 %), trachoma (6.8 %), childhood blindness (5.3 %) and onchocerciasis (4 %) (WHO, 2009a). In Table 1 is given the global estimate of visual impairment.

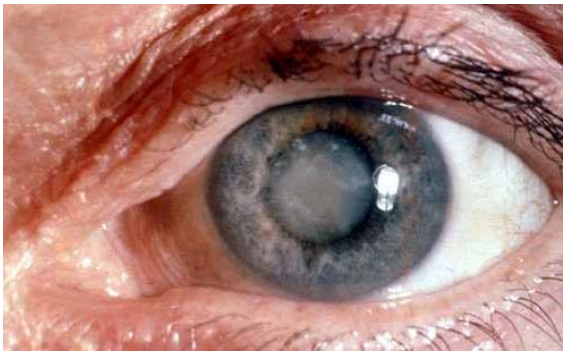

Figure 2. An eye with cataract (Source: Microsoft Encarta reference library, 2007)

1.1 Causes of Blindness and Visual Impairment

1.1.1 Cataracts of the Eye

Cataracts are formed in the lens of the eye which is behind the black dot (pupil) in the middle of the eye. It is a clouding of the lens, which prevents a clear, sharp image being produced. A cataract forms because the lens is sealed in a capsule (pupil as shown in Fig. 1) and as old cells die they get trapped in the capsule, with time this causes a clouding over of the lens (Fig. 2.). This clouding results in blurred images. This is when the lenses become opaque meaning that no light goes through.

1.1.2 Glaucoma of the Eye

Another disease is called glaucoma (Figure 3). The most common type of this disease occurs in people who are 40 years or older and the other type occurs in babies when they are born. The eye produces a clear fluid (aqueous humor) from the lacrimal gland that fills the space between the cornea and the iris as shown in 3. This fluid produces tears to clean, moisten and lubricate the eyes and then drains the excess fluid into the nose through a complex drainage system. It is the balance between the production and drainage of this fluid that determines the eyes intraocular pressure (IOP).

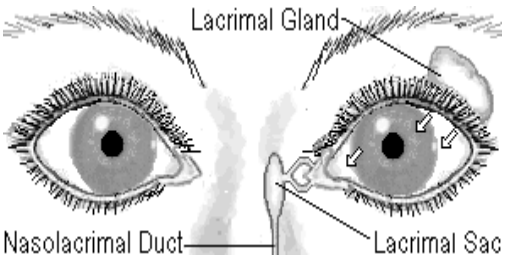

Figure 3. Glaucoma of the eye

1.1.3 Trachoma of the Eye

Trachoma popularly known in Ghana as "Apollo" is one of the oldest infectious diseases known to mankind. It is caused by Chlamydia trachomatis – a micro organism which spreads through contact with eye discharge from the infected person (on towels, handkerchiefs, fingers, etc.) and through transmission by eye-seeking flies. After years of repeated infection, the inside of the eyelid may be scarred so severely that the eyelid turns inward and the lashes rub on the eyeball, scarring the cornea (the front of the eye). If untreated, this condition leads to the formation of irreversible corneal opacities and blindness.

1.1.4 Age-Related Macular Degeneration

Macular degeneration makes people not see things at the center of their field of vision. This is a degenerative condition of the macula (the central retina). It is caused by the hardening of the arteries that nourish the retina. This deprives the retinal tissue of the nutrients and oxygen that it needs to function and causes deterioration in central vision. This disease cuts off the circulation of blood in the center of the retina. It can be treated with a laser. This loss of sight often occurs as people's age increases.

1.1.5 Diabetic Retinopathy

Diabetic retinopathy happens to people who have diabetes mellitus for a few years. Diabetes changes the blood vessel of the retina. The retina is the part of the eye that absorbs light rays. Sometimes the blood vessels will burst and cause bleeding in the eye. Sometimes the retina is detached from the back of the eye. Another case is when fluid leaks from capillaries in the retina. If your retina is detached or you have bleeding in the eye the clear fluid fills the center of the eye that can cause blindness.

1.2 Distribution of Visual Impairment

Visual impairment distribution is done according to age, gender, and geographical location factors.

1.2.1 Age

Visual impairment is unequally distributed across age groups. More than 82 % of all people who are blind are 50 years of age and older, although they represent only 19% of the world's population. Due to the expected number of years lived in blindness (blind years), childhood blindness remains a significant problem, with an estimated 1.4 million blind children below age 15 (WHO, 2009b).

1.2.2 Gender

Available studies consistently indicate that in every region of the world, and at all ages, females have a significantly higher risk of being visually impaired than males (WHO, 2009b).

1.2.3 Geographical Location

Visual impairment is not distributed uniformly throughout the world. More than 90% of the worlds visually impaired live in developing countries (WHO, 2009b).

1.3 Reading Techniques

Reading is an activity characterized by the translation of symbols, or letters, into words and sentences that have meaning to the individual. The ultimate goal of reading is to be able to understand written material, to evaluate it, and to use it for one's needs. Reading exposes people to the accumulated wisdom of human civilization. Mature readers bring to the text their experiences, abilities, and interests; the text, in turn, allows them to expand those experiences and abilities and to find new interests. In order to read, one must follow a sequence of characters arranged in a particular spatial order. For example, English flows from left to right, Hebrew from right to left, and Chinese from top to bottom. The reader must know the pattern and use it consistently.

Ordinarily, the reader sees the symbols on a page, transmit the image from the eye to the brain and pronounce them in the mind or aloud through the vocal cavity. However, reading techniques for the blind namely the Moon and the Braille are quite different from the sighted person. The technique employed by a blind is shown in Figure 4.

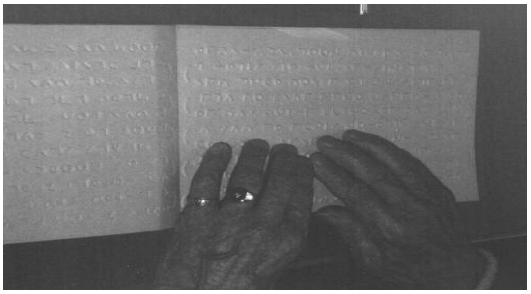

Figure 4. A person reading moon or braille.
(Source: Microsoft Encarta library, 2007)

Table 1. Global estimate of visual impairment

	African Region	Region of the Americas	Eastern Mediterranean Region	European Region	South-East Asia Region	Western Pacific Region	Total
Population	672.2	852.6	502.8	877.9	1,590.80	1,717.50	6,213.90
Number of blind people	6.8	2.4	4	2.7	11.6	9.3	36.9
Percentage of total blind	18 %	7 %	11 %	7 %	32 %	25 %	100 %
Number with low vision	20	13.1	12.4	12.8	33.5	32.5	124.3
Number with visual impairment	26.8	15.5	16.5	15.5	45.1	41.8	161.2

(Source: WHO, 2009b)

1.3.1 Braille

Braille is a writing system which enables blind and partially sighted people to read and write through touch. It was revised by Louis Braille (1809-1852), a French teacher of the blind. It consists of patterns of raised dots arranged in cells of up to six (6) dots in a 3 x 2 configuration as shown in Figure 5. Braille has been adapted to writing many different languages including even Chinese, and is also used for musical and mathematical notations. Each cell represents a letter, numeral or punctuation mark. Some frequently used words and letter combinations also have their own single cell patterns.

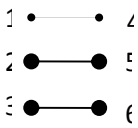

Figure 5. Six dots in 3 × 2 configuration

Braille can be categorized into the grades 1, 2, and 3. Grade 1 consists of the 26 standard letters of the alphabet and punctuation. It is only used by people who are first starting to read Braille. Secondly**,** grade 2 consists of the 26 standard letters of the alphabet, punctuation and contractions.

The contractions are employed to save space because a Braille page cannot fit as much text as a standard printed page. Books, signs in public places, menus, and most other Braille materials are written in Grade 2 Braille. Last but not least grade 3 which is used only in personal letters, diaries, and notes. It is a kind of shorthand, with entire words shortened to a few letters.

(1) Formation of Letters of the Alphabet in Brail

The formation of letters of the alphabet is best organized as: letters from A – J which are the first ten (10) upper dots followed by the letters from K – T which are letters formed by adding dot three (3) to each of the first ten letters, letters of from U – Z are formed by adding dot six (6). Table 2 gives the summary of table representation of basic letters and abbreviations of some words. Braille representation of words and abbreviations is presented in Table 3.

Table 2. Summarized table representation of basic letters

a	b	c	d	e	f	g	h	i	j	k	l	m

(Source: Anon, 1999a)

Table 3. Braille representation of words and abbreviations

a	but	can	do	every	from	go	have	just	knowledge	like	more	not
people	quite	rather	so	that	us	very	will	it	you	as	and	for
of	the	with	child/ch	gh	shall/sh	this/th	which/wh	ed	er	out/ou	ow	bb
cc	dd	en	gg; were	in	st	ing	ar					

(Source: Anon, 1999a)

(2) Sample Texts in Braille

The Braille text below in Figure 6 is transliterated to mean, “Be kind to others”

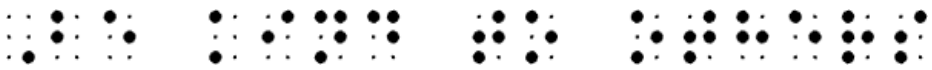

Figure 6. Braille representation of "Be Kind to Others"

Braille text in Figure 7 below is the article 1 of the universal declaration of human rights.

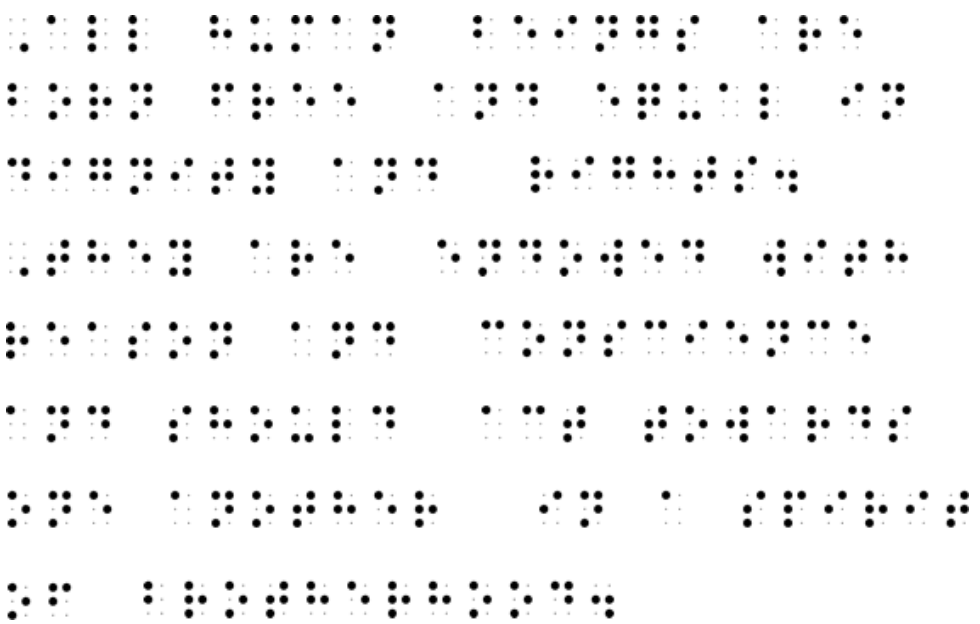

Figure 7. Article 1 of the universal declaration of human rights in Braille (Source: Anon, 1999a)

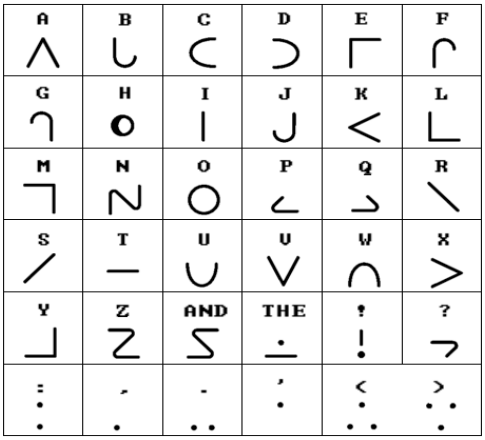

Figure 8. The moon alphabets (Source: Anon, 1999b)

The text in Figure 7 is transliterated as "All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood."

1.3.2 The Moon Alphabets

The Moon system of embossed reading was invented in 1845 by Dr William Moon of East Sussex. The Moon is a simple method of reading based upon the standard alphabet. The Moon alphabet is made up of 14 characters used at various angles, each with a clear bold outline. For many elderly blind people especially, Moon is easier than the more complex Braille system, although many people gain confidence from learning Moon to move onto Braille. The Moon alphabets are presented in Figure 8.

2. Materials and Methods

2.1 Signal Processing and Reading Machine Technologies

Signal processing is the extraction of information bearing attributes from measured data, and any subsequent transformation of those attributes for the purposes of detection, estimation, classification, or waveform synthesis. It is observed that the signals typically used in signal processing are functions of time, such as temperature measurements, velocity measurements, voltages, blood pressures, earth motion, and speech signals. Most of these signals are initially continuous signals (also called analogue signals) which are measured by sensors that convert energy to electricity. Some of the common types of sensors used for collecting data are microphones, which measure acoustic or sound data; seismometers, which measure earth motion; photocells, which measure light intensity;

optical scanners, which measure printed character representation; thermistors, which measure temperature; and oscilloscopes, which measure voltage.

When continuous electrical signals are collected from sensors, the continuous signal is converted to a digital signal (a sequence of values) with a piece of hardware called an analogue-to-digital (A/D) converter. Once digital signals are collected, computer could be applied to digital signal processing (DSP). These DSP techniques are designed to perform a number of operations such as: removing noise that is distorting the signal, extracting information from the signal, separating components of the signal, encoding the information in a more efficient way for transmission, detecting information in a signal just to mention a few of signal processing techniques. For some applications, an analog or continuous output signal is needed, and thus a digital-to-analogue (D/A) converter is used to convert the modified digital signal to a continuous signal. Another device called a transducer can be used to convert the continuous electrical signal to another form; for example, a speaker converts a continuous electrical signal to an acoustical signal.

In this section the three basic signals processing techniques for a reading machine are presented first from a theoretical point of view, secondly from an implementation point of view, and lastly from an applications point of view. The theoretical point of view includes the development of mathematical models and the development of software algorithms and computer simulations to evaluate and analyze the models both with simulated data and with real data. Real-time implementation can use VLSI (very large scale integration) techniques, with commercial DSP chips, or it can involve custom design of chips, MCMs (multichip modules), or ASICs (application-specific integrated circuits).

2.2 Mathematical Model: Fourier Transform

The Fourier transform is a mathematical tool that is used to expand signals into a spectrum of sinusoidal components to facilitate signal analysis and system performance. The Fourier transform is also used for spectral analysis, or for spectrum shaping that adjusts the relative contributions of different frequency components in the filtered result. In other applications the Fourier transform is important for its ability to decompose the input signal into uncorrelated components, so that signal processing can be more effectively implemented on the individual spectral components. Decorrelating properties of the Fourier transform are important in frequency domain adaptive filtering, sub band coding, image compression, and transform coding.

Classical Fourier methods such as the Fourier series and the Fourier integral are used for continuous-time (CT) signals and systems, i.e., systems in which the signals are defined at all values of t on the continuum $-\infty < t < \infty$. A more recently developed set of discrete Fourier methods, including the discrete-time (DT) Fourier transform and the discrete Fourier transform (DFT), are extensions of basic Fourier concepts for DT signals and systems. A DT signal is defined only for integer values of n in the range $-\infty < t < \infty$. Fourier methods are particularly useful as a basis for digital signal processing (DSP) because it extends the theory of classical Fourier analysis to DT signals and leads to many effective algorithms that can be directly implemented on general computers or special-purpose DSP devices.

2.2.1 Classical Fourier Transform for CT Signals

The CT Fourier transform is useful in the analysis and design of CT systems, i.e., systems that process CT signals. Fourier analysis is particularly applicable to the design of CT filters which are characterized by Fourier magnitude and phase spectra, i.e., by $|H(j\omega)|$ and arg. $H(j\omega)$, where $H(j\omega)$ is commonly called the frequency response of the filter.

A CT signal $s(t)$ and its Fourier transform $S(j\omega)$ form a transform pair that are related by the equation (1) for any $s(t)$ for which the integral (1a) converges (Madisetti and Williams, 1999):

$$s(j\omega) = \int_{-\infty}^{\infty} s(t)\, e^{-j\omega t}\, dt \qquad (1a)$$

$$s(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} s(j\omega)\, e^{j\omega t}\, dt \qquad (1b)$$

Equation (1a) is simply called the Fourier transform, whereas Eq. (1b) is called the Fourier integral. The relationship $S(j\omega) = F\{s(t)\}$ denotes the Fourier transformation of s(t), where F{} is a symbolic notation

for the integral operator and where ω is the continuous frequency variable expressed in radians per second. A transform pair $s(t) \leftrightarrow S(j\omega)$ represents a one-to-one invertible mapping as long as s(t) satisfies that condition which guarantee that the Fourier integral converges.

The operation of uniformly sampling a continuous time signal s(t) at every T sec is characterized by Eq. 2 presented below:

$$s_a(t) = \sum_{n=-\infty}^{\infty} s_a(t)\,\delta(t-nT) = \sum_{n=-\infty}^{\infty} s_a(nT)\,\delta(t-nT) \quad (2)$$

Where, $\delta(t)$ is a symbol used to denote a CT impulse function that is defined to be zero for all $t \neq 0$, undefined for $t = 0$, and has unit area when integrated over the range: $-\infty < t < \infty$. Since $s_a(t)$ is in fact a CT signal, it is appropriate to apply the CT Fourier transform to obtain an expression for the spectrum of the sampled signal:

$$F\{s_a(t)\} = F\{\sum_{n=-\infty}^{\infty} s_a(nT)\,\delta(t-nT)\} = \sum_{n=-\infty}^{\infty} s_a(nT)[e^{j\omega T}]^{-n} \quad (3)$$

Since the expression on the right-hand side of Eq. (3) is a function of $e^{j\omega T}$ it is customary to express the transform as $F(e^{j\omega T}) = F\{s_a(t)\}$. If ω is replaced with a normalized frequency, $\omega' = \omega / T$, so that $-\pi < \omega' < \pi$, then the right side of Eq. 3 becomes identical to the discrete time Fourier transform that is defined directly for the sequence $s[n] = s_a(nT)$ (Madisetti and Williams, 1999).

2.2.2 DT Fourier Transform

The DT Fourier transfom (DTFT) is obtained directly in terms of the sequence samples s(n) by taking the relationship obtained in Eq. (3) to be the definition of the DTFT. By letting T = 1 so that the sampling period is removed from the equation and the frequency variable is replaced with a normalized $\omega' = \omega T$, the DTFT pair is defined by Eq. (4). In order to simplify notation it is not customary to distinguish between ω and ω', but rather to rely on the context of the discussion to determine whether ω refers to the normalized (T = 1) or to the unnormalized ($T \neq 1$) frequency variable.

$$S(e^{j\omega'}) = \sum_{n=-\infty}^{\infty} s[n]\,e^{-j\omega' n} \quad (4a)$$

$$s[n] = \frac{1}{2\pi}\int_{-\pi}^{\pi} s(e^{j\omega'})\,e^{jn\omega'}\,d\omega' \quad (4b)$$

The spectrum $S(e^{j\omega'})$ is periodic in ω' with period 2π the fundamental period in the range $-\pi < \omega' < \pi$ sometimes referred to as the baseband, is the useful frequency range of the DT system because frequency components in this range can be represented unambiguously in sample form (without aliasing error). In much of the signal-processing literature the explicit primed notation is omitted from the frequency variable. However, when so many related Fourier concepts are discussed within the same framework.

By comparing (Madisetti and Williams, 1999) Eqs. (3) and (4a), and noting that $\omega' = \omega T$ we see that:

$$F\{s_a(t)\} = DTFT\{s[n]\} \quad (5)$$

Where,

$$s[n] = s(t)\big|_{t=nT}$$

This demonstrates that the spectrum of s_a (t) as calculated by the CT Fourier transform is identical to the spectrum of s[n] as calculated by the DTFT. Therefore, although s_a (t) and s[n] are quite different sampling models, they are equivalent in the sense that they have the same Fourier domain representation.

A reading machine relies on three basic technologies as follows:

- Scanner technology to scan an image into computer memory
- Digital image processing or optical character recognition (OCR) technology to convert the image to text
- Text-to-speech (TTS) technology to convert the text into intelligible speech.

3. Results

The reading machine, is the combination of three ubiquitous technologies, namely the scanner technology, the optical character recognition technology, and the text-to-speech technology.

3.1 Composite Parts of Reading Machine

3.1.1 Scanner

The scanner technology comprising the lamp, mirror, lens, CCD, and ADC converts the printed text to a bitmapped signal that is easily interpreted by the processor. The IRIS-Pen handheld scanner is the most fit for this work. It works just like a highlighter. Simply slide it over printed information from books, newspapers, magazines, faxes, letters, spreadsheets etc. and instantly it converts words and numbers into the reading processor application.

3.1.2 Processor

The processor, which engulfs the digital image processing technology and the text-to-speech technology, is the brain behind the entire operation. The output signal from the digital image processing is fed into the front-end compartment of the TTS. This first part has to process the signal through: text analysis, phonetic analysis, and prosodic analysis. A phoneme is the sound associated with each letter. These signals in turn drive the speech synthesizer circuits in the back-end block compartment. Fig. 9 gives the block diagram representation of the reading machine.

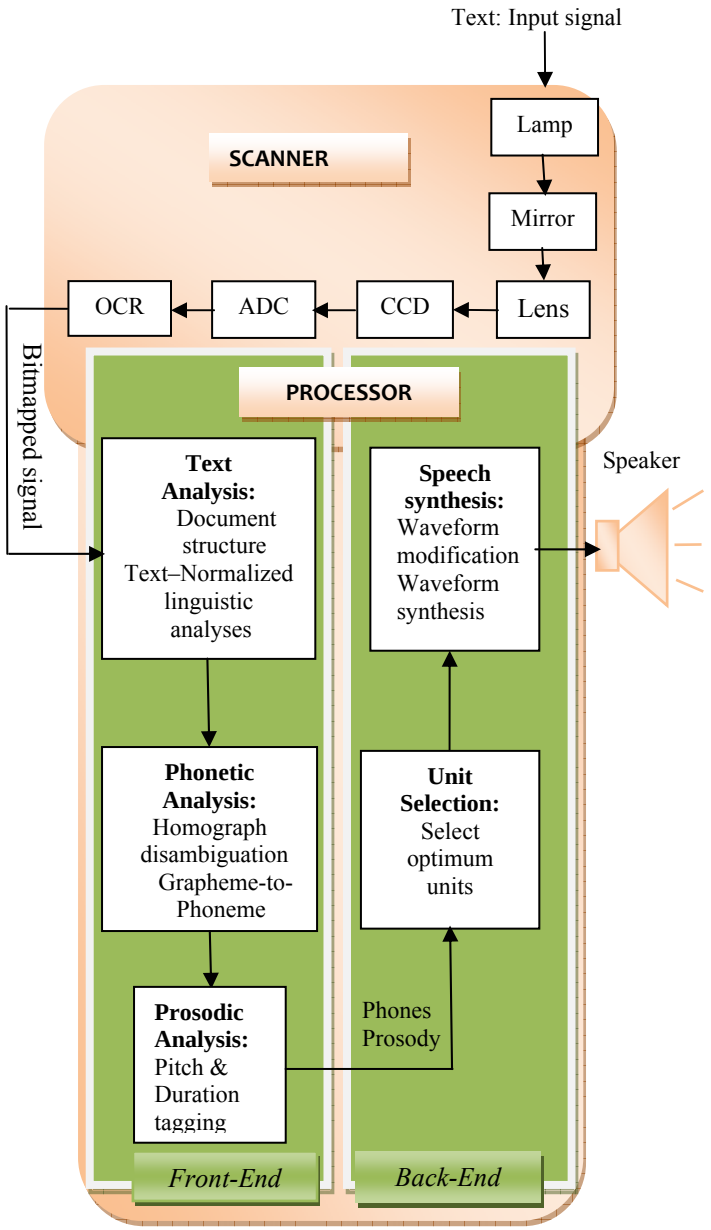

Figure 9. Block diagram of reading machine

4. Discussion

4.1 Operation of Reading Machine

The sequence of operation of the reading machine begins when the scanner using an integrated scanning array scans the letters in each word and feeds the data directly into the processor. The Euraka handheld scanner and Iris-Pen express 6 handheld scanner are capable of doing this work perfectly. The Iris-Pen hand held scanner has these technical specifications: an universal serial bus (USB) interface, a personal computer platform, 16-bit (64 k colors)

maximum color depth and dimensions; width 1.41 inch, depth 0.94 inch, height 5 inch and weight 0.24 lb. Figure 10 shows samples.

Figure 10. Sample of Iris-Pen handheld Scanners (Source: Anon, 2000)

A shape analysis program identifies the words and convert them into bitmap text code. If necessary, other programs using contextual and other clues assist in the identification. The TTS processes are made up of two giant blocks namely the front-end and back-end blocks.

4.1.1 Front-End Processing

The front-end section accepts text as input and produces a sequence of phones and associated prosody at its output. The front-end section can be subdivided into three distinct blocks: text analysis, phonetic analysis, and prosodic analysis.

The text analysis block performs a preprocessing step to analyze the document structure and organize the input sentences into manageable lists of words. In particular, punctuation must be correctly handled. For example, the text analysis block must understand that the colon in '23:45' indicates a time, and to disambiguate between an end of sentence period and decimal point such as in the sentence 'It is 3.14 miles to the city.' Text normalization deals with transforming abbreviations, acronyms, numbers, dates, and times into full text. This requires careful processing. For example, '20/08/1976' must be transformed into 'twentieth of August nineteen seventy six' and not erroneously as 'twenty forward slash zero eight forward slash one thousand nine hundred and seventy six'. It should be clear from these examples that the performance of the document structure and text normalization tasks is critical for ensuring accuracy of the TTS system. The text analysis block also performs some linguistic analysis. The part of speech category (e.g. noun, verb, adjective, etc.) for each word is determined based on its spelling.

The phonetic analysis block is concerned with grapheme-to-phoneme conversion (also called letter-to-sound conversion). Pronunciation dictionaries are employed at word level to provide the phonetic transcriptions. In order to keep the size of the dictionary manageable, words are generally restricted to morphemes. A set of morphophonemic rules is applied to determine how the phonetic transcription of a target word's morphemic constituents is modified when they are combined to form that word. Automatic grapheme-to-phoneme conversion based on rules is used for words not found in the dictionary as a fallback, though this approach is often error prone. The phonetic analysis block must also provide homographic disambiguation. For example 'how much produce do they produce?' Contextual information can aid in selecting the right pronunciation. A popular approach is to use a trained decision tree called a Classification and Regression Tree (CART) that captures the probabilities of specific conversions given the context.

The prosodic analysis block deals with determining how a sentence should be spoken in terms of melody, phrasing, rhythm, and accent locations – factors critical to ensure both intelligibility and naturalness of the resultant speech. From the perspective of the speech signal, prosody manifests as dynamic pitch changes, amplitude and duration of phones, and the presence of pauses.

4.1.2 Back-End Processing

The back-end stage of a concatenative TTS synthesizer consists of storing, selecting, and smoothly concatenating prerecorded segments of speech (units) in addition to modifying prosodic attributes such as pitch and duration of the segments i.e. subject to the target prosody supplied by the front-end. This section takes into account some of the key design questions such as: what unit of speech to use in the database, how the optimum speech units are chosen given phonetic and prosodic targets, how the speech signal segments are represented or encoded, and how prosodic modifications can be made to the speech units.

Different types of speech unit may be stored in the database of a concatenative TTS system. Obviously, whole words may be stored. However, whole word units are impractical for general TTS due to the prohibitively large number of words that would need to be recorded for sufficient coverage of a given language. Also, the lack of coarticulation at word boundaries results in unnatural sounding speech.

Modern speech synthesizers have evolved away from using databases with a single, 'ideal' diphone for a given context to databases containing thousands of examples of a specific diphone. By selecting the most suitable diphone example at runtime, and in many cases avoiding making quality-affecting prosodic adjustments

to the segment, significant improvements in the naturalness of the speech can be obtained.

4.2 Software Implementation

Speech synthesis markup language (SSML) is a standard, extensible markup language (XML-based), markup annotation for instructing speech synthesizers how to convert written language input into spoken language output employed by NaturalReader software. SSML is primarily intended to help application by controlling aspects of the speech output such as pronunciation, volume, pitch and rate. SSML can also express playback of prerecorded audio.

4.2.1 Document Structure

SSML documents are identified by the media type application/ssml+xml. Table 4 summarizes the elements and attributes defined in SSML. The basic structure of an SSML document is illustrated in Figure 11:

```
<?xml version="1.0" encoding="UTF-8"?>
<speak version="1.0"
        xmlns="http://www.w3.org/2001/10/synthesis"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.w3.org/2001/10/synthesis
                            http://www.w3.org/TR/speech-synthesis/synthesis.xsd"
        xml:lang="en-GB">
    Hello world!
</speak>
```

Figure 11. Sample structure of SSML document (Burke, 2007)

All SSML documents include the root element <speak>. The version attribute indicates the version of SSML and is fixed at 1.0. The default namespace for the SSML <speak> element and its children is indicated by the xmlns attribute and is defined as http://www.w3.org/2001/10/synthesis. The xmlns:xsi attribute associates the namespace prefix of xsi to the namespace name http://www.w3.org/2001/XMLSchema-instance. The namespace prefix is defined since it is needed for the attribut, xsi:schemaLocation.

The xsi:schemaLocation attribute indicates the location of the schema to validate the SSML document against. The xml:lang attribute indicates the language for the document and optionally also indicates a country or other variation. The format for the xml:lang value follows the language tag syntax. Table 4 illustrates examples of language identifiers.

The <p> element and <s> element can be used explicitly to demarcate paragraphs and sentences.

Table 4 Elements and Attributes Defined in SSML

Elements	Attributes	Description
<Speak>	Version Xmlns Xml:lang xmlns:xsi xsi:schemaLocation xml:base	Root element for SSML documents.
<lexicon>	uri type	References an external pronunciation lexicon document
<p>	xml:lang	Explicitly demarcates a paragraph
<s>	xml:lang	Explicitly demarcates a sentence
<audio>	src	Inserts a recorded audio file.
<phoneme>	ph alphabet	Provides a phonemic/phonetic pronunciation for the contained text.
<sub>	alias	Provides acronym / abbreviation expansions.
<say-as>	interpret-as format detail	Used to indicate information on the type of text construct contained within the element.
<break>	time strength	Controls the pausing or other prosodic boundaries between words.
<emphasis>	level	Requests that the contained text be spoken with emphasis.

<voice>	xml:lang gender age variant name	Requests a change to the speaking voice
<prosody>	pitch contour range rate duration volume	Provides control of the pitch, speaking rate and volume of the speech output.
<mark>	name	Places a marker into the text/tag sequence.
<meta>	name http-equiv content	Contains metadata for the document
<metadata>	—	Contains metadata for the document

(Burke, 2007)

4.2.2 Interpreting Text

The <say-as> element is used to indicate information about the type of text construct contained within the element and to help specify the level of detail for rendering the contained text. Interpreting the contained text in different ways will typically result in a different pronunciation of the content (although a speech synthesizer is still required to pronounce the contained text in a manner consistent with how such content is normally produced for the language).

The <say-as> element has three attributes: interpret-as, format and detail. The format, and detail attributes are optional. The <interpret-as> attribute indicates the content type of the contained text construct, e.g. date to indicate a date, or telephone to indicate a telephone number. The optional format attribute provides further hints on the precise formatting of the contained text, e.g. a value of dmy could be used to indicate that a date should be spoken in the format of date, then month, then year. The optional detail attribute indicates the level of detail to be spoken although it is not defined for many interpret-as types.

In Figure 12 below are some common examples of <say-as>:

```
<say-as interpret-as="date" format="mdy">2/3/2006</say-as>
<!-- Interpreted as 3rd of February 2006 -->
<say-as interpret-as="time" format="hms24">01:59:59</say-as>
<!-- Interpreted as 1 second before 2 o'clock in the morning -->
```

Figure 12. Sample structure of prosodic interpretation. (Burke, 2007)

4.3 Power Management

Li-Ion batteries are leading edge battery technology and are an ideal selection for use on portable computers and cellular phones due to their high energy density and high voltage. A typical Li-Ion cell is rated at 3.6V and this is three times more than the typical NiCd or NiMH cell voltage (1.2V).

4.3.1 Features of Lithium Ion Batteries

These features are as follows:

- High energy density that reaches 400 Wh/L (volumetric energy density) or 160 Wh/Kg (mass energy density).
- High voltage. Nominal voltage of 3.6 V or even 3.7 V on newer Li-Ion batteries.
- No memory effect. Can be charged any time, but they are not as durable as NiMH and NiCd batteries.
- High charge currents (0.5-1A) that lead to small charging times (around 2-4 hours).
- Flat discharge voltage allowing the device to stable power throughout the discharge period.
- Typical charging Voltage 4.2 ± 0.05V.
- Charging method: constant current - constant voltage (CV-CC).
- Typical operation voltage 2.8 V to 4.2 V
- Recommended temperature range 0-4 ^{0}C

4.3.2 Safety Circuits inside the Li-Ion Battery Pack

Inside a Li-Ion battery pack there is always a safety circuit that consists of four main sections: the controller IC, control switches, temperature fuses, and the thermistor (Figure 13). The controller IC monitors each cell (or parallel cells) voltage and prevents the cells to overcharge or over discharge controlling accordingly the cutoff switches. Also the voltage across the switches is monitored in order to prevent over current. The control switches usually comprise FET structures that cutoff the charge or discharge depending on the control signals of the controller IC. The temperature fuses cutoff the current if the control switches experience abnormal heating. This fuse is not recoverable. The thermistor, usually called PTC measures the battery temperature inside the pack. Its terminals are connected to the charger so it can sense the temperature of the pack and control the charge current until the battery is fully charged.

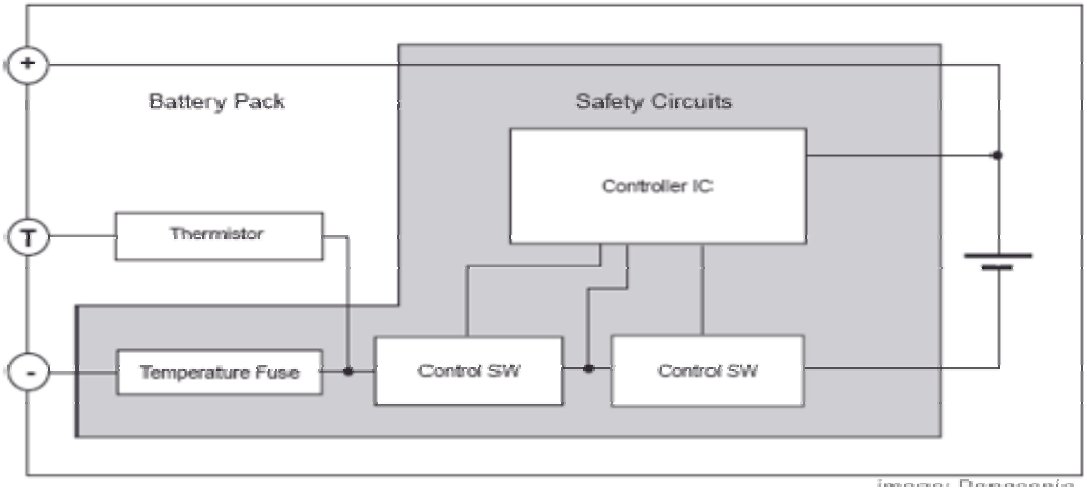

Figure 13. A typical block diagram of Li-Ion battery pack
(Source: Anon, 2004)

5. Conclusions

The architecture of a reading machine designed to achieve a high rate of correct interpretation of text by the blind and visually impaired has been presented. Three ubiquitous technologies were invoked: the scanner, the optical character recognition, and text-to-speech technologies. Multiple algorithms in a Fourier transform domain were used in signal and image processing. With the implementation of the reading machine developed, the feasibility of reading unconstrained printed materials will be achieved and information should be carried indiscriminately to the blind and visually impaired.

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Internet security - cyber crime Paradox

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Abstract: The objective of this study is to review the issues involved in internet security and cyber crime. Apparently this poses a paradox since the technological advances made in both software and hardware to increase internet security measures are also available to cyber criminals who immediately use them to counteract these measures. Another problem is infringement on privacy that has to be dealt with as stricter security measures and legislation are put into effect. Cyber crimes are briefly reviewed, and legislative and technological ways to combat them are presented. [Journal of American Science 2010;6(1):15-24]. (ISSN: 1545-1003).

Key words: Cyber crimes, internet security, legal aspects, intrusion detection

1. Introduction

Cyber crimes have progressed into serious threats and proper legislation and prosecution is badly needed to combat them. Cyber crime legislation is always lagging behind the fast-growing technological advances which are used by the criminals as well as those who wish to combat them. There is also a need to consider the competing interests between individual rights of privacy and free speech, and the integrity of public and private networks. Due to the international nature of today's networks, no single country can enact laws to effectively address the issues related to cyber crimes. (Sinrod and Reilly, 2000).

The use of the internet has become so wide-spread now that it covers almost every aspect of human life today. Acts such as banking, payment of bills, shopping, personal affairs, etc. are relying on computers and the internet more and more. Therefore, the internet has become very vital in man's economic and social life.

Violation of intellectual property is another major concern for many industries such as automobile manufacturers, manufacturers of luxury goods, etc. who suffer from great financial losses.

The term "cyber crime" refers to the use of a computer and the internet to commit a criminal act such as identity theft, domain theft, Internet auction fraud, blackmail, forgery, embezzlement, online gambling, defamation, pornography, web sex with minors, violation of intellectual property, cyber terrorism, etc. One may also cite e-mail spam, hacking and cracking, denial of service attacks and spreading computer viruses as other issues of great concern.

The potential threats of cyber crimes and their socioeconomic costs have become so large that demand special attention to both legislative aspects of cyber crimes and technical aspects of data security.

The best approach to the issue of cyber crimes is the analysis of the types of cyber crimes, the legislative aspects of fighting such crimes, and the technological improvements required in the field of data security to hinder these crimes.

When an offense is done, a computer may be the target of that offense, the tool of the offense, or it may contain evidence regarding that offense. Malicious viruses, hackers, crackers, espionage, and cyber-warfare are instances of cyber crimes that target computers. When a computer is the target of the offense, the goal of the attacker is to either steal data or cause damage to the computer system. Computers may be incidental to the offense and contain evidence of crimes such as child pornography or attempts at sex with minors.

2. Cyber crimes and cyber attacks

Any use of a computer and the internet to do some act that would be considered a crime is called a cyber crime since a crime is usually defined in terms of the end result. There are many types of cyber crimes including hacking, cracking, extortion, child pornography, money laundering, fraud, software pirating, and corporate espionage. The tem 'hacker'

usually refers to a computer user who wants to gain unauthorized access to a computer system while the term 'cracker' is used to refer to a hacker with criminal intentions. Crackers sabotage computers, steal information, and disrupt networks with malicious intents. Naturally, hacking and cracking should not be looked upon in the same way. Nearly a third of theft of confidential information and trade secrets is done by employees who have access to the target computer systems.

Types of computer crimes include

1- Salami attacks

In these attacks the amount of alteration in each individual case is so small that it goes unnoticed. However, the overall effect is tremendous. For example, an attacker may subtract a minor sum from every bank customer's account which would add up to a large sum when deposited into his own account.

2- Data alteration

In this form of attack data is changed just before being processed by the computer and then changed back again into its original form afterwards. This would make the results seem justifiable, although they are not.

3- E-mail bombing

In this case, the goal of the attacker is to interrupt the victim's e-mail service by sending him a large number of e-mails.

4- Denial of Service (DoS) attack

Denial of service attack refers to an explicit attempt by an attacker to prevent legitimate users of a service from using that service. Examples include:

1-Flooding a network and preventing legitimate network traffic.

2- Disrupting a server by sending more requests than it can possibly handle to prevent access to a service.

3- Preventing a particular individual from accessing a service.

4- Disrupting service to a specific system or person.

In a denial of service attack one user takes up so much of a shared resource that none of the resource is left for other users. Such attacks compromise the availability of the resources that may be processes, disk space, percentage of CPU, printer paper, etc. In the internet this takes the form of

4-1 SYN Flood attacks,

4-2 UDP Flood attacks,

4-3 ICMP Flood attacks,

4-4 New generation attacks such as smurf, fraggle, and papasmurf

4-5 DDoS attacks such as Trinoo, Tribe Flood Network, Tribe Floodnet 2k, and Stachel-draht.

Common symptoms of DoS attacks are as follows:

1- unusually slow network performance.

2- unavailability of a particular web site.

3- inability to access any web sites.

4- a drastic increase in the number of received spam emails.

There are four possible forms of defense against DDos attacks as follows:

1-Blocking SYN floods which are caused when the attacker spoofs the return address of a client machine so that a server receiving a connection message from it is left hanging when it attempts to acknowledge receipt.

2- Implementing BCP 38 network ingress filtering techniques to guard against forged information packets.

3- Zombie Zapper tools to tell a 'zombie' which is flooding a system to stop doing so.

4- Low-bandwidth web sites to prevent primitive DDoS attacks by not having enough capacity.

5- Web Site Defacing

In this form of attack, the system cracker changes the visual appearance of the site under attack by breaking into the web server and replacing the hosted website with his own.

6- Malicious codes such as viruses, worms, Trojans and RATs

Malicious code may be used by cyber criminals for various goals. Computer programs can sometimes be damaging or malicious in nature. If the source of the damaging program is an individual who intended that the abnormal behavior occur, the instructions are malicious code. The following actions are possible forms of defense against hacker attacks:

1- Scanning for already known vulnerabilities in the system

2- Checking Web application holes

3- Testing the network for potential weak links and entry points.

Malicious code or malware include the following:

6- 1 Security tools and toolkits

Software to detect cyber attacks has been developed as cyber threats have evolved. Sophisticated anti-spyware and anti-virus solutions capable of detecting very complex viruses have been developed as security tools and are easily available over the internet. These programs automatically scan for computer security weaknesses and quickly probe a computer or an entire network for hundreds of weaknesses. However, some of these tools may be used by attackers. Moreover, there are some readily available programs on the internet whose only function is to attack computers. Computer users should be cautious of potential vulnerabilities in their computer system due to the availability of potentially malicious security tools and high-quality attackware.

6-2 Back doors or trap doors

Back doors are code written into applications or operating systems to grant programmers access to programs without requiring them to go through the normal methods of access authentication. They become threats when they are used to gain unauthorized access into a computer system.

6-3 Logic bombs

Logic bombs are programmed threats which are dormant for some time before they are triggered. Once triggered, they perform a function not intended for the program in which they are embedded. One may protect his computer against malicious logic bombs by not installing software without thoroughly testing it, and by keeping regular backups of his important work.

6-4 Viruses

A computer virus is a sequence of code inserted into other executable code such that the viral code is executed when the program is run. The virus copies itself into other programs. Viruses need to have a host program to enable them to be activated when run.

6-5 Worms

Worms are programs that can run independently. They travel from one computer to another through network connections. Worms do not change other programs. However, they may carry viruses. An example is the installation of keystroke logging Trojans using a virus or a worm.

6-6 Trojans and RATs

Trojan horses are programs that appear to be doing what the user wants while they are actually doing something else such as deleting files or formatting disks. All the user sees is the interface of the program that he wants to run. RATs are remote access Trojans that provide a backdoor into the system through which a hacker can snoop into your system and run malicious code. Hackers can even use these hijacked systems to launch attacks against others. By having thousands of computers accessing the same site at the same moment, the site servers may be overburdened and no longer be able to process requests. These attacks are referred to as Distributed Denial of Service, or DDoS attacks.

6-7 Bacteria or rabbit programs

Bacteria or rabbits are programs that are meant to replicate themselves. Thus they reproduce themselves exponentially and take up all the processor capacity, memory, or disk space.

3 Cyber warfare

Cyber warfare includes cyber espionage, web vandalism, political propaganda, distributed denial of service, equipment disruption, cyber attack on critical infrastructures such as power, water, fuel, communications, etc. and compromised counterfeit hardware with malicious software, firmware or even malicious microprocessors. Cyberwar is another instance of cyber crime committed by one country against another. The recent cyber attacks in the Middle East and particularly Estonia as a result of which the country was almost brought to a standstill were presented by (Jenik, 2009). Estonia was subject to cyber attacks in April 2007 in the form of distributed denial of service when the newly appointed government initiated plans to relocate the Bronze Soldier of Tallinn. Estonian authorities accused the Kremlin of direct involvement in the cyber attacks. IT security specialists worldwide were called in for help and an ad-hoc digital rescue team was formed. After a few days, frontline defenses were set up which mainly involved implementing BCP 38 network ingress filtering techniques across affected routers to prevent source address spoofing of internet traffic. In the days it took to fight off the attack, Estonia lost billions of Euros in reduced productivity and business downtime.

The threat of cyber attacks against the government is so high that the British are setting up a new multi-agency office of U.K. Cyber Security Operations Center. With the recent DDos attacks that began on July 4, 2009 and knocked out the web sites of several government agencies in the United States including some in charge of fighting cyber crime, implementation of more strict security measures are badly needed. Even the web sites of some major government agencies, banks and newspapers in South Korea were paralyzed under the recent cyber attacks.

4 Legislation against cyber crime

The main question to be addressed regarding legislation against cyber crime is whether or not existing penal laws are adequate to deal with cyber criminals. Existing legislation regarding cyber crimes are different in various parts of the world. Some of them are sufficient to deal with some forms of cyber crime while they may not be able to properly deal with other forms of cyber crime. New laws and technology are needed to effectively combat cyber crimes. Existing legal framework for fighting cyber crimes is insufficient in many countries including China that has the most number of internet users in the world. (Qi et al., 2009) reported that internet related regulations put forth so far tend to be reactive. They presented an overview of cyber crime legislation in China by starting from the history of computer and network development, cyber crime development and corresponding legislation development in China.

Depending on the type of crime, the various existing legislation may or may not be sufficient. For example, credit card frauds are sufficiently covered by existing legislation since the fraudulent transaction is still considered fraudulent even though it is done online instead of on paper. However, some other forms of cyber crime such as hacking or denial of service attacks are not sufficiently covered by the law. There are also problems related to presenting proof of such crimes. Some legislation has attempted to restrict activities which may lead to cyber crimes. For example, the Australian Spam Act of 2003 prohibits sending commercial e-mails to recipients without their consent by requiring that the e-mails contain precise information about the sender, and practical ways for the receivers to unsubscribe. Or the U.S. Fraud and Abuse Act (CFAA) prohibits unauthorized access to computer networks that causes damage in a 1-year period of $5000 or more, transmission of viruses and any other destructive codes. The Council of Europe Convention on Cyber crime has also required all member and other signatory states to adopt legislation to establish accessing a computer system without right, intercepting non-public transmissions without right, damaging of computer data without right, serious hindering of computer functioning without right, etc. as criminal offenses. The Interpol has also been active in combating cyber crimes by establishing regional working parties on IT crimes to facilitate the development of strategies, technologies, and information on the latest IT crime methods. Interpol uses its global police communications system to fight cyber crimes with the active participation of all member countries.

The Computer Fraud and Abuse Act (1984) deals with a compelling federal interest, where computers of the federal government or certain financial institutions are involved, the crime itself is interstate in nature, or computers are used in interstate and foreign commerce. The CFAA was amended in 1986, 1994, 1996, in 2001 by the USA Patriot Act and by the Identity Theft Enforcement and Restitution Act in 2008. The Computer Fraud and Abuse Act (CFAA) does not treat authorized persons and company insiders' negligence and damage the same as outsiders. The non-authorized hackers are held liable for any damages done while insiders are only held liable for intentional damages. Another important point needed in legislation against cyber crimes is provisions for broad jurisdiction. For example, the Virginia Computer Crime Act defines using a computer or network within the State of Virginia as conferring jurisdiction in Virginia giving that state broad authority since the bulk of U.S. internet goes through Virginia (Blakeley, 2008).

The intention behind the Cybercrime Act, 2001 of Australia was to criminalize activities such as computer hacking, denial of service attacks, spreading computer viruses and interfering with websites. The Act has established the following acts as offenses:

(a) Unauthorized access to or modification of data stored in a computer with intent to commit a

serious offence

(b) Unauthorized impairment of electronic communication to or from a computer with intent to commit a serious offence

(c) Unauthorized modification of data to cause impairment

(d) Unauthorized impairment of an electronic communication

(e) Unauthorized access to, or modification of restricted data, where the restricted data is either held for or on behalf of the Commonwealth or the access to or modification of it is caused by means of a telecommunications service

(f) Unauthorized impairment of data held on a computer disk, etc.

(g) Possession or control of data with intent to commit a computer offence

(h) Producing, supplying or obtaining data with intent to commit a computer offence.

India's Information Technology Act, 2000 allows punishment for cyber crimes such as hacking, damaging source code, electronic publication of obscene material, breach of confidentiality and privacy, and publication of false digital signatures. However, this law was not adequate to combat all present forms of cyber crimes and was primarily intended to foster e-commerce. The Information Technology (Amendment) Bill, 2008 was drafted in order to overcome the shortcomings of that Act regarding threats which have come up due to the development of new technologies. It says that dishonestly receiving stolen computer resource, identity theft, cheating by impersonation by using computer resource and violation of privacy will result in imprisonment up to three years apart from a monetary fine. Transmitting or receiving material containing sexually explicit acts in electronic form would be punishable by imprisonment of up to five years along with a monetary fine. It even enables any government agency to interrupt, monitor or decrypt any information generated, transmitted, received or stored in any computer. It also stipulates life imprisonment for those indulging in cyber terrorism and empowers the government to intercept or monitor any information through any computer resource in any investigation and block websites in national interest.

Iran has recently passed a cyber crime act that is effective since July 2009. The act consists of fines and penalties for violation of data security, data integrity, and fraudulent data manipulation in computer and communication systems; storage, production or distribution of sexually explicit content, violation of privacy or distribution of individual or family related private content; distribution of false accusations; the unauthorized sale or distribution of user id and passwords; and distribution or sale of data, software or hardware meant for committing cyber crimes. It also forces internet service providers to restrict the users' access to sexually explicit content, and to inform the authorities regarding the existence of any such materials in the facilities to which they provide internet service. ISP providers also have to store data up until three months after a subscription expires, and provide user IP's to authorities. The act empowers the authorities to seize media containing data and/or computer related equipment or facilities and computer systems. Moreover, the act empowers the authorities to tap internet data that may be considered as a threat against national security or an infringement on some individual's rights.

The recent attacks have led to the proposal of a bill in the United States that would empower the U.S. president to order the disconnection of any Federal government or U.S. critical infrastructure information system or network for national security.

5 Internet security

The World Wide Web is constructed from programs called Web servers that make information available on the network. Web browsers can be used to access the information that is stored in the servers and to display it on the user's screen. Another use of the Web involves putting programs created with a protocol called the Common Gateway Interface (CGI) behind Web pages, such as a counter which increments every time a user looks at that page or a guest book to let users sign in to a site. Many companies use the WWW for electronic commerce. The World Wide Web poses profound security challenges such as

1- Possible unauthorized access to other files in the computer system by taking advantage of bugs in the Web server or CGI scripts.

2- Unauthorized distribution of confidential information on the Web server.

3- Interception of transmission of confidential

information between the Web server and the browser.
4- Access to confidential information on the Web client.
5- Potential threat due to vulnerabilities of specially licensed software meant to combat internet security issues.

As more corporate computer systems become connected to the internet and more transactions take place between computer systems, the identification and prevention of cyber misuse becomes increasingly critical. (Owens and Levary, 2006) presented an adaptive expert system for intrusion detection that uses fuzzy sets with the ability to adapt to the type and/or degree of threat.

There is a need for a more intuitive, automated systems-level approach to determining the overall security characteristics of a large network. Given the complex nature of security tools and their general lack of interoperability, it is difficult for system designers to make definitive statements about the nature of their network defense. (Rasche et al., 2007) presented an approach for automatically verifying the correctness of cyber security applications through formal analysis guided by hierarchical models of the network, its applications, and potential attacks. They focused on creating an environment in which security experts can model the security aspects of complex networks using a graphical notation that is intuitive and natural for them, and automatically perform security activities such as formally verifying the safety of the network against known threats and exploring the network design for potential vulnerabilities.

(Ruili et al., 2008) proposed an expert system based malware detection that integrates signature-based analysis and anomaly-detection using the CLIPS expert system development tool. They introduced anomaly-based detection into the malware detection process in order to overcome the inability of signature-based detection methods to detect zero-day attacks and malware which adopt circumvention techniques to evade detection.

The importance of the threat of cyber crime as an expanding, global industry, operating in a major shadow economy that closely mimics the real business world, was presented by (Ben-Itzhak, 2009) who stressed that the impact of cyber crime on payment cards is being felt by firms holding customer's credit and debit card details.

Other criminals use Web sites to spread malware in order to steal personal data or take over users' computers into a botnet. A botnet refers to a collection of software robots that can be used to send spam or mount cyber-attacks against Web sites and other Internet services. Spam leads users to online scams and phishing Web pages. Phising is the fraudulent attempt to acquire people's information like login username, passwords, and other financial information by disguising themselves as a trustworthy entity in an electronic communication. Phishers have been targeting bank customers and online payment services. Phishers try to determine which banks potential victims use. Social network sites have also been targeted by phishers since they contain personal details that can be used in identity theft. Most phishers use link manipulation to make a link in an e-mail appear as though it belongs to the spoofed organization. Common tricks used include misspelled URLs, mirrored web sites or the use of subdomains. (Aaron et al., 2008) presented a panel discussion to respond to Internet threats and abuses with which Web site operators, Internet users, and online service providers are facing.

(Ryu and Na, 2008) presented guidelines and definition of technology to track and locate the source of attacking programs and present the prerequisite factors for networking considering tracking technologies for counter-cyber attacks to program developers including security companies. They also presented trace back scenarios under various networking domain environment allowable for cyber attacks and described the required factors for tracing the attacking origins as well as other general things viewed from program requesters. (Downs et al., 2009) studied Chicago residents' knowledge about Internet security and their utilization of prevention and detection tools. Using hierarchical linear models, they conclude that there are significant gender, race, age, and community differences in knowledge about firewalls, spyware, phishing and data encryption and the utilization of tools such as anti-virus programs, pop-up blockers and parental control software. They hoped their findings could be used by experts to identify those people that may be more susceptible to cyber victimization.

There is a growing trend of developing automatic

vulnerability analysis tools that utilize the model of network configurations and vulnerabilities. With this tool, network administrators can analyze the effects of vulnerabilities on the network and detect complex attack scenarios before they actually happen. (Shahriari et al., 2008) presented a general logic-based framework for modeling network configurations and topologies, modeled several important and wide-spread network vulnerabilities as general inference rules and implemented the approach using an expert system to analyze network configurations and detect how an attacker may exploit chain of vulnerabilities to reach his goal. Their model can simulate major parts of Denial of Service attacks.

Common recommendations for cyber safety are as follows:

1- Use of antivirus software on the system
2- Use of firewall on the system
3- Frequent change of passwords
4- Frequent scanning against spyware
5- Maintaining backup of your important work
6- Installing system software patches
7- Removal of unnecessary software

However, common security methods are outdated with the advent of new methods by cyber criminals who take the initiative to set the strategy of attacks. (Amit, 2009) noted that cyber crimes are not random and follow world events and seasonal trends. He suggested adopting an anticipatory security strategy to help close vulnerabilities.

6 Intrusion detection systems

Intrusion detection was first studied by analysis of computer system audit data. Intrusion detection systems (IDS) are software and/or hardware solutions meant to detect unwanted attempts at accessing, manipulating or disabling computer systems through networks. An IDS consists of several components including sensors to generate security events, a console to control the sensors and monitor events and alerts. It also includes a central engine to record sensed events in a database. The IDS uses a system of rules to generate alerts from security events received.

It is very likely that an intruder who breaks into a computer system may behave much different from a legitimate user. (Lunt et al., 1990) designed and developed a real-time intrusion-detection expert system (IDES) that observes user behavior on one or more monitored computer systems and flags suspicious events. It monitors the activities of individual users, groups, remote hosts and entire systems to detect suspected security violations. The main feature of IDES is that it adaptively learns users' behavior patterns over time and detects any deviation from this behavior. Their next step was the development of NIDES that performs real-time monitoring of user activity on multiple target systems connected via Ethernet to analyze audit data collected from various interconnected systems and search for unusual and/or malicious user behavior. Their previous efforts have finalized into the EMERALD project representing research and development of systems and components for anomaly and misuse detection in computer systems and networks including:

- Scalable Network Surveillance
- High-volume Event Analysis
- Light-weight Distributed Sensors
- Generic Infrastructure and Pluggable Components
- Easy Customization to New Targets and Specific Policies

Popular Intrusion detection systems include Snort as an open source IDS, OSSEC HIDS as an open source host based IDS, Fragroute as a network intrusion detection evasion toolkit, BASE as a basic analysis and security engine, and Sguil as the analyst console for network security monitoring.

The most popular of these is Snort that is an open source network intrusion prevention and detection system (IDS/IPS) developed by Sourcefire. It can perform real-time traffic analysis and packet logging on IP networks. Snort can also perform protocol analysis and content searching/matching, detect a variety of attacks and probes, such as buffer overflows, stealth port scans, CGI attacks, SMB probes, and OS fingerprinting attempts. Snort uses a flexible rules language to describe traffic that it should collect or pass plus a detection engine that utilizes a modular plug-in architecture. OSSEC is an Open Source Host-based Intrusion Detection System that performs log analysis, file integrity checking, policy monitoring, rootkit detection, real-time alerting and active response. OSSEC runs on most operating systems. Fragroute has a simple ruleset

language and it can delay, duplicate, drop, fragment, overlap, print, reorder, segment, source-route, or otherwise monkey with all outbound packets destined for a target host. It has minimal support for randomized behavior.

Intrusion detection is an indispensable part of cyber security. (Bhatia et al., 2008) presented the integration of Host-based Intrusion Detection System (HIDS) with existing network based detection on Gen 3 Honeynet architecture involving the stealth mode operation of HIDS sensor, code organization to generate HIDS alerts, enhancement of the functionality of data fusion, and further visualization on Graphical Analysis Console.

Cyber security professionals and the FBI estimate that the global hacker criminal economy is worth at least $10bn annually, causes $100bn in annual damage, and has up to 30 percent growth rate. (Gilman, 2009) reported that under these circumstances, millions of people are participating in a global hacker culture. There is an ever increasing growth of cyber attack tools. (Dwyer, 2009) reported that cyber attacks from the United States and China are on the rise. Online transactions are one of the main targets of cyber attacks since million of dollars of transactions are done online every day (Rodrigues, 2009).

Technological measures to combat cyber crimes include measures such as public key cryptography, digital signatures, firewalls and honeypots. On the other hand, cyber forensics is needed in order to identify, preserve, analyze and present digital evidence in a legally acceptable manner in the courts of law. Legislation and legal enforcement should also be improved to combat cyber crime.

Critical infrastructures may also be subjected to cyber threats and should be safe-guarded. Such operations as communications, government and emergency operations, gas and oil supply and delivery operations, water and electricity supplies and transmission and distribution systems, transportation, banking and financial actions are all subject to cyber threats and should be security hardened. Competing schemes for security-hardening the power grid have different installation costs and coverage which they provide against cyber attacks. Since finding an optimal solution is an NP hard problem, (Anwar et al. 2009) presented a dynamic programming solution to the problem of maximizing overall network security under a fixed budget constraint and implemented it along with logic-based models of the power grid. The feasibility of the tool chain implementation was demonstrated by security hardening the IEEE power system 118-bus test case from a pool of five different best practice schemes.

7 Cyber security standards

There is a growing need for information assurance and security since sensitive information is often stored in computers that are attached to the internet. In addition to critical infrastructures, personal identity, important fiscal information, trade secrets, proprietary information and customers' information must also be safeguarded against possible cyber attacks. Cyber security standards are developed to provide security techniques in order to minimize the number of successful cyber attacks and provide guidelines for implementation of cyber security.

The British Standards Institute published BS 7799 in 1995. This standard was revised several times and was finally adopted as ISO/IEC 17799 - "Information Technology - Code of practice for information security management" - in 2000. It was later revised and named ISO/IEC 27002 in 2007.

The second part of BS7799 known as BS 7799 Part 2 titled "Information Security Management Systems - Specification with guidance for use" focused on how to implement an Information security management system referring to the information security management structure and controls identified in BS 7799-2. BS7799 Part 3 was published in 2005, covering risk analysis and management.

8 Network forensics

Digital and network forensics deals with discovering and retrieval of information about computer or cyber crimes to provide court-admissible digital evidence. The problem in network forensics is the huge network traffic that might crash the system if the traffic capture system is left unattended. Kim et al. (2004) proposed a fuzzy logic based expert system for network forensics to analyze computer crimes in networked environments and automatically provide digital

evidence. The proposed system can provide analyzed information for forensic experts to educe the time and cost of forensic analysis.

Reliability and scalability of real-time processing is a major need on any intrusion detection system. In addition to the reinforcement of security policies, development and use of antispam, antivirus software, firewalls as means to combat cyber crimes, there is a serious need for the development and implementation of reliable and scalable hardware data security controllers. (Peiravi and Rahimzadeh, 2009) proposed a scalable high performance content processor for storage disks to be installed in any host using a new architecture based on Bloomier filters as an interface between the hard disk and the system bus plus a novel and powerful exact string matching architecture to search for several thousand strings at very high rates.

9 Conclusions

The paradox between internet security and cyber crime is due to the fact that both the researchers in the area of internet security and the cyber criminals have access to and benefit from technological advances. As some progress is made in the area of internet security, cyber criminals make other advances and find newer ways to pose new cyber threats. Even in some cases, they hide behind cyber security tools and seem to the internet user to be there to assist them, while indeed they have their own malicious intentions. International cooperation and legislation to combat cyber crimes plays a vital role in hindering criminal intentions. However, more work needs to be done to reinforce internet security through the development of reliable and scalable hardware/software security tools, as well as educating the public internet users as to ways to best protect themselves.

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Application of String Matching in Internet Security and Reliability

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Abstract: In this study the role of string matching algorithms in hardware/software applications in virus scanners or intrusion detection systems in improving data security over the internet is stressed. The author's contribution to an architectural design of a new string matching algorithm implemented on an FPGA for improving hardware based data security over the internet with improved performance over previously published results is reported. This can be used in applications such as hardware virus scanners or intrusion detection systems to further improve internet reliability in case of cyber attacks. After indicating the basic measures of intrinsic internet reliability such as MTTF, MTTR and availability, a new measure is introduced to account for the availability of the internet including the effect of cyber attacks. The new index that is introduced is a measure of downtime due to a cyber attack and is called mean down time due to cyber attack (*MCADT*). Results of empirical measurement of the intrinsic availability of a sample of 159 internet hosts in Iran using a developed software tool are presented and compared with those of a similar study over international hosts. [Journal of American Science 2010;6(1):25-33]. (ISSN: 1545-1003).

Key words: Internet reliability, availability, string matching, data security, cyber attack

I. INTRODUCTION

The Internet is completely unreliable. How can we deal with that? With the rapid growth of the world wide web and increased reliance on the web for almost every aspect of man's life today, Internet reliability is perhaps the most important challenge that researchers and practitioners face today.

The reliability issues of the world wide web stem from various underlying factors. The first and most basic one is the intrinsic reliability that depends on the hardware topology of the network, the various computer and communications systems and devices which make the physical connection possible, and the protocols and operating system software that make it operational. The next element of reliability in the internet is the maintainability of the various subsystems involved as maintainability is a key ingredient of reliability.

The real growth of the internet lies in bandwidth-intensive web content, rich media, and web and IP-based applications. There are many challenges facing internet reliability as businesses move more of their critical functions on-line, and as consumer entertainment shifts to the internet from other broadcast media. Leighton (2009) considered the most serious reliability challenge as the ownership of the heterogeneous internet infrastructure by many competing entities with little incentive to expand capacity.

However, we feel that the most important issue in the reliability of the internet stems from the fact that there are as many potential points of attack in it as there are computers connected to it, making it the most vulnerable system man has ever put to use in such a large scale.

The fact that more and more transactions are being done via the internet has resulted in a wide spread effort by cyber criminals to attempt to earn illegitimate income from the internet. Intrusion of privacy and accessing people's private information has also been attempted with various motives. There have also been attempts at other crimes that are beyond the scope of this paper including espionage, cyber attacks and even cyber war.

There are various approaches to deal with internet reliability problems. One is the use of hardware redundancy. We may consider having alternate ways to get online for the users, or having several mirror sites for the servers to allow more available access of their system to customers as examples of hardware redundancy. Another means of improved hardware reliability is the use of hardware for backing up important information. We may even rely on public services for backing up our important work.

A third important point is having a good connection. This concept refers to what is commonly called carrier hotels, internet peering points or co-location buildings. Such co-location buildings usually sit at major points of internet connectivity,

have redundant power supply connections from the electricity grid plus backup power in case of blackout. Such locations offer high availability in the order of 99.999 percent that is equivalent to 5 minutes of downtime per year [Strom (2008)].

To improve internet intrinsic reliability, three distinct areas require attention:

1- The terminals and user equipment should be more reliable. The personal computers, set-top boxes, cable modems, and routers should have backup batteries to provide service, and the operating system and applications software should be free of bugs.

2- Network infrastructure should be built with a high-availability objective. Individual switches, cross-connects, multiplexers, transmitters, and all associated software should have built-in redundancy such that the network can allow instant rerouting in case of any equipment or cable failure.

3- The protocols on which the networks and services operate should provide perfect access to all features and capabilities of the web.

II. BASIC MEASURES OF RELIABILITY

Reliability is usually defined as the probability of successful operation of a mission under predefined operating conditions and for a specified mission time. There are many different measures used to measure reliability as presented below.

II.1. *Failure Rate* and MTTF

The most basic measure of reliability is the failure rate that indicates the average number of failures per unit time as follows:

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{1}{\Delta t} P[System\ Down\ \ in\ (t, t+\Delta t) \mid System\ Up\ at\ \ t)] \quad (1)$$

In cases where the failure rate is constant

$$\lambda(t) = \lambda \quad (2)$$

Reliability is found from the failure rate function as follows:

$$R(t) = e^{-\int \lambda(t)dt} \quad (3)$$

For constant failure rate, the reliability is

$$R(t) = e^{-\int \lambda dt} = e^{-\lambda t} \quad (4)$$

The next measure of reliability is the mean time to failure, or the expectation of the stochastic variable T_U that defines the uptime of the system.

$$MTTF = E[T_U] = \int_0^\infty t f_U(t)dt = \int_0^\infty R(t)dt \quad (5)$$

For a system with exponential probability density function for T_U we have:

$$MTTF = E[T_U] = \int_0^\infty t f_U(t)dt = \int_0^\infty e^{-\lambda t}dt = \frac{1}{\lambda} \quad (6)$$

II.2. *Mean Time to Repair (MTTR)*

The next important measure affecting a system's reliability is its maintainability indicated by mean time to repair as follows:

$$MTTR = E[T_D] = \int_0^\infty t f_D(t)dt \quad (7)$$

II.3. *Mean time between failures (MTBF)*

Another reliability index used in repairable systems is the mean time between failures as:

$$MTBF = MTTF + MTTR \quad (8)$$

This index shows the average time between successive failures or repairs. Table 1 indicates typical MTBF values for computers and related equipment usually used in the internet.

TABLE 1

MTBF FOR COMMERCIAL COMPUTER EQUIPMENT

Equipment	**MTBF (Hours)**
Personal Computer	5000-50000
Monochrome Display	20000-30000
Color Display	5000-30000
Hard Drive	30000-90000
Floppy Drive	20000-40000
Tape Drive	7500-12000
Compact Disk Drive	30000-60000
DVD Drive	75000-125000
Keyboard	30000-60000
Dot Matrix Printer	2000-4000
Plotter	30000-40000
Modem	20000-30000
Router	50000-500000
Power Supply	20000-40000

II.4. *Availability*

Another measure of reliability for repairable

systems is availability which takes into account both MTTF and MTTR as follows:

$$Availability = \frac{MTBF}{MTBF + MDT} \quad (9)$$

And

$$MDT = MTTR + MCADT \quad (10)$$

where MCADT is a new index proposed in this study to denote the mean downtime due to cyber attacks such as denial of service or distributed denial of service, or any other attack which hinders the normal operation of the system.

II.5. *Intrinsic Availability of the Internet*

If we consider ideal conditions and no presence of cyber abnormal activity such as hacking or denial of service attacks, then

$$MCADT = 0 \quad (11)$$

Then the intrinsic system availability that is the highest possible level of system reliability is:

$$Ao = \frac{MTTF}{MTTF + MTTR} \quad (12)$$

Therefore, the factors that can affect the availability of the internet in these conditions are just related to technical and maintenance problems. However, any attacks on the internet can drastically affect its performance and such attacks should be considered in internet reliability by inclusion in MCADT.

III. RELIABILITY OF THE INTERNET

We can obtain a model for the reliability of the internet if we assume the following simple model in which the user's facilities, the web server with which he is communicating, and the rest of the network which is involved in this connection are modeled as three separate entities as shown in the reliability block diagram of Figure 1.

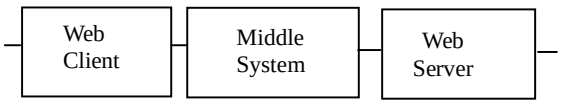

Fig 1- The simplified reliability block diagram of the internet

Notice that the internet relies on packet switching to deliver each packet from one point to another point through various nodes and branches. The availability of the middle system for each packet transmitted would be the product of the availabilities of the facilities in the middle that are involved in the transmission of that specific packet. The use of redundancy in the internet and the packet switching protocol helps the packet travel through some available path. This helps increase the availability of the middle system. However, this is not the only factor involved in the overall availability of internet service for a given user.

If we assume the availabilities of the user's facilities or the web client, middle system facilities and the web server facilities as A_1, A_2, A_3 respectively, then the internet reliability measure or intrinsic internet availability for this user will be

$$A = A_1 A_2 A_3 \quad (13)$$

The typical values of availability are from 0 to 1 with numbers close to 0.99 or better expected. If we assume availabilities of 0.99 for each of these parts, then

$$A = A_1 A_2 A_3 = 0.99^3 = 0.970299$$

However, when there is a cyber attack, the MCADT will become important, and the associated value of availability will be reduced drastically. Whether this happens at the web client, the middle system or the web server, the overall effect is the same as far as the user is concerned. He will experience a very low availability rate that is almost the same as no availability at all. For example, if the web server's availability is low, or the web client's availability is low, we would get a drastic drop in internet availability:

$$A = A_1 A_2 A_3 = 0.99^2 0.1 = 0.09801$$

Another internet reliability issue is related to content reliability and security. It should be noted that the content that we may find available on the internet may not be reliable. A lot of information is posted on the internet. However, this does not guarantee that the content we find is reliable. One should be very careful and check for the accuracy of what he may find on the internet. It may also be not secure and contain viruses, worms, Trojans or other malicious codes embedded in it.

IV. STRING MATCHING AND INTERNET RELIABILITY

IV.1. String Matching Algorithms

String matching is simply defined as how to check whether or not a given string occurs in a given text. This is a common problem in many applications such as text processing, virus detection, molecular biology, intrusion detection, web searching, genetics, etc.

There are many reported string matching algorithms. The problem addressed in string matching is defined as follows. Given a text, T, where T is an array T[1..n] of characters and a pattern P, where P is an array P[1..m] of characters with $m < n$, and typically $m << n$, we wish to know whether P appears as a substring of T, and if so, where.

The most basic algorithm for string matching is the naive algorithm or the brute force method in which there is no need for any preprocessing. In the brute force algorithm there is checking, at all positions in the text between 0 and n-m, whether an occurrence of the pattern starts there or not. Then the pattern is shifted by exactly one position to the right. During the search phase, the text character comparisons can be done in any order.

There are also many other algorithms such as the Morris-Pratt, Knuth-Morris-Pratt, Galil-Seiferas, Boyler-Moore, Turbo-Boyler-Moore, Tunnel-Boyler-Moore, Zhu-Takaoka, Berry-Ravidran, Smith, Raita, Horsepool, etc. to name only a few. The details of these algorithms are presented in many papers and could be pursued by interested readers.

The basic concept behind the naive approach is character by character matching, shifting the whole string down by one character against the text when there is a mismatch and starting again at the beginning. This requires too many repetitions of matching of characters making this algorithm have a time complexity of $O((n-m+1)m)$.

Since the naive algorithm forgets all information about previously matched symbols after a shift of the pattern, it may recompare a text symbol with different pattern symbols again and again leading to a worst case complexity of $O(mn)$ where m denotes the length of the pattern and n denotes the length of the text in which we are searching.

This could be improved upon by noting that when a mismatch is detected somewhere in the text, we have already detected some matched characters. This could be used to decide where to restart matching. This is the basis of the Knuth-Morris-Pratt (1977) algorithm and it solves the problem with n-m comparisons. The time complexity of Knuth-Morrsi-Pratt algorithm is $O(m+n)$. This algorithm uses the information gained by previous symbol comparisons and never compares a text symbol that has matched a pattern symbol again. The complexity of the searching phase of the Knuth-Morris-Pratt algorithm is $O(n)$. Of course, this algorithm requires pattern preprocessing with complexity of $O(m)$ to analyze structure making the overall complexity $O(m+n)$. Since usually $m < n$, the complexity of the Knuth-Morris-Pratt algorithm is approximately $O(n)$.

Hashing was first proposed by Harrison (1971) and provides a simple method that avoids the quadratic number of character comparisons in most practical situations, and runs in linear time under reasonable probabilistic assumptions. He proposed a fast implementation of a test to determine if one string contains a specified substring. The proposed hashing technique used the ability to do many Boolean operations in parallel on a standard computer. Later, Karp and Rabin (1987) presented an algorithm where a hash function h is used for strings of length m. Instead of checking at each position of the text if the pattern occurs, it is more efficient to check only if the contents of the window look like the pattern. Hashing is used to check the resemblance between these two words. In this algorithm, the preprocessing has a time complexity $O(m)$ and searching has a time complexity $O(mn)$ making the overall expected number of text character comparisons $O(n+m)$.

Other algorithms were presented later. For example, in the Boyer-Moore Algorithm both character-jump heuristic and looking glass heuristic are applied. Here the worst case run-time is $O(n*m+|\Sigma|)$ where Σ denoted the alphabet, and the runtime can be improved to $O(m+n)$ by using the good-suffix heuristic.

IV.2. String Matching and Data Security over the Internet

String matching can be effectively used to improve data security over the internet to improve reliability. Goel and Bush (2003) presented a distributed model for security based on biological paradigms of epidemiology and immunology whereby each node in the network has an immune system that identifies and destroys pathogens in the incoming network traffic as well as files resident on the node. In this scheme, each node compiles a list of pathogens that are perceived as threats by using information from all other nodes. The signatures are incorporated into the detector population of the immune systems to increase the probability of detection. They clearly state that the detection scheme is the most critical part for the success of the proposed system. They examined three separate schemes for detecting pathogens namely, contiguous string matching, Hamming distance, and Kolmogorov Complexity. Brönnimann et al. (2005) studied string matching in a stream of network packets as part of a larger system for facilitating network forensics across and within networks. The proposed system monitored

network traffic, created hash-based digests of payload, and archived them periodically. A user-friendly query mechanism provides the interface to answer post-mortem questions about the payload.

Another application of string matching is in data mining, mirroring, storage, and content distribution. Managing large collection of replicated data in centralized or distributed environments is very important. It is true that redundancy can be used to increase the reliability. However, uncontrolled redundancy would aggravate the performance of the system in the retrieval phase. It may even be useless if the returned documents are obsolete. Document similarity matching algorithms do not provide the information on the differences of documents. Moreover, file synchronization algorithms are inefficient since they ignore the structural and syntactic organization of documents.

Another application of string matching is in detection of plagiarism which is of interest to publishers. There are a variety of methods used in plagiarism detection. However, the usual trade-off between speed and reliability still remains. Mozgovoy et al. (2007) introduced a two-step approach to plagiarism detection that combines high algorithmic performance with the quality of pairwise file comparison. In their proposed system, a fast detection method is used to select suspicious files first and then more precise and naturally slower algorithms are used to get reliable results.

Ayqun (2008) proposed a matching approach called S2S that is composed of structural and syntactic phases to compare documents. In this approach, the documents are first decomposed into components by syntax in the structural phase and are compared at the coarse level. The decomposed documents are processed in the structural mapping phase based on syntax without actually mapping at the word level. Then a syntactic matching algorithm uses a heuristic look-ahead algorithm for matching consecutive tokens with a verification patch.

V. INTERNET SECURITY

The World Wide Web is constructed from programs called Web servers and Web browsers. Many companies use the web for electronic commerce, but it poses profound security challenges such as

1- Possible unauthorized access to other files in the computer system using bugs in the Web server or CGI scripts.
2- Unauthorized distribution of confidential information on the server.
3- Interception of transmission of confidential information.
4- Access to confidential information on the client.
5- Potential threat of specially licensed software meant to combat internet security issues.

As more corporate computer systems are connected to the internet and more transactions take place over computerized systems, the identification and prevention of cyber misuse becomes increasingly critical. Owens and Levary (2006) presented an adaptive expert system for intrusion detection that uses fuzzy sets with the ability to adapt to the type and/or degree of the threat.

There is a need for a more intuitive, automated systems-level approach to determining the overall security characteristics of a large network. Given the complex nature of security tools and their general lack of interoperability, it is difficult for system designers to make definitive statements about the nature of their network defense. Rasche et al. (2007) presented an approach for automatically verifying the correctness of cyber security applications through formal analysis guided by hierarchical models of the network, applications, and potential attacks.

VI. INTRUSION DETECTION SYSTEMS

The use of Network Intrusion Detection System (NIDS) has been increasing due to the rising trend in cyber crimes. Software based solutions for NIDS are inefficient when they are employed on high speed high volume networks. Many researchers have studied hardware solutions hoping to acquire a much higher efficiency. However, these solutions pose major problems of flexibility, reliability, scalability, efficiency, speed and cost.

Intrusion detection systems (IDS) are software and/or hardware solutions meant to detect unwanted attempts at accessing, manipulating or disabling computer systems through networks. An IDS consists of several components including sensors to generate security events, a console to control the sensors and monitor events and alerts. It also includes a central engine to record sensed events in a database. The IDS uses a system of rules to generate alerts from security events received.

It is very likely that an intruder who breaks into a computer system may behave much different from a legitimate user. Lunt et al. (1990) designed and developed a real-time intrusion-detection expert system (IDES) that observes user behavior on one or more monitored computer systems and flags suspicious events. It monitors the activities of individual users, groups, remote hosts and entire systems to detect suspected security violations. The main feature of IDES is that it adaptively learns

users' behavior patterns over time and detects any deviation from this behavior. Their next step was the development of NIDES that performs real-time monitoring of user activity on multiple target systems connected via Ethernet to analyze audit data collected from various interconnected systems and search for unusual user behavior.

Popular Intrusion detection systems include Snort as an open source IDS, OSSEC HIDS as an open source host based IDS, Fragroute as a network intrusion detection evasion toolkit, BASE as a basic analysis and security engine, and Sguil as the analyst console for network security monitoring.

The most popular one is Snort that is an open source network intrusion prevention and detection system (IDS/IPS) written by Martin Roesch at Sourcefire. It can perform real-time traffic analysis and packet logging on IP networks. Snort can also perform protocol analysis and content searching/matching, detect a variety of attacks and probes, such as buffer overflows, stealth port scans, CGI attacks, SMB probes, and OS fingerprinting attempts. Snort uses a flexible rules language to describe traffic that it should collect or pass plus a detection engine that utilizes a modular plug-in architecture. OSSEC is an Open Source Host-based Intrusion Detection System that performs log analysis, file integrity checking, policy monitoring, rootkit detection, real-time alerting and active response, and can run on most operating systems. Fragroute has a simple ruleset language. It can delay, duplicate, drop, fragment, overlap, print, reorder, segment, source-route, etc. all outbound packets.

Choi and Lee (2005) presented a parallel coordinate attack visualization tool called PCAV for detecting unknown large-scale attacks including worms, DDOS, and network scanning. They used hashing to develop nine attack signatures and their detection mechanism.

The effectiveness and precision of network-based intrusion detection signatures can be evaluated either by direct analysis of the signatures or by using black-box testing. Recently, several techniques have been proposed to generate test cases by automatically deriving mutations of attacks. Kruegel et al. (2007) proposed an approach for test case generation by using the information gathered by analyzing the dynamic behavior of the intrusion detection system. They applied dynamic data flow analysis techniques to the intrusion detection system to identify which parts of a network stream are used to detect an attack and how these parts are matched by a signature.

Intrusion detection is an indispensable part of cyber security. Bhatia et al. (2008) presented the integration of Host-based Intrusion Detection System (HIDS) with existing network based detection on Gen 3 Honeynet architecture involving the stealth mode operation of HIDS sensor, code organization to generate HIDS alerts, enhancement of the functionality of data fusion, and further visualization on Graphical Analysis Console.

VII. A Contribution to Data Security on the Internet

Proodfoot et al. (2008) proposed a system that uses a modified version of Snort. Their proposed system runs Snort in software until it gets to the pattern matching function and then offloads that processing to the FPGA. The designed hardware is claimed to be able to process data at up to 1.7GB/s on one Xilinx XC2VP100 FPGA. Since the rules are not coded in hardware, the proposed system is more flexible than other FPGA string matching designs. Since their proposed design allows parallel use of FPGAs to increase speed, it is claimed to be scalable.

A scalable high performance content processor was designed by the author for storage disks which could be easily installed in any host as an interface between the hard disk and the system bus to improve internet reliability. Moreover, a novel and powerful exact string matching architecture was presented to search for several thousand strings at high rates. The proposed architecture was implemented on a Xilinx XC4VFX100 Field Programmable Gate Array (FPGA) and it was shown that the system can search for over sixteen-thousand 32 byte strings with a speed near the maximum stated in ATA-7 standard. The design showed a much better performance as measured in Throughput/(LogicCells/Char) when compared with the best existing designs. Later, this design was upgraded and the matching architecture was implemented on a Virtex4 FX 100 -11 chip using Xilinx ISE 10.1i that supports up to 16K single size signatures of 32 bytes. The design achieves a Throughput/(LogicCells/Char) of 31.6 that is much better than any existing system since it only uses embedded on-chip memory blocks, and the logic resources required for implementing it are independent of the number of strings. This contribution has been reported elsewhere and is accepted for publication [Peiravi and Rahimzadeh (2009)].

VIII. Measurement of Internet Availability

Peiravi and Shahraeeni (2004) developed a Web Availability Analyzer Software Tool to measure the

availability of the internet as shown in Figure 2. The tool was run for 90 days to measure reliability data for 159 Iranian hosts. The hosts chosen included 18 universities, 6 news agencies, 36 internet service providers, 29 government agencies and the rest were other public sites. This mix was chosen so as to obtain an average measure of intrinsic internet availability in Iran. This unavailability data measurement was executed from two different points of connection to the internet to remove any unavailability data related to the facilities of the measurement site itself, and purely obtain the behavior of the hosts under study.

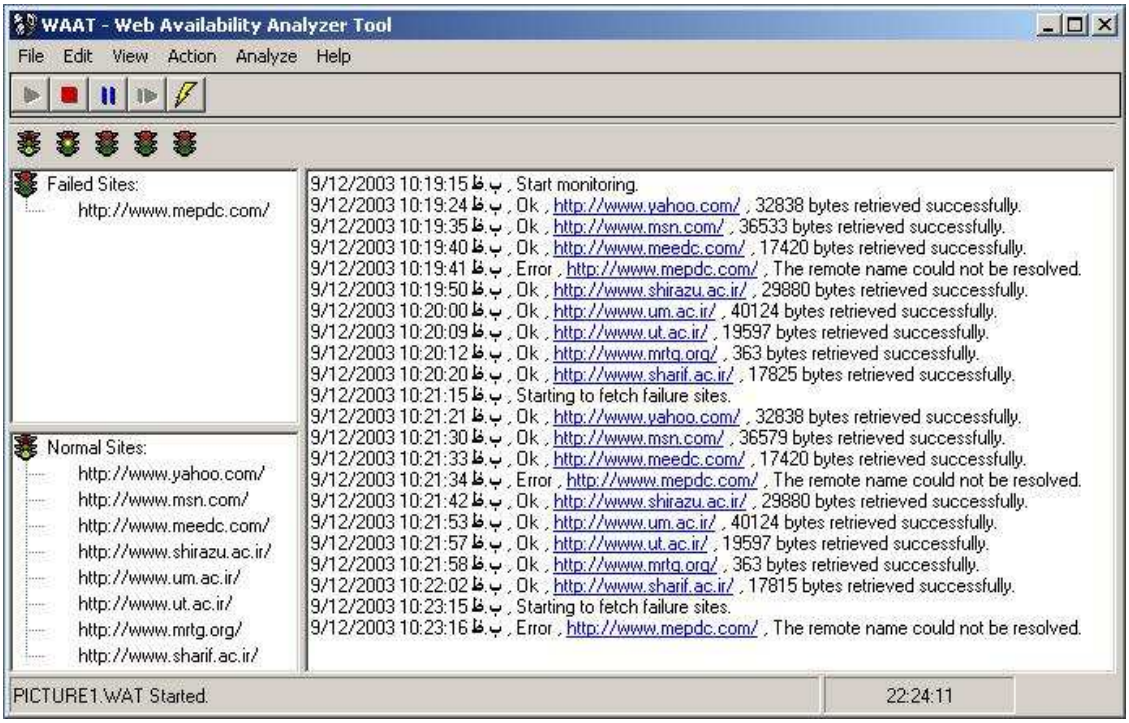

Fig. 2. A sample of WAAT running

The tool generated a log file for each 24 hours. Later analysis of these log files revealed the following results as shown in Tables 2, 3 and 4. We used ping to exclude failures related to intermediate lines and nodes, and thus eliminated any failures due to the internet backbone, too.

Table 2 - The mean and median MTTF values

Mean MTTF	21.56 days
	±0.68 (50% confidence)
	±1.82 (95% confidence)
	±2.46 (99% confidence)
Median MTTF	14.24 days
Number of hosts	159

Availability can be computed from the data shown in Tables 2 and 3 as shown in Table 4.

Table 3 - The mean and median MTTR values

Mean MTTR	3.375 days
	±0.310 (50% confidence)
	±0.668 (95% confidence)
	±0.908 (99% confidence)
Median MTTR	1.012 days
Number of hosts	159

Table 4 - The mean and median Availability values

Mean availability	0.865
	±0.007 (50% confidence)
	±0.012 (95% confidence)
	±0.016 (99% confidence)
Median availability	0.934
Number of hosts	159

Long et al. (1995) had reported a similar study with the following results after surveying 1170 hosts that were uniformly distributed over the name space and could respond to RPC polls for 90 days. Their results are shown in Tables 5 and 6.

Table 5 - The mean and median MTTF values

Mean MTTF	15.92 days
	±0.28 (50% confidence)
	±0.82 (95% confidence)
	±1.08 (99% confidence)
Median MTTF	5.53 days
σ	28.86

Table 6 - The mean and median MTTR values

Mean MTTR	1.201 days
	±0.021 (50% confidence)
	±0.062 (95% confidence)
	±0.082 (99% confidence)
Median MTTR	0.3394 days
n	3500 intervals
σ	1.885

Availability was computed from the data shown in Tables 5 and 6 as shown in Table 7.

Table 7 - The mean and median Availability values

Mean MTTR	0.9260
	±0.002 (50% confidence)
	±0.007 (95% confidence)
	±0.009 (99% confidence)
Median MTTR	0.9723
Number of hosts	1162

Table 8 – A comparison of results for the survey on Iranian hosts and international hosts

Hosts	**MTTF (days)**	**MTTR (days)**	**Availability**
159 Iranian Hosts	21.56	3.375	0.865
1162 International Hosts	15.92	1.201	0.9260

Table 8 shows a comparison of the results of the two studies. This indicates an average lower level of reliability for Iranian hosts, compared with international hosts indicating that a lot more work is needed for Iranian hosts to reach the average international availability levels.

IX. CONCLUSIONS

In this paper the various issues related to the reliability of the internet were reviewed. Hardware redundancy and software issues were presented as means of improving internets intrinsic reliability. A new measure was proposed to include down time due to cyber attacks in internet availability. The issue of data security that is the next most important aspect of internet reliability was addressed. Results of the development of a new string matching architecture implemented on an FPGA for implementation in fast hardware based data security applications such as intrusion detections systems or virus scanners was presented. Results of actual measurement of internet availability for hosts in Iran were presented and compared with international hosts indicating lower availability for the Iranian hosts.

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Morphology, Germination and early Seedling Growth in *Phaseolus mungo L.* with Reference to the Influence of Various Plant Growth Substances

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ABSTRACT: The paper presents the results of studies on morphological characters, seed germination and the influence of different concentrations of plant growth substances on *Phaseolus mungo* including the comparative growth patterns of the seedlings. Seeds were pre-soaked for 24h under the various concentrations (0.1, 1.0 and 10 ppm) of GA_3, IBA and NAA. Soaked seeds were arranged in sterilized petriplates lined with filter paper for germination at thermostatically controlled seed germinator. A control set was soaked only in distilled water. Observations were taken in 16 hrs light and 8 hrs dark at 25±2°C conditions. The mean value of germination percentage, growth of root, shoot and cotyledonary expansion and biomass of seedlings were computed. The highest percentage of germination was recorded when seeds were treated with 0.1ppm concentration of IBA while 1ppm concentration of IBA resulted in highest root length. The fresh and dry weight of shoots increased with GA_3 treatment. GA_3 10 ppm showed highest shoot length and cotyledonary expansion and highest biomass production in the form of root dry weight. GA_3 0.1ppm gained maximum shoot-root ratio. After seed germination, all the developmental processes decreased with increasing dose of hormonal concentrations. Invariably all the growth regulators stimulated high percentage of seed germination compared to the control which has shown only highest shoot dry weight. Present findings deal with comparative use of plant growth substances for the improvement of germination potential of *Phaseolus mungo* under the controlled laboratory conditions. [Journal of American Science 2010;6(1)34-41]. (ISSN: 1545-1003).

Keyword: *Phaseolus mungo*, Morphology, Plant Growth Substances, Seed Germination, Seedling Growth.

INTRODUCTION

Production of high quality seeds is primary source to the success of Indian agriculture. Every farmer is sensitive to need for the rapid uniform seedling emergence and establishment of an even and productive stand. Crop production relies heavily on high quality planting seeds. The latest ISTA rules (ISTA, 2008) contain seed testing protocols of a large number of species cultivated all over the world and it forms the basic reference book for all kinds of seed testing activities and also for the international seed trade. Seeds are fundamental input to agriculture and natural ecosystem. The production of high percentage of viable seeds with capacity to germinate quickly is necessary for the propagation. *Phaseolus mungo* is basically a warm season crop, but in India it is grown in both summer and winter, up to 1800 m above MSL. It is quite drought resistant but intolerant of frost and prolonged cloudiness. It is normally grown in areas with an average temperature of 25–35°C and an annual rainfall of 600–1000 mm. In higher rainfall areas it may be grown in the dry season on residual moisture. However, well-drained soils such as black-cotton soils with pH 6–7 are preferred.

This is one of the most highly prized and important short duration pulse crop grown in cropping systems of India as a mixed crop and sequential crop besides growing as sole crop under residual moisture condition after harvesting of rice. In India it is grown on an area of about 3.90 million hectare with a total production of 1.80 million tones with an average productivity of 498 Kg/ha. As a tropical crop it is cultivated both in kharif and rabi season due tolerance to high temperature. It is an erect, sub-erect or trailing, densely hairy annual herb. The tap root produces a branched root system with smooth, rounded nodules. The pods are narrow, cylindrical and up to 6 cm long.

Its seeds are highly nutritious with protein, carbohydrates, vitamins and minerals. It is an aphrodisiac and nervine tonic. It should not be taken by those who are easily predisposed to rheumatic

diseases and urinary calculi as it contains oxalic acid in high concentration. Seeds and fruits of different species vary greatly in appearance, shape, size and ornamentation and structure of the embryo in relation to storage tissues. The germination of seed is affected by hormonal secretion and enzymatic activity with in the seeds. The major event occurring in the seed germination is water imbibitions. Germination represents a critical event in plant's life cycle and its timing largely predetermines the chances of survival of a seedling up to maturity. Temperature is an important physical parameter of an environment, which determines the success or failure of a species of a species in a particular locality, which in turns depends mostly on the germinability of the seed of particular specie. It is well known that the different population of the same species varies in their temperature and light requirements for germination. Germination requirements of a particular species are a result of the interaction of its genetic makeup with the environment and dormancy pattern of seeds of various plant species, which enable them to survive during adverse conditions (Wittington, 1973; Nikolaeva, 1977). The present investigation is carried out to investigate the response of different concentrations of the Plant Growth Substances on seed germination, root, shoot and hypocotyls elongation and biomass production of seedlings. Some morphological features of seed have also been observed along with seedling development process.

MATERIAL AND METHODS

Experiments were conducted to investigate morphological characters, seed germination and the influence of different concentrations of plant growth substances including the comparative growth patterns of the seedlings on *Phaseolus mungo.* It is an erect, sub-erect or trailing, densely hairy annual herb. The tap root produces a branched root system with smooth, rounded nodules. The pods are narrow, cylindrical and up to 6 cm long and seeds are small, oblong cylindrical and slightly truncated (Table 1). It is very nutritious and is recommended for diabetics.

Table 2. The effects of various concentrations of different plant growth substances on seed germination and seedling growth of *Phaseolus mungo*.

GA_3	0.1ppm	1ppm	10ppm
IBA	0.1ppm	1ppm	10ppm
NAA	0.1ppm	1ppm	10ppm
Control	Only distilled water		

Seeds were pre-soaked for 24h under the various concentrations (0.1, 1.0 and 10 ppm) of Plant Growth Substances viz. GA_3, IBA and NAA. A control set was soaked only in distilled water (Table 2). The seeds were placed on a wet filter paper in petridish and kept in seed germinator. On each alternate day, the mean valve of germination percentage, growth of root, shoot and cotyledonary expansion and biomass of seedlings were computed.

Table 1. The Morphological Features of *Phaseolus mungo* Seeds

S.No.	Parameters studied	Range of variation
1.	Shape of fruit	A cylindrical pod with long hairs and short hooked beak
2.	Fruit size	4–7 cm × 0.5 cm, erect or almost so. 4-19 seeded
3.	Shape	Seed are small, ellipsoid oblong and cylindrical to ovoid, slightly truncated at square ends, raised and concave hilum
4.	Flower colour	Bright yellow
5.	Flowering	Starts 30–60 days after sowing.
6.	Maturity	Reaches in 60–140 days after sowing.
7.	Color	Brown to black in color
8.	ornamentation	Smooth
9.	Length	4.0 – 5.2 mm.
10.	Width	3.5 – 4.1 mm.
11.	Seed Weight	The 1000-seed weight is 15–60 g.
12.	The seed rate	10–30 kg/ha,
13.	Seedling	Emerges through epigeal germination
14.	Germination time	Germination of black gram normally takes 7–10 days.

After thorough mixing the whole lot was sampled and dried in open air for 10 days and stored at room temperature till they were used for the experiment. The observation recorded on various morphological features of the seed such as seed color, shape, size and texture of the seeds. For this, 50 seeds were taken into consideration and their mean values computed for the morphological study. The moisture content of seeds was determined by air oven method. Subsequently, the sample contained in glass and dried thermostatically at room temperature and weighed, then placed in hot air oven at 80^0C for 48hrs to find out the average dry weight and calculated using the following formula (Anonymous, 1976).

$$\text{Moisture content (\%)} = \frac{\text{Fresh Weight – Dry weight}}{\text{Fresh weight}} \text{ X100}$$

Observations on root, shoot growth and dry weight along with cotyledonary expansion have been recorded on each alternate day up to the final day of experimentation.

RESULTS AND DISCUSSION

The observations recorded from the experiment showed that IBA 0.1ppm resulted in cent percent germination which was followed by 99 percent of germination recorded through $GA_3$1 ppm, IBA1ppm, and IBA10ppm. The control set and NAA10ppm showed the lowest germination (96%) slightly less than $GA_3$1ppm, $GA_3$10ppm and NAA 0.1ppm (Table 3).

In case of the seedling growth, IBA-1ppm attained maximum (6.17 cm) root length while NAA 10ppm showed minimum (1.65 cm) root length. The higher shoot elongation was observed under GA_3 10ppm (11.1 cm) and minimum in NAA 10 ppm (4.42 cm). GA_3 10ppm (3.52±0.5) have shown the best expansion of the cotyledons which was followed by IBA 0.1ppm (3.46 ±0.2). The lowest performance was recorded through NAA 10 ppm 0.29±0.4 and IBA 10ppm 1.87±0.5 while the controlled set exhibited better cotyledonary expansion (3.25±0.5) than these hormonal concentrations (Fig.1-3).

On the biomass observations, GA_3 10 ppm have shown maximum root dry weight (0.074 g) followed by NAA 0.1ppm (0.035±0.1) almost similar (0.0034±0.1) to control set, whereas GA_3 0.1-ppm resulted minimum (0.002g) root dry weight (Table 4). Heavy seeds generally have superior germination, survivorship, and seedling mass Aaron M. Ellison (2001). Seed size and germination requirements can be determined to be useful characters for resolving systematic and phylogenetic problems Douglass H (1985).

Heavy seeds generally have superior germination, survivorship, and seedling mass **as** mentioned by Aaron M. Ellison (2001). In the findings of Douglass H (1985) have also been summarized that seed size and germination requirements can be determined to be useful characters for resolving systematic and phylogenetic problems. Archna and Shivana (1985) have studied the requirements for seed germination and seedling formation of a hemi-root parasite *Sopubia delphinifolia*. Light was found to be essential for germination; none of the growth substances could replace the light requirement. Light responses seem to be mediated through the phytochrome system. They indicated that the emergence of the radicle, its further growth into the root and the emergence of cotyledons are controlled by different factors.

Table 3: Effect of various concentrations of Plant Growth Substances on seed germination and seedling development of *Phaseolus mungo*

Treatments	Germination %	Shoot Length (cm)	Root Length (cm)	Cotyledon Expansion (cm)
GA_3 0.1 ppm.	97	9.77 ±0.5	5.2 ±0.6	2.92 ±0.5
IBA 0.1 ppm.	100	10.14 ±0.6	4.82 ±0.5	3.46 ±0.2
NAA 0.1 ppm.	97	8.6 ±0.4	5.75 ±0.5	2.45 ±0.4
GA_3 1 ppm.	99	7.4 ±0.4	5.77 ±0.5	2.62 ±0.4
IBA 1 ppm.	99	9.87 ±0.5	6.17 ±0.4	3.44 ±0.5
NAA 1 ppm	98	8.13 ±0.5	3.9 ±0.6	2.58 ±0.5
GA_3 10ppm.	97	11.1 ±0.5	4.0 ±0.8	3.52 ±0.5
IBA 10 ppm.	99	6.94 ±0.6	5.0 ±0.8	1.87 ±0.5
NAA 10ppm.	96	4.42 ±0.4	1.65 ±0.4	0.29 ±0.4
Control	96	10.47 ±0.6	5.2 ±0.8	3.25 ±0.5

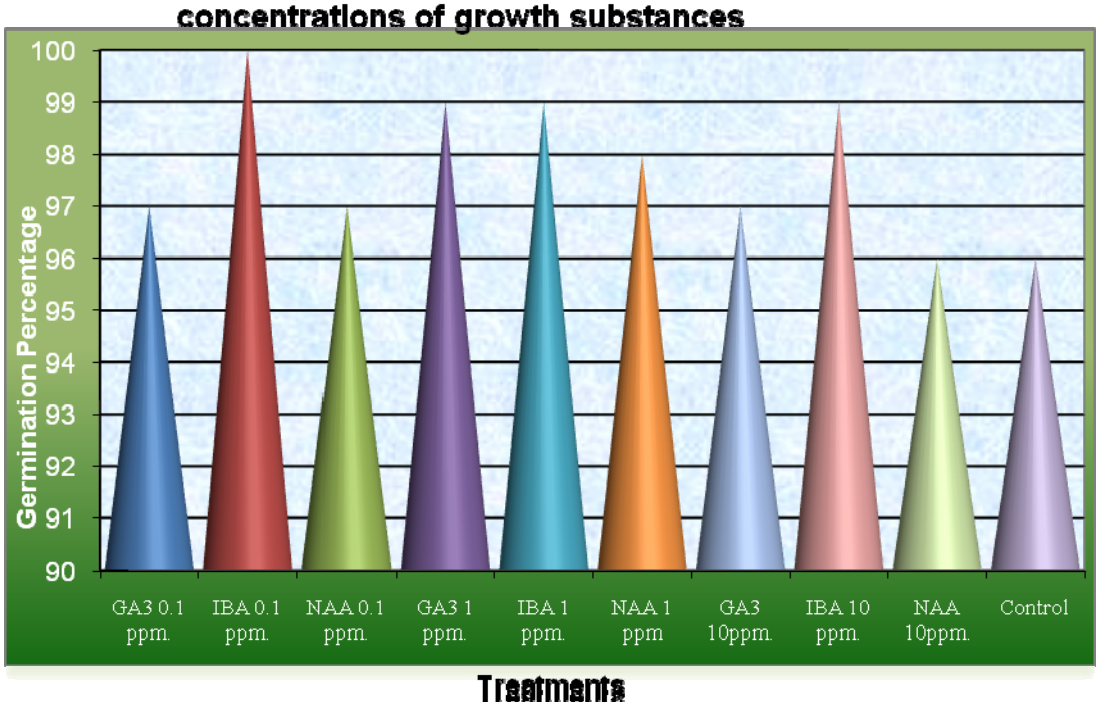
Seeds must attain certain minimum specific moisture content, before they germinate thus germination may be inhibited if the amount of water is too low and it is further inhibited if too much water is present (Negbi et.al. 1966; Coumans *et.al*. 1979). Role of the growth regulators in the promotion of cell division and the growth through changes occur in the pattern of enzyme development have mentioned by a number of researchers such as Liu and Loy (1976); Adams et.al. (1973) and Broughton McComb (1971). Similar studies were carried out by Parameswari & Srimathi (2008) to evaluate the influence of growth regulators on seed germination and seedling quality characteristics of tamarind seeds.

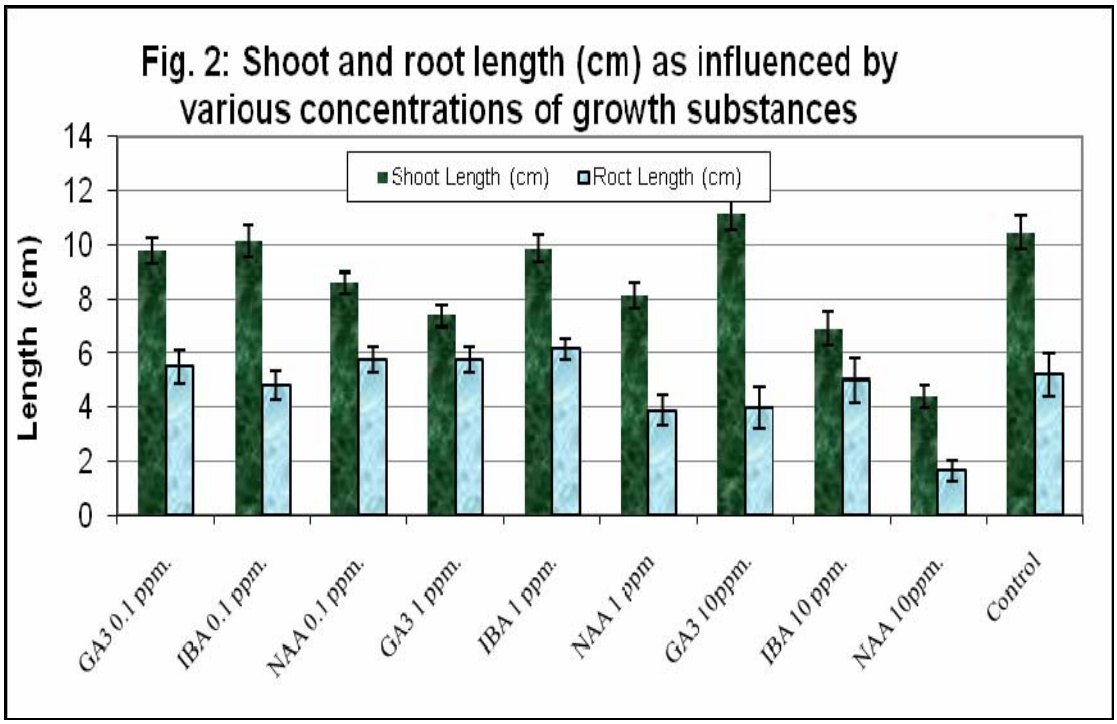
Table 4: Effect of various concentrations of Plant Growth Substances on shoot and root dry weight of *Phaseolus mungo.*

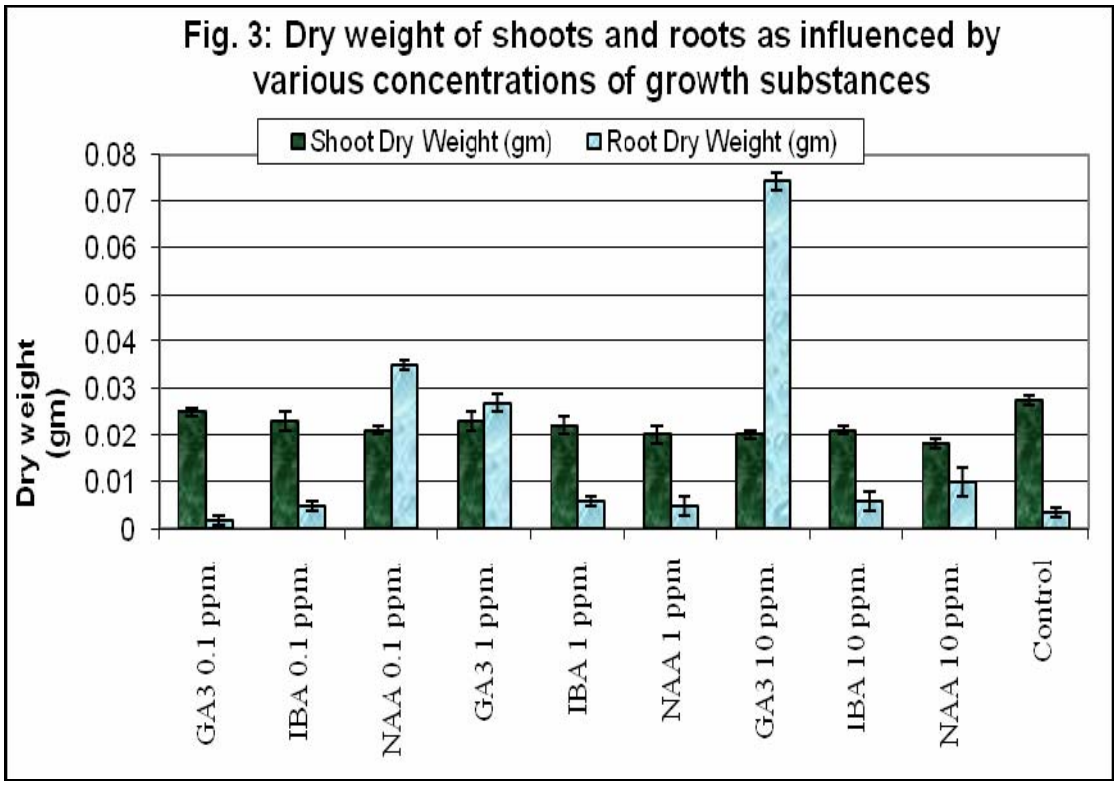
Treatments	Shoot Dry Weight (gm)	Root Dry Weight (gm)	Shoot: root ratio	Epicotyls length (cm)	No. of Roots
GA_3 0.1 ppm.	0.025 ±0.001	0.002 ±0.001	1: 13	2.92	7
IBA 0.1 ppm.	0.023 ±0.002	0.005 ±0.001	1: 4.1	3.46	8
NAA 0.1 ppm.	0.021 ±0.001	0.035 ±0.001	1:0.6	2.45	7
GA_3 1 ppm.	0.023 ±0.002	0.027 ±0.002	1:0.8	2.62	9
IBA 1 ppm.	0.022 ±0.002	0.006 ±0.001	1:3.6	3.44	8
NAA 1 ppm	0.020 ±0.002	0.005 ±0.002	1:40	2.58	7
GA_3 10ppm.	0.020 ±0.001	0.074 ±0.002	1:0.2	3.52	9
IBA 10 ppm.	0.021 ±0.001	0.006 ±0.002	1:3.5	1.87	8
NAA 10ppm.	0.018 ±0.001	0.010 ±0.003	1:1.8	0.29	6
Control	0.0276 ±0.001	0.0034 ±0.001	1: 6.7	3.25	8

The seeds were imposed with pre-sowing fortification treatment using growth regulators viz., GA3, IAA, IBA and Kinetin in different concentrations of 50,100 and 200 ppm for 16 hours in a seed to solution volume ratio of 1:1.

Fig. 1: Germination percentage as influenced by various concentrations of growth substances







They revealed that the concentration of 100 and 200 ppm GA_3 were found to enhance both the seed germination and seedling vigour parameters, such as root length, shoot length, hypocotyl length, dry matter production and vigour index values. Seed fortification with GA_3 100 ppm performed well even under nursery conditions recording a higher leaf number and stem circumference.

The effect of seed-soaking for 24 hours with different Plant Growth Substances has been examined by M. Grzesik. (2006) on the growth of seedlings of Lathyrus *odoratus*, Zinnia *elegans*, *Matthiola incana* and Antirrhinum *majus*. GA_3 improved the germination of the treated seeds. The seedlings of Zinnia, *Matthiola* and Antirrhinum treated with NAA, GA_3 and GA_{4+7} where higher, better branched and of better quality than the non-treated plants. The experiment was designated by M. Farooq *et al*. (2006) to investigate the possibility of rice seed invigoration by pre-sowing ethanol seed treatment. They revealed that employing ethanol treatments at lower concentrations can invigorate fine rice seeds.

High temperature both delayed and inhibited the germinations of barley and radish seeds (Cavusoglu K & Kabar K 2007). Irfan Afzal et al., (2005) have shown the effects of seed soaking with plant growth regulators (IAA, GA_3 and kinetin) on wheat emergence and seedling growth under normal and saline conditions and found their usefulness in increasing relative salt-tolerance. Among the 14 pre-sowing treatments, KNO_3 (150 min) and $NaHClO_3$ (30 min) significantly stimulated seed germination of *Angelica glauca* and reduced mean germination time under both laboratory and nursery trials, as well as developed seedling vigour under nursery conditions (Jitendra S. Butola and Hemant K. Badola 2004). A similar experiment was carried out by Gao HuanZhang et al., (2002) in which Walnuts cv. Jianshi were soaked in water (control), IBA at 80 mg/kg, IAA at 100 mg/kg, NAA at 80 mg/kg, ABT root-growing powder at 1 g/kg, or 6-BA at 5 mg/kg. In this experiment, different concentrations of GA_3, IBA and NAA, the maximum germination percentage (100%) was recorded in seed treated with IBA 0.1 ppm, which shows that the lower concentrations of growth hormone shows better performance than higher which was similar to the results of James Chukwuma Ogbonna and P.G. Abraham (1989). Heavy seeds generally have shown superior germination, survivorship, and seedling mass.

GA_3

IBA

NAA

IBA treated seedlings grow 37.5% taller than the control (Fig. 4). The most effective root length (6.17 cm) was observed in IBA 1ppm while maximum shoot length and highest cotyledonary expansion in GA_3 10ppm. In the biomass calculation of seedlings, the maximum 'root dry wt.' observed under GA_3 10ppm while maximum shoot dry weight was responded by control set but best shoot-root ratio has gained under GA_3 0.1ppm.

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Hydro-Chemistry, Macro-Invertebrate Fauna And Fish Production Of Acdja Fishing Sites In A Tropical Lagoonal Ecosystem

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ABSTRACT: An investigation of the hydrochemistry, macro – invertebrates fauna and fish production of three selected acadja fishing sites was carried out for six months (April – September, 2004) in the Lagos lagoon. Depth, Total suspended solid, total dissolved solid, nitrates, phosphates, sulphates, dissolved oxygen, biochemical oxygen demand and chemical oxygen demand recorded high or increasing values during the rainy season while transparency and salinity showed progressively lower values. The biological oxygen demand (BOD) and chemical oxygen demand (COD) ranged from 70.0 to 115.0mg/l and 20.0 to 75.0mg/l respectively. A total of twenty species and eighteen genera of Macro - invertebrate were recorded. The mollusks were the most abundant and diverse phyla, followed by the crustacean and annelids. The dominant species throughout the study were *Tympanoyonus fuscatus var radula, Balanus pallidus, Aloidis trigona* and *Mercierella enigmatica.* A total of 89.80kg (38.52%) fish was harvested in Site A, 71.30kg (30.59%) in Site B and 72.0 kg (30.89%) in Site C. *Sarotherodon melanotheron* and *Tilapia guineensis* contributed 36.75% of the total weight in Site A, 34.64% in Site B and 38.75% in Site C. Twelve fish species occurred in the Site A and C while eleven fish species occurred in fishing Site B with least species diversity. The profitability indices show that 'acadja' brush park fishing practice is a profitable business in the lagoon. [Journal of American Science 2010;6(1):42-48]. (ISSN: 1545-1003).

Keywords: Hydro – chemistry, macro – invertebrate, fish acadja, lagoonal ecosystem.

INTRODUCTION

Ecological studies of benthos in the Lagos lagoon were initiated several decades a go by Webb and Hill (1958), also Sandison and Hill (1966) and Oyenekan (1988) have also been major contributors. More recently are the investigations by Brown (1998) and Brown and Oyenekan (1998). Oyenekan (1988) put forward a classification of the benthic communities of the Lagos lagoon. The classification was based on the natine of deposit in which they occur and on the characteristics faunal element. Five communities were identified identified in Lagos lagoon: mangrove, pachymelina, estuarine, amphiophus, venus and estuarine rock communities (Oyenekan, 1988). The fish and the fisheries of the Lagos lagoon has been documented by authors like Fagade (1969); FAO (1969), Fagade and Olaniyan (1974), Udolisa and Solarin (1979), Solarin (1998), Solarin and Kusemiju (2003a&b), Emmanuel *et al.,* (2008a &b).

Over the years the Lagos lagoon has continued to be under intensifying pressure from pollution. According to Ajao *et al.,* (1996) coastal waters can be contaminated from both natural and anthropogenic sources of pollution. The anthropogenic sources include sand mining, industrial and domestic effluents, logging and timber transportation by water. The anthropogenic pollutants/waste has an attendant effect on the biodiversity of aquatic resources. Reduction in the composition and density of algae, zooplankton, benthic invertebrates, fish and fisheries resources has been linked to the increasing menace over the years of aquatic pollution in the Lagos lagoon, Nigeria (Akpata *et al.,* 1993; Nwankwo, 1998; Solarin 1998; Emmanuel *et al.,* 2008a&b).

Lagos lagoon has supported decades of small-scale fisheries which have shown signs of over-exploitation. The fishing gears and crafts used include gillnet, stownets traps, liftnets, longline, basket traps etc (Fagade, 1969; Solarin, 1998; Emmanuel 2008; Emmanuel *et al.,* 2008a&b).

The term 'acadja' describes a family of installation of the fish-park type that is currently found in several of the West African coastal lagoon (Welcomme, 1972). Welcomme and Batley (1998) listed fish shelter as one of the techniques for stock enhancement. Acadja fish fence provide shade, hiding place, shelter as well as food for fishes. The acadjas also act as breeding, spawning or nursery areas for fishes and also act as point of attachments for algae and macrobenthic invertebrate. The sticks used for the acadja are progressively colonized by bacteria, fungi algae, nematodes, annelids, mollusk and other invertebrates forms which all serve as food for a wide away of fishes. Hence, the mechanism of fish aggregation is prompted by the shelter, security and colonization of the fish fences by plankton and invertebrates organism which in turn prompts the growth of a large number of small planktophagus and benthophagus fishes which feed on them. It takes about three or more months for the sticks to deteriorate

appreciably and then harvest is imminent. Acadja harvests over the years have been shown to be higher during the dry season as correlated with high phytoplankton and zooplankton productivity (Nwankwo, 1991; Nwankwo *et al.*, 1994, Solarin 1998; Emmanuel and Onyema 2007).

The acadja, apart from slowing down the water current occasionally traps aquatic weeds like water hyacinth (*Eichhornia crassipes*) release exudates, tannins, lignins and other leachates which may adversely impair water quality. The study aimed at assessing the hydro-chemistry at the acadja site as well as the fishes and macrobenthic invertebrate composition biomass, temporal variation as these forms are an important component of the fish feed and fish production.

MATERIALS AND METHODS

Description of Study Site

The coastline of south-western Nigeria is a meandering network of lagoons and creeks of which the Lagos lagoon with an area of 208sqkm is the largest **(Fig. 1)**. The Lagos lagoon is shallow with an average depth of 1.5m except at the channels that are dredged occasionally (Webb, 1958), Brown and Oyenekan (1998) citing FAO (1969) records that the Lagos lagoon with an area of 208km^2 is the largest of the four lagoon systems in West Africa. It opens into the gulf of Guinea through the Lagos harbour which is the only opening of any size for fresh and brackish water to the sea for the entire western lagoons of Nigeria (Hill and Well, 1958). The lagoon is shallow and brackish with a salinity range between 0‰ at the mouth of Ogun River and 20‰ at the harbour (Webb, 1958).

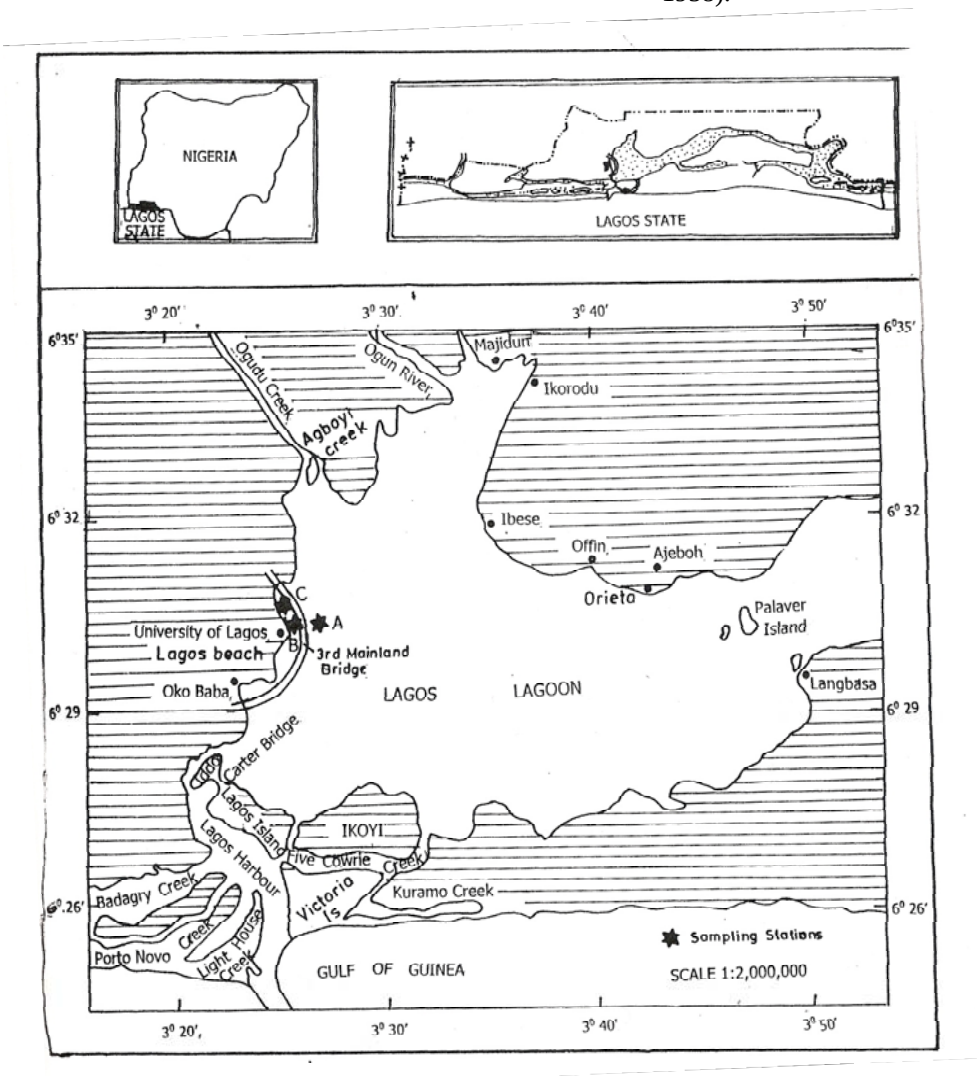

Fig. 1: Map of Lagos Lagoon showing the study sites

The influx of seawater from the sea give rise to brackish conditions in the lagoon and encourages the growth of mangrove which lines the edges of the many waters ways and cover those areas of low lying swampy grounds which are inundated at the high (Spring) tides.

Sampling Stations

For this study, there strategic sites have been chosen for ecological assessment. Station A is a pollution relatively free site within the lagoon whereas Station B is a site where kitchen waste and organic materials from University of Lagos staff club and guest house are channeled into the lagoon. Household or domestic waste and sewage are prevalent in Station C, emanating from household at the edges and within the lagoon.

Collection of water sample and sediment, temperature were measured in-situ on the field with mercury in glass thermometer. Water samples were collected at each site in a 250ml water container between April and September 2002. Van-Veen grab ($0.1m^2$) was used to collect the sediment. The water samples were then transported and stored in a refrigerator for further analysis. The sediment were empted into a black polythene bag and stored in a deep freezer ($<0^0C$).

Physico-Chemical Parameters

Surface water samples were collected about 10cm the water surface. On each trip, temperature (^0C) was recorded with mercury-in-glass thermometer and transparency (cm) measured by a 20cm diameter Secchi disc. Salinity (‰) was determined using the silver-nitrate-chromate method as suggested by Barnes (1980) and Nwankwo (1991) and pH measured in the field a Hackkit (Del, 2001). Dissolved oxygen (mgl^{-1}) was measured by the Griftin oxygen meter (Model 40). Total suspended solids (TSS), (mgl^{-1}) was estimated by the evaporation of a 100ml aliquot.

Sediment Analysis

Sediment particle size analysis was done using the method described by Brown (1991) and total organic matter determined by the rapid ash method employed by Oyenekan (1975).

Macrobenthic Invertebrate and Fish Collection

One of the grab was washed through a 0.5mm sieve in the field. The retained materials were preserved in 4% formalin and kept in labeled jars for further sorting and analysis in the laboratory. Fishes in the acadja sites were collected with enacting net (10mm-mesh polyamide) which was used to form a complete fence. The debris within was removed and gradually the net was drawn together to entrap the fishes.

(1) Statistical Analysis

All statistical methods used were adapted from Ogbeibu (2005). Macrobenthic community structure was estimated using the Margalef's species richness index (d) (Margalef, 1951); Shannon-Weiner information function (AS) (Shannon and Weaver, 1949) and Equitability index or Evenness (Lloyd and Ghellardi, 1964).

(2) Economic and Profitability Analysis

The economic and profitability analyses as described by Ayinde and Aromolaran (1998) and Abdul *et al.*, (2004) were adopted. Net income of fisherman practicing "acadja" fishing was calculated for the six month. This analysis was used in the profitability analysis to calculate return to management, capital and family labour, return to investment, return on fixed cost or gross margin, rate of return on fixed cost, rate of return on variable cost and rate of return on labour cost.

Return to management, capital and family labour (RMCF):
RMCF = TVP – TFC – TVC less cost of capital borrowed and cost of family labour
Rate of Return to Investment (RRI): RRI = (RMCF/TC) x 100
Return on Fixed Cost (RFC) or Gross Margin (GM): RFC = TVP – TVC
Rate of Return on Fixed Cost (RRFC): RRFC = (RFC/TFC) x 100
Rate of Return on Variable Cost (RRVC): RRVC = (RTVP – TFC/TVC) x 100
Rate of Return to Labour (RRLC):
RRLC = TVP – All costs except labour cost/total labour cost (man/day) x 100
Where, TVP = Total value of product
TFC = Total fixed cost
TVC = Total variable cost
TC = Total cost

RESULTS

The monthly variation in the physico-chemical parameter of water at the acadja fishing sites in the lagoon is shown in **Table 1 a&b**. The highest surface water temperature during the study was 32^0C in May and the lowest was 28^0C in July. pH values were essentially alkaline throughout the study period. pH range of 7.2 – 8.0 was recorded for water while that of sediment ranged between 7.0 and 8.0. A

neutral pH of 7.0 was recorded in Station A and B in July for sediment and water respectively. Total dissolved solid ranged between 10.0 and 24.0mg/l and the highest (24.0mg/l) was recorded in June while the lowest (10.mg/l) was recorded in April, August and September. Total suspended solids in study areas ranged between 10.0 and 21.5mg/l. Turbidity was generally high for the months of May, June, July, August and September with highest value of 22.5mg/l in Station A. Salinity value was highest in April (20.5‰) while the lowest (2.0‰) was recorded in September. Chloride content of the study areas was fairly constant with a range of 10.0 – 18.0mg/l. The highest chloride value was observed in June and July. Low value of oil and grease was obtained in this study with maximum value of 0.25mg/l in July. The highest nitrate value (2.5mg/l was recorded in April. Phosphate value was high in June with 4.5mg/l and the lowest (2.2mg/l) in July. Dissolved oxygen was high during the early party of the rainy season (April – June) with 6.5mg/l value at Station A and B in June and Station B in May and the lowest (3.0mg/l) in August (Station A & B) and September (Station C). A trend of high chemical oxygen demand was recorded in April, May, June and July with a peak in June (75mg/l). A range of 70 – 115.0mg/l was recorded for BOD in the study area with the maximum value noted at Station B in May and the lowest in Stations A and B in August and Station B in September. The sulphate level was very low with maximum value of 1.5mg/l. Total organic content (TOC) did not show any marked variation both in the station and the study period.

Macrobenthic Invertebrates

A total of twenty (20) species of benthic were recorded in this study. The species constituted three phyla: Mollusca, Annelids and Crustacea (Table 2). The mollusca constituted fifteen species, the annelida crustacean a constituted two and three species respectively. The gastropod molluscs include *Semifusus morio, Pachymelania aurita, Thais haemistoma, Natica flammulata, Neritina glabrata, Nerita* sp, *Tympanotonus fuscatus, var radula, Terebra micans* and *Turritella ungulina*, while the bivalvea molluses include *Aloidis trigona, Dreissena africana, Mactra* sp and *Cryphaea gasar*. The annelids were *Nereis succinea* and *Mercierella enigmatica*. The crustacean were represented by the common lagoon crab – *Callinectes amnicola* and the hermit crab – *Clibenarius africana* and *Balanus pallidus*, *Tympanotonus fuscatus var radula* was the most abundant organism during the study, followed by *T. fuscatus, Mercienella enigmatica* and *Balanus pallidus*. No specimen was recorded for Station A in April. Figs 2 to 4 show the number of individual organisms, percentage abundance of classes and monthly variation in the abundance of major taxonomic group of macro – invertebrate in the acadja sites respectively.

Three attached form were recorded in this study these are *Balanus pallidus, Mercierella enigmatica* and *Cryphaea gasar*, they were found attached to shells of *Tympanotnus fuscatus* var *radula*. The crustacean and annelids forms *(Balanus pallidus* and *Mercierella enigmatica*) were the more frequent forms on *T. fuscatus* var *radula* shells. Lesser density of these organisms was also found to attach to shells of *Gryphae gasar*. *Pallidus* was also found attached to stones located on the bottom of the study area. Juveniles of the *T. fuscatus* var *radula* were encountered from June, July, August and September.

Fish species composition and production in the acadja sites

The fish species composition of the acadja fishing sites is shown in Table 3. A total of 89.80kg (38.52%) fish was harvested in Site A, 71.30kg (30.59%) in Site B and 72.0kg (30.89%) in Site C. *Sarotherodon melanotheron* and *Tilapia guineensis* contributed 36.75% of the total weight in Site A, 34.64% in Site B and 38.75% in Site C. Twelve fish species occurred in the Site A and C while eleven fish species occurred in fishing Site B with least species diversity. The production of the acadja fishing in Lagos lagoon was estimated in **Table 4**. The production in Site A was ₦19, 463 (US$ 161.92), ₦15, 877 (US$132.07).

In this study the abundance of benthos was related to fish production in the 'acadja' fishing sites. **Table 5** shows that, at the end of six month of operation, a total of N23,000 was invested on three 'acadja' brush parks out of which N17,000 and N6,000 were variable and fixed costs respectively. Individual fisherman spent N3, 000 on seine-net rentage, N9, 000 on labour, N2, 000 on brush park maintenance and N3, 000 on canoe rentage. On fixed he spent N6, 000 on 'acadja' installation. An economic analysis indicated a fisherman net income of N28, 016. Profitability analysis shows that return to management, capital and family labour (RMCF) and Return on fixed cost (RFC) were N28, 016 and N34, 016 respectively. The rate of returns on investment (RRI), Fixed cost (RRFC), Variable cost (RRVC) and labour cost (RRLC) were 121.8%, 566.9%, 264.8% and 411.3% respectively (Table 6).

The performance of acadja fishery is illustrated in **Fig. 5**.

Table 1a: Monthly variations in the Physico-chemistry of water samples at the three acadja fishing sites in the Lagos lagoon

Parameters	April			May			June			July			August			September		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Water temperature	31	31	32	31	32	32	30	30	31	28	28	28	29	28	29	29	30	30
Water pH	7.5	7.2	7.5	7.5	7.2	7.2	7.5	7.5	7.2	8.0	7.0	7.5	8.2	7.4	7.6	8.2	7.5	7.5
TSS	12.0	10.5	12.5	12.5	10.5	10.5	20.0	20.0	21.5	8.5	10.5	10.5	10.0	10.0	12.0	10.0	15.0	15.0
TDS	15.0	12.0	10.0	14.0	15.0	15.5	24.0	22.0	22.5	12.0	11.0	10.5	10.0	12.0	15.0	10.0	15.0	15.5
Turbidity	10.0	9.5	8.2	12.5	10.5	9.5	22.5	21.5	20.0	11.5	10.5	10.0	10.0	10.0	12.5	10.0	15.0	18.5
Salinity	20.5	20.5	18.5	15.0	14.5	14.0	4.0	4.5	4.0	10.0	6.5	5.0	5.0	4.0	3.5	3.0	3.5	3.0
Chloride	10.0	10.0	12.0	-	10.0	12.0	15.0	18.0	0.0	18.0	12.0	15.0	15.0	15.0	12.0	10.0	12.5	12.0
Oil & grease	0.10	0.15	0.09	0.10	0.09	0.12	0.08	0.06	0.10	0.018	0.25	0.20	ND	ND	ND	ND	0.09	0.05
Nitrate	4.5	4.2	3.5	3.5	3.5	3.8	2.5	3.0	4.5	3.0	3.2	2.5	2.5	3.0	3.5	3.0	2.5	3.0
Phosphate	2.5	2.0	2.4	2.8	2.5	3.2	4.5	4.5	3.0	2.5	2.0	2.2	4.0	4.5	3.5	2.5	2.5	3.5
Dissolved 0_2	4.8	5.0	5.5	6.0	6.5	5.0	6.0	6.5	6.5	5.0	4.0	4.5	3.0	3.0	3.5	3.5	4.0	3.0
Chemical 0_2 demand	60.0	55.0	65.0	70	65	75	75	70.0	75	65	70	72	35	20	25	40	35	30
Biochemical 0_2 demand	100.0	95.0	90.0	110.0	115.0	112.5	100.5	95.5	85.0	95.5	85.0	120.0	70	75	95.5	80	75	100
Sulphate	1.5	0.06	0.60	0.15	0.10	0.09	0.10	0.12	0.18	0.15	0.12	0.10	0.09	0.15	ND	0.07	0.12	0.12
Depth	0.95	1.45	1.30	1.51	1.29	1.81	1.71	1.37	1.43	1.24	1.43	1.52	1.86	1.67	1.48	3.8	1.7	2.4
Transparency	0.85	0.68	0.73	0.91	0.65	0.6	0.73	0.56	0.52	0.26	0.33	0.35	0.36	0.35	0.3	0.4	0.35	0.4
Rainfall	159			221			372			296			85			189		

*ND = Not detected

Table 1b: Monthly variations in the Physico-chemistry of sediment samples at the three Acadja fishing sites in the Lagos lagoon

Parameters	April			May			June			July			August			September		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Soil pH	7.4	7.5	7.4	7.6	7.5	7.2	8.0	7.6	7.4	7.0	7.2	7.4	7.5	7.4	7.2	8.0	7.5	7.5
Total Organic Matter	19.93	71.72	12.72	20.52	21.15	17.93	19.45	18.62	14.43	18.85	19.73	17.75	15.57	12.23	14.45	17.75	18.83	20.15

Table 2: Composition and abundance of macrobenthic invertebrates at three Acadja fishing sites in Lagos lagoon, Nigeria (April – September, 2002)

Taxa	April			May			June			July			August			September		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Phylum - Mollusca																		
Class I – Galeodidae																		
Family I – Galeodidae																		
**Semifusus morio*							1											
Family II – Melaniidae																		
**Pachymelania aurita*				6		8	3					10	3					
Family III – Muricidae																		
**Thais haemostoma*										1								
Family IV – Naticacea																		
**Natica flammulata*				1			1	1					1					
**N. flannel*				1			1											
Family V – Neritidae																		
**Neritina glabrata*			2				3						7	1			2	
**Nerita* sp							1						3	1				
Family VI – Potamididae																		
**Tympanotonus fuscatus*						29		1		1		51	1					
**T. fuscatus var radula*		31	60	66	19	91	61	26	75	41	24	56	4		14	14	38	35
Family VII – Terebridae																		
**Terebra micans*																		
Family VIII – Turritellidae																		
**Turritella unqulina*				1	4	3			2	2				1				
Class II – Bivalvia																		
Family I – Aloididae																		
**Aloidis trigona*			3	4	6		3		2	3		4	8	1			3	7
Family II – Dieissenacea																		
** Dreissena africana*				3	1				1			7						
Family III – Mactridae																		
** Mactra glabrata*				5				3	3									
Family IV – Ostreaceae																		
** Gryphaea gasar*				10	1	4	10		1									
Phylum – Annelida																		
Class – Polychaeta																		
Family I – Nereidae																		
**Nereis succinea*			4															
Family II – Serpulidae																		
** Mecierella enigmatica*		2	4		9		21	31	58	2		53		13				3
Phylum – Crustacea																		
Class I – Malacostraca																		
** Callinectes amnicola*				2														
** Clibinarius africana*																		1
Class II – Cirripedia																		
** Balanus pallidus*		3	5			385			45	6		34	5	21	5	12	3	34
Total No. of Species	**0**	**3**	**6**	**10**	**6**	**6**	**10**	**5**	**8**	**7**	**1**	**7**	**8**	**6**	**1**	**2**	**4**	**5**
Total No. of Individuals	**0**	**36**	**78**	**99**	**40**	**520**	**105**	**62**	**187**	**56**	**24**	**215**	**32**	**38**	**14**	**26**	**46**	**80**
Ecological Indices																		
SHANNON WEINER'S	**0**	**0.48**	**0.89**	**1.28**	**1.39**	**0.82**	**1.34**	**0.99**	**1.29**	**1.01**	**0**	**1.66**	**1.89**	**1.08**	**0**	**0.69**	**0.65**	**1.12**
MARGALEF'S INDEX	**0**	**0.56**	**1.15**	**1.96**	**1.36**	**0.79**	**1.93**	**0.97**	**1.34**	**1.49**	**0**	**1.12**	**2.02**	**1.37**	**0**	**0.31**	**0.78**	**0.91**

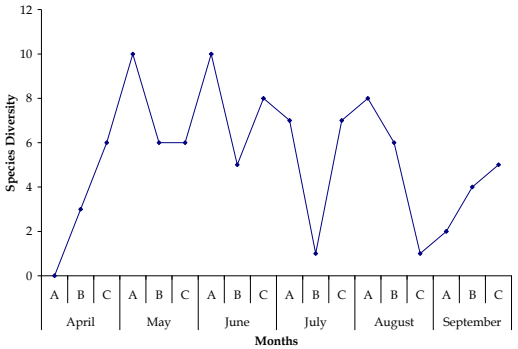

Fig.2: Number of Individual organisms at the Acadja Fishing Site

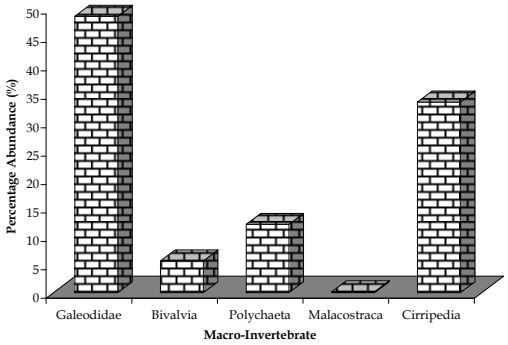

Fig. 3: Percentage Abundance of classes of macro-invertebrate fauna at Acadja Fishing Site at the Lagos Lagoon (April – September, 2002)

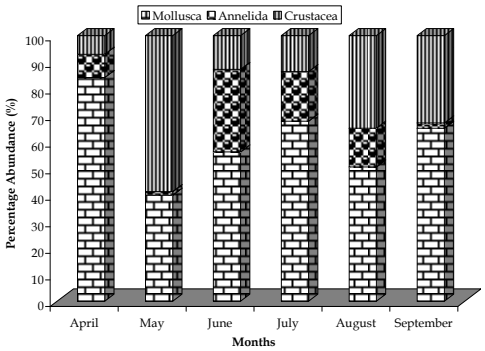

Fig. 4: Monthly variation in the abundance of major taxonomic groups

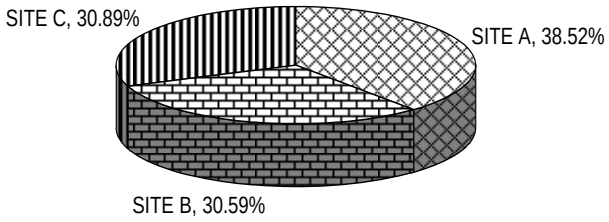

Fig. 5: Percentage weight of fish caught in acadja fishing sites

Table 3: Fish composition of the 'Acadja" fishing sites per six months

Family/Fish Species	Acadja					
	A(kg)	%	B(kg)	%	C(kg)	%
Cichlidae						
Sarotherodon melanotheron (Ruppell)	20.5	22.83	15.6	21.88	19.00	26.39
Tilapia guineensis (Bleeker)	12.5	13.92	9.10	12.76	8.90	12.36
Hemichromis fasciatus (Peters)	6.0	6.68	5.0	7.01	5.20	7.22
Bagridae						
Chrysichthys nigrodigitatus (Lacepede)	7.0	7.80	7.0	9.82	7.10	9.86
Liza falcipinnis (Valenciennes)	8.1	9.02	4.8	6.73	5.6	7.77
Cynoglossidae						
Cynoglossus senegalensis (Kaup)	5.6	5.90	5.0	7.01	5.1	7.10
Elopidae						
Elops lacerta (Cuvier & Valencicnnes)	6.7	7.46	6.0	8.42	5.9	8.19
Lutjanidae						
Lutjanus goreensis (Valenciennes)	7.6	8.46	6.7	9.40	4.7	6.53
Psettras sebae (Cuvier)	3.0	3.34	1.0	1.40	2.1	2.92
Carangidae						
Caranx hippos (Linnaeus)	4.1	4.57	6.2	8.70	2.2	3.06
Trichiurus lepturus (Linnens)	3.1	3.45	0.0	0.0	1.2	1.67
Portunidae						
Callinectes amnicola (DeRochneburne)	5.6	6.24	4.9	6.88	5.0	6.94
TOTAL	**89.8**		**71.3**		**72.0**	
Percentage total weight	**38.52%**		**30.59%**		**30.89%**	

Table 4: Fish production in 'Acadja' Fishing Practice per six months

Fish Species	Station A		Station B		Station C	
	Wt of fish (kg/fishing /ha)	Price (₦)	Wt of fish (kg/fishing /ha)	Price (₦)	Wt of fish (kg/fishing /ha)	Price (₦)
S. melanotheron	20.50	4,305	15.6	3,276	19.0	3,990
T. guineensis	12.50	2,625	9.60	1,911	8.90	1,869
H. fasciatus	6.00	900	5.00	750	5.20	78.0
C. nigrodigitatus	7.00	2,100	7.00	2,100	7.10	2,130
L. falcipinnis	8.1	1,701	4.80	1,008	5.60	1,176
C. senegalensis	5.61	1,400	5.00	1250	5.10	1,275
E. lacerta	6.70	107	6.00	1260	5.90	1,239
L. goreensis	7.60	1,900	6.70	1,675	4.70	1,175

P. sebae	3.00	360	1.00	120	2.10	252
C. hippos	4.10	1,025	6.20	1,550	2.20	550
T. lepturus	3.10	620	0.00	0.00	1.20	240
C. amnicola	5.60	1,120	4.90	980	5.00	1,000
TOTAL	**89.80**	**19,463**	**71.30**	**15,817**	**72.0**	**15,676**

₦120.20 = US$1

Table 5: Economic income analysis of Acadja brush park fishing practice

ITEMS	VALUE	
A. INCOME		
1. Sales of fish per six month	51,016.00	**51,016.00**
B. COST		
(i) Variable cost per six month		
(ii) Seine net (55mm) rent 3 times @ N1,000/day	3,000.00	
(iii) Labour (3 'acadja')	2,000.00	
(iv) Maintenance	9,000.00	
(v) Rentage of 2 canoe @ N500/day for 3 'acadja' for 3 days	3,000.00	**17,000.00**
2. Fixed Costs		
(i) Acadja installation (3)	6,000.00	**6,000.00**
TOTAL COST		**23,000.00**
NET INCOME (A – B)		**28,016.00**

N120.22 = US$1

Table 6: Profitability analysis of acadja fishing in Lagos lagoon

PROFITABILITY RATIOS	VALUE
Return to management capital and family labour (RMCF)	28,016
Rate of Return to Investment (%)	121.8
Return on Fixed Cost (RFC)/Gross Margin (GM)	34,016
Rate of Return on Fixed Gross (RRFC) (%)	566.9
Rate of Return on Variable Cost (RRVC) (%)	264.8
Rate of Return on Labour Cost (RRLC)	411.3

DISCUSSION

The results of the physico-chemical and biological data in this study showed similarly with results from previous ecological investigations (Webb, 1958; Oyenekan, 1988; Nwankwo *et al.*, 1994; Brown, 1998 and Emmanuel & Onyema, 2007). Depth, total suspended solids, chemical oxygen demand and biological oxygen demand gave high or increasing values during the rainy period (April to September), on the other hand transparency and salinity showed lower(ed) values. Rainfall associated with floodwater conditions have been shown to reduce transparency while increasing turbidity depth and the nutrient levels (Nitrate, phosphate and sulphate) of the same water body (Nwankwo, 1991; Brown, 1998; and Chukwu & Nwankwo, 2004). This studied revealed the linkage among the biological abiotic factors and rainfall pattern in the lagoon. This correlates with the report of Hill and Webb (1958) that there is a close correlation between the salinity and other factors in the Lagos lagoon and harbour and the rainfall of the regions draining into the lagoons. Brown and Oyenekan (1998) also attributed the variability in temporal distribution of physical, chemical and biological parameters in the Lagos lagoon to the two

seasons experienced yearly with alternative high and low salinity value being recorded in the lagoon.

Biological data from this investigation reveals reduction in the diversity of species compared with earlier works (Oyenekan, 1988; Akpata *et al.*, 1993; and Brown & Oyenekan, 1998). Ajao *et al.* (1996) identified sand mining, sand filling, industrial effluent discharge, oil wastes, domestic waste, sewage discharges among others as human related activities capable and presently destroying the sensitive coastal environment of Nigeria species.

The Pachymelania community as described by Oyenekan (1988) in the study of benthic macrofaunal communities in the Lagos lagoon seen to be the likely community encountered in all the three sites studied. According to the report, the community is characterised by sand and muddy sand deposit. Nominate member include *T. fuscatus, A. trigona, N. glabrata, N. succinea, P. Aurita* among others. Salinity and sediment type would seem to be the more important factors controlling the community structure and variability (Brown, 1998).

The occurrence of *N. succinea* in Site C in April in this study indicated that the site is polluted. This agreed with Akpata *et al.* (1993) that the presence of *N. succinea* in large numbers in particular site in the Lagos lagoon reveals that the areas has high organic pollutant load. Observed economically important benthic species utilized at the local level, which are highly valued by man as a source of food were: *T. fuscatus* var *radula, T. fuscatus* and *P. aurita*. All benthic macrofauna also serve as source of food for fish. Thus, they occupy a significance position in the aquatic food web (William and Feltmate, 1992; Mackie, 1998; Olomukoro and Ezemonye, 2007).

The profitability indices show that 'acadja' brush park fishing practice is a profitable business in the lagoon. Every N1 invested in the business generated N1.22 as profit. According to Ayinde and Aromolaran (1998) and Abudl *et al.* (2004) calculated rate of return to investment is acceptable only if the opportunity cost of capital and family labour utlised in agric-business is zero. For every N1 spent on hired labour asbout double the amount went back to the fisherman. According to Otubusin (2001) and Emmanuel (2009) economic viability of any fisheries business depends on the inter play of various components of the operation. In addition to this the fisherman should endeavour to have more acadja for more profit.

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Evaluating the selective performance of gillnets used in a tropical low brackish lagoon south – western, Nigeria.

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Abstract: The result of the investigations of evaluating the selective performance, aspect of design and operation of gillnet used in Lekki lagoon between March, 2006 and February, 2008. The gillnet was the most abundant and constituted 50.04% and 48.74% of the fishing gears in the Lekki lagoon for March 2006 to February 2007 and March 2007 to February 2008 respectively. It was estimated that the 514 gillnet canoes produced a total of 218.73t fish at a low rate of 0.43t canoe/year. The catch per unit effort (CPUE) (kg/canoe/month) range between 14.2kg and 23.0kg with a mean value of 18.9± 2.91. The 30 – 45mm, 50 – 70mm and 75 – 180mm gillnet sizes caught an average of 2.05kg, 2.19kg and 2.32kg fish per canoe per day respectively. Monofilament gillnets caught more fish (by weight) than multifilament gillnets. The performance of gillnet was positively influenced by the improvised poles and concrete sinkers. To provide an overall (aggregated) effect of gillnet on the fish assemblage, multi – species selection curve for 40mm, 50mm and 75mm showed mean retention length of 135mm, 170mm and 235mm respectively. [Journal of American Science 2010;6(1):49-62]. (ISSN: 1545-1003).

Keywords: Gillnet, selectivity, catch per unit effort, slippers, concrete sinkers.

Introduction

Gillnets are used extensively by the small – scale artisanal fishermen in the fresh, brackish and coastal waters of Nigeria (Solarin and Kusemiju, 2003; Emmanuel et al., 2008b; Emmanuel, 2009). Emmanuel et al. (2008b) stated that gillnet is a large wall of netting vertically hanging in the water. Hamley (1975) observed that the design characteristics of the rectangular curtain of netting influenced the performance of the net. Udolisa and Solarin (1979) gave detailed technical features of gillnets in the Lagos lagoon.

The knowledge of the size – selectivity of fishing gear types is crucial to fisheries management and ecology (Emmanuel et al., 2008b). The gillnet selectivity of most tropical lagoon fish is poorly known (Emmanuel et al. 2008b) and the knowledge of the size selectivity of fishing gear types is crucial to fisheries management in order to maximize a sustainable yield (Millar and Holst, 1997; Huse et al., 2000; Emmanuel et al., 2008a; Emmanuel et al., 2008b).

Millar and Fryer (1999) recently clarified the conceptual of fishing gear selection processes and detailed the statistical framework to assess and obtain unbiased results in size – selectivity experiments. Estimates of gear selectivity by age and length – based population models are well documented in industrial fisheries and used for estimating stock size and establishing management measures directed to reduce by – catch and discards (ICES, 1996; Caddy, 1999). However, the selective performance of fishing gears used in small – scale fisheries has been scarcely documented (Erzini et al., 1996; Stergiou et al., 1996; Stergiou and Erzini, 2002; Emmanuel et al., 2008b) particularly in tropical estuaries. The proper interpretation of survey data is relevant in such fisheries, which have an overwhelming social value as sources of both food and income for local fishers (Blaber, 1997). These multi – species and multi – fleet fisheries are generally open – access with low operating costs, which make fish resources more susceptible to over fishing (Rueda, 2007). In this setting, one critical point to improve management requires considerable technical changes to the gear to increase its selectivity (Caddy and Cochrane, 2001).

Past reports on the uses of gillnet in Nigeria include those of Reed et al, (1967), FAO (1969), Solarin and Udolisa (1979), Solarin (1998), Emmanuel et al (2008b) and Emmanuel (2009). Based on the statistical frame work developed by Millar and Fryer (1999) and following further developments by Zuur et al (2001) and Rueda (2007), this paper assesses the selection processes affecting catch efficiency of the gillnets in the Lekki lagoon. The gillnet is used in small – scale tropical and inshore fisheries from Latin America and the Caribbean, Africa and South east Asia (Arias, 1988; Nedelec, 1990; Trinidad *et al*., 1993; Emmanuel *et al*., 2008b; Emmanuel, 2009). The primary aim of this paper is to quantify the catch efficiency of gillnet in terms of probability of capture of fish species, based on an experimental approach. A secondary objective was to combine species – specific selectivity curves to

demonstrate the overall effect of gillnets on a multi specific basis.

Materials and Methods

Description of study area

The Lekki lagoon is one of the largest lagoons in West Africa and it supports a major fishery (Emmanuel, 2009). The lagoon is located between Lagos and Ogun States of Nigeria and lies between longitude 4^0 00' and 4^0 15' E and between latitude 6^0 25' and 6^0 37'N (Figure 1). According to Kusemiju (1973), the lagoon has a surface area of about 247 square kilometers and it is mostly shallow (less than 3.0m deep) the maximum depth being 6.4 metres. Lekki lagoon is a freshwater environment fed by the river Oni in the North eastern part and by Rivers Oshun and Saga in the north western parts of the lagoon.It opens into the sea via the Lagos lagoon and Lagos harbour. The lagoon is transitional in that it connects three south western states (Ondo, Ogun and Lagos). The lagoon is part of an intricate system of waterways made of lagoons and creeks that are found along the coast of South-western Nigeria from the Dahomey border to the Niger Delta.

The two distinct seasons (dry and rainy) are observable in the lagoon which is typical of the southern part of Nigeria. The fisheries techniques obtained in the lagoon are mostly small scale based. Thus little capital is required to set up fishing business. The lagoon serves as the fish basket of the protein source of the surrounding settlements.

The vegetation around the Lekki lagoon consists mainly of stilt rooted trees, a dense undergrowth of shrub and raphia palms (*Raphia sudanica*) and oil palms (*Elaeis guineensis*). The floating grass (*Saccarum sp*) occurred on the periphery of the lagoon while coconut palms (*Cocos nucifera*) are widely distributed in the surrounding villages. Some parts of the lagoon are covered by floating plant like the water lettuce, *Pistia stratiotes*, duck weed, *Lemna* sp and the water hyacinth, *Eichhornia crassipes* are always found in the periphery and are distributed allover the lagoon during the dry season more especially December, January, February and early March of the year

Gill net operation and production in Lekki lagoon

Gillnet wooden canoes were inventoried monthly in 25 villages, settlements and landing sites in the Lekki lagoon. The design details including the mesh size, the fishing operation and the catch per unit effort (kg/canoe/month) as well as total length of fish were recorded. The fish species were identified with the aid of available literatures (Tobor and Ajayi, 1979; Fischer et al., 1981; Schneider, 1990; Olaosebikan and Raji, 1998).

Gillnets operation was investigated in Lekki lagoon between March 2006 and February 2008.The design details showing geographical configuration in three dimensional forms, the fishing operation, the catch composition, and the catch per unit effort (CPUE) equivalent was recorded. Gill net made of 0.20mm twine thickness, multifilament 210D/9 and 50mm, 54mm mesh sizes were designed and constructed with hanging ratio 0.51 or 51.28%. Mesh selectivity study was carried out with gill nets to observe relationship between fish size (total length), fish growth and stretched mesh size of net. The monofilament and the multifilament catch variation were observed. The effect of *Callinectes amnicola* on the gill net was also observed.

The current market prices of fishing inputs, the running costs of the operational methods and retail prices of the fish species were collated for production analysis. Return on investment (ROI) was calculated using the formula:

ROI = End of the year investment value – Beginning of the year investment value/ Beginning of the year investment value.

Results

Gillnet Design Details in Lekki lagoon

The two types of gillnets used in Lekki Lagoon surface drift and the anchored bottom gillnets. Both of them are walls of netting hanging vertically in water by the combined actions of the floats (Slipper, Raphia) attached to the headlines and the lead/stone sinkers were attached at intervals of (1.35 – 2) meter to the foot ropes to sink the nets to the lagoon bed while the floats were attached at intervals of (1.1 – 1.95) metres to the headlines which allow the heads of the nets to float thereby maintaining the vertical opening of the gillnets. The differences in the designs of a surface gillnets and an anchored bottom gillnet were that more weights (lead /stones) including the anchor were attached to the footrope of the anchored bottom gillnet than the surface gillnet while more float were attached to the headline of the surface gillnet than the anchored bottom gillnet.

The netting materials were white monofilament polyethylene and white multifilament polyamine. The headline materials were polyethylene and kuralon with diameters ranged between 2.5 and 3mm (210D/6 and 210D/9 respectively). The mesh sizes ranged between 39 – 160mm the mesh openings ranged between 38 and 159mm. The mesh circumferences ranged between 78 and 318mm.

The rubber slipper floats had the following dimensions 6 x 4 x 4cm; 8 x 5 x 1.3cm and 7 x 5 x 4cm. The floats numbers on the headlines varied from 733 to 2001 and the headline lengths varied from 804.67m to 3,900m. The distances between floats varied from 1.1 to 2.0m. Each of the lead sinkers weighted about 35g and the numbers of sinkers per foot rope ranged from 404 to 2,890. The foot rope lengths varied from 804.67m to 3,900m. The distances between sinkers varied from 1.35 to 2.2m.

Materials used to construction gillnets in Lekki Lagoon were rope, float for the float line, sinkers for the lead line and twine to sew everything together. Floats and sinkers were improvised for in the lagoon. The floats were improvised with poles and wood while the sinkers were improvised with concrete, stone and old bottles filled with sand concrete sinkers. The concrete was produced by mixing cement and sand in ratio 2 to 1 that is one bag of cement to 25kg of sand to prevent it from easily breaking.

In net making, the rope was stretched to get all the snarls and tangles out by tighten the rope between to house pillars. The netting material was measured and straight across the meshes. The netting was hung on the float line and the lead line with fishermen's needle. The staples (loops of twine) that connected the netting with the rope were exactly the same distance apart so that all the meshes were of the same shape. The float line ends were tightened between two pillars. The floats were thread-on at regular interval. The twine was passed through the mesh on the corner of the piece a spot. The staples were as long as the stretched lengths of the one mesh.

Two major types of gillnets were recorded in Lekki lagoon base on the set depth in the lagoon. These are surface and bottom gill nets (Figures 3 and 4). The surface gill net targets fishes that moves on the water column (pelagic species) while the bottom set gillnet targets fishes that move on the bottom (demersal species). Gillnets are also classified based on the mode of operation as motorized (operating using outboard engine) and non- motorized (operating without outboard engine or with pole or paddle).

Gill net selectivity and efficiency in Lekki lagoon

Out of 514 canoes, 110 canoes (21.40 %) operated gillnets with mesh size ranging between 30 and 45mm, 178 canoes (34.63%) operated gill nets with the mesh size ranging between 50mm and 70mm and the third group consisted of 226 canoes (43.97%) which operated gillnets with mesh size ranging between 75mm and180mm. Table 1 shows the frequency of gillnets by mesh size between 2006 and 2008.

The major fish species composition of the gill nets based on the mesh size categories in the lagoon is shown in Table 2. The gill nets with 30 – 45mm mesh size caught mostly *E. fimbriata, T. guineensis, C. nigrodigitatus, C. walkeri and C. filamentosus* which accounted for 64.2 % of the catch. *T. guineensis* and *S. barracuda* were two fish species which are predominant to gill nets with 50 -70mm mesh size. The gill nets with 75 – 180mm mesh size caught mostly *S. barracuda*, *C. hippos*, *T. teraia* and *C. senegalensis*. Gillnets with mesh sizes of 30 – 45mm, 50 – 70mm and 75 – 180mm harvested a total fish weight of 225.6kg, 386.4kg and 524.4kg *T. guineensis* respectively. A summary of the fish caught in the three gillnet categories is given in Table 3. 110 gillnet canoes operating 30 – 45mm meshed net caught a total of 225.6kg (19.85%) fish with an average of 2.05kg per canoe. 178 gillnet canoes operating 50 – 70mm meshed net caught 386.4 kg (34.01%) fish with an average value of 2.19kg per canoe. 226 canoes using 75 – 180mm meshed nets caught 524.4kg (46.14%) fish with a mean of 2.34kg per canoe. The 75 – 180mm stretched mesh category of gillnets performed relatively better than the other two categories in terms of fish weight. The 514 gillnet canoes produced atotal of 218.73t fish at a low rate of 0.43t/ canoe/year. The catch per unit effort (CPUE) (kg/canoe/month) ranged between 14.2kg and 23.0kg with a mean value of 18.9 ± 2.91.

Mesh selectivity study of the prototype gillnets (the most used fishing gears in the lagoon) was undertaken as a conservation strategy for *T. guineensis*, one of the most abundant fish species that command high economic value in the lagoon. Table 4 shows the percentage length frequency distribution of *T. guineensis* caught by gillnets with 40mm, 50mm and 75mm stretched mesh sizes respectively. The most caught fish length for 40mm mesh size was fish of total length 14cm while fish of total length 16cm was mostly caught by 50mm gillnet and 75mm gillnet mesh size caught mostly fish of 22cm total length. Figure 3 shows the selectivity curves of the fish caught by the three mesh sizes. The larger the mesh size the bigger the size of fish caught in the net. T. guineensis specimen with length ranges of 10.0 – 19.0cm, 12.0 – 22.0cm and 17.0 – 30.0cm were caught by 40mm, 50mm and 75mm mesh gillnets respectively. The corresponding mean retention lengths were 13.5cm, 17.0cm and 23.5cm respectively (Table 5and Figure 4). The mean retention length increased with the increase in mesh size of gillnets. The relationship between the mean retention length (Lm) and mesh size gave a regression equation:

$Lm = 2.5577 + 2.8077 M$

The correlation coefficient (r) was 0.995 which indicated a high positive relationship between the mean retention lengths of fish and the mesh size of the net.

To further support the selectivity result of the gillnets, data were grouped by mesh size for the whole period of the test and number of fish caught according to mesh size, means and standard deviations of head girth and maximum girth were shown in Table 6& Figure 5.The relationship between head girth and total length and maximum/body girth and total length obtaied from fitting the linear regression for ***T. guineensis*** were as follows for 50mm and 54mm mesh size:

Gmax = 1.2212 + 0.6951 TL (n = 317)
r = 1
Gh = -0.066 + 0.6443TL (n = 317)
r = 1

Figure 6 shows that the optimum catch length of the 50mm net appears to be greater for fish in14.5cm length group, the same also was observed for 54mm mesh size but with lower number of fish.

Variation in the Catches of the monofilament and multifilament gillnets in Lekki lagoon.
The weight of fish caught in monofilament gillnet were more than those of the fish caught in multifilament gillnet (Table 7). The Chi square test revealed that the weight of fishes caught with monofilament were not statistically significant to that of multifilament.

Crabs destructive effect on gillnets
In one of the fishing trips, the damage caused by crab was estimated and a small crab of carapace length 3cm tore a net size about $1.1m^2$. Then an estimation of $55m^2$ gap will be created if 50 crabs of this size were caught.

Fish production cost and revenues for gillnets in Lekki lagoon.
The current market values and cost of fish were used in the analysis of annual production costs and revenues from the small scale fisheries in Lekki Lagoon in 2007 (Table 8). The initial capital investment or fixed cost included the cost price of canoe, the fishing gear (net twine, rope, hooks and the accessories like the floats and sinkers as well as the cost price of outboard engine or paddle for canoe propulsion). The operational or variable costs covered fuel and lubrication oil, canoes maintenance estimated as 10% of the initial cost of the canoe, engine maintenance (15% of cost), net repair (10% of cost) and cost of labour (if the fisherman was hired) estimated as one third of the revenue from fish sale according to Solarin (1998). The total annual revenue from fish sale amounted to annual catch (kg) multiplied by the average price of fish per kilogram. The profit margin or loss amounted to the total revenue minus both capital and operational costs.

At the end of one year fishing operation, unmotorised canoes gillnet fishery gave 125.1% return on investment. In motorized gillnet fishery a loss of N31,322.00 (USD 261.02) or 10.0% was due to the high initial capital investment especially the cost of out board engine as well as the operational cost incurred in the buying of fuel and lubrication oil.

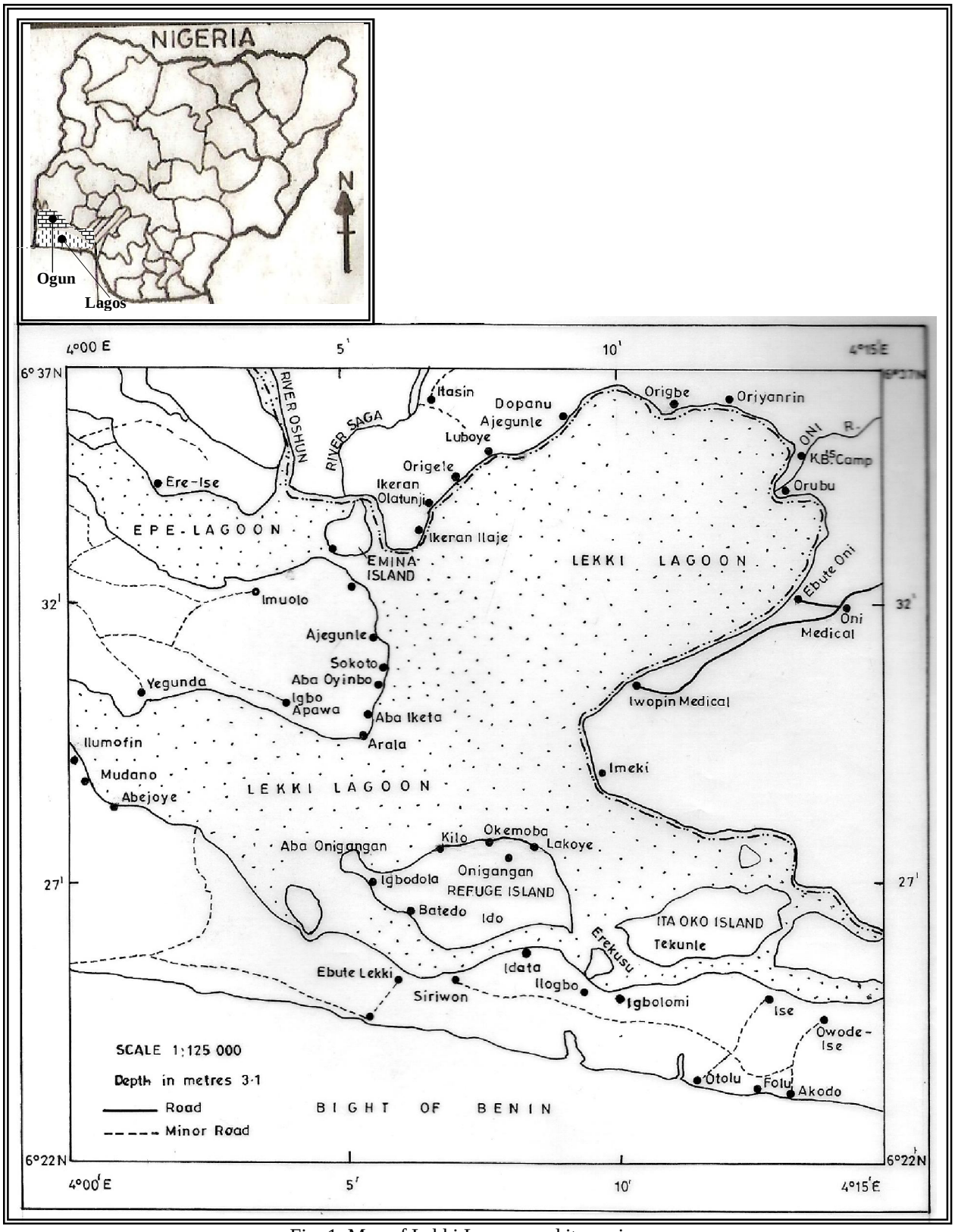

Fig. 1: Map of Lekki Lagoon and its environs

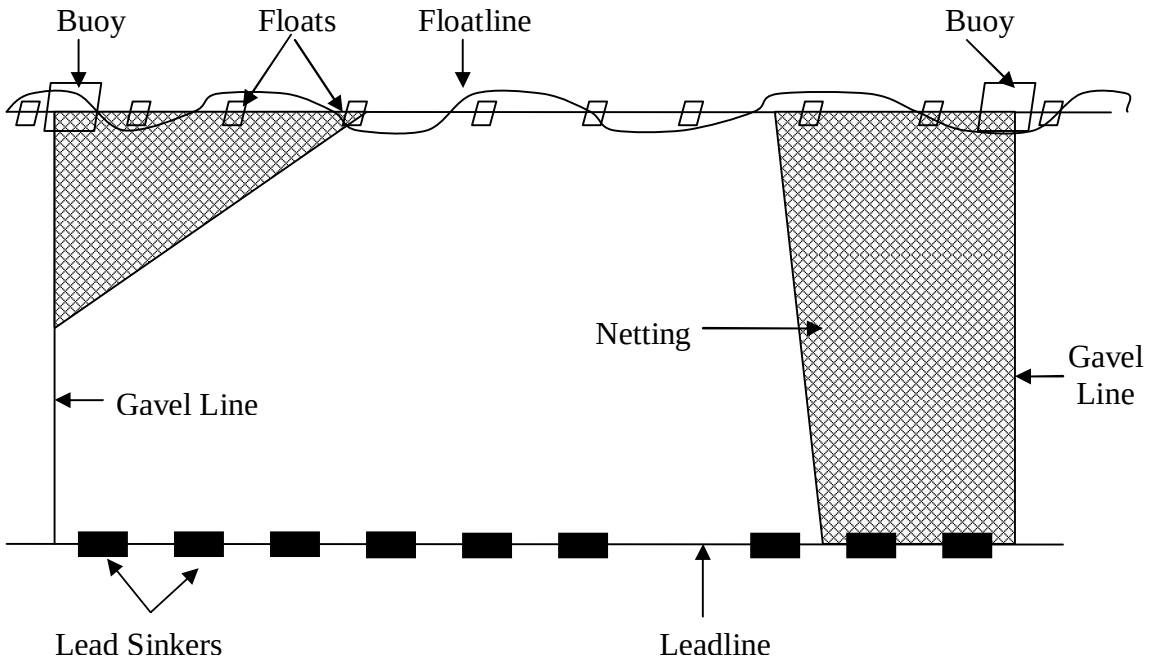

Fig. 2: A surface gillnet

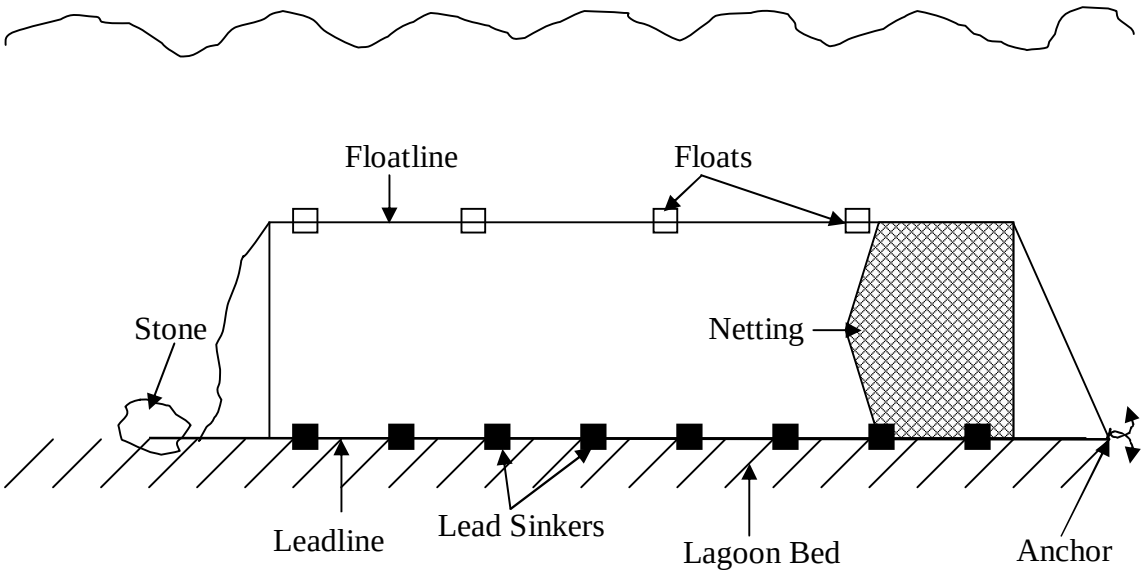

Fig. 3: A bottom set gill net

Table 1: Frequency of Different Meshes of Gillnet used by Fishermen in 2006 -2008 in Lekki Lagoon

Stretches Mesh Size (mm)	Number of Gillnets Canoes	Percentages (%)
30	20	3.9
40	38	7.4
45	52	10.1
50	36	7.0
55	34	6.6
60	36	7.0
65	36	7.0
70	36	7.0
75	42	8.2
80	40	7.8
85	32	6.2
90	0	0
100	32	6.2
120	40	7.8
160	20	3.9
180	20	3.9
	514	**100**

Table 1: Fish species composition by weight (kg) caught by different mesh size ranges of gillnets in Lekki lagoon (Percentage in parenthesis)

Fish species	Mesh size of gillnet		
	30 - 45	50 – 70	75 – 180
Tilapia guineensis	37.8 (16.8)	64.9(16.8)	54.1 (10.3)
Ethmalosa fimbriata	50.6 (22.4)	20.2 (5.2)	0.0
Chrysichthys nigrodigitatus	20.7 (9.2)	30.2 (7.8)	54.9 (10.5)
Chrysichthys walkeri	20.1 (8.9)	29.2 (7.6)	52.5 (10.0)
Chrysichthys filamentosus	15.6 (6.9)	28.7 (7.4)	54.5 (10.4)
Caranx hippos	10.7 (4.5)	34.4 (8.9)	75.9 (14.5)
Sphyreana barracuda	10.1 (4.5)	40.7 (10.5)	90.5 (17.3)
Cynoglossus senegalensis	6.7 (3.0)	24.4 (6.3)	65.1 (12.4)
Trachinotus teraia	5.6 (2.5)	21.4 (5.5)	75.9 (14.5)
Hemichromis fasciatus	15.2 (6.7)	24.2 (6.3)	0.0
Schilbe mystus	12.1(5.4)	18.4 (4.8)	0.0
Alestes baremose	4.2 (1.9)	17.4 (4.5)	1.0 (0.2)
Mormyrus rume	6.1 (2.7)	16.4 (4.2)	0.0
Synodontis clarias	10.1 (4.5)	15.9 (4.1)	0.0
Total	225.6 (100)	386.4 (100)	524.4(100)

Table 3: Different mesh size ranges of gillnet category and weight (kg) of caught in Lekki lagoon (Percentage in parenthesis).

Gillnet category based on mesh size (mm)	Number of gillnet canoes	Weight (kg) of fish caught	Average catch/canoe (kg)
30 – 45	110 (21.40)	225.6 (19.85)	2.05
50 – 70	178 (34.63)	386.4 (34.01)	2.19
75 – 180	226 (43.97)	524.4 (46.14)	2.32

Table 4: Length frequency distribution of *Tilapia guineensis* caught by gillnets 40mm, 50mm and 75mm stretched mesh sizes.

Total length (cm)	**Number of fish species (Percentage in parenthesis)**		
	40mm	**50mm**	**75mm**
10	20 (2.0)	0	0
11	85 (8.5)	0	0
12	120 (12.0)	50 (4.3)	0
13	260 (25.9)	150 (12.9)	0
14	300 (29.9)	169 (14.5)	0
15	180 (17.9)	215 (18.4)	0
16	20 (2.0)	290 (24.9)	0
17	10 (1.0)	250 (21.4)	50 (4.2)
18	5 (0.5)	20 (2.0)	90 (7.6)
19	4 (0.4)	10 (0.9)	120 (10.10)
20	0	5 (0.4)	172 (14.5)
21	0	4 (0.3)	200 (16.8)
22	0	2 (0.2)	225 (18.9)
23	0	0	100 (8.4)
24	0	0	82 (6.9)
25	0	0	70 (5.9)
26	0	0	40 (3.4)
27	0	0	20 (1.7)
28	0	0	10 (0.8)
29	0	0	5 (0.4)
30	0	0	5 (0.4)
Total	**1004**	**1166**	**1189**

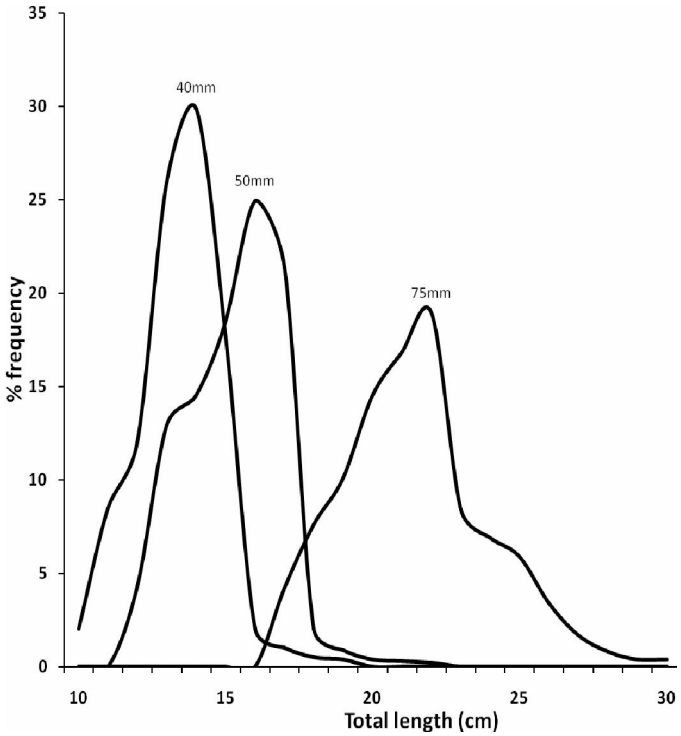

Fig. 4: Selection curve for T. guineensis caught by gillnets in Lekki lagoon.

Table 5: Length range, mean retention length and standard deviation of *T. guineensis* caught by gillnets in Lekki lagoon.

Mesh size(cm)	Total length range (cm)	Mean retention length (cm)
4	10.0 – 19.0	13.5
5	12.0 – 22.0	17.0
7.5	17.0 - 30.0	23.5

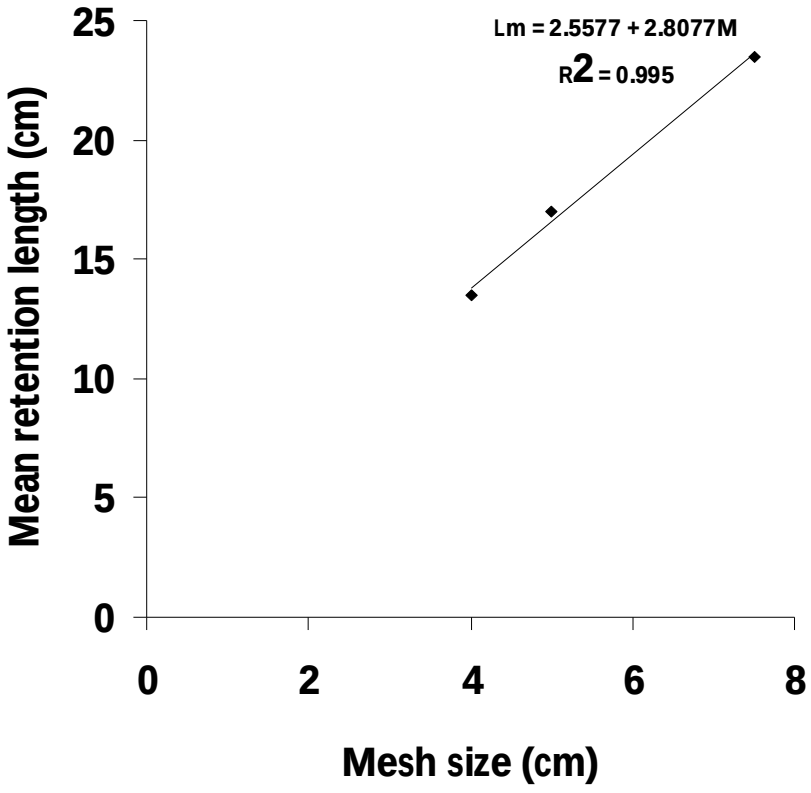

Fig. 5: The variation of mean retention length of *T. guineensis* with mesh size.

Table 6: Total length frequency distribution of fish caught according to mesh size, mean and standard deviations of head girth and maximum girth for *T. guineensis.*

Length	Stretched mesh size		Mean Head Girth	S.D Head Girth	Mean Max. Girth	S.D. Max. Girth
Class (cm)	50mm	54mm				
12.5	9	0	8.02	0.51	9.91	0.39
13.5	74	8	8.64	0.50	10.60	0.33
14.5	100	72	9.26	0.42	11.31	0.48
15.5	23	21	9.88	0.43	12.00	0.78
16.5	6	3	10.50	0.60	12.68	0.98
17.5		1	11.29		13.39	
Mean			9.60	0.49	11.65	0.59

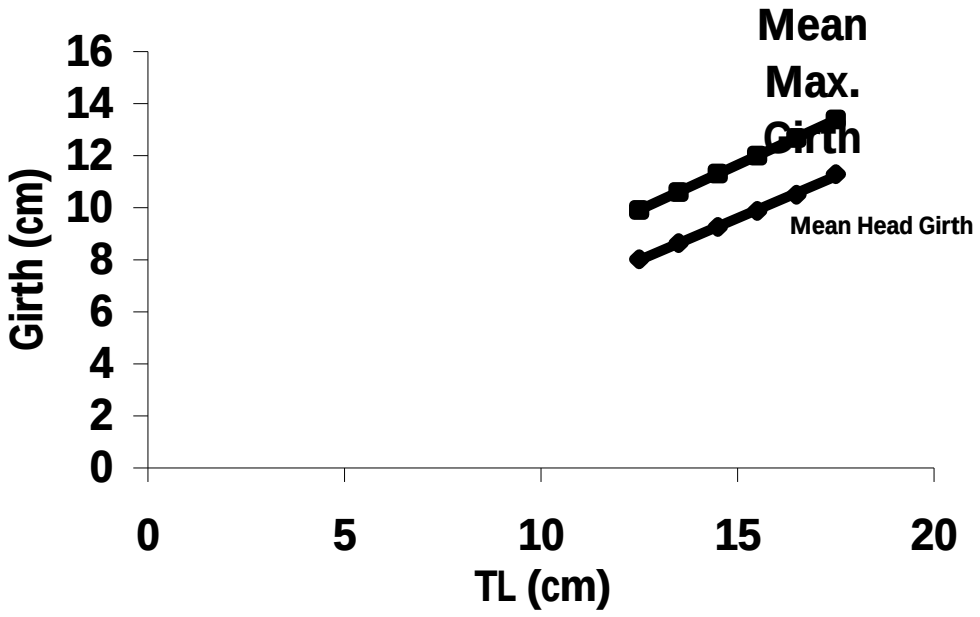

Fig. 6: Relationship between mean head girth and total length and mean body girth and total length of *T. guineensis.*

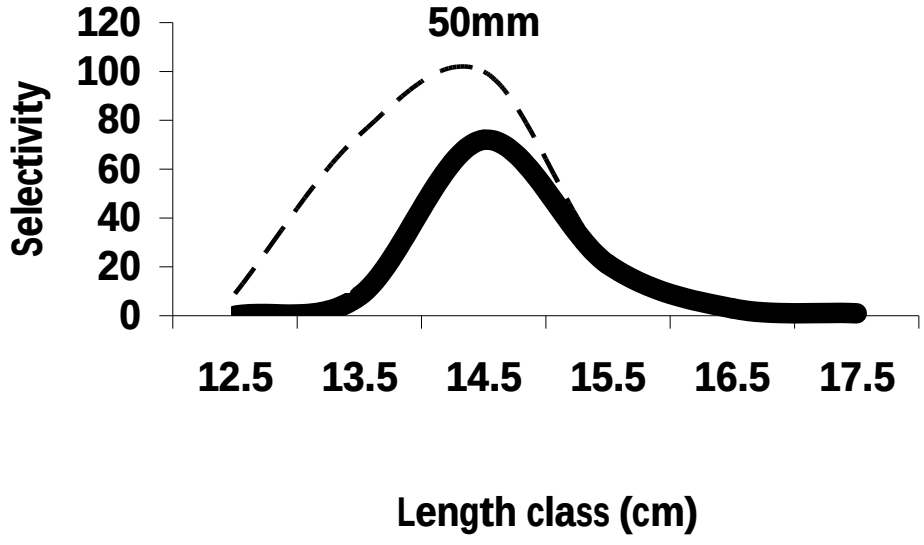

Fig. 7: Observed estimated gillnet selectivity curve for the 50mm and 54mm mesh sizes used in the Lekki lagoon.

Table 7: Monthly variation by weight (kg) of *Tilapia guineensis* caught from 50mm mono and multifilament gillnets in Lekki lagoon.

Month	**Monofilament**	**Multifilament**	**Mean**
January	5.51	4.90	5.21
February	8.20	5.00	6.60
March	10.10	7.28	8.69
April	9.22	6.94	8.08
May	11.26	8.26	9.76
June	7.82	6.27	7.05
July	7.26	5.22	6.24
August	8.21	4.20	6.21
September	6.21	5.22	5.72
October	8.61	7.12	7.87
November	10.10	9.11	9.61
December	12.12	8.97	10.54
Total	**104.62**	**78.49**	

Table 8: Estimates of Annual Production Costs and Revenues in Small Scale Fisheries in Lekki Lagoon in 2006/2007

Cost and Revenue	**Non-Motorised Gillnet (N)**	**Motorised Gillnet**
A.CAPITAL INVESTMENT OR FIXED COST		
- Canoe	20,900.00 ($174.17)	35,200.00 ($293.33)
- Fishing gear/net and accessories	40,000.00 ($333.33)	40,000.00 ($333.33)
- Outboard engine or paddle	500.00 ($4.17)	85,000.00 ($708.33)
Sub-Total (A)	**N61,400.00 ($511.67)**	**N160,200.00 ($1,335)**
B. OPERATIONAL OR VARIABLE COSTS		
- Fuel and Lubrication	NIL	75,000.00 ($625.00)
- Canoe Maintenance (10% of Cost)	2,090.00 ($17.42)	3,520.00 ($29.33)
- Engine maintenance (15% of Cost)	NIL	12,750.00 ($106.25)
- Net Repairs (10% of Costs)	4,000.00($33.33)	4,000.00 ($33.33)
- Labour (1/3 of revenue)	57,672.99 ($480.61)	57,672.99 ($480.61)
Sub-Total (B)	63,762.99 ($531.36)	152,942.99 ($1274.52)
C. ANNUAL REVENUE		
- Average Catch (kg/Canoe /day)	6.10	6.10
- Annual Catch (kg) C_2	1342.0	1342.0
- Average Price of fish/kg C_3	210 ($1.75)	210($1.75)
- Total Annual Revenue (N) C_4	281,820.00 ($2,348.50)	281,820.00 ($2,348.50)
- Profit (if any) or Loss (C_4 – A – B)	156,657.01 ($1305.48)	31,322.99 ($261.02)
- **Return on Investment**	**125.1%**	**10.0% (loss)**

Discussion

This study provides the first catch efficiency estimates of an important gear used in small – scale fisheries of low brackish tropical lagoon system from south western, Nigeria. In Lekki lagoon, there are over 3,000 active fisher folks from 25 fishing villages covered in the study. Gillnet is the most used fishing gear in the lagoon and the use of monofilament nettings alone or in combination with multifilament materials should be encouraged to improve the efficiency of the net. This agreed with Solarin (1998) who stated that finest materials gave the best of catching result in Lagos lagoon. A minimum of 0.23mm twine thickness (instead of 0.16mm) is advised to reduce net wear and tear during fishing operation. The wide use of gillnets in the lagoon was because of its versatility, low cost and ease of operation. The efficiency of these net types is influenced by mesh size, exposed net area, flotation, mesh shape and hanging ratio, visibility and type of netting material in relation with stiffness and breaking strength. The knowledge of the efficiency of gillnets is

important for the reconstruction of the population in fish stock. This agreed with the report of Machiels *et. al*. (1994) in the use of bottom gillnets for pike perch (*Stizostedion lucioperca*) and bream (*Abramis brama*).

In gill net opreration care must be taken to prevent net wearing into the lagoon. Gears were noted to be lost for a variety of reasons including but not limited by: inclement weather (e.g. storms), macrophytes infestation, logging activities in the lagoon, bottom snags, and navigational collisions (e.g. with surface cargo boats and wrecks and entanglement with other gears), faulty fishing methods, abandonment, human error, and vandalisng and gear failure. The worn net if not retrieved in time will turn to ghost fishing gear. Emmanuel (2009) defined ghost fishing as the ability of fishing gear to continue fishing after all control of that gear is lost by fishermen.

Four different methods of catching fish by gillnets were observed during this study. These are:

(i) Fish kept by a mesh over the head (snagged);

(ii) Fish kept tightly by mesh behind the gill cover (gilled);

(iii) Fish kept tightly by a mesh around body or at base of dorsal fin (wedged); and

(iv) Fish hung up in the net by teeth, whisker (*Chrysichthys* sp.), fins or other projections (like the spines in *Chrysichthys* sp., *Schilbe mytus* and so on) or tangles in twisted or folded parts of the netting (entangled).

These gave clues to understand why the catching efficiency is so dependent on the ratio between mesh size and fish length. The efficient catching according to i, ii and iii above required a certain relationship between the mesh size and the width of different parts of the body as reported by Karlsen and Bjarnason (1987).

A fish that was smaller than mesh size will pass through it without being caught in a single mesh while a larger fish will not penetrate far enough into the net to get snagged or gilled. Consequently, it could be concluded that methods i to iii contributed mostly towards the narrow, high, efficient part of the selectivity curve and thereby the main reason for the importance of right mesh selection. This according to Karlsen and Bjarnasson (1987) depends on several factors such as the shape of the fish, the softness if its skin and the elasticity of the twine in the net. The iv above was not dependent on the mesh size and the efficiency of entangling the fish depends on factors mainly related to type of fish sought, the twisting of the twine used, the hanging ratio of the net and the ballast and floats used.

The most common synthetic material used for gillnet was polyamide (PA) in Lekki lagoon. The least used synthetic material was polyethylene (PE). The advantage of polyamide compared to other synthetic materials according to Karlse and Bjarnasson (1987) is that it is more elastic. This good elongation of PA twines was found to increase selection range; this also has positive effect on the efficiency in relation to the twine thickness and the swimming force of the fish. The elongation also supported the first three ways fish are caught in gillnets mentioned above (snagged, gilled or wedged).The tested netting materials observed showed majorly polyamide while only one group was polyethylene. In addition to the advantages of polyamide, the following disadvantages were noted: it was easily damaged when stuck by stump. This was also reported by Karlsen and Bjarnasson (1987) that when too many herrings were wedged in PA nylon nets, resulted in both increases release work and severe damage to the herring and the net.

The monofilament nylon caught more fish than the multifilament but the multifilament had longer life span than the monofilament. In the monofilament group the least netting twine diameter was 0.16mm and the largest twine diameter observed was 0.23mm. The 0.16mm caught more fish than 0.23mm but had shorter longevity than 0.23mm. The thickness of the netting twine determines the price.

The special gillnet materials used in Lekki lagoon was multifilament polyamide twine ranging from 0.20mm to 0.36mm (mesh size 90mm – 180mm). They were used majorly for the big fishes (*Tranchionotus teraia*, *Sphyraena barracuda*, *Caranx hippos* and *Polydactylus quadrifilis*).The netting materials were expensive to purchase, between N40,000 or USD333.33 (half bundle) to N80,000 or USD 666.66 (full bundle). This group of net can last for 5 to 7 years if properly managed, mended and preserved (bitumen and *Rhizophora* sp. bark extract).

There was no specific preservation technique for the monofilament gillnet in the study area unless the mending techniques used to prolong its life span. This agreed with Karlsen and Bjarnasson (1987) who reported that unlike the multifilament nets which can be coloured by dying, the colour of monofilament was determined during the production process. One problem that was associated with the reduction of the twine thickness was that the meshes break more easily because of the struggle of large fish during hauling. In addition to this, problem with thinner twine was that it cuts into the skin of the fish more easily and thereby damages them.

The local fishermen set their nets between five and six o'clock in the evening and retrieve it at 6.30 – 7 o'clock the following morning. The long hours of setting (soak time) was believed to yield greater catch, but in most cases, a good percentage of the catch was not marketable because the fishes were already decomposing. This directly or indirectly attracts the swimming crab, *Callinectes amnicola* which caused

great damage to both the fresh catch and the net itself. The crab's damage to gillnet was enormous. In one of the fishing trips, the damage caused by crab was estimated and small crab of carapace length 3cm tore a net size about 1.1m^2. Then an estimation of 55m^2 gap will be created if 50 crabs of this size were caught. Consequently if this net were not mended then, the whole net may be condemned. Solarin (1998) and Emmanuel (2009) jointly reported that, the longer the soak time the lower the catch rate. Fagade (1969) recorded that setting gillnet for a long time (e.g. 24 hours could lead to greater catch but 10 – 20% of the catch were not marketable because of deteriorating condition. Solarin (1998) suggested that to prevent fish deterioration and also prevent predators from devouring them, damaging the net and at the same time ensure optimal efficiency, gillnet should be checked at internal of 4 – 6 hours. This will result in sleepless night which may bring ill-health and addition expenses on the part of the fisher folks.

Due to the damage caused by the floating macrophytes, *Eichhornia crassipes* bottom set gillnet was recommended for this lagoon. Improvisation of fishing inputs, example the use of concrete sinkers and raffia to replace the more expensive lead weights and rubber slippers floats respectively should be encouraged in other to minimize cost of net construction to increase return on investment (ROI) for consequent fishing operation years.

Unmotorised canoes gillnet fishery recorded 125.1% return on investment over a period of 12 months or 1 year. The loss recorded by motorized gillnet fishery in the first one year of operation (with a 25 – horsepower out board engine which can last for eleven to fourteen years) should be regained in the subsequent operational years.

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Response of Maize (Zea mays L) to Different Rates of wood-ash Application in acid Ultisol in Southeast Nigeria

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Abstract.Maize (Zea mays L) is an important cereal crop in Southeast Nigeria. Yet few data exists on the effect of soil acidity on its production. A field study was conducted in 2007 and 2008 cropping seasons to determine the effect of different rates of woodash on soil properties and maize grain yield. Results of the study showed significant difference ($p< 0.05$) in soil pH , ECEC (Cmolkg-^{1}),OM%, total N%, aggregate stability%, among treatments in both seasons while dispersion ratio (DR) was not significant in the second season. Organic matter concentration ranged between 4.4-15.6 and 4.2-14.8 (g/kg) in the first and second cropping seasons respectively. Maize grain yield varied significantly among treatments except at 4 and 6 t ha-^{1} in both seasons. Wood-ash application generally improved soil properties which in turn enhanced maize grain yield. [Journal of American Science 2010;6(1):53-57]. (ISSN: 1545-1003).

Keywords: *soil acidity, wood-ash, degradation, agricultural soils, lime materials.*

1. Introduction

Maize (*Zea mays L*) belongs to the grain under the family graminae and class of cereals that thrive under a wide range of environmental conditions. Maize does well with pH of 5.5-5.7 while strongly acidic soil (pH ≤ 5.0) is unsuitable for good yield. In southeast Nigeria soil acidity is a problem hindering proper agricultural production since most of the crops grown are susceptible to dangerous effects of acidic soils. Ohiri and Ano (1989) attributed the acidic nature of the soils in South east Nigeria to their parent material, leaching and degradation in soil physical properties. To reduce or make the soil less acidic it is common practice to apply lime to agricultural soils. However, the unavailability and high cost of lime materials led to the invention and research into low cost, affordable and adoptable organic and inorganic material like wood-ash (Igbokwe *et al.* 1981). Ojeniyi *et al. (*2001) found that yield of vegetable crops and nutrient content were improved by wood-ash in South east Nigeria. Similarly, Odedina *et al.* (2003) and Adetunji (1997) reported reduced acidity and increased cation availability in soils amended with wood-ash. Omoti *et al.* (1991) indicated that there was great potential of reducing fertilizer and lime bills in maize production of an acidic soil by replacing it with application of wood-ash, since it helps to increase soil pH, available cations and yield. In the study area, Agbani in Enugu South East Nigeria farmers apply wood-ash with out specific recommendation due to lack of research works. The objective of this study was to find out the effects of different rates of wood-ash on soil properties and maize yield with a view to make recommendations on appropriate level for maize production.

2. Material and Methods.

The study was conducted for two consecutive cropping seasons in the Teaching and Research Farm of Faculty of Agriculture and Natural Resources Management, Enugu State University of Science and Technology, Enugu-Agbani Campus. The area lies between latitude 06^{0} 25^{1}N and 07^{0} 15^{1}E with mean elevation of 450m above sea level. The rainfall pattern is bimodal between April and October, while the dry season is between November and March. The soil is lateritic and is of the sandy loam textural class. It is an Ultisol and classified as Typic Haplustult (FDALR,1985).

2.1 Experimental layout and Management.

The experiment was established in April 2007 and laid out as a randomized complete block design (RCBD) with plot sizes of 3m x 4m replicated five times. The land was cleared of vegetation and manually tilled. Four levels of wood-ash (0, 2, 4 and 6 t ha-^{1}) were applied (spread evenly on the soil surface) and incorporated into the soil during tillage. Maize

variety oba super 11 was planted at a spacing of 0.5m x 0.5m inter and intra- row, respectively and two maize grains planted per hill. This was thinned down to one plant per hill ten days after germination to give a total plant population of 53,333 plants / hectare. At maturity in 2007 cropping season, maize grain was harvested, air dried and the dry weight taken and expressed on a 12.5% moisture basis. In 2008 cropping season, the area was cleared, tilled and maize planted without addition of woodash to test the residual effect.

Soil was sampled at the beginning of 2007 cropping season and at the end of the study. Soil samples were taken at six different spots per plot and then bulked to one sample and were analyzed for their nutrient content, dispersion ratio and aggregate stability. The soil sample (0-15cm) and woodash were air dried and sieved through a 2-mm sieve. The samples were analyzed for organic carbon, total nitrogen, Mg, Ca, pH, effective cation exchange capacity, Available P, soil aggregate stability and dispersion ratio. Total Nitrogen was determined by Kjeldahl method (Bremner and Mulvaney, 1982) while OC was determined by the Walkey and Black (1934) dichromate oxidation procedure. Soil pH in water (1:2.5 soil to water ratio) was determined using glass electrode pH meter while effective cation exchange capacity (ECEC) was determined by summation. Aggregate stability was determined at the macro-level (WSA>0.5mm) and micro level (dispersion ratio, DR= ratio % silt x clay dispersed in calgon) using wet sewing techniques of Kemper and Rosenau (1986) and the Middleton (1932), respectively.

Data analysis

Data collected from the experiment was analyzed using analysis of variance test based on RCBD (using F-LSD at P=0.05) according to Steel and Torrie (1980).

3. Results

Table 1 show the chemical properties of the soil before the study. The soil was sandy loam in texture with pH of 4.9. The soil OC and TN were 11.1 and 0.56 g/kg, respectively. The exchangeable bases Ca, Mg, K and Na were 0.7, 1.6, 0.09 and 0.17 Cmolkg^{-1} respectively. Analysis of the wood-ash showed that it contains all the nutrients needed by plants. Analysis showed Mg, Ca, K and Available P of 13 Cmolkg^{-1}, 8.6 Cmolkg^{-1}, 50 Cmolkg^{-1} and 10 g/kg respectively.

Table 1: Properties of the soil before study

Parameter	unit	value
Sand	g/kg	490
Silt	,,	250
Clay	,,	260
Texture		sandy loam
PH		4.9
OC	g/kg	11.1
TN	,,	0.56
Ca	Cmol kg^{-1}	0.17
K	,,	0.09
Na	,,	0.17
Mg	,,	1.6
CEC	,,	15.6
Avail P	mgkg^{-1}	3.71

Table 2: **Effect of wood ash on Selected Soil properties**

Re Treatment	DR	AS%	TN%	OM%	ECEC	$_P$H(H_2O)	Avail .P
Year 1							
No woodash	0.735	38	0.48	0.44	10.6	4.7	3.6
2 t ha^{-1} **WA**	0.753	43	0.58	1.46	18.8	5.4	5.6
4 t ha^{-1} **WA**	0.803	45	0.70	1.53	20.8	5.7	8.4
6 t ha^{-1} **WA**	0.877	46	0.86	1.56	21.8	6.2	10.3
Mean	0.772	43	0.65	1.25	18	5.50	6.98
LSD 0.05	0.06	1.20	0.02	0.02	0.70	0.75	0.30
Year 11							
Treatment	DR	AS%	TN%	OM%	ECEC	$_P$H(H_2O)	Avail .P
No woodash	0.712	36	0.40	0.42	6.3	4.6	3.4
2 t ha^{-1} **WA**	0.806	40	0.48	1.30	9.8	5.1	5.5
4 t ha^{-1} **WA**	0.895	43	0.52	1.44	11.3	5.6	6.3
6 t ha^{-1} **WA**	0.883	44	0.60	1.48	12.6	5.8	7.8
Means	0.824	40.8	0.50	1.16	10.01	5.28	5.75
LSD 0.05	NS	2.1	0.02	0.02	0.14	0.14	0.24

NS=Non-significant, DR=Dispersion ratio, AS=Aggregate stability, WA = wood ash

3.1 Effect of wood-ash on soil properties

Table 2 shows the effect of wood-ash on the soil properties. Dispersion ratio (DR) showed significant (P<0.05) difference with the lowest value (0.735) from the control (no wood-ash treated soil) in the first cropping season. In the second cropping the effects of the amendments on DR were not significant. Significant differences were observed in soil aggregate stability (AS) due to wood-ash application. The highest AS value of 46% was observed in 6 t ha-^{1} in the first season. The value was 3%, 7% and 18 % higher than the O, 2 and 4 t ha-^{1} rate of application. In the second season aggregate stability values ranged between 36-44% with 6 tha-^{1} recording the highest value. Similarly, OM showed significant difference (p= 0<0.5) in the both seasons with lowest value (0.44%) in the first season from treatment receiving 0 t ha-^{1} while the highest value (1.56%) was observed in the plots where 6 t ha-^{1} wood-ash was applied. Total nitrogen (TN) content varied significantly with wood-ash levels, increasing directly with a corresponding increase in amount of wood-ash applied. The control had the lowest concentration in both seasons while 6 t ha-^{1} application ratio had the highest concentration. Table 2 also show that values of ECEC cmolkg^{-1} were highest in plots with 6 t ha-^{1} wood-ash in both seasons. Observed ECEC values ranged between 10.6-21.8 cmolkg-^{1} and 6.3-12.6 cmolkg-^{1} in the first and second cropping seasons, respectively. The results in table 2 also showed that pH increased significantly (p=0.05) with the application of different levels of wood-ash. The pH of the un-amended plot were 4.7 in the first season and 4.6 in the second cropping season while those of the amended plots ranged between 5.7-6.2 and 5.1- 5.8 in the first and second cropping seasons respectively. There was minimal difference of 1% and no-difference in yield between 6 t ha-^{1} and 4 t ha-^{1} in the first and second cropping seasons, respectively. Wood-ash treatment significantly affected the maize plant height (Table 3).

Table 3: Effect of wood-ash on plant (cm) and grain yield (t ha-^{1})

Parameter	Plant height (cm)		Grain Yield	
	2007	2008	2007	2008
No woodash	134	80	0.63	0.52
2 t ha-^{1} **WA**	148	124	1.02	0.96
4 t ha-^{1} **WA**	162	148	1.61	1.46
6 t ha-^{1} **WA**	173	153	1.63	1.46
Mean	154.3	126.3	1.22	1.10
LSD 0.05	0.74	1.81	0.04	0.19

WA= Wood ash

The least plant height of 134 cm in the first season was recorded in the un-amended plots. Relatively higher plant heights were observed in the first cropping season. The mean height was 22% higher than the mean height value of 126.3cm observed in the second cropping season. Generally, addition of wood-ash increased maize grain yield relative to the control in both seasons. The treatment 6 t ha-^{1} of wood-ash gave the highest grain yield of 1.63 t ha-^{1} in the first season. This value (1.63 t ha-^{1}) was 1%, 60% and 159% higher than values observed in wood-ash application rates of 0, 2 and 4 t ha-^{1}, respectively. The order of yield increase in the second cropping season was 6 = 4 >2 > 0 t ha-^{1}. In both seasons non-significant (p=0<0.05) difference in yield were observed between 6 and 4 t ha-^{1} rate of application.

4. Discussions

Results from this study show that wood-ash when used as soil amendment reduced soil acidity to levels required for maize production. The 4 t ha-^{1} is a good estimate of amount required to significantly improve yield in soils low in pH. Hence wood-ash being a Ca containing mineral raised soil pH. Using Cocoa pod -ash as an amendment Ayeni ***et al.*** **(**2008) reported increased soil pH relative to non- ash treated soil. Haynes and Naidu (1998) reported that at low pH acid soils are normally flocculated. As pH is raised by addition of wood-ash the net negative change on soil surface is increased and the ratio of negative to positive (+ve) charges also increases. At same time Al $^{3+}$ activity declines as Al precipitates as hydroxyl- Al polymers. As a result repulsive forces between particles dominate and lead to dispersion. The increased available P could be attributed to traces of P released from Al^{3+} in line with the observation of Ikpe *et al.* (1997). Adetunji (1997) showed that ash derived from wood reduced soil acidity and increased cations / nutrient available in the soil. Similarly, studies by Owolabi *et al.* **(**2003),Odedina *et al.* (2003**)** and Awodun *et al.* (2007) showed that **plant** derived ash increased soil nutrient content. Kayode and Agboola (1993) attributed the increased CEC in wood-ash amended soils to increased cations viz Ca, K and Na. The high ECEC observed in wood-ash amended soil was in line with the observation of Nottidge *et al.* (2006). Baath and Arnebrant (1994) observed the increased soil nutrient due to wood-ash application could be due to enhance microbial activities in the soils and production of organic matter. The increased maize gain yield could

be attributed to higher organic matter in the woodash amended plots. Organic matter according to Tisdall (1993) and Brady and Weil (2006) play important roles in essential nutrient availability and soil improvement.

4. Conclusion.

The results of this study showed that wood-ash application improved soil properties and increased maize grain yield. In both seasons application of woodash at 6 t ha^{-1} gave highest grain yield. However, there was no significant difference ($p<0.05$) in grain yield between 4 and 6 t ha^{-1} rate of application. Though application of wood-ash at 6 t ha^{-1} gave highest grain yield, applying at this rate or higher may increase soil nutrient content without necessarily increasing yield. The excess nutrient may be leached to rivers and lakes causing eutrophication or other environmental degradation. This placed 4 t ha^{-1} in this experiment as the optimum rate of woodash application for maize production.

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Performance of an irreversible Diesel cycle under variable stroke length and compression ratio

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Abstract: Finite-time thermodynamic analysis of an air-standard internal-combustion Diesel cycle is performed in this paper. The relations between the power output and the compression ratio, between the power output and the thermal efficiency are derived by detailed. The maximum power output and the corresponding efficiency limit of the cycle with considerations of heat transfer and friction like term losses are also found. Detailed numerical examples are given. The results shows that if compression ratio is less than certain value, the power output increases with increasing stroke length, while if compression ratio exceeds certain value, the power output first increases and then starts to decrease with increasing stroke length. With further increase in compression ratio, the increase of stroke length results in decreasing the power output. The results obtained in the present study are of importance to provide good guidance for performance evaluation and improvement of practical Diesel engines. [Journal of American Science 2010;6(1):58-64]. (ISSN: 1545-1003).

Keywords: Diesel cycle; power output; thermal efficiency; irreversible; friction; stroke length

1. Introduction

Significant achievements have ensued since finite-time thermodynamics was developed in order to analyze and optimize the performances of real heat-engines (Mozurkewich and Berry, 1982; Andersen and Band, 1984; Sieniutycz and Shiner, 1994; Chen et al., 1998; Aragon-Gonzalez et al., 2000; Chen et al., 2004]. Hoffman et al. (1985) used mathematical techniques, developed for optimal-control theory, to reveal the optimal motions of the pistons in Diesel cycle engine. Klein (1991) studied the effect of heat transfer on the performance of the Otto and Diesel cycles. Blank and Wu (1993) examined the effect of combustion on the work or power optimised Otto, Diesel and Dual cycles. They derived the maximum work or power and the corresponding efficiency bounds. Orlov et al. (1993) obtained the power and efficiency limits for internal combustion engines. Chen et al. (1996) derived the relations between the power output and the thermal efficiency for the Diesel cycle with the consideration of the heat-transfer losses. Bhattacharyya (2000) proposed a simplified irreversible model for an air-standard Diesel cycle by using the finite time thermodynamic approach. In his study, global thermal and friction losses are lumped into an equivalent friction term, which is linear in the piston velocity. Chen et al. (2002) modelled the diesel cycle with friction-like term loss during a finite time and studied the effect of friction-like term loss on the cycle performance. Burzler (2002) determined the optimum piston trajectory that yielded maximum power output and efficiency of the diesel cycle with different losses when the cycle period, fuel intake per cycle, fuel–air mixture composition, and compression ratio are taken as constants. Rocha-Martinez et al. (2002) investigated the effect of variable specific-heats on the Otto and Diesel cycle performance. Chen et al. (2002) modeled the behaviors of Diesel cycle, with friction losses, over a finite period. Qin et al. (2003) and Ge et al. (2005a) derived the performance characteristics of the diesel cycle with heat transfer and friction like term losses when the maximum temperature of the cycle was not fixed. Wang and Hou (2005) studied the performance analysis and comparison of an Atkinson cycle coupled to variable temperature heat reservoirs under maximum power and maximum power density conditions, assuming a constant specific heat, too. Their results showed an engine design based on maximum power density is better than that based on maximum power conditions, from the view points of engine size and thermal efficiency. Ge et al. (2005b) considered the effect of variable specific heats on the cycle process and studied the performance characteristics of endoreversible and irreversible Otto cycles when variable specific heats of working fluid are linear functions of the temperature. Ozsoysal (2006) gave the valid ranges of the heat transfer loss parameters of the Otto and diesel cycles with consideration of the heat loss as a percentage of the

fuel's energy. Zhao and Chen (2006) performed analysis and parametric optimum criteria of an irreversible Atkinson heat engine using finite time thermodynamic. Al-Sarkhi et al. (2006) studied the effects of variable specific heats of the working fluid on the performances of the Diesel and Miller cycles. Ge et al. (2007) studied the effects of variable specific heats of the working fluid on the performances of the Diesel cycle. Ge et al. (2008a, 2008b) analyzed the performance of an air standard Otto and Diesel cycles. In the irreversible cycle model, the non-linear relation between the specific heat of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered. Ebrahimi (2009) studied the effects of the temperature dependent specific heat ratio of the working fluid on the performance of the diesel cycle.

As can be seen in the relevant literature, the investigation of the effect of stroke length on performance of Diesel cycle does not appear to have been published. Therefore, the objective of this study is to examine the effect of stroke length on performance of air standard Diesel cycle.

2. Thermodynamic analysis

The Diesel cycle shown in Fig. 1 approximates the compression stroke up to ignition with the adiabatic reversible (isentropic) process $1 \to 2$; it assumes that the combustion process is represented by the reversible constant pressure process $2 \to 3$; it approximates the power stroke with the isentropic expansion process $3 \to 4$; and it assumes that the heat-removing process is the reversible constant volume process $5 \to 1$.

In a real cycle, the specific heat ratio is generally modeled as the first and second order equation of mean charge temperature (Gatowski et al., 1984; Brunt and Emtage, 1997; Ebrahimi, 2006). Thus, it can be supposed that the specific heat ratio of the working fluid is function of temperature alone and has the second order equation forms:

$$\gamma = aT^2 + bT + c \qquad (1)$$

Where γ is the specific heat ratio and T is the absolute temperature. a, b and c are constants.

The heat added per second in the isobaric ($2 \to 3$) heat addition process may be written as

$$Q_{in} = M_{nl}\int_{T_2}^{T_3} c_p dT = M_{nl}\int_{T_2}^{T_3}\left(\frac{R\left(aT^2+bT+c\right)}{aT^2+bT+c-1}\right)dT = M_{nl}R\left(T_3 - T_2 + \frac{2}{D}\left[arctg\left(\frac{2aT_3+b}{D}\right) - arctg\left(\frac{2aT_2+b}{D}\right)\right]\right) \qquad (2)$$

Where D is defined as $D = \sqrt{4ac - 4a - b^2}$. R and c_p are gas constant and specific heat at constant pressure for the working fluid, respectively. M is the molar number of the working fluid per second.

The heat rejected per second in the isochoric heat rejection process ($4 \to 1$) may be written as

$$Q_{out} = M_{nl}\int_{T_1}^{T_4} c_v dT = M_{nl}\int_{T_1}^{T_4}\left(\frac{R}{aT^2+bT+c-1}\right)dT = \frac{2M_{nl}R}{D}\left[arctg\left(\frac{2aT_4+b}{D}\right) - arctg\left(\frac{2aT_1+b}{D}\right)\right] \qquad (3)$$

where c_v is the molar specific heat at constant volume for the working fluid.

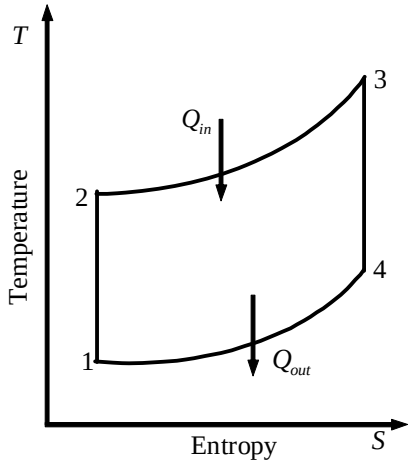

Figure 1. Temperature-entropy $(T-S)$ diagram for the air standard Diesel cycle

Since c_p and c_v are dependent on temperature, the adiabatic exponent $\gamma = c_p/c_v$ will vary with temperature as well. Therefore, the equation often used in a reversible adiabatic process with constant γ cannot be used in a reversible adiabatic process with variable γ. However, according to Refs. (Ebrahimi, 2009a; Chen et al., 2008), the equation for a reversible adiabatic process with variable can be written as follows:

$$TV^{\gamma-1} = \left(T + \mathrm{d}T\right)\left(V + \mathrm{d}V\right)^{\gamma-1} \qquad (4)$$

From Eq. (4), one gets

$$\frac{1}{2(c-1)}\ln\left(\frac{aT_j^2+bT_j+c-1}{aT_i^2+bT_i+c-1}\right)+$$
$$\frac{b}{(c-1)D}\left[arctg\left(\frac{2aT_j+b}{D}\right)-arctg\left(\frac{2aT_i+b}{D}\right)\right]- \quad (5)$$
$$\frac{\ln(T_j/T_i)}{c-1}=\ln(V_j/V_i)$$

The compression, r_c, and cut-off, β, ratios are defined as

$$r_c=V_1/V_2 \quad \text{and} \quad \beta=V_4/V_3=T_4/T_3 \quad (6)$$

Therefore, the equations for processes $(1\to 2)$ and $(3\to 4)$ are shown, respectively, by the following:

$$\frac{1}{2(c-1)}\ln\left(\frac{aT_2^2+bT_2+c-1}{aT_1^2+bT_1+c-1}\right)+$$
$$\frac{b}{(c-1)D}\times\left[arctg\left(\frac{2aT_2+b}{D}\right)-arctg\left(\frac{2aT_1+b}{D}\right)\right]- \quad (7)$$
$$\frac{\ln(T_2/T_1)}{c-1}=\ln(1/r_c)$$

and

$$\frac{1}{2(c-1)}\ln\left(\frac{aT_4^2+bT_4+c-1}{aT_5^2+bT_3+c-1}\right)+$$
$$\frac{b}{(c-1)D}\times\left[arctg\left(\frac{2aT_4+b}{D}\right)-arctg\left(\frac{2aT_3+b}{D}\right)\right]- \quad (8)$$
$$\frac{\ln(T_4/T_3)}{c-1}=\ln\left(\frac{r_c}{\beta}\right)$$

For an ideal Diesel cycle model, there are no losses. However, for a real internal combustion engine cycle, heat transfer irreversibility between the working fluid and the cylinder wall is not negligible. One can assume that the heat loss through the cylinder wall is proportional to the average temperature of both the working fluid and the cylinder wall and that the wall temperature is constant at T_0. If the released heat by combustion for one molar working fluid is A_1, and the heat leakage coefficient of the cylinder wall is B_1, one has the heat added to the working fluid per second by combustion as the following linear relation (Chen et al. 2006).

$$Q_{in}=M_{nl}\left(A_1-B_1\frac{T_2+T_3}{2}-T_0\right)=$$
$$M_{nl}\left(A_1+B_1T_0-\frac{T_2+T_3}{2}\right)=M_{nl}\left[A+B(T_2+T_3)\right] \quad (9)$$

where $A=A_1+B_1T_0$ and $B=B_1/2$ are two constants related to combustion and heat transfer.

Taking into account the friction loss of the piston, as deduced by Al-Sarkhi et al. (2006) for the Diesel cycle, and a dissipation term represented by a friction force which in a linear function of the velocity gives

$$f_\mu=-\mu v=-\mu\frac{dx}{dt} \quad (10)$$

where μ is the coefficient of friction, which takes into account the global losses, x is the piston's displacement and v is the piston's velocity. Therefore, the lost power due to friction is

$$P_\mu=\frac{dW_\mu}{dt}=-\mu\left(\frac{dx}{dt}\right)^2=-\mu v^2 \quad (11)$$

Running at N cycles per second, the mean velocity of the piston is

$$\bar{v}=4LN \quad (12)$$

where L is the total distance the piston travels per cycle.

Thus, the power output of the Diesel cycle engine can be written as

$$P_{out}=Q_{in}-Q_{out}-P_\mu=\frac{2M_{nl}R}{D}\left[\frac{D}{2}(T_3-T_2)+\right.$$
$$arctg\left(\frac{2aT_1+b}{D}\right)+arctg\left(\frac{2aT_3+b}{D}\right)- \quad (13)$$
$$\left.arctg\left(\frac{2aT_2+b}{D}\right)-arctg\left(\frac{2aT_4+b}{D}\right)\right]-16\mu(LN)^2$$

The efficiency of the Diesel cycle engine is expressed by

$$\eta_{ot}=\frac{Q_{in}-Q_{out}-P_\mu}{Q_{in}}=$$
$$\frac{2}{D}\left[arctg\left(\frac{2aT_1+b}{D}\right)+arctg\left(\frac{2aT_3+b}{D}\right)-\right. \quad (14)$$
$$\left.arctg\left(\frac{2aT_2+b}{D}\right)-arctg\left(\frac{2aT_4+b}{D}\right)\right]+$$
$$\frac{(T_3-T_2)-16\mu(LN)^2}{T_3-T_2+\frac{2}{D}\left[arctg\left(\frac{2aT_3+b}{D}\right)-arctg\left(\frac{2aT_2+b}{D}\right)\right]}$$

When r_c and T_1 are given, T_2 can be obtained from equation (7), then, substituting equation (2) into equation (9) yields T_3, and the last, T_4 can be worked out by equation (8). Substituting T_1, T_2, T_3 and T_4 into equations (13) and (14), respectively, the power output and thermal efficiency of the Diesel cycle engine can be obtained. Therefore, the relations between the power output, the thermal efficiency and the compression ratio can be derived.

3. Results and discussion

The following constants and parameters have been used in this exercise: $T_1 = 300\,K$, $A = 60000\,J.mol^{-1}$, $\beta = 1.5$, $B = 28\,J.mol^{-1}K^{-1}$, $a = 1.6928\times10^{-8}\,K^{-1}$, $b = -9.7617\times10^{-5}\,K^{-1}$, $c = 1.4235$, $r_c = 1.5 - 56.6$, $L = 40 - 120\ mm$, $M_{nl} = 2.24\times10^{-4}\,NL\,kmols^{-1}$, $\mu = 12.9\,Nsm^{-1}$ and $N = 4500\,rpm$ (Chen et al., 2006; Ghatak and Chakraborty, 2007; Ge et al., 2007; Ebrahimi, 2009b). Using the above constants and range of parameters, the power output versus compression ratio characteristic and the power output versus efficiency characteristic with varying the stroke length can be plotted. Numerical examples are shown as follows.

The variations in the temperatures T_2, T_3 and T_4 with the compression ratio are shown in figure 2. It is found that T_2 and T_3 increase with the increase of compression ratio, and T_4 decreases with the increase of compression ratio.

Figures 3-4 show the effects of the variable stroke length on the cycle performance with heat resistance and irreversible friction losses. From these figures, it can be found that the stroke length plays important roles on the power output. It is clearly seen that the effects of stroke length on the power output is related to compression ratio. They reflect the performance characteristics of a real irreversible Diesel cycle engine. It should be noted that the heat added and the heat rejected by the working fluid increase with increasing stroke length. (see equations. (2) and (3)).

Figure 3 indicates the effects of the stroke length on the power output of the cycle for different values of the compression ratio. It can be seen that the power output versus compression ratio characteristic is approximately parabolic like curves. In other word, the power output increases with increasing compression ratio, reach their maximum values and then decreases with further increase in compression ratio. The maximum power output increases with increasing stroke length up to about 80 mm where it reaches its peak value then starts to decline as the stroke length increases. This is consistent with the practical working stroke length of engines, which are between 70 and 90 mm in general. The optimal compression ratio corresponding to maximum power output point remains constant with increase of engine speed. The working range of the cycle decreases as the stroke length increases. The results shows that if compression ratio is less than certain value, the power output increases with increasing stroke length, while if compression ratio exceeds certain value, the power output first increases

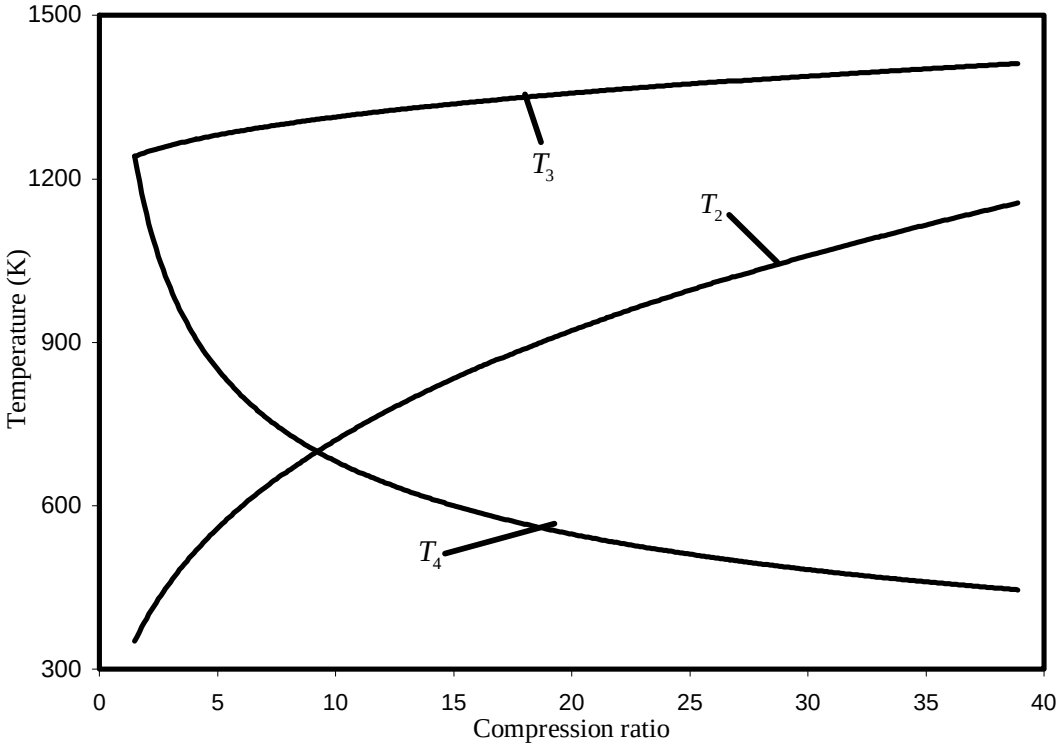

Figure 2. The temperature versus compression ratio ($L = 70\,mm$)

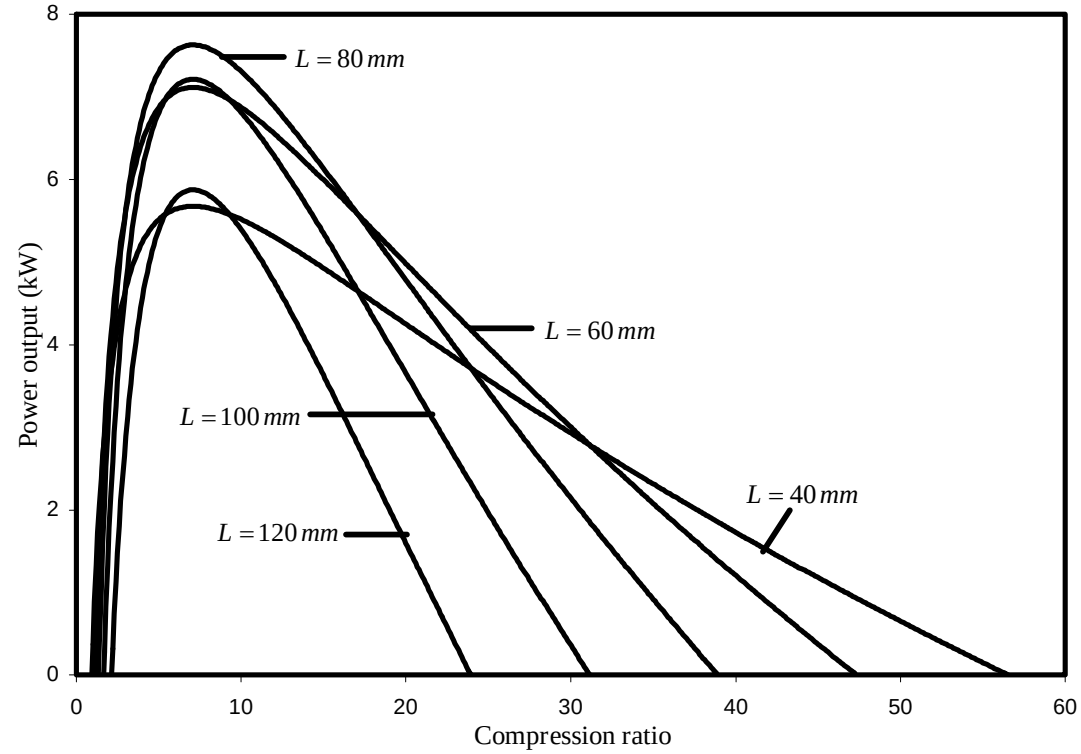

Figure 3. Effect of L on the $P_{out} - r_c$ characteristic

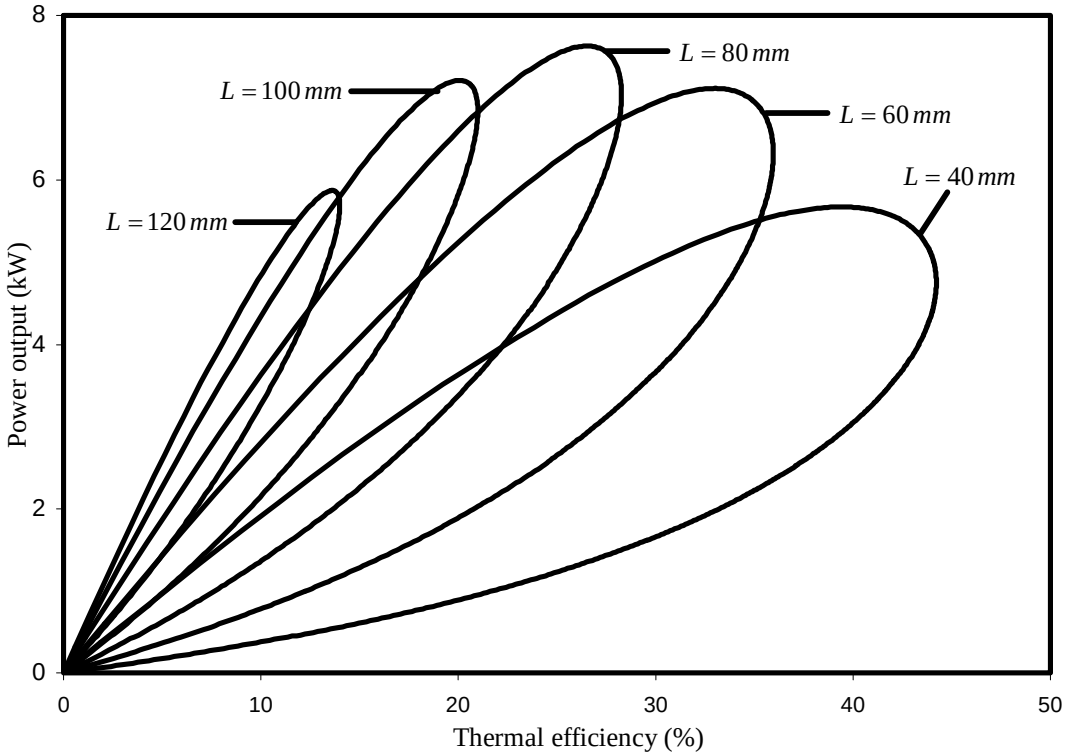

Figure 5. Effect of L on the $P_{out} - \eta_{at}$ characteristic

and then starts to decrease with increasing stroke length. With further increase in compression ratio, the increase of stroke length results in decreasing the power output. Numerical calculation shows that for any same compression ratio, the smallest power output is for $L = 120\,mm$ when $r_c \le 5.4$ or $r_c > 9.3$ and is for $L = 40\,mm$ when $5.4 < r_c \le 9.3$ and also the largest power output is for $L = 40\,mm$ when $r_c \le 1.65$ or $31.2 < r_c$, is for $L = 60\,mm$ when $1.65 < r_c < 3$ or $17.1 \le r_c \le 31.2$ and is for $L = 70\,mm$ when $3 \le r_c < 17.1$.

The influence of the stroke length on the power output versus thermal efficiency is displayed in figure 4. As can be seen from this figure, the power output versus thermal efficiency is loop shaped one. It can be seen that the power output at maximum thermal efficiency improves with increasing stroke length from 40 to around $70\,mm$. With further increase in stroke length, the power output at maximum thermal efficiency decreases. The thermal efficiency at maximum power decreases with increase of stroke length from 40 to $120\,mm$.

According to above analysis, it can be found that the effects of the stroke length on the cycle performance are obvious, and they should be considered in practice cycle analysis in order to make the cycle model be more close to practice.

4. Conclusion

An air-standard Diesel-cycle model, assuming a temperature-dependent specific heat ratio of the working fluid, and heat resistance and frictional irreversible losses, has been investigated numerically. The performance characteristics of the cycle with varying stroke lengths and compression ratios were obtained by numerical examples. The results show that if compression ratio is less than certain value, the power output increases with increasing stroke length, while if compression ratio exceeds certain value, the power output first increases and then starts to decrease with increasing stroke length. With further increase in compression ratio, the increase of stroke length results in decreasing the power output. The results also show that the maximum power output increase with increasing stroke length. With further increase in stroke length, the increase of stroke length results in decreasing the maximum power output. The analysis helps us to understand the strong effect of stroke length on the performance of the Diesel cycle. Therefore, the results are of great significance to provide good guidance for the performance evaluation and improvement of real Diesel engines.

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Physicochemical, Rheological and Consumer acceptability of cassava starch salad cream

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Abstract: Cassava is popularly consumed as a staple in many regions of the developing world. Limitation to utilization of cassava roots by processors is its high perishability and bulkiness. Salad Cream is a ready made creamy-white dressing with a flowing consistency of which modified maize flour serves as the base raw material. At present there is little information on the physical, chemical, pasting and rheological properties of salad cream from cassava starch. This work was aimed to evaluate the physicochemical, rheological and consumer acceptability of cassava starch salad cream from three Nigerian low cyanide cassava varieties (96/01632, 98/0505 and TME419). Commercial salad and cassava starch salad cream were evaluated for physical (colour), chemical (titratable acidity, pH, total solids, protein, sugar, starch, fat, ash, moisture content and dry matter) and rheological (viscosity). Consumer acceptability was evaluated by ten-member panel randomly selected from male and female adults. Lightness (L*) values of cassava starch salad cream from 96/01632 (85.17), 98/0505 (84.21), TME 419 (84.38) and control (77.28), Chroma were 96/01632 (15.77), 98/0505 (16.13), TME 419 (17.59) and control (28.97). Commercial salad cream was significantly higher at $p<0.05$ in moisture (48.99%), protein (1.61%), sugar (17.59%), titratable acidity (8.63), total solids (61.92%) and ash (2.75%). However, cassava starch salad cream from TME 419 was significantly higher in fat (21.64%). The viscosity of the salad creams was non-Newtonian with cassava starch salad cream from 98/0505 having viscosity (0.43Pa.s) at 50^0C. Sensory evaluation showed increased preference for cassava starch salad cream. Acceptable and nutritious salad cream can be processed from cassava starch. [Journal of American Science 2010;6(1):65-72]. (ISSN: 1545-1003).

Keywords: cassava starch salad cream, cassava, cassava starch, sensory evaluation

Introduction

Cassava (*Manihot esculenta* Crantz) is a root crop cultivated and consumed as a staple in many regions of the developing world. The world output of cassava in 2004 was 202 million Metric tones (Ashaye *et al* 2007). Nigeria produced 38,179,000 Mt of cassava in 2004 making the country the highest producer of cassava in the world (Ashaye *et al* 2007). The potential of the crop is large because it offers the cheapest source of food calories and the highest yield per unit area. It also has multiple roles as a famine reserve, food and cash crop, industrial raw material and livestock feed (Albert *et al* 2005, Oboh and Akindahunsi 2003). There are also many agronomic (relative resistance to pests and diseases, flexibility in planting and harvesting, etc.) and social reasons (income earner for women, flexible labour requirements) why cassava has become so important (Ashaye *et. al*., 2007).

However, a major hindrance to the utilization of cassava roots by processors is its high perishability and bulkiness. This has increased the post-harvest losses of cassava to well over 8.4% (Maduagwu 1979). Once harvested, cassava roots are highly perishable and when stored, rapid physiological and microbiological deterioration occurred. Cassava thus needs to be processed into dried forms that are more shelf stable. Processing of cassava into dry form reduces the moisture content; convert it into more durable and stable product with less volume, which makes it more transportable. Processing is also necessary to improve palatability, eliminate or reduce the level of cyanide cassava (Cardoso *et al* 2005). Starch is one of such shelf-stable products from cassava.

The fresh roots of cassava contains 30% to 40% dry matter of which 85% is starch, since the roots are rich in starch, they are increasingly used as raw materials. Hence, starch is the main constituent of cassava. About 25% starch may be obtained from mature, good quality tubers. About 60% starch may be obtained from dry cassava chips and about 10% dry pulp may be obtained per

100kg of cassava roots.(Oyewole and Obieze 1995)

The Industrial uses of starch is based on its properties and suitability to different purposes; in paper and paper tapes; in textiles industry for sizing and finishing; as drilling mud in oil drilling; as dye stuff and in building, metal and chemical industries, starch pearls (sag) dextrose, glucose, spirit, alcohol. In the food industry, starch is mainly used as food, but is also readily converted chemically, physically, and biologically into many useful products, which include beverages, confectionery, pharmaceuticals, etc. Cassava starch has many remarkable characteristics, including high paste viscosity, high paste clarity, and high freeze-thaw stability, which are advantageous to many industries. .(Oyewole and Obieze 1995)

Salad Cream is a ready made creamy-white dressing with a flowing consistency for eating with salad (mixture of raw vegetables), is prepared with various ingredients of which modified maize flour serves as the base raw material. (Turgeon., 1996).

However, there is a death of information on the physical, chemical and rheological properties of salad cream from cassava starch.

Therefore the objectives of this study are

To assess the chemical and rheological properties of Cassava starch salad cream.

To determine the consumer acceptability of the Cassava starch salad cream

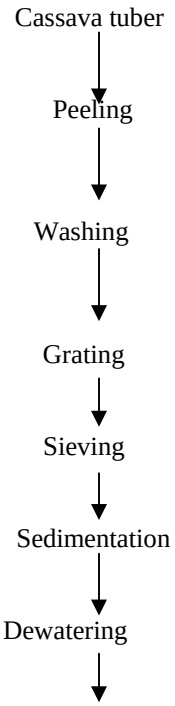
Materials and Methods

Raw materials

Three newly released low cyanide cassava varieties (96/01632, 98/0505 and TME419) from International Institute of Tropical Agriculture (IITA), Ibadan were used. The cassava varieties were planted at the research farm of IITA under rain-fed condition. No fertilizers or herbicides were applied during the course of the experiment. Hand weeding was done when necessary. Harvesting was done at 12 months after planting. The harvested cassava roots were processed into starch within 60 minutes after harvest.

Extraction of cassava starch

This was done following the traditional method of starch extraction as described by Oyewole and Obieze, (1995). 7kg of freshly harvested cassava roots were peeled, washed in water and grated with an electric motor powered mechanical grater (Fig 1). The resultant pulp was immediately sieved through a screen and suspended in 10L of water. This separates the fibrous and other coarse root material from the starch pulp. The starch pulp was allowed to settle for 4 – 6 hrs before decanting. The supernatant was decanted and the thick sediment is the wet starch. The starch was then dried using a convectional oven dryer at 60°C for 18 hrs and packed.



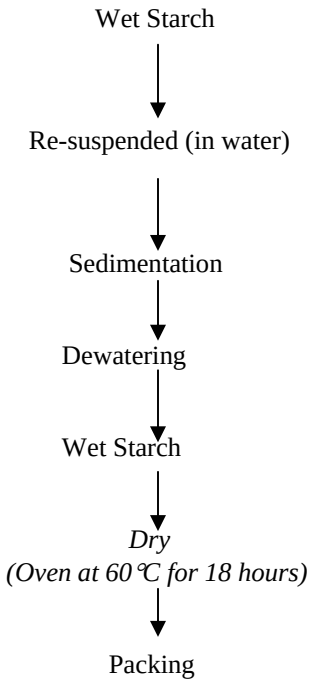
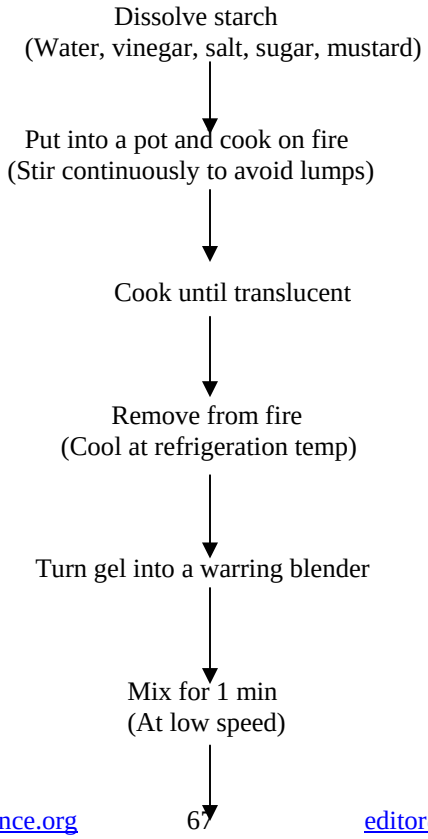


Figure 1: Flow Chart of Cassava Starch Production

Preparation of cassava starch-based salad cream

Dry cassava starch was reconstituted with water, vinegar, salt, sugar and mustard (Fig 2). It was then cooked on fire until translucent. This was then cooled and blended in a warring blender for one minute after which, egg yolk and vegetable oil were added and then blended for another five minutes. The resultant salad cream was then poured into a covered jar.



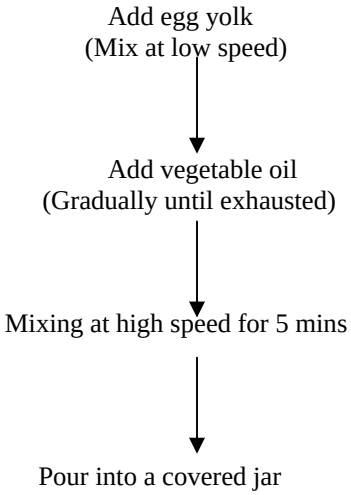


Figure 2. Preparation of Cassava starch based salad cream

Chemical analysis

pH determination:

The pH meter (model BA 350 EDT instruments) was standardized with standard buffer solution 4. 0. and 7.0. The pH was measured by inserting directly the electrodes into 10ml beaker containing the sample.

Determination of titratable acidity:

Titratable acidity was determined according to the method described by Ruck (1969). 1g of blended portion of Roselle jam sample were weighed and put into 50ml centrifuge tube respectively. 10ml of distilled water was added to each tube to dissolve each respectively and then flitted. 1ml aliquot of each solution was taken into another 50ml centrifuge tube and 10ml of distilled water added to dilute the sample because it is highly colored. 10ml of the diluent was titrated against 0.1N NaOH solution using phenolphthalein (2 drops) indicator percentage titratable acidity was calculated.

Determination of dry matter and moisture content:

Two milliliters (2mls) of each sample was measured into a previously weight crucible, dry over water for some time. The crucible plus sample taken was then transferred into the oven set at 100^0C to dry to a content weight for 24hour over night. At the end of 24hours, the crucible plus sample was removed from the oven and transfer to dessicator cooled for ten minutes and weighed.

If the weight of empty crucible is $W_{0,}$ then, the weight of crucible plus sample is W_1. Weight of crucible plus oven dried sample is W_3

$$\% \text{ Dry matter} = \frac{W_3 - W_0}{W_1 - W_0} \times \frac{100}{1}$$

$$(\% \text{ Moisture}) = \frac{W_1 - W_3}{W_1 - W_0} \times \frac{100}{1}$$

% Moisture Content = 100 - % DM

Determination of Ash

The sample (2 g) was weighed into a porcelain crucible. This was transferred into the muffle furnace set at 550°C and left for about 4 hours. About this time it had turned to white ash. The crucible and its content were cooled to about 100°C in air, then room temperature in a dessicator and weighed (AOAC, 1990).

The percentage ash was calculated from the formula below:

$$\% \text{ Ash content} = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times \frac{100}{1}$$

Determination of Crude Protein

The micro-Kjeldahl method for protein determination is employed for protein determination. This is based on three principles:

Procedure

The finely ground dried sample (0.5g) was weighed into the micro-Kjeldahl flask. To this were added 1 Kjeldahl catalyst tablet and 10ml of

conc. H_2SO_4. These were set in the appropriate hole of the digestion block heaters in a fume cupboard. The digestion was left on for 4 hours after which a clear colourless solution was left in the tube. The digest was carefully transferred into 100ml volumetric flask, thoroughly rinsing the digestion tube with distilled water and the volume of the flask made up to the mark with distilled water. 5ml portion of the digest was then pipetted to Kjeldahl apparatus and 5ml of 40% ($^{w}/_{v}$) NaOH added.

The mixture was then steam distilled and the liberated ammonia collected into a 50ml conical flask containing 10ml of 2% boric acid plus mixed indicator solution. The green colour solution was then titrated against 0.01 NHCL solution. At the end point, the green colour turns to wine colour, which indicates that, all the nitrogen trapped as ammonium borate have been removed as ammonium chloride. The percentage nitrogen was calculated by using the formula:

% N = Titre value x atomic mass of nitrogen x normality of HCL used x 4

The crude protein is determined by multiplying percentage nitrogen by a constant factor of 6.25 (AOAC, 1990).

Crude Fat Determination

The dried sample (1g) was weighed into fat free extraction thimble and plug lightly with cotton wool. The thimble was placed in the extractor and fitted up with reflux condenser and a 250ml soxhlet flask which has been previously dried in the oven, cooled in the dessicator and weighed. The soxhlet flask is then filled to ¾ of it volume with petroleum either (b.pt. 40 – 60°C) and the soxhlet flask extractor plus condenser set was placed on the heater. The heater was put on for six hours with constant running water from the tap for condensation of ether vapour. The set is constantly watched for ether leaks and the heat sources are adjusted appropriately for the ether to boil gently. The ether is left to siphon over several times at least 10 – 12 times until it is short of siphoning. It is after this is noticed that any ether content of the extractor is carefully drained into the ether stock bottle. The thimble-containing sample is then removed and dried on a clock glass on the bench top. The extractor flask with condenser is replaced and the distillation continues until the flask is practically dried. The flask which now contains the fat or oil is detached, its exterior cleaned and dried to a constant weight in the oven (AOAC, 1990). If the initial weight of dry soxhlet flask is Wo and the final weight of oven dried flask + oil/fat is W_1, percentage fat/oil is obtained by the formula:

$$\frac{W_1 - Wo}{\text{Weight of sample taken}} \times \frac{100}{1}$$

Determination of sugar

1 gm of sample was weighed into a boiling tube and 30ml of hot 80% ethanol was added into the boiling tube and shake on a shaker. The mixture was allowed to rest for 20-30mins. The mixture was then filtered through a Whatman no 41 filter paper. The process was repeated to ensure complete extraction of sugar. The extract was then evaporated until dry. 10ml of distilled water was added to dissolve the contents and transferred into a 100ml volumetric flask. The contents were washed into a beaker two or three times and made up to 100ml with distilled water.

1 ml of aliquot was pippeted into a test tube and 1 ml of distilled water was also pipetted into a test tube separately as blank. 1ml of 5% phenol was added to each tube and shake. Into the mixture 5 ml of 96% H_2SO_4 was added and shook vigorously to obtain a good mixing.. Allow the tubes to stand for 10mins for the development of golden yellow colouration. The absorbance of the golden yellow was measures against the blank at 490nm (A.O.A.C 1990)

Sugar = Absorbance of sample x Dilution factor x gradient factor/10,000 x weight of sample

Total Solids

3g of sample was weighed into a flat Petri dish, heat on steam bath for 15 minutes, exposing maximum bottom to live steam. Heat for 3 hrs in an air oven at 100^0C. Cool in desiccators, weight quickly and report % Residue as total solid.

$$\% \text{ Total solid} \quad W_2 - \frac{W_1 \times 100}{S}$$

Colour Analysis

This was determined using colour meter (Color Tec PCMTM Color Tec associates, Inc., 28 Center STREET, CLINTON, NJ 08809). The colorimeter operates on the CIE (Commission Internationale de I'Eclairage) L*, a*, b* colour scheme. Multiple measurements of several points on samples were made. The instrument was first standardized (L=87.82, a=02.97, b=-00.29) with a Business Xerox 80g/m^2 white paper with 136 CIE whiteness D65. About 3g of starch were put in a transparent polythene bag and the colour meter was placed on the sample by allowing the sensor to touch the sample. The reading was taken

directly for L*. The instrument display three-dimensional colour difference in uniform colour space (Lab) co-ordinates. Uniform colour space defines three directions, a Light to Dark direction, called L*, a Red to Green direction called a*, and a blue to yellow direction called b* (Patterson, 2002).

Rheological properties

The viscosity of different Cassava starch salad cream samples with control were measured in triplicates at controlled temperature of 50^0C using a digital rotational Brookfield viscometer (Brookfield Engineering Laboratories, Middleboro, USA, Model DV – E). There readings were taken per samples at 20, 40 and 1 min rotation at each speed (30, 60 and 100 rpm). Spindle #4 was used for all measurements. A 600 ml beaker was used for the measurement with the viscometer guard leg on. The samples were poured into the beaker to reach a level that covers the immersion groove on the spindle shaft. All viscosity measurements were carried out immediately after preparing the salad cream.(Radomir, 2009)

Sensory Evaluation

Sensory evaluation carried out comprised of eight – man panelists, ranking method was used to make simultaneous comparison of samples on the basis of a single characteristic, colour, taste, texture aroma and sheen. IFT, (1964)

Statistical Analysis

Statistical analysis of data was with the Statistical Analysis Systems (SAS) package (version 8.2 of SAS Institute Inc 1999). Significant differences ($P<0.05$) were determined by Duncan Multiple.

Results and discussion

Physicochemical properties of Cassava starch based salad cream

Table 1 depicts the physicochemical properties of cassava starch based salad cream. Commercial salad cream was significantly higher in moisture (48.99%), titratable acidity (8.63%), total solids (61.92%), protein (1.61%), sugar (17.59%) and ash (2.75%). Higher values reported in this product is not unrelated to the difference in the method of preparation. Different methods of preparation affect the compositional attributes of any food product (Ashaye *et al* 2001, Saxema *et a*l 2009 and Vilai *et al* 2001)

Table 1: **Physicochemical properties of Cassava starch based salad cream**

Variety	Moisture content %	Dry matter %	Titratable Acidity	pH	Total solids %	Protein %	Sugar %	Starch %	Fat %	Ash %
96/01632	35.73^{b}	64.28^{a}	3.84^{b}	3.14^{c}	38.85^{b}	0.37^{b}	5.85^{b}	12.25^{a}	25.94^{ab}	1.74^{c}
98/0505	35.46^{b}	64.55^{a}	3.94^{b}	3.19^{b}	38.56^{b}	0.38^{b}	6.02^{b}	10.94^{ab}	28.71^{a}	1.75^{c}
TME419	35.44^{b}	64.57^{a}	3.75^{b}	3.23^{a}	37.89^{b}	0.39^{b}	4.37^{c}	10.64^{ab}	21.64^{b}	1.78^{b}
Commercial salad cream	48.99^{a}	51.01^{b}	8.63^{a}	3.07^{d}	61.92^{a}	1.61^{a}	17.59^{a}	8.03^{b}	6.66^{c}	2.75^{a}

Means in the same column having the same letter are not significantly different from each other at $P<0.05$

It was also seen that cassava based salad creams were not significantly different from each other in dry matter, titratable acidity, total solids and protein. Cassava salad creams processed from cassava varieties (96/01632 and 98/0505) are not significantly different from each other in sugar (5.85% and 6.02%) and ash contents (1.745 and 1.75%) at $p<0.05$.

Colour of Cassava Starch salad cream and control.

Table 2 shows the colour of cassava starch salad creams. L* values of the Cassava starch salad cream from cassava varieties 96/01632, 98/0505 and TME 419 was higher than control with values 85.17, 84.21 and 84.38 respectively. Control (commercial salad cream) was 77.28. These values showed an indication of the cassava starch base salad cream tending towards white colouration more than the control.

The b* value of the control salad cream was higher (27.53) compared to other cassava starch salad creams with increased prominent yellowish colouration.

The Hue and Chroma reveals the intensity of the colour pronounced by the L* and b* values (McWatters *et al*., 2001).

Table 2: Colour of Cassava Starch salad cream and control.

Varieties	L*	A*	B*	Hue (Rad)	Chroma
96/01632	85.17	-6	14.47	-1.17	15.77
98/0505	84.21	-3.98	15.26	-1.33	16.13
TME 419	84.38	-7.43	15.84	-1.13	17.59
Control	77.28	2.14	27.53	0.45	28.97

Viscosity properties of cassava starch based salad cream

Fig 3 indicates significant difference in the viscosity of the Salad cream prepared from cassava starches of 96/01632, 98/0505, TME 419 and control at different shear rates and temperature. There is a great interaction in their behavior. All exhibit a pseudo plastic behaviour (Non Newtonian behaviour) as the shear rate increase the viscosity decreases, highest viscosity was observed at lowest shear rate exhibiting a thinning properties. (Morris, 1989).

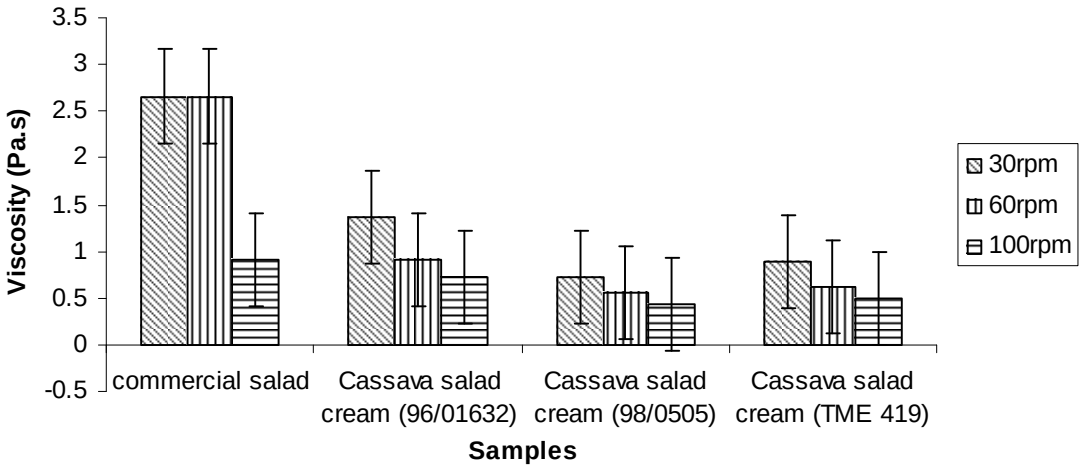


Fig 3: Viscosity of cassava starch based salad cream at 50^0C

The highest viscosity was observed with control cassava starch salad cream; this observation could be due to the modified corn flour and gums additives used in its preparation, Elder and Smith. (1969).

Sensory evaluation scores for cassava based salad cream

The sensory evaluation of cassava based salad cream was presented in table 3. The colour of commercial salad cream was (3.6) while there was no significant difference in the colour of other cassava based salad creams. The result showed increased likeness for the colour of cassava based creams. The consistency and odour of cassava salad creams from 96/01632 and 98/0505 were not significantly different. However the consistency of the commercial salad cream (Control) was highly accepted. There was no significant difference in the taste and sheen of all the salad creams.

Table 3 Sensory evaluation scores for cassava based salad cream.

Varieties	Colour	Consistency	Taste^{ns}	Odour	Sheen ^{ns}
96/01632	1.3b	1.8ab	1.9	2.0a	1.1
98/0505	1.4b	1.9ab	1.9	2.0a	1.1
TME 419	1.6b	2.0a	1.8	2.0a	1.2
Control	3.6a	1.4b	2.0	1.5b	1.3

Mean values having different superscripts within column are significantly different (P<0.05).

Conclusion.

It can be concluded that cassava based salad creams compared favourably with commercial salad in proximate composition and sensory attributes. Viscosities of the salad creams were also Non-Newtonian. Therefore, acceptable and nutritious salad cream can be processed from cassava starch.

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Multipurpose Tree Species Of Western Himalaya With An Agroforestry Prospective For Rural Needs

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Abstract: The Western Himalaya is rich in multipurpose tree species (MPTs) which are traditionally preferred in agro-forestry. Indigenous plants remained excluded in all reforestation and afforestation programmes run by the Govt. agencies due to lack of the knowledge of local MPTs and planting material. In present paper a list of 70 MPTs is presented with their brief notes on their uses and distribution, suitable for agroforestry plantation. There is need to study the propagation behaviour of these short listed plants so that suitable planting material may be made available for the successful agroforestry programme to ensure people participation. [Journal of American Science 2010;6(1):73-80]. (ISSN: 1545-1003).

Key words: Agroforestry, Himalaya, Propagation behavior, Peoples participation, Rural needs.

1. Introduction

Agro-forestry can play major role in the protecting environment and forest (Khurana and Khosala 1993; Gaur 1993; Quli, 2001). The agro-forestry practice in the Garhwal of Uttarakhand in Western Himalaya is permanent feature of agricultural landscape (Semwal and Maikhuri 1996; Maikhuri et al. 1996; Bhatt and Badoni, 1995; Bhatt and Todaria, 1999; Semawal et al. 2001). However, this system is practiced in unplanned manner. People have little choice in selection of plants and what ever grows naturally is accepted. The planting of sapling by conscious efforts is unknown because people have no knowledge of how to raise a particular plant nursery (Vashishtha, et al. 2005). The farmers have integrated crops, trees and animals in their farming and land management systems reasonably for solving the problem of acute shortages of fuel wood, fodder and other forest produce (Bhatt, 2002).

Spread over 18% of the total area of the country, the Himalaya has had a great influence on the life and culture of Indian people (Boserup, 1965; Gaur et al. 1985; Nand and Kumar, 1989; Swaroop, 1993). The mountainous belt of Himalaya present unique environment concern owing to their young age, origin of the major rivers and complex and fragile ecosystem (Gaur et al. 1985; Ramakrishnan, 1994; Kumar et. al. 1996; Purohit, 1997; Gaur, 1993; Dhar et al. 2000). Therefore, the main objective of the action oriented research in Himalayan region is to promote the socio-economic development of the hill people in harmony with preservation of ecological balance. It should envisage conservation and utilization of ecosystem of Himalayan region under the thrust area such as, creation of nurseries and seedling banks, study of ecosystem and optimal utilization of local resources (Semwal and Maikhuri, 1996).

Promotion of agroforestry can be another step to check deforestation in the hills. It can meet the demand of fodder, and fuel locally and thus lessen the dependence on the forest. Ecological hazards originating from denudation of mountains have generally encouraged attempts to reclaim the barren landscape by

reforestation. However, selection of species remained an ignored aspect in these programmes because information is lacking on indigenous species and large numbers of exotics are being introduced, which may constitute a threat to the ecological security of the region and unfit for the local needs. So far in the annual plantation activity, *Bamboos, Eucalyptus, Acacia, Albizia, Prosopis, Dalbergia Delonix, Grevillea, Melia* etc. constitute 90% of plantation programmes, which could very well be replaced by local tree species of the region. We cannot reverse this trend unless we know the indigenous MPTs suitable for agroforestry and their propagation behaviour. This should help in raising the saplings of desired tree species in nurseries for plantation purposes and also accommodate the local preference by the farmers.

In this paper, the study presented a list of MPTs which are indigenous to Garhwal region of Western Himalaya and suitable for agroforestry particularly and other forestry programmes in general and Model developed by community for fulfillment of daily needs (Fig. 1).

2. Material and Methods:

The study covers the entire Garhwal of Western Himalaya, which lies in between $29^0$31.9' N to $31^0$26.5'N lat and $77^0$33.5'E to $80^0$60' E long. Physiographically, the whole terrain is mountainous and can be divided in to three zones-lower Himalayan zone (300-500masl); middle Himalaya (600-1000masl); and upper Himalaya (1100-2500masl). Extensive surveys were made during different seasons in various zones of the study area. A tentative list of MPTs was compiled which included more than 70 trees species with notes on folk knowledge regarding multipurpose trees (MPTs), their adaptation and use. The methods of collection, preservation and Herbarium preparation were followed as usual practices adopting by Jain and Rao (1977). The identification of specimens was done with the help of regional floras (Babu, 1977; Hara et al. 1978; Naithani, 1984 and 1985; Gaur, 1999). The description includes botanical names of plants followed by some important citations such as Hooker (1872-97), Duthie (1903-29), Babu (1977), Hara et al. (1978), Naithani (1984-1985) and Gaur (1999).

3. Results and Discussion:

On the basis of survey conducted, it is quite evident that agroforestry is though practiced but by and large is an unplanned activity in Garhwal of Western Himalaya. People prefer to collect fodder for their livestock around their agricultural land, but seldom plant a tree. They harbour and patronise trees which naturally grow and have no choice on their selection. Generally, the rule of natural selection and adaptability governs the distribution. On the basis of survey most commonly used 70 MPTs were identified in the entire Garhwal of Western Himalaya of which 13 species are growing in lower region, 24 species are growing in middle Himalaya and rest 31 species in upper Himalayan zone. The brief description of the plants is presented as following:

List of Plants:

1. *Adina cordifolia* Roxb. Vern. Haldu, F. Rubiaceae, upto 800m; Fl. May-Jul., Fr. Mar-May; Fuel, Timber, Medicine.
2. Aesendra butyrcea Roxb. Vern. Chiura, F. Sapotaceae, Fl. Jan-Mar; Fr. Jun-Jul., upto 800m; edible oil, medicine,bee forage, timber.
3. *Aegle marmelos* L., Vern. Bel, F. Rutaceae, Fl. Feb.-Mar., Fr. May-Aug.; upto 1200 m; Fuel, Fruit, Medicine.
4. *Albizia lebbeck L.*, Vern. Siris, F. Mimosaceae, Fl. Feb. – Apr., Fr. Oct-Dec., upto 1200 m; Fuel, Timber, Nitrogen Fixing.
5. *Albizia procera* (Roxb.) Benth., Vern. Karah, F. Mimosaceae, Fl. May - Aug., Fr. Oct-Dec., upto 800 m; Fuel, Timber, medicine N_2 Fixing.
6. *Alnus nepalensis* D., Vern. Ust, F. Betulaceae, Fl. Oct.-Nov., Fr. Oct-Jun., upto 1000-2500m; Fodder, Fuel, Timber, Nitrogen Fixing.
7. *Artocarpus lacucha* Buch.-Ham., Vern. Dheu, F. Moraceae, Fl. Mar. – Apl., Fr. May – Aug. upto 1000m; Fodder, medicine, Ghee, Fuel,
8. *Bauhinia purpurea* L., Vern. Guiral, F. Caesalpiniaceae, Fl. Sept.-Nov., Fr. Jan-Mar., upto 700m; Fodder, Fuel, Timber, Medicine, Nitrogen Fixing.
9. *Bauhinia variegata* L., Vern. Kwiriyal, F. caesal piniaceae, Fl. Feb.-Apr., Fr. May-Aug., upto 800-2000 m.; Fodder, Fuel, Timber, Medicine, Nitrogen Fixing.
10. *Bauhinia semla* Wunderlin. Vern. Kanda F. Caesalpiniaceae, Fl. Sept.-Nov., Fr. Feb-Apr., upto 1000-1500m;

Fodder, Fuel, Timber, Medicine, Nitrogen Fixing.

11. *Bauhinia racemosa* Lam. Vern. Jhingora F. Caesalpiniaceae, Fl. Mar. - Jun., Fr. Jan. - May, upto 1000-1600m; Fodder, Fuel, Fibre, Timber, Medicine.
12. *Bauhinia vahlii* Wight & Arn. Vern. Malu F. Caesalpiniaceae, Fl. Apl. - Jun., Fr. Jun. - Sept., upto 1300m; Fodder, Fuel, Fibre, Cup-plats.
13. *Betula alnoides* Buch. – Ham., Vern. Saur, F. Betulaceae, Fl. & Fr. Mar-Jun., upto 2000-3000m, Fodder, Fuel, Timber, Nitrogen Fixing.
14. *Boehmeria regulosa* Wedd., Vern. Genthi, F. Urticaceae, Fl. & Fr. July-Nov., upto 1000-1600 m; Fodder, Fuel, Medicine.
15. *Bombax ceiba* L., Vern. Semal, F. Bombacaceae, Fl. Jan-Mar., Fr. Apr-May; upto 1200m; Fuel, Fibre, Timber, Medicine.
16. *Butea monosperma* Lam., Vern. Dhak, F. Fabaceaee, Fl. & Fr. March-May, upto – 1500 m; Fodder, Fuel, Timber, Medicine.,
17. *Cassia fistula* L., Vern Kirala, F. Caesalpiniaceae, Fl. Feb.-Apr., Fr. May-June, upto 1400m; Fodder, Fuel Timber, Medicine, Nitrogen fixing.
18. *Celtis australis* L., Vern. Khairk, F. Ulmaceae, Fl. Mar-Apr, Fr. Sept.-Oct., upto – 2400 m; Fodder, Fuel Fruit, Timber, Medicine .
19. *Cordia dichotoma* Forster f, Vern. Lisora, F. Ehretiaceae, Fl. Mar-Apr; Fr. May-Jul., upto – 1800 m; Fuel, Fruit, Timber.
20. *Desmodium elegans* DC., Vern., Chamlai, F. Fabaceae, Fl. Apr-Jun, Fr. Jul-Oct., upto – 2000-3500m; Timber, Nitrogen Fixing .
21. *Debregeasia salicifolia* D. Dun, Vern. Syanry, F. Urticaceae, Fl.& Fr. Feb-Aug, Fuel.
22. *Daphniphyllum himalense* Benth; Vern. Ratniyalu, F. Daphniphyllacea, Fl. Mar-Apr., Fr. Jun-Aug., upto 1600-2800 m; Fodder, Fuel, Timber, Nitrogen Fixing.
23. *Emblica officinalis* Gaertner, Vern. Amla, F. Euphorbiaceae, Fl. Feb-Apr, Fr. Sept-Nov.,
24. *Ficus glomarata* Roxb., Vern. Umra, F. Moraceae, Fl. Mar-May, Fr. Jun-Aug; Fodder, Fuel, Fruit, Medicine.
25. *Ficus hispida* L.f., Vern, Bhumra, F. Moraceae, Fl. Mar-Apr, Fr. May-Jun., upto – 600m; Fodder, Fuel, Fruit, Fibre, Medicine.
26. *Ficus nemoralis* Wallich ex Miq., Vern., Thelku, F. Moraceae, Fl. Mar-Apr. Fr. Aug-Sep., upto – 1200-2200 m; Fodder, Fuel, Fruit.
27. *Ficus palmata* forsk; Vern. Bedu, F. Moraceae, Fl. May-Jun, Fr. Jun-Aug., upto 900-1200m; Fodder, Fuel, Fruit, Medicine.
28. *Ficus semicordata* Buch. –Ham., Vern. Khaina, F. Moraceae, Fl. May-Jun, Fr. Jun-Oct., upto 900-1200m; Fodder, Fuel, Fruit, Fibre, Medicine.
29. *Ficus subincisa* Buch. – Ham., Vern. Chanchri, F. Moraceae, Fl. & Fr. Mar-Jun., upto 900-1200m; Fodder, Fuel, Fruit, Medicine.
30. *Ficus auriculata* Lour, Vern. Timla, F. Moraceae Fl. Mar-May, Fr Jun-Jul, upto 900-1200m; Fodder, Fuel, Fruit, Medicine.
31. *Fraxinus micrantha* Lingeisheim, Vern. Angu, F. Oleaceae, Fl. Mar-Apr., Fr. Jul-Sept., upto 1800-2600 m; Fodder, Timber, Medicine.
32. *Grewia asiatica* L. Vern. Dhaman, F. Tilliceae Fl. Apr-May, Fr. Jun-Aug., upto 1000-1500m ;Fodder, Fuel, Fruit, Fibre, Medicine.
33. *Grewia eriocarpa* A.L. Juss, Vern. Pharasain, F. Tilliaceae, Fl. May-Jun, Fr. Jul-Aug. Fodder, Fuel, Fruit, Fibre, Medicine.
34. *Grewia oppositifolia* Buch.-Ham., Vern. Bhimal, F. Tilliaceae, Fl. Apr-Jun, Fr. Aug-Nov., upto 800-1600m; Fodder, Fuel, Fruit, Fibre, Medicine.
35. *Holarrhena pubescens* Buch.-Ham, Vern. Kura, F. Apocynaceae, Fl. Apr-Jul, Fr. Oct-Feb, upto 1250 m, Fodder, Fuel.
36. *Litsea glutinosa* Lour., Vern. Maida-lakari, F. Lauraceae, Fl. Jun. – Aug., Fr. Sept. - Oct., upto 600m; Fodder, Fuel, Timber Medicine.
37. *Litsea monopetala* Roxb., Vern. Kadwai, F. Lauraceae; Fl. Mar-July, Fr. July-Nov., upto 800-1600m; Fodder, Fuel, Timber Medicine.
38. *Lyonia ovalifolia* Wallich, Anyar, F. Ericaceae, Fl. Mar-Jul, Fr. Jul-Nov., upto 800-1600m; Fuel, Timber, Medicine.

39. *Madhuca longifolia* Koenig; Vern. Mahwa, F. Sapotaceae, Fl. Mar-Apr, Fr. Jun-Jul. upto 500m; Fuel, Timber, Medicine.
40. *Mallotus phillippensis* Lam., Vern. Ruina, F. Euphorbiaceae, Fl. Sept-Nov, Fr. Mar-May, upto 800-1600m; Fodder, Fuel, Timber, Medicine.
41. *Melia azedarach* L. Vern. Dainken, F. Meliaceae, Fl. Mar-Apr, Fr. Apr-May upto 1400m; Fodder, Fuel, Timber, Medicine.
42. *Milletia extensa* Benth. Vern. Gauj; F. Fabaceae, Fl. Apl. – May, Fr. Jul. – Aug., upto 1500m, Fodder, Medicine, Soil binding, Fibre.
43. *Moringa oleifera* Lam., Vern. Sainjna, F. Moringaceae, Fl. Feb-Apr, Fr. May-Jun. upto 1200m; Fodder, Fuel, Medicine.
44. *Morus alba* L. Vern. Sahtoot, F. Moraceae, Fl. & Fr. Feb-Jan. Fodder, Fuel, Fruit, Fibre, Medicine.
45. *Myrica esculenta* Buch. – Ham. Vern. Kaphal, F. Myricaceae, Fl. Aug-Oct, Fr. Apr.-Jun., upto 900-2000m; Fuel, Fruit, Timber, Medicine.
46. *Neolitsea pallens* D. Don., Vern. Belaru F. Lauraceae, Fl., Mar-Apr, Fr. Sep. – Oct., upto 1500-3000m ; Fodder, Fuel, Timber, Medicine.
47. *Neolitsea cuipala* Buch – Ham, Vern. Lampatiya, F. Lauraceae, Fl. Mar-Apr., Fr. Sep-Oct., upto 1000-2500m; Fodder, Fuel, Timber, Medicine.
48. *Ougeinia oojeinensis* Roxb., Vern, Sandan, F. Fabaceae, Fl. Mar-Apr, Fr. May-Jul. upto 1500m, Fodder, Fuel, Medicine, Timber.
49. *Prunus cerasoides* D. Don, Vern., Panya, F. Rosaceae, Fl. Oct-Dec., Fr. Feb-Mar, upto 2400 m; Fuel, Timber, Medicine.
50. *Persea duthiei* King ex.Hook, Vern. Kaula, F. Lauraceae, Fl. Feb-Apr, Fr. Jun-Sept. upto 2200 m; Fodder, Fuel, Timber, Medicine.
51. *Phoenix humilix* Royle., Vern. Khajoor, F. Are Caceae, Fl. March- Apr, Fr. May-Jun., upto 1600m; Fodder, Fuel, Fruit, Fibre, Medicine.
52. *Premna barbata* Wallich., Vern. Bakrya, F. Verbenaceae, Fl. Mar-May, Fr. Jun-Jul. upto 1500m; Fodder, Fuel.
53. *Pyrus pashia* Buch. – Ham., Vern. Mole, F. Rosaceae, Fl. Feb.-Mar, Fr. May-Dec., upto 2400m. Fuel, Fruit, Timber, Medicine.
54. *Quercus leucotrichophora* A., Vern. Banj, F. Fagaceae, Fl. Mar-Apr, Fr. Oct-Jun.,upto 2000m; Fodder Fuel, Timber, Medicine.
55. *Quercus floribanda* Lindley, Vern. Moru; F. Fagaceae, Fl. Apr-May, Fr. Aug-Oct., upto 2000-2800m; Fodder, Fuel, Timber, Medicine.
56. *Quercus glauca* Thumb., Vern. Harinj, F. Fagaceae, Fl. May-June, Fr. Jun-Aug., upto 800-2000m; Fodder, Fuel, Timber, Medicine.
57. *Rhododendron arboreum* Smith, Vern. Burans F. Ericaceae, Fl. March-May, Fr. Apr. – Nov; Fuel, Timber, Medicine.
58. *Rhus parviflora* Roxb., Vern, Tungla, F. Anacardiaceae, Fl. May-Jun, Fr. Jul-Nov, upto 1800m; Fuel, Fruit, Medicine.
59. *Salix babylonica* L. Vern. Majnu, F. Salicaceae Fl. & Fr. Feb-Jul; Fodder, Fuel, Timber, Medicine.
60. *Schleichera oleosa* (Lour.) Oken. Vern. Kusum, F. Sapindaceae, Fl. Mar. – Apl., Fr. Jul. – Aug., upto 1200m, Medicine, Fodder, Bee forage.
61. *Sesbania bispinosa* Jacquin., Vern. Dhaincha, F. Fabaceae, Fl. & Fr. Sept-Jan, Fodder, Fuel, Fibre, Medicine.
62. *Spondias pinnata* L.F., Vern. Amra, F. Anacardiaceae, Fl. Feb-Apr, Fr. Sept.-Nov., upto 1400m; Fuel, Medicine.
63. *Swida macrophylla* Wallich, Vern., Khagsi, F. Cornaceae, Fl. Apl. – Jun., Fr. Jul. – Oct., 1400-2500m, Fodder, Fruit, Bee forage, Agri. Implements.
64. *Syzygium cumini* L., Vern. Phalenda, F. Myrtaceae, Fl. Mar-May, Fr. Jun-Jul. upto – 900m. Fuel, Fruit, Timber, Medicine,
65. *Terminalia alata* Roxb., Vern. Asin, F. Combretaceae, Fl. Jun-Jul. Fr. Feb.-Mar. upto 1500m. Fodder, Fuel, Timber, Medicine.
66. *Terminalia bellirica* Roxb., Vern. Bahera, F. Combretaceae, Fl. Apr-Jun, Fr. Jun-Jul. upto 1200m. Fodder, Fuel, Fruit, Timber, Medicine.
67. *Terminallia chebula* Retz. Obs., Vern. Haira, F. Combretaceae, Fl. Apr.-Jun, Fr. Jun-Mar. upto 1600m; Fodder, Fuel, Fruit, Timber.

68. *Toona ciliata* Roemer, Vern. Tun, F. Meliaceae Fl. Mar-Apr, Fr. Jun-Jul. upto 1000m; Fuel, Timber.
69. *Wrightia arborea* Dennstaeff. Vern. Darula, F. Apocynaceae, Fl. May-Jun, Fr. Mar-Apr. upto 1200m. Fodder, Fuel, Timber, Nitrogen Fixing.
70. *Woodfordia fruticosa* L. Vern. Dhaula, F. Lythraceae, Fl. Jan-Apr., Fr. Apr-Jun., upto 1500m; Fodder, Fuel, Medicine.

There are large numbers of multipurpose trees which grow indigenously in Garhwal region of Western Himalaya and are used by the people for their needs traditionally for fodder, fuel and also as cheap timber. It has been noted that those plants which are not used as construction material in plains are quite adequate to meet the demands in hills because in colder climate the wood is insect resistant. This cheap wood and fuel comes from non-timber MPTs which are equally good as provider of fodder.

It is remarkable that the lower Himalayan region has predominance of the multipurpose trees *Bauhinia semla., B. purpurea, Bombax ceiba, Phyllanthus emblica, Ficus hispida, F. glomerata, Albizia lebbeck, Adina cordifolia, Acacia catechu, L. chinensis, Madhuca longifolia,., Mallotus philippensis, Syzygium cumini, Dalbergia sissoo, Melia azedarach, Moringa oleifera* etc. while the middle Himalaya have the MPTs such as *F. auriculata, F. subincisa, Boehmeria rugulosa, Grewia eriocarpa, Litsea monopetala, Terminalia* sps *Ougeinia oojeinensis, Bauhinia variegata, Pyrus pashia*. In the upper Himalayan ridges *Ficus nemoralis, Salix babyloinca, Alnus nepalensis,Betula alnoides, Quercus leucotrichophora, Q. gluaca,,Q semicarpifolia* etc are quite common.

There has been noticeable reflection of stricking cultural diversity in the agroforestry too. While in Pauri, Rudraprayag and Chamoli district of Garhwal the most commonly preferred agroforestry plants are *Ficus auriculata, F. palmata, F. nemoralis, F. subincisa, Quercus sps, Celtis australis, Grewia oppositifolia, G. eriocarpa, Boehmeria rugulosa, Litsea monopetala* etc., in Tehri and Uttarkashi district the plants of choice are *Bauhinia* sps. such as *Bauhinia vahlii, B. variegata, B. purpurea and Albizia lebbeck, Mallotus phillippensis, Premna barbata etc.*

The preference of MPTs at different altitude is also different. For example the *Ficus* sps. are considered highly valuable fodder in the higher altitude (1000-18000m asl) area whereas *Celtis australis* and *Grewia oppositifolia* are consider the best fodder in the lower altitude (300-1400m asl) of Garhwal of Western Himalaya. The other striking observation was that agroforestry was kept away willingly and wittingly from irrigated land. Here the main consideration was maximum crop yield. Any plant around the field was considered unwanted. Hardly any plant was seen in and around the fields in irrigated area (as has been revealed during the survey in different localities, Barsu, Agustyamuni, Tilwara, Gholtir in Rudraprayag; Gauchar, Maldhar-Saikot in Chamoli; Purola, Barkot, Uttarkashi in Uttarkashi Disdrict). The agroforestry was promoted on the marginal and unirrigated land and treated as welcome supplement to the poor crop yield. The people depended more on livestocks in these area (Guptkashi, Ukhimath, Kandara, Bhanaj in Rudraprayag and Gpeshwer, Joshimath, Gairsain, Naryanbagar, Tharali in district Chamoli).

At present, the plants which Government agencies use in forestry and social forestry are commonly *Acacia auriculoformis, Albizia lebbeck, Dalbergia sissoo, Eucalyptis sps., Grevillea robusta, Jacarands sps., Leucaena leucocephala, Mangifera indica, Melia azadirach, Morus alba, Salix sps., vitex negundo.* However, these plant species are not native to Garhwal, still they may have been preferred mainly because the propagation of these plants is well known and planting material is easily available. But this shall be a short cut approach and might be largely responsible for failure to make it people programme. People wisely think of a plant well known to them ethnically and socially. Therefore there is need to know the local MPTs so that they may be involved in agroforestry. They also make it better from the point of view of crop-plant interaction, since their trial through ages. Further, the community agroforestry may hold a new promise to the conservation of ecology and prosperity of people. Any such movement would involve a requirement of suitable planting material. Here we have selected and identified most commonly used multipurpose trees giving complete details of their uses and habitat. From the list presented, plants can be choosen for particular location altitude wise. There are some plnts such as *Ficus auriculata, F. nemoralis, F. palmata, Litsea monopetala, Celtis australis, Grewia oppositifolia, Boehmeria rugulosa, Debregeasia*

salisifolia, *Pyrus pashia*, *Toona ciliate*, *T. serrata* which grow over from very low altitude in valley to very high altitude while other group have very restricted habitat. Plants such as *Ficus hispida*, *F. semicordata*, *Terminalia alata*, *T. bellirica*, *T. chebula*, *Wrightia arborea*, *Litsea chinensis*, *Artocarpus lacoocha* can only be selected for plantation in lower heights (300-800m asl)

Women folk have to walk miles to get fodder and fuel leaving little time for child care and other household duties; least is to be said about their own emancipation. If agroforestry is adopted, it has a potential to shed off waste of time and efforts. However, it has to be a planned activity and people should have a choice of MPTs and opportunity of sapling availability. In this way the present study may prove to be a turning point. This shall prove especially helpful for Government agencies involved in agroforestry and forestry.

Thus the agroforestry can play a major role in restoring the ecological imbalance by meeting the demand of fuel, fodder and timber of the rural community locally around their fields in Himalayan hills. To make it popular programme, there is a need to include indigenous MPTs of the area. Indigenous MPTs has other advantages also, besides providing fodder, fuel and many of them provide high quality fibre (*Ficus semicordata, Grewia oppositifolia, G. asiatica* etc) and edible fruits (*Celtis australis, Grewia oppositifolia, G. asiatica, Ficus auriculata, Ficus palmata, Ficus semicordata, Ficus nemoralis, Pyrus pashia, etc*). A judicious selection of plant species will feed the local needs, an important input for successful programme. Though several workers have recently documented the flora of the region (Naithani, 1984-85; Gaur and Barthwal. 1995; Gaur, 1999), but no attempt have so far been made to list the MPTs, which can be recommended for agroforestry. Therefore the present work would be an important step in popularizing the agroforestry in Garhwal.

Figure 1. Aagroforestry model developed through peoples participation for fulfilling rural needs.

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The Water Chemistry, Crustacean Zooplankton And Some Associated Faunal Species Of A Tropical Tidal Creek In Lagos, Nigeria

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Abstract: The water chemistry characteristics, crustacean zooplankton and associated species spectrum of the Abule-Agege creek was investigated. The water chemistry and zooplankton characteristics showed variations in response to tidal (brackish water) incursion from the adjoining Lagos lagoon and inflow of fresh water conditions from land. The transparency values of the area increased with reduction in the amount of rainfall while the water temperature as well as salinity values increased appreciably with the dry season. The pH of the area was alkaline throughout the study. The adult zooplankton spectrums were from four main phyla namely: the crustaceans (Arthropoda) being the most prominent. Other associated species were from the phyla Chaetognatha, Chordata and Cnidaria. The Arthropoda made up 59.31% (excluding juveniles), the Chaetognathas comprised 0.81%, the Chordates 0.20% and the Cnidarians recorded 2.83% of the total zooplankton crop. Similarly, the total recorded juvenile stages were dominated by crustacean forms. They were the zoea, megalopa, nauplii, fish larvae and fish eggs. Higher number of individuals was encountered in February and portends suitable hydro-climatic conditions at the period in terms of nutrients and water chemistry characteristics. [Journal of American Science 2010;6(1):81-90]. (ISSN: 1545-1003).

Key words: water chemistry, zooplankton spectrums, zoea larvae, megalopa, nauplii

1. Introduction

Crustaceans are an important and successful group in the ecology of marine ecosystems especially with regards to trophic relationships. Presently, there are over 45,000 species in this group (Pechenik, 2005). Crustaceans are consumed by man, important in eliciting data from fossils and are good indicators of water chemistry status. Furthermore, some adult crustaceans as well as the juveniles of a good number of this group are known to be planktonic. Holoplankton crustaceans accounts for at least 70% of the total zooplankton of the sea (Olaniyan, 1969, 1975; Nybakken, 1988) and marine meroplankton forms consists of a wide array of larvae with crustaceans having the greatest number of forms (Lawal-Are, 2006; Olaniyan, 1975 and Onyema *et al*., 2003). Hence, zooplanktonic crustaceans permanently exist as plankton while other are zooplankton spend only part of their life cycle in the plankton (Olaniyan, 1969; Odum, 1971; Waife and Frid, 2001). According to Lawal-Are (2006), the presence of three stages of larval development of *C. amnicola* (early zoea larval stage, late zoea larval stage and megalopa) observed in the plankton haul in the Lagos lagoon during the months of March and April was indicative of early life history beginning in the high brackish water. A few other studies on the zooplankton community in south-western Nigeria include Olaniyan (1969, 1975), Akpata *et. al.* (1993), Onyema *et. al.* (2003, 2007), Emmanuel and Onyema (2007) and Onyema and Ojo (2008).

Tidal creeks are known to be fertile coastal environment used as feeding and nursery grounds by a large number of fishes and aquatic crustaceans (Kusemiju, 1991). In south western Nigeria, a number of ecological studies have been carried out over the years with regards to the study of crustacean in the creeks and lagoons. Published works in this area include a study of the pink shrimp, *Penaeus duorarum* off Lagos coast (Kusemiju, 1975), while Bayagbona *et. al.,* (1971) and Adetayo, and Kusemiju (1994) evaluated the shrimp resources of Nigeria particularly those of the Lagos coastal area. Shrimps, crabs, lobsters and molluscs that constitute the shellfish resources of Nigerian coastal environment were reported by Dublin-Green and Tobor (1992). More recently are literature on the biology of the lagoon crabs, *Callinectes amnicola* and smooth swim crabs, *Portunus validus* (Lawal-Are, 2003; Lawal-Are and Bilewu, 2009). Furthermore, Lawal-Are and Kusemiju (2009) reported on the effect of salinity on the survival and growth of the blue crab, *Callinectes amnicola* from the Lagos Lagoon.

The aim of this study was to investigate the zooplankton assemblage with special emphasis on the crustacean in

relation to water chemistry characteristics in the Abule-Agege creek.

2. Materials and Methods

2.1. Description of Study Site

Abule – Agege creek (Fig 1) is a brackish water creek situated within the fringe of the University of Lagos and its linked to the Lagos lagoon. The site of this study is located at about longitude 06°30° 614 and latitude 003°24°142 Lagos, Nigeria. The creek is shallow (≤1m), tidal and sheltered. It is fed by water from the adjoining Lagos lagoon at high tide, and at low tide the water ebbs through it into the lagoon. The region is located in south-western Nigeria and hence exposed to two distinct seasons, the wet (May - October) and the dry season (November - April) (Nwankwo, 1996). The creek meanders through a mangrove swamp which is inundated at high tide and partially exposed at low tide. Some notable species located in the swamps include *Paspalum orbiquilare, Acrotiscum aureum, Phoenix reclinata, Rhizopohora racemosa, Avicenia nitida, Drepoanocarpus lunatus* and *Cyperus articulatus*. Notable fauna include *Periopthalmus* sp, *Balanus pallidus, Chthamalus* sp, *Uca tangeri, Seserma huzardi, Gryphea gasar, Tympanotonus fuscatus* var. *radula* and shorebirds that browse the area especially at low tide.

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2.2. Collection of Water and Plankton Samples

Water samples were collected from the creek (Abule-Agege) at one station in the 1st and 3rd week of four consecutive months (January - April 2008) from the creek. The collection was carried out between 8 and 12hr on each sampling day. The water samples were collected with 50cl plastic containers with screw caps just below the surface of the water, labeled and taken to the laboratory for further water physico-chemistry analysis.

The plankton was collected using a standard plankton net of 55µm mesh size. The net was tied unto a motorized boat and towed horizontally at low speed (< 4 knots) for 5 minutes.

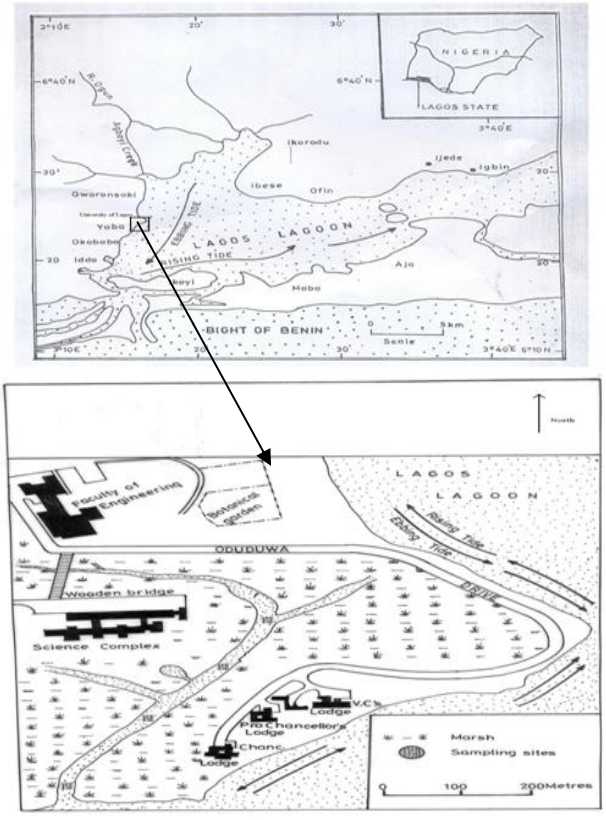

Fig. 1: The Abule-Agege creek and the adjoining Lagos lagoon.

After 5 minutes, the horizontal plankton haul was retrieved and the plankton samples were concentrated and stored in 50cl plastic containers with screw caps. Samples were labeled properly after which 4% unbuffered formalin was added to preserve the organisms.

2.3. Analysis of Physical and Chemical Parameters

Air and surface water temperatures were measured in-situ using a mercury thermometer while water depth was estimated with a calibrated pole. Salinity was determined using a refractometer (BIOMARINE Aqua Fauna Model). Transparency was measure using a 20cm black and white secchi disc. Total Dissolved Solids (TDS) were determined by evaporating 100ml aliquot at 105^{o}C and Total Suspended Solids (TSS) estimated by filtering 100ml of sample through a pre-weighed filter paper, dried to constant weight and reweighed. Conductivity was measured using a Philip PW9505 Conductivity meter. The surface water pH was determined with a Griffin pH meter (model 80) while dissolved oxygen was measured using a Griffin oxygen meter (Model 40). Biological and chemical oxygen demands were measured using methods described in APHA (1998) for water analysis. Calorimetric methods using a Lovibond Nessler were adopted for the direct determination of phosphate-phosphorus and nitrate-nitrogen values while sulphate levels were measured using the gravimetric method (APHA, 1998). Calcium and magnesium ions were determined using a 400 single channel, low flame photometer (APHA, 1998). Concentrations of copper, iron and zinc were determined with an atomic absorption spectrophotometer (AAS) Unicam 99model.

2.4. Zooplankton analysis

Plankton samples were allowed to settle in the lab for at least 24hr and concentrated by filtering via a filter paper to 20ml (filtrate). For each bottle five drops of well mixed samples were thoroughly investigated. On each occasion, one drop of sample was investigated using the Drop Count Method described by Onyema (2007). For each mount as many transects were thoroughly investigated with each transect at right angles with the first. Zooplankton species were examined, identified and counted using a Carl Zeiss Standard IV monocular microscope also consulting appropriate texts to aid identification (Newell and Newell, 1966; Wimpenny, 1966; Olaniyan, 1975; Gibbons, 2001; Waife and Frid, 2001). The number of each taxa occurring in each field and the total number of taxa per group were recorded as number of organisms per ml.

3. Results

3.1. Water Quality Indices

The bi-monthly variation in water quality indices at the Abule-Agege creek linked to the Lagos lagoon between January and April, 2008) is shown in Table 1and Figs. 2, 3 and 4.

Air temperatures during the study ranged from 18 to 29^{o}C, while rainfall values were between 17.6 and 74.4mm and Salinity ranged between 15.2 and 24.3‰. Transparency ranged from 95.5 to 149.5cm while conductivity was between 95.5 and 149.5cm. Total Dissolved Solids (TDS) and Total Suspended Solids (TSS) range between 13255 and 23162 mg/L and 3 and 122mg/L respectively while chloride was between 7910.0 and 13200mg/L. Acidity ranged from 4.0 to 11.8mg/L while Alkalinity was between 75 and 280 mg/L. Lowest value for Dissolved oxygen recorded was 3.9mg/L and the highest value was 5.0mg/L. Biological Oxygen Demand and Chemical Oxygen Demand were between 8 and 122mg/L and 39 and 388mg/L respectively. Values for nitrates was between 2.6 and 8.1mg/L, phosphate ranged between 0.06 and 2.6mg/L, sulphate ranged between 300.8 and 620mg/L and silica values were between 2.0 and 3.9mg/L. The cations which included calcium and magnesium ranged between 61.2 – 1005.0mg/L and 655.6 and 1290mg/L respectively. The monthly range in variation of the heavy metals were notable copper (0.002 – 0.008mg/L), Iron (0.08 – 0.16mg/L) and Zinc (0.003 – 0.03mg/L).

3.2. Biological Characteristics

The composition and abundance of zooplankton species at the Abule-Agege creek in the 1st and 3rd weeks between January and April, 2008 are presented in Table 2, Figs. 3, 4 and 5. The zooplankton throughout the sampling period were represented by four phyla namely: Arthropoda, Chordata, Chaetognatha and Cnidaria. A total of 2,470 individuals were recorded throughout the period of study. The arthropods which were the most abundant accounted for 1,465 individuals which gave 59.31% of the total individuals recorded. The chordates recorded 5 (0.20%), the cnidarians recorded 70 (2.83%), the chaetognatha recorded 20 (0.81%). The juvenile stages comprised the Barnacle nauplii, Copepod nauplii, Zoea larva, Megalopa, Fish egg and Fish larva which made up 36.84% of the total individual recorded. Zooplankton species with high occurrence throughout the sampling months include: *Nauplii* larvae, *Acartia clausii, Acartia discaudata* and *Cyclopina longiconis*. Other forms that occurred during the study were *Paracalanus* sp, *Calanoides, Oncaea, Penillia, Mysid* and *Sagitta* species.

3.3. Zooplankton Community Structure Analysis
The analysis of species diversity index, species richness, species equitability index and other bio-indices showed monthly variations (Table 3), while the relative abundance of zooplankton classes is shown in Fig. 4 and the percentage abundance of Juvenile stages in Fig. 5.

Table 1: Bi-monthly variation in water quality indices at the Abule-Agege creek of Lagos Lagoon (January – April, 2008).

PARAMETERS	January		February		March		April	
	1st week	3rd week	1st week	3rd week	1st week	3rd week	1st week	3rd week
Air Temperature (°C)	18	22	26	22	25	28	25	29
Water Temperature (°C)	27	24	28	26	28	27	28	30
pH at 26°C	7.49	7.57	7.17	7.43	7.44	7.11	7.38	7.51
Transparency (cm)	102.7	106.5	132.0	131.0	149.5	103.6	95.5	124.4
Conductivity (µS/cm)	29600	25500	30900	35200	41500	24900	38600	33700
Total Dissolved Solids (mg/L)	15390	13255	16351	18650	21980	14940	23162	21300
Total Suspended Solids (mg/L)	108	101	122	10	11	5	4	3
Rainfall (mm)	74.4		17.6		44.5		65.3	
Salinity (‰)	17.30	15.20	18.50	20.3	24.3	16.7	22.6	20.6
Chloride (mg/L)	8963.6	7910.0	8966.5	10100.0	13200.0	8864.0	12188.0	11080.1
Total Hardness (mg/L)	4680.1	6255.0	4865.5	5020.1	6335.0	4865.0	5556.0	6255.0
Acidity (mg/L)	11.3	11.8	5.2	4.1	4.0	4.2	4.0	4.0
Alkalinity (mg/L)	210.5	210.0	75.0	188.0	280.1	205.0	220.1	222.8
Dissolved Oxygen (mg/L)	4.0	4.2	3.9	4.8	4.9	4.3	4.8	5.0
Biochemical Oxygen Demand (mg/L)	105	122	26	20	24	16	12	8
Chemical Oxygen Demand (mg/L)	360	388	205	180	195	50	44	39
Nitrate (mg/L)	2.6	4.0	2.6	6.8	5.4	8.1	5.9	6.6
Phosphate (mg/L)	1.1	0.9	1.24	2.6	1.4	0.08	0.10	0.06
Sulphate (mg/L)	350.0	300.8	320.5	410.1	502.5	500.0	600.0	620.1
Calcium (mg/L)	895.9	905.3	695.0	722.8	1005.0	61.2	66.0	64.3
Silica (mg/L)	2.1	2.2	3.9	3.2	3.0	3.6	2.9	2.0
Magnesium (mg/L)	655.6	950.0	744.6	695.3	968.5	1127.3	1290.0	1108.9
Copper (mg/L)	0.002	0.002	0.004	0.008	0.005	0.006	0.005	0.003
Iron (mg/L)	0.16	0.15	0.102	0.16	0.14	0.10	0.08	0.12
Zinc (mg/L)	0.028	0.030	0.003	0.010	0.008	0.020	0.013	0.022

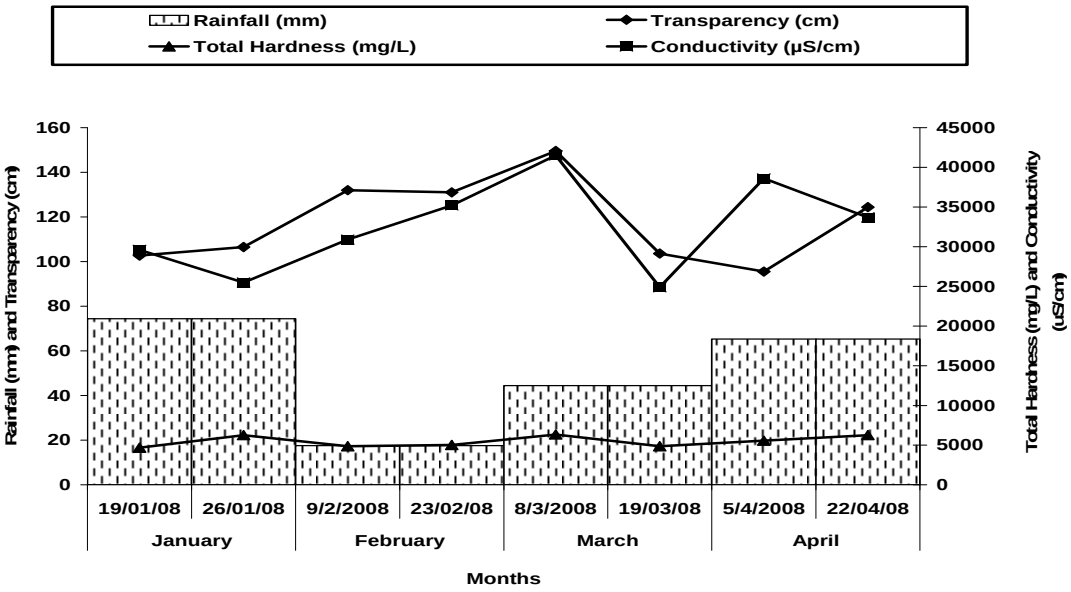

Fig. 2: Bi-monthly variation in Conductivity, Transparency, Total Hardness and Rainfall at the Abule-Agege Creek of the Lagos Lagoon. (January – April, 2008).

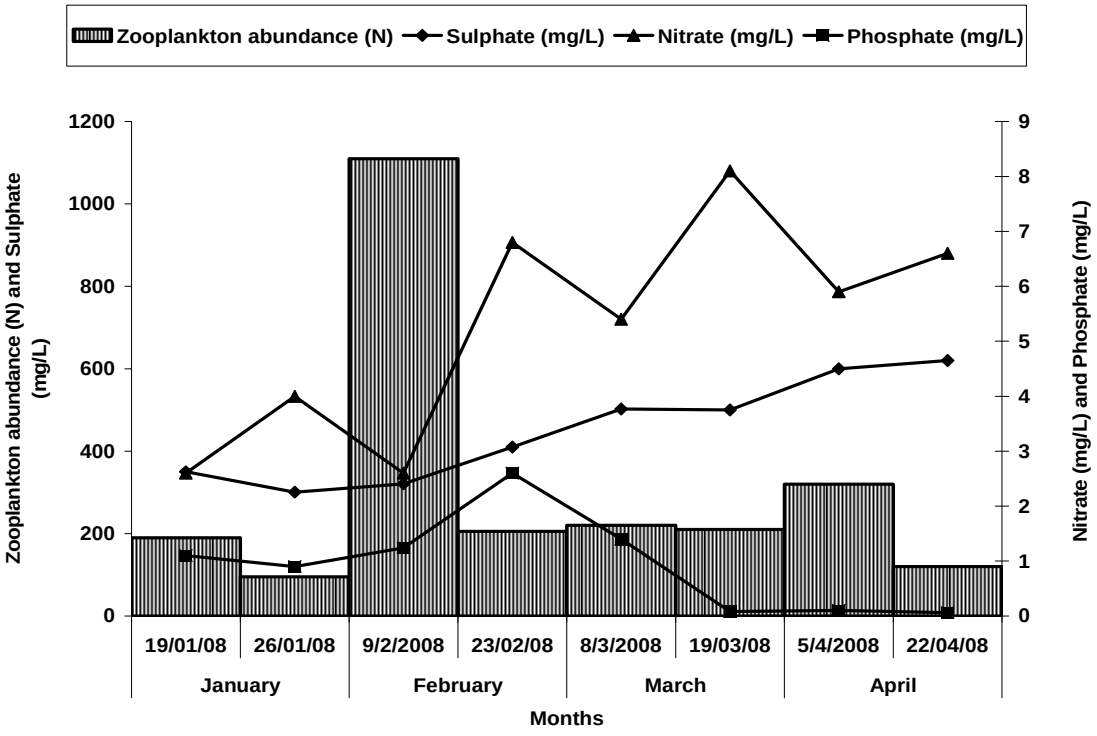

Fig 3: Bi -monthly variation of Zooplankton abundance and some nutrients at the Abule-Agege creek of the Lagos Lagoon (January – April, 2008).

Table 2: Bi-Monthly Variation In Zooplankton Taxa (Cell/ml) At The Abule - Agege Creek (January–April, 2008)

TAXA	JANUARY		FEBRUARY		MARCH		APRIL	
	1st week	3rd week	1st week	3rd week	1st week	3rd week	1st week	3rd week
PHYLUM :ARTHROPODA								
CLASS: CRUSTACEA								
SUBCLASS I: COPEPODA								
ORDER: CALANOIDA								
FAMILY: PARACALANIDAE								
Acartia clausii Giesbrecht	75	20	35	90	15	15	75	30
Arcatia discaudata Giesbrecht	20	55	55	55	5	25	115	45
Arcatia tonsa Giesbrecht	-	5	5	25	-	10	-	-
Calanoides carinatus	-	-	10	-	10	-	-	-
Paracalanus parvus Claus	5	5	15	-	-	-	-	5
ORDER 11: CYCLOPOIDA								
FAMILY: CYCLOPOIDAE								
Cyclopina longiconis Boeck	5	-	450	-	-	5	55	-
Oncaea sp.	-	-	40	-	-	-	15	-
ORDER 111: HEPATICOIDA								
FAMILY: HEPATICOIDAE								
Clytemnestra scutellata	-	-	10	-	-	-	-	-
SUB-CLASS 11: BRANCHIOPODA								
ORDER 1:CLADOCERA								
Penillia avirostris Dana	-	-	5	5	10	-	-	10
Evadne tergestina Claus	-	-	-	-	-	-	-	15
SUB-CLASS 111: MALACOSTRACA								
ORDER : MYSIDACEA								
Mysid sp.	-	-	5	5	5	-	-	-
PHYLUM :CHAETOGNATHA								
ORDER: APHARAGIMORPHA								
Sagita enflata Vogt	-	-	-	-	20	-	-	-
PHYLUM : CHORDATA								
CLASS : LARVACEA								
Oikopleura dioica Vogt	-	-	-	-	5	-	-	-
PHYLUM :CNIDARIA								
SUB-PHYLUM: MEDUSOZOA								
CLASS: HYDROZOA:								
Unidentified jelly fish	10	-	30	5	-	20	-	5
JUVENILE STAGES								
Fish egg	-	-	5	-	5	-		-
Fish larvae	-	-	5	-	-	-	-	-
Megalopa larva	-	-	-	-	5	-	-	-
Zoea larva	5	5	15	5	25	20	30	-
Nauplii larva of copepod	55	-	175	-	10	10	25	-
Nauplii larva of barnacle	15	5	250	15	105	105	5	10

Table 3: Zooplankton Community Structure Indices at The Abule-Agege creek (January – April, 2008).

	JANUARY		FEBRUARY		MARCH		APRIL	
	1st week	3rd week	1st week	3rd week	1st week	3rd week	1st week	3rd week
Total species diversity (S)	8	6	16	8	12	8	7	7
Total zooplankton abundance (N)	190	95	1110	205	220	210	320	120
Log of Species diversity	0.90	0.78	1.20	0.90	1.08	0.90	0.85	0.85
Log of zooplankton abundance	2.28	1.98	3.05	2.31	2.34	2.32	2.51	2.08
Shannon-Wiener Index (Hs)	0.70	0.55	0.78	0.66	0.80	0.70	0.71	0.72
Menhinick Index (D)	0.58	0.62	0.48	0.56	0.81	0.55	0.39	0.64
Margalef Index (d)	1.33	1.10	2.14	1.32	2.04	1.31	1.04	1.25
Equitability Index (j)	0.77	0.70	0.65	0.73	0.75	0.78	0.84	0.85
Simpson's Dominance Index (C)	0.26	0.39	0.25	0.29	0.26	0.29	0.23	0.22

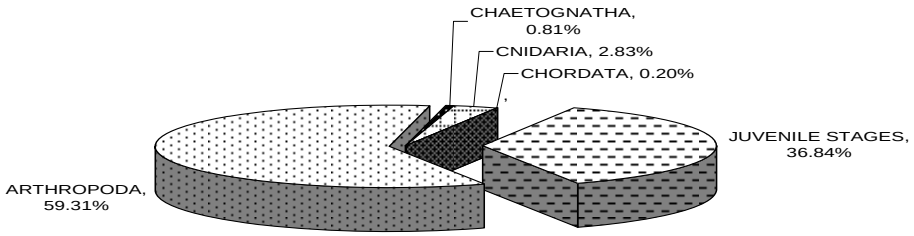

Fig 4: Relative abundance of zooplankton classes at the Abule-Agege creek of the Lagos Lagoon (January–April, 2008).

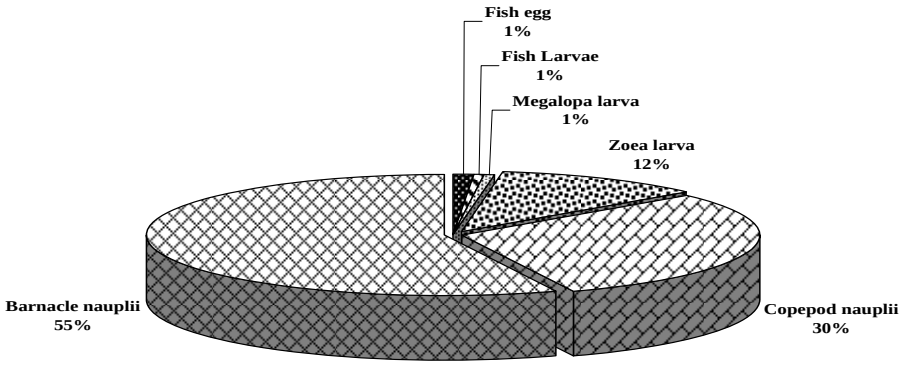

Fig 5: Percentage abundance of Juvenile stages at the Abule-Agege creek

4. Discussion

The present water chemistry data confirms an earlier report by Emmanuel and Onyema (2007), though fewer parameters were investigated in that study for the creek. According to them, the diluting and enriching effects of floodwaters, inflow of lagoon brackish water hence the existence of environmental gradients, governs the distribution of creek and lagoon biota in south-western Nigeria. Air and water temperatures were typical for the tropics and similar regimes have been reported by Lawal-Are (2006). The surface water pH values in the Abule-Agege creek were alkaline in all the months this alkaline pH may be due to the buffering effects of the seawater (Onyema *et al*., 2007). Nwankwo (1990) highlighted that seasonal variation in transparency in the coastal waters of South-western Nigeria is linked to the rainfall pattern and associated floods. Furthermore, high transparency values confirm the known phenomenon that transparency and rainfall are inversely related in the region. Conductivity values of the study site increased with rise in the total dissolved solids and a decrease in the total suspended solids. These variations to a large extent could be attributed to the effect of tidal sea water incursion and also freshwater input from adjoining creeks and land as expected during the dry season (Onyema, 2009).

Salinity regimes in the Lagos lagoon have been related to rainfall distribution. According to Fagade and Olaniyan (1975), Nwankwo (1996) and Onyema *et. al*. (2006), salinity is an environmental barrier in the distribution of biota. The cations values (Calcium and Magnesium) recorded were relatively high and increased with the dry season while the heavy metal concentrations were low. Nutrients concentrations recorded were high especially sulphates. The high levels of nitrate-nitrogen and sulphide may be due to the effect of direct discharges of pollutants and other biodegradable wastes into the coastal waters coupled with the enrichment of adjoining wetlands, creek and subsequent run-offs for the coastal water of south-western Nigeria. The level of the phosphate-phosphorus and nitrate-nitrogen during the period suggested nutrient enrichment required by plankton for growth and reproduction (Nybbaken, 1988). Increases in phytoplankton production in the dry season may have led to a corresponding increase in zooplankton diversity and density in February and March.

According to Nwankwo (1998), dissolved Oxygen decreases with increased Biological Oxygen Demand, probably due to increased metabolic activities of bacteria and fungi which are common in polluted sites. Similarly, Akpata *et al.* (1993) reported that the continuous activities of bacteria led to the release of nutrients into the water. These nutrients directly enhance the multiplication of phytoplankton leading to an increase in zooplankton biomass. It is important to note however that Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) can be employed to determine the level of pollution in an aquatic environment (Onyema and Nwankwo, 2009).

Olaniyan (1969) observed that zooplankton spectrum in the Lagos harbour varied with season and that recruitment was mainly from the sea. Crustacean zooplankton were the key components of the plankton of the creek. The calanoid copepod were the more frequent and notable species occurring in the survey. Other crustacean categories such as cladoceran and mysids were also recorded. The array of juvenile stages comprising of fish egg and larvae of crabs - megalopae and zoea larvae were also noted in the creek. According to Lawal- Are (2009) and Lawal-Are and Bilewu (2009), crabs are known to begin the early stages of their lives in estuarine systems which are regarded as "nursery grounds". They also point to the suitability of the water quality characteristics of the creek to sustain diverse aquatic life. The chordate (*Oikopleura dioica*), arrow worm (*Sagitta enflata*) and the jelly fish are likely pointers of an array of planktonic faunal components that inhabit the creek at varying time of the year especially from the sea via the Lagos lagoon. According to Onyema *et al*. (2006) in a study of diatoms and dinoflagellates recorded from the Lagos Lagoon reported that the source of recruitment of the lagoonal dinoflagellates was the adjacent sea since most reported species were warm water oceanic forms.

The relatively high species richness and Diversity indices showed a fortnightly variation in conformity with the zooplankton distribution. High values of the diversity index indicated that the species were more evenly dispersed. The occurrence of higher values of copepod populations confirmed the observations of Olaniyan (1975) that crustacean copepods are the taxonomically more important zooplankton group in the Lagos lagoon and adjoining water systems. Similarly, Onyema *et al*. (2003, 2007) are of the view that although diatoms dominated the phytoplankton spectrum, copepods were prominent members of the zooplankton assemblage of the Lagos lagoon. Higher values of zooplankton diversity, abundance

and bio-indices were recorded especially in February and March. These months were associated with higher salinity values and reduced biological and chemical oxygen demand for the creek. Transparency and conductivity were also higher during this period. In conformity with Onyema *et al*. (2003) increasing tidal influence occasioned by dry conditions usually elevates salinity and creates conditions suitable for the colonization and development of marine species in the Lagos lagoon. This situation must have affected the adjoining Abule-Agege creek and determined largely its water chemistry and zooplankton crop.

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Increase in somatostatin immunoreactivity in the organotypic slice culture of mouse hypothalamic suprachiasmatic nucleus

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Abstract: The suprachiasmatic nucleus (SCN), site of the dominant mammalian circadian clock, contains a variety of different neurons that tend to form groups within the nucleus. Somatostatin was first discovered in hypothalamic extracts and identified as a hormone that inhibited secretion of growth hormone. Subsequently, somatostatin was found to be secreted by a broad range of tissues, including pancreas, intestinal tract and regions of the central nervous system outside the hypothalamus. *In vivo* the localization of somatostatin immunoreactivity (SS-ir) in mouse SCN was examined before. However, detailed information about the localization and developmental distribution of SS-ir neurons in the mouse SCN slice culture is lacking. SCN derived from 3 day old mouse, were maintained in culture at the interface between air and a culture medium. SS-ir neurons are detected within the general central SCN area and the surrounding region. The density of SS-ir was clearly increased during the SCN development in organotypic slice cultures at the level of the cell bodies. The results show that not all SCN-neuropeptidergic systems decline with *in vitro* development, and suggest a specific age-related role for SS in the SCN. These findings may provide new morphologic evidences for explaining the functional mechanism in the SCN. [Journal of American Science 2010;6(1):91-98]. (ISSN: 1545-1003).

Key words: Somatostatin immunoreactivity, Immunohistochemistry, Hypothalamus suprachiasmatic nucleus, Organotypic slice culture, Mice.

1. Introduction

In mammals, the master clock located in the suprachiasmatic nucleus of the hypothalamus is able to generate and distribute a rhythmic message to the whole body (Reppert and Weaver, 2001; Tousson, et al., 2003; Tousson and Meissl, 2008; Silver and Schwartz, 2005; Reghunandanan and Reghunandanan, 2006; Choi et al., 2008). These paired SCN in rodents are composed of about 8000 neurons and are divided anatomically into a ventrolateral, an intermediate and a dorsomedial part, or, as more recently proposed a core and a shell, corresponding to the ventral input site with large neurons and the dorsal region with smaller neurons, respectively (Abrahamson and Moore, 2001; Moore *et al.,* 2002; Morin and Allen, 2006). Some of the neuropeptides that have been identified to date in the rodent SCN (in vivo) are vasopressin (VP), vasoactive intestinal polypeptide (VIP), Gamma-amino butyric acid (GABA), gastrin releasing peptide (GRP), substance P, somatostatin (SS) and calbindin (CalB) (Moore, 1996; Abrahamson and Moore, 2001; Moore *et al.,* 2002; Tousson, 2005b; Reghunandanan and Reghunandanan, 2006; Tousson and Meissl, 2008). Neurons synthesising VIP, substance P and GRP are located in the core of the SCN (Moore, 2001; Moore *et al.,* 2002; Biemans *et al*., 2002), where as VP neurons are found in the shell (Abrahamson and Moore, 2001; Moore *et al.,* 2002; Tousson, 2005b). GABA and CalB producing neurons have been demonstrated in the core and shell (Wang et al., 1996; Biemans *et al*., 2002; Moore *et al.,* 2002; Novak and Albers, 2004; Morin and Allen, 2006). Ageing of the circadian system has been associated with amplitude reduction of circadian rhythms, fragmented rhythms, and higher day-to-day rhythm variability, shortening of period length and altered responses to light (Turck *et al.*, 1985). The physiological basis for these age-related changes in circadian rhythms may be (partly) found in altered SCN neuropeptide organization. Decrease of VP-ir, VIP-ir and CalB-ir neurons were detected in aged SCN rodents (Biemans *et al.*, 2002) while an increase of Calretinin-ir neurons were detected in aged SCN rodents (Ikeda and Allen, 2003). Somatostatin was first discovered in hypothalamic extracts and identified as a hormone that inhibited secretion of growth hormone. Subsequently, somatostatin was found to be secreted by a broad range

of tissues, including pancreas, intestinal tract and regions of the central nervous system outside the hypothalamus (Fukuhara *et al*., 1994). Somatostatin is often referred to as having neuromodulatory activity within the central nervous system, and appears to have a variety of complex effects on neural transmission (Reghunandanan and Reghunandanan, 2006). Injection of somatostatin into the brain of rodents leads to such things as increased arousal and decreased sleep, and impairment of some motor responses (Biemans *et al*., 2002). Detailed information about the localization of SS-ir during the mouse SCN development *in vitro* is lacking. Therefore, we are showing the changes of SS-ir neurons during the mouse SCN development in organotypic slice cultures.

2. Materials and Methods

2.1 Animals

The animals used in this study were male CD1 mouse (24 mouse of ages 3 days old), the mice were bred in the department facilities under controlled conditions (12h : 12h light – dark cycle, light on at 6:00 a.m) with about 60% humidity and 25°C temperature.

2.2 Organotypic slice cultures

Organotypic slice cultures from hypothalamus were prepared using the interface culture methods described by Tousson and Meissl (2004). Four hours after light on, animals were taken from the animal house and killed by decapitation, the skulls were opened with fine scissors and the brains were quickly removed under sterile conditions into ice-cold artificial cerebrospinal fluid (aCSF; 124 mM NaCl, 5 mM KCl, 1.25 mM KH_2PO_4, 1.3 mM $MgSO_4$, 26 mM $NaHCO_3$, 2.2 mM $CaCl_2$, 10 mM glucose, 10 mM HEPES). Hypothalami were excised and 300 µm thickness coronal slices were made using a vibroslicer. Slices were transferred into ice-cold aCSF in a Petri dish and those presumed to contains the bilateral SCN and the PVN. Selected slices were trimmed dorsally at the level of the anterior commissure and laterally just before the supraoptic nuclei and kept in drops of aCSF for 30 minutes. The selected slice was then positioned over Millicell filter in Petri dish and incubated for 1 hour at 37°C in 5% CO_2/95% air with a small amount of culture medium (DMEM/F12 supplemented with 10% fetal calf serum, 10mM HEPES, 100 U/ml penicillin and streptomycin and 100 µg/ml ascorbic acid). Then, the Petri dish was filled with culture medium. The culture medium must be not completely cover the Millicell filter. The culture medium was exchanged every 3 days. SCN slice at different time (1day (1DIV), 1Week (1WIV), 2Weeks (2WIV) and 4Weeks (4WIV) *in vitro*) were excised and fixed in 4% paraformaldhyde in phosphate buffered saline (0.1M, pH 7.4 PBS) for 24 hours at 4°C and then cryoprotected in 30% sucrose in PBS at 4°C for 72 hours. SCN slices were sectioned with a freezing microtome at the level of the hypothalamus into 20 µm coronal sections and mounted on gelatine coated slides and stored at -20°C prior to processing for SS immunohistochemistry.

2.3 Somatostatin immunoreactivity:

Immunohistochemical labeling was carried out by using the indirect fluorescence method (Cho *et al*., 2007). Sections were blocked for 1 hour in a solution containing 10% NGS, 1% bovine serum albumin (BSA) and 0.5% Triton- X-100 in PBS. Sections were incubated in primary antibody diluent (3% NGS, 1% BSA and 0.5% Triton-X-100 in PBS) prior to incubation in rabbit anti-SS primary antisera (dilution 1:1000, Sigma) for overnight at room temperature. Sections were rinsed in 0.1M PBS and then incubated for 1 hour (in dark room) in a goat anti-rabbit as secondary antibody (1:500). Then they were rinsed for 10 minutes in PBS and mounted and cover slipped with vectashield antifading mounting medium and examined under epifluorescence for SS-ir. All fluorescent specimens were viewed by using a Leica TCS fluorescence microscope and a digital camera (Cannon 620) captured images. Each region was imaged under high magnification (40X) and labeled cells were individually marked and manually counted. For analysis, the mean number of CalB-ir cells was calculated from the counts of four alternate images showing the highest number of labeled cells. Brightness and contrast of the images were adjusted using Adobe Photoshop software.

3. Results:

In stationary organotypic culture, the mouse SCN consists of paired nuclei, located on either side of the midline just dorsal to, and extending into, the optic chiasm in the anterior hypothalamus (Figs. 1, 2). Medially, the periventricular nucleus and the third ventricle border SCN (Fig. 3). The dorsal, lateral, rostral and caudal boundaries can be determined in Nissl stained material because of the greater packing density of cells in SCN relative to the surrounding other parts of the hypothalamus.

Due to the small size and tight packing density of SCN cells, it is difficult to ascertain the finer morphological characteristics of individual neurons in Nissl stained material (Figs. 3, 4.). Explants survival was excellent, only about *3%* of the slices being discarded as unfit for experiments, due to detachment from the filter. Slice explants flattened appreciably, however, the twin bulges of SCN remained somewhat thicker than the surrounding tissue in the end of 3rd week *in vitro* (Fig. 2). At 4th week of incubation, the slice cultures were thinner enough to allow observation of cell layers and the fine morphological characteristics of individual neurons in SCN.

The detection and distribution of SS-ir neurons in the hypothalamic SCN organotypic slices are illustrated in figures 5-13. Numerous intensely labelled SS-ir neurons were evident throughout the cultured SCN (Figs. 5 & 6). Labeling SS-ir neurons outside SCN was associated mainly with the PVN and scattered periventricular magnocellular neurons. A small number of SS-ir cells that either bipolar or multipolar where found in the area of lateral hypothalamus and in PVN that are more abundant several hundred microns dorsal to SCN, and seen to be of the same population due to their large size and close apposition to the third ventricle (Fig. 5). In 0DIV (3 day old mouse in vivo and zero day in vitro) a clear SS-ir neurons were found in the optic chiasm (Fig. 5). SS-ir labelled neurons showed variations in morphology within the SCN where the majority of neurons were round and oval cells with multipolar dendrites (Fig.6).

SS-ir neurons were scattered in the whole SCN (core and shell). At the medial level, they were primarily located in the intermediate zone and more lateral at the caudal level (Fig. 7). The intensity of SS-ir neurons was increased during the SCN *in vitro* development where the number of SS-ir neurons in core more than in shell (Fig. 8-13). At the 1st and 4th days in vitro (1DIV & 4DIV) no marked increasing in SS-ir neurons (Figs, 7 & 8) while at 7, 14, 21 and 21 days *in vitro*, marked increasing were observed in SCN core (Figs. 9-12). From the 7DIV, the intensity of SS-ir neurons in the intermediate zone and shell region of SCN were increased (Figs. 9-12).

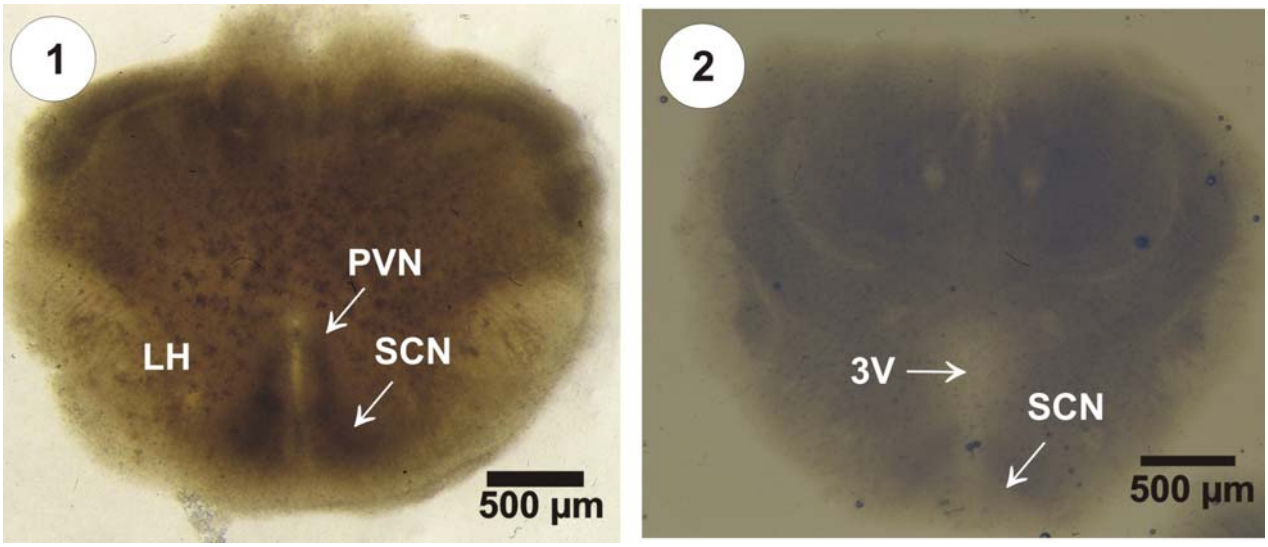

Fig. 1: Photomicrograph of an organotypic slice culture maintained 21day *in vitro* (21DIV). The explants slice is flattened and the different hypothalamic areas can be clearly distinguished.

Fig. 2: Photomicrograph of an organotypic slice culture maintained 28 day *in vitro* (28DIV).

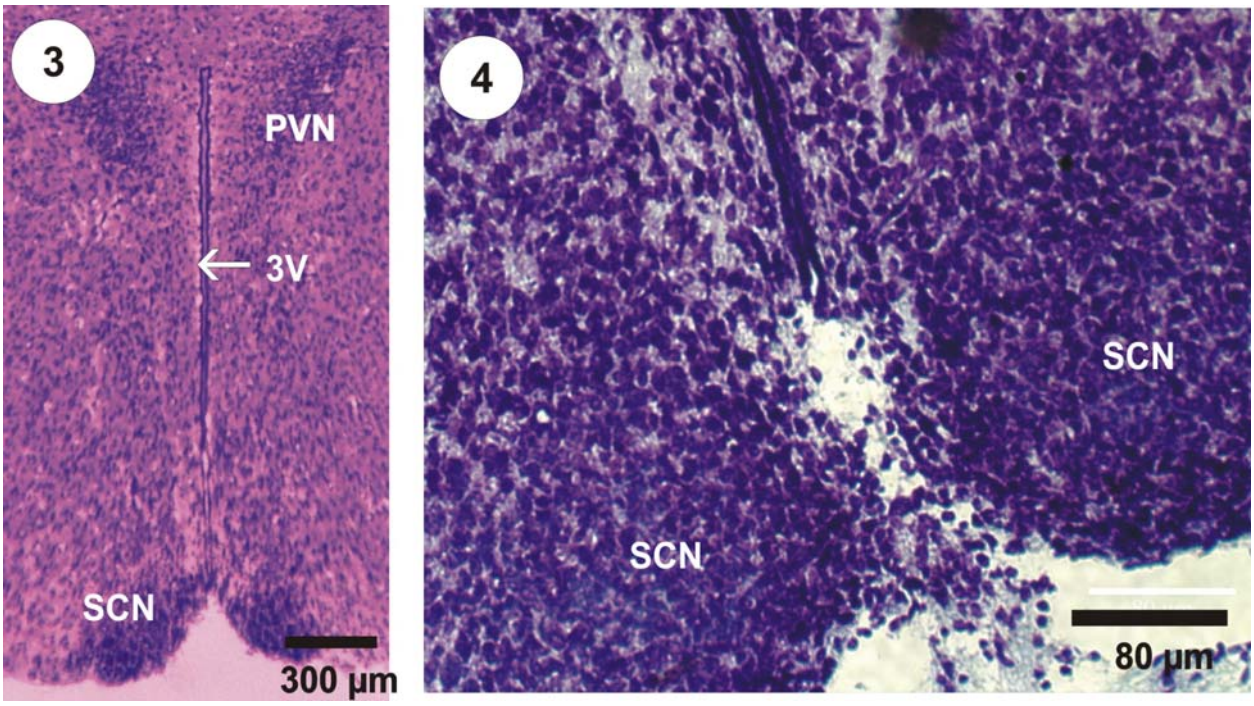

Fig. 3: Photomicrograph stained with cresyl violet showing the bilateral PVN and SCN lying lateral to the third ventricle and dorsal to the optic chiasm.
Fig. 4: High power photomicrograph stained with cresyl violet showing SCN in culture but without the optic chiasm.

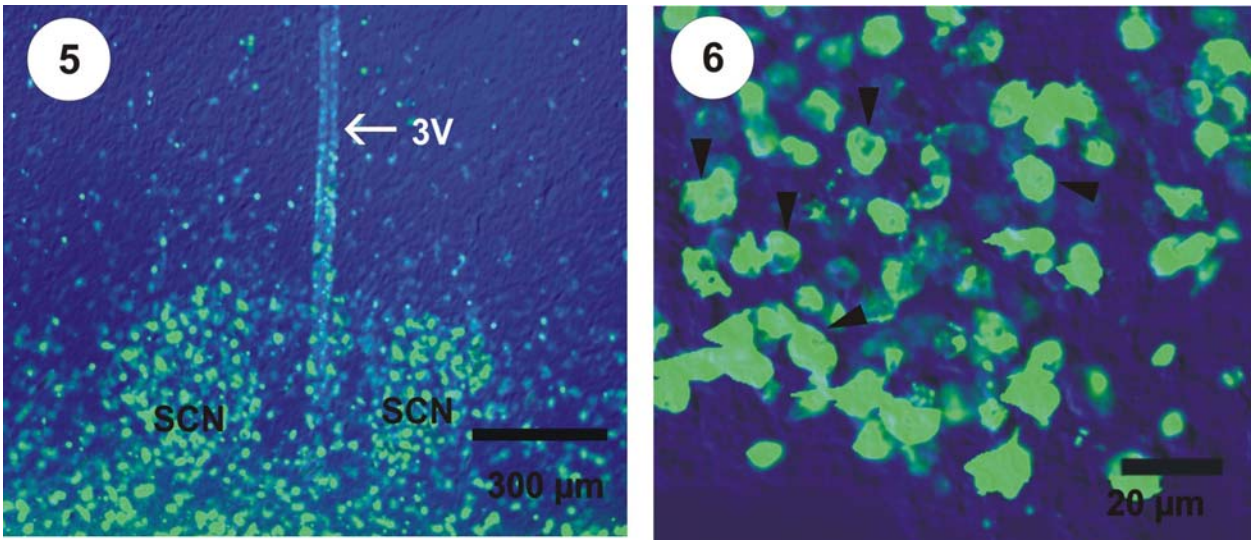

Fig. 5-12: Photomicrographs of SS-ir neurons in the mouse hypothalamic organotypic slice culture.
Fig. 5: Photomicrograph of SS-ir showing the SS-ir neurons within SCN in vitro (0DIV).
Fig. 6: High power micrograph displaying SS immunoreactive neurons in the unilateral SCN.

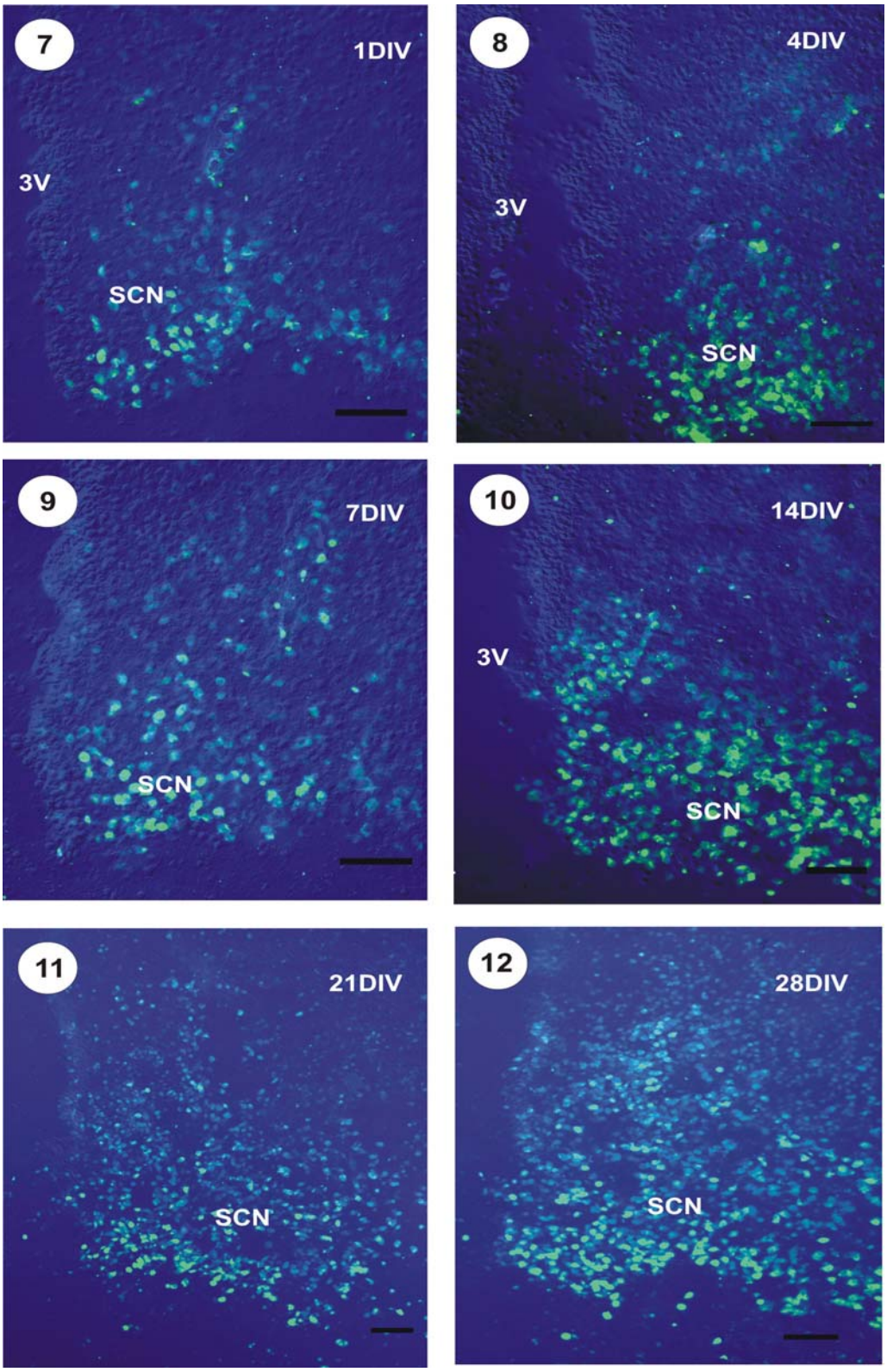

Fig.. 7-12: Photomicrographs of immunoreactive SS neurons in the hypothalamic organotypic slice culture (7: 1DIV; 8: 4DIV; 9: 7DIV; 10: 14DIV; 11: 21DIV; 12: 28DIV) showing the density of SS-ir neurons during the development of SCN in the slice cultures (3V: third ventricle, OC: optic chiasm) Scale bar 50 µm.

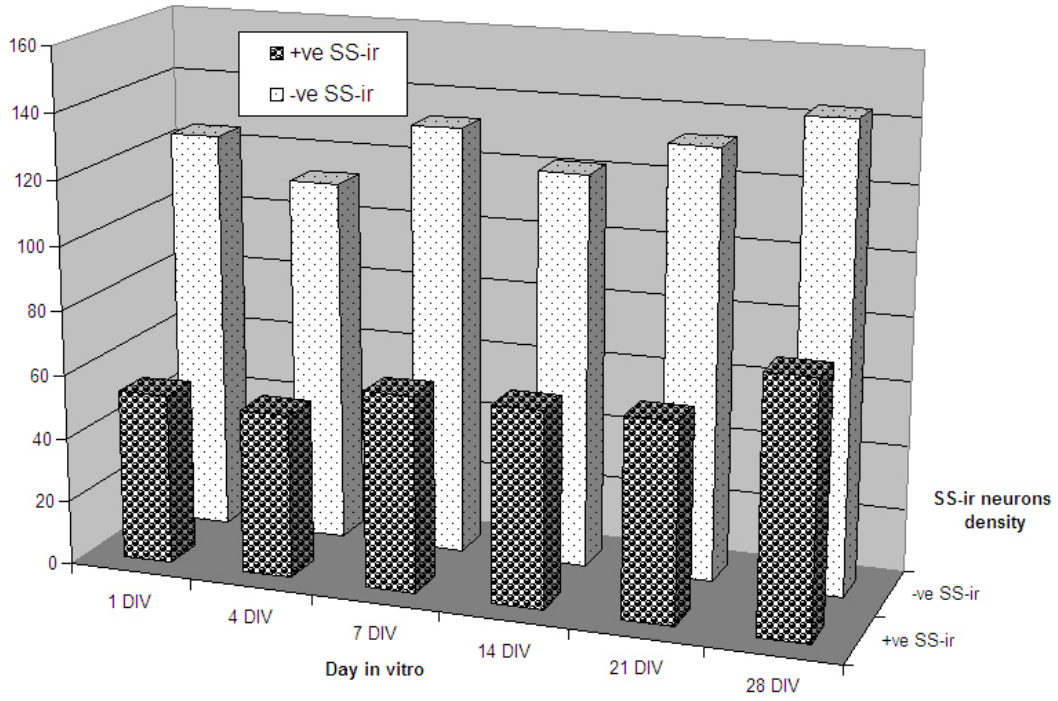

Fig. 13: Histogram showing the density of SS-ir neurons during the development of SCN in the slice cultures.

4. Discussion

In this study, it is reported that this simple culture technique is very convenient and successful for explants of nervous tissue and more specifically hypothalamic slices also we report a remarkable, SCN-specific increase of SSir in vitro. *In vivo*, a number of neuropeptides, including VP, VIP, cholecystokinin, GRP, peptide histidine isoleucine, SS and SP have been immunolocalized within SCN (Wang *et al.,* 1997; Van Easseveldt *et al.,* 2000; Abrahamson and Moore, 2001; Adolph, 2002; Albers *et al.,* 2002; Biemans *et al.,* 2002; Moore *et al.*, 2002; Caldwell and Albers, 2004; Tousson, 2005b; Tousson and Meissl, 2008). The distribution of SS-ir neurons in the mouse organotypic cultures were similar to the pattern found in the adult mouse (Abrahamson and Moore, 2001; Biemans *et al.,* 2002; Moore *et al.*, 2002; Tousson, 2005b) and in the SCN culture (Belenky *et al.,* 1996; Adolph, 2002; Tousson et al., 2003; Tousson, 2005a).

Ageing of the circadian system has been associated with amplitude reduction of circadian rhythms, fragmented rhythms and higher day-to-day rhythm variability, shortening of period length and altered responses to light (Turck *et al.*, 1985; Biemans *et al.*, 2002). The physiological basis for these age-related changes in circadian rhythms may be (partly) found in altered SCN neuropeptide organisation. From our previous study it appeared that loss of AVPir and VIPir (Biemans *et al.*, 2002; Van der Zee *et al.*, 2005) has been shown in aged rats. Biemans et al., (2002) reported a significant increase in SS and SP immunoreactivity in aged Wistar rats as compared to young ones, thereby indicating that not all SCN neuropeptidergic systems decline with age.

In long-term organotypic cultures, the expression of SS immunoreactivity during the mouse SCN development has never been reported before. Our results' showing that, SS-ir neuron is present within the general central SCN area, the surrounding region and generally throughout the entire nucleus. Results also revealed that, the intensity of SS-ir neurons were increased *In vitro*. Somatostatin is produced by neuroendocrine neurons of the periventricular nucleus of the hypothalamus, these neurons project to the median eminence, where somatostatin is released from neurosecretory nerve endings into the hypothalamo-hypophysial portal circulation (Morin, et al., 2006; Reghunandanan and Reghunandanan, 2006). These blood vessels carry somatostatin to the

anterior pituitary gland, where somatostatin inhibits the secretion of growth hormone from somatotrope cells. The somatostatin neurons in the periventricular nucleus mediate negative feedback effects of growth hormone on its own release; the somatostatin neurons respond to high circulating concentrations of growth hormone and somatomedins by increasing the release of somatostatin, so reducing the rate of secretion of growth hormone (Morin and Allen, 2006). *In vitro*, the circadian rhythmicity in the hypothalamus depends on the presence of an intact SCN (Tousson and Meissl, 2004). Completely lesions of SCN from the mouse hypothalamus slice culture showing circadian rhythmicity in the other hypothalamic regions (Tousson *et al*., 2003), but bilateral ablation of the SCN completely abolished all rhythms in the PVN and in adjacent hypothalamic areas. The circadian locomotor rhythm is restored after implantation of fetal SCN tissue into the third ventricle of previously SCN-lesioned adult hamsters (Ralph *et al*., 1990) or in acute slice of mouse (Tousson *et al*., 2004).

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Current Welding Technology in Myanmar

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Abstract: This is the paper to describe briefly the resume about current welding technology of Myanmar. The application of metal joining in Myanmar started over a hundred years ago in the field of Shipbuilding, Bridges and Steel Structures by using mechanically joining methods, such as rivet, screws and shrinkage fit. Now, Myanmar is trying to establish a Myanmar Welding Society. This paper does not say about the new findings or new research in the field of welding techniques but it is just to review and resume about the welding processes being used, difficulties, problems, weak points, requirements dealing with our daily welding works. [Journal of American Science 2010;6(1):99-104]. (ISSN: 1545-1003).

Key words: Welding Technology, Welding Society, Welding Process

1. Introduction

Welding has been using for more than one century in the world. In the early 19th century, electricity was developed and at the same time, welding technology was remarkably changed by introducing electric arc welding. It can also be said that civilization was advanced one step with developing arc welding process. Manual metal arc welding can do on various metals by using different filler rods. It is sure to say that, welding is one of the important roles and it provides basic needs to build into modernized and developed nations.

2. Welding Processes using in Myanmar

At present, developed countries have been using the latest welding techniques and the most advanced welding technique by inventing robotic, semi and fully automatic welding equipments, such as narrow gap welding process, laser beam welding process, plasma arc welding process, friction stir welding process, under water welding process and so on. Everyday, they are doing researches to develop their advanced welding techniques more and more efficiently. Actually, we couldn't follow yet their up-to-date methods. We are still in the stages of just running or operating the processes they invented, only in the ***manual*** arc welding techniques. Among the processes, arc welding process is most widely used for metal-joining purpose. Table 1 indicates the various kinds of welding processes being mostly used in Myanmar.

2.1 Shielded Metal Arc Welding Process

Manual Metal Arc Welding or Shielded Metal Arc Welding (**MMAW / SMAW**) or stick welding process was invented in 1907, more than one century before. However, this process is still being widely used in Myanmar now. This process is very simple. Equipments are not expensive, reliable, easy to maintain. It can also be used for both indoor and outdoor purposes. It is largely used in heavy industries such as Ship-construction & Ship-repair sites, Steel-structure fabrication works, building construction sites, hydro-power plants, penstock and most of the places. Almost all of the welders in Myanmar are very familiar to this process and equipments. Although there doesn't have exact data, it can be said that, 80% of all welding processes applied in Myanmar would be SMAW.

There is also called ***Gravity Welding*** which is used with SMAW power sources. Gravity welding is done with gravity welding electrode (bigger and longer than normal electrode) and control or handling device is operated by gravity force as shown in picture. It is semi-auto process but it doesn't use any other machine and electric source. One operator can apply at least 4 handling devices and so welding speed is also 4 times faster than manual welding. But, it can only be used for flat and horizontal fillet position of straight bead. So, it is very useful and economy for mass production of products. But it is hardly used in Myanmar.

2.2 Metal Active Gas Welding Process (MAGW)

Nowadays, the use of MAGW and FCAW-G processes become larger in capacities than MMAW in all parts of the world. The application of MAG welding (CO_2) has been introduced in Myanma since over 1990s. In those years, we have been using this process depending upon the customers' requirements. Some companies have been using this process in the production line of mass production products. Actually, this process is very fast, high deposition rate, semi-auto and fully auto available, no slag or thin layer of slag can be chipped-out easily and provides good penetration &

sound weld. They are very reasonable points to choose and use widely this process for mass production of products. However, Myanmar doesn't seem to be able to use efficiently in nationwide. The following points are challenging not to be able to utilize widely in Myanmar:

1. Power sources are very expensive
2. CO_2 gas is not so cheap
3. Consumable parts such as nozzle, contact tip and contact tip body are imported from abroad and result high cost
4. Spare parts of power source and feeder unit are very rare in local markets
5. Wires cannot be obtained in time at local markets when we need
6. Workers' daily charges are not high and so, semi or fully auto welding processes are not interested to substitute *workers*
7. Local customers/owners still want to make their products with cheaper cost and lesser grantee
8. No or very less export markets for products

2.3 Tungsten Inert Gas Welding Process (TIG) & Metal Inert Gas Welding Process (MIG)

TIG/GTAW & MIG processes are mainly used in industries and steel structure fabrication sites especially for Stainless Steel and Aluminum works. TIG process is best suited for root run of pipe welding. Inert gas is used as shielding gas and so weldment has no oxidation, no spatter and the appearance is very nice. This process is also used in ship-outfitting works of stainless steel and some steel furniture works. In contrast, inert gas is very expensive and deposition rate is slow. So, this process is still limited to use widely.

2.4 Submerged Arc Welding Process (SAW)

Submerged Arc Welding process is not used as widely as **SMAW**. This process is limited and best suited to down-hand welding position and horizontal position of straight bead but it can be applied with high deposition rate with more than one electrode wire. As deposition rate is very high, Initial investment cost for power source also very high. However it is very economy for fillet and butt joints of mass production products with thick-section. Thick steel plates can be joined by only one travel pass. It is being used in some Industrial Zones to fabricate I-Beams and H-Beams for steel structure and bridges now.

Most of the shipyards in Myanmar are mainly manufacturing inland going vessels such as landing crafts, cargo barges, pushing tug, passenger ships and coastal cargo ships too. Their thickness of the hull plate is not more than 10mm and their capacity is under 2500dwt. Very small. So it is not convenient to use SAW in the process of ship construction. SAW takes some time for preparation works before start and it is not economy for thin plates joining and small production works. So, it is hardly used in Shipyards.

3. Welding Power-sources and Equipments

Myanmar is mostly using both AC and DC arc welders made by China, Malaysia, Japan, Sweden, England, America and so on… Some China made welding transformers are cheaper than others but not so durable and reliable for long run. Now, local made welding transformers are available with both AC and DC type. Most of the transformers are operated by moving core type.

Foreign made Inverter and IGBT type power sources (light and compact designs) are available in the local market now. Some companies are importing Europe made SAW & SMAW power sources, CNC Plasma cutting machines, China made TIG welding machines, Japan and Malaysia made MIG & MAG welding machines. Laser cutting system is particularly used only in the medical treatments. There are some difficulties in repairing due to lack of a few or no service centers in Myanmar, to make in good order if some problems are happened to the high tech-power sources.

Apart from power sources, welding gauges and other measuring instruments in enough quantity and good quality can't be available in the local markets.

3.1 Workshop Facility

Most of the workshops are old in design and out of date now in Myanmar. Some metal handling equipments and machines are needed to be substituted with new and more powerful equipments. While shops still need to be equipped with machines so as products are to be manufactured step by step in production line for mass production. Modernized positioners, welding jigs and fixtures are also essentials in modern workshops.

3.2 Parent Metal

Now, steel industrial zones are set up in large cities such as Yangon and Mandalay, where, it can be produced and sold various kinds and types of metals, steel sheets, bars, angles, pipes, channels, etc. Most of the metals come from neighboring countries and they have no mill certificates. Anybody can buy what they have in the local markets but it is difficult to get what you want exactly such as material grade, type, size, quality and certificate. We cannot trace the material we bought. It is a problem.

Table 1. Various kinds of welding processesb mostly used in Myanmar.

ISO Reference Number	Welding Process	AWS Designation
1	**Arc Welding**	(AW)
111	Manual metal arc welding	(SMAW)
114	Self-shielded tubular-cored arc welding	(FCAW-S)
12	Submerged arc welding	(SAW)
13	**Gas-shielded metal arc welding**	**(GMAW)**
131	Metal inert gas welding: MIG welding	(GMAW)
135	Metal active gas welding: MAG welding	(GMAW)
136	Tubular cored metal arc welding with Active gas shield	(FCAW-G)
141	Tungsten inert gas welding: TIG welding	(GTAW)
2	**Resistance Welding**	(RW)
21	Spot welding	(RSW)
22	Seam welding	(RSEW)
22	Resistance butt welding	(UW)
3	**Gas Welding**	(OFW)
311	Oxy-acetylene welding	(OAW)
8	**Cutting**	
81	Flame cutting (Oxy-fuel cutting)	(OFC)
83	Plasma cutting	(PAC)

3.3 Welding Consumables

Generally using welding electrodes, wires, filler rods and flux powder can be bought somewhat quantities in the local market, imported from neighboring countries, most likely China and Thailand. In general, E-6013 (RB-26, J-38, Kobe-30) welding electrodes are being mostly used in shipyards and construction sites. It is because most of the base metals we used are mild steel in Myanmar.

3.4 Health and Safety

Safety equipments are also very expensive if compare to daily income. Some safety apparatuses cannot be readily available in the local markets. Some workers are still lack of safety shoes or safety glasses or safety helmets or ear plugs even at work sites. Some employers issue Personal Protective Equipments to all its employees but some do not wear PPE because of low knowledge.

Most of the work-sites (at assembly stages) are in the open space, not enough shelter under sunshine and rain. Although fabrication works can be done inside the workshops, there are limited for product size and weight because of overhead crane facility and transportation problems. So, everybody has to take much care oneself, not to occur danger and electric hazards, especially in the rainy season.

Voltage reducing devices are needed to install to welding power sources for narrow and high location jobs. Welding power sources are not still properly used with return cable at some worksites. Welders sometimes use steel wasted parts or sticks by tack-welds instead of using safe return cable. For this reason, power loss is occurred at loose connection points and it is difficult to control arc stability and result welding defects. Over heated is usually occurred at loose connection point and it is very dangerous to neighboring.

Air blowers and extractors are required to use more at narrow and confined spaces to get proper ventilation. Face masks or nose masks are also needed to be used at sites appropriately.

3.5 Welding Products and Heat Treatment

In Myanmar, there are lots of projects relating with welding products such as pressure vessels, ships, tanks, rolling stocks, automobiles, bicycles, steel furniture and steel utensils, piping, penstocks, bridges, steel structures and so on. Almost all of the products are used for local market only, not or very less export markets.

Some of welding products may be required to apply heat treatment before or during or after the welding works for the sake of reduce distortion, avoid cold cracking, improve mechanical properties and decrease stress. But it is very scarce to take into consideration. So it is necessary to pay much attention to the welding of

high strength steel or thicker plate having more than one inch and to follow heat treatment procedures.

3.6 Welding Training Centers and Material Testing Lab

These training schools or centers are essentials to bear out qualified welders. Qualified welders are those who understand about the welding sequences, welding symbols, welding techniques, dos and don'ts of before, during and after a welding work, according to their grades. There are only a few welding training centers in Myanmar. They are needed more.

After some training period of time, trainees who passed written and practical examinations, attain their qualification certificates with different grades e.g. 1G, 2G, 6G etc. Here, these certificates should be prepared to be able to use not only in every part of mother country but also in other foreign countries. So, training curriculums are to be updated and added advanced welding technologies. Welding tests are to be carried out according to one of the international classification society's codes and standards.

It is needed to enhance training facilities to these welding training schools by providing training equipments and testing equipments. And it is also needed to arrange training programs and send trainers to developed countries and study the advanced welding technology. After attending training and arriving back to mother country, it needs to get chances in order to share their knowledge gained and materials and technical knowhow to colleagues and any other relating persons in their respective fields. This is, what we called, technology transfer we need.

Material testing lab must has non destructive and destructive (NDT & DT) equipments such as tensile and bending testing machine, impact load testing machine, surface hardness testing equipment, hydraulic breaking test machine, microscope and micro-etching equipments for DT and radiographic testing equipment, ultrasonic testing equipment, penetrate testing equipment, magnetic particles testing equipments for NDT. Class room, library room, X-ray shooting room, dark room and material testing room are also included.

Some training centers in Myanmar are equipped with much facility but training fees are also very high. Normal workers cannot attend to such kind of training centers. So, training fees should be compromised not to be so high. Some government organization has its own testing equipments and inspection team grouped by well experienced and trained persons as well.

3.7 Testers

Here, we need to establish a team to carry out non destructive tests and destructive tests for welder qualification or certification systems, material verification and any other material tests. This team must play as a third party and it should be one of the branches of Myanmar Welding Engineering Society or something like this. So, it is here also necessary to establish a material testing center in which various kinds of testing machines are to be equipped depending on the qualification standards or code requirements.

Some testing equipments were already set up in some government and private sectors. We have to collect these data and can manage to co-operate each other in order to perform welding technology for the development of Myanmar.

4. Welders/Welding Operator

Generally, most of the welders in Myanmar are not the qualified welders trained from welding training centers. First, they enter to the companies as general workers or helpers. After some years, they become pipe fitters, steel structure fabricators, welders and medium skilled labors depending upon their interests, efforts and talents. Most of welders do not have enough knowledge about welding even though they are very skill in their practical works. Some cannot explain you about E-6013, if you ask them. Some become experts in their specialization after much experience, but no certificates. Some skilled persons try to work at aboard for their better lives. They do not earn reasonable salary because of no competent certificates, even though they can perform their jobs to the best.

There are some certified welders from various classes in Myanmar. They are employed in both private sectors and government organizations. Government and private sectors have their own certified welders of various classes according to their specific jobs and projects. However, the total amount of certified welders in Myanmar are still very less.

5. Welding Procedure Specification (WPS)

It is so called as WPS, Welding Procedure Specification, which is very popular and fundamental and as well as key point for welding relating works. In Myanmar, most of the people, who have been working in welding fields for years, do not understand WPS very well. Some persons have never heard about it. Some know what WPS and PQR are and what the advantages are, but do not use it. Why? Why don't they follow it? Why don’t they use it? In fact, they also feel that WPS brings some complicated works and needs so many steps before starting job, it takes time and is especially costing.

WPS is one of paper document forms that needs to fill up the blanks with technical data received from the procedure test, that are to be followed in actual process of production. After welding is done according to the preliminary welding procedure specification (pWPS), NDT and DT tests are made and observed whether it achieves the required quality or not. If still not, try again

the procedure test with new data until it meets the designed requirements.

After successful, it is recorded with the final data in the PQR (Procedure Qualification Record) form including NDT & DT test- records and WPS becomes approved document. After that, plate joining works can be done by qualified welders of suitable grades by following this WPS for such kind of joints. If the type of joint or the material or welding consumable or welding process is different or metal thickness is out of applicable range, another WPS and PQR are needed.

6. Control of Welding and Related Works

Another aspect we should understand is good weld quality. It can only be achieved by managing not only the actual welding but also the related work. One of the important points to get the quality products is depending upon the responsibilities of welding coordination personnel or welding engineers.

Welding related works are management of base metal, welding consumable, welding power sources, electric sources, plate cutting and beveling, WPS attaining, plate forming, fabricating, assembling, heat treatment before and after welding, back gouging, grinding, fairing, finishing, inspecting and testing.

Here, I would like to present my papers by discussing some future upcoming activities according to current welding technology conditions of Myanmar.

First, welding capabilities, before start we must consider and understand ourselves that how much we can do, what process we can follow, how many certified welders, welding supervisors, inspectors and equipments we have, how fast we can perform, what workshop-facilities we have, how much electricity is available and so on. Actually, we cannot consider all the things to be 100% perfect at one time. But we need to understand actual conditions and have to decide the best ways.

Before starting a project, it is needed to cooperate between designer and welding engineer. They have to discuss about how welding is made. Sometimes designer's structure connections are very difficult to fabricate by welding, in actual condition. Besides, complicated structure gives harmful effects, such as weld defects tend to occur than normal, result residual stress, more distortion are likely to be happened, more skilled welders are required to perform welding and so on.

The second point is weld design. This is very important. Under this activity, the following points are needed to be predetermined. What welding standard to be followed? What are design requirements? How inspection and testing methods should apply? How joint details are? How is the quality standard? What are the acceptance criterion requirements? ….

Sometimes, builders do not clear themselves what welding standard or code they are using although running their jobs. Although it seems they follow a standard, you will see that they cannot apply it deeply or fully when you watch details in the processes of production, for instant, there is no WPS. Sometimes, they apply a welding standard only for some limited amount of products, not for all. Other different products are being manufactured without complying any welding standards, at the same time.

Actually, we must strictly follow at least one std. e.g. JIS (Japanese Industrial Standard) or AWS (American Welding Society) or ISO (International Organization for Standardization) or any other else. Our people, not only the builders but also the owner and customers, do need to understand more and be familiar to the welding standards and how these standards benefit to us. Sometimes, foreign customers order products to produce with a specific standard, but builders encounter many difficulties to follow the standard, such as lack of certified welders, WPSs, qualified parent metals, welding consumables, welding power sources, limited time and so on.

Next, according to the design requirements, the following points are needed to be predetermined clearly and definitely. They are weld joint details, welding schedule, parent material selection, subsequent inspection, tests and acceptance criteria limits. These facts are to be convenient to the actual service conditions. And then WPS is to be prepared.

Roles of skilled workers who make steel plate works, so we called "Platers", are also very important. Good edge preparation and fitting of joints help to get good quality of weld joints. But most of the construction sites in developing countries are still using manual flame cutting techniques (oxy-acetylene cutting). So, it is required to assign enough welding supervisors to check at conditions of joint preparation such as misalignment, root gap, root face, groove angle, free of moisture, dust, slag, paint, oil at sites, according to the approved WPS before welding.

For the last point, visual inspection is very fundamental method among the non-destructive examinations. Everybody can do it at every step easily and immediate repair can be applied if defects are found. Welding supervisors are responsible to check throughout the welding operations, before, during and after the welding, if all steps are going according to the approved WPS. If something is wrong or required quality couldn't be achieved, immediate action must be given to rectify the problems. So PDCA circle (Plan, Do, Check, Action) rotates smoothly and hence it will help to get good quality products.

The quality and reliability of welding construction and products are guaranteed only when welding is carried out under the supervision of qualified welding engineer and inspector who have adequate knowledge

and experience in the field of welding technology and inspection technique.

Therefore, roles of qualified welding coordination personnel or welding engineers who are able to manage practical and theoretical aspects of welding technology and inspection technique as they apply to the day-to-day running of welding fabrication, construction or maintenance, are also important as mention above and enough personnel are being required more and more throughout the nation, as long as advanced welding techniques are being applied increasingly.

7. Conclusion

Good weld quality is best accomplished by good communication and cooperation between every section related to the welding work, with good control and performance of not only the welding itself, but also all related activities as well. Good communication and cooperation between all related activities are very important for all welding techniques, whichever it may be low or high. So, every related person needs to have enough knowledge, to pay much attention and to obey all instructions and welding disciplines throughout the whole process of production to upgrade welding technology of Myanmar.

Acknowledgement:

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Fishing crafts characteristics and preservation techniques in Lekki lagoon, Nigeria

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Abstract: The fishing crafts characteristics and preservation techniques in Lekki between March, 2006 and February, 2008 were investigated. The fishing crafts in the lagoon were mainly the monohull (single hull) wooden dugout canoes, planked canoes and the planked dugout or half dugout canoes. The dugout canoes were carved out from a log of red iron wood (*Lophira alata*) which predetermines its size with length overall (LOA) which ranged between 3.10 and 6.76 m, the maximum breadth (moulded) ranged between 0.71 and 1.00m. The LOA of half dugout canoes ranged between 5.33 and 10.20 m, the maximum breadth (moulded) ranged between 0.86 and 1.49m and the depth moulded ranged between 0.42 and 0.77 m. The planked canoe had flat bottom hull completely built with planks fixed together with frames, u-shaped metal fasteners and nailing a strip of galvanized iron aluminum pluck caulking over the plank seams (joints). The canoe preservative used in the lagoon was by painting with bitumen, coating the back hull with cement and bitumen with ground pepper, although there has not been any scientific backing for the use of pepper against biofouling attack, the fisherfolks guaranteed its success. [Journal of American Science 2010;6(1):105-110].

Keywords: Fishing craft, dug out, planked canoes, biofouling, fisherfolks.

Introduction

Like fishing gears, crafts have passed the test of time, evolving from logs of wood, floating calabash and papyrus raft to wooden dugout canoes, planked canoes and fibre glass, all in an attempt to improve effectiveness, complement changing water condition and various fishing gear developed and employed (Ambrose *et al.*, 2001). They stated further that in the coastal artisanal fisheries, crafts are designed to suit the following: Surf crossing, beach landing, buoyancy and stability at sea and different types of artisanal fishing techniques. Gulbrandson (1974) and Haug (1974) outlined the construction and suitability of V-shaped and flat shaped bottom canoes respectively in different water bodies and stated the restrictive use of flat bottom cause in inland protected water ways. Udolisa and Solarin (1985) gave an account of the performance of a 13-metre (LOA) wooden shallow draft vessel designed to cross over the estuarine sand bars of Imo River. Ambrose et al. (2001) recorded that the design and construction of an ideal fishing craft is an illusive idea, because the condition for an ideal crafts so varied and depends on an array of factors such as people's culture, fishing gear, water body and motorization. It is therefore easier to design a craft that will satisfy a few major concerns at a time.

According to Kwei (1961) the attachment of outboard motors to the dugout canoes presents quite a problem. It was further recorded that in Ivory Coast the fishermen used outboard motor/engine in a well in the centre of the boat to enable them to get to and from the fishing grounds faster. The fitting of outboard engine was also reported by Udolisa et al (1994) for most planked canoes in Nigeria. Kwei (1961) reported side fitting of outboard engine in Ghana. Solarin (1998) recorded the canoes types used in the Lagos lagoon where the three aforementioned types of canoes were identified.

Solarin (1998) stated that dugout canoes generally provided little space to accommodate the crew, gear and the fish caught during fishing operation. It was further reported that the dugout canoes had relatively small free board and thereby displayed low reserved buoyancy and were less stable compared to any other canoe types. It was added that all the dugout canoes were propelled with paddles.

Solarin (1998) also stated that the planked canoe with flat bottom hull was completely built with planks fixed together with frames, U-shaped metal fasteners and nails. It was further implicated that the joints were generously sealed by caulking with natural fibres or yarns especially cotton often soaked in oil mixed with the lime to prevent leakage or seepage. In Lagos lagoon less than half of the planked canoe actually used out board engine (8-15 Hp) for fishing operation (Solarin, 1998).

According to Udolisa *et al* (1994) dugout canoes are carved by skilled craftsmen scattered throughout the country from green logs of Opepe (*Nauchia diderrichii),* Mahogany (*Khaya ivorensis),* Afara *(Terminalia ivorensis)* White afara *(Terminalia superb),* red iron (*Lophira alata),* Silk cotton free *(Ceiba pentandra* and *Bombax buonopozense),* Missada (*Erythrophleum suaveolens)* and Obeche *(Triplochiton scleroxylon* and *Alstonia* sp.).

Materials and Methods

Canoe types, specifications and wood materials used in their construction and mode of propulsion were investigated. Monthly inventory of the operational fishing canoes was carried out in 25 villages, settlements and fish landing sites. Principal and constructional dimensions of the canoes such as thwart distance from stern, length overall, length between perpendicular moulded depth at midship, moulded breadth at midship draft and free board were taken with a measuring tape according to the method described by Nomura and Yamazaki (1975) and Ambrose et al (2001). The canoes used in the lagoon exclusively for fishing was distinguished from those used for transportation, sand digging and for buying fish. Biofouling organisms of wooden canoes were collected by scraping part of the affected canoes and identified in the laboratory using appropriate texts (Edmund, 1978).

Results

Small-scale fishing craft type and specifications in Lekki lagoon

The fishing crafts in the lagoon were mainly the monohull (single hull) wooden dugout canoes, planked canoes and the planked dugout or half dugout canoes. The canoes used in Lekki lagoon had lesser length overall compared to those used in the other lagoon like Lagos lagoon. Constructional features of the canoes are elaborated in Table 1.

Hull Features of Canoes in the Lagoon

Dugout Canoes:

The dugout canoes were carved out from a log of red iron wood (*Lophira alata*) which predetermines its size. The thickness of the canoe hulls in Lekki lagoon ranges between 2 and 2.3 cm. The length overall (LOA) ranged between 3.10 and 6.7 6m, the maximum breadth (moulded) ranged between 0.71 and 1.00 m. Due to the nature of its construction, the hull is strong and rigid. Longitudinal re-enforcement of hull was not required while transverse strength was achieved by few number of thwarts (3-4) laid across the deck from one side of free board deck line to another. The dugout canoes had relatively small free board and thereby displayed low reserved buoyancy and were less stable compared to plank and half dugout types.

Table 1: Features of wooden canoes used in Lekki lagoon between March 2006 and February 2008

Characteristics	Dugout	Planked canoe	Half Dugout (planked - dugout)
Length overall (LOA)(m)	3.10 – 5.86	5.20 – 11.00	5.33 – 10.20
Maximum width or moulded breadth (m)	0.71 – 1.00	0.93 – 1.80	0.86 – 1.49
Draft/ maximum Depth (moulded) (m)	0.18 – 0.40	0.27 – 0.60	0.42 – 0.77
Load water line (LWL) (m)	2.60 – 4.77	2.10 - 6.10	3.52 – 8.20
Number of Thwarts	3 – 4	4 – 6	4 - 7
Cubic Number / Size (m^3)	0.42 – 2.70	1.31 – 11.88	1.93 – 11.70
Trim	More or less equal	By stern	More or less equal
Transom	Absent	Present in motorized canoe only	Present in motorized canoe only
Keel	Absent	Present	Absent
Frame	Absent	Present	Present
Gunwale	Absent	Present	Present
Bottom Profile	Round	Flat	Round
Free Board	Low	High	Medium
Breast hook	Absent	Present	Present
Stern piece	Absent	Present	Absent
Free board ratio	2:1	1:2	1:1
Bouyancy	Poor	Average	Good
Mode of Propulsion (Percentage in parenthesis)	Paddle (100) Outboard engine (0.0)	Paddle (90) Outboard engine (10)	Paddle (85) Outboard engine (15)

Plate 1: A newly carved dugout canoe at Emina water front in Lekki lagoon

The aft of the canoes terminated in a stern piece which served as a platform for standing during fishing gear operations and for sitting while paddling. The shape was narrow, low curvature with long water line length. The log was excavated from inside to form the canoe shape. Excavation was completed by burning out the interior, using dry grass as fuel. This was done to disinfect and preserve the fabric of the boat and to drive out insects and other parasites. During the burning, the wood tends to expand; then contraction on cooling was prevented by placing struts of wood across the canoe. The controlled burning with grass is to gives the canoe the characteristics black colour after carving. Paddles are made of wood, carved according to various patterns (pointed, rounded and blunted edges) and poles from bamboo or palm. Two types of paddles were observed in the lagoon (the arrow - like and the blunt end type). Plate 1 shows newly carved dugout canoe at Emina water front in Lekki lagoon.

Half-Dugout Canoes:

This is the combination of the dugout and the planked canoe features. The round bottom hull profile of the dugout canoe was built up with planks on each side to increase the size or cubic number of the canoe. The LOA of half dugout canoes ranged between 5.33 and 10.20m, the maximum breadth (moulded) ranged between 0.86 and 1.49m and the depth moulded ranged between 0.42 and 0.77m. The heavy hull reduced buoyancy of dug-out canoe was buffered by the addition of one or more planks made of soft wood like Opepe (*Nauclea diderrichi*), Mahogany (*Khaya ivorensis*) and black afara (*Terminalia ivorensis*), to both sides of the free board and deck line. The rigidity of the hull was maintained by more thwarts laid across the deck for transverse strength. The cubic number was relatively larger than dugout canoe and ranged between 1.93 and 11.70m^3 and provided enough space to carry a lot more crew and large fishing gear such as the seine net operated at Igbodola, Iwopin and Imeki also for floating Island fishery at Ikeran Olatunji. Gunwale is another hull feature that impacts longitudinal strength and stiffness to the canoe. This was nailed to the top side of the freeboard deck line and runs from the fore to after on both side of canoe. It had a long water line with low degree of curvature. Trim was equal at both stem and sterm. The canoe was propelled with paddle (85%) and outboard engine (15%).

Planked Canoe:

The canoe had flat bottom hull completely built with planks fixed together with frames, u-shaped metal fasteners and nailing a strip of galvanized iron aluminum pluck caulking over the plank seams (joints). The longitudinal and transverse reinforcement was by gunwale and the thwarts ranged between 4 and 6. The frames also provide transverse strength. The canoe had a flat keel about 5 – 9cm wide for upright sit on the roller or on the sand when being hauled on beach. Reserved buoyancy in high, at load waterline, a freeboard draft ratio of 1:2 was recorded. The canoes had a long narrow beam and equal trim. About 10% of them were provided with transom for installation of outboard engine to propel the canoe. The outboard used ranged between 8 and 40Hp from Yamaha, Suzuki, Tohatsu and Marina brand. Plates 7.1– 7.4 show the various stages in planked canoe construction at Epe.

Most dugout canoes used in Lekki lagoon were carved at Saga village by the Ijaws while the planked canoes were constructed at Epe (Lagos State Government, Ministry of Agriculture Co-operative and Rural Development, United Nation Development Programme (UNDP), Support programme on Artisanal fisheries, fisheries development unit, Ebute Afuye, Epe Local Government), Iwopin and Ebute Lekki.

The most common canoe used in Lekki lagoon was planked canoe. The production of dugout canoes was restricted to Ijaw carvers at Saga village and was limited by the scarcity of timber which competed for some other uses like in furniture and building construction. Most canoes used in the lagoon were generally tied to the planked jetties and left in water throughout the year. The wood absorbed a lot of water infested with algae such as *Spirogyra* spp which added more to the weight which eventually reduce the speed of the canoe when propelled.

Plate 1.1: Planks placed on attender for framing before it is used in canoe construction at Epe.

Plate 1.3: New constructed planked canoe at Epe (back hull)

Plate 1.2: Planked canoe under construction at Epe.

Plate 1.4: A newly constructed planked canoe with strips of galvanized iron aluminum

Fisheries frame survey of Lekki lagoon

The numerical compositions as well as the percentages of the canoes types between 2006 and 2007 are shown in Table 2. In 2006 there were 1027 wooden canoes made up of 24.29% dugout, 54.29% planked and 21.43% planked dugout canoes. In 2007 the canoes number was reduced drastically with a total number of 995 wooden canoes made up of 248 (24.93%) dugout, 558 (56.08%) planked canoes and 189 (18.99%) planked dugout canoes. The details of the canoe units recorded in the fishing villages within the lagoon between 2006 and 2008 are presented in Table 3. The percentage decrease in the number of canoe was 3.12% between 2006 and 2007.

Table 2: Types of fishing canoes in Lekki lagoon (Percentage in parenthesis)

Year	Wooden canoe types			Total
	Dugout	Planked	Planked dugout	
2006- 2007	249 (24.29)	558 (54.29)	220 (21.43)	1027
2007- 2008	248 (24.93)	558 (56.08)	189 (18.99)	995

Table 3: Fishing villages and the canoe units in Lekki lagoon between 2006 and 2008

Fishing village	Number of functional fishing canoes	
	March, 2006 – Feb. 2007	March, 2007 – Feb. 2008
Emina	43	43
Abomiti – nla	34	33
Abomiti – Sokoto	20	19
Ajegunle	17	16
Ikeran Olatunji	46	45
Take	19	18
Luboye	19	18
Abatitun	29	28
Iwopin	123	119
Siriwon	39	38
Dopanu	32	31
Dopanu-Ajegunle	73	72
Idata	21	20
Igbolomi	42	42
Aba – oyinbo	24	23
Ikeran –Aba Ilaje	52	51
Origbe	48	47
Oriyanrin	46	45
Imeki	45	44
Lakoye	17	16
Ebute – Lekki	51	50
Arala	22	21
Igbodola	25	24
Aba – Onigangan	31	30
Ise	109	105
Total	**1027**	**995**

Fishing crafts preservation techniques

Most canoes used in the lagoon were generally tied to the planked jetties and left in water throughout the year. The wood absorbed a lot of water infested with algae such as *Spirogyra* spp which added more to the weight which eventually reduce the speed of the canoe when propelled. The attack of barnacles and annelid worm (*Mercierella enigmatica*) was not common in Lekki lagoon, it was only observed at Iwopin in only two canoes (planked) and one planked canoe at Ebute Lekki.

The canoe preservative used in the lagoon was by painting with bitumen, coating the back hull with cement and bitumen with ground pepper, although there has not been any scientific backing for the use of pepper against biofouling attack, the fisherfolks guaranteed its success. The pepper was used in ratio 1:2 to the bitumen, mixed thoroughly,

rubbed on the outer canoe hull and dried under the sun for 3 to 5 days before use.

Discussion

In Lekki lagoon the most common canoe used was the planked canoe. The production of dugout canoes was restricted to Ijaw carvers at Saga village and was limited by the scarcity of timber which competed for some other uses like in furniture and building construction. This agreed with Solarin (1998) who reported that dugout canoes production was limited by the scarcity of timber which competed for some other uses like in furniture and building construction in Lagos lagoon.

Most canoes used in Lekki lagoon were generally tied to the jetties and left in water throughout the year. The wood absorbed a lot of water infested with algae such as *Spirogyra* spp. which added to the weight and reduce the speed of the canoes when propelled. The attack of barnacles was not common in the Lekki lagoon, it was observed at Iwopin in only two canoes (planked) and one planked canoe at Ebute-Lekki. The canoes were also left uncovered and water logged during the rainy season which could submerge or sink it. In most cases, if the storm were too much at any time, it may result in permanent loss of dugout canoes carved from Opepe (*Nauclea diderrichi*) due to its poor bouyancy. Exposure to the hot sun also results in cracks leading to water seepage. The preservative used for canoes in Lekki lagoon was by painting with bitumen, coating the back hull with cement and bitumen combined with grinded pepper. Although there has not been any scientific backing for the use of pepper in biofouling attack prevention, the fisherfolk have accepted its success.

Construction of more robust planked canoes is to compensate for the shortage of large dugout canoe to non-availability of big timber, to increase the deck working space and to improve their lagoon worthiness. The technological status and development prospects of small scale fishing crafts in Nigerian coastal water were documented by Ambrose *et. al.* (2001) which supported the observation in this study.

Canoe maintenance should focus on:

(a) The prevention or reduction of water absorption by the wooden structure.

(b) The prevention of rot, decay as well as the control of boring and fouling organisms.

(c) Protection against splits or cracks as reported by Solarin (1998) in Lagos lagoon.

Wooden canoes have had a wide acceptance by the fishermen and will continue even if a new material for construction is introduced. Planked canoe can be improved by increase in hull size and stiffness, water tightness of deck by appropriate coating, caulking and fastening.

Safety measures in canoes should include adequate provision of life jackets. In Lekki lagoon the use of light indicator bouy for night fishing operation is highly important because of the tugging and cargo boat movement to prevent life and net losses.

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The Water Chemistry and Plankton Dynamics of a Tropical High Energy Erosion Beach in Lagos

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ABSTRACT: The water chemistry characteristics and plankton dynamics of a high energy beach in Lagos was investigated from July 2008 to February 2009. The water chemistry conditions and variations reflected tropical sea water quality with turbidity and dissolved oxygen values pointing to perturbations on the shoreline linked to breaking waves. Conditions were increasingly sea-like in the dry than wet season. Whereas the phytoplankton recorded 67 species, the zooplankton was composed of 20 species and 10 juvenile stages. For the phytoplankton, the diatoms (84%), dinoflagellates (13%) and blue-green algae (3%) were the representatives. For the adult zooplankton, the copepods (70%), cladocerans (10%), mysids (5%), chaetognatha (5%), chordate (5%), and decapods (5%) were represented. Generally, plankton diversity and density were higher in the dry (December to February) than wet season (July to November). The water chemistry reflected a similar trend as the plankton spectrum. The bioindices values also followed a similar regime. Notable species in terms of frequency of occurrence and abundance were *Coscinodiscus, Odontella, Pleurosigma, Acartia, Paracalanus, Oithona*, barnacle and copepod nauplii larvae. The phytoplankton, adult zooplankton and juveniles signify suitable / favourable sea water quality characteristics at the beach during the duration of the study. [Journal of American Science 2010;6(1):111-122].

INTRODUCTION

The key and foundational role of the plankton in the aquatic environment especially with regard to trophic relationships has been reported by many authors. In this regard, the phytoplankton and zooplankton are the first and second steps respectively of the aquatic food chain (Odum, 1975; Nwankwo, 2004; Emmanuel and Onyema, 2007; Onyema *et al*., 2007). The plankton has also been reported by investigators to reflect water quality status and changes, hence acting as bio-diagnostic components that point to the health of the ecosystem (Onyema *et al*., 2003). For instance according to Onyema (2007a), phytoplankton satisfy conditions to qualify as suitable indicators in that they are simple, capable of quantifying changes in water quality, applicable over large geographic areas and can also furnish data on background conditions and natural variability.

In the adjoining creeks, Lagos lagoon and immediate sea offshore Lagos, literature on the plankton community are scanty. Whereas Akpata *et al.*, (1993), Onyema *et al.,* (2003, 2007), Nwankwo *et al*., (2008) considered the plankton assemblage in the Lagos and Kuramo lagoons, Emmanuel and Onyema (2007) and Onyema and Ojo (2008) have also considered the plankton in the Abule-agege and Agboyi creeks. However, there exists ample literature on the phytoplankton diversity and dynamics of the region (Nwankwo, 1986, 1988, 1996, 1998a,b, 2004; Nwankwo *et al*., 2003; Onyema, 2008).

Around the vicinity of the Victoria beach, there exist reports by Nwankwo *et al*., (2004), Edokpayi and Nkwoji (2006), Onyema (2007 a,b) and Onyema *et al*., (2007). Presently there is only one report of a checklist of phytoplankton species offshore Lagos (Nwankwo and Onyema, 2003) and another report at the Light house beach (Nwankwo *et al*., 2004).

The Victoria beach has been reported as one of the fastest eroding beaches in the world (30m per year) (Ibe, 1988, Awosika and Ibe, 1992). According to Nwankwo *et al*., (2004), the shoreline of Lagos is exposed to high energy waves that constantly pound it. Furthermore Onyema *et al* (2007a) and Onyema (2007b) have also reported that the Light house beach is an accretion (depositional) beach, whereas the Victoria beach is an erosion beach. The Victoria beach is presently undergoing massive coastal development processes and hence, the many environmental challenges relating to human-induced impacts faced in the area are noteworthy.
The aim of this project was to investigate the water chemistry characteristics and plankton dynamics at the Bar beach in Lagos.

DESCRIPTION OF STUDY SITE

Lagos State is an African megacity and is located in south-western Nigeria on the West Coast of Africa. Lagos is located within latitudes 6° 23N and 6°41N and longitudes 2°42E and 3°42E and is undoubtedly the commercial nerve-centre of Nigeria. A significant percentage of the land in Lagos State has

an elevation of less than 15m above sea level. The climate is the wet equatorial type influenced by nearness to the equator and the Gulf of Guinea. There are two main seasons in the region, namely; the rainy season (April to October) and dry season (October to March). The rainy season has two peak periods; usually in June and September or October, with rainfall being heavier in June (Fig. 2). Floods associated to rain events usually results at these periods, and dilute the ionic concentration while usually increasing the nutrient levels of coastal waters.

The Victoria beach (Fig. 1) also called the Bar beach is the south most front of Victoria Island in Lagos. The beach is located to the east of the east mole. According to Nwankwo *et al*., (2004) the construction of the east, training and west moles along the Lagos coastline (habour) was more of an economic than ecological consideration. It achieved the protection of ships from waves in the habour and created Tarkwa bay. Additionally, however, it changed the hydrodynamics and sediment regime that resulted in the accretion of sand at the light house beach and retrogation at the Victoria beach (Ibe, 1988; Nwankwo *et al*., 2004; Onyema, 2007b).

The Bar beach is about 1.75km long and located to the west of the Kuramo lagoon and beach. The station chosen for this study was located at the intertidal zone of the beach with Global Position System (G.P.S.) location of Latitude 6^{o} 34.900N and Longitude 3^{o} 24.400E.

Collection of Samples

Water samples were collected for water chemistry analysis in 75cl plastic containers with screw cap. Collection of plankton samples on the other hand was by filtering 100L of seawater through a 55µm standard plankton net and stored in 250ml plastic containers. Both water and plankton samples were collected between 4th of July, 2008 and 24th of February, 2009 at the study site. Samples were collected between 1200 and 1400hrs. At the end of each trip, the plankton samples were preserved with 4% unbuffered formalin and labeled.

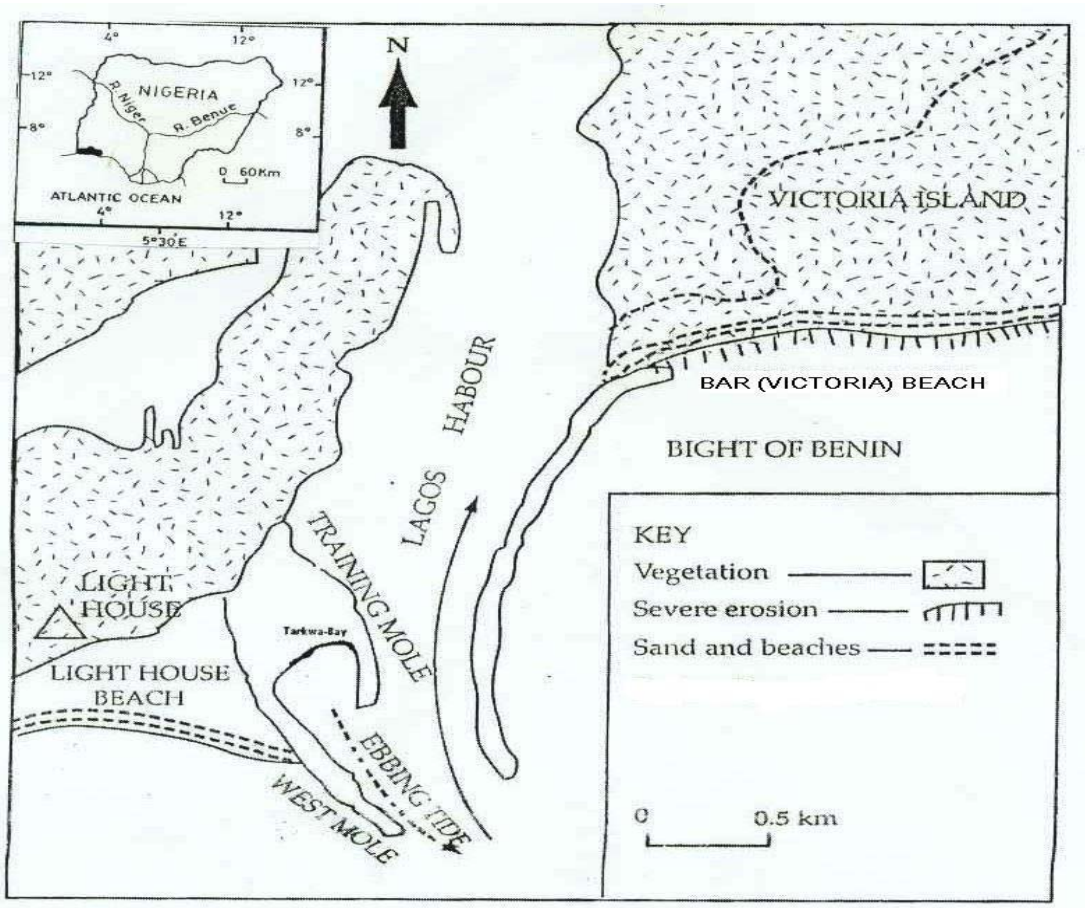

Fig. 1: The Bar (Victoria) beach, Lagos habour and Tarkwa bay in Lagos Nigeria.

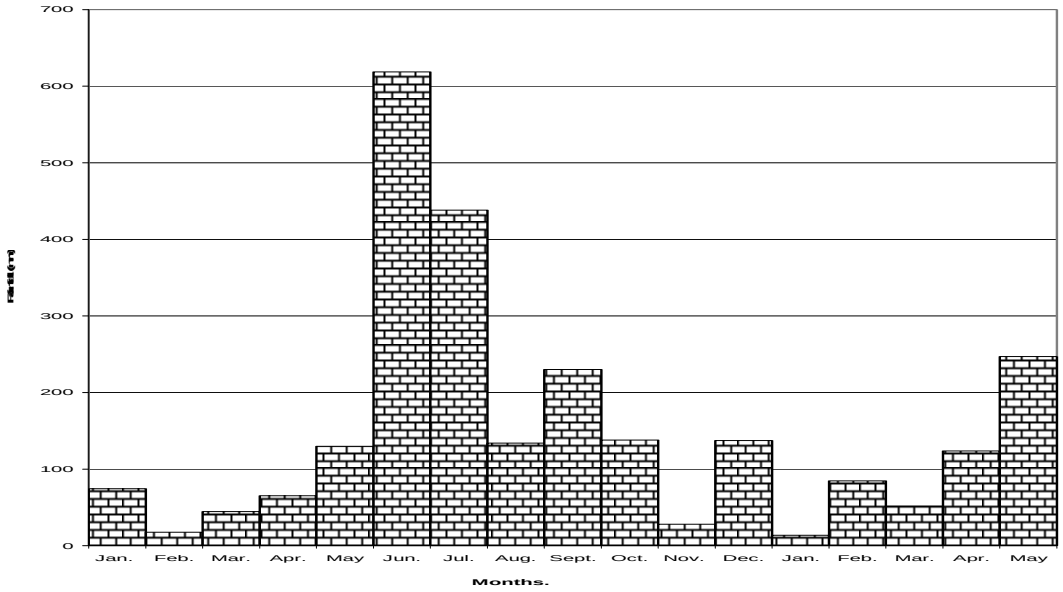

Fig. 2: Monthly distrivutive rainfall volumes from Jan., 2008 to May., 2009.

Water chemistry analysis

Air and surface water temperatures were measured *in-situ* using a mercury thermometer. Conductivity was measured using a Philip PW9505 Conductivity meter while salinity was determined by using a refractometer (BIOMARINE Aqua Fauna Model). The surface water pH was determined with a Griffin pH meter (model 80) while dissolved oxygen was determined titrimetrically using the Winkler's methods.

Plankton analysis.

In the laboratory, five drops (using a dropper) of the concentrated sample (10ml) was investigated at different magnifications (50X, 100X and 400X) using a Wild II binocular microscope with calibrated eye piece and the average recorded. The drop count microscope analysis method described by Lackey (1938) and modified by Onyema (2007) was used to estimate the plankton flora and fauna. Final data were presented as number of organisms (cells, filaments, colonies and whole organism) per ml. Appropriate texts were used to aid identification of the species. (**Phytoplankton**-Hendey 1958, 1964; Wimpenny, 1966; Patrick and Reimer, 1966, 1975; Vanlandingham, 1982; Nwankwo, 1990, 1995, 2004; Bettrons and Castrejon, 1999; Lange-Bertalot, 2001; Witkowski *et al*., 2000; Siver, 2003; Rosowski, 2003; **Zooplankton** - Newell and Newell, 1966; Olaniyan, 1975; Barnes *et al.,* 1993 and Waife and Frid, 2001).

Community structure analysis

Bio-indices applied to the biological data for this study were Species richness index (d), Menhinick's Index (D), Shannon and Wiener diversity index (Hs), Species Equitability or Evenness index (j) and Simpsons dominance index (C) (Ogbeibu, 2005). Correlation coefficient between water quality parameters and rainfall were also investigated.

RESULT

Variation in some physical and chemical characteristics of the Bar beach are presented in Table 1 and Figure 2. Air temperature ranged from 25 in September to 31 in July while water temperature ranged from 26^{o}C in Sept. to 30 ^{o}C in November and December the pH throughout the study was alkaline (8.05 – 9.10). Dissolved oxygen levels were between 6mg/L in November and 11 mg/L in August. Conductivity value on the other hand fluctuated between 40 and 52.7µS/cm. Furthermore, turbidity ranged between 13.5 (July) and 58 mg/L (August.). Alkalinity was between 16 mg/L recorded in Oct. and Nov, and 42 mg/L recorded in August while salinity varied between 25 and 34.7**‰.** Rainfall value was

highest in July (438mm) and lowest in Jan. (13.7mm).

Table 1: Some physical and chemical characteristics of the Victoria Beach (July, 2007 – February, 2008).

Date	04-Jul.	17-Jul.	01-Aug.	14-Aug.	11-Sept.	26-Sept.	16-Oct.	06-Nov.	30-Nov.	30-Dec.	23-Jan.	11-Feb.	24-Feb.	Mean
Air Temperature (^{0}C)	31	28	27	26	25	27	26	29	28	29	23	27.5	28	27.27
Water Temperature (^{0}C)	29	28	28	27	26	26	28	28	30	30	26	29.5	29.5	28.08
pH	8.05	8.63	8.8	8.56	9.1	9.1	8.8	8.7	8.7	8.8	8.98	8.62	8.53	8.72
Conductivity (µS/cm)	51.4	47.7	51.8	51.8	52	48	40	48	51	47	52.7	52	51.3	49.59
Turbidity	13.5	42.5	88	58	56	16	10	26	16	26	25	28	45	34.62
Salinity (‰)	33.9	31.2	34.2	34.2	34	31	25	32	34	31	34.7	34.4	33.8	32.57
Dissolved oxygen (mg/L)	8.4	8.8	11.7	6.4	7.2	8.4	8	6	6.4	8.8	7.2	6.6	8	7.84
Alkalinity (mg/L)	19	20	18	42	38	18	16	16	20	18	24	20	22	22.38

Table 2: Pearson correlation co-efficient matrix between water quality parameters at the Bar beach (July, 2007 – February, 2008).

	Air Temperature	Water Temperature	pH	Conductivity	Turbidity	Salinity	Dissolved oxygen	Alkalinity
Air Temperature	1							
Water Temperature	0.70	1						
pH	-0.70	-0.59	1					
Conductivity	-0.10	-0.07	-0.14	1				
Turbidity	-0.23	-0.20	0.12	0.44	1			
Salinity	-0.03	0.00	-0.18	0.99	0.42	1		
Dissolved oxygen	0.13	0.03	0.23	-0.09	0.47	-0.12	1	
Alkalinity	-0.47	-0.47	0.12	0.45	0.45	0.41	-0.34	1

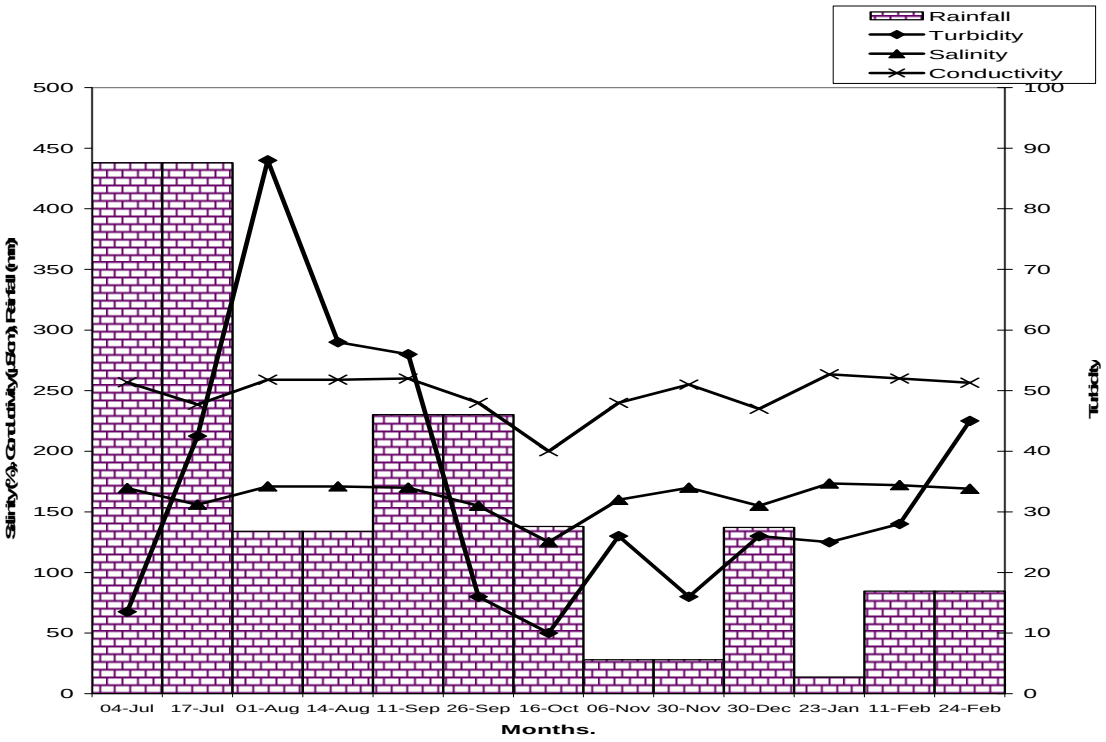

Fig. 3: Variation in some ecological factors at the Bar beach from July, 2008 - Feburary, 2009.

Plankton characteristics

The phytoplankton spectrum recorded a total of 67 species. Higher diversity and numbers per ml were recorded between November and February. The diatoms (Bacillariophyta – 56 species) (84%), Blue-green algae (Cyanophyta – 2 species) (3%) and Dinoflagellate (Prryophyta – 9 species) (13%) species were recorded.

For the diatoms, the centric forms recorded 37 species while the Pennate forms were represented by 19 species. Among these, *Coscinodiscus* – 9 species, *Odontella* – 6 species and *Melosira* – 2 species were the key genera encountered. The blue-green algae was represented by two species namely *Trichodesmium thiebautii* Gomont and *Oscillatoria limnosa* Agardh. The dinoflagellates on the other hand were represented by 9 species with the genus *Ceratium* made up of 7 species. Other species were *Peridinium africana* and *Dinophysis caudata*.

With regard to the bio-indices, generally higher values were recorded between November and February than at other times. Shannon-wiener index was highest in February (1.19) and lowest in August (0.80), while Menhinicks index fluctuated between 0.43 (August) and 0.94 (January). Margalef index was between 1.53 (July) and 2.99 (January) while equitability index values were between 0.83 (July and November) and 0.94 (February). Simpson's dominance index varied between 0.07 (February) and 0.20 (August).

For the Zooplankton, crustaceans (18 species), cladocerans (2 species), chaetognaths (1 species), chordates – (1 species), decapods (1 species), mysids (1 species), and an array of juvenile stages (10 forms) formed the Zooplankton crop. The crustaceans were represented by the calanoid and Cyclopoid copepods (70%), cladocerans (10%), mysids, chaetognath, chordate, and decapods (5% each) were represented in terms of diversity.

Acartia clausii, *Acartia discaudata*, *Paracalanus parvus* and *Temora stylifera* (calanoid copepods) were notable forms for the study in terms of frequency of occurrence. Other species included

Oithona plumifera Baird, *Oncaea venusta* (cyclopoid copepods), *Lucifer foxonii* (decapod) and *Sagitta enflata* (chaetognaths).

For zooplankton, higher bio-indices values were recorded between November and February, Shannon wiener index was highest in February. (1.01) and lowest in August. (0.51), while Menhinicks index fluctuated between 0.45 (December) and 0.99 (August). Margalef index was between 0.81 (September) and 2.14 (January) while equitability index values were between 0.73 (August) and 0.95 (September). Simpson's dominance index varied between 0.11 (February) and 0.42 (August).

Species composition and abundance in general were higher in the dry season months than the rainy months. January and February recorded the highest diversity and abundance of zooplankton species.

With regard to the juvenile stages, apart from copepod and fish egg recorded, the others were larvae of other species. The total number of forms and abundance also recorded higher values or numbers between December and February. Nauplii larvae of barnacle and copepod were more important in terms of number.

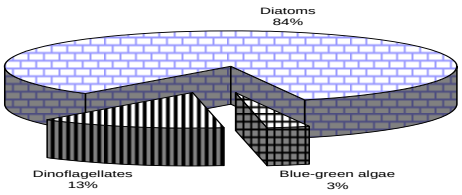

Fig. 4: Percentage abundance of phytoplankton at the Bar beach.

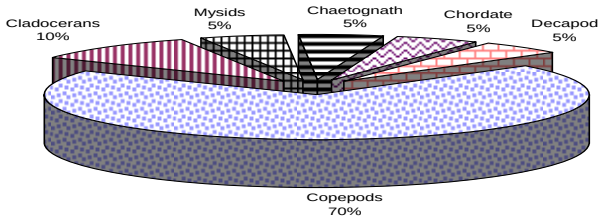

Fig. 5: Percentage diversity of adult zooplankton at the Bar beach.

Table 3: A checklist of phytoplankton species at a high energy beach in Lagos.

DIVISION – BACILLARIOPHYTA
CLASS-BACILLARIOPHYCEAE
ORDER I – CENTRALES
Actinoptychus splendens Ehrenberg
Amphiprora alata Ehrenberg
Meloseira moniliformis Agardh
Meloseira nummuloides Agardh
Campylodiscus clypeus (Ehr.) Kutzing
Chaetoceros atlanticum Cleve
Chaetoceros convolutus Castracane
Chaetoceros decipens Cleve
Odontella aurita (Lyngbe) Brebisson
Odontella biddulphiana Bayer
Odontella laevis Ehrenberg
Odontella mobilensis Bailey
Odontella regia (Schultze) Ostenfeld
Odontella sinensis Greville
Coscinodiscus centralis Ehrenberg
Coscinodiscus eccentrius Ehrenberg
Coscinodiscus jonesianus (Greville) Ostenfeld
Coscinodiscus gigas Ehrenberg
Coscinodiscus lineatus Ehrenberg
Coscinodiscus marginatus Ehrenberg
Coscinodiscus oculus-iridis Ehrenberg
Coscinodiscus radiatus Ehrenberg
Coscinodiscus sub-bulliens Jorg
Cyclotella menighiniana Kutzing
Cyclotella striata (Kutzing) Grunow
Ditylum brightwelli (T. West) Grunow
Eucampia zodiacus Ehrenberg
Hemidiscus cuneiformis Wallich
Leptocylindricus danicus Cleve
Paralia sulcata Ehrenberg
Podosira sp
Rhizosolenia alata Brightwell
Rhizosolenia styliformis Brightwell
Skeletonema coastasum Cleve
Terpsinoe musica (Ehr) Hustedt
Thalasiosira subtilis (Ostenfeld) Gran
Triceratium favus Ehrenberg

Order II – PENNALES
Achnanthes longipes Agardh
Bacillaria paxillifer (O.F. Muller) Hendey
Cymbella affinis Kutzing
Fragillaria islandica Grunner
Fragillaria oceanica Cleve
Gomphonema parvulum Grunner
Gyrosigma balticum (Ehr.) Rabenhorst
Gyrosigma scalproides (Rabh) Cleve
Hantzschia amphioxys (Ehr.) Rbenhorst
Navicula ergadensis Ralfs
Nitzschia closterium Wm. Smith
Nitzschia sigmoidea (Witesch) W. Smith
Parabelius delognei E.J. Cox
Pleurosigma angulatum (Quekett) Wm Smith
Synedra crystallina (Ag) Kutzing
Thalasiothrix fraunfeldii Cleve et Grunow
Thalasionema longissima Cleve & Grunow
Thalassionema nitzschioides Cleve &Grunow
Thalaiossira gravida Ehrenberg

DIVISION – CYANOPHYTA
CLASS – CYANOPHYCEAE
Order – HORMOGONALES
Oscillatoria limnosa Agardh
Trichodesmium thiebautii Gomont

DIVISION – DINOPHYTA
CLASS – DINOPHYCEAE
ORDER – PERIDINALES
Ceratium fusus Ehrenberg
Ceratium lineatum Ehrenberg
Ceratium macroceros (Ehr.) Cleve
Ceratium massilense Gourret
Ceratium trichoceros Ehrenberg
Ceratium tripos (O.F.M.) Nitzsch
Ceratium vultur Cleve
Dinophysis caudata Kent
Peridinium africana Kofoid

Table 4: A checklist of zooplankton species of a high energy beach in Lagos.

CLASS: CRUSTACEA
SUB-CLASS: COPEPODA
ORDER I: CALANOIDA
Acartia clausii Giesbrecht
Acartia discaudata Giesbrecht
Acartia tonsa Giesbrecht
Calanus finmarchicus (Gunn.)
Centropages furcatus Dana
Metridia longa (Lubbock)
Paracalanus parvus Claus
Paracalanus scotti Fruchtl
Temora stylifera Dana

ORDER II: CYCLOPOIDA
Corycaeus obtusus Dana
Cyclopina longicornis Claus
Cyclops sp.
Oithona plumifera Baird
Oncaea venusta Phillipi

SUB-CLASS II: BRANCHIOPODA
ORDER: CLADOCERA
Alona sp.
Penilia avirostris Dana

CLASS: MYSIDACEA
FAMILY: MYSIDAE
Mysis sp

Order II-DECAPODA
Lucifer foxonii Borrad

Phylum-CHAETOGNATHA
Order-APHRAGMORPHA
Sagitta enflata Vogt

PHYLUM: CHORDATA
CLASS: LARVACEA
Oikopleura dioica Vogt

JUVENILE STAGES
Copepod eggs
Bivalve larva
Fish eggs
Fish larvae
Gastropod larva
Lucifer zoea larva
Megalopa larva
Nauplii larva of Barnacle
Nauplii larva of copepods
Zoea larva

PHYLUM: CNIDARIA
CLASS: SCYPHOZOA
ORDER: SIPHONOPHORA
Unidentified jelly-fish

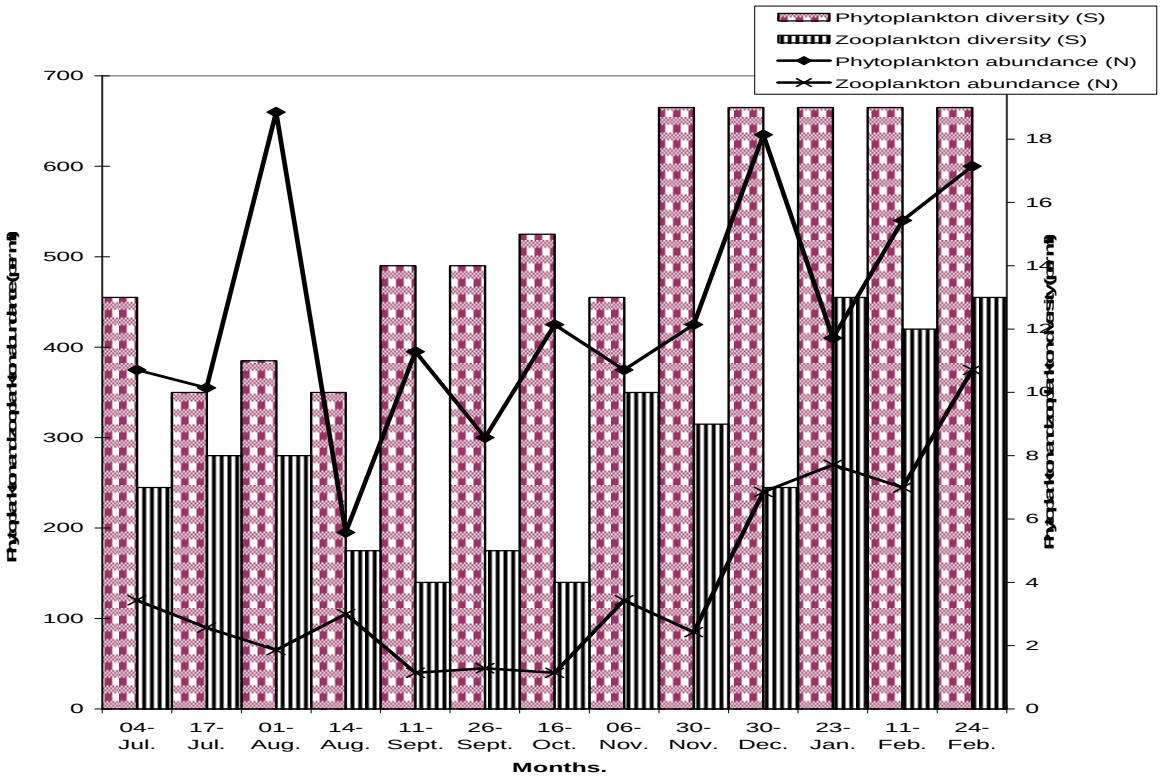

Fig. 7: Variation in phytoplankton and zooplankton dynamics at the Bar beach from July, 2008 - Feburary, 2009.

Table 5: Phytoplankton community structure indices.

Bio-index	04-Jul.	17-Jul.	01-Aug.	14-Aug.	11-Sept.	26-Sept.	16-Oct.	06-Nov.	30-Nov.	30-Dec.	23-Jan.	11-Feb.	24-Feb.
Species diversity (S)	**13**	**10**	**11**	**10**	**14**	**14**	**15**	**13**	**19**	**19**	**19**	**19**	**19**
Phytoplankton abundance (N)	375	355	660	195	395	300	425	375	425	635	410	540	600
Shannon-Wiener Index (Hs)	0.92	0.86	0.80	0.87	1.06	1.03	1.08	0.92	1.17	1.17	1.16	1.21	1.19
Menhinick Index (D)	0.67	0.53	0.43	0.72	0.70	0.81	0.73	0.67	0.92	0.75	0.94	0.82	0.78
Margalef Index (d)	2.02	1.53	1.54	1.71	2.17	2.28	2.31	2.02	2.97	2.79	2.99	2.86	2.81
Equitability Index (j)	0.83	0.86	0.76	0.87	0.93	0.90	0.92	0.83	0.92	0.91	0.90	0.94	0.93

Simpson's Dominance Index (C)	0.16	0.17	0.20	0.18	0.10	0.11	0.10	0.16	0.08	0.08	0.08	0.07	0.07

Table 6: Zooplankton community structure indices.

	04-Jul.	**17-Jul.**	**01-Aug.**	**14-Aug.**	**11-Sept.**	**26-Sept.**	**16-Oct.**	**06-Nov.**	**30-Nov.**	**30-Dec.**	**23-Jan.**	**11-Feb.**	**24-Feb.**
Species diversity (S)	**7**	**8**	**8**	5	**4**	5	**4**	**10**	**9**	7	**13**	**12**	**13**
Zoolplankton abundance (N)	120	90	65	105	40	45	40	120	85	240	270	245	375
Shannon-Wiener Index (Hs)	0.77	0.80	0.85	0.51	0.57	0.66	0.57	0.88	0.80	0.67	0.93	1.01	1.00
Menhinick Index (D)	0.64	0.84	0.99	0.49	0.63	0.75	0.63	0.91	0.97	0.45	0.79	0.77	0.67
Margalef Index (d)	1.25	1.56	1.68	0.86	0.81	1.05	0.81	1.88	1.80	1.09	2.14	2.00	2.02
Equitability Index (j)	0.91	0.89	0.94	0.73	0.95	0.95	0.95	0.88	0.84	0.80	0.83	0.94	0.90
Simpson's Dominance Index (C)	0.19	0.19	0.16	0.42	0.28	0.23	0.28	0.16	0.22	0.27	0.15	0.11	0.12

DISCUSSION

Ecological factors estimated and characterized by this study reflect a typical tropical neritic /shoreline water quality characteristics. For instance, air and water temperatures were within previously recorded limits (Longhurst 1964; Nwankwo *et al*. 2004; Onyema *et al*. 2008). In determining ecological changes in the tropics, temperature may not be as significant as rainfall (Webb 1960; Nwankwo 2004b). According to Nwankwo (2004b), rainfall distributive pattern cause four distinct ecological seasons keyed to salinity in the Lagos lagoon. Monthly rainfall volumes observed before and after this study followed known bi-modal distributive pattern as previously recorded by a number of authors (Hill and Webb 1958; Chukwu 2002; Nwankwo *et al*. 2003; Edokpayi and Nwoji 2007). The low air temperature (25^{o}C) recorded in September was probably due to imminent rain event and associated cloud cover / high humidity effects at the time of collection. Similarly the least air temperature recorded in January may be due to the presence of the harmattan season. According to Onyema *et al.* (2003) the low temperature value recorded in the same period and region may be due to the harmattan spell associated with dust haze and reduced isolation. This situation is also known to affect water temperature in lagoons and creeks of South-western Nigeria (Onyema and Nwankwo, 2009; Onyema 2008, 2009a; Onyema and Ojo 2008).

Alkaline pH values recorded throughout the study were a reflection of high amounts of Carbon (IV) oxide known to be stored as forms of carbonates in seawater. Onyema *et. al*. (2003) are of the view that the observed alkaline environment recorded for the Lagos lagoon is as a result of the buffering effect of the inflowing seawater. Similar observations have been reported by Nwankwo (1986, 1991). Dissolved oxygen levels were higher in this investigation than any other reports for the region. It is possible that the breaking of high energy plunging waves on the sand beaches on the coast-line was responsible for the increased dissolution of atmospheric oxygen in the shore waters. These agitations may also be an additional reason for higher than previously recorded pH values at the beach as more Carbon (IV) oxide is dissolved. Furthermore, perturbation form the breaking wave may also have suspended already settled particles and keeping them in suspension, hence increasing turbidity or particulate level. Turbidity values were generally higher in the wet than in the dry season. This trend has been commonly reported in the region as transparency (Nwankwo, 1998; Onyema, 2007a; Edokpayi *et al*. 2004; Emmanuel and Onyema, 2007; Onyema and Emmanuel, 2009). Turbidity and dissolved Oxygen were also positively correlated (r =0.45) with points to the perturbation of breaking waves.

Conductivity and salinity have been previously reported as associated factors (Onyema and Nwankwo 2009, Onyema 2009b). These two parameters showed a similar relationship for this study. This is evident in Table 2 (r = 0.99). Nwankwo (1996) is of the view that the dynamic interplay between freshwater inflow and tidal seawater incursion determines the Lagos lagoon environment. The least salinity (October) recorded was probably a reflection of dilution from rainfall. Salinity over the years has been singled out as a key factor in coastal waters of Nigeria in determining the absence / presence or density of endemic species (Sandison and Hill 1966, Oyenekan 1988, Brown and Oyenekan, 1998; Nwankwo 2009b, Onyema 2008).

According to Nwankwo and Onyema (2003) in a study of phytoplankton species offshore Lagos, a total of sixty three species were encountered and diatoms followed by dinoflagellates were the key groups recorded for the phytoplankton spectrum. In this study a similar order was also noted. According to Nwankwo (1988), phytoplankton

production in the Lagos lagoon is high and dominated by diatoms. Furthermore Nwankwo (1998) and Onyema *et al.* (2003) are of the view that the Lagos lagoon which is linked to the Atlantic Ocean is dominated by diatoms with regard to its phytoplankton spectrum. Additionally a number of the species recorded have been reported by more recent studies in the Lagos, Kuramo, Iyagbe, Apese lagoons and adjacent creeks (Nwankwo 1988, Onyema *et al.* 2006, Nwankwo *et al*. 2008, Onyema 2007 Ijora 2009b, Onyema and Nwankwo 2009, Emmanuel and Onyema 2007).

Diatoms and dinoflagellates are important components of photosynthetic organism that form the base of the aquatic food chain (Davis, 1955; Sverdrop *et al.*, 2003). According to Onyema *et. al*. (2006) dinoflagellates are second in importance only to the diatoms as basic food producers in the plankton of marine waters. Nwankwo (1997) is of the view that with regard to the creek and lagoons around Lagos, there is an increase in the dinoflagellate cell numbers during periods of high salinity and low nutrient levels and this suggests a possible relationship. The author also suggests that the source of recruitment of the lagoonal dinoflagellates (Lagos lagoon) is the adjacent sea since most of the reported species are warm water oceanic forms. Additionally, *Trichodesmium thiebautii,* a blue-green algae encountered has been reported in blooms by Nwankwo (1993) off the Lagos coast during thermocline and low nutrient periods. Generally, changes in the standing stock of the phytoplankton follow a similar trend as that reported by Atkins and Jenkins (1953) for the western part of the English Channel as indicated by chlorophyll concentration.

In the zooplankton spectrum, the copepods particularly the calanoid forms were the more important members in terms of occurrence and frequency.

According to Onyema *et al.* (2003), in the adjoin Lagos lagoon, diatoms and copepods dominated the plankton spectrum. *Alona* sp. and *Penilia avirostris* Dana (Cladoceran) are known seawater cladocerans (Winnipenny 1966, Newell and Newell 1966: Olaniyan 1975) and these confirm the water quality situation of the Bar beach. Similarly *Lucifer foxonii*, *Sagitta enflata* and *Oikopleura dioica* fall into the same category as sea species that have been previously reported by the aforementioned authors. These marine species have also been recorded in the Lagos harbor, lagoon and the Opobo channel (Niger delta) over the year during high salinity periods in the dry season (Akpata *et. al*. 1993; Kusemiju *et. al*. 1993; Onyema *et al*. 2003, 2007).

Eggs, larvae and spores of pelagic and benthic organisms are often a conspicuous part of the plankton of neritic waters and some of the obvious seasonal changes are related to the reproductive seasons / times of the sea organisms (Tait, 1981). The diversity of forms of juvenile plankton recorded in this study is similar to that recorded by Harvey *et al*. (1935) and Harvey (1950).

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Engine speed effects on the characteristic performance of Otto engines

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Abstract: The performance of an air-standard Otto cycle is analyzed using finite-time thermodynamics. In the model, the linear relation between the specific heat ratio of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies and the heat transfer loss are considered. The relations between the power output and the compression ratio, between the power output and the thermal efficiency are derived by detailed numerical examples. The results shows that if compression ratio is less than certain value, the power output increases with increasing engine speed, while if compression ratio exceeds certain value, the power output first increases and then starts to decrease with increasing engine speed. With further increase in compression ratio, the increase of engine speed results in decreasing the power output. The results obtained in this paper may provide guidance for the design of practical internal-combustion engines. [Journal of American Science 2010;6(1):123-128]. (ISSN: 1545-1003).

Key words: Otto cycle; heat resistance; internal irreversibility; performance optimization

1. Introduction

Since finite-time thermodynamics (Andresen et al., 1984; Bejan, 1996; Aragon-Gonzalez et al., 2000) is a powerful tool for the performance analysis and optimization of real internal combustion engine cycle, much work has been performed for the performance analysis and optimization of finite time processes and finite size devices (Aragon-Gonzalez et al., 2006; Chen et al., 2007; Aragon-Gonzalez et al., 2008; Ge et al., 2008a). Mozurkewich and Berry (1982) used mathematical techniques, developed for optimal-control theory, to reveal the optimal motions of the pistons in Diesel and Otto cycle engines, respectively. Left (1987) calculated the maximum work output and efficiency of an Otto heat engine. Wu and Blank (1993) also optimized the endoreversible Otto cycle with respect to both net power output and mean effective pressure. Angulo-Brown et al. (1994) modeled the behaviors of Otto with friction loss during finite times. Chen et al. (1998) derived the relations between the net work-output and the efficiency for Otto cycle with due consideration of heat-transfer losses. Gonzalez et al. (2000) derived the maximum irreversible work and efficiency of the Otto cycle by considering the irreversible adiabatic processes with the compression and expansion efficiencies. Wang et al. (2002) optimized the power output of Diesel and Otto engines with friction loss during finite times. Rostovtsev et al. (2003) considered how to improve the efficiency of an ideal Otto heat engine. Chen et al. (2003) derived the characteristics of power output and thermal efficiency for Otto cycle with heat transfers and friction like term losses. Ge et al. (2005a, 2005b) studied the effects of variable specific heats of the working fluid on the performances of an Otto cycle with heat transfer loss and with heat transfer and friction losses, respectively. Chen et al. (2006) investigated the performance of an Otto heat engine by considering the irreversibility resulting from the compression and expansion processes, finite-time processes and heat loss through the cylinder wall. Ozsoysal (2006) gave the valid ranges of the heat transfer loss parameters of the Otto and diesel cycles with consideration of the heat loss as a percentage of the fuel's energy. Hou (2007) compared the performances of air standard Atkinson and Otto cycles with heat transfer loss considerations. Ge et al. (2008a; 2008b) analyzed the performance of an air standard Otto and Diesel cycles. In the irreversible cycle model, the non-linear relation between the specific heat of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered. Lin and Hu (2008) analyzed the effects of heat loss by a percentage of the fuel's energy, friction and variable specific heats of

working fluid on the performance of an air standard Otto cycle with a restriction of maximum cycle temperature. Gumus (2009) studied the performance analysis for an Otto cycle based on alternative performance criteria namely maximum power, maximum power density and maximum efficient power.

As can be seen in the relevant literature, the investigation of the effect of engine speed on performance of Otto cycle does not appear to have been published. Therefore, the objective of this study is to examine the effect of engine speed on performance of air standard Otto cycle.

2. Thermodynamic analysis

The temperature-entropy diagram of an irreversible Otto heat engine is shown in Fig. 1, where T_1, T_{2s}, T_2, T_3, T_4 and T_{4s} are the temperatures of the working substance in state points 1, 2s, 2, 3, 4 and 4s. Process $1\to 2s$ is a reversible adiabatic compression, while process $1\to 2$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real compression process. The heat addition is an isochoric process $2\to 3$. Process $3\to 4s$ is a reversible adiabatic expansion, while $3\to 4$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real expansion process. The heat-removing process is the reversible constant volume $4\to 1$.

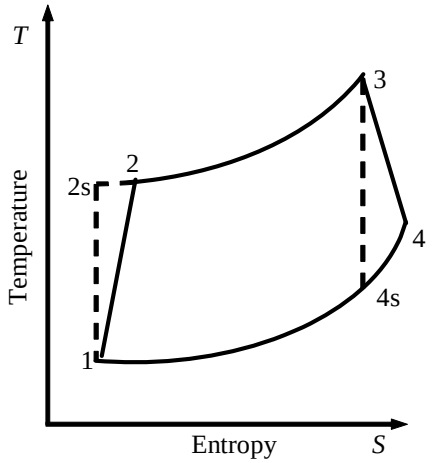

Figure 1. temperature-entropy diagram for the air standard Otto cycle

In a real cycle, the specific heat ratio is generally modeled as the first order equation of mean charge temperature (Gatowski, et al., 1984; Brunt, et al., 1998; Ebrahimi, 2006). Thus, it can be supposed that the specific heat ratio of the working fluid is function of temperature alone and has the first order equation forms:

$$\gamma = \gamma_o - k_1 T \tag{1}$$

where γ is the specific heat ratio and T is the absolute temperature. γ_o and k_1 are constants.

The heat added per second in the isobaric ($2\to 3$) heat addition process may be written as:

$$Q_{in} = M_n \int_{T_2}^{T_3} c_v dT = M_n \int_{T_2}^{T_3} \left(\frac{R}{\gamma_o - k_1 T - 1} \right) dT = \frac{M_n R}{k_1} \ln \left(\frac{\gamma_o - k_1 T_2 - 1}{\gamma_o - k_1 T_4 - 1} \right) \tag{2}$$

where M_n is the molar number of the working fluid which is function of engine speed. R and c_v are molar gas constant and molar specific heat at constant pressure for the working fluid, respectively.

The heat rejected per second in the isochoric heat rejection process ($4\to 1$) may be written as:

$$Q_{out} = M_n \int_{T_1}^{T_4} c_v dT = M_n \int_{T_1}^{T_4} \left(\frac{R_{air}}{\gamma_o - k_1 T - 1} \right) dT = \frac{M_n R}{k_1} \ln \left(\frac{\gamma_o - k_1 T_1 - 1}{\gamma_o - k_1 T_4 - 1} \right) \tag{3}$$

For the two reversible adiabatic processes $1\to 2s$ and $3\to 4s$, the compression and expansion efficiencies can be defined as(Ge et al., 2008a; Ge et al., 2008b; Lin and Hou, 2008):

$$\eta_c = (T_{2s} - T_1)/(T_2 - T_1) \tag{4}$$

and

$$\eta_e = (T_4 - T_3)/(T_{4s} - T_3) \tag{5}$$

These two efficiencies can be used to describe the internal irreversibility of the processes.

Since c_p and c_v are dependent on temperature, the adiabatic exponent γ will vary with temperature as well. Therefore, the equation often used in a reversible adiabatic process with constant γ cannot be used in a reversible adiabatic process with variable γ. However, according to Refs. (Ge et al. 2007; Chen et al., 2008), the equation for a reversible adiabatic process with variable γ can be written as follows:

$$TV^{\gamma-1} = (T + dT)(V + dV)^{\gamma-1} \tag{6}$$

From Eq. (6), one gets

$$T_i(\gamma_o - k_1 T_j - 1) = T_j(\gamma_o - k_1 T_i - 1)(V_j / V_i)^{\gamma_o - 1} \tag{7}$$

The compression ratio, r_c, is defined as:

$$r_c = V_1 / V_2 \tag{8}$$

Therefore, the equations for processes ($1\to 2s$) and ($3\to 4s$) are shown, respectively, by the following:

$$T_1(\gamma_o - k_1 T_{2s} - 1)(r_c)^{\gamma_o - 1} = T_{2s}(\gamma_o - k_1 T_1 - 1) \tag{9}$$

and

$$T_3\left(\gamma_o - k_1 T_{4s} - 1\right) = T_{4s}\left(\gamma_o - k_1 T_3 - 1\right)\left(r_c\right)^{\gamma_o - 1} \quad (10)$$

The energy transferred to the working fluid during combustion is given by the following linear relation (Chen et al., 2008; Ebrahimi, 2009b)

$$Q_{in} = M_n\left[A - B\left(T_2 + T_4\right)\right] \quad (11)$$

where A and B are two constants related to combustion and heat transfer which are function of engine speed. From equation (10), it can be seen that Q_{in} contained two parts: the first part is $M_n A$, the released heat by combustion per second, and the second part is the heat leak loss per second, $M_n B\left(T_2 + T_4\right)$.

Taking into account the friction loss of the piston and assuming a dissipation term represented by a friction force that is a linear function of the piston velocity gives (Chen et al., 2006; Ge et al. 2007; Ebrahimi, 2009a)

$$f_\mu = -\mu v = -\mu \frac{dx}{dt} \quad (12)$$

where μ is the coefficient of friction, which takes into account the global losses, x is the piston's displacement and v is the piston's velocity. Therefore, the lost power due to friction is

$$P_\mu = \frac{dW_\mu}{dt} = -\mu\left(\frac{dx}{dt}\right)^2 = -\mu v^2 \quad (13)$$

Running at N cycles per second, the mean velocity of the piston is

$$\bar{v} = 4LN \quad (14)$$

where L is the total distance the piston travels per cycle.

Thus, the power output of the Otto cycle engine can be written as

$$P_{out} = Q_{in} - Q_{out} - P_\mu = \frac{M_n R}{k_1}\left[\ln\left(\frac{\gamma_o - k_1 T_2 - 1}{\gamma_o - k_1 T_3 - 1}\right) - \ln\left(\frac{\gamma_o - k_1 T_1 - 1}{\gamma_o - k_1 T_4 - 1}\right)\right] - 16\mu\left(LN\right)^2 \quad (15)$$

The efficiency of the Otto cycle engine is expressed by

$$\eta_{th} = \frac{Q_{in} - Q_{out} - P_\mu}{Q_{in}} = \frac{M_n R\left[\ln\left(\frac{\gamma_o - k_1 T_2 - 1}{\gamma_o - k_1 T_3 - 1}\right) - \ln\left(\frac{\gamma_o - k_1 T_1 - 1}{\gamma_o - k_1 T_4 - 1}\right)\right] - 16 k_1 \mu\left(LN\right)^2}{M_n R \ln\left(\frac{\gamma_o - k_1 T_2 - 1}{\gamma_o - k_1 T_3 - 1}\right)} \quad (16)$$

When r_c, η_c, η_e and T_1 are given, T_{2s} can be obtained from Eq. (9), then, substituting T_{2s} into Eq. (4) yields T_2. T_3 can be deduced by substituting Eq. (2) into Eq. (11). T_{4s} can be found from Eq. (10), and T_4 can be deduced by substituting T_{4s} into Eq. (5). Substituting T_1, T_2, T_3 and T_4 into Eqs. (15) and (16), respectively, the power output and thermal efficiency of the Otto cycle engine can be obtained. Therefore, the relations between the power output, the thermal efficiency and the compression ratio can be derived.

3. Results and discussion

The following constants and parameters have been used in this exercise: $M_n = 1.57E-5 \times N\ kmols^{-1}$, $\eta_c = 0.97$, $\eta_e = 0.97$, $k_1 = 7.18\times10^{-5}\ K^{-1}$, $\gamma_o = 1.41$, $A = 60000\ J.mol^{-1}$, $L = 70\ mm$, $B = 28\ J.mol^{-1}K^{-1}$, $b = -9.7617\times10^{-5}\ K^{-1}$, $N = 2000 - 6000\ rpm$, $r_c = 1 - 70$, $\mu = 12.9\ Nsm^{-1}$ and $T_1 = 300\ K$ (Heywood, 1988; Chen et al. 2007; Ghatak and Chakraborty, 2007; Ge et al., 2008b; Ebrahimi, 2009a). Using the above constants and range of parameters, the power output versus compression ratio characteristic and the power output versus efficiency characteristic with varying the engine speed can be plotted. Numerical examples are shown as follows.

Figures 2 and 3 show the effects of the variable engine speed on the cycle performance with heat resistance, internal irreversibility and friction losses. From these figures, it can be found that the engine speed plays important roles on the power output. It is clearly seen that the effect of engine speed on the power output is related to compression ratio. They reflect the performance characteristics of a real irreversible Otto cycle engine. It should be noted that the heat added and the heat rejected by the working fluid increase with increasing engine speed (see Eqs. (2) and (3)).

Figure 3 indicates the effects of the engine speed on the power output of the cycle for different values of the compression ratio. It can be seen that the power output versus compression ratio characteristic is approximately parabolic like curves. In other word, the power output increases with increasing compression ratio, reach their maximum values and then decreases with further increase in compression ratio. The maximum power output increases with increasing engine speed up to about 5000 rpm where it reaches its peak value then starts to decline as the engine speed increases. This is consistent with the experimental results in the internal combustion engine (Mercier, 2006).

The optimal compression ratio corresponding to maximum power output point remains constant with increase of engine speed. The working range of the

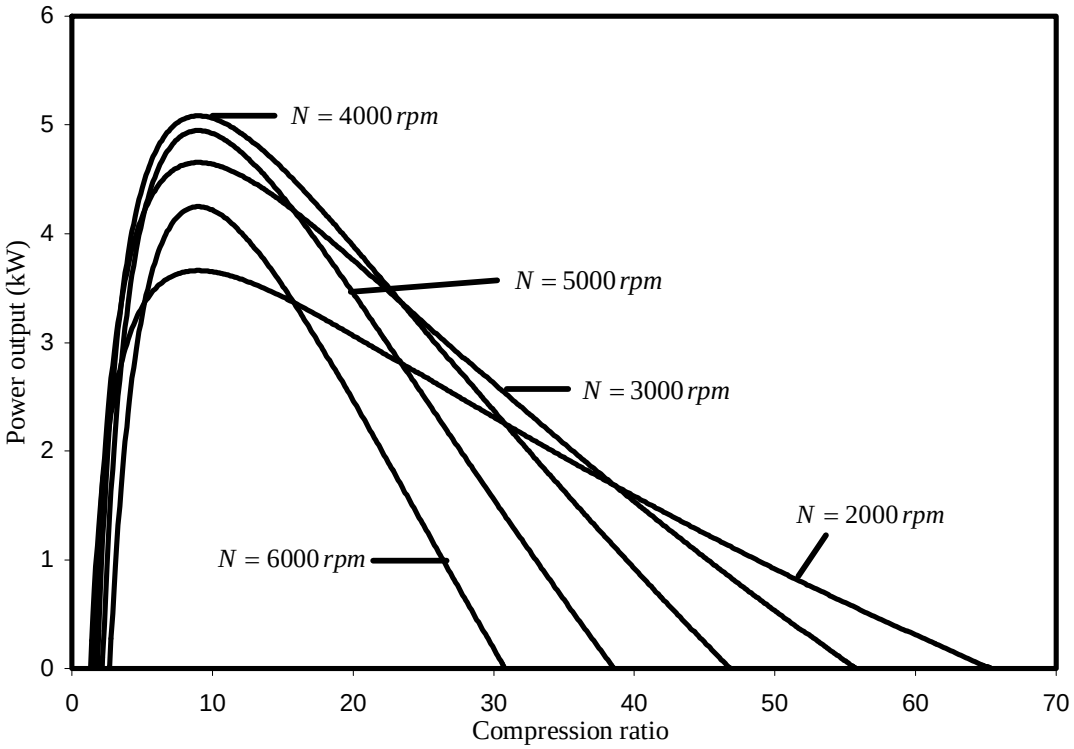

Figure 1. Effect of N on the $P_{out} - r_c$ characteristic

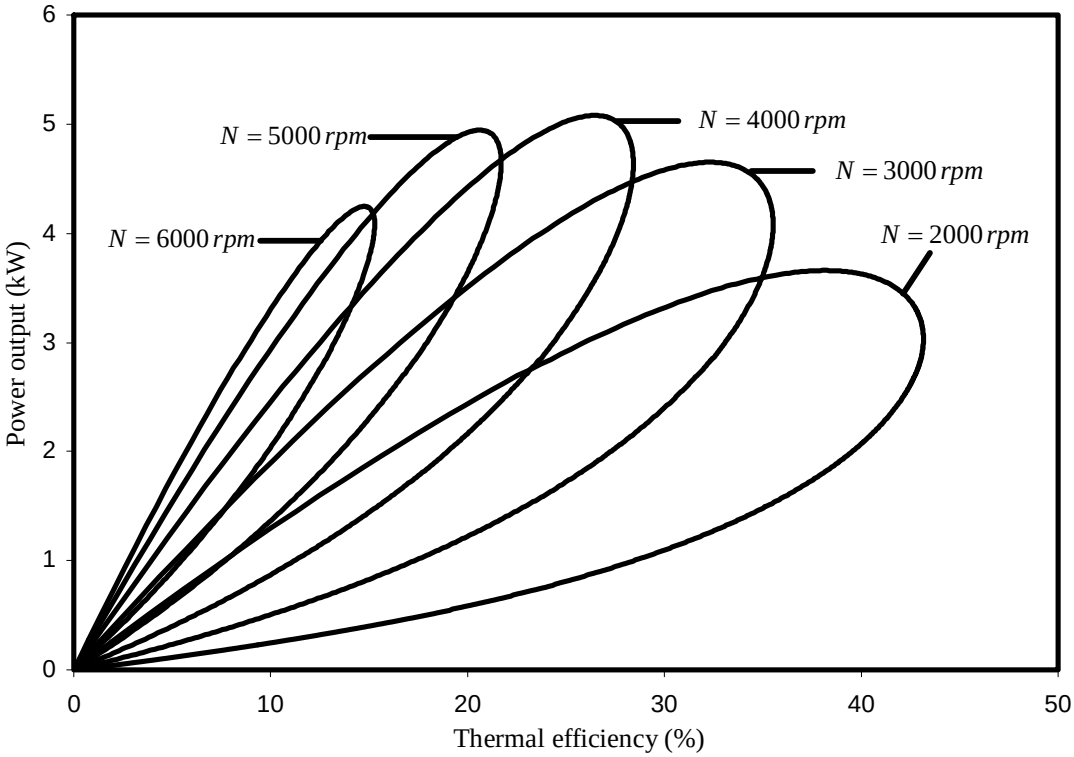

Figure 2. Effect of N on the $P_{out} - \eta_{th}$ characteristic

cycle decreases as the engine speed increases. The results shows that if compression ratio is less than certain value, the power output increases with increasing engine speed, while if compression ratio exceeds certain value, the power output first increases and then starts to decrease with increasing engine speed. With further increase in compression ratio, the increase of engine speed results in decreasing the power output. Numerical calculation shows that for any same compression ratio, the smallest power output is for $N = 6000\,rpm$ when $r_c \le 5.2$ or $r_c > 15.7$ and is for $N = 2000\,rpm$ when $5.2 < r_c \le 15.7$ and also the largest power output is for $N = 2000\,rpm$ when $r_c \le 2.2$ or $r_c > 38.6$, is for $N = 3000\,rpm$ when $2.2 < r_c \le 3.6$ or $23.4 \le r_c \le 38.6$ and is for $N = 6000\,rpm$ when $3.6 \le r_c < 23.4$.

The influence of the engine speed on the power output versus thermal efficiency is displayed in figure 4. As can be seen from this figure, the power output versus thermal efficiency is loop shaped one. It can be seen that the power output at maximum thermal efficiency improves with increasing engine speed from 2000 to around $N = 4000\,rpm$. With further increase in engine speed, the power output at maximum thermal efficiency decreases. It can also be seen that the thermal efficiency at maximum power decreases with increase of engine speed from 2000 to $N = 6000\,rpm$.

According to above analysis, it can be found that the effects of the engine speed on the cycle performance are obvious, and they should be considered in practice cycle analysis in order to make the cycle model be more close to practice.

4. Conclusion

An air standard Otto cycle model, assuming a temperature dependent specific heat ratio of the working fluid, and heat resistance and frictional irreversible losses, has been investigated numerically. The performance characteristics of the cycle with varying engine speeds and compression ratios were obtained by numerical examples. The results show that if compression ratio is less than certain value, the power output increases with increasing engine speed, while if compression ratio exceeds certain value, the power output first increases and then starts to decrease with increasing engine speed. With further increase in compression ratio, the increase of engine speed results in decreasing the power output. The results also show that the maximum power output increase with increasing engine speed. With further increase in engine speed, the increase of engine speed results in decreasing the maximum power output. The analysis helps us to understand the strong effect of engine speed on the performance of the Otto cycle. Therefore, the results are of great significance to provide good guidance for the performance evaluation and improvement of real Otto engines.

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Path Analysis Model of the Development of Handicraft Industries in Kelantan, Malaysia

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Abstract: This study identify factors that contribute to the development of handicrat industries. The focus is on batik industries. The study was carried out in the District of Kota Bharu in the State of Kelantan, Malaysia, and targeted the entrepreneurs in the batik handicraft enterprises. The study is based upon both quantitative and qualitative analysis of material derived from field-work in several villages in the study area. The analysis of data employed path-analysis model in order to determine the factors that contribute to the explanation of the dependent variable – the development of the industries. The finding show that the selected factors have contributed significantly in the explanation of the development of the industries. The findings imply that it is imperative to consider and understand the local resources, skills, attitudes and aspirations in any government efforts to foster the development of these handicraft industries. Journal of American Science 2010;6(1):129-136]. (ISSN: 1545-1003).

Keywords: handicraft , batik,rural development, rural industries

1. Introduction

It is widely recognised that rural development in most developing countries is unlikely to be achieved by the development of one sector alone, such as agriculture. Although the agricultural sector is of prime importance in the development of rural areas, other fields of social and economic development must be included in a truly integrated approach (Austin, 1981, p 1). It has been postulated that industrialisation can make a significant contribution to rural development through increased rural production and productivity, the provision of employment opportunities and the satisfaction of basic needs, and the establishment of linkages with other sectors of the economy (Hogg, 1978, p. 19). In relation to this, interest in rural non-agricultural development has been growing in many developing countries as a result, *inter alia*, of severe limitations on the capacity of the agricultural sector to absorb the existing supply of rural labour and to satisfy even minimum subsistence requirements for a large proportion of the rural population (Sand, 1983, p 1). Given agriculture's limited capacity to absorb labour, rural non-farm activity assumes increased importance as an alternative or supplementary source of rural employment and income. Thus, the promotion of the small enterprise sector (e.g. handicrafts, cottage industries, small-scale rural industries) could play an important role in the implementation of a development strategy.

On the hand, rural development starts with people and their education, organisation, and discipline. Without these three, all resources remain latent, untapped potential" (Schumacher, 1975, p. 168). Meanwhile, Wellisz writes that,"Technological progress is the prime mover of economic development, but unfortunately, it is not a miracle drug. To develop, the economically backward countries must modernize, but a simple injection of modernization does not cure poverty. It is clear, first of all, that modernization is not a substitute for investment. Obsolete equipment must be replaced, new factories built, and new machines installed to embody the new techniques. Investment in human beings is also needed if a country is to modernize."(Wellisz, 1966, p. 234). Human factors or "human resources" constitute some of the main factors that can either constrain or hold the key to future development and change. However, besides those factors, the physical resources such as capital for investment in new technology are also clearly important. Thus, this paper attempts to explain a path-analysis model which depict the factors that contribute to the development of handicraft industries.

2. Litrature Review

General background of the development of batik industries

We attempt to illustrate the general overview of the development of the batik

industries, particularly in the state of Kelantan. The word “batik” is originally a Javanese term, denoting a resist technique for producing designs on fabrics (Krevitsky, 1964, p. 7). The exact origin of batik is uncertain. It is so old a craft that its true origin has never been determined, but it can safely be presumed to be 2,000 years old. It is in Java, Indonesia, that batik was most extensively developed and has been continually practised on a large scale. From Java batik was introduced to Europe by Dutch traders, who first imported it to the Netherlands in the middle of the seventeenth century (Hitchcock, 1991). Today, batik is still identified throughout the world with Java or Indonesia. The development of batik-making in Malaysia can be traced from the making of traditional *pelangi batik*, in which the *pelangi* technique preceded efforts to adopt batik locally. This method (tie-resist) of decorating cloth was practised by Malays during the eighteenth and nineteenth centuries. It is believed that *pelangi batik* was available during the reign of the third ruler of Trengganu, Sultan Zainal Abidin II (1773-1808), where Minah Pelangi was the most famous producer of batik during the time. The "modern" way of batik making began with the *canting* method, believed to be a Javanese invention which dates back to the seventeenth century. A rather new method of batiking which was introduced in the middle of the nineteenth century was called the *chop* (or *cap*) or "printing block", which was also invented by the Javanese. The invention rapidly enabled the far-sighted batik manufacturers to place their production on a semi-industrial basis. There were several factors that contributed to the development of the industry during the time. Among others were (i) the importation of raw materials such as dye stuff from Germany, and cotton cloth from India; (ii) the availability of a market; (iii) the small amount of capital needed for the establishment of the industry; and (iv) the many workers who had obtained experience and had opened their own businesses. The demand for batik products is increasing. Some of the Malaysian batiks have been exported to the overseas market, among others to the United States, Japan, Europe, Australia and Africa. In the country the wearing of batiks has been encouraged by the government in order to preserve a national identity. Batik shirts (especially hand-drawn) are considered an appropriate formal attire for Malaysian men. In women's attire, batik provides a Malaysian flavour for high fashion western style dresses. Batik has been recognised as a national dress, worn by all ethnic groups and is no longer associated with the Malays (Arney, 1987). Our study also illustrate the dynamic aspects of the industries, in terms of whether they have improved, have declined within the past ten years, or have experienced no change ("stagnation"). The development of the aspects or elements of the industries could indicate the process of their development: for instance, where an enterprise has started well but is now gradually shrinking, while others are developing and enlarging. Table 1 reveals the development process of the study enterprises within the last ten years.

Table 1: The development of aspects of the silverware and batik industries during the past ten years (N=140)

Aspect of Development	Improved	Stagnant	Declined
Design	84	-	-
Quality	63	21	-
Productivity	51	24	9
Size	42	24	18
Numbers of workers	36	21	27
Quantity of product	18	57	9
Market	12	60	12
Technology	3	75	6

The heuristic model of development of handicraf industries

In this study, for the purpose of the analysis and for convenience of discussion, we attempt to put the variables into a simple heuristic framework as follows. The state of development of the industries employed in this study is specifically indicated by the size (i.e. based on the number of workers, capital, and production); and not the level of "modernity" of the industries (level of technology, and so on), since all of the batik industries employ traditional technology and management in production. Modern small industry is characterised by appropriate use of efficient machines, good plant layout, precise control of

production processes; appropriate use of business planning and budgeting, market analysis, cost accounting and so on (Staley and Morse, 1965, p. 4).

Although there are conceivably an infinite variety of factors (such as the personality of entrepreneurs, socio-psychological aspects, physical resources, family histories, economic background, etc) associated with the development of the industries, we employed the above-mentioned composite variables as the explainers largely because they represent the "tangible" and "intangible" factors of development. The tangible factors we refer to include the background of the producers such as age (which can also be used as a proxy variable for other factors, such as level of education and other personal background variables), their possession of physical resources (such as land and income), and also the priority given by the producers to the industries (in terms of, for instance, time allocated to the industries vis-a-vis other forms of economic activity, level of involvement in the industries, i.e. whether part-time or full-time, and so on). On the other hand the intangible factors we refer to include the attitudinal and experiential features of the producers: level of entrepreneurship of the entrepreneurs. Furthermore, these variables describe the ability and willingness of the entrepreneurs to change. In other words we hypothesize that the development of the industries is principally explained by the variables mentioned. In order to analyze the relationships between variables, we placed the variables in a path-diagram, as illustrated in the results and discussions.

3. Study Area

The study was carried out in the state of Kelantan, Malaysia, where Kota Bharu District was chosen as study location based on the existence of the batik industries. In Kelantan, and even in Malaysia more generally, the District of Kota Bharu is famous for its batik industry. The state of Kelantan itself is always recognised as the "home of Malaysian batik", and most of the batik industries are found in the District of Kota Bharu. The batik industries were chosen based on the following criteria: (i) comparatively they involved a quite large number of people, and contributed significantly to the livelihood of the people; (ii) they are relatively long-established handicraft industries, and are technologically underdeveloped although with early signs of technological and organisational change; (iii) they are among the more popular crafts and thus have a certain amount of development potential; and (iv) in terms of location the industries tend to be clustered in certain areas where they are easily reachable. The state of Kelantan is located in the northern part of the east coast of Peninsular Malaysia, and covers an areas of 14,943 square kilometres (see Appendix, Figure 2).

4. The Research Methodology

In order to achieve the goals of the study we utilised a combination of research methods. Thus, this study included a variety of methods: interviews with government officials; library research; interviews with key informants and fieldwork in the Districts of Tumpat and Kota Bharu in the state of Kelantan. The fieldwork consisted of observation activities and informant interviews in the initial months at the primary research site; a preliminary survey of batik industrial activities in the research site; intensive interviewing of samples of producers/ entrepreneurs and intensive interviewing of key informants/selected 'cases'. Generally, the questionnaires comprised questions or statements which demanded information regarding the attributes, beliefs, attitudes and behaviour of the respondents. They consisted of a collection of background information of the respondents and the industries, their attitudes, their willingness, and their personal characteristics. From the entrepreneurs' questionnaire we identified seven main variables which are related to our analysis. The variables are:

i. The state of development of the industries (DEVST). The composite variable DEVST refers to the level of development of the enterprises, and is strictly indicated by their size. The variable is made up of other variables: total amount of production (financial value), total capital involved, total income from the enterprise, number of workers, and the kind of organisation of production.
ii. The level of willingness of the entrepreneurs to make certain sacrifices in order to develop their industries (WILLING). The variable WILLING represents the entrepreneurs' willingness to take part in the development of their enterprises. The variable is a composite variable consisting of willingness to increase production, willingness to participate in using machines, willingness to participate in development when there is a market, and willingness to participate in adopting new designs..
iii. The entrepreneurs' attitude towards the development of their industries (ATTDEV).

iv. The entrepreneurs' attitude towards their industries (ATTINDUS).
v The entrepreneurs' level of "entrepreneurship" (ENSHIP).
vi The availability of "physical resources" (including capital and land) (PHYING)
vii. The age of the entrepreneurs (AGE).

With the exception of age, the remaining seven variables are composite variables. Although it is recognised that these composite variables may not be the ideal way of showing the variables of interest to our study, we anticipate that each composite variable should be a more generally accurate indicator than a single variable

The path-analysis model: relationships between variables.

We summarise the seven variables of interest in a simplified form by using a linear, recursive model, involving only a one-way causation framework (i.e. no feedback loops). The main dependent variable in this analysis is the state of development of the industries (DEVST). The other variables are considered as the dependent and intervening variables or factors. Based on assumptions (theoretical ideas) about the sequence of causation of the development we posit this causal model, though there may be reciprocal causation among some of the factors, and these causal orderings may not necessarily fit every industry or entrepreneur.

A path-analysis model is employed in identifying the relative strength of the contribution of the various factors (when analysed simultaneously) in explaining the dependent variable (i.e. the state of development). The aim of path-analysis is to provide quantitative estimates of the causal connections between a set of variables. Path-analysis uses statistical techniques of correlation and multiple regression in order to identify the strength of each factor in explaining the other variables, and the strength of the model itself. As ordered in the path diagrams (i.e. based on the logic of causal relationships), each variable is assumed to have causal influences on the variables to its right. The relative strength of the direct influence of one variable on the other is measured by the path coefficient, while the strength of the model is measured by the value of the R^2. Meanwhile, the causal models we derived are essentially unsaturated or over-identified, i.e. leaving out some linkages that are statistically non-significant or considered not important in the theoretical framework. The results of the statistical analyses of the factors that related to the stage of development of the batik enterprises are presented in the path-diagrams found in Figure 1.

5. Results and Discussions

The results of the statistical analyses of the factors that related to the stage of development of the silverware and batik enterprises are presented in the path-diagrams found in Figure 1. Table 2 shows the correletion coefficient between variables of the study.

Table 2: Zero-order correlation coefficients of variables related to the batik industry

Variables		V1	V2	V3	V4	V5	V6	V7
V1	DEVSTATE	-						
V2	WILLING	-24	-					
V3	ATTDEV	-.42	.92	-				
V4	ATTINDUS	.25	-.10	-.07	-			
V5	ENSHIP	.84	-.18	-.39	.21	-		
V6	PHYING	.84	-.52	-.65	.19	.82	-	
V7	AGE	.48	-.94	-.95	.10	.40	.71	-

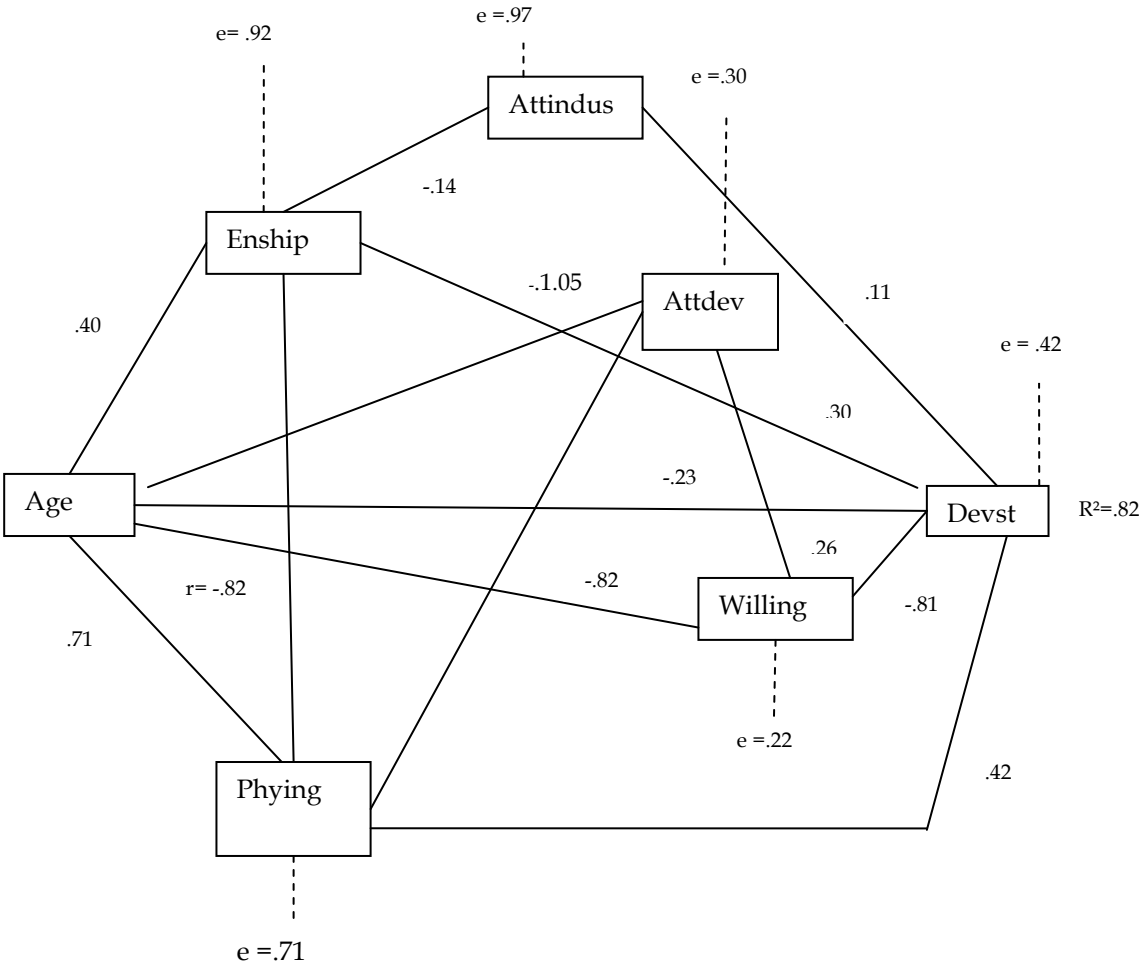

Figure 1: Recursive path-diagram of factors effecting the state of development of the batik industries

Based on the R^2 values in the diagrams, we can establish that our model is very "powerful" and "successful" in explaining variation in the state of the development of batik industries. We find that 82 percent (R^2=.82) of variation in the state of development of batik industries is explained by the variables selected, i.e. those variables located to the left of the dependent variable (DEVST). Specifically, the state of development in the the batik industries is significantly explained by age (p=.84), willingness (p=-.81), attitude towards the industries (p=.11), level of entrepreneurship (p=.30), and the availability of physical resources (p=.42). For convenience, in the discussion of constraints and potential we attempt to discuss each factor separately. Bearing in mind that the variables/factors are related to each other, we also attempt to discuss one factor in relation to other factors. First, we attempt to illustrate the contribution of physical resources in the development of batik industries. We refer to physical resources as those resources that could be employed as capital for the development of the industries, such as income, savings and land (for collateral in borrowing money). However for the purpose of discussion in this section we also include external factors such as the availability of raw materials, technology, market, workers and also the physical support provided as a result of government policies. From the path-diagrams, it is evident that the availability of physical resources, as we might expect, has a powerful influence on the development of the industries (p=.42). This is supported empirically by the correlation analysis. The availability of physical resources is in turn significantly explained by age (p=.71). These findings imply that the physical resources are an important pre-requisite for development. In other words, we assume that the limited availability of physical resources could represent constraints, and thus underpin or perpetuate the underdevelopment of the industries.

In terms of entrepreneurship (which include skills and knowledge), it is found from

the path-diagrams that the level of entrepreneurship has contributed to the explanation of the state of the development of the industry (p=.30). Meanwhile, the correlation coefficients show that there is a positive correlation (r=.40) between age and entrepreneurship. Since age is also a proxy for other background variables, such as education and years of experience as entrepreneurs, which might also explain the level of entrepreneurship, these correlation findings need further discussion. Our question is to what extent does age contribute to the explanation of entrepreneurship in the industries? In the batik industries we believed that the entrepreneurs were "self-made", i.e. they acquired their entrepreneurship through many years experience in business. For the older entrepreneurs, the more years they have been managing the industries, the more experience they have in the business, thus the more entrepreneurial they were.

In terms of attitude towards the industries the findings in the path-diagrams and correlation coefficients we could identify those group of entrepreneurs who were less favourably and those who were more favourably disposed towards the industries. The attitude towards industries has contributed significantly towards the development of the industries (P=.11). Meanwhile, the attitude is explained by the entrepreneurhip variable (p=.14), meaning that the higher the level of entrepreneurshp, the lower their attitude towards the industries. It seems that factors, such as the availability of resources and age do not contribute signifuicantly in the explaination of the attitude.

In terms of the variables related tod the attitude towards development and willingness, the findings of the path-analyses show that 92 percent of variation/change in the attitudes towards development of the industries among the batik entrepreneurs is explained by variations in the variables selected. In the batik industries the variation is significantly explained by age (p=-1.05), and the possession of physical resources (p=-.23). Meanwhile, from the path diagrams we also find that in the batik industry 95 percent (R^2=.95) of the variations in the entrepreneurs' willingness to participate in the development of the industries is explained by the factors on its left. We safely derive that these "sub-models" are very successful. Specifically, it is explained by age (p=-.82) and attitude towards development (p=.26). Additionally, the willingness to participate in development has contributed significantly in the explanation of the state of the development (p=-.81). The findings of the analyses of the entrepreneurs' attitudes and willingness could be summarised thus: the younger entrepreneurs, despite having limited physical resources, have the tendency to have a more favourable attitude towards the development of the industries and were more willing to participate in their development than the older entrepreneurs.

6. Conclusion

In this study we attempt to present a summary of the findings based on the research hypotheses. First, the industries in the study area are underdeveloped because they are treated as a secondary or supplementary activity to agriculture or other occupations. The findings indicate those entrepreneurs who are involved in the industry as their part-time occupation have a comparatively smaller size of enterprise than those who are involved full-time and have made the enterprises the main source of income. The findings indicate that there are linkages or correlations between the characteristics of the entrepreneurs and the state of the development of their industries. The findings indicate that the comparatively more developed industries were owned by the older entrepreneurs who have lower levels of education but have more income. Fourth, there is a link between producers' characteristics and their ability to change in a way which is necessary to modernise the industries. The findings show that the older entrepreneurs have a lower tendency or ability to change in terms of their negative attitude towards development and their unwillingness to participate in the development of their enterprises. Fifth, the development of the industries will necessitate some disruptions and sacrifices; some entrepreneurs will be unwilling to accept these changes. The findings indicate that, particularly among the older entrepreneurs, the development of the industries was perceived to threaten to disturb their rhythm of life. Furthermore, the introduction of new machines was seen as harmful not only to the product but also to the community's identity and reputation. Thus it can be seen that, on the basis of the quantitative and qualitative analysis presented in this chapter, it is possible generally to support the hypotheses which were posed at the commencement of this thesis, and which provided the basis for our enquiry. In the following chapters we will examine the constraints and potential facing the development of the handicraft industries under investigation from a fresh perspective by assessing the attitudes, attributes and ability of handicraft workers and non-participants to make a contribution to rural industrial development in the future. The findings imply and recommend

that it is imperative to consider and understand the local resources, skills, attitudes and aspirations in any government efforts to foster the development of these handicraft industries. The entrepreneurs and those who are involved in the industries should be consulted and involved during the process of policy formation. During the process of development of the industries the focus should be on the elimination of the constraints of development through, *inter alia*, the provision of infrastructure (such as capital, raw materials and marketing), and the acquisition of skills. In relation to the model of development, the Government should promote an appropriate model which is accorded with the artisans' needs and expectations, and which does not jeopardise the industries and their relationships with the community. Meanwhile, innovations such as new designs and value-added products should be pursued. Furthermore, for future development more people (particularly the younger people) should be encouraged to get involved in the industries. Finally, it is recommended that rural industrial development programmes need to be fully integrated within the national development framework, and with national industrial programmes.

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Appendix

Figure 2: Map of Kelantan, Malaysia

Students' Online Shopping Behavior: An Empirical Study

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ABSTRACT: The ever-increasing use of the internet in Malaysia provides a developing prospect for E-marketers. Such marketers' awareness of the factors affecting Malaysian buyers' attitude can further develop their marketing strategies in converting potential customers into active ones, while maintaining their existent online customers. This paper sets out to examine the factors influencing students' attitudes towards online shopping in Malaysia through a five-level Likert scale self-administered questionnaire, which was developed based on prior literature. A total of 370 students were randomly selected. The multiple regression analysis demonstrated the most significant determinants of consumers' attitudes towards online shopping. The results indicated that utilitarian orientation, convenience, price, and a wider selection influenced consumers' attitudes towards online shopping. Therefore, e-retailers should emphasize a more user-friendly function in order to provide utilitarian customers a way to find what they need efficiently. [Journal of American Science 2010;6(1):137-147]. (ISSN: 1545-1003).

Keywords: Attitude; online shopping; behavior, students

1. INTRODUCTION

Online shopping has been a growing phenomenon in all four corners of the world, in particular amongst countries possessing highly developed infrastructure available for marketing activities through the internet. Today, internet is not only a networking media, but also a global means of transaction for consumers. Internet usage has grown rapidly over the past years and it has become a common means for information transfer, services and trade. It has been reported that more than 627 million people in the world shopped online in 2006. (AcNielsen., 2007). Forrester (2006) anticipated that e-commerce market would grow from $228 billion in 2007 to $288 billion in 2009. Likewise in 2004, researchers were aware online retail sales in the US that were US$65 billion in 2004 would rise to US$117 billion in four years by 2008. Further, in 2005, it was anticipated that by 2010 e-commerce would account for US$316 billion in sales; that is to say, 13 percent of overall retail sales; therefore, 61 percent of online users in the US would make purchases via internet in 2010, compared with just 46 percent in 2004 (Jupiter Research Survey, 2005).

University Students, a population 90 percent of which access the internet daily, spends $200 billion a year in buying power to the US market, with the average student's available discretionary spending totaling $287 monthly (Gardyn, 2002). Therefore, because of student's power in the marketplace, it is important for retailers and consumers behavior educator to better understand this population's attitude toward online shopping. In the Malaysian context, with the expansion of educational services, university students have become common consumers of market segments (Sabri et al., 2008).

International Data Corporation (IDC) presents an outlook of internet and e-commerce industry in Malaysia, demonstrating the future market development from 2008 to 2012. The increase of unique internet users in Malaysia will create an awareness of e-commerce and make people interested in internet commerce. A mid-2005 survey by the Malaysian Communication and Multimedia Corporation (MCMC) indicated only 9.3 percent of internet users had purchased products or services through the internet during the preceding three months. Among those who did so, airline tickets were the most popular items (43.8%) followed by books (15.6%) and music (6.8%).

A large body of research is available on the online shopping in the world. However, there is still a need for closer examination on the online shopping buying behavior in specific countries. Considering that internet shopping is still at the early stage of development in Malaysia, little is known about consumers' attitudes towards adopting this new shopping channel and factors that influence their attitude (Haque, Sadeghzadeh, & Khatibi, 2006). The consumers' attitudes towards online shopping is known as the main factor that affects e-shopping

potential (Shwu-Ing, 2003). Attitudinal issues are also thought to play a significant role in e-commerce adoption; that is to say, through motivation and perception, attitudes are formed which, in turn, directly influence decision making (Haque et al., 2006). Therefore, understanding consumer attitude toward online shopping helps marketing managers to predict the online shopping rate and evaluate the future growth of online commerce. This paper first examines the relationship between consumer factors and attitude toward online shopping, and then analyzes the factors that influence attitude toward online shopping.

2. Factor affecting online shopping

Factors influencing peoples' online shopping attitude have been researched and documented in the context of traditional consumer literature. Consumers' characteristics such as personality nature, online shopping benefits and perceptions have also been found to influence consumers' online shopping behaviors and online shopping rate (Goldsmith & Flynn, 2004; Shwu-Ing, 2003). Therefore, understanding consumer attitudes helps marketing managers to predict the online shopping rate and evaluate the future growth of online commerce.

2.1 Personalities

Consumers have different personalities, which may influence their perception and how they perceive their online shopping behaviors that can be classified in two main orientations of utilitarian and hedonic (Wolfinbarger & Gilly, 2001).

Consumers who are utilitarian have goal-oriented shopping behaviors. Utilitarian shoppers shop online based on rational necessity which is related to a specific goal (Kim & Shim, 2002). They look for task-oriented, efficient, rational, deliberate online shopping rather than an entertaining experience (Wolfinbarger & Gilly, 2001). What they expect most from online shopping is to purchase in an efficient and timely way and to achieve their goals with the least amount of irritation (Monsuwe, Dellaert, & de Ruyter, 2004). In terms of the effect of utilitarian orientations, Shim et al. (2001) posit that consumers who highly evaluate the utilitarian aspect of shopping will more likely use the internet for an information source. According to Ndubisi and Sinti (2006), utilitarian orientation of the website rather than hedonic orientation has a significant influence on Malaysian adoption. Since customers attach greater importance to the transaction related features of the website rather than the entertainment features. Furthermore, Moe (2003) argues that consumers' underlying objectives of visiting a website will play a significant role in their purchase attitude towards that website. Results from her study also indicate a positive effect of a utilitarian orientation mode on purchase attitude.

Consumers who are hedonist have experiential shopping behavior. Hedonists not only gather information by shopping online but also seek fun, excitement, arousal, joy, festive, escapism, fantasy, adventure, etc. (Monsuwe et al., 2004). These experiential shoppers want to be immersed in the experience rather than to achieve their goals by shopping online (Wolfinbarger and Gilly, 2001) and their perceived experiences also depend on the medium characteristics that induce enjoyable experiences (Sorce, Perotti, & Widrick, 2005). Hedonic (or experiential) shoppers are more attracted to well-designed online shopping sites that are easy-to-navigate and visually appealing. Generally, when hedonists are satisfied, the possibility of impulse purchases and frequency of visiting the website will increase (Wolfinbarger and Gilly 2001). Therefore, the design of a website to attract experiential shoppers merits special attention to insure the conversion of shoppers' product navigation into purchases. Childers et al. (2001) have confirmed that hedonic orientations for online shopping are important predictors of attitudes toward online shopping. Thus, for systems that are hedonic in nature, researchers can expect hedonic orientations to play a significant role in consumers' attitudes toward online shopping.

2.2 Online shopping perceived benefits

Perceived benefits are ramifications derived from attributes. The benefits can be physiological, psychological, sociological, or material in nature. Within the online shopping context, the consumers' perceived benefits are the sum of online shopping advantages or satisfactions that meet their demands (Shwu-Ing, 2003).

Most of the previous online shopping research has focused on identifying the attributes of online stores that promote success (Davis, 1989; Muylle, Moenaert, & Despontin, 2004). Findings by Forsythe et al. (2002) showed a positive and highly significant relationship between perceived benefits of Internet shopping and both frequency of shopping and amount spent online. Consumers' shopping benefits may similarly affect shopping behaviors in the virtual environment. Moreover, Shwu-Ing (2003) found consumers' benefits perception, comprising convenience, selections freedom, information abundance, homepage design and company name familiarity, had a significant relationship with attitude toward online shopping. Consumers usually compare the perceived benefits between shopping channels. The main motivation to shop online is that it is more convenient than to shop in-store; in other words, convenience is the most prominent factor that

motivates consumers to shop through the internet. Moreover, ease of search, good price/deal, good selection/availability, fun, impulse, customer service, and wider selection of retailers are additional reasons why people shop online (Khatibi, Haque, & Karim, 2006).

3. MATERIALS AND MODELS

In this study, the research model (Figure 1) that was adhered to examine the factors affecting online shopping contains constructs that have demonstrated literature support, and is based on a body of research done in this area in different countries, particularly online shopping on end-user perspective.

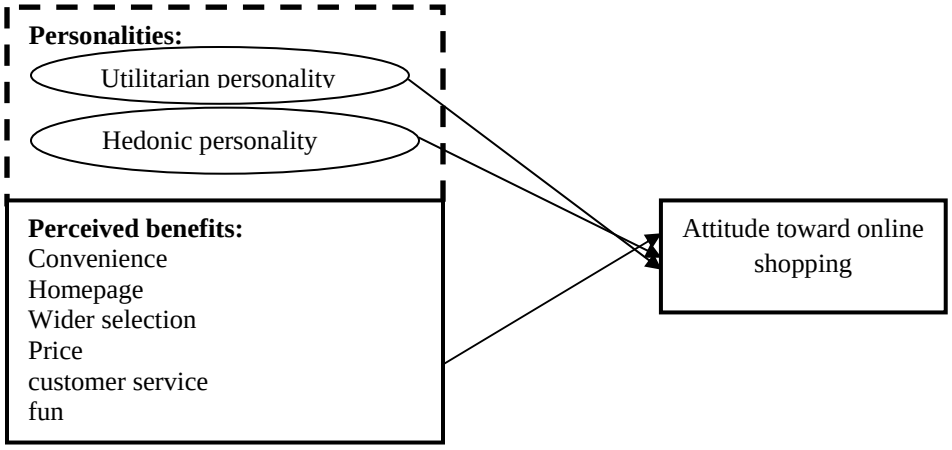

Figure1: Research Model

The schematic diagram of the research model above shows the relationship between the dependent and independent variables. Attitude toward online shopping is the dependent variable in this research. The dependent variable is analyzed in order to find out the answers or solution to the problem. Meanwhile, the independent variables in this research are online shopping orientations and consumers' perceived benefits. The independent variables are believed to be the variables that influence the dependent variable (attitude toward online shopping) in either a positive or a negative way.

A review of the related research shows that the theories of Reasoned Action (Fishbein & Ajzen, 1975) and Technology Acceptance Model (TAM) (Davis, 1989) are among the most popular theories used to explain online shopping behavior. Therefore, the theoretical framework of this study is based on these theories. The classic Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980), and Technology Acceptance Model (TAM) have been extensively adopted for explaining and predicting user behavior in an online shopping environment.

The TAM posits that actual system use is determined by users' behavioral intention to use, which is, in turn, influenced by their attitude toward usage. Attitude is directly affected by users' belief about a system, which consists of perceived usefulness and ease of use (Davis 1986). This belief-affect-intention-behavior causality has proven valid in the online shopping environment. The TAM was developed to predict and to explain consumer acceptance of online shopping by extending the belief-attitude-intention-behavior relationship in the TAM and TRA. In construction/development of the TAM, perceived usefulness and perceived ease of use reflect the utilitarian aspects of online shopping, while perceived enjoyment reflects the hedonic aspects of online shopping. Past research shows that perceived usefulness and perceived ease of use reflect utilitarian aspects of online shopping, whereas perceived enjoyment reflects hedonic aspects of online shopping (Monsuwe et al., 2004). Therefore, in the TAM, both utilitarian and hedonic aspects can be considered and both utilitarian and hedonic aspects of consumer experience influence consumer attitude toward using a new technology or system.

The TRA and the TAM claim that beliefs such as online shopping perceived benefits are completely mediated by attitude. The TRA asserts that beliefs such as perceived benefits are completely mediated by attitude. Verhoef and Langerak (2001) who employed the TRA in a study found that outcome beliefs had a significant influence on the attitude toward online shopping. The perceived benefits of online shopping in relation to traditional store shopping are one of the

driving forces in the adoption. The empirical findings support the premise that beliefs in online shopping attributes are positively related to attitudes to online shopping.

Hypotheses: The following hypotheses were developed from the proposed research model:
Hypothesis 1: There is a significant relationship between utilitarian personality and attitude toward online shopping
Hypothesis 2: There is a significant relationship between hedonic personality and attitude toward online shopping
Hypothesis 3: There is a significant relationship between perceived benefits and attitude toward online shopping.
Hypothesis 3a: There is a significant relationship between convenience and attitude.
Hypothesis 3b: There is a significant relationship between homepage and attitude.
Hypothesis 3c: There is a significant relationship between wider selection and attitude.
Hypothesis 3d: There is a significant relationship between price and attitude.
Hypothesis 3e: There is a significant relationship between customer service and attitude.
Hypothesis 3f: There is a significant relationship between fun and attitude.

3.1 Sample and data collection

Data for the study were gathered by primary data collection method through consumer survey questionnaires administered among postgraduate students from a public university in Malaysia. A self-administered questionnaire was distributed to 500 students in the selected institutes. All the selected respondents were enrolled in their respective faculties or institutes doing a broad range of courses. Among 500 questionnaires that were distributed, approximately 405 were returned, but only 370 fully answered questionnaires from the respondents were analyzed.

Frequency distribution profile of respondents showed that 64.3 percent of the respondents were female while 35.7 percent of the remaining respondents were male. The majority of the respondents (43.8 %) fall in the age range between 20 to 25 years of age. Respondents having a monthly income ranging from RM 1000 to 2000 were the majority income group (37.3 %). From the ethnic point of view, Malays comprised 44% followed by Chinese and Indians that composed 40% and 13% of the study sample respectively (Table 1).

Table 1: Demographic characteristics of respondents

Variables and category	frequency	Percentage
Gender		
Male	132	35.7
Female	238	64.3
Age(Years)		
20-25years	162	43.8
25-30	108	29.2
30-35	61	16.5
35-40	35	9.5
More than 40years	4	1.1
Level of education		
Master	290	78.4
Ph.D	72	19.5
Post-doctoral	8	2.2
Monthly Income		
Under RM1000	73	19.7
RM 1001-2000	138	37.3
RM 2001-3000	36	9.7
RM 3001-4000	82	22.2
Over RM 4000	41	11.1
Ethnicity		
Malay	165	44.6
Chinese	150	40.5
Indian	49	13.2
Others	6	1.6

3.2 Data Collection Instrument

The data for the study were gathered through a structured questionnaire. All variables were operationalized using the literature on online shopping (Babin, Darden, & Griffin, 1994; Bruner & Hensel, 1996; Forsythe et al., 2002; Huang & Liaw, 2005; Hui, Tan, & Goh, 2006; Kim & Shim, 2002; Mathieson, 1991; Turban & Gehrke, 2000; Vijayasarathy, 2002).

The first part of the questionnaire included questions concerning internet usage habits of the respondents such as where they accessed the internet, how often they browsed the internet, how much time they spent, what purposes they used the internet for and which kind of products they purchased online. The second part consisted of questions measuring all the variables including two questions which were meant to measure the frequency of their online shopping. All the questions utilized a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.3 Measures

Validity, the degree to which the instrument measures what it claims to be measuring. More specifically, content validity is demonstrated by assessing if the instrument is a representative sample of the content it was originally designed to measure which is often addressed in the development stage. The researcher sought to account for the content validity of the instrument by basing its items on the related literature and exploiting the experience of other researchers and experts. Moreover, in order to improve the face validity of the survey, the instrument was reviewed for two times by an expert panel consisted of 4 members of professionals in the area.

On the other hand, to ensure convergence validity of the variables, factor analysis (principal component) was used to determine the underlying constructs that explain significant portions of the variance in the instrument items. The factor loadings, i.e. the correlation coefficients between the items and factors, were examined in order to impute a label to the different factors. The factor loadings for all items exceeded the minimum value of 0.4 considered for this study. Table 2 shows the number of items comprising each factor loading value.

Cronbach's alpha coefficient is the most frequently used estimate of internal consistency reliability. Cronbach Alpha scores for online shopping orientation, online shopping perceived benefits and attitude toward online shopping were computed to assess inter-item reliability for each of the multi-item variables. Cronbach's alpha coefficient was high in all scales, ranging from 0.83 to 0.90. These alpha scores exceed the .80 recommended acceptable inter-items reliability limit, indicating that the factors within each multi-item variable are, in fact, inter-related.

Table 2: Rotated Factor Matrix (a)

Measures and factors	1	2	3	4	5	6	7	8
Utilitarian1	.866							
Utilitarian2	.780							
Utilitarian3	.761							
Utilitarian4	.628							
Utilitarian5	.602							
Hedonic1		.909						
Hedonic2		.844						
Hedonic3		.771						
Hedonic4		.747						
Hedonic5		.665						
Hedonic6		.591						
Hedonic7		.589						
Convenience1			.851					
Convenience2			.832					
Convenience3			.777					
Convenience 4			.734					
Convenience5			.711					
Convenience6			.687					
Convenience7			.620					
Wider Selection1				.859				

Wider Selection2				.766			
Price1					.886		
Price2					.692		
Customer Service1						.827	
Customer Service2						.809	
Customer Service3						.799	
Customer Service4						.649	
Customer Service5						.618	
Homepage1							.790
Homepage2							.556
Homepage3							.436
Fun1							.693
Fun2							.679
Fun3							.602
Fun4							.569
Fun5							.536

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser, Normalizatio

3.4 Data analysis techniques

Frequency distribution of the respondents was carried out according to questions related to internet usage and product purchase behavior. To test the hypotheses of this study, multiple regressions were conducted. The analysis enabled us to examine the individual relationship between the independent variables and attitude toward online shopping. This study employs user attitude toward online shopping as dependent variables and utilitarian personality, hedonic personality and consumers' perceived benefits as independent variables.

4. RESULT

4.1 Internet usage

More than half of the respondents (61.1 %) accessed the internet from their homes or apartments. Therefore, the mode for the most frequent source of access to the internet among respondents was home. Regarding the length of time the users spent per week on surfing the internet, 43.8 percent of respondents used it for more than 20 hours. While only a minority of respondents (5.7%) spent less than 5 hours per week on the internet. In conclusion, the results show a general pattern of internet usage of young consumers in Malaysia whereby it could be concluded that because they have their own internet connection at home leads them to the be active internet users who spend ~~is~~ an average of more than 20 hours a week web surfing. In addition, majority of respondents had wireless access to the internet. With regard to users' computer experience, as presented in Table 3, 38.6 percent of respondents indicated having used the computer between seven and ten years while participants who reported have used computers for more than 10 years represented more than 45% of the sample.

Table 3: General usage of Internet

	frequency	Percentage
Primary access location		
Home/Dorm/Apartment	226	61.1
Workplace	85	23.0
Public facilities	59	15.9
Mode of access		
Dial-up	88	23.8
High speed(DSL/Cable/T1)	127	34.3
Wireless	155	41.9
Internet Surfing (H/W)		

less than 5 hours/week	21	5.7
5-10 hours/week	23	6.2
11-15 hours/week	68	18.4
16-20 hours/week	96	25.9
more than 20 hours/week	162	43.8
Computer experience		
less than 1 years	-	-
1-3 years	11	3.0
4-6 years	83	22.4
7-10 years	107	28.9
more than 10 years	169	45.7
Internet experience		
Less than 1 years	6	1.6
1-3 years	31	8.4
4-6 years	108	29.2
7-10 years	143	38.6
More than 10 years	82	22.2

4.2 Product purchase behavior

Regarding product purchasing, the current study results revealed the type of online purchases made by Malaysian students (Table 4). In ranking order, respondents indicated they would mostly like to shop online for "computer/electronics/software" (36.9%), "book/DVD/CD" (31.18%), "clothing/accessory/shoes" (18.26%) and "food/beverage" (5.35%), while the smallest proportion of purchases included "toys" (4.24 %). Therefore, the current study results revealed that the types of products purchased online by Malaysian students were similar to products purchased online by global internet shoppers.

Table 4: Product purchase behavior

	frequency	Percentage
Online buying:		
Food/beverage	29	5.35
Clothing/Accessory/Shoes	99	18.26
Toys	23	4.24
Computer/Electronics/Software	200	36.9
Book/DVD/CD	169	31.18
Others	22	4.05

4.3 Hypotheses testing

Ho1: There is no significant relationship between utilitarian personality and attitude.

The multiple regression result indicates a regression coefficient of beta = .115 and a significant value of p = .000 which is smaller than alpha at .05 level of significance which means that the null hypothesis is rejected. It can thus be concluded the association between utilitarian personality and attitude toward online shopping was positively significant.

Ho2: There is no significant relationship between hedonic personality and attitude.

A regression coefficient of beta = .037 and a significant value of p = .076 for utilitarian personality which is larger than alpha at .05 level of significance which means that we fail to reject the second null hypothesis. It can thus be concluded there was no relationship between hedonic personality and online shopping.

Ho3a: There is no significant relationship between the convenience and the attitude.

According to the results of the multiple regression analysis, convenience indicated a regression coefficient of beta = .437 and a significant value of p = .000 < .05, which means that the null hypothesis was rejected. Therefore, it can be concluded that there was a significant and positive association between convenience and attitude toward online shopping at .05 level of significance.

Ho3b: There is no significant relationship between the homepage and the attitude.
According to the results of multiple regression, utilitarian personality indicated a regression coefficient of beta = .019 and a significant value of $p = .212 > .05$, which means that we fail to reject the null hypothesis. Therefore, it can be concluded that there was a positive but insignificant association between homepage and attitude toward online shopping at .05 level of significance.

Ho3c: There is no significant relationship between the price and the attitude.
The results of multiple regression indicated a regression coefficient of beta = .206 for price and a significant value of $p = .000 < .05$. It can be interpreted that the null hypothesis mentioned above is rejected. Therefore, it is concluded that there was a positive and significant association between price and attitude toward online shopping at .05 level of significance.

Ho3d: There is no significant relationship between the wider selection and the attitude.
The results of multiple regression indicated a regression coefficient of beta = .243 for wider selection and a significant value of $p = .000 < .05$ which can thus be interpreted that the aforementioned null hypothesis is rejected. Therefore, it was concluded that there was a positive and significant association between wider selection and attitude toward online shopping at .05 level of significance.

Ho3e: There is no significant relationship between the customer service and the attitude.
The results of multiple regression indicated a regression coefficient of beta = .085 for customer service and a significant value of $p = .060 > .05$ which can thus be interpreted that we fail to reject the aforementioned null hypothesis. Therefore, it was concluded that there is no significant association between customer service and attitude toward online shopping at .05 level of significance.

Ho3f: There is no significant relationship between the fun and the attitude.
The results of data analysis indicated a regression coefficient of beta = .063 for fun and a significant value of $p = .095 > .05$ which can thus be interpreted that we fail to reject the aforementioned null hypothesis. Therefore, it is concluded that there was no significant association between fun and attitude toward online shopping at .05 level of significance.

Table 5: Estimates of coefficients for the model

Attitude dimension(Y)	B (Unstandardized Coefficients)	Std. Error	Beta (Standardized Coefficients)	t	*p-value*
Constant	-5.513	0.750		-7.349	0.000
Convenience	0.800	0.050	0.437	16.121	0.000
Price	0.961	0.097	0.206	9.948	0.000
Wider selection	1.154	0.115	0.243	9.768	0.000
Utilitarian	0.273	0.053	0.115	5.196	0.000
homepage	-0.057	0.046	-0.019	-1.251	0.212
Hedonic	-0.050	0.028	-0.037	-1.780	0.076
Customer service	0.234	.044	0.085	2.274	0.060
Fun	0125	.045	0.063	2.799	0.095

Notes: $R = 0.672$; $R^2 = 0.664$; Adj. $R^2 = 0.661$

5. DISCUSSION AND CONCLUSION

The analytical results of our investigation indicate relationships between consumers' perception of the factors that influence their attitude toward online shopping. The findings suggested that utilitarian orientations, convenience, price and wider selection are important determinants of users' attitude toward online shopping. Moreover, they have a significantly positive impact on users' attitude toward online shopping. A practical assessment of

these dimensions revealed that individuals, who purchase online, perceived significantly greater benefit in terms of convenience, price and a wider selection.

The analytical results are generally consistent with the findings of previous studies. Consumers' personal tendency was shown to affect their attitude toward online shopping. The findings showed that utilitarian orientations had higher affect on attitude while hedonic orientations had no significant effect with attitude toward online shopping. This may be due to the low level of involvement of the young consumers who have experience in online shopping (only 4.2 % buy through online regularly) (Shah Alam, Bakar, Ismail, & Ahsan, 2008). Therefore, findings from this study are consistent with previous studies by Moe (2003), Shim et al. (2001), and Li et al. (2002). As a result, users are goal-orientated and have previously been planning their most recent online purchase. Utilitarian shoppers may be inclined to shop through internet in order to increase shopping productivity. On the other hand, consumers' tendency when doing online shopping would be more likely to be utilitarian than hedonic (Ndubisi & Sinti, 2006). Therefore, e-retailers, who focus on utilitarian customers, should emphasize a more user-friendly function in order to provide utilitarian customers a way to find what they need efficiently.

In addition, a further aspect of the study included online shopping perceived benefits. The findings of the study imply that students are looking for more convenience (time and money saving), cheaper prices and wider selection when they shop online, making them as the dominant factors that motivate consumers to shop online. On the other hand, there were not significant relationship between users' attitude toward online shopping and homepage, customer service, and fun.. This may be due to the low level of involvement of the young consumers who have experience in online shopping (only 4.2 % buy through online regularly) (Shah Alam et al., 2008).

According to previous researches, it is suggested that convenience has a positive impact on attitude toward online shopping (Kim & Kim, 2004). A practical assessment of these dimensions revealed that individuals who purchase online, perceive value convenience and price as the most significant advantages of online shopping. Therefore, online retailers need to ensure that the online shopping process through their websites is made as simple and inexpensive as possible for consumers to shop online.

What is more, the findings of the study imply that a wider selection is a dominant factor in that it motivates students to shop online, a finding that is in line with previous research conducted by Haque et al, (2006) who found that good selection and a wider availability of product choices, offered by online retailers, motive consumers to purchase goods and services over the internet. In other words, the online shopping motivation scales capture a wide variety of reasons why people go shopping online or choose not to purchase online. Therefore, online retailers need to offer good selection and wider choice of products for shoppers.

The findings of the study imply that a price is a dominant factor in that it motivates users to shop online The result is consistent with the findings of Ghani et al. (2001) that has identified price positively influencing online purchase behavior. In addition, a lower price is the main reason online shoppers tend to purchase through internet because of competitive pressure, especially from new online retailers using price as a main competitive weapon to attract customers (Haque et al, 2006). Therefore, online retailers need to provide competitive price for products in order to attract online shoppers to their websites and encourage them to make a purchase decision. However, this will lead to intense price competition which is expected to increase even further with the availability of intelligent search engines and comparing shopping agents that enable online consumers to easily compare product offerings from various online retailers. Thus, in order to avoid intense price competition, online retailers need to find other ways to differentiate themselves from their competitors.

Finally, the findings suggest that online retailers need to provide more connivance and competitive price and more variety of products in order to attract more people encouraging them to make a purchase decision. However, this will lead to competition among retailers and the level of competition is expected to increase even further with the availability of intelligent search engines and the ascending number of shopping agents that enable consumers to easily obtain product information and compare product offerings from various online retailers. It is necessary to recognize the limitations of the current study. Then, it is proposed for future research to apply this instrument to variant consumer groups, be them university or non-university members. Moreover, Future investigation could also examine the causal relationships between factors and consumers' overall attitude toward online shopping employing a Structural Equation Modeling technique. In addition, Future research should use a more elaborate model in cooperating additional antecedent factors beyond those mentioned in this study.

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07/09/2009

Indirect Boundary Element Method For Calculation Of Potential Flow Around A Prolate Spheroid

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Abstract: In this paper, an indirect boundary element method (IDBEM) is applied to calculate an incompressible potential flow around a prolate spheroid using linear boundary elements and such potential flow around a prolate spheroid is calculated using different numbers of boundary elements to approximate the body surface.. In this case, the indirect boundary element method with dipoles distribution is used. IDBEM is based on the distribution of singularities, such as sources or dipoles over the boundary of the body and computes the unknowns in the form of singularity strengths. With indirect boundary element method one can choose a singularity type to best model a given system. IDBEM is popular due to its simplicity and it is more general and flexible for the solution of a given problem. A comparison study between computed results for velocity distribution and analytical results is made and it can be seen from tables and graphs that the computed results for velocity distribution are seen to be quite good in agreement with the analytical results for the problem under observation. [Journal of American Science 2010, 6(1):148-156].(ISSN:1545-1003)

Keyword: indirect direct boundary element method, potential flow, axisymmetric flow, steady flow, prolate spheroid.

Introduction:

The boundary element method (BEM) is a numerical technique consisting of sub-diving the surface of the fluid flow field into a series of discrete elements over which the function can vary and it has been progressing for the last forty years due to its simplicity and efficiency. Such method is gaining popularity day by day among the computational and engineering communities. The term boundary element method opened eyes in the department of civil engineering, Southampton University, United Kingdom (Brebbia,C.A,1978). In literature, these methods existed under different names such as 'panel methods', 'surface singularity methods', 'boundary integral equation methods' or 'boundary integral solutions'. In the past, finite difference method (FDM) and finite element method, etc. (Hirt,C.W.et al,1978, Markatos,N.G,1983, Demuran,A.O.et al,1982 and Ecer,A.,1982) were being used to find the numerical solutions of problems in computational fluid dynamics. But the boundary element methods offer important advantages over the domain type methods. One of the advantages is that with boundary element methods one has to define the whole surface of the body, whereas with domain methods it is necessary to discretize the entire flow field. So, it is easier to use, economical, cost effective and time saving due to small data than the other competing computational methods i.e. finite difference and finite element methods etc. The most important characteristics of these methods are the much smaller system of equations and considerable reduction in data, which are perquisite to run a computer program efficiently. Furthermore, boundary element methods are well suited to flow problems with infinite domains. The boundary element methods can be classified into direct and indirect boundary element methods. The direct method takes the form of a statement, which provides the values of unknown variables at any flow field point in terms of the complete set of all the boundary data The equation of direct method can be formulated using either as an approach based on Green's function (Lamb,H,1932, Milne-Thomson,L.M,1968, Kellogg,O.D,1929) or a particular case of the weighted residual methods (Brebbia,C.A. and Walker,S,1980). BEMs are classified as 'indirect' and 'direct' methods. The indirect method utilizes a distribution of singularities over the boundary of the body and computes this distribution as the solution of integral equation and the equation indirect method can be derived from that of direct method. The flow fields around three-dimensional bodies were calculated by using a lower-order indirect method (Hess,J.L. and Smith,A.M.O,1962,1967). The direct method was applied for calculating the potential flow problems

(Morino. et al,1975;Mushtaq,2009). Boundary element methods are essential the methods for solving partial differential equations (PDEs) arising in problems in such diverse topics as stress analysis, heat transfer and electromagnetic theory, potential theory, fracture mechanics, fluid mechanics, elasticity, elastostatics and elastodynamics, etc. (Muhammad,G,.et al,2009). These methods are also being used for the solution of incompressible flows around complex configurations. Thus the boundary element methods are powerful numerical techniques receiving much attention from computational researchers and engineering community, which are offering the numerical solutions of a large number of flow problems of different types and the computational cost, labor and time in these methods are much smaller than other computational methods.

Flow past a prolate spheroid:

Let a prolate spheroid be generated by rotating an ellipse with semi – major axis 'a' and semi – minor axis 'b' about its major axis and let a uniform stream of velocity U be in the positive direction of z–axis as shown in figure (1) (Shah.,2008;Mushtaq,2009) .

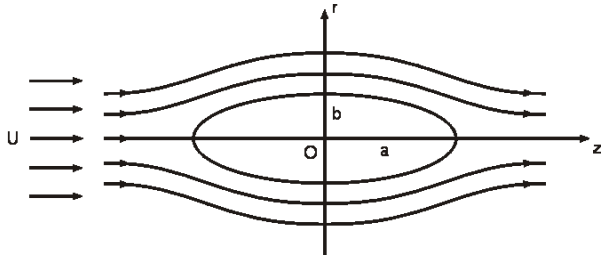

Figure 1

The Prolate spheroid is defined by the transformation

$$z + i\,r = c\cosh\zeta = c\cosh(\xi + i\eta)$$
$$= c\cosh\xi\cosh(i\eta) + c\sinh\xi\sinh(i\eta)$$
$$= c\cosh\xi\cos\eta + i\,c\sinh\xi\sin\eta$$

Comparison of real and imaginary parts gives

$$z = c\cosh\xi\cos\eta\,,\quad r = c\sinh\xi\sin\eta \qquad (1)$$

Therefore the curve $\xi = \xi_0$ is an ellipse in the z r – plane whose semi – axes are

$$\left.\begin{aligned} a &= c\cosh\xi_0 \\ b &= c\sinh\xi_0 \end{aligned}\right] \qquad (2)$$

and so $\xi = \xi_0$ is a Prolate spheroid .

The stream function ψ for a Prolate spheroid moving in the negative direction of the z – axis with velocity U is given by

$$\psi = \frac{\frac{1}{2}U b^2\left(\cosh\xi + \sinh^2\xi \ln\tanh\frac{\xi}{2}\right)\sin^2\eta}{\frac{a}{c} + \frac{b^2}{c^2}\ln\frac{a+b-c}{a+b+c}} \qquad (3)$$

Also , the stream function ψ for the uniform stream with velocity U , in the positive direction of z – axis is given by

$$\psi = -\frac{1}{2}U r^2$$

Therefore the stream function ψ for the streaming motion past a fixed Prolate spheroid in the positive direction of the z – axis becomes

$$\psi = -\frac{1}{2}U r^2 + \frac{\frac{1}{2}U b^2\left(\cosh\xi + \sinh^2\xi \ln\tanh\frac{\xi}{2}\right)\sin^2\eta}{\frac{a}{c} + \frac{b^2}{c^2}\ln\frac{a+b-c}{a+b+c}} \qquad (4)$$

which on using (1) becomes

$$\psi = -\frac{1}{2}U c^2\sinh^2\xi\sin^2\eta + \frac{\frac{1}{2}U b^2\left(\cosh\xi + \sinh^2\xi \ln\tanh\frac{\xi}{2}\right)\sin^2\eta}{\frac{a}{c} + \frac{b^2}{c^2}\ln\frac{a+b-c}{a+b+c}} \qquad (5)$$

To determine the formula for the velocity , the following relation is used (Shah,N.A.,2008)

$$V^2 r^2 f'(\zeta)\,\bar{f}'(\bar{\zeta}) = \left(\frac{\partial\psi}{\partial\xi}\right)^2 + \left(\frac{\partial\psi}{\partial\eta}\right)^2 \qquad (6)$$

Since $f(\zeta) = c\cosh(\zeta)$

$$f'(\zeta) = c\sinh(\zeta) = c\sinh(\xi + i\eta)\,,$$

$$\bar{f}'(\bar{\zeta}) = c\sinh(\xi - i\eta)$$

and $f'(\zeta)\,\bar{f}'(\bar{\zeta})$

$$= c^2(\sinh^2\xi\cos^2\eta + \cosh^2\xi\sin^2\eta) \qquad (7)$$

When $\xi = \xi_0$, then from (1) , (6) and (7)

$$V^2 c^4\sinh^2\xi_0\sin^2\eta\,(\sinh^2\xi_0\cos^2\eta + \cosh^2\xi_0\sin^2\eta) = \left(\frac{\partial\psi}{\partial\xi}\right)^2_{\xi=\xi_0} + \left(\frac{\partial\psi}{\partial\eta}\right)^2_{\xi=\xi_0} \qquad (8)$$

Now from (5) , we get

$$\left(\frac{\partial \psi}{\partial \xi}\right)_{\xi=\xi_0} = -U c^2 \sinh\xi_0 \cosh\xi_0 \sin^2\eta + \frac{U b^2 \left(\sinh\xi_0 + \sinh\xi_0 \cosh\xi_0 \ln\tanh\frac{\xi_0}{2}\right)\sin^2\eta}{\frac{a}{c}+\frac{b^2}{c^2}\ln\frac{a+b-c}{a+b+c}} \quad (9)$$

Since for a Prolate spheroid $a = c\cosh\xi_0$,

$$b = c\sinh\xi_0 \quad (10)$$

$$\text{But } \tanh\frac{\xi_0}{2} = \frac{a+b-c}{a+b+c} = \frac{b}{a+c} \quad (11)$$

From (9) , (10) , and (11) , we get

$$\left(\frac{\partial \psi}{\partial \xi}\right)_{\xi=\xi_0} = U\sin^2\eta\left[-ab + \frac{\frac{b^3}{c}+\frac{ab^3}{c^2}\ln\frac{b}{a+c}}{\frac{a}{c}+\frac{b^2}{c^2}\ln\frac{b}{a+c}}\right]$$

$$= U\sin^2\eta\left[\frac{-cb}{\frac{a}{c}+\frac{b^2}{c^2}\ln\frac{b}{a+c}}\right] \quad (12)$$

and from (5) , (10) , and (11) , we obtain

$$\left(\frac{\partial \psi}{\partial \eta}\right)_{\xi=\xi_0} = 0 \quad (13)$$

Using (12) and (13) , (8) becomes

$$V^2 c^4 \sinh^2\xi_0 \sin^2\eta \left[\sinh^2\xi_0\cos^2\eta + \cosh^2\xi_0\sin^2\eta\right] = \frac{U^2 b^2 c^2 \sin^4\eta}{\left[\frac{a}{c}+\frac{b^2}{c^2}\ln\frac{b}{a+c}\right]^2} \quad (14)$$

But from (1) and (2) , we get

$$\frac{z}{a} = \cos\eta, \quad \frac{r}{b} = \sin\eta \quad (15)$$

Using (10) , (15) in (14) , we have

$$V^2 = \frac{U^2 r^2 a^2 c^2}{\left[\frac{a}{c}+\frac{b^2}{c^2}\ln\frac{b}{a+c}\right]^2 (b^4 z^2 + a^4 r^2)} \quad (16)$$

Taking square root of (16) , the magnitude of exact velocity distribution over the boundary of a Prolate spheroid is given by

$$V = \frac{U a c r}{\left[\frac{a}{c}+\frac{b^2}{c^2}\ln\frac{b}{a+c}\right]\sqrt{b^4 z^2 + a^4 r^2}} \quad (17)$$

Boundary Conditions

The boundary condition to be satisfied over the surface of a Prolate spheroid is

$$\frac{\partial \phi_{p.s}}{\partial n} = U\left(\hat{n} \cdot \hat{k}\right) \quad (18)$$

where $\phi_{p.s}$ is the perturbation velocity potential of a Prolate spheroid and $\hat{n}$ is the outward drawn unit normal to the surface of a Prolate spheroid

The equation of the boundary of the Prolate spheroid

$$\frac{z^2}{a^2}+\frac{y^2}{b^2}+\frac{x^2}{b^2} = 1$$

$$\text{Let } f(x, y, z) = \frac{z^2}{a^2}+\frac{y^2}{b^2}+\frac{x^2}{b^2} - 1$$

$$\text{Then } \nabla f = \frac{2x}{b^2}\hat{i} + \frac{2y}{b^2}\hat{j} + \frac{2z}{a^2}\hat{k}$$

Therefore

$$\hat{n} = \frac{\nabla f}{|\nabla f|} = \frac{\frac{2x}{b^2}\hat{i} + \frac{2y}{b^2}\hat{j} + \frac{2z}{a^2}\hat{k}}{\sqrt{\left(\frac{2z}{a^2}\right)^2 + \left(\frac{2y}{b^2}\right)^2 + \left(\frac{2x}{b^2}\right)^2}}$$

$$\text{Thus } \hat{n} \cdot \hat{k} = \frac{\frac{2z}{a^2}}{\sqrt{\left(\frac{2z}{a^2}\right)^2 + \left(\frac{2y}{b^2}\right)^2 + \left(\frac{2x}{b^2}\right)^2}} = \frac{\frac{z}{a^2}}{\sqrt{\frac{z^2}{a^4}+\frac{y^2}{b^4}+\frac{x^2}{b^4}}}$$

Therefore, the boundary condition in (18) takes the form

$$\frac{\partial \phi_{p.s}}{\partial n} = U\frac{\frac{z}{a^2}}{\frac{\sqrt{b^4 z^2 + a^4 y^2 + a^4 x^2}}{b^2 a^2}} = \frac{z b^2}{\sqrt{b^4 z^2 + a^4 (y^2 + x^2)}}$$

(Taking U = 1) (19)

Equation (19) is the boundary condition, which must be satisfied over the boundary of a Prolate spheroid

For exterior flow for three-dimensional problems, the mathematical formulation for indirect

boundary element method in terms of doublets distribution over the boundary ς of the body is given by

$$-\frac{1}{2}\Phi_i + \phi_\infty + \iint_{\varsigma - i} \Phi \frac{\partial}{\partial n}\left(\frac{1}{4\pi r}\right) d\varsigma = z_i \quad (20)$$

Which is discretized by dividing the boundary of the body under consideration into 'm' elements and finally, it is written in matrix form as

$$[H]\{\underline{U}\} = \{\underline{R}\} \quad (21)$$

Whereas usual [H] is a matrix of influence coefficients, {U} is a vector of unknown total potentials Φ_p and $\{\underline{R}\}$ on the R.H.S. is a known vector whose elements are the negative of the values of the velocity potential of the uniform stream at the nodes on the boundary of the body.

Method of Element Distribution

The indirect boundary element method is applied to calculate the potential flow solution around the prolate spheroid for which the analytical solution is available.

Consider the surface of the sphere in one octant to be divided into three quadrilateral elements by joining the centroid of the surface with the mid points of the curves in the coordinate planes as shown in figure (2) (Mushtaq,M.et al,2009).

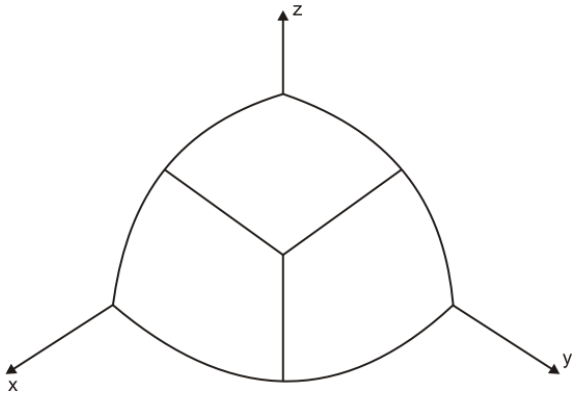

Figure 2

Then each element is divided further into four elements by joining the centroid of that element with the mid–point of each side of the element. Thus one octant of the surface of the sphere is divided into 12 elements and the whole surface of the body is divided into 96 boundary elements. The above mentioned method is adopted in order to produce a uniform distribution of element over the surface of the body.

Figure (3) shows the method for finding the coordinate (x_p, y_p, z_p) of any point P on the surface of the sphere.

From figure (3), we have the following equation

$$|\vec{r}_p| = 1$$

$$\vec{r}_p \cdot \vec{r}_1 = \vec{r}_p \cdot \vec{r}_2$$

$$(\vec{r}_1 - \vec{r}_2) \cdot \vec{r}_p = 0$$

or in cartesian form

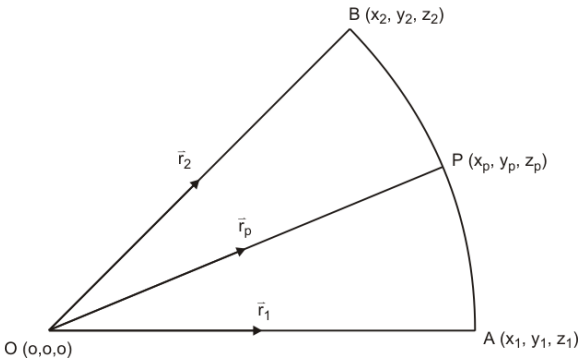

Figure 3

$$x_p^2 + y_p^2 + z_p^2 = 1$$

$$x_p(x_1 - x_2) + y_p(y_1 - y_2) + z_p(z_1 - z_2) = 0$$

$$x_p(y_1 z_2 - z_1 y_2) + y_p(x_2 z_1 - x_1 z_2) + z_p(x_1 y_2 - x_2 y_1) = 0$$

As the body possesses planes of symmetry, this fact may be used in the input to the program and only the non–redundant portion need be specified by input points. The other portions are automatically taken into account. The planes of symmetry are taken to be the coordinate planes of the reference coordinate system. The advantage of the use of symmetry is that it reduces the order of the resulting system of equations and consequently reduces the computing time in running a program. As a sphere is symmetric with respect to all three coordinate planes of the reference coordinate system, only one eighth of the body surface need be specified by the input points, while the other seven–eighth can be accounted for by symmetry.

The prolate spheroids of fineness ratios 2 and 10 are discretised into 24and 96 boundary elements and the computed velocity distributions are compared with analytical solutions for the prolate spheroids. In both cases of spheroids, the input points are

distributed on the surface of a sphere and the x and y-coordinates of these points are then divided by the fineness ratios to generate the points for the prolate spheroids. The number of boundary elements used to obtain the computed velocity distribution is the same as are used for the sphere.

The calculated velocity distributions are compared with analytical solutions for the prolate spheroid of fineness ratios 2 and 10 using Fortran programming.

Table (1): Comparison of the computed velocities with exact velocity over the surface of a prolate spheroid with fineness ratio 2 using 24 boundary elements.

ELEMENT	XM	YM	ZM	R = $\sqrt{(YM)^2 + (ZM)^2}$	COMPUTED VELOCITY	EXACT VELOCITY
1	-.321E+00	-.374E+00	.161E+00	.40718E+00	.11669E+01	.11871E+01
2	-.748E+00	-.161E+00	.161E+00	.22769E+00	.77235E+00	.93409E+00
3	-.748E+00	.161E+00	.161E+00	.22769E+00	.77235E+00	.93409E+00
4	-.321E+00	.374E+00	.161E+00	.40718E+00	.11669E+01	.11871E+01
5	.321E+00	.374E+00	.161E+00	.40718E+00	.11669E+01	.11871E+01
6	.748E+00	.161E+00	.161E+00	.22769E+00	.77235E+00	.93409E+00
7	.748E+00	-.161E+00	.161E+00	.22769E+00	.77235E+00	.93409E+00
8	.321E+00	-.374E+00	.161E+00	.40718E+00	.11669E+01	.11871E+01
9	-.321E+00	-.161E+00	.374E+00	.40718E+00	.11669E+01	.11871E+01
10	-.321E+00	.161E+00	.374E+00	.40718E+00	.11669E+01	.11871E+01
11	.321E+00	.161E+00	.374E+00	.40718E+00	.11669E+01	.11871E+01
12	.321E+00	-.161E+00	.374E+00	.40718E+00	.11669E+01	.11871E+01

Table (2): Comparison of the computed velocities with exact velocity over the surface of a prolate spheroid with fineness ratio 10 using 24 elements.

ELEMENT	XM	YM	ZM	R = $\sqrt{(YM)^2 + (ZM)^2}$	COMPUTED VELOCITY	EXACT VELOCITY
1	-.321E+00	-.748E-01	.321E-01	.08139E+00	.10315E+01	.10199E+01
2	-.748E+00	-.321E-01	.321E-01	.04539E+00	.94676E+00	.10071E+01
3	-.748E+00	.321E-01	.321E-01	.04539E+00	.94676E+00	.10071E+01
4	-.321E+00	.748E-01	.321E-01	.08139E+00	.10315E+01	.10199E+01
5	.321E+00	.748E-01	.321E-01	.08139E+00	.10315E+01	.10199E+01
6	.748E+00	.321E-01	.321E-01	.04539E+00	.94676E+00	.10071E+01
7	.748E+00	-.321E-01	.321E-01	.04539E+00	.94676E+00	.10071E+01
8	.321E+00	-.748E-01	.321E-01	.08139E+00	.10315E+01	.10199E+01
9	-.321E+00	-.321E-01	.748E-01	.08139E+00	.10315E+01	.10199E+01
10	-.321E+00	.321E-01	.748E-01	.08139E+00	.10315E+01	.10199E+01
11	.321E+00	.321E-01	.748E-01	.08139E+00	.10315E+01	.10199E+01
12	.321E+00	-.321E-01	.748E-01	.08139E+00	.10315E+01	.10199E+01

Table (3): Comparison of the computed velocities with exact velocity over the surface of a prolate spheroid with fineness ratio 2 using 96 boundary elements.

ELEMENT	XM	YM	ZM	R = $\sqrt{(YM)^2 + (ZM)^2}$	COMPUTED VELOCITY	EXACT VELOCITY
1	-.177E+00	-.467E+00	.885E-01	.47529E+00	.12038E+01	.12048E+01
2	-.522E+00	-.399E+00	.785E-01	.40676E+00	.11455E+01	.11521E+01
3	-.798E+00	-.261E+00	.785E-01	.27264E+00	.94257E+00	.97640E+00
4	-.934E+00	-.885E-01	.885E-01	.12511E+00	.48460E+00	.57150E+00
5	-.934E+00	.885E-01	.885E-01	.12511E+00	.48460E+00	.57150E+00
6	-.798E+00	.261E+00	.785E-01	.27264E+00	.94257E+00	.97640E+00
7	-.522E+00	.399E+00	.785E-01	.40676E+00	.11455E+01	.11521E+01
8	-.177E+00	.467E+00	.885E-01	.47529E+00	.12038E+01	.12048E+01
9	.177E+00	.467E+00	.885E-01	.47529E+00	.12038E+01	.12048E+01

10	.522E+00	.399E+00	.785E-01	.40676E+00	.11455E+01	.11521E+01
11	.798E+00	.261E+00	.785E-01	.27264E+00	.94257E+00	.97640E+00
12	.934E+00	.885E-01	.885E-01	.12511E+00	.48460E+00	.57150E+00
13	.934E+00	-.885E-01	.885E-01	.12511E+00	.48460E+00	.57150E+00
14	.798E+00	-.261E+00	.785E-01	.27264E+00	.94257E+00	.97640E+00
15	.522E+00	-.399E+00	.785E-01	.40676E+00	.11455E+01	.11521E+01
16	.177E+00	-.467E+00	.885E-01	.47529E+00	.12038E+01	.12048E+01
17	-.157E+00	-.399E+00	.261E+00	.47693E+00	.12001E+01	.12059E+01
18	-.470E+00	-.352E+00	.235E+00	.42289E+00	.11630E+01	.11659E+01
19	-.703E+00	-.235E+00	.235E+00	.33220E+00	.10325E+01	.10695E+01
20	-.798E+00	-.785E-01	.261E+00	.27264E+00	.94257E+00	.97640E+00
21	-.798E+00	.785E-01	.261E+00	.27264E+00	.94257E+00	.97640E+00
22	-.703E+00	.235E+00	.235E+00	.33220E+00	.10325E+01	.10695E+01
23	-.470E+00	.352E+00	.235E+00	.42289E+00	.11630E+01	.11659E+01
24	-.157E+00	.399E+00	.261E+00	.47693E+00	.12001E+01	.12059E+01
25	.157E+00	.399E+00	.261E+00	.47693E+00	.12001E+01	.12059E+01
26	.470E+00	.352E+00	.235E+00	.42289E+00	.11630E+01	.11659E+01
27	.703E+00	.235E+00	.235E+00	.33220E+00	.10325E+01	.10695E+01
28	.798E+00	.785E-01	.261E+00	.27264E+00	.94257E+00	.97640E+00
29	.798E+00	-.785E-01	.261E+00	.27264E+00	.94257E+00	.97640E+00
30	.703E+00	-.235E+00	.235E+00	.33220E+00	.10325E+01	.10695E+01
31	.470E+00	-.352E+00	.235E+00	.42289E+00	.11630E+01	.11659E+01
32	.157E+00	-.399E+00	.261E+00	.47693E+00	.12001E+01	.12059E+01
33	-.157E+00	-.261E+00	.399E+00	.47693E+00	.12001E+01	.12059E+01
34	-.470E+00	-.235E+00	.352E+00	.42289E+00	.11630E+01	.11659E+01
35	-.522E+00	-.785E-01	.399E+00	.40676E+00	.11455E+01	.11521E+01
36	-.522E+00	.785E-01	.399E+00	.40676E+00	.11455E+01	.11521E+01
37	-.470E+00	.235E+00	.352E+00	.42289E+00	.11630E+01	.11659E+01
38	-.157E+00	.261E+00	.399E+00	.47693E+00	.12001E+01	.12059E+01
39	.157E+00	.261E+00	.399E+00	.47693E+00	.12001E+01	.12059E+01
40	.470E+00	.235E+00	.352E+00	.42289E+00	.11630E+01	.11659E+01
41	.522E+00	.785E-01	.399E+00	.40676E+00	.11455E+01	.11521E+01
42	.522E+00	-.785E-01	.399E+00	.40676E+00	.11455E+01	.11521E+01
43	.470E+00	-.235E+00	.352E+00	.42289E+00	.11630E+01	.11659E+01
44	.157E+00	-.261E+00	.399E+00	.47693E+00	.12001E+01	.12059E+01
45	-.177E+00	-.885E-01	.467E+00	.47529E+00	.12038E+01	.12048E+01
46	-.177E+00	.885E-01	.467E+00	.47529E+00	.12038E+01	.12048E+01
47	.177E+00	.885E-01	.467E+00	.47529E+00	.12038E+01	.12048E+01
48	.177E+00	-.885E-01	.467E+00	.47529E+00	.12038E+01	.12048E+01

Table (4): Comparison of the computed velocities with exact velocity over the surface of a prolate spheroid with fineness ratio 10 using 96 boundary elements.

ELEMENT	XM	YM	ZM	R = $\sqrt{(YM)^2 + (ZM)^2}$	COMPUTED VELOCITY	EXACT VELOCITY
1	-.177E+00	-.934E-01	.177E-01	.95057E-01	.10261E+01	.10205E+01
2	-.522E+00	-.798E-01	.157E-01	.81353E-01	.10256E+01	.10186E+01
3	-.798E+00	-.522E-01	.157E-01	.54527E-01	.10027E+01	.10099E+01
4	-.934E+00	-.177E-01	.177E-01	.25022E-01	.86585E+00	.95627E+00
5	-.934E+00	.177E-01	.177E-01	.25022E-01	.86585E+00	.95627E+00
6	-.798E+00	.522E-01	.157E-01	.54527E-01	.10027E+01	.10099E+01
7	-.522E+00	.798E-01	.157E-01	.81353E-01	.10256E+01	.10186E+01
8	-.177E+00	.934E-01	.177E-01	.95057E-01	.10261E+01	.10205E+01
9	.177E+00	.934E-01	.177E-01	.95057E-01	.10261E+01	.10205E+01
10	.522E+00	.798E-01	.157E-01	.81353E-01	.10256E+01	.10186E+01
11	.798E+00	.522E-01	.157E-01	.54527E-01	.10027E+01	.10099E+01
12	.934E+00	.177E-01	.177E-01	.25022E-01	.86585E+00	.95627E+00

13	.934E+00	-.177E-01	.177E-01	.25022E-01	.86585E+00	.95627E+00
14	.798E+00	-.522E-01	.157E-01	.54527E-01	.10027E+01	.10099E+01
15	.522E+00	-.798E-01	.157E-01	.81353E-01	.10256E+01	.10186E+01
16	.177E+00	-.934E-01	.177E-01	.95057E-01	.10261E+01	.10205E+01
17	-.157E+00	-.798E-01	.522E-01	.95386E-01	.10202E+01	.10206E+01
18	-.470E+00	-.703E-01	.470E-01	.84578E-01	.10247E+01	.10191E+01
19	-.703E+00	-.470E-01	.470E-01	.66440E-01	.10478E+01	.10150E+01
20	-.798E+00	-.157E-01	.522E-01	.54527E-01	.10027E+01	.10099E+01
21	-.798E+00	.157E-01	.522E-01	.54527E-01	.10027E+01	.10099E+01
22	-.703E+00	.470E-01	.470E-01	.66440E-01	.10478E+01	.10150E+01
23	-.470E+00	.703E-01	.470E-01	.84578E-01	.10247E+01	.10191E+01
24	-.157E+00	.798E-01	.522E-01	.95386E-01	.10202E+01	.10206E+01
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27	.703E+00	.470E-01	.470E-01	.66440E-01	.10478E+01	.10150E+01
28	.798E+00	.157E-01	.522E-01	.54527E-01	.10027E+01	.10099E+01
29	.798E+00	-.157E-01	.522E-01	.54527E-01	.10027E+01	.10099E+01
30	.703E+00	-.470E-01	.470E-01	.66440E-01	.10478E+01	.10150E+01
31	.470E+00	-.703E-01	.470E-01	.84578E-01	.10247E+01	.10191E+01
32	.157E+00	-.798E-01	.522E-01	.95386E-01	.10202E+01	.10206E+01
33	-.157E+00	-.522E-01	.798E-01	.95386E-01	.10202E+01	.10206E+01
34	-.470E+00	-.470E-01	.703E-01	.84578E-01	.10247E+01	.10191E+01
35	-.522E+00	-.157E-01	.798E-01	.81353E-01	.10256E+01	.10186E+01
36	-.522E+00	.157E-01	.798E-01	.81353E-01	.10256E+01	.10186E+01
37	-.470E+00	.470E-01	.703E-01	.84578E-01	.10247E+01	.10191E+01
38	-.157E+00	.522E-01	.798E-01	.95386E-01	.10202E+01	.10206E+01
39	.157E+00	.522E-01	.798E-01	.95386E-01	.10202E+01	.10206E+01
40	.470E+00	.470E-01	.703E-01	.84578E-01	.10247E+01	.10191E+01
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46	-.177E+00	.177E-01	.934E-01	.95057E-01	.10261E+01	.10205E+01
47	.177E+00	.177E-01	.934E-01	.95057E-01	.10261E+01	.10205E+01
48	.177E+00	-.177E-01	.934E-01	.95057E-01	.10261E+01	.10205E+01

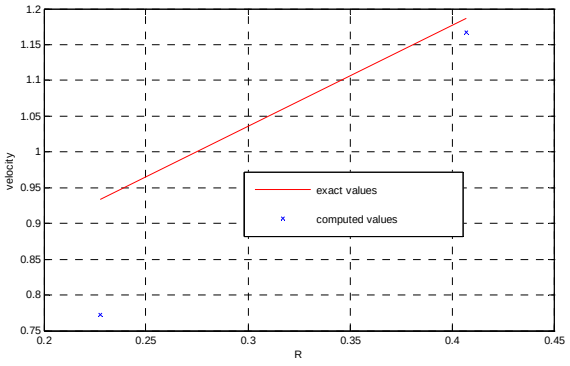

Figure 4: Comparison of computed and analytical velocity distributions over the surface of a prolate spheroid using 24 boundary elements with fineness ratio 2

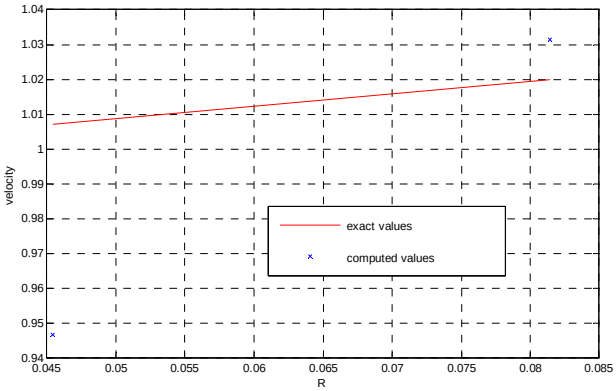

Figure 5: Comparison of computed and analytical velocity distributions over the surface of a prolate spheroid using 24 boundary elements with fineness ratio 10

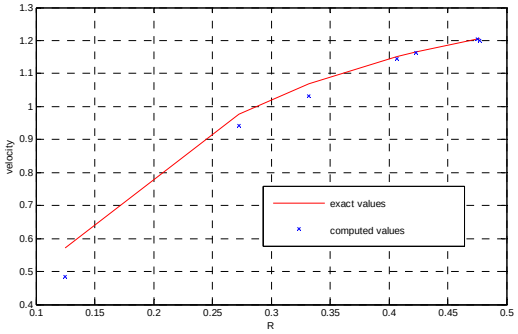

Figure 6: Comparison of computed and analytical velocity distributions over the surface of a prolate spheroid using 96 boundary elements with fineness ratio 2

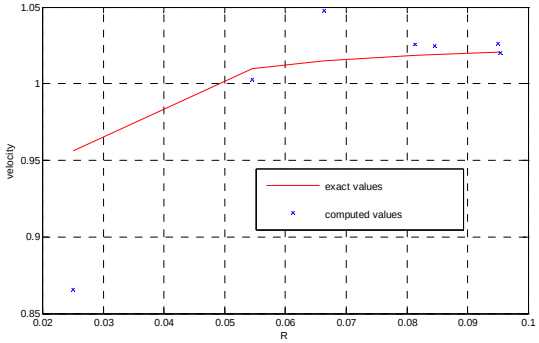

Figure 7: Comparison of computed and analytical velocity distributions over the Surface of a Prolate spheroid using 96 boundary elements with fineness ratio 10

Conclusion

An indirect boundary element method (IDBEM) is applied for calculation of an incompressible potential flow around a prolate spheroid. The computed results for flow velocities obtained by this method are compared with the analytical solutions for flow past a prolate spheroid. It is found from tables and graphs that the computed results for velocity distribution in both cases of prolate spheroids of fineness ratios 2 and 10 are seen to be quite good in agreement with the analytical results and the accuracy of results increases with the rise of number of boundary elements and fineness ratio. Indirect direct can be very useful in modeling bodies of complicated types like airplanes, road vehicles, space shuttle, missiles ,ships and submarines, etc.

Acknowledgement

We are thankful to the University of Engineering & Technology, Lahore – Pakistan for financial support.

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Performance optimization of a Diesel cycle with specific heat ratio

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Abstract: The performance of an air standard Diesel cycle is analyzed by using finite-time thermodynamics. The relations between the power output and the compression ratio, between the thermal efficiency and the compression ratio, and the optimal relation between power output and the efficiency of the Diesel cycle are derived by detailed numerical examples. Moreover, the effects of specific heat ratio of the working fluid on the irreversible cycle performance are analyzed. The results show that there are significant effects of the specific heat of the working fluid on the performance of the Diesel cycle. The conclusions obtained in this investigation are in full agreement with those of published studies for other cycles and may be used when considering the designs of actual Diesel engines. [Journal of American Science 2010;6(1):157-161]. (ISSN: 1545-1003).

Key words: finite-time thermodynamics; Diesel cycle; internal irreversibility; performance optimization

1. Introduction

In the last two decades, by using finite time thermodynamics theory, many optimization studies based on various performance criteria have been carried out for endoreversible and irreversible heat engine models. (Sieniutycz and Salamon, 1990; Chen et al., 2008; Ge et al., 2008a). Mozurkewich and Berry (1982) and Hoffman et al. (1985) used mathematical techniques, developed in optimal-control theory, to reveal the optimal motions of the pistons in Otto and Diesel cycle engines, respectively. Orlov and Berry (1993) deduced the power and efficiency upper limits for internal-combustion engines. Blank and Wu (1993) examined the effect of combustion on the work or power optimised Otto, Diesel and Dual cycles. They derived the maximum work or power and the corresponding efficiency bounds. Lin et al. (1999) derived the relations between the net power and the efficiency for the Dual cycle with due consideration of the heat-transfer losses. Akash (2001) investigated the effect of heat transfer on thermal performance of an air-standard Diesel cycle. Chen et al. (2002) modeled the behaviors of Diesel cycle, with friction losses, over a finite period. Wang et al. (2002) modeled the dual cycle with a friction like term loss and studied the effect of the friction like term loss on cycle performance. Chen et al. (2003, 2004) determined the characteristics of power and efficiency for Otto and Dual cycles with heat transfer and friction losses. Ge et al. (2005) derived the performance characteristics of the diesel cycle with heat transfer and friction like term losses when the maximum temperature of the cycle was not fixed. Parlak and Sahin [2006] defined the internal irreversibility by using entropy production, and analyzed the effect of the internal irreversibility on the performance of irreversible reciprocating heat-engine cycle. Al-Sarkhi et al. (2006) found that friction and the temperature-dependent specific heat of the working fluid of a Diesel engine had significant influences on its power output and efficiency. Ge et al. (2007) studied the effects of variable specific heats of the working fluid on the performances of the Diesel cycle. Ge et al. (2008a; 2008b; 2009) analyzed the performance of an air standard Otto, Diesel and dual cycles. In the irreversible cycle model, the non-linear relation between the specific heat of the working fluid and its temperature, the friction loss computed according to the mean velocity of the piston, the internal irreversibility described by using the compression and expansion efficiencies, and the heat transfer loss are considered. Ebrahimi (2009a) studied the effects of the temperature dependent specific heat ratio of the working fluid on the performance of the Dual cycle.

As can be seen in the relevant literature, the investigation of the effect of specific heat ratio on performance of Diesel cycle does not appear to have been published. Therefore, the objective of this study is to examine the effect of engine speed on performance of air standard Diesel cycle.

2. An air standard Diesel cycle model

An air-standard diesel cycle model is shown in Fig. 1. Process $1 \to 2s$ is a reversible adiabatic compression, while process $1 \to 2$ is an irreversible

adiabatic process that takes into account the internal irreversibility in the real compression process. The heat addition is an isobaric process $2 \to 3$. Process $3 \to 4s$ is a reversible adiabatic expansion, while $3 \to 4$ is an irreversible adiabatic process that takes into account the internal irreversibility in the real expansion process. The heat rejection is an isochoric process $4 \to 1$.

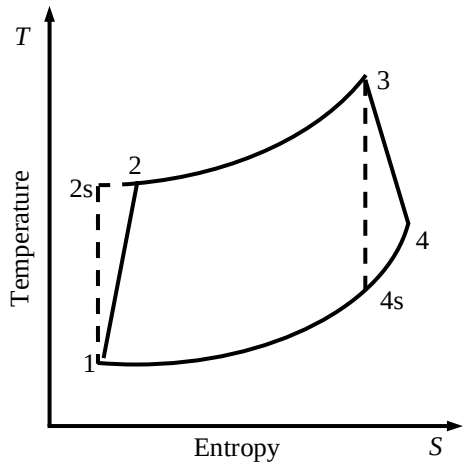

Figure 1. $T-S$ diagram for the air standard Diesel cycle

For the heat addition and heat rejection ($2 \to 3$ and $4 \to 1$ stages, respectively), it is assumed that heating occurs from state 2 to state 3 and cooling ensues from state 4 to state 1 and proceed according to isothermal rates, as shown in Eqs. (1) and (2) (Chen et al., 2002; Al-Sarkhi et al., 2006):

$$dT/dt = 1/K_1 \quad (\text{for } 2 \to 3) \tag{1}$$

and

$$dT/dt = 1/K_2 \quad (\text{for } 4 \to 1) \tag{2}$$

where T is the absolute temperature and t is the time; K_1 and K_2 are constants. By integrating Eqs. (1) and (2), we obtain:

$$t_1 = K_1(T_3 - T_2) \tag{3}$$

and

$$t_2 = K_2(T_4 - T_1) \tag{4}$$

where t_1 and t_2 are the heating and cooling periods, respectively. Then, the cycle period is

$$\tau = t_1 + t_2 = K_1(T_3 - T_2) + K_2(T_4 - T_1) \tag{5}$$

The total reversible power output is

$$P_{rev} = \frac{W_{out}}{\tau} = \frac{Mc_p(T_3 - T_2) - Mc_v(T_4 - T_1)}{K_1(T_3 - T_2) + K_2(T_4 - T_1)} \tag{6}$$

where W_{out} is the total reversible work, c_v is the constant volume specific heat, c_p is the constant pressure specific heat and M is the molar number of the working fluid.

The relation between the specific heat at constant pressure and the specific heat at constant volume is:

$$c_p - c_v = R \tag{7}$$

where R is the molar gas constant of the working fluid.

The compression ratio is defined as:

$$r_c = V_1/V_2 \tag{8}$$

For the processes $1 \to 2s$ and $3 \to 4s$, we have

$$T_{2s} = T_1 r_c^{\gamma-1} \tag{9}$$

and

$$T_{4s} = T_1^{\gamma-1} T_3^{\gamma} r_c^{(1-\gamma)\gamma} \tag{10}$$

Where γ is the ratio of specific heats, $\gamma = c_p/c_v$.

For the two reversible adiabatic processes $1 \to 2s$ and $3 \to 4s$, the compression and expansion efficiencies can be defined as (Ge et al., 2008a; Ebrahimi, 2009c; Lin and Hou, 2008):

$$\eta_c = (T_{2s} - T_1)/(T_2 - T_1) \tag{11}$$

and

$$\eta_e = (T_4 - T_3)/(T_{4s} - T_3) \tag{12}$$

where:

By substituting Eqs. (7)–(12) into Eq. (6), The total reversible power output becomes:

$$P_{rev} = \frac{\begin{MR}\left[T_1\left(\eta_c - \gamma r_c^{\gamma-1} + \gamma\right) - \eta_c\gamma + \right.\\ \left. T_3\left(\eta_c\eta_e - \eta_c + \eta_c\gamma\right) - \eta_c\eta_e T_1^{\gamma-1} T_3^{\gamma} r_c^{(1-\gamma)\gamma}\right]\end{MR}}{\begin{(\gamma-1)}\left[T_1\left(K_1 - K_1 r_c^{\gamma-1} - K_2\eta_c\right) + \right.\\ T_3\left(K_1\eta_c + K_2\eta_c - K_2\eta_c\eta_e\right) - K_1\eta_c + \\ \left. K_2\eta_c\eta_e T_1^{\gamma-1} T_3^{\gamma} r_c^{(1-\gamma)\gamma}\right]\end{(\gamma-1)}} \tag{13}$$

Taking into account the friction loss of the piston and assuming a dissipation term represented by a friction force that is a linear function of the piston velocity gives (Chen et al., 2006; Ge et al., 2007; Ebrahimi, 2009a)

$$f_\mu = -\mu S_p = -\mu\, dx/dt \tag{14}$$

where μ is the coefficient of friction, which takes into account the global losses, x is the piston's displacement and S_p is the piston's velocity. Therefore, the lost power due to friction is

$$P_{los} = dW_{los}/dt = -\mu(dx/dt)(dx/dt) = -\mu(S_p)^2 \tag{15}$$

The piston mean velocity is

$$\bar{S}_p = (x_1 - x_2)/\Delta t_{12} = \left[x_2(r_c - 1)\right]/\Delta t_{12} \tag{16}$$

Where x_2 is the piston at minimum volume and Δt_{12} is the time spent in the power stroke. Thus, the

resulting power output $\left(P_{out} = P_{rev} - P_{los}\right)$ is:

$$P_{out} = \frac{MR\left[T_1\left(\eta_c - \gamma r_c^{\gamma-1} + \gamma\right) + T_1\left(K_1 - K_1 r_c^{\gamma-1} - K_2\eta_c\right) \eta_c\eta_e T_1^{\gamma-1} T_3^{\gamma} r_c^{(1-\gamma)\gamma} - \eta_c\gamma\right]}{(\gamma-1)\left[K_2\eta_c\eta_e T_1^{\gamma-1} T_3^{\gamma} r_c^{(1-\gamma)\gamma} + T_3\left(K_1\eta_c + K_2\eta_c - K_2\eta_c\eta_e\right) - K_1\eta_c + T_1\left(K_1 - K_1 r_c^{\gamma-1} - K_2\eta_c\right)\right]} - b\left(r_c - 1\right)^2 \quad (17)$$

Where $b = \mu x_2^2 / \left(\Delta t_{12}\right)^2$, and the thermal efficiency of the Diesel cycle engine is expressed by

$$\eta_{th} = P / \left(Q_{in} / \tau\right) \quad (18)$$

where:

$$Q_{in} = M c_p \left(T_3 - T_2\right) \quad (19)$$

Notice that both power and efficiency are convex functions of the compression ratio.

The relations between the power output and the compression ratio, as well as between the efficiency and the compression ratio, can be derived from Eqs. (17) and (18). The maximum power and the corresponding efficiency can be obtained by numerical calculations.

3. Numerical examples and discussions

According to references (Chen et al. 2006; Ghatak and Chakraborty, 2007; Ge et al., 2009; Ebrahimi, 2009b), the following parameters are used: $\eta_e = 0.97$, $\eta_c = 0.97$, $M = 1.57 \times 10^{-5}\ kmol$, $T_3 = 2200\ K$, $K_1 = 8.128 \times 10^{-6}\ s.K^{-1}$, $\gamma = 1.3 \to 1.4$, $b_1 = 15\ kW$ $K_2 = 18.67 \times 10^{-6}\ s.K^{-1}$, $r_c = 1 \to 40$ and $T_1 = 300\ K$. Using the above constants and range of parameters, the characteristics of $P_{out} - r_c$ and $\eta_{th} - r_c$ can be plotted.

Figures 2–4 show the effects of the specific heat ratio of the working fluid on the power output and the thermal efficiency of the cycle with irreversible friction losses (The dashed lines in the figures denote where the cycle cannot work). From these figures, it can be found that the specific heat ratio plays an important role on the power output and the thermal efficiency. They reflect the performance characteristics of an irreversible Diesel cycle engine.

The variations of the power output with respect to the compression ratio and the specific heat ratio are indicated in Figure 2. It can be seen that the power output versus the compression ratio characteristic is parabolic like curve. In other words, there is a maximum power output in the range of compression ratio. With increasing specific heat ratio, the maximum power output and the compression ratio at the maximum power output point increase. Therefore, it can be resulted that the effect of specific heat ratio on the performance of the cycle is related to compression ratio. It should be noted that the increase of the value of maximum power output with increasing specific heat ratio is due to the increase in the ratio of the heat added to the heat rejected. Numerical calculation shows that when specific heat ratio increases by about 7.7%, the maximum power output and the compression ratio at the maximum power output point increase by about 22.2% and 1.3%, respectively.

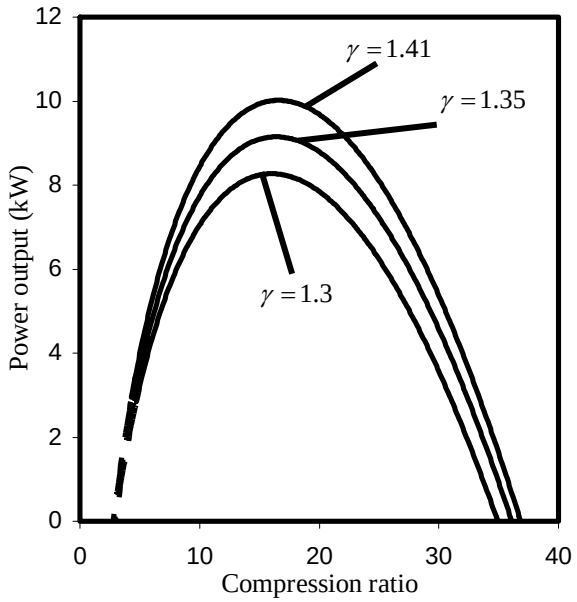

Figure 2. Effect of specific heat ratio on the variation of the output power with compression ratio

Figure 3 shows the effects of specific heat ratio on thermal efficiency with respect to the compression ratio. It can be seen that the thermal efficiency versus the compression ratio characteristic is parabolic like curve. In other word, the thermal efficiency increase with increasing compression ratio, reach their maximum values and then decrease with further increase in compression ratio. With increasing specific heat ratio, the maximum thermal efficiency increases while the compression ratio at maximum thermal efficiency point remains approximately constant. It should be noted that the increase of the value of maximum thermal efficiency with increasing specific heat ratio is due to the increase in the ratio of the heat added to the heat

rejected. Numerical calculation shows that when specific heat ratio increases by about 7.7%, the maximum thermal efficiency increases 25.4%.

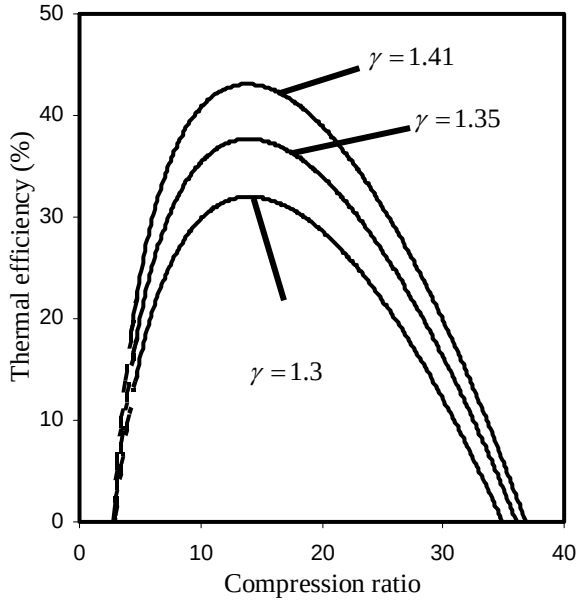

Figure 3. Effect of specific heat ratio on the variation of the thermal efficiency with compression ratio

Figure 4 shows the effects of the specific heat ratio on the power output versus the thermal efficiency characteristic. The power output versus thermal efficiency characteristics exhibit loop shaped curves as is common to almost all real heat engines (Chen et al., 1999; Gordon and Huleihil, 1992). From the figure, it is found that the parameter specific heat ratio has a significant influence on the power output versus thermal efficiency characteristic. They show that the maximum power output point and the maximum efficiency point are very adjacent. When specific heat ratio increases, the efficiency at the maximum power output point, as well as the power output at the maximum efficiency point, will also increase. If specific heat ratio increases by about 7.7%, the optimal power output corresponding to maximum efficiency and the optimal thermal efficiency corresponding to maximum power output increase by about 19.9% and 43.7%, respectively.

According to the above analysis, it can be found that the effects of the specific heat of the working fluid on the cycle performance are obvious, and they should be considered in practice cycle analysis to make the cycle model more close to practice.

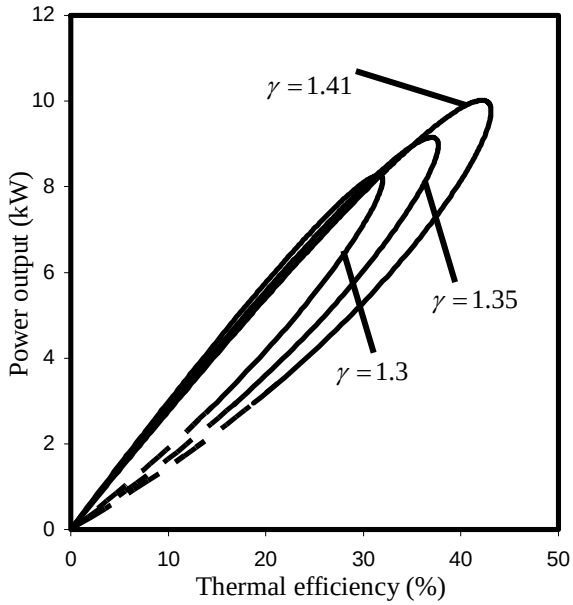

Figure 4. Effect of specific heat ratio on the variation of the output power with thermal efficiency

4-Conclusion

In this paper, an irreversible air standard Dual cycle model which is more close to practice is established. In the model, the friction loss computed according to the mean velocity of the piston and the internal irreversibility described by using the compression and expansion efficiencies are considered. The performance characteristics of the cycle were obtained by numerical examples. The results show that there are significant effects of the specific heat of the working fluid on the performance of the cycle, and this should be considered in practical cycle analysis. The conclusions of this investigation are of importance when considering the designs of actual Diesel engines.

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8/9/2009

Advantages and Disadvantages of Boundary Element Methods For Compressible Fluid Flow Problems

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Abstract:

In this paper, the advantages and disadvantages of boundary element methods (BEMs) for compressible fluid flow problems are presented. BEMS are gaining popularity due to their applications in the vast fields of science and technology and it is also being applied for calculating the solution of compressible fluid flow problems. All techniques have some advantages and disadvantages. The efficiency as well as accuracy of a method can be easily checked for the solution of a certain problem by its advantages as well as disadvantages. So the performance of BEMs in the present case is judged by giving its advantages and disadvantages in details. [Journal of American Science 2010; 6(1): 162-165]. (ISSN: 1545-1003).

Keywords: Advantages and disadvantages, Boundary Element Methods, Compressible Flow, CFD.

1. Introduction

A compressible flow is different from an incompressible one in that the density of fluid does not remain the same. In compressible flow, the equation governing the inviscid compressible flow of a homogeneous fluid were first derived by Euler. Euler considered all the characteristics of the fluid to be continuous functions of time and space. The approach taken by Euler assumes that the fluid is a continuum (Schreier, 1982). In applying the continuum assumption, the care must be taken that the average distance between molecules is small as compared to the scale of the problem under consideration. From the time of fluid flow modeling, it had been struggled to find the solution of a complicated system of partial differential equations (PDE) for the fluid flows which needed more efficient numerical methods. From time to time, many numerical techniques such as finite difference method, finite element method, finite volume method and boundary element method etc. came into beings which made possible the calculation of practical flows. Due to discovery of new algorithms and faster computers, these methods were evolved in all areas in the past such as stress analysis, heat transfer and electromagnetic theory, potential theory, fracture mechanics, fluid mechanics, elasticity, elastostatics and elastodynamics, biological and biomedical problems ,etc. These methods are CPU time and storage hungry. Boundary element method originated within the Department of civil engineering at Southampton University, U.K. (Brebbia, 1978). These methods existed under different names such as 'Panel Method', 'Surface singularity methods', 'boundary integral equation methods', or 'boundary integral solutions'. Now a days, the boundary element method is successfully applied by numerical community. One of the advantages is that with boundary elements one has to discretize the entire surface of the body, whereas with domain methods it is essential to discretize the entire region of the flow field. The most important characteristics of boundary element methods are the much smaller system of equations and considerable reduction in data which is prerequisite to run a computer program efficiently. Moreover, this method is well–suited to problems with an infinite domain. From above discussion, it is concluded that boundary element method is a time saving, accurate and efficient numerical technique as compared to other numerical techniques which can be classified into direct boundary element method and indirect boundary element method which depends on whether the functions used in derivatives are physical quantities or fictitious density functions (Becker, A.A). The direct method takes the form of a statement which provides the values of the unknown variables at any field point in terms of the complete set of all the boundary data. Whereas the indirect method utilizes a distribution of singularities over the boundary of the body and computes this distribution as the solution of integral equation. The equation of direct boundary element method (DBEM) can be

formulated using either as an approach based on Green's theorem (Lamb, 1932; Milne-Thomson, 1968 and Kellogge, 1929) or a particular case of the weighted residual methods (Brebbia and Walker, 1980). The equation of indirect method can be derived from that of direct method. In the early 1980, a surge in research activities on BEMs occurred and this technique found its way in the field of fluid mechanics (Gaul et al, 2003). The direct boundary element method was used for flow field calculations around complicated bodies (Morino et al., 1975 Luminita, 2007, Mushtaq, 2008). While the indirect method has been used in the past for flow field calculations surrounding arbitrary bodies (Hess and Smith, 1967; Hess, 1973, Muhammad, 2009, Luminita, 2008, Mushtaq, 2009). Now the boundary element method is being used for the solution of compressible flows around complex configurations. Thus it can be said that the boundary element method is a powerful numerical technique receiving much attention from researchers, engineering community and is becoming popular technique in the computational solution of a number of physical problems.

2. General Mathematical Formulation of Boundary Element Method

Consider the differential equation

$$L\ (u) = b \qquad (1)$$

or $L\ (u) - b = 0$ in Ω

Where L is an arbitrary linear differential operator with constant coefficients, 'u' is the field variable and 'b' is an arbitrary source distribution in Ω.

In multi–dimensional case, equation (1) can be written as:

$$\int_{\Omega} \left(L\ (u) - b\right) w\, d\Omega = 0 \qquad (2)$$

In two and three – dimensional problems, the domain integrals are reduced to boundary integrals by using integration by parts and Gauβ' theorem as follows

$$\int_{\Omega} L^{*}(u)\, w\, d\Omega + \int_{\Gamma} \left[F(u).S^{*}(w) - S(u).F^{*}(w)\right] d\Gamma - \int_{\Omega} L\ (u)\, w\, d\Omega = 0 \qquad (3)$$

The first integral in equation (3) can be eliminated by using the shifting property of the Dirac distribution and the following formula is obtained

$$u\ (i) = \int_{\Gamma} (F(u).S^{*}(w) - S(u).F^{*}(w)\, d\Gamma - \int_{\Omega} b\, u^{*}\, d\Omega \qquad (4)$$

The equation (4) holds only, if 'i' is inside the domain. By shifting the load point to the boundary point in a special limiting process, the boundary integral equation can be obtained in which all unknown field variables have been transformed to the boundary. This equation is the basis of boundary element method.

3. Advantages and Disadvantages of Boundary Element Methods:

(a) Advantages:

(i) Less data:

In BEMs, less data is required to run a program efficiently.

(ii) Less Time:

In BEMs, less time is required for the solution of a problem due to a small system of equation.

(iii) Less Unwanted Information:

In such technique, unwanted information is much less than other numerical techniques.

(iv) Process of discretization:

In BEMs, the process of discretization takes place only on the surface of body so that the system of equations is much smaller.

(v) Not costly:

Since the discretization is only on the surface in boundary element method. Thus amount of data is small. That is why such technique is not costly.

(vi) Open domain:

BEM is well-suited to problems of open domains.

(b) Disadvantages:

(i) Non-Linear Flow Problems:

BEM is not successfully applied to non-linear fluid flow problems.

(ii) Unfamiliar Mathematics

The mathematics used in BEM is unfamiliar to engineering community. So they are not interested in such mathematics.

(iii) Fully populated matrix:

Matrices resulted in BEM are unsymmetric and fully populated. They are not easy to solve.

4. Conclusion

In this paper, the advantages and disadvantages of boundary element methods (BEMs) for compressible fluid flow problems have been presented. Like other numerical methods, BEMs have also advantages and disadvantages. Since advantages of such methods are more than its disadvantages, Therefore it can be successfully applied for compressible fluid flow problems, and it can be very useful in modeling of different types of bodies such as airplanes, space shuttle, etc.

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8/25/2009

Indirect Boundary Element Technique For The Flow Past A Fixed Sphere

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Abstract: In this paper, an indirect boundary element technique is applied for calculating the flow past a fixed sphere. Such technique requires the concept of sources or doublets, which is simple and flexible. A comparison study between computed and analytical results is also made and it can be seen from tables and figures that the computed results are good in agreement with analytical results for a fixed sphere. [Journal of American Science 2010;6(1):166-171].(ISSN:1545-1003).

Keywords: Indirect boundary element technique, Flow past, Velocity distribution, Fixed sphere.

1. Introduction

From the time of fluid flow modeling, it had been struggled to find the solution of a complicated system of partial differential equations (PDE) for the fluid flows which needed more efficient numerical methods. With the passage of time, many numerical techniques such as finite difference technique, finite element technique (Hirt et al,1978, Markatos,1983, Demuran et al,1982, Ecer,1982) and boundary element technique etc. came into beings which made possible the calculation of practical flows. Due to discovery of new algorithms and faster computers, these techniques were evolved in all areas in the past. Such techniques are CPU time and storage hungry. The term 'boundary elements' originated in the department of civil engineering, Southampton University, United Kingdom (Brebbia,1978). One of the advantages is that with boundary elements one has to discretize the entire surface of the body, whereas with domain techniques it is essential to discretize the entire region of the flow field. The most important characteristics of boundary element technique are the much smaller system of equations and considerable reduction in data, which is prerequisite to run a computer program efficiently. Furthermore, this technique is well–suited to problems with an infinite domain. From above discussion, it is concluded that boundary element technique is a time saving, accurate and efficient numerical technique as compared to other numerical techniques which can be classified as direct and indirect boundary element techniques. The indirect technique utilizes a distribution of singularities over the boundary of the body and computes this distribution as the solution of integral equation. The equation of direct boundary element technique can be formulated using either as an approach based on Green's theorem (Lamb,1932, Milne-Thomson,1968, Kellogg,1929) or a particular case of the weighted residual formulation (Brebbia and Walker,1980). The flow field caculations around three-dimensional bodies were calculated (Hess and Smith,1962;1967). Direct boundary element technique was applied for potential flow problems (Morino,1975; Mushtaq, 2008 & 2009). Boundary element technique is now widely applied to several fields such as potential theory, elasticity, elastostatics, elastodynamics, etc (Brebbia and Walker, 1980) and biomedical problems (Muhammad, 2008 & 2009). Thus boundary element technique s are more powerful than other numerical techniques because of their boundary modeling approach.

Flow Past a Fixed Sphere:

Let a fixed sphere be of radius 'a' with center at the origin and let the onset flow be the uniform stream of velocity U in the positive direction of the y–axis, as shown in figure (1).

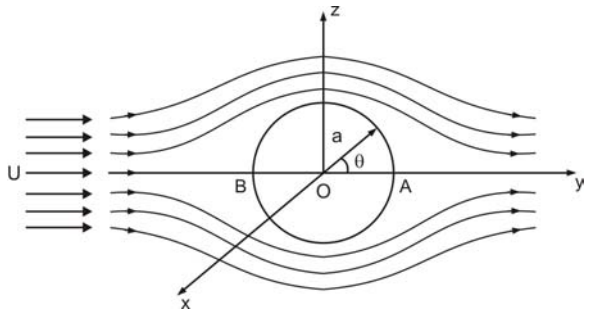

Figure 1

The velocity potential and stream function for a sphere of radius a moving of velocity U in the negative direction of y – axis in an infinite mass of fluid at rest at infinity are given by (Shah, 2008,Mushtaq,2009)

$$\phi = -\frac{1}{2} U \frac{a^3}{r^2} \cos\theta , \quad \psi = \frac{1}{2} U \frac{a^3}{r} \sin^2\theta \quad (1)$$

If a uniform velocity field 'U' is impressed upon the sphere and the fluid in the positive direction of y – axis , the sphere will come to rest and the uniform stream which was at rest at infinity will start moving with velocity U in the positive direction of y – axis . Thus the streaming motion past a fixed sphere will be obtained.

The superposition of the velocity field U in the positive direction of y – axis amounts to the addition of the term $-U r \cos\theta$ to the velocity potential and the term $-\frac{1}{2} U r^2 \sin^2\theta$ to the stream function in equations (1) . Thus the velocity potential and stream function for the streaming motion past a fixed sphere of radius a in the positive direction of y – axis take the form

$$\phi = -U r \cos\theta - \frac{1}{2} U \frac{a^3}{r^2} \cos\theta$$

$$= -U \left(r + \frac{a^3}{2 r^2} \right) \cos\theta \quad (2)$$

$$\psi = -\frac{1}{2} U r^2 \sin^2\theta + \frac{1}{2} U \frac{a^3}{r} \sin^2\theta$$

$$= -\frac{1}{2} U \left(r^2 - \frac{a^3}{r} \right) \sin^2\theta \quad (3)$$

The velocity components at any point (r , θ) are given by

$$v_r = -\frac{\partial \phi}{\partial r} = U \left(1 - \frac{a^3}{r^3} \right) \cos\theta$$

$$v_\theta = -\frac{1}{r} \frac{\partial \phi}{\partial \theta} = -U \left(1 + \frac{a^3}{2 r^3} \right) \sin\theta$$

The speed at any point in the flow field is given by

$$V = \sqrt{v_r^2 + v_\theta^2}$$

$$= U \sqrt{\left(1 - \frac{a^3}{r^3} \right)^2 \cos^2\theta + \left(1 + \frac{a^3}{2 r^3} \right)^2 \sin^2\theta} \quad (4)$$

The velocity components at any point (a , θ) on the boundary of a sphere r = a become

$$v_r = 0 , \quad v_\theta = -\frac{3}{2} U \sin\theta \quad (5)$$

Equation (5) shows that the velocity on the boundary of the sphere is purely tangential .

Therefore the speed at any point on the sphere itself is given by

$$V = \sqrt{v_r^2 + v_\theta^2}$$

$$= \sqrt{0 + \left(-\frac{3}{2} U \sin\theta \right)^2}$$

$$= \frac{3}{2} U \sin\theta \quad (6)$$

For exterior flow for three-dimensional problems, the mathematical formulation for indirect boundary element method in terms of doublets distribution over the boundary S of the body is given by

$$-\frac{1}{2} \Phi_i + \phi_\infty + \iint_{S-i} \Phi \frac{\partial}{\partial n} \left(\frac{1}{4 \pi r} \right) d S = y_i \quad (7)$$

Which is discretized by dividing the boundary of the body under consideration into 'm' elements and finally, it is written in matrix form as

$$[H] \{ \underline{U} \} = \{ \underline{R} \} \quad (8)$$

Whereas usual [H] is a matrix of influence coefficients, $\{\underline{U}\}$ is a vector of unknown total potentials Φ_p and $\{ \underline{R} \}$ on the R.H.S. is a known vector whose elements are the negative of the values of the velocity potential of the uniform stream at the nodes on the boundary of the body.

3. Boundary Conditions

The boundary condition to be satisfied over the surface of a sphere is

$$\frac{\partial \phi_{sphere}}{\partial n} = U \left(\hat{n} \cdot \hat{j} \right) \quad (9)$$

where ϕ_{sphere} is the perturbation velocity potential of a sphere and $\hat{n}$ is the outward drawn unit normal to the surface of a sphere

Let $f(x, y, z) = x^2 + y^2 + z^2 - a^2$

Then $\nabla f = 2x\,\hat{i} + 2y\,\hat{j} + 2z\,\hat{k}$

Therefore $\hat{n} = \dfrac{\nabla f}{|\nabla f|} = \dfrac{2x\,\hat{i} + 2y\,\hat{j} + 2z\,\hat{k}}{\sqrt{(2x)^2 + (2y)^2 + (2x)^2}}$

Thus $\hat{n} \cdot \hat{j} = \dfrac{2y}{\sqrt{(2x)^2 + (2y)^2 + (2x)^2}}$

$= \dfrac{y}{\sqrt{x^2 + y^2 + z^2}}$

The equation of the surface of the sphere is

$x^2 + y^2 + z^2 = 1$, where the radius a is taken as 1.

Therefore, the boundary condition in (9) takes the form

$$\frac{\partial \phi_{sphere}}{\partial n} = U\,y$$

$$= y, \quad (\text{Taking } U = 1) \qquad (10)$$

Equation (8) is the boundary condition which must be satisfied over the boundary of a sphere.

4. Discretization of Elements

Consider the boundary of the sphere in one octant to be divided into three quadrilateral elements by joining the centroid of the boundary with the mid points of the curves in the coordinate planes as shown in figure (2) (Mushtaq et al,2008 &2009).

Then each element is divided further into four elements by joining the centroid of that element with the mid–point of each side of the element. Thus one octant of the boundary of the sphere is divided into 12 elements and the whole bounday of the body is divided into 96 boundary elements. The above mentioned method is adopted in order to produce a uniform distribution of element over the boundary of the body.

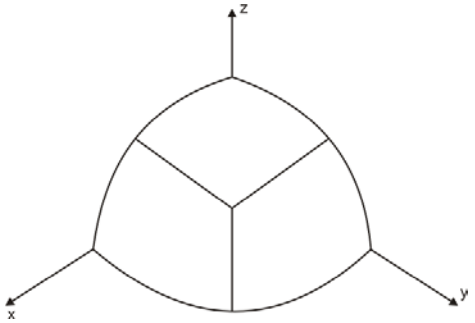

Figure 2

Figure (3) shows the method for finding the coordinate (x_p, y_p, z_p) of any point P on the surface of the sphere.

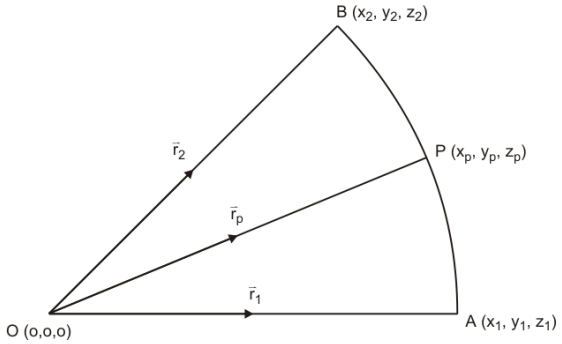

Figure 3

From figure (3), we have the following equation

$$|\vec{r}_p| = 1$$

$$\vec{r}_p \cdot \vec{r}_1 = \vec{r}_p \cdot \vec{r}_2$$

$$(\vec{r}_1 - \vec{r}_2) \cdot \vec{r}_p = 0$$

or in cartesian form

$$x_p^2 + y_p^2 + z_p^2 = 1$$

$$x_p (x_1 - x_2) + y_p (y_1 - y_2) + z_p (z_1 - z_2) = 0$$

$$x_p (y_1 z_2 - z_1 y_2) + y_p (x_2 z_1 - x_1 z_2) + z_p (x_1 y_2 - x_2 y_1) = 0$$

As the body possesses planes of symmetry, this fact may be used in the input to the program and only the non–redundant portion need be specified by input points. The other portions are automatically taken into account. The planes of symmetry are taken to be the coordinate planes of the reference coordinate system. The advantage of the use of symmetry is that it reduces the order of the resulting system of equations and consequently reduces the computing time in running a program. As a sphere is symmetric with respect to all three coordinate planes of the reference coordinate system, only one eighth of the body surface need be specified by the input points, while the other seven–eighth can be accounted for by symmetry.

The calculated velocity distributions are compared with analytical solutions for the sphere using Fortran programming.

Table 1: Comparison of the computed velocities with exact velocity over the surface of a sphere using 24 boundary elements.

ELEMENT	XM	YM	ZM	COMPUTED VELOCITY	EXACT VELOCITY
1	-.321E+00	-.748E+00	.321E+00	.13129E+01	.13953E+01
2	-.748E+00	-.321E+00	.321E+00	.63485E+00	.77853E+00
3	-.748E+00	.321E+00	.321E+00	.63485E+00	.77853E+00
4	-.321E+00	.748E+00	.321E+00	.13129E+01	.13953E+01
5	.321E+00	.748E+00	.321E+00	.13129E+01	.13953E+01
6	.748E+00	.321E+00	.321E+00	.63485E+00	.77853E+00
7	.748E+00	-.321E+00	.321E+00	.63485E+00	.77853E+00
8	.321E+00	-.748E+00	.321E+00	.13129E+01	.13953E+01
9	-.321E+00	-.321E+00	.748E+00	.13129E+01	.13953E+01
10	-.321E+00	.321E+00	.748E+00	.13129E+01	.13953E+01
11	.321E+00	.321E+00	.748E+00	.13129E+01	.13953E+01
12	.321E+00	-.321E+00	.748E+00	.13129E+01	.13953E+01

Table 2: Comparison of the computed velocities with exact velocity over the surface of a sphere using 96 elements.

ELEMENT	XM	YM	ZM	COMPUTED VELOCITY	EXACT VELOCITY
1	-.177E+00	-.934E+00	.177E+00	.14526E+01	.14747E+01
2	-.522E+00	-.798E+00	.157E+00	.12418E+01	.12623E+01
3	-.798E+00	-.522E+00	.157E+00	.82398E+00	.84609E+00
4	-.934E+00	-.177E+00	.177E+00	.34768E+00	.38819E+00
5	-.934E+00	.177E+00	.177E+00	.34768E+00	.38819E+00
6	-.798E+00	.522E+00	.157E+00	.82398E+00	.84609E+00
7	-.522E+00	.798E+00	.157E+00	.12418E+01	.12623E+01
8	-.177E+00	.934E+00	.177E+00	.14526E+01	.14747E+01
9	.177E+00	.934E+00	.177E+00	.14526E+01	.14747E+01
10	.522E+00	.798E+00	.157E+00	.12418E+01	.12623E+01
11	.798E+00	.522E+00	.157E+00	.82398E+00	.84609E+00
12	.934E+00	.177E+00	.177E+00	.34768E+00	.38819E+00
13	.934E+00	-.177E+00	.177E+00	.34768E+00	.38819E+00
14	.798E+00	-.522E+00	.157E+00	.82398E+00	.84609E+00
15	.522E+00	-.798E+00	.157E+00	.12418E+01	.12623E+01
16	.177E+00	-.934E+00	.177E+00	.14526E+01	.14747E+01
17	-.157E+00	-.798E+00	.522E+00	.14495E+01	.14801E+01
18	-.470E+00	-.703E+00	.470E+00	.13038E+01	.13113E+01
19	-.703E+00	-.470E+00	.470E+00	.96588E+00	.10301E+01
20	-.798E+00	-.157E+00	.522E+00	.82398E+00	.84609E+00
21	-.798E+00	.157E+00	.522E+00	.82398E+00	.84609E+00
22	-.703E+00	.470E+00	.470E+00	.96588E+00	.10301E+01
23	-.470E+00	.703E+00	.470E+00	.13038E+01	.13113E+01
24	-.157E+00	.798E+00	.522E+00	.14495E+01	.14801E+01
25	.157E+00	.798E+00	.522E+00	.14495E+01	.14801E+01
26	.470E+00	.703E+00	.470E+00	.13038E+01	.13113E+01
27	.703E+00	.470E+00	.470E+00	.96588E+00	.10301E+01
28	.798E+00	.157E+00	.522E+00	.82398E+00	.84609E+00
29	.798E+00	-.157E+00	.522E+00	.82398E+00	.84609E+00
30	.703E+00	-.470E+00	.470E+00	.96588E+00	.10301E+01
31	.470E+00	-.703E+00	.470E+00	.13038E+01	.13113E+01

32	.157E+00	-.798E+00	.522E+00	.14495E+01	.14801E+01
33	-.157E+00	-.522E+00	.798E+00	.14495E+01	.14801E+01
34	-.470E+00	-.470E+00	.703E+00	.13038E+01	.13113E+01
35	-.522E+00	-.157E+00	.798E+00	.12418E+01	.12623E+01
36	-.522E+00	.157E+00	.798E+00	.12418E+01	.12623E+01
37	-.470E+00	.470E+00	.703E+00	.13038E+01	.13113E+01
38	-.157E+00	.522E+00	.798E+00	.14495E+01	.14801E+01
39	.157E+00	.522E+00	.798E+00	.14495E+01	.14801E+01
40	.470E+00	.470E+00	.703E+00	.13038E+01	.13113E+01
41	.522E+00	.157E+00	.798E+00	.12418E+01	.12623E+01
42	.522E+00	-.157E+00	.798E+00	.12418E+01	.12623E+01
43	.470E+00	-.470E+00	.703E+00	.13038E+01	.13113E+01
44	.157E+00	-.522E+00	.798E+00	.14495E+01	.14801E+01
45	-.177E+00	-.177E+00	.934E+00	.14526E+01	.14747E+01
46	-.177E+00	.177E+00	.934E+00	.14526E+01	.14747E+01
47	.177E+00	.177E+00	.934E+00	.14526E+01	.14747E+01
48	.177E+00	-.177E+00	.934E+00	.14526E+01	.14747E+01

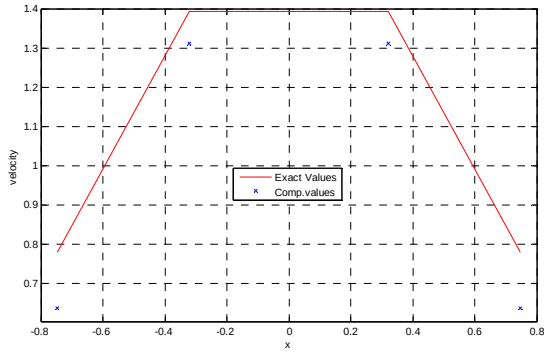

Figure 3: Comparison of computed and analytical velocity distributions over the surface of a sphere using 24 boundary elements

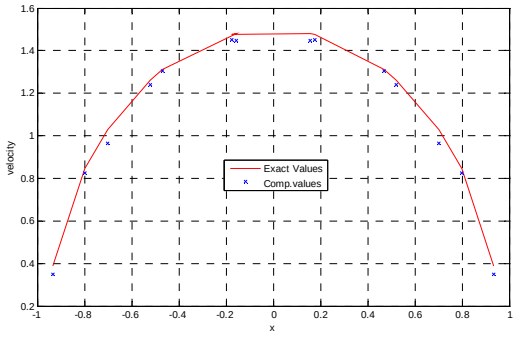

Figure 4: Comparison of computed and analytical velocity distributions over the surface of a sphere using 96 boundary elements

5. Conclusion

An indirect boundary element technique has been applied for the calculation of flow past a fixed sphere. The calculated flow velocities obtained using this technique are compared with the analytical solutions for flow over the boundary of a sphere. It is found that the computed results obtained by such technique are good in agreement with the analytical ones for the body under consideration and the accuracy of the results increases with the increase of number of boundary elements.

Acknowledgements

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Community Capacity Building: A Review of its Implication in Tourism Development

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Abstract: The purpose of this study is to explore the concept of community capacity building and implication of its dimensions in tourism development processes. Community capacity building is a necessary condition for improving the process of tourism and enhancing its benefits for local communities. Therefore, assessing dimensions of community capacity building is an important step in developing strategies to achieve community goals. This study also provided unique theoretical framework for tourism developers and researchers for tourism development in local communities with respect to building community capacity. "[Journal of American Science 2010; 6(1):172-180]. (ISSN: 1545-1003)"

Keywords: community capacity building, tourism development, community

1. Introduction

Community capacity building (CCB) is a necessary condition for improving the process of tourism development. Community capacity can be defined as the characteristics of a community that enable it to mobilize, identify and solve problems. Chaskin et al. (2001) provided a very useful definition, whereby they state community capacity is the interaction of community capitals, and organizational resources existing within a given community that can be leveraged to solve collective problems and improve that community (Chaskin et al., 2001).

There is an argument that CCB is necessary for community development and participatory processes at the community level (Reid & Gibb, 2004). This research is important because up to the present moment, there has been very little research or discussion focusing upon the CCB in tourism development. The concept of CCB has been given only limited attention in tourism literature, even though it has been extensively used in other areas of development, especially health, education and agriculture (Laverack, 2006; Moscardo, 2008).

The literature about implication CCB in tourism development supported by the literature and research evidence from health (George et al., 2007; Labonte & Laverack, 2001a; 2001b; Labonte at al., 2002; Maclellan-Wright et al., 2007; Raeburn et al., 2007; Seremba & Moore, 2005; Wickramage, 2006), education (Harris, 2001; Smyth, 2009) and agriculture (Dollahite et al., 2005). CCB is vital in order to empower local people to take advantage of the opportunities provided by tourism development (Laverack & Thangphet, 2007). Hence tourism development needs to be supported by CCB activities.

2. Community Capacity Building

community capacities are understood as the "qualities of a capable community" (Labonte & Laverack, 2001a). Labonte & Laverack (2001b) argued that there is a broad agreement concerning the dimensions of community capacity. Previous attempts to conceptualize CCB have involved identifying characteristics or qualities of a capable community (Labonte & Laverack, 2001a).

Several groups have identified such dimensions (Bopp et al., 2000; Chaskin et al., 2001; Goodman et al., 1998; Jackson et al., 1999a; 1999b; Kwan, Frankish, Quantz, & Flores, 2003; Labonte & Laverack, 2001a; 2001b), all of which have attempted to classify the characteristics of CCB. As Chaskin (2001, p. 318) believed CCB must focus on these components at the individual level, it is important to develop human resource and community leadership. At the organizational level, efforts could be made to develop the ability of community organizations to serve in community development. At the community level, it seeks to focus on association and relations between community residents, local groups and local community organization to

build up community development. The dimensions of community capacity which are most important for achieving systematic change in local communities are; participation, and leadership, community resources, social network and community power. Collectively, these four dimensions of community capacity represent a community's social capital (Thomposon et al.,2003).

Labonte & Laverack (2001a, p. 117) identify nine dimensions of community capacity: participation, leadership, organizational structure, problem assessment, resource mobilization, asking why, link with others, role of external agents and program management. Bopp et al. (2000) identifies seven dimensions: shared vision, sense of community, community participation, community leadership, resources, skill and knowledge, communication and ongoing learning. Laverack (2005) outlines nine dimensions of community capacity including; participation, problem assessment capacities, equitable relationship with external agents, organizational stature, resource mobilization, links to other resources and people, leadership, asking why, and control over program management.

Maclellan et al. (2007) outlines nine dimensions of community capacity including; community participation, community leadership, community structures, asking why, resource mobilization, link with others, external support, skill and knowledge, and sense of community. Attempts to make the definition of community capacity more specific usually involve articulating dimensions. This research has identified eight essential dimensions of community capacity that can be fostered within local communities. Although these dimension have been used to study of assessing the level of CCB for tourism development in local communities of Shiraz, Iran (Aref, 2009).

2.1 Community Leadership

Goodman et al. (1998) labeled leadership as a dimension for community capacity. He stated that community leaders enhance capacity when they ensure active involvement of a diverse network of community members, thus enabling those with disparate interests to take collective action by forming a unit of solution. Edwards et al., (2000) also considered community leadership to be important an dimension in measuring CCB. Community leadership was identified as a key factor in developing tourism in local communities (Moscardo, 2008). The importance and need for community leadership in building strong capacity communities cannot be ignored. In order to develop in current economic and social environment, communities need leaders who can help local group, businesses, and non-profit organizations to work together to address challenges and promote local strengths (Wituk et al., 2003). Community capacity is achieved through developing community leadership and decision making skills in community members (Ife, 2002). In a community capacity approach, community leaders play a vital role in handling the programs and plans towards achieving the goals of the community. In addition, a community without leadership may not be equipped to mobilize resources or influence tourism planning. Local communities, like other organization leaders cannot proceed successfully without having and dynamic leaders willing and able to take initiatives. Therefore the success of local community depends on the quality, creativity and commitment of its leadership in maintaining its daily affairs (Uphoff et al., 1998). Community leadership requires a strong base of participants, and participation without good leadership often leads to disorganization (Labonte & Laverack, 2001a).

Kirk & Kraft (2004), Mills (2005), and Williams & Wade (2002) have made substantial contribution to studies of community leadership in development. Collectively, they suggest community leadership emphasized a collaborative, ongoing, influential process based on relationship between people for development processes. Raik et al. (2003; 2005b) also believed community leadership is important for collaborative community based tourism development.

2.2 Community Participation

Community participation is a concept that attempts to bring different stakeholders together for community problem solving and decision making (Talbot & Verrinder, 2005). Community participation is considered necessary to get community support for tourism development projects (Cole, 2007). Goodman et al. (1998) labeled community participation as a dimension of community capacity. Community participation refers to peoples' engagement in activities within the community. It plays an essential and long-standing role in promoting quality of life (Putnam, 2000).

Community participation in tourism development processes can support and uphold local culture, tradition, knowledge and skill, and create pride in community heritage (Lacy et al., 2002). Community participation is one of the mechanisms to empower people to take part in community development. It was launched as a key concept of tourism development. Increased community participation is a means to achieve

community capacity to resolve the community problems (Lasker et al., 2001). Community participation also is the mechanism for active community involvement in partnership working, decision making and representation in community structures (Chapman & Kirk, 2001). The World Bank recognized the lack of community participation as a reason for failure of many development attempts in developing countries (World Bank, 1993). Without community participation, there is obviously no partnership, no development and no program. Hence lack of community participation in decision making to implement tourism development can lead to failure in the community development (Miranda, 2007). Meanwhile, some scholars provided a typology of participation, but they do not directly deal with tourism development (Leksakundilok, 2006). Therefore, this study attempts to establish a typology of community participation in tourism development based on those models. Table 1 showed six broad categories or levels of participation, which had been formulated. The six rungs are categorized into three categories. The top of the ladder represents full or genuine participation. The next grouping encompasses three degrees of tokenism, which allow the participants to be heard, to have a voice. At the level of symbolic participation, citizens gain some degree of influence though it is still a form of tokenism as traditional power-holders continue to have the right to decide (Arnstein, 1969). It is the illusion of a voice without the voice itself. The two bottom rungs of the ladder (informing and Manipulation) represent non-participation. In this level, people are allowed to participate, but is does not give them any opportunity to change programs to their own needs and a result maintain the status quo in power relations (Arnstein, 1969).

Table 1: Types of Community Participation in Tourism Development

Levels	Types	Characteristics
Genuine Participation	Empowerment	Local people may directly contact explorer tourists and develop tourism by themselves (Choguill, 1996; Dewar, 1999; Pretty, 1995).
Symbolic Participation	Partnership	There are some degrees of local influence in tourism development (Arnstein, 1969).
	Interaction	People have greater involvement in this level. The rights of local people are recognized and accepted in practice at local level (Pretty, 1995).
	Consultation	Developers may accept some contribution from the locals that benefits their project (Arnstein, 1969).
Non-Participation	Informing	The developers run the projects without listening to local people's opinions (Arnstein, 1969).
	Manipulation	Tourism is generally developed by some powerful individuals, or government, without any discussion with the people (Arnstein, 1969)**.**

Source: Adapted from Leksakundilok (2006)

2.3 Community Structures

Community structures can provide the source of both problems and potential solutions in the sphere of community development (Richards & Hall, 2000). According to Godfrey & Clarke (2000) community resource helps tourism destinations to identify linkages in supply and opportunities which could be pursued to increase their potential for tourism development. Hence community resource is the baseline of tourism development activities. Success in tourism development comes from knowing what resource are available for tourism development (Godfrey & Clarke, 2000, p. 8). Local community structures can bridge the gap between individual and organizations in a community. They also can have a significant effect on processes of tourism development. Community structures are labeled as a dimension of community capacity (Maclellan-Wright et al., 2007; Public Health Agency of Canada, 2007). Community structures in a community include small groups such as committees, and youth groups. Laverack (2001) labeled community structures as a domain of community capacity. According to Anderson et al. (2007) community structures refer to smaller or less formal community groups and committees that foster belonging and give the community a chance to express views and exchange information for tourism development.

2.4 External Supports

Maclellan (2007) and also Public Health Agency of Canada (2007) labeled external supports as a dimension of community capacity. External supports can as a means of determining the community's access to external supports for development of tourism in local communities, community's access to external supports that are both internal and external to a community, social capital or the ability to generate trust, confidence and cooperation, existence of communication channels within and outside of a community. External support such as government departments and local authorities can link communities and external resources in tourism development. External support may also contribute to empowering community organization to take full advantage of opportunities for community development (Reid & Gibb, 2004).

2.5 Skill and Knowledge

To build community capacity, community participants need to procure skills and knowledge. Knowledge helps people to think and act in new ways. Many authors identify the important role knowledge play in individual capacity (Bopp et al., 2000; Frank & Smith, 1999). The concept of community skill and knowledge is regarded as a tool to assist in tourism development and community development as well in local communities. Skill and knowledge has become an important source for tourism development. Bopp et al. (2000) labeled skill and knowledge as one dimension of community capacity. Increased skill and knowledge can be attained by any stakeholder in community based tourism development, local government officials, leaders and community residents.

The findings from analysis of 392 case studies of tourism development indicated that the greatest barriers to effective tourism development were due to a lack of skill and knowledge about tourism in general. This lack of tourism skill and knowledge are critical barriers that not only directly limit the ability of local people to participate in tourism development but also contribute to the next set of barriers: a lack of tourism leadership and domination of external agents (Moscardo, 2008).

Moscardo (2008) also argues that a lack of knowledge of tourism has been used in many developing countries to justify the exclusion of local residents and other community stockholders from involvement in marketing decisions and there exists little information on how to resolve this problem. According to Hall et al. (2005, p. 5) limited awareness of tourism can contribute to false expectations about the benefits of tourism and a lack of preparedness for change associated with tourism, and limits opportunities for locals to benefit from tourism opportunities. Thus, enhancing community knowledge and skill is one aspect of building community capacity for tourism development in local communities (Moscardo, 2008). Lack of skill and knowledge also constrains the ability of local communities to fully control their participation in tourism development (Cole, 2007). Community development also requires a broad base of skill and knowledge on many subjects. Thus development skill and knowledge are important to long-term success of any community tourism development process (Frank & Smith, 1999).

2.6 Resource Mobilization

Resource mobilization was measured in this study as a means of determining the community's ability to identify resources development of tourism in local communities as well as being a dimension within community capacity (Goodman et al., 1998). A successful building capacity process for tourism development requires strategic use of community resources. Goodman et al., (1998) discussed the dimension of resource mobilization as pertaining to resource acquisition, diversity, equitable distribution, sharing, use, appreciation and planning.

Eng & Parker (1994) discussed resource mobilization as the measurement of relations with wider society. Fawcett et al. (1995) identified access to resources to be one of the multiple dimensions of environmental factors influencing initiatives and ability to engage in an empowerment building process. A local community with capacity also has access to resources. These resources include those of economic, human, physical and political nature (Chaskin et al., 2001). These resources represent the community's ability to make instrumental links with larger social systems, and the ability to access and leverage resources located inside and outside of the community.

According to Schaeffer & Loveridge (2000) building capacity in communities requires multiple source and also time to develop. Hence community resources mobilizations are an essential component for community capacity. They can affect the community's ability to achieve their goals. Community resources mobilization comes in many forms. The community resource for community capacity in tourism development can be accessed from a variety of sources including, private and voluntary sector. But the financial resources are arguably the most central aspect of community

resources (De Vita et al., 2001). Tourism development as an important part of any community development must be accompanied with resource allocation. The future of any community development depends largely on local ability to raise or restore their community-based tourism.

2.7 Community Power

Community power is often unequally distributed across groups within local communities. The notion of community power is considered as a tool to assist in tourism development in local communities (Sebola & Fourie, 2006). Chaskin et al. (2001) states community power is necessary to maintain some ongoing community capacity. Efforts to strength community capacity in local communities have multiple motivations. The most common one is to improve quality of life in the community by increasing its ability and power as well as increasing ability to access external resources (Chaskin et al., 2001).

According to Smyth (2009) community power is helping residents act together so as to strategically acquire resource necessary to improve community development. Community power has become an umbrella for supposedly a new genre of development intervention (Tosun, 2000). It can be seen as a process whereby the community residents are given a voice and a choice to participate in issues affecting their lives (Theron, 2005a). Bianchi (2003) and Cheong & Miller (2000) have made substantial contributions to studies of community power in tourism development. Successful tourism development needs overcoming barriers to community empowerment at structural, operational and cultural level. Community power is manifestly critical in tourism development (Cheong & Miller, 2000). Simmons (1994) has argued that involvement of a community in tourism decision making processes is vital for the residents of destination. However community power as a component of community capacity often faces barriers in tourism development (Moscardo, 2008). Ashley & Roe (1998) describe community power as a spectrum from passive to active involvement to full participation. The above theoretical arguments for community power in tourism development seem to indicate that if their views are applied and put into action, most of the problems of tourism development may be avoided.

2.8 Sense of Community

The sense of community plays an important role in fostering support for tourism development and may enhance its long-term sustainability as a broad basis for tourism development planning (Hall et al., 2005). Sarason (1974) defined sense of community as the interdependence between an individual and community. Bopp et al. (2000, p. 113) defines sense of community in the following way: “sense of community refers to the quality of human relationship that makes it possible for people to live together in a healthy and sustainable way”. Sense of community also helps people feel they are a part of something larger than themselves. Developing a sense of community contributes to CCB by enabling people to feel connected and motivated to live in harmony and work together towards common community goals. A key term used in community development and community capacity is sense of community. Sense of community is a sense of belonging to a community in which it entails interaction with other members of the community (Buckner, 1988). Sense of community can be seen as the capacity of the local people to participate in development activities (Cupples, 2005). Tourism developers often like to encourage a sense of community among community residents as a way of contributing to building community capacity. Thus local communities play a vital role in addressing tourism development base capacity building (Beeton, 2006).

In relation to this, community leaders, stockholders, and tourism development practitioners should regard the concept of sense of community as a refinement of community members. While there is a substantial body of literature on the definition and conceptualization of sense of community (Chavis & Wandersman, 1990; Davidson & Cotter, 1989; McMillan & Chavis, 1986), only a few literatures discuss the practical application of approaches that have been successfully used to measure sense of community in different cultural contexts. Local communities for building community capacity in tourism development requires strengthening of sense of community (Conway & Hachen, 2005). The lack of sense of community has been reported as one of the reasons as to why people do not participate in development activities (DeNeui, 2003).

3. Conclusion

The literature review revealed the importance relevance of CCB for tourism development planning in local communities. This study showed eight dimensions of CCB in three levels are involved in processes of tourism development. This study is the first of its kind to use the CCB for tourism development in local communities. The findings of this study

contribute to tourism literature and community development. In addition, the findings of this study can be useful in assisting tourism planners, and academic researchers to assess, monitor and evaluate current or potential tourism development. The outcome of this investigation also assists researchers in the field of community development and the tourism industry.

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Relationship between creativity and academic achievement: A study of gender differences

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Abstract: The objective of this research is to examine if a relationship exists between creativity and academic achievement and if the relationship differs between males and females. Two research questions are examined in this paper: (1) what is the relationship between different aspects of creativity and academic achievement? (2) Is there any significant gender differences regarding the relationship between different aspects of creativity and academic achievement? Participants (N= 153; male = 105 and female = 48) completed creativity test. Cumulative grade point average (CGPA) was used to select the participants. Creativity was measured using the Khatena-Torrance Creative Perception Inventory (KTCPI). Pearson Correlation analysis indicated that aspects of creativity are related to academic achievement for both males and females. However, implications of the findings for this study in creativity and academic achievement are discussed. [Journal of American Science 2010;6(1):181-190]. (ISSN: 1545-1003).

Keywords: Academic Achievement, Creativity, Gender

1. Introduction

Numerous recent research has been conducted on the subject of creativity (Charlton, 2009; Heinze, Shapira, Rogers, & Senker, 2009; Ivcevic, 2009; Miller, 2007; Runco, 2007a, 2007b; Simonton & James, 2007; Yusuf, 2009) in relation to academic achievement (Deary et al., 2007; Lau & Roeser, 2008; Noftle & Robins, 2007; Steinmayr & Spinath, 2009), creativity and academic achievement (Ai, 1999; Coyle & Pillow, 2008; Palaniappan, 2005; Palaniappan, 2007a; Steinmayr & Spinath, 2009) academic achievement and gender (Barkatsas, Kasimatis, & Gialamas, 2009; Hosenfeld, Köller, & Baumert, 1999; Penner & Paret, 2008) as well as creativity and gender (Ai, 1999; Habibollah. et al., 2008; Naderi et al., 2008; Palaniappan, 2000, 2007b).

Earlier investigations have revealed that an individual's background characteristics affect his/her cognitive and non-cognitive behaviors (Ai, 1999). Such studies indicated that gender is one of the most significant and influential characteristics in academic achievement (Ai, 1999; Fennema, 1998; Habibollah. et al., 2008; Naderi et al., 2008). However, the literature on gender differences and the relationship between creativity and academic achievement is limited (Ai, 1999). Hence, investigators in this research concentrated on gender differences in their examination of the relationship between creativity and academic achievement.

The relationship between creativity and academic achievement has been examined by a number of investigators. According to one study, creativity is hardly correlated with academic achievement (Ai, 1999). Ai (1999) noted that "the zeal to investigate the relationship between creativity and academic achievement dates back to the 1960s, when Getzels (1962) first reported the results of their research on the role of creativity in school achievement''. Their investigation had an important effect on psychology in the field of education and set off a flood of investigations to understand what the nature of creativity was like. Their study involved 449 high school students, on whom they examined in order to find similarities and differences in the groups of students who had scored well on intelligence assessments and students who had scored well on creativity tests (Guilford of scores).

Ai (1999) studied the relation between creativity and academic achievement especially. In this study, the students were randomly selected from 68 schools (2,264 students, 38% were boys and 62% were girls). Three creativity batteries, the Torrance Test of Creative Thinking (TTCT), the Abedi-Schumacher Creativity Test (CT), and the Villa and Auzmendi Creativity Test (VAT), were administered to the students. The academic

achievement of the students' was assessed using a self-reported achievement in six subject areas: Spanish, Basque, English, natural science, mathematics and social science. A canonical correlation analysis found that when operationalized by their grades, creativity was related to academic achievement for both boys and girls. For girls, *elaboration* related to four of the academic subject areas (Basque, Spanish, social science and English) and *fluency* related to natural science and mathematics. For boys, *flexibility* was the predominant factor that related to all six academic subject areas. When operationalized by the other three measures (TTCT, VAT and CT), on the other hand, creativity was scarcely related to academic achievement. Yet, several other researchers also have alluded to the idea that creativity is related to academic achievement (Asha, 1980; Karimi, 2000; Mohamad Taghi Mahmodi, 1998; Marjoribanks, 1976; Murphy & 1973).

It is not always the case that studies of the relationship between creativity and academic achievement are consistent with each other in their results (Ai, 1999). Edwards (1965) examined 181 ninth grade students and found that for these students, creativity was not related to school achievement. In another research investigation, Nori (2002) studied the sex difference and the type of relationship between creativity and academic achievement among high school students in Shiraz city. There were 306 high school students (150 boys and 156 girls) in the research. To measure the rate of creativity, Nori (2002) used an Abedi questionnaire and CGPA for academic achievement. The results were analyzed by CGPA for academic achievement. The analysis revealed that there was no significant relationship between creativity and academic achievement, but the result was different for the two sexes. Other researchers, such as (Behroozi, 1997; Mayhon, 1966; Tanpraphat, 1976; E. P. Torrance, 1962) also supported the view that creativity was not related to academic achievement.

Some investigators have found a low correlation between academic achievement and creativity. For example (Karimi, 2000) replicated the studies of (Haddon, 1968; Krause, 1972, 1977) on secondary school students in the Shiraz school in Iran. The results show the relationship between creativity and academic achievement to be as low as 25%. According to some studies (Haddon, 1968; Krause, 1972, 1977), creativity has low correlation with academic achievement. Ai (1999) wrote that "some researchers in other countries also reported low correlations between school achievement and creativity test scores." Such was the case on Haddon's work done in the United Kingdom. A research on the Federal Republic of Germany and Switzerland (Krause, 1972, 1977) showed that correlations between creativity scores and grades were as low as .09 (physics) or .15 (art). In fact, a longitudinal study from the 7th to the 11th grade in West Germany (Sierwald, 1989) revealed a correlation between creativity test scores and school grades that was actually negative in the case of physics (-.12) and did not go beyond .26, even for art.

The research studies referred to above can be separated into three groups according to their conclusions in respect of how creativity relates to academic achievement. Some researchers (Ai, 1999; Asha, 1980; Getzels, 1962; Karimi, 2000; Mohamad Taghi Mahmodi, 1998; Marjoribanks, 1976; Murphy & 1973; K. Yamamoto, 1964, (1964)) found that there is a relationship between creativity and academic achievement. Other researchers (Behroozi, 1997; Edwards, 1965; Mayhon, 1966; Nori, 2002; Tanpraphat, 1976) showed that creativity was not related to academic achievement in any significant way. However, Ai (1999) referred to others who investigated this matter (J. C Bentley, 1966; S. H. Shin, & Jacobs, S. S, 1973; I. L. Smith, 1971) and deduced that creativity was actually correlated with advanced levels of academic achievement.

What are the possible reasons for the lack of a final conclusion in the previous research studies conducted on creativity, and how it is related to academic achievement? One possible rationalization is that the relationship between creativity and academic achievement is possibly dissimilar for females and males, depending on which special aspects of creativity are being considered. Also, past research has usually concentrated simply on whether there is a relationship between creativity and academic achievement without taking into consideration whether the relationship could be dissimilar for the two groups, male and female (Ai, 1999).

Not many researchers have examined gender differences in the relationship between creativity and academic achievement (Ai, 1999; Asha, 1980; Habibollah. et al., 2008; Palaniappan, 1994; 2000). Those that have focused their studies on this aspect mention that creativity is related to academic achievement for both males and females, but this does not infer that different aspects of creativity might be important for males and females. The study undertaken as part of this research aimed to examine the relationship between creativity and academic achievement, and it looked at whether the relationship may be different for males and females. Given the goals of this study, the research questions were as follows;

1. What is the relationship between different aspects of creativity and academic achievement?
2. Are there any significant gender differences with regard to the relationship between the different aspects of creativity and academic achievement?

2. Methodology

2.1 Sample

One hundred and fifty three Iranian undergraduate students in Malaysian Universities (31.4% females and 68.6% males) were recruited as respondents in this study. Their ages ranged from 18-27 years for females and 19-27 years for males.

2.2 Measures

2.2.1 Cumulative Grade Point Average (CGPA)

For the purposes of this study, Cumulative Grade Point Average (CGPA) was used as a proxy of academic achievement. The CGPA was calculated by dividing the total number of grade points earned by the total number of credit hours attempted. A student's academic achievement was based on their mid-year examination results. Academic achievement was the aggregate or the total number of grade points in the mid-year examinations. In these examinations, each university subject was graded along a one hundred (or four) point scale, the best grade point being one hundred (or four) and the lowest being zero. Hence the aggregate would range from 75 to 100 (3 to 4); notably the lower the aggregate, the better the academic achievement. This approach was used because other researchers have used the measure and found it an acceptable one for measuring academic achievement (Palaniappan, 2007a) cited several researchers (Nuss, 1961; J. P. Parker, 1979; Taylor, 1958; Wilson, 1968).

2.2.2 Khatena-Torrance Creative Perception Inventory (KTCPI)

Every student was examined using a Khatena-Torrance Creative Perception Inventory (KTCPI) to measure the creative perception of the undergraduate students (Palaniappan, 2005). The KTCPI instrument was comprised of two subscales, namely, "Something About Myself" (SAM) and "What Kind of Person Are You" (WKOPAY)? Table 1 shows the SAM measure of creative perception which is based on the rationale that creative behavior is reflected in an individual's personal creative characteristics, characteristics possessed and in use in creative thinking and creative productions (Palaniappan, 2005; 2007a). It tests six factors, namely, *environmental sensitivity, initiative, intellectuality, self-strength, individuality* and *artistry* (p.125).

According to Palaniappan's (2005; 2007a) definitions, *environmental sensitivity* relates to being open to ideas of others, relating ideas to what can be seen, touched, or heard, interest in beautiful and humorous aspects of experiences, and sensitivity to meaningful relations. *Initiative* relates to directing, producing, and /or playing leads in dramatic and musical productions; producing new formulas or new products; and bringing about changes in procedures or organization. *Self-strength* relates to self-confidence in matching talents against others, resourcefulness, versatility, willingness to take risks, desire to excel and organizational ability. *Intellectuality* relates to intellectual curiosity, enjoyment of challenging tasks, imagination, preference or adventure over routine, liking for reconstruction of things and ideas to form something different, and dislike for doing things in a prescribed routine. *Individuality* relates to preference for working by oneself rather than in a group, seeing oneself as a self-starter and somewhat eccentric, critical of others' work, thinking for oneself and working for long periods without getting tired and *artistry* relates to production of objects, models, paintings, carvings, musical composition, receiving awards or prizes or holding exhibitions, production of stories, plays, poems and other literary pieces.

The WKOPAY measure of creative perception is based on the rationale that an individual has a psychological self whose structures have incorporated both creative and noncreative ways of behaving. It covers five factors: *acceptance of authority, self-confidence, inquisitiveness, awareness of others* and *disciplined imagination*. The Creative Perception score is the total score obtained on the 'What Kind of Person Are You?' inventory (Palaniappan, 2005; 2007a).

According to (Palaniappan, 2005; 2007a) *acceptance of authority* relates to being obedient, courteous, conforming, and accepting of the judgments of authorities. *Self- confidence* relates to being socially well adjusted, self-confident, energetic, curious, thorough and remembering well. *Inquisitiveness* relates to always asking questions, being self-assertive, feeling strong emotions, being talkative and obedient. *Awareness of others* relates to being courteous, socially well-adjusted, popular or well-liked, considerate of others, and preferring to work in a group and *disciplined imagination* relates to being energetic, persistent, thorough, industrious, imaginative, adventurous, never bored, attempting difficult tasks and preferring complex tasks.

Two subscales of 100 items were used. The SAM consisted of 50 items that required 'yes'

or 'no' answers and the WKOPAY was comprised of 50 items that needed 'A' or 'B'' responses. The scoring of responses to this measure presented little difficulty; it was done by simple frequency counts of the positive responses on the total scale. The respondents took their time to complete the test, but it usually took 20-30 minutes (Palaniappan, 2007). All blank responses were scored zero. The test was translated into the Persian language, the first language of the respondents. The reliability was established in a pilot study. The pilot study had good reliability in the assessment of creativity both for the SAM (alpha =0.779) and WKOPAY (alpha = 0.775).

TABLE 1. Subtest KTCPI

KT CPI	SAM	WKOPAY
1- SAM	Environmental Sensitivity	Acceptance of authority
	Initiative	Self confidence
	Self-strength	Inquisitiveness
2- WKOPAY	Intellectuality	Awareness of others
	Individuality	Disciplined Imagination
	Artistry	

2.3 Procedure

The students who participated in this study were all undergraduates. The research questions posed for the study required the students to identify and analyze the distributions and correlations of certain creativity perception were best addressed in the form of a descriptive study. Creativity levels were assessed by self- report instruments and were confirmed by consideration of the results from the administration offices of the universities (described below). They were then divided by gender, with the total scores and subscales calculated for each male and female.

The participant sample, women (18-27 years) and men (19-27years), was asked to respond during the regular course time. Both written and oral instructions were given for all participants, and the subjects were ready to answer upcoming questions in the class. Multiple significance tests were conducted, and the data were analyzed by t-test. Participants answered the tests either using their name or anonymously (whichever they preferred). They received no rewards for participating but were advised they would be given information of their results in the form of a self-referenced level of abilities at a later date. Scores for the creativity scale and its factors, were entered into the SPSS statistical program.

3. Results

3.1 Descriptive Statistics

The data were analyzed on the basis of the relationship of creativity and academic achievement between males and females, and the results are reported in the Tables and Figures below. SPSS for Windows Version 16.0 was used to conduct the analysis. Table. 2 shows that the females' mean (2.89) score was lower than the males' mean (3.00) for cumulative grade point average; but the standard deviations between females and males were not highly different (males = 0.53& females = 0.56).

In this study, the females' mean score was greater than the males for 'Something About Myself', but the standard deviations between females and males were not higher differences (males = 4.36 and females = 4.55). However, there was a different result for the factors scores. The females' mean scores were higher than the males' mean scores for *environmental sensitivity*, *self-strength*, *intellectuality*, and *individuality*, but the females' mean scores were lower than males' for *initiative* and *artistry*. There were also different results for 'What Kind of Person Are You' and its factor scores. The males' mean general or overall scores were greater than the females, as well as the factor scores of the subtest 'What Kind of Person Are You' (*acceptance of authority, self confidence, inquisitiveness, awareness of others* and *disciplined imagination*).

TABLE 2. Descriptive Statistics on Creativity

	Males (n= 105)		Females (n=48)	
	M	SD	M	SD
CGPA	3.00	.53	2.89	.56
Something About My Self	31.90	4.36	33.21	4.55
Environmental Sensitivity	4.7 1	1.25	5.10	0.88
Initiative	2.98	1.61	2.23	0.973
Self-strength	7.10	1.68	7.58	1.47
Intellectuality	6.54	1.65	7.04	1.77
Individuality	3.48	1.30	3.70	1.57
Artistry	2.60	1.50	2.31	1.53
What Kind of Person Are You	28.97	4.80	26.75	5.25
Acceptance of authority	2.30	1.40	2.25	1.60
Self confidence	6.15	1.95	5.87	1.72
Inquisitiveness	2.79	1.09	2.56	1.341
Awareness of others	5.73	1.82	5.65	2.32
Disciplined Imagination	4.65	1.91	4.46	1.57

3.2 Pearson Correlation

This part presents the results from Pearson Correlation on creativity and academic achievement variable for the males and the females, respectively. Table 3. shows the relationship between creativity and its components with academic achievement and the differences for males and females.

Female The correlations for females' creativity were negative and significantly related to Academic Achievement for components of *initiative* (r = -.566, p<0.01), *self-strength* (r = -.080, p<0.01), *artistry* (r = -.190, p<0.01), *inquisitiveness* (r = -.008, p<0.01) and *disciplined imagination* (r = -.425, p<0.05). The overall Something About My Self scores (r = -.054, p<0.05) and What Kind of Person Are You (r = -.506, p<0.01) were also significant and negatively related to Academic Achievement. All the others were positive and significantly correlated for components of *environmental sensitivity* (r = .515, p<0.01), *acceptance of authority* (r = .161, p<0.01), *self confidence* (r = .248, p<0.01) and *awareness of others* (r = .588, p<0.01).

Males *Environmental sensitivity* and Academic Achievement were positively significantly correlated (r = .227, p<0.01), while disciplined imagination, on the other hand, were also significantly but negatively related to Academic Achievement (r = -.219, p<0.01).

TABLE 3. Pearson Correlation Results for Males and Females [a]

Variables	**Females**		**Males**	
	r	**p**	**r**	**p**
Something About My Self	-.054*	.010	.285	.381
Environmental Sensitivity	.515 **	.000	.227**	.007
Initiative	-.566 **	.000	.136	.523
Self-strength	-.080 **	.004	.116	.995
Intellectuality	.089	.090	.103	.632

Individuality	-.155	.362	-.041	.218
Artistry	-.190 **	.000	-.026	.938
What Kind of Person Are You	-.506**	.000	.216	.058
Acceptance of authority	.161 **	.000	-.044	.823
Self confidence	.284 **	.000	.041	.715
Inquisitiveness	-.008 **	.000	.104	.106
Awareness of others	.588 **	.000	-.070	.099
Disciplined Imagination	-.425 *	.036	-.219 **	. 005

a. Dependent Variable; CGPA
** p< 0.01
* p< 0.05

3.3 Academic achievement predictors

Females Tables 4 and 5 display the main effect of creativity and its factors which was found significant for academic achievement. Independent variables (creativity and its factors) explained .852 of the variance (R-squared) in academic achievement (CGPA), which is significant, as indicated by the ($F_{(13, 34)} = 15.048$, *P<0.0001)*. The finding indicated a high correlation independent variables and CGPA for females in this study (see Table 2 for means and SD).

TABLE 4. Model Summary for Females [b]

R	R-Square	Adjusted R	Std. Error
.923[a]	.852	.795	.252

a. Predictors: Something About Myself, *environmental sensitivity, self-strength, intellectuality, individuality, initiative, artistry, acceptance of authority, self confidence, inquisitiveness, awareness of others* and *disciplined imagination*)

b. Dependent Variable: CGPA

TABLE 5
ANOVA for Females [b]

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	12.454	13	.958	15.048	0.000[a]
Residual	2.165	34	.064		
Total	14.619	47			

a. Predictors: Something About Myself, *environmental sensitivity, self-strength, intellectuality, individuality, initiative, artistry, acceptance of authority, self confidence, inquisitiveness, awareness of others* and *disciplined imagination*).
b. Dependent Variable: CGPA

TABLE 6. Model Summary for Males [b]

R	R-Square	Adjusted R	Std. Error
.527[a]	.278	.175	.478

a. Predictors: (Constant, Creativity Perception Inventory, Something About Myself, What Kind of Person Are You, *environmental sensitivity, self-strength, intellectuality, individuality, initiative , artistry ,acceptance of authority, self confidence, inquisitiveness, awareness of others* and *disciplined imagination*).
b. Dependent Variable: CGPA

TABLE 7. ANOVA for Male [b]

Model	Sum of Squares	df	Mean Square	F	Significance
Regression	8.013	13	.616	2.699	0.003[a]
Residual	20.784	91	.228		
Total	28.797	104			

a. Predictors: (Constant, Creativity Perception Inventory, Something About Myself, What Kind of Person Are You, *environmental sensitivity, self-strength, intellectuality, individuality, initiative, artistry, acceptance of authority ,self confidence, inquisitiveness, awareness of others* and *disciplined imagination*).
b. Dependent Variable: CGPA

Males Tables 6 and 7 show a main effect of creativity and its factors was found significant for academic achievement. Independent variables (creativity and its factors) explained .278 of the variance (R squared) in academic achievement (CGPA), which is significant, as indicated by the ($F_{(13, 91)} = 2.699$, *P<0.01)*, which is significantly related. This finding indicates a low correlation of independent variables and CGPA for males in this study (see Table 2 for means and SD).

4. Discussion

The result of this research indicated that there existed gender differences regarding specific aspects of creativity, in relation to academic achievement. Dissimilar aspects of creativity and academic achievement were found to be significant for males and females. One interpretation that might explain this gender difference is that males and females do extremely well in different aspects of creativity. This dissimilarity may be possibly due to gender identity. Some studies (Ai, 1999; Habibollah, Rohani, Tengku Aizan & Jamaluddin, 2009; Palaniappan, 2000) show that males surpass females on some components of creativity, but females are generally better than males on others. Habibollah et al. (2009) found no gender differences on the overall factor scores for both 'What Kind Of Person Are You'? and 'Something About Myself', except for *environmental sensitivity* and *initiative* among Iranian students. Females scored significantly higher on *environmental sensitivity* than males and males scored significantly higher on *initiative*. This is consistent with the findings in Palaniappan (2000)'s study, which supported the view that there are no gender differences for general factor scores, with the exception of *environmental sensitivity* and *initiative* among Malaysian students. Palaniappan (2000) stated there was no significance difference on the factor *environmental sensitivity* between males and females, while males obtained higher scores on *initiative* than females.

However, a study on Spanish students indicates that some differences exist between males and females on aspects of creativity related to academic achievement, although creativity is shown to be related to academic achievement for gender (Ai, 1999). These differences may be explained by the different gender roles for males and females in most countries. Hence, it is conceivable that the gender differences in creative ability are determined by the different characteristics that identify the genders.

Another possible explanation of the result may be related to the different batteries used to assess different aspects of creativity. The multiple batteries led to different conclusions about the relationship between creativity and academic achievement. Utilizing different aspects of creativity measures may be one of the reasons that lead previous researchers to different conclusions about the relationship between creativity and academic achievement. This explanation has a possible broader application. This implies that various measures may be employed to identify creative students.

As with all other studies, this research has some limitations. One concerns the operationalization of academic achievement. Academic achievement was measured using cumulative grade point average (CGPA) in general. However, this research needs to be extended to include grades given by subject such as mathematics, language, science, and others, and standardized achievement examination scores in different fields of study.

5. Conclusion

To conclude, this study provides empirical support for the relationship between aspects of creativity and academic achievement and the finding that this relationship appears to have differences, depending on whether it is between males or females. The relationship could be altered when different gender is examined and when different creativity measure employed. Further research is needed to verify the nature of this relationship using other measures of creativity and academic achievement, and across other nations and different programs of study, in order to establish if similar findings hold in other settings and contexts.

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