

KJMS



ISSN 2579-2229

KDU Journal of Multidisciplinary Studies

Volume - 01, Issue – 02 2018

KDU Journal of Multidisciplinary Studies Volume - 01, Issue - 02 2018



General Sir John Kotelawala Defence University
Sri Lanka.

KDU Journal of Multidisciplinary Studies

Volume 1, Issue 2

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**KDU JOURNAL OF
MULTIDISCIPLINARY STUDIES**

Vol 1 - Issue 2

2018

**General Sir John Kotelawala
Defence University
Sri Lanka**

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ISSN 2579-2229

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SPECTROSCOPIC DETERMINATION OF ELECTRON TEMPERATURE AND ELECTRON DENSITY OF PLANETARY NEBULAE

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ABSTRACT

The electron temperature of 16 Planetary Nebulae were determined by means of [OIII] forbidden line intensities. The forbidden [OIII] lines $\lambda 5007$, $\lambda 4959$ and $\lambda 4363$ were identified from the spectra obtained from the "astrosurf" planetary nebulae archives. The observed intensities for these lines were corrected for interstellar reddening. The calculated electron temperatures () of our sample spectra range were between $9000 \lesssim T_e \lesssim 24000 K$ while the ratio $I(5007)/I(4959)$ was in ~ 2.6 and ~ 3.5 . The intensity ratios of [SII] forbidden lines, $\lambda 6716$ and $\lambda 6731$, were also determined for these planetary nebulae in order to evaluate the electron densities. A mathematical model was constructed to estimate the electron temperature of a Planetary nebula from [OIII] line ratios.

KEYWORDS: *Electron temperature, Electron densities, Interstellar reddening*

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1. INTRODUCTION

A planetary Nebula (PN) is a typically small, faint nebulae, created during the final stages of an Asymptotic Giant Branch (AGB) star whose birth mass was comparable to the Sun. This aging star undergoes a series of bursts in luminosity called thermal pulses which eject shell of material into space and divests itself completely of its outer layers. These outer layers of gas expand into space, forming a gas envelope around the core of the star. The remaining central core is known as white dwarf which no longer supports itself by fusion reactions in its center. The gravitational forces due to the material in the outer part of the core that push the inner parts, make the central core more heated up. The temperature of this central core, white dwarf, generally sometimes exceeds $\sim 200,000\text{K}$ and it emits UV radiations which are energetic enough to ionize and excite the expanding outer gas envelope. These gases then glow and emit visible light through the fluorescence. Therefore, a PN is a very low density cloud of ionized gas around its central star.

Under the low density condition, the PN spectra were identified as being collisionally excited "forbidden" lines of the ionized and neutral forms of common elements such as oxygen, nitrogen, and carbon.

The recombination lines which occurred due to the cascade of the electron down the ground state can also be identified in PN spectra. The recombination lines include the H, He and many very-faint lines of other elements.

PN can be recognized by their emission line spectra and the absence of continuum. Emission lines & stellar spectrums and Spectroscopic methods can be used to extract those spectrums with the help of reference spectrums of telescopes using image analysis facility software. In order to analyze the spectrums, we used IRAF V2.16 (Image Reduction and Analysis Facility), developed by National Optical Astronomy Observatories (NOAO) in Arizona.

Due to these various excitations, PN spectra provide a wealth of information of its

temperature and density of the gas, as well as the abundances of the elements.

2. METHODOLOGY AND CALCULATIONS

Method of Determining Electron Temperature

Since the strengths of emission lines that produced in gaseous nebulae are very sensitive to the electron temperature the ratio of forbidden emission lines of PN spectra can be used to determine the electron temperatures of the planetary nebulae. For example Kaler (1986) used the ratio of [OIII] and [NII] forbidden lines to determine the electron temperatures of 115 PNs while Osterbock *et al* (2005) has derived the undermentioned ratio of [OIII] at 5007 Å, [OIII] at 4959 Å and [OIII] at 4363 Å (auroral) forbidden lines to determine the electron temperature of low dense planetary nebulae.

$$T_e = - \frac{32990}{\text{Log} \left[\frac{7.575}{R_{[\text{OIII}]}} \right]} \quad (1)$$

$$T_e = \frac{14320}{-0.89 + \text{Log}[R_{[\text{OIII}]}]} \quad (2)$$

$$T_e = \frac{32900.}{\text{Log}[0.120482R_{[\text{OIII}]}]} \quad (3)$$

$$T_e = \frac{32900.}{\text{Log}[0.126584R_{[\text{OIII}]}]} \quad (4)$$

The above methods, described by Kwok (2007), Kaler (1986), Acker (2001) and Osterbock *et al* (2005) respectively, were used to calculate the electron temperature in this research because all [OIII] forbidden lines are prominent when compared with [NII] forbidden lines in the spectra used for this research. Where,

$$R_{[OIII]} = \frac{I(\lambda 5007) + I(\lambda 4959)}{I(\lambda 4363)}$$

Method of Determining Electron Densities

Letzia and Kaler (1988) have calculated electron densities of 146 Planetary nebulae by using [OII], [Cl III], [SII] and [ArIV] forbidden lines. It was found that the [OII] densities are generally lower than those from [Cl III], by an average factor of 0.65. A good agreement between [OII] and [SII] ratios were found as 0.95. Saraph & Seaton (1970) and Aller & Epps (1976) also made comparisons among the electron densities in planetary nebulae from different ions.

In this research we have used [SII], $\lambda 6716$ and $\lambda 6731$, ratios of PN spectra as described below by Acker (2005) to estimate the electron densities.

$$R_{[SII]} = \frac{I(6716)}{I(6731)} \quad (5)$$

$$R_{[SII]} = 1.49 \left[\frac{1 + 3.77x}{1 + 12.8x} \right] \quad (6)$$

Where $x = 10^{-2} / \sqrt{T_e}$.

Now electron density N_e is given by the following formula.

$$N_e = 10^{-2} \sqrt{T_e} \left[\frac{R_{[SII]} - 1.49}{5.62 - 12.8R_{[SII]}} \right] \quad (7)$$

De-Redden the Observed Spectra

Due to the intervening dust between the observer and the PNs, the effect of interstellar reddening affects the [OIII] and [SII] forbidden lines intensity ratios used for temperature and density calculation of observed spectra. As a result of the interstellar dust reddening the ratio of Balmer lines commonly known as ‘‘Balmer decrement’’ is changed. This is because micron-sized dust particles selectively dim shorter-wavelengths

more than they do longer-wavelengths leading to Balmer line ratios that differ systematically from the theoretical predictions. As per Osterbrock & Ferland (2006), under typical conditions in planetary nebulae, the theoretical Balmer decrements are:

$$\frac{H_\alpha}{H_\beta} = 2.86 \text{ or } \frac{H_\gamma}{H_\beta} = 0.47.$$

In order to check whether the spectra of this research are affected by the interstellar dust, the Balmer decrement of the sample spectra were compared with above values, and it was found that all our spectra in sample were affected by the interstellar reddening (see Table 1 and 2)

In order to de-redden the observed spectra in our sample, Whitford extinction function described by Kaler (1986) was used.

$$I_c(\lambda) = I_0(\lambda)10^{cf(\lambda)} \quad (8)$$

where,

1. I_c is the de-reddened line intensity and I_0 is the observed intensity with reddened.
2. $f(\lambda)$ is known as reddening curve for observed wavelength λ as described by Kaler (1976) in the following.

$$f(\lambda) = 2.5634\lambda^2 - 4.8735\lambda + 1.7636 \quad (9)$$

3. c , the extinction coefficient that can be calculated as,

$$c(H_\beta) = 3.08 \log(I(H_\alpha)) - 7.55 \quad (10)$$

Where $I(H_\alpha)$ is the observed intensity of H_α relative to $H_\beta = 100$ by convention. The de-reddened intensity values of forbidden [OIII] and [SII] were used to calculate the electron temperatures and density respectively in our sample of 16 planetary nebula spectra.

3. RESULTS

Table 1. The observed Balmer decrement and un-reddened Balmer decrement

Name	Experimental Value H_{α}/H_{β}	Theoretical Value H_{α}/H_{β}	Difference $ d $
NGC2346	0.40177665	2.86	2.458223
NGC2392	0.349821022	2.86	2.510179
NGC2371	0.402126822	2.86	2.457873
NGC2438	0.243537061	2.86	2.616463
NGC6058	0.524066577	2.86	2.335933
NGC6537	0.127973464	2.86	2.732027
NGC6543	0.202366218	2.86	2.657634
NGC6563	0.247916667	2.86	2.612083
NGC6565	0.311614731	2.86	2.548385
NGC6567	0.113352839	2.86	2.746647
NGC6741	1.172810281	2.86	1.68719
NGC6751	0.157275132	2.86	2.702725
NGC6905	0.085309901	2.86	2.77469
NGC2440	0.274412721	2.86	2.585587
IC289	0.186716539	2.86	2.673284
M57	0.367807446	2.86	2.492193

Table 2. The extinction coefficient (C).

Name	C
NGC2346	-0.17027
NGC2392	0.014955
NGC2371	-0.17144
NGC2438	0.49938
NGC6058	-0.52571
NGC6537	1.360071
NGC6543	0.747095
NGC6563	0.475538
NGC6565	0.169657
NGC6567	1.522348
NGC6741	-1.60322
NGC6751	1.084287
NGC6905	1.902522
NGC2440	0.339715
IC289	1.39910809
M57	-0.05211

Electron Temperatures

independently from above (1), (2), (3) and (4) equations.

We have calculated the $R_{[OIII]}$ values for each planetary nebula in our sample (See the table 3). Then electron temperatures were calculated

Table 3.[OIII] Ratio values.

Name	R[OIII]
NGC2346	36.33579
NGC2392	60.15652
NGC2371	87.03611
NGC2438	66.93878
NGC6058	32.34378
NGC6537	55.49495
NGC6543	293.8021
NGC6563	112.3536
NGC6565	172.6705
NGC6567	54.59635
NGC6741	77.53829
NGC6751	76.08837
NGC6905	37.97054
NGC2440	62.29644
IC289	30.02491
M57	114.7267

Table 4.Electron temperatures (K).

Name	Kwok T_e (K)	Kaler T_e (K)	Acker T_e (K)	Osterbrock & Ferland T_e (K)
NGC2346	21041.56	21362.47	22281.71	21560.47529
NGC2392	15921.84	16102.87	16610.34	16206.20168
NGC2371	13512.91	13642	13999.6	13711.41622
NGC2438	15141.19	15304.41	15760.31	15396.02096
NGC6058	22728.71	23104.57	24188.22	23340.63143
NGC6537	16566.75	16763.17	17315.46	16876.73471
NGC6543	9018.705	9074.463	9224.34	9098.341668
NGC6563	12233.48	12338.59	12627.64	12392.70342
NGC6565	10551.96	10629.31	10839.73	10666.15608
NGC6567	16703.68	16903.46	17465.52	17019.25726
NGC6741	14184.25	14326.93	14723.54	14405.12649
NGC6751	14300.32	14445.41	14848.98	14525.17713
NGC6905	20467.07	20770.28	21636.83	20956.10981
NGC2440	15657.7	15832.6	16322.29	15931.88331
IC289	23956.59	24375.23	25587.74	24641.15522
M57	12139.39	12242.83	12527.14	12295.89386

The graph of Electron temperature vs $R_{[OIII]}$

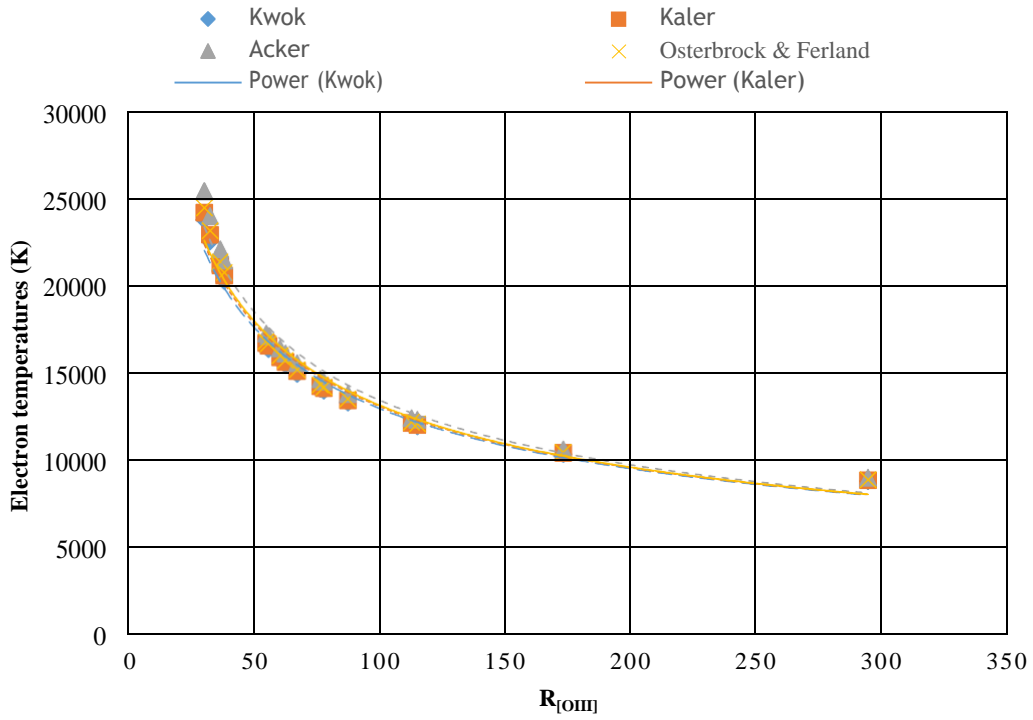


Figure 1. The correlation between the electron temperature and the $R_{[OIII]}$ for each method given in four different equations

A relationship between average electron temperatures (see table 5) and [OIII] ratio was obtained (figure 2) as a new model to determine the electron temperature of a PN for given [OIII] ratio (see the equation 12).

Table 5. Average Electron temperatures (K)

Name	Average Electron Temperature(K)
NGC2346	21682.03305
NGC2392	15798.45427
NGC2371	13748.82331
NGC2438	15137.05187
NGC6058	23340.53064
NGC6537	16354.4802
NGC6543	9006.693454
NGC6563	12595.76197
NGC6565	10892.88016

NGC6567	16474.46833
NGC6741	14326.97543
NGC6751	14425.80875
NGC6905	20641.73804
NGC2440	15573.78738
IC289	23329.09236
M57	12507.16901

The fitted model for the above relationship is,

$$R_{[OIII]} = 32.343 + 5104.149e^{-0.000329925205T_e} \quad (12)$$

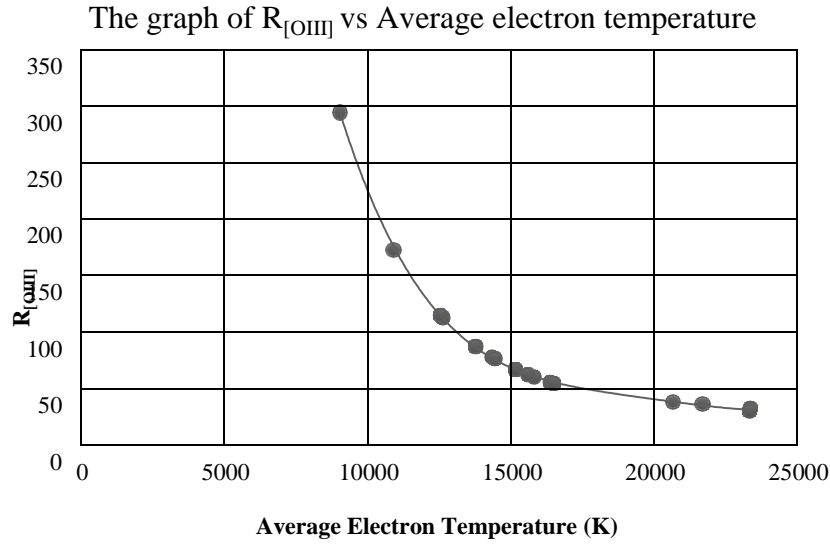


Figure 2. The fitted model for the graph of $R[OIII]$ vs average electron temperature.

Hence an expression can be obtained to estimate electron temperature from the [OIII] line ratios as follows.

$$T_e = -3030.3030 \ln \left(\frac{|R_{[OIII]} - 32.34351|}{5104.15} \right) \quad (13)$$

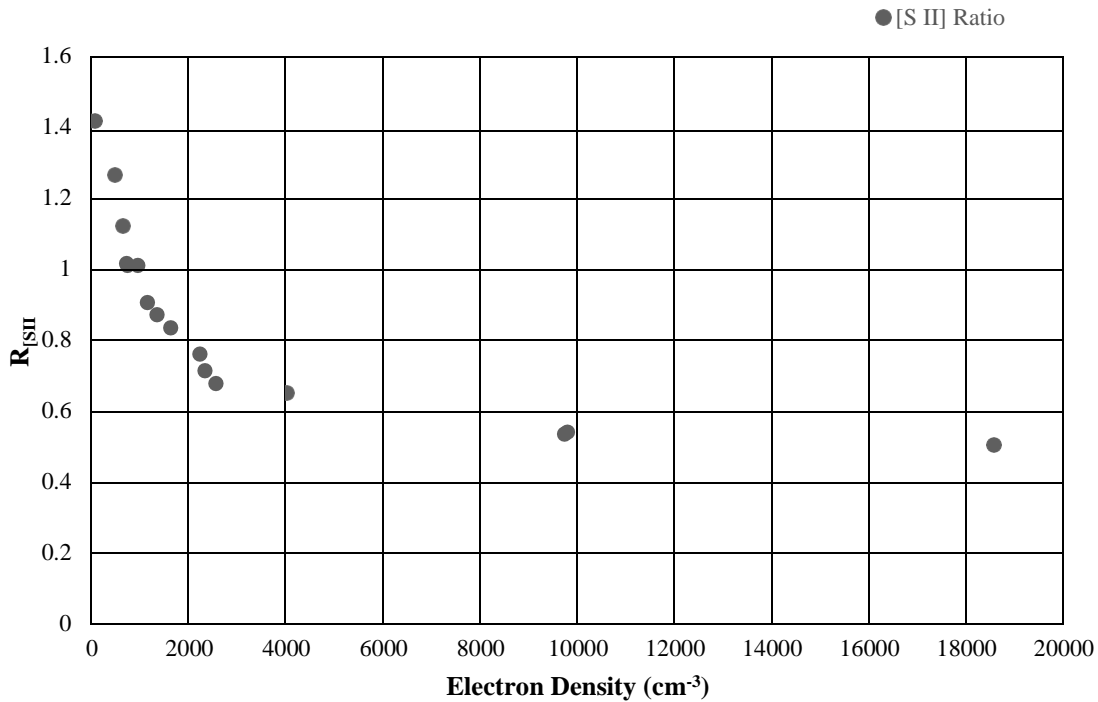
The Electron Densities

From the average electron temperatures and the [SII] line ratios the electron densities for each planetary nebula were evaluated by the equation 7 (see the Table 6).

Table 6. Electron Densities

Name	[S II] Ratio	Average Electron Temperature (K)	Electron Density (cm^{-3})
NGC2346	0.499588498	21682.03305	18584.39543
NGC2392	0.833636922	15798.45427	1628.100553
NGC2371	0.904967876	13748.82331	1146.802707
NGC2438	1.415385025	15137.05187	73.29270112
NGC6058	1.261398003	23340.53064	487.4664244
NGC6537	0.535561861	16354.4802	9796.747258
NGC6543	0.674777301	9006.693454	2552.841711
NGC6563	1.009735715	12595.76197	735.8614294
NGC6565	0.710689579	10892.88016	2329.844695
NGC6567	0.647489779	16474.46833	4033.791007
NGC6741	0.530435506	14326.97543	9731.997869
NGC6751	0.870731301	14425.80875	1341.905529
NGC6905	1.009241954	20641.73804	943.7972179
NGC2440	0.758218474	15573.78738	2227.18599
IC289	1.118653582	23329.09236	650.3616977
M57	1.014953345	12507.16901	718.7391972

The graph of [S II] Ratio vs Electron density

Figure 3. $R_{[SII]}$ variation with respect to the electron densities

4. CONCLUSIONS

A sample of 16 planetary nebulae was selected and their electron temperatures and electron densities were calculated. It was found that all the PNs in the sample were affected by interstellar reddening. Using Whitford extinction function, all PNs were de-reddened. Four methods were used to determine the electron temperatures of these PNs. The calculated electron temperatures were averaged and $R_{[OIII]}$ ratios were plotted against them. A good mathematical relationship was found between $R_{[OIII]}$ ratios and electron temperatures, and the obtained relationship can be used to determine the unknown electron temperatures from given $[OIII]$ ratios. The standard deviation of the averaged electron temperatures is 1.109 and the RMS value of the model is 0.679. Since the electron temperatures of all PNs in the selected sample are greater than 10000K, this mathematical

relationship should be tested for the lower electron temperature planetary nebulae as a future work. Another significance of this relationship is that for higher electron temperatures such as beyond 24000K, the $R_{[OIII]}$ value becomes constant. This concludes that, for higher electron temperatures, $R_{[OIII]}$ will reach its minimum value. The electron densities were also determined for this selected sample of planetary nebulae.

Depending on the Average Electron temperatures, we have evaluated the electron densities via the method of $[SII]$ ratios. From the graph of $[SII]$ ratio vs electron density it can be observed that the numerical validity of $[SII]$ is varying between 0.5 and 1.5. Although the scatter plot shown in Figure 3 had been drawn for different electron temperatures, it can be observed a curvature of the function to be fitted (Figure 3) in the relationship between $[SII]$ ratio and electron density. The Pearson correlation of $[SII]$ and electron density is -0.717, which is a strong correlation.

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ESCALATION OF TENSIONS BETWEEN CHINA AND JAPAN: SHOULD THERE BE A PARADIGM SHIFT IN JAPANESE FOREIGN POLICY?

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ABSTRACT

The dispute between China and Japan is a manifestation of the growing Chinese influence in the region. China has been making steady progress on the economic and military front and the recent advances in military technology have US forces in a very vulnerable position. China may perhaps harbor thoughts on taking over Taiwan. The Chinese Navy and Air force have made threatening maneuvers in and around the Pacific Ocean sending strong signals to Japan and US and it is a force to be reckoned with. The Chinese military buildup in the region and the converting of an Island in the Spratly Islands into a military facility clearly demonstrates China's willingness to take on Japan and the US at a given time in the future. On the contrary, there has been marked lack of progress on the Japanese navy to counter China threat and the US forces have been spread across the globe for countering other threats. Japan also cannot entirely rely on the US security umbrella finalized during the Second World War. This article focuses on the hard choices Japan is faced with in the wake of growing Chinese influence not only in the Pacific region but also in the Indian Ocean. This article also tries to build a strong case for Japan and the diplomatic and security measures it would have to adopt in countering the threat from China.

KEYWORDS

China, Japan, Spratly Islands, Taiwan, Defence, Diplomacy

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1. INTRODUCTION

The dispute between China and Japan would certainly be a melting pot if the situation is not properly appreciated by the world nations. China has made mammoth strides on its economic and military spheres and the strength of the China's defence establishment should not be taken lightly. Asia survived five centuries of colonial domination and yet another colonial power may be on the rise which could be an even bigger threat than the British colonial domination.

China does not have the required natural resources to fuel its economy hence it will have to rely on her requirements from overseas and a supply routes and logistics will have to be maintained for yet another century until it is firmly on its own feet.

The escalation of tensions between China and Japan is a turning point in Asian politics and all hinges on the East China Sea islands that both states claim as their own — known as the Senkaku in Japanese, and the Diaoyu in Chinese. Moreover the building of airfields and other defences around the Spratly islands would be tantamount to sounding alarm bells to Asian region. The crucial questions that Asian and Pacific leaders must ponder are – When will China put an end to its domination in the Pacific region? Would it stop after the airfields in Spratly Islands are built? Would it expand into other areas where clashes or the Third World War might erupt? Is Russia worried over the safety of their oil fields? Is America worried over the vulnerability of its air and naval bases in the Pacific Ocean which are meant to protect Japan, Taiwan and South Korea? (Manicom,,2014,,55).

2. JAPANESE PERCEPTIONS ABOUT CHINA

Chinas has frequently conducted naval war games and in fact sent patrol boats into the waters around the Senkaku/ Diaoyu islands, and the Japanese public generally supports taking a tough stance against such provocations. Japanese public have seen the close encounters Chinese air force and Navy have had over the years projecting their firepower against Japan. Recent convergence of Russian and Chinese defence contacts would also be a cause for concern for Japan. Russian is occupying the Sakhalin Island which had been taken over by the Red Army during the Second World War and Russia is currently exploiting its natural resources such as crude oil and gas. It is a legitimate territory of Japan. The *New York Times* editorial says that “a joint survey conducted this summer by the Japanese nongovernmental group Genron NPO and the China Daily, 93 percent of the Japanese do not have a good impression of China. But many Japanese also understand that China is an important neighbor and essential to their own peace and prosperity: In the same survey, over 70 percent of Japanese said the relationship between Japan and China was important, and about 80 percent expressed concern over its current state or the need to improve it. Mr. Abe knows this” (Takahara ,2014).

Experts are of the view that if this had been a problem of fishing rights and natural resources then the dispute could have had a history of at least 50 years. If so then why did it hyped up during last three years. It was clear that China was targeting the oil resources in the deep seas of Spratly islands as oil resources are a vial commodity required for China. There has been a surge

in the patriotism and militarization in view of China's rapid growth in economic and military power. Japan is worried that it might lose its grip over international community as China is making rapid advances. It is about high time Japan took stock of the situation and adjust its defence and foreign policy in line with the current developments. Domestic political opinion in both China and Japan have become a point of rallying nationalism, patriotism and reinforcing national identify.

3. JAPAN AND THE US SECURITY PARTNERSHIP

With the surrender of Japanese forces during Second World War, a new strategic defence partnership was established with the United States, which provided security guarantees for Japan. In the aftermath of World War II, the Treaty of Mutual Cooperation sealed the US.-Japan defence alliance and it enabled the United States to establish military bases in Japan in exchange for the assurance that it would provide security for Japan from external aggression. This has now turned into a robust and important defense alliance between the two nations that has served as the foundation for peace, security, and stability in the Asia-Pacific region. The partnership has blossomed over the years ever since it was concluded (Osirus, 2002).

If China confronts Japan it would not only be confronting Japan but with the US as well. The US is under an obligation to protect Japan hence the stakes in Pacific are extremely sensitive. The White House has given a clear message to Japan that the US is solidly behind Japan. President Barack Obama reiterated the US security commitments to Japanese Prime Minister Shinzo Abe reiterated that "the US.-Japan

alliance is the central foundation for our regional security and so much of what we do in the Pacific region." (*Japan Times*, 2013). This is a clear endorsement of security guarantees for Japan which is part of the US.-Japan security agreement which endorses US's resolve that it would back Japan, should China decides to take over the islands, which in turn could set off ripples across the Asia-Pacific and beyond.

A Japanese Ministry of Defence document says that

"In order to ensure Japan's peace and security under any circumstances, from peacetime to contingencies, and to promote a stable, peaceful, and prosperous Asia-Pacific region and beyond, bilateral security and defense cooperation will emphasize: seamless, robust, flexible, and effective bilateral responses; synergy across the two governments' national security policies; a whole-of-government alliance approach; cooperation with regional and other partners, as well as international organizations; and the global nature of the Japan-US. Alliance.

The two governments will continuously enhance the Japan-US. alliance" (Ministry of Defence, Japan Report, 2015).. The report even says that "The United States will continue to extend deterrence to Japan through the full range of capabilities, including US. nuclear forces" (Ministry of Defence, Japan Report, 2015).

4. CONFLICT WITH TAIWAN

Territorial claims to islands of Senkaku will not rest with China and Japan as it has also been claimed by Taiwan. The security of Taiwan is totally dependent on the goodwill of the US and given the current US commitments worldwide on anti-terrorist and humanitarian operations, and its preparedness to defend Taiwan would have to be closely studied. If China attacks Taiwan and secures it, that would be a major shift of political tectonics in the region. It would further reduce the US influence in the region and would certainly be a game changer in Asian politics. Taiwan has been relying on the US supply of arms and ammunition and the large-scale war ships and other strategic partnerships. China knows for sure that the US would provide Taiwan with military intelligence, arms and ammunitions, training and other logistical support if China attacks Taiwan and it would be a huge miscalculation for China and hamper China – US relations. China exports around 15% of its exports to the US and there is a huge trading relationship with the US . If China attacks Taiwan the whole edifice of China – US trade partnership would collapse. In 1979, the US and Taiwan entered into a security partnership for the sale of advanced military equipment, “which continued even after Washington established diplomatic relations with Beijing and ended the defense treaty with Taiwan. The level of arms sales has been relatively high over the last two decades. In the first term of the Obama administration, for example, the United States transferred over \$12 billion in weaponry to Taiwan” (Bush, 2016). There is a looming doubt whether US would be able to counter the rising power of Chinese Navy which keeps enlarging its fleet of

ships and its recently tested weapons technology. Will. US be able to contain Chinese weapons?

China, with a population as estimated by CIA at 1.3 billion (July 2016 estimated) (CIA Country Report on China) and with a GDP growth rate at 7.3% (2014 estimate) (CIA Country Report on China), one would naturally pose a question as to the influence of China on the world map. China boasts a literacy rate of 95.1% though official figures as to accessibility to internet are not available. Since GDP is growing alarmingly it is naturally in search of resources to keep moving its industry. This is a mammoth task as energy resources are totally insufficient to reap the full potential of Chinese economic miracle. China has been active in the African continent looking for potential allies (*Economist, 2013*). The rapid economic growth also enabled China to modernize its military industry and hardware necessary to protect the vital sea lanes of communications. The latest manifestation of China’s aggressive stance is amply demonstrated by threats made to Japan and forcibly engaging in oil drilling activities in South China sea off Vietnam.

This is a wakeup call to the US to further increase its presence in the Pacific Ocean. Japan requires an immediate overhaul of its defence apparatus and a paradigm shift is required in :

- human resource mobilisation both civil and military within Japan,
- acquisition of modern state of the art weaponry,
- conduct defence research

- explore whether the constitution can be amended to meet the threats
- mobilise the all international propaganda and information warfare resources and establish a Radio Station to conduct programs in Chinese and to reach China.
- evaluate military training doctrine in the wake of China's aggressive behavior.
- take decisive efforts to mobilise the Japanese diplomatic corps overseas to stem the growing Chinese influence in the region and to make an awareness on the Chinese aggressive posture in the South China sea.

The recent aggressive behavior in the South China seas amply demonstrates that China would not sit idle by when there is a massive boom in the Chinese economic activities. It has also augmented its naval war fighting capability with newly built aircraft carriers and submarines. China has now threatened its neighbor Japan. Japan has been peaceful nation since 1945 and failed to take into account the consequences of the threats from the emerging China. Japan still has time to reorganize its defence capabilities. Japanese economy is entirely dependent on the energy resources from Middle East, Australia and other countries. Japan must therefore ensure that vital sea lanes of communications are secured. Any interdiction of such Japan bound cargo would have dramatic consequences and it would cripple the Japanese economy (Tarrant,2010).

5. CAN JAPAN TOTALLY RELY ON THE US?

Japan cannot solely rely on US to provide defence cover as US. too is highly pre-occupied with other potential threats. There

have been moves to cut the defence spending and this is done at a time when China is leapfrogging in defence capabilities. It is imperative that Japan stays ahead of the military capability on its own. Defence planning is of paramount importance and Japan cannot wait until events to unfold. It would be prudent to have in place advance preparations. Japan has come under threats not only from China but from North Korea as well. The US Congressional Research report says that

“North Korea's increased asymmetric capabilities pose a direct threat to Japan. A territorial dispute with China over a set of islets in the East China Sea raises the risk of military escalation, a scenario that could trigger US. treaty obligations to defend Japan. Japan has pursued security cooperation with others in the region, including Australia, India, and several Southeast Asian countries. Of concern to the United States is the tense Japan-South Korea relationship, which has prevented effective trilateral coordination. Without cooperation among its allies, the United States may find itself less able to respond to North Korean missile threats and to influence China's behavior” (Chanlett, 2016).

The recent developments in the North Korean defence posture where North Korea had proven its capability in delivering nuclear capable ballistic missiles has put the region US defence alliances with Japan

and South Korea in an awkward position where the US will have to project a sterner defence posture as a counter to North Korea.

6. STRATEGIC PETROLEUM RESERVE IN SRI LANKA

This author had proposed a strategic petroleum reserve for Japan in the Hambantota district in Sri Lanka as far back as 1993 as an independent strategic consultant. (*Daily Financial Times, 2012*). If it had been given due recognition Japan would have secured a vital strategic asset in Sri Lanka (*Daily Financial Times, 2012*). The petroleum reserve would have provided an insurance policy for any eventuality in the Middle East and it would have ensured that the continuous flow of crude oil to Japan. China seem to have secured energy supplies through its pipeline in Myanmar and the supply route from Central Asia whereas Japan solely relies on the ocean transport of its energy supplies and passes through the troubled waters of the South China.

7. CYBER SPACE AND SECURITY

As far as the US is concerned, it has a very high rate of accessibility to the internet. The entire US society is now logged on to the internet in one way or the other. A life without internet in the US is unimaginable and any disruption of the free flow of information would pose grave political and commercial consequences. The entire US Government machinery functions on information technology. IT infrastructure/Cyber security is so crucial that it is linked to Japan and other the US Allies in Europe as well. The protection of

IT infrastructure/Cyber security is of paramount importance.

In 2007, China demonstrated that it has the ability to take on an ailing satellite and China was successful in destroying the satellite (Nicholson, 2007). This is an alarming development and had wider corollary for US National Security concerns. Does China have the capacity to destroy the US military satellites? Does the US have the ability to counter Chinese capacity to target the US commercial and military satellites? These are vital US national security concerns. Has the US ever conducted war games in the absence of a network of satellites? Almost all the war games hitherto conducted have been to test the effectiveness of plans and weapons and its high technological effectiveness. Never has there been a war game to prepare the US for a situation where there is a total breakdown of communications. Communications play a central role in governing a country and without it a military high command cannot function and it would put the entire country at risk.

8. SECRET SUBMARINE BASE

There have been reports that China had constructed a secret submarine base in the Hainan Island primarily to counter the US military presence in the Pacific. India too had expressed concern as the base is within the striking distance of Indian territory and India would be vulnerable to submarine-launched ballistic missiles (Harding, 2008). This is a clear manifestation of China's grand intentions in the region. China is a secretive society unlike the US. where public affairs are conducted every hour on the hour using high technology through mass media channels. Neither the US nor

India could fathom the exact military capabilities of China (Harding, 2008). Neither country has the capability to penetrate the secret defence research being undertaken in China. Does the Indian Naval Intelligence have the ability to account for all the Chinese naval and merchant fleet in the Indian Ocean? Would it not be prudent to mount a joint US, Japan India Naval intelligence to monitor Chinese naval forces (Harding, 2008). There have been reports that China is trying to encircle India using ports in Pakistan, Myanmar and Sri Lanka. It would be highly unlikely that the Sri Lankan Government would allow China to take advantage of the Port of Hambantota as a strategic staging point against India. No Government in power would allow China to threaten the security of India. This is inconceivable and it would never happen. However any Chinese vessels with commercial registration may engage in providing logistical facilities for the Chinese Naval forces in the Indian Ocean regions. Government of Sri Lanka may not be in a position to deny any Chinese commercial vessels anchoring or berthing at Port of Hambantota when its requirement is for fuel and other logistical needs. However, the historic and cultural relations with India far transcend the political expediency of China's military strategies whether covert or overt.

9. CHINESE PRODUCTS MAKING INROADS INTO MARKETS.

Chinese products keep penetrating markets worldwide at an alarming rate. The products range from footwear to machinery. Chinese construction companies have in the recent past made inroads into traditional markets receptive to

US and European companies. European designs have been extensively copied by Chinese entrepreneurs and it would be difficult for an unsuspecting individual to differentiate the Chinese product of original handcrafted quality footwear from the US or European product. China has invested heavily in industrial espionage (Roper,2014) and Chinese nationals have been caught in the very acts of espionage. The Chinese domestic political landscape is so interwoven that people can be mobilized at will by the State, unlike in the US, where civil and political rights have been guaranteed by the Constitution and conscription would be politically suicidal for the Government. The Chinese domestic political situation is a far cry from the US system and molded on the needs of the military (Roper,2014).

10. CHINESE CONSTRUCTION INDUSTRY

Chinese construction companies have been awarded construction projects worldwide, especially in the Middle East region without weighing the pros and cons of engaging a construction company with a track record (Anderson, 2011). In some cases, cost aspects have taken precedence over quality and safety matters, thus rendering the project vulnerable to catastrophes (Rabinovich,2011). The cost of engaging a Chinese company is much cheaper than employing a US company. A group of Chinese engineers could share a congested room at a construction site whereas an American or a European engineer would require a fully furnished apartment with frequent travel to and from home base and also additional facilities such as family packages to compensate for working outside the US territory. These factors keep

US and European companies from competing with Chinese companies. This has been so due to societal norms in the US. But to counter rising China, the US. needs a much more holistic approach that would encompass its traditional US allies and India in particular. There has been a foray by the Chinese companies to enter the European market (Dasgupta, 2016). The US. must have a political dialogue with India as India is the only country that can be pitted against China. What the US. should now be doing is empowering India and its people to face the reality before it is too late. It would be difficult for the US. to deal with China given the current social, cultural and political considerations to mount a campaign to withstand rising China in about 20 years' time.

11. THE US PIVOT TO ASIA

The Obama administration first mooted the concept the "US. pivot to Asia" in the wake of rising China in terms of economic and massive investments in the Asia region, display of military power and influence in the region. The US had to redefine its role in Asia. The pivot encompasses a diplomatic, economic, foreign investments and display of military assets and holding naval maneuvers in competition with US Navy (Foreign Policy Initiative). There has been a sustained diplomatic effort that led to the reviving of former US enemies, such as Myanmar and Vietnam. The central thrust behind this move was to resuscitate and reassert the US role as Asian countries move towards regional integration and to project the US as an indispensable nation (Foreign Policy Initiative). The US Assistant Secretary of State for East Asian and Pacific Affairs Kurt Campbell said in an interview with the Foreign Policy Institute

that "we all have to recognize as a player and a major player, a dominant player, is that every country in Asia wants a better relationship with China. That's just a fact on the ground. So, it's very different than a Cold War environment. And what countries also want is a good relationship with the United States. They want a good relationship with the United States in its own right, but they also believe that a strong, durable, stable reliable relationship with the United States gives them a better ability to deal with the giant in the neighborhood" " (Foreign Policy Initiative). Under Trump administration, US still continues to send war ships to South Pacific as counter to Chinese naval expansion and to send a strong signal to Beijing that it does not recognize the artificial Islands and its territorial ambitions in South Pacific. The Trump foreign policy is still evolving and it is yet to manifest its true impact. The Prime Minister Abe was the first Head of Government to meet President Trump and indicator for strong US – Japan alliance (Dias, 2017).

12. CONCLUSION – WHAT POLICY ALTERNATIVES TO BE CONSIDERED

Japan does not have a strong lobby in Washington DC to check the foreign policy objectives or garner support from the US. Government unlike Israel which has a permanent lobbying organization called American Israel Public Affairs Committee – AIPAC. The lack of progress on Japanese Russian dialogue and access to arctic resources has not been pursued with Russian Government. A strong military contacts with NATO as a front has not yet been exploited. Japan has an ongoing dialogue with NATO over shared values

and currently Japan has partnered with NATO on Cyber defence (Scimia, 2018). Japan does not have a central strategic investment entity where Japan can invest in other countries strategically. Japan should consider investing in strategic ports, port development partnership and airport development as well. China seems to have made inroads into African and Asian countries on the pretext of developing strategic infrastructure such as ports and airports and investment zones.

Missile defense is yet another area Japan must venture into in view of the threats from North Korea and for its defence posture. China would soon acquire hypersonic missiles and Japanese defence research must now focus on missile defence by countering hypersonic anti-missile system with equal speed. The US Government is in a fix on countering hypersonic missiles but US does have the technical competency and wherewithal to come up with an antidote (Sonne, 2018). Ever since Soviet Union collapsed, the US Government relaxed its defence research and underestimated the Russia, and Chinese resolve to undertake further defense research.

13. RECOMMENDATIONS

- Japan should also seek support from Russia as emerging China would one day be a potent threat to Russia as well. One way of garnering support from Russia would be to build an oil pipeline linking Russia to Japan and also by procuring military hardware.

This has some impact on the Japanese US relations hence any such move must have

the sanction from US administration. Alternatively, the US. too could be involved in the exploration and pipeline construction or it could be 100% US private equity participation so that the US policy towards Japan would not be hampered. Japan needs to look afresh on the dispute with Russia over Sakhalin Islands and explore whether any joint exploration of hydro carbon would be possible in an effort to nurture political relations with Russia. There should be coherent public diplomacy efforts by the Government of Japan to garner support from the whole world. Global media plays a vital role in shaping public opinion and Japan is ahead of China over this and must continue the momentum. Public diplomacy is about global perceptions and seeks to promote the national interest and the national security through understanding, informing, and influencing foreign publics and broadening dialogue between American citizens and institutions and their counterparts abroad (USIS definition).

- Japan's strategic influence will have to be explored and exploited by the Japanese Diplomatic Corp overseas just the same way US went about immediately after the 9/11 incident – though the office strategic influence was scrapped thereafter. This is a new phenomenon for Japanese Diplomatic Corp overseas. A paradigm shift in Japanese foreign policy is now needed to counter China. Where there is high Chinese influence, Japan must move in to neutralize Chinese influence through overt and covert diplomatic maneuvers. The Government of Japan should create a Japan Foreign Intelligence Surveillance Agency to monitor Chinese infiltration of

Japanese defence establishment, keeping tabs on Chinese economic espionage on Japanese advanced technologies and domestic propaganda.

- Japan must keep tabs on domestic political activities and on pro-China political affiliations. There could be covert activities to dilute the Abe Administration and might funnel money to elect a government in Japan more pliant to China. There has to be a strong internal defence mechanism to ward off any Chinese influence and infiltration. The Government of Japan should inculcate a sense of patriotism among Japanese population. Introduce a National Security Levy to galvanise patriotic citizens of Japan to collect money for defence budget.

- Japan must build a Coalition against China and keeping the pressure on China to desist from such aggressive behavior. Japan must rope in South Korea, Vietnam, Brunei, and Malaysia, Philippines, Taiwan and rest of the World. Other coalition partners too must make similar diplomatic offensives against China. Japan, US, India must jointly establish a Trilateral Commission/ A Secretariat so that diplomatic channels are ever ready to meet and discuss the joint action. Japan and India must open another front and recent media reports indicate that Japan and India to work on joint exercises with Indian and Japanese forces. Japan must build additional naval assets such as Aircraft carriers to project power beyond Japanese shores. US and Japan must assess the industrial and commercial opportunities in India vis-à-vis competition with Chinese products.

- It would be prudent for Japan to initiate an internationally accepted quality assurance/ quality control regime/ convention so that Chinese products will be required to comply with such international standards and this will enable the signatories to comply with the requirements of the convention with penalties for transgressions.

- Introduce a mechanism whereby Chinese manufacturing could be subjected to international inspection for compliance. Thorough checks and balances on Chinese manufactured products would deter Chinese products being entertained by end users. Japan needs to mobilise her friends all over the world and devise an international convention so that Chinese piracy can be held at bay. US and Japan must forge greater strategic cooperation with Indian defence establishments and on defence research. Japan should explore whether it could participate in the antiballistic missile defence shield. Japan too should actively contribute to advances in antiballistic missile defence.

- Japan must have a lobbying organization along the lines of American Israel Public Affairs Committee (AIPAC) in Washington DC to check US domestic political opinion and support legislators who are in favor of Japanese policy. This would allow Japan to elect a President who is more in favor of supporting Japan. This approach must be introduced to other coalition partners. The same attitude must be present in countries where incumbent governments are either not aggressive enough or elect a government which would support Japan diplomatically and in militarily in case of an emergency.

Government of Japan must use the entire government machinery in a concerted effort to influence China to abide by the international rules and norms.

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CHEMICAL EVALUATION OF SOME SELECTED METAL COMPOSITION IN EDIBLE SALT

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ABSTRACT

It is important to assess the quality of salt as salt is the most used food additive worldwide. Determination of metallic elements of salt samples which were purchased from retail outlets of Ambalangoda were done by Inductively Coupled Plasma Mass Spectrometry. All the samples complied with SLS 79: 2014 (Food Grade Salt Granular Form) and SLS 80: 2014 (Food Grade Salt powdered Form) with respect to arsenic, cadmium and copper as arsenic and cadmium levels were lesser than 0.5 mg/kg and copper levels of samples were lesser than 2.0 mg/kg. However, two samples did not comply with above standards as lead content was greater than the maximum limit (2.0 mg/kg). One sample contained 0.4 mg/kg of mercury content which was four times greater than maximum limit for mercury (0.1 mg/kg). Beryllium, Cobalt, Selenium, Silver, Rubidium, Cesium, Thallium, Uranium, Vanadium, Zinc and Gallium were lesser than 0.1mg/kg in salt samples that were tested. Concentration of Aluminum, Manganese, Strontium, Barium and Nickel varies from <0.1 to 18.7, <0.1to 4.8, <0.1to 45.3, <0.1 to14.6 and <0.1to2.9 mg/kg consecutively. Although exact reason is not clear,all samples except one sample contained a higher amount of strontium content with respect to that of other metals. Even though minute in quantity, chromium is available in 82% of the samples which were tested. Helium mode of ICP MS seems to be a reliable method to analyze metals in salt as percentage of recovery is in between 80% to 120% for most of the metals tested.

KEY WORDS: Salt, Heavy Metals, Icp-Ms, Quality

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1. INTRODUCTION

Salt has been a common commodity and household staple for thousands of years. It is considered that salt production dates back from 6000 BC. Salt is the common name given to sodium chloride (NaCl), and it plays various roles in food preparation. For example, salt makes food acceptable during food processing, preserves food by retarding the growth of spoilage microorganisms, gives proper texture to foods, regulate the rate of fermentation in food processing, and strengthens gluten in bread. Sodium chloride is an essential constituent for human body functions, such as maintenance of osmotic balance in cells, transmission of nerve impulse signaling, hydration etc. (Munteanu et al., 2011).

Salt can be prepared by mining from salt deposits or by evaporation. Sea salt consists of about 98% of NaCl with remaining 2% constituted by trace elements such as iron, magnesium, sulfur, iodine, potassium, magnesium, calcium, zinc, nickel, chromium, cadmium, manganese, copper, cobalt etc. (Mohammad N. et al., 2013). Irrespective of the source of origin, there is a high probability for the occurrence of toxic substances such as heavy metals in salts. Heavy metals are required for both plants and animals in small quantities, but they are harmful when present in excessive amounts (Morris et al., 2008). Heavy metal contamination in food even at relatively low concentrations can cause adverse health effects. Since edible salt is the most used food additive worldwide, any contamination of salt could be easily spread within entire community.

Therefore, it is extremely important to know the salt quality in terms of essential and non-essential metals as it is one of the basic food items used in daily routine by all the people.

Considering the above facts, it is essential to conduct a thorough scientific research to check the occurrence and to quantify essential and non-essential metals in salt which leads to take meaningful actions to generate awareness within Sri Lankan community.

2. METHODOLOGY

Ten retail outlets of Ambalangoda were selected to collect samples. Packets of salt from different brands were randomly chosen from each of the selected retail outlets. During selection of samples, both granular form and powdered form samples were purchased from each retail outlet. From every brand of salt, two packets from one batch were purchased. In total, seventeen samples from different batches of seven brands of salt including both granular and powdered salt were analyzed. Among the selected samples, there were ten crystal samples and seven powdered samples. Sealed plastic packets of salt brands were bought in 400 g, 500 g, 900 g, and 1 kg quantities. The anonymity and confidentiality of salt brands was maintained by the use of codes during analysis of samples.

Samples were labeled and transferred to the laboratory of Industrial Technology Institute and stored in 25 ± 2 °C, without allowing expose to sunlight until analysis was completed. Corn and quartering was done to obtain a representative sample to carry out analysis.

As to SLS 79: 2014 (Food Grade Salt Granular Form) and to SLS 80: 2014 (Food Grade Salt powdered Form), moisture content was determined in salt samples by drying approximately 10 g of the sample at 140°C to 150°C for at least 4 hours.

To prevent the occurrence of contamination from the glassware, prior to sample preparation, all the volumetric flasks of 50 mL were washed by laboratory detergent, following rinsing in water, and they were soaked in 10% nitric acid overnight. Then they were rinsed with distilled water. The volumetric flasks were finally washed with 1% nitric acid and then with ultrapure water immediately just before the preparation of samples. When preparing salt samples for the analysis of metal composition, 0.5 g of salt from the homogenized samples was accurately weighed by using a calibrated analytical balance. Salt was dissolved in ultrapure water by thoroughly shaking

the glass volumetric flasks of 50 mL after stoppered. To each volumetric flask, high purity analytical grade (AristAR[®]) nitric acid was added to obtain a solution with the acid strength of 6%. Volumetric flasks of 50 mL were filled to the mark with ultrapure water. Reagent blank was prepared by using ultrapure water and high purity analytical grade (AristAR[®]) nitric acid.

Recovery study was carried out for the quality assurance of data. For that two samples of spiking solutions of 0.2mg/kg were prepared. One sample was prepared by using a known weight of AnalaR NORMAPUR grade sodium chloride and to other sample known weight was added from randomly selected granular salt sample. These solutions were spiked by the addition of 2mL from the 10 mg/kg certified reference material which consisted of multi elements. Determination of metallic elements presence in salt solutions was done by using Agilent 7900 ICPMS (High matrix introduction, Helium mode). Calculation of metal content was done on dry basis. For the preparation of calibration curve, 10 mg/kg multi element standard and a solution of 6% (V/V) nitric acid which was prepared by using high purity analytical grade (AristAR[®]) nitric acid and ultrapure water was used. The standard series which was prepared consisted of 1µg/kg, 10 µg/kg, 50 µg/kg, 100 µg/kg and 200 µg/kg. All the data were analyzed using SPSS version 17.1. One tailed T test was used for the determination of difference in levels of metals and metal profile in powdered and crystal salt samples. $P < 0.05$ was considered as significant differences.

3. RESULTS

The minimum detection limit for metal ions is 0.1mg/kg. All the samples, except one sample in which strontium content was lesser than 0.1mg/kg, contained a higher amount of strontium content with respect to other metals. Among the salt samples in which strontium was present, the lowest observed value for strontium was 6.13 mg/kg and the highest observed value was 45.3 mg/kg. Even

though minute in quantity, chromium was available in 14 samples out of 17 samples which were tested.

In the salt samples which were analyzed, Beryllium (Be), Cadmium (Cd), Cobalt (Co), Selenium (Se), Silver (Ag), Rubidium (Rb), Cesium (Cs), Thallium (Tl), Uranium (U), Vanadium (V), Zinc (Zn), Gallium (Ga) were lesser than 0.1mg/kg levels.

Arsenic and cadmium levels of the samples were lesser than 0.5 mg/kg and the copper content of the samples were lesser than 2.0 mg/kg respectively. Lead content of the two samples of two different brands were greater than 2mg/kg. From the samples analyzed, 41% of salt samples contained lead below 2 mg/kg. One salt sample, which was granular in nature, contained 0.4 mg/kg of mercury content. Variation of concentration of metals in salt samples that were analyzed is shown in table 01.

Table 01 –Types of metal verses variation in concentration in different brands of granular and powdered salt samples.

Type of metal	Average concentration of metal in powdered samples / (mg/kg)	Average concentration of metal in granular samples / (mg/kg)	Range of concentration / (mg/kg)
As	<0.1	0.03±0.1	<0.1 – 0.3
Cr	0.21±0.1	0.16±0.3	<0.1- 0.9
Al	1.33±2.4	2.64±5.9	<0.1- 18.7
Mn	0.54±0.7	1.41±1.9	<0.1- 4.8
Cu	0.22±0.6	0.15±0.5	<0.1- 1.6
Sr	14.94±6.9	26.23±13.8	<0.1- 45.3
Ba	3.19±5.1	3.62±4.7	<0.1-14.6
Pb	0.03±5.1	0.51±0.1	<0.1-2.5
Ni	0.41±1.1	0.35±0.8	<0.1- 2.9
Hg	<0.1	0.04±0.1	<0.1- 0.4

There is no any significant variation in between the metal contents in powdered salts and granular salts ($P > 0.05$).

In addition to that, there was no any significant variation in the metal profile in powdered salts and granular salts ($P > 0.05$).

In both spiked solutions which were prepared by using AnalAR NORMAPUR grade sodium chloride and a randomly selected sample of edible common salt, percentage of recovery was in between 80% to 120% of Aluminum (Al), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Manganese (Mn), Mercury (Hg), Nickel (Ni), Silver (Ag) and Vanadium (V) .. Correlation of coefficient for each and every metal was calculated. Among the metals, Arsenic and Aluminum, Arsenic and Mercury and Aluminum and Mercury consist of a correlation of coefficient closer to 1. Moreover, Chromium and Nickel and Manganese and Lead have a correlation coefficient which is closer to 0.7

4. DISCUSSION

As to SLS 79: 2014 (Food Grade Salt Granular Form) and to SLS 80: 2014 (Food Grade Salt powdered Form) maximum limits available only for Arsenic as As, Cadmium as Cd, Lead as Pb, Mercury as Hg, Copper as Cu are 0.5, 0.5, 2.0, 0.1 and 2.0 mg/kg consecutively.

Therefore, all the samples are complied with respective standards with respect to arsenic, cadmium and copper. But three samples do not comply with SLS standards for salt due to presence of higher level of lead and mercury.

ISO standards for food grade salt, granular type and crystal type or codex standards have not established maximum allowable limits for metals except for lead, cadmium, mercury and arsenic.

Out of the seventeen samples which were tested, two crystal samples of two different brands do not comply with above mentioned standards as lead

content of those samples are greater than the maximum limit (2mg/kg). Lead content may be high in salt due to sea pollution; sea water which was used in preparation of salt may contain higher concentration of lead. Moreover, salts of lead may easily precipitate along with sodium chloride. Lead accumulates in the body. Data published in literature indicates that excessive intake of lead, even in minute quantities causes harmful effects on different systems and organs such as central and peripheral nervous system, gastrointestinal tract, muscles, kidneys etc.

Cadmium accumulates in kidneys and has a long biological half-life in humans of 10–35 years. Moreover, cadmium is a well-known carcinogen. In all the samples which were analyzed, cadmium content is lesser than mg/kg level. Hence, salt seems to free from potential toxicity with respect to cadmium.

International agency for research on cancer has categorized chromium and mercury as carcinogens. One crystal sample consists of mercury which is four times higher than the maximum allowable limit for mercury by above standards. Therefore, it is important to continuously monitor the level of mercury presence in salt. It is equally important to pay attention to the level of chromium in salt as 14 samples consist of chromium. Although the level of chromium is minute, there is a high possibility to cause chronic toxicity of chromium via salt as salt is consumed in everyday by Sri Lankan consumers.

Inorganic arsenic is considered as a carcinogen which causes cancers in the skin, lungs, liver and bladder. Lower level exposure can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, and damage to blood vessels. Arsenic content in salt samples that were tested is lesser than 0.5mg/kg, and salt samples comply with SLS specifications with respect to arsenic. Therefore, salt does not act as a source of arsenic. But it is important to evaluate the quality of salt Island wide via a comprehensive

study, with respect to arsenic prior to reaching such conclusion.

The highest value of barium presented in tested samples is 14.6 mg/kg. Barium is not known to be carcinogenic or mutagenic. Short term excessive exposure can cause vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, muscle weakness and hypertension. According to the regulatory limits which were established by United States Environmental Protection Agency for drinking water, the maximum allowable limit for barium is 2.0 parts per million (ppm). Although there is a maximum limit available for Barium to be present in water, there is no such maximum allowable limit for barium with respect to salt. It is important to evaluate the level of barium in edible salt as maximum barium concentration observed in edible salt is seven times greater than that of maximum allowable limit for barium in drinking water.

According to literature, prolonged excessive exposure of silver causes argyria, a condition in which skin and hair are heavily discolored by silver in the tissues, there is no any associated health risk of silver with respect to salt as silver is not detected in mg/kg quantities in any of the samples which were analyzed.

Since most of the samples contain a higher amount of strontium, it is important to further study about the significance of strontium content and also the concentration of radioactive strontium proportion of the edible salt. Problems with bone growth may occur in children eating or drinking unusually high levels of strontium, especially if the diet is low in calcium and protein. Radioactive strontium may cause cancer as a result of damage to the genetic material in cells. As to the agency for toxic substances and disease registry of United States department of health and human services, an increase in leukemia over time was reported in individuals in one foreign population who

consumed relatively large amounts of ^{90}Sr and other radioactive materials due to usage of river water contaminated by a nuclear weapons plant. Although the cause which makes strontium concentration to become high in salt is not clear, the reason could be that strontium may easily precipitate by forming salts along with sodium chloride. Additionally, strontium content may be high in sea water which is used for the production of salt.

Since the correlation of coefficient of Arsenic and Aluminum, Arsenic and Mercury and Aluminum and Mercury is closer to 1, it could be concluded that there is a strong correlation for the presence in salt is available within those metals. Even though the exact reason is not clear, this may be due to similar chemical properties of the cations of these metals.

As Chromium and Nickel and Manganese and Lead have a correlation closer to 0.7, it could be concluded that moderate correlation is available within these metals in salt samples.

Since percentage of recovery is in between 80% to 120% of most of the metals analyzed, it could be recommended that high matrix introduction, Helium mode of ICPMS is a good method to analyze metals in salt.

5. CONCLUSION

High matrix introduction, Helium mode of ICPMS is a good method to evaluate and quantify metals in salt. (This statement is valid if recovery studies have been done for all the metals analyzed)

It is essential to analyze salt quantitatively for the presence of heavy metals as salt is universally consumed. Although salt samples which were analyzed comply with SLS standards with respect to Cadmium, Copper and Arsenic, 17% of total samples do not comply with SLS standards for salt due to presence of higher level of lead and mercury. Therefore, it is important to assess salt quality with respect to heavy metals since salt is one of the commonly consumed ingredient every day.

Since chromium is present in most of the samples, it is important to determine the chromium content even though SLS specifications for salt have not given any upper limit for chromium.

It is important to assess the concentration of radioactive strontium level of salt as most of the samples consisted of considerably higher levels of strontium.

6. ACKNOWLEDGEMENTS

The authors wish to acknowledge Mr. B Wijegunasekara, Senior Deputy Director of Chemical and Microbiological laboratories, Mr H A A Perera and R Chathuranga of Residual Analysis Laboratories of Industrial Technology Institute and Dr (Mrs) Meththika Vithange of Institute of Fundamental Studies for the support they have given during the study.

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SOCIAL AND ECONOMIC FACTORS AFFECTING ETHNIC FERTILITY DIFFERENTIALS IN SRI LANKA

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ABSTRACT

In the Sri Lankan context, society consists of different ethnic groups with distinctive languages, cultures, values and norms, and the behavior of people in many ethnic groups is attached to their ethnicity. Further at present Sri Lankan society has also changed with the influence of various economic and political policies. Especially modern economic and political policies influenced on Family, the bottom of the society pyramid among different ethnic groups. Therefore, the main objective of the study is to identify the impact of ethnic differentials on fertility. This study used secondary data from the Sri Lanka Demographic and Health Survey (SLDHS) conducted in 2006/2007 by the Department of Census and Statistics. 13753 currently married women aged 15-49 years were used to identify their fertility behavior by study. Poisson regression model was used for analysis. The study found that after controlling for demographic and socio economic variables, Tamil and Muslim women are statistically significant and show a positive relationship with number of children. Considering the socio economic and demographic factor variations which affect fertility among ethnic groups, age at marriage, partners' and women's education negatively effect on all ethnic groups. All ethnic groups show a positive relationship between number of children ever born and number of children preferred. Wealth status of household and age difference between spouses show a negative relationship with fertility. "There is a positive relationship between the number of women who have not been frequently exposed to the media and the number of children born

KEYWORDS: *Ethnicity, fertility differential*

1. INTRODUCTION

Even though reproduction is a biological and universal phenomenon, socio cultural norms and physical environmental conditions also influence on fertility. Hirschman and Young (2000) state that “fertility behavior, like all individual behavior, is Influenced by the social, economic, and cultural context as well as by individual circumstances”, by emphasizing “change in fertility behavior is a product of large-scale changes in the organization of societies that are filtered through changes in individual characteristics and the opportunities that the individuals face.” Further Freedman (1995) pointed out that ideological and cultural differences also influence fertility behavior in addition to socio economic development, changes in attitudes about family planning and life styles. On the other hand, Baulch et al., (2004); Van de Walle and Gunawardena, (2001); Swinkels and Turk, (2006) pointed out deprivation and social exclusion among minority communities occurred due to higher fertility. Especially Ethnicity is also associated with access to, and control of economic resources among women. It is a powerful factor in most developing countries, which affects all aspects of life for the individuals. Especially people derive their fundamental identities and values through their ethnicity. Therefore, cultural values and identity determine the behavior of people including reproduction.

There are a number of scholars and policymakers interested in ethnic differences in demographic and reproductive outcomes (Dubuc, 2009; Garenne and Zwang, 2006; Zaidi and Reichenbach, 2009) due to different reasons. The first reason is that ethnicity is

a powerful factor which affects all aspects of life of people in many societies. Especially, it affects school participation, employment opportunities, promotion and political participation. Further, it influences on partner selection, attitudes of number of children and contraception. The second reason is that ethnicity influences on the social structure of a society, which means that the behavior of persons including reproduction is shaped by ethnicity.

Considering the Sri Lankan ethnic group differences, 74.9% of the population represent the Sinhalese and the majority are concentrated in the south-west and central parts of the Island. The Sri Lankan Tamils are the largest minority group living predominantly in the north-east of the island by marking up 11.2% of the population. There are also Indian Tamils who form a distinct ethnic group which comprises 4.2% of the population. The Moors, who moved from Arab traders that settled in Sri Lanka, form the third largest ethnic group at 9.2% of the population. Smaller minorities include the Malays and the Burghers.

The prime objective of the study is to identify the fertility differentials by ethnicity with their different socio economic characteristics.

2. PROBLEM STATEMENT

Reproductive behavior is an important incidence in the life cycle of women. The different socio economic factors influence on the fertility of women. Among these factors, ethnicity plays an important role in many societies regarding decision making on fertility.

Considering the total fertility rate among different ethnic groups, Sri Lankan Moors

recorded the highest total fertility rate (3.3 live births) and the second place goes to Indian Tamils (2.9). Sri Lankan Tamils and Sinhalese recorded 2.3. (UNFPA, 2016). Further, compared to Sri Lankan Moor women, Sinhalese women reported one child less in 2011. In view of minority ethnic groups, the total fertility rate among Malay and Burger Women were recorded as 2.7 and 2.2 live births respectively. Therefore, it is seemed that all major ethnic groups contributed to a decline in the fertility in the past, and it has changed during the past 10-15 years. Further Ethnic differentials in fertility in Sri Lanka has contributed to changing population growth among ethnic groups. The Sri Lankan Moors recorded the highest rate of annual growth (1.9%) during 1981-2012 and the annual growth rate of the Sinhalese population is 1.1%. On the other hand, Sri Lanka Tamils and Indian Tamils recorded a low population growth (UNFPA, 2016). In this scenario, the study attempts to identify the impact of ethnicity on fertility in the Sri Lankan context and the factors that affect the determination of the ethnic fertility difference among ethnic groups. It will help to policy planers to enhance the wellbeing of the population and to rethink about national fertility programs.

3. LITERATURE REVIEW

The previous literature interprets ethnic differences in demographic behavior including fertility, mortality, migration and nuptiality using three hypothesis: the “characteristics hypothesis”, “Norms/cultural hypothesis” and “minority hypothesis” (Goldscheider, 1971; Addai, 1999a; Addai and Trovato, 1999). Those hypotheses have been used by most scholars to explain ethnic differences in fertility, contraceptive

use and marriage patterns (Kollehlon, 1989; Addai and Trovato, 1999; Addai, 1999a; Zulu, 2001)

The characteristics hypothesis attempts to identify the ethnic differences in demographic behavior with different socio economic characteristics of persons of various ethnic groups. According to Addai and Trovato (1999), it is assumed that people of different ethnic backgrounds are incorporated into socio economic structure of the larger society with the improvement of socio-economic status through education, urban residence and modern occupations. The second hypothesis: cultural hypothesis explains that different reproductive related behaviours may occur due to differences in norms, values and attitudes of different ethnic groups.

The minority hypothesis states that the fertility of the minority group will be lower than that of the majority group under several conditions. These conditions are: the minority group must have similar socioeconomic and demographic characteristics as the majority group. Minority group must not have pro-natalist norms, instead of desire to acculturate the values of the majority group, and the minority group must have an aspiration for upward mobility with no feelings of insecurity and marginality. (Goldscheider, 1971). “Insecurities of a minority religious group lead them to limit family size to facilitate social mobility, provided that the group seeks both acculturation and social and economic mobility, and that the religion does not have a strong pro-natalist ideology or one that specifically discourages birth control” (Kondel et al, 1999). However, if the majority community feels a political, economic or social uncertainty, the fertility may be high. (Stinner and Mader, 1975) Martin,

et al. (2011) found that Hispanic whites recorded a higher fertility rate than non-Hispanic whites. Njogu (1991) found that the increased use of contraception and the increase in the average age first marriage are the major factors which decline fertility among certain ethnic groups in Kenya (Kikuyu, Kalenjin, Kisii, Luhya, Embu and Meru). Brunette (1996) examined fertility differences between the major ethnic groups in Nigeria and Senegal and found that cultural settings directly affect fertility.

Oheneba-Sakyi and Heaton, 1993 through studies in Ghana found that ethnicity is the strongest predictor of fertility. According to Abu (1994); Agyei and Migadde (1995), high fertility and high polygyny are dominated by certain ethnic groups in Africa. Shapiro and Tambashe (1997) found fertility differentials by ethnicity in the city of Kinshasa, Zaire and higher educational attainment of women had the effect of reducing the differences across ethnic groups. Kritz et al. (2000) found that ethnic group differences in fertility are strongly changed by empowerment contexts.

The following empirical studies also identified different proxy and non proxy determinants of fertility among women.

Kalwij (2000) shows that female employment status is a major determinant of the presence and number of children in household and that employed women postpone child birth and have fewer children compared to non-employed women holding educational attainment constant. Most of the studies found negative relationship between women's education and number of children (Adhikari, 2010; Dwivedi & Rajaram, 2004). Further, the negative impact of age

at marriage on the number of children was recorded by themselves. Adhikari (2010) also reported negative relationship between wealth and fertility. Considering the Sri Lankan context, place of residence, ethnicity, religion and education are major factors in determining fertility (Abeykoon, 1987; Puvanarajan and De Silva, 2001; Fernando,2014; De Silva, 2015). According to Puvanarajan and De Silva (2001), the increase in the average age at marriage and the increasing use of contraception are the two main factors for the decline of fertility among the ethnic groups in Sri Lanka. However, it was recorded less susceptible among Moors than other groups and high fertility level can be seen among all ethnic groups. The study done by Abeykoon (1987) has identified age at marriage is the most important factor that determines the number of ever born children, and it has a strong negative effect on all ethnic groups. However, it was highly influenced on Sri Lankan Tamils. Fernando (2014) concluded that wealth and the ever use of contraceptives are highly influential factors on fertility among integrated and segregated Muslims in Sri Lanka.

4. METHODOLOGY

This study used secondary data from the Sri Lanka Demographic and Health Survey (SLDHS) conducted in 2006/2007 by the Department of Census and Statistics. The data were collected through personal interviews based on questionnaires. 13753 currently married women aged 15-49 years were used to identify their fertility behaviour in the study. Descriptive statistics including frequencies and cross tabulations and methods of data presentation like graphs and diagrams were used for the preliminary analysis.

Poisson regression was used for final analysis. Winkelmann and Zimmermann (1994) highlighted that Poisson regression model is a very important model for count data. It has a wide application to life cycle events (Trussell and Rodriguez, 1990). Brostrom (1985) and Rodriguez and Cleland (1988) used Poisson regressions to model nuptial fertility. The Poisson regression model is a technique used to describe count data as a function of a set of predictor variables. Especially Poisson regression is appropriate when the conditional value of Y is likely to have a Poisson distribution. The Poisson distribution is discrete, so Y should be discrete.

In Poisson regression Response/outcome variable Y is a count. But we can also have Y/t, the rate (or incidence) as the response variable, where t is an interval representing time, space or some other grouping. When the response variable is in the form of a discrete number, e.g. a count we model the data by linking the logarithm of the outcome variable to a linear function

$$\text{Log}(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n$$

Explanatory variables, $X = (X_1, X_2, \dots, X_k)$, can be continuous or a combination of continuous and categorical variables.

Y is the number of ever born children and explanatory variables, $X = (X_1, X_2, \dots, X_k)$, variable are women labour force participation, age at marriage, women's and husband's education level, current age of women, use of contraceptive devices, experience of waste pregnancy, wealth index, ethnicity and residential sector, media expose, BMI, husband's occupation, preferred number of children that the study used.

5. RESULT AND DISCUSSION

By using sub sample of currently married women in demographic and health survey, determinants of the number of ever born children to currently married women can be identified as follows.

Table 1: Determinants of ethnic fertility differentials (Poisson regression result of Number of Ever Born Children)

Parameter	Total		Tamil		Muslim		Sinhala	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.
(Intercept)	.449	.000	.767	.00	.777	.000	-.105	.243
Ethnicity								
Tamil	.154	.000						
Muslim	.102	.000						
Others	-.043	.603						
Sinhala	0	.						
Wealth status of household								
Poorer	-.055	.029	-.012	.87	-.097	.148	-.057	.058
Poorest	-.041	.083	-.038	.60	-.059	.321	-.033	.231
Middle	-.063	.006	-.029	.70	-.072	.202	-.069	.011
Rich	-.058	.008	-.024	.73	-.126	.020	-.049	.058
Richest	0	.	0	.	0	.	0	.
Women labor force participation								
Unemployed	-.056	.000	-.101	.01	.065	.183	-.066	.000
Employed	0	.	0	.	0	.	0	.
Residential Sector								
Urban	-.030	.093	-.039	.48	.041	.300	-.049	.028
Estate	-.101	.001	-.109	.02	-.300	.305	-.108	.067
Rural	0	.	0	.	0	.	0	.
Partner's occupation								
Elementary	.022	.144	.004	.92	.006	.869	.025	.177
Others	.119	.136	.293	.32	.033	.882	.151	.091
Professional	.053	.051	.055	.57	.048	.475	.058	.070
Skill	0	.	0	.	0	.	0	.
Age difference between spouses								
Same	-.085	.001	-.084	.17	-.145	.030	-.066	.035
1-4	-.062	.003	-.073	.15	-.088	.107	-.047	.065
5-9	-.053	.010	-.072	.16	-.117	.027	-.031	.229

Social and economic factors affecting ethnic fertility differentials in Sri Lanka

10+	0	.	0	.	0	.	0	.
Waste Pregnancy								
No	-.013	.410	.044	.31	-.036	.410	-.020	.270
Yes	0	.	0	.	0	.	0	.
Media expose								
No	.064	.001	.033	.45	.110	.008	.049	.061
Yes	0	.	0	.	0	.	0	.
Ever use of contraceptive								
yes	.523	.000	.331	.00	.261	.000	1.016	.000
No	0	.	0	.	0	.	0	.
Age at marriage	-.017	.000	-.021	.00	-.014	.001	-.015	.000
Husband's education (years)	-.016	.000	-.012	.01	-.017	.004	-.017	.000
BMI	.010	.000	.004	.26	.008	.011	.013	.000
Women's education (years)	-.031	.000	-.026	.00	-.038	.000	-.032	.000
Preferred number of children	.167	.000	.207	.00	.155	.000	.164	.000
Goodness of fit – Overall model	Likelihood Ratio Chi-Square-1742.385	Df-23						
		Sig						
		.						
		0						
		0						
		0						

Source: Author's calculation

The ethnicity or religion background adjusts the behaviour of people. The relationship between fertility and ethnicity is considered after controlling for demographic and Socioeconomic variables. Considering the Poisson regression result, Tamil and Muslim women are statistically significant and show positive relationship with number of children. Especially considering the Tamil and Muslim society, their cultural and religious backgrounds have highly influenced the maintenance of a high fertility rate.

Difference in the logs of expected counts is expected to be 0.056 lower for women who are not engaged with labour market activities than women employees, given the other variables are held constant in the model. The parameter estimates for unemployed are negative and highly significant. Women who are in labour market have high financial security. Therefore, the ability of maintaining high fertility rate is possible. Butt and Jamal (1997) found that nonworking women desired to have less number of children. However, considering the ethnic difference, women labour force participation is not significant for Muslim women.

According to classical economists, fertility raises with increase in income. However in the long run, its effect becomes negative. Further, the theory of opportunity cost shows that needs of time and finance of a couple cause declines in fertility. Quality and quantity theory also concluded negative relationship. According to Becker (1960) and Becker & Lewis (1973), wealthy parents prefer to have few children with high quality. Wealth index may have positive or negative effect (Becker, 1981).

When children are considered as durable items, positive effect can occur on fertility, which is called income effect. When the opportunity cost of child rearing is high, it has a negative effect called price effect. Therefore, economic status of households is a very important variable to determine their fertility behavior. According to the study, wealth index of the household is statistically significant. All the wealth categories show a negative relationship with the number of ever born children. Especially middle and rich categories recorded the highest value. Adhikari (2010) also reported negative relationship wealth and fertility. Considering the ethnic difference, the Muslim women who are in the rich category have recorded a negative value and the others are insignificant. It may be because the Muslim women who are in rich families have more freedom to use contraceptives and to make decisions regarding fertility. Further, the Sinhala women in the middle category also recorded a negative value. The difference in the logs of expected counts is expected to be 0.101 lower than for women who are in the estate sector compared to women in the rural sector respectively, while holding the other variables constant in the model. Family planning programmes are successfully operated and media exposure of women is high in Sri Lanka. Therefore, women's knowledge about family planning activities and exposures to outside world may reduce their intention. The Sinhala women who live in the urban sector recorded a negative relationship.

This is the Poisson regression estimate for a one year increase in age at marriage, given the other variables are held constant in the model. If currently married women

were to increase their age at marriage by one year, the difference in the logs of expected counts would be expected to decrease by 0.015, while holding the other variables in the model constant. Therefore, there is a negative relationship between the number of ever born children and age at marriage by indicating reduction of fertility due to delayed marriages. Similar result can be seen in the previous literature (Adhikari, 2010; Dwivedi & Rajaram, 2004). Age at marriage is negatively related to fertility for all ethnic groups in Sri Lanka.

When partner's education increases by one year, the difference in the logs of expected counts would be expected to decrease by 0.016, while holding the other variables in the model constant. Therefore, there is a negative relationship between the number of ever born children and partners' education.

If a currently married women's education increases by one year, the difference in the logs of expected counts would be expected to decrease by 0.031, while holding the other variables in the model constant. Therefore, there is a negative relationship between the number of ever born children and women's education. Higher education opportunities delay the age at marriage and provide more labour market opportunities for women. Further, it increases the awareness of family planning methods and women can bargain regarding quality versus quantity of children. Most of the fertility studies have concluded similar results. (Adhikari, 2010; Dwivedi & Rajaram, 2004). All ethnic groups indicate that women's education and partners' education are negatively related to fertility.

The BMI represents the health status of

currently married women. The parameter estimate of BMI is positive and significant. It means that the body mass index of currently married women increase by one units of kg/m^2 , the difference in the logs of expected counts would be expected to increase by 0.012, while holding the other variables in the model constant.

Haven't a media expose and number of ever born children shows positive relationship. The difference in the logs of expected counts is expected to be 0.064 higher than for women who haven't media expose frequently compared to women who have media expose while holding the other variables constant in the model. When the media expose is increase, the knowledge of family planning and health also increase. Media expose is insignificant factor to determine the number of ever born children among Muslim women. It may be due to their cultural and religious norms.

Number of ever born children and age difference between spouse shows a negative relationship. The difference in the logs of expected counts is expected to be 0.05 lower than for women with lower/same age difference compared to women with more than ten years' age differences between spouses, while holding the other variables constant in the model. It is the highest coefficient value indicating that the women with lower/same age difference have considerable bargaining power of decision making of fertility than other women.

The preferred number of children measures the fertility desire of the family. It can change from time to time. However, according to the above result, there is a positive relationship between preferred number of children and the number of ever

born children. Adhikari (2010) found similar results in Nepal and Bangladesh. All ethnic groups show a positive relationship.

6. CONCLUSION

The aim of this study was to identify the ethnic difference of fertility in Sri Lanka using DHS data. Poisson regression was employed. The study found that after controlling for demographic and Socio economic variables, Tamil and Muslim women are statistically significant and show a positive relationship with the number of children. Considering the Socioeconomic and demographic factor variations which affect fertility among ethnic groups, age at marriage, partner's and women's education negatively effect on all ethnic groups. All ethnic groups show a positive relationship between number of ever born children and preferred number of children. Wealth status of household and age difference between spouse show a negative relationship with fertility. The women who have not been exposed media frequently show a positive relationship between numbers of ever born children.

Increasing educational level of women, employment opportunities and media exposure is important in every ethnic group to improve their fertility behaviour. Especially the awareness of contraceptives and media access should be increased among Muslim women.

7. ACKNOWLEDGEMENT

Author would like to acknowledge the Department of Census and Statistics for providing Demographic and Health Survey (SLDHS) 2006/2007 data for this analysis.

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NAIPAUL, POSTCOLONIAL IDENTITY POLITICS AND TOTALITARIANISM: ZIZEKIAN RE-READING OF THE NOVEL, *A BEND IN THE RIVER*

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ABSTRACT

Based on the fictional evidence in the novel A Bend in the River by V.S. Naipaul, this essay examines how the 'totalitarian symptoms' are sustained within the identity politics in the postcolonial world. This interpretation uses the theoretical insight developed in the Zizekian school of thought on totalitarianism as well as the literary evidence given through the observatory eyes of an inside-outsider, namely the main character Salim in the above novel. It then suggests that 'the Big Man' (presumably Mobutu in Zaire) displays totalitarian potential when he gradually exploits the fragile nationalism and identity politics inspired by the fantasy of the bush, void of the river and the forest in this imaginary African country for his steady ascend to power. He manipulates the 'refined' symbolic background to elevate himself to be an agent-instrument of historical Will, absorbing all the rational content constructed under postcolonial liberalism. The presentation of the totalitarian 'kingship' in his regime is such that its unconditional authority demands nothing but submission to its irrational order that 'externalizes' the social Other; 'the foreigners' and 'the whites'. The totalitarian madness in the Big Man allows all sorts of irrational violence, murders and plunders performed by his political followers who seek some obscene jouissance that is derived through the violation of symbolic Law. Within the above context, through a critical hermeneutic analysis of this novel, this essay concludes that the 'fantasy of the bush' that alienates the social/ethnic Other eventually leads to hysterical rise of totalitarianism that destroys the whole symbolic life in this imaginary African country. The final exodus of the main character Salim indicates that the multi-ethnic composition of the former colonial setting is drastically transforming into something dangerous for traders of foreign origin and is gradually replaced with a monolithic and totalized African hegemony that takes over the life-world in the Bend.

KEYWORDS: V.S. Naipaul, *A Bend in the River*, Totalitarianism, Postcolonial Identity Politics, Slavoj Zizek

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1. INTRODUCTION

‘The more you try to change, the more it remains the same’.

Many liberal democratic structures in the postcolonial nations have, in one way or another, fallen into the trap of the totalitarian master. In their social evolution, postcolonial nations have been unable to fully realize the secular and rational social order and still live in between traditional world-order and modern secularism. The dream of independence, once the colonized nations’ imperial masters left them after centuries of exploitations, under new ingenuous masters, has been overshadowed by complete anarchy triggered by economic instability. The present uncertainty and insecurity have unfortunately made them surrender to the call of the totalitarian master who promises the impossible. The true socio-cultural and ethnic divisions within these societies, previously hidden under the imperialistic masters, were dangerously widening to give rise to identity politics and its dictatorial regimes to ‘save us’ from the evils of the westernized modernity. The totalitarian master often suggests those communities to escape from modern evils by returning to the nostalgia of a lost past; probably to a value system prevailed before the arrival of the colonial master. The nostalgia to return to a fantasized past is identified as a ‘postmodern phenomenon’ where people, as part of escapism from the complexities of modern secularism (Habermas, 2007),

look for security in the ideology of the tradition. The tension generated by the collapse of the tradition and the forceful intrusion of modernity have caused them to believe in tradition and retaliate to modernity through the weapons borrowed from a fundamentalist past. The fictional evidence in the novel *A Bend in*

the River (2002) displays how the horror of the authoritarianism gradually overtakes the entire life-world of the individuals, disregards even some of the most significant modern values and social relationships, and how they become irrational and blindly obedient subjects to the command of some unseen irrational authority. This tricky ‘shift in the master’ evident in the dictatorial character in the novel, who suddenly moves from modern values to the fantasy of the bush can be identified as a postcolonial symptom that is overwhelmingly prevalent in the developing nations. Instead of true social transition, these political maniacs want the societies to freeze and end in a symbolic death. But the real problematic is that the subjects in these societies endlessly believe in and wait for such rulers whom they think can rescue them.

Despite its truly revolutionary potential, the postcolonial politics was also influenced by contemporary nationalism (Hardt & Negri, 2000) that believed in *classified difference* such as gender, race, language, age etc. Instead of universal emancipation, identity politics grew on its inherent misidentification called ‘inclusion and exclusion’ (Hall & Paul, 1996), and its fundamental essence was based on *self* that corresponds to some imaginary common origin or shared characteristics. Instead of resuscitating broader political themes of universal significance, such passionate identification of *differences* and restoring historically shared values and hopes have been effective “in the face of confusing insecurity of a modern secular global society” (Zizek, 2011, p. 96). Zizek (2011) terms this prevalent trend as a “pseudo-liberating effect of contemporary nationalism” (p. 96) that is founded on the obscene permissive superego suspended on a moral prohibition that guarantees *surplus of enjoyment* (Zizek,

2002b). The hysterical patriotic nationalists who set the borders and frontiers between 'inside and outside' (Wells, 2014) and whose identity politics are limited to the false ideology of 'perfect final stage of mankind' (Sharpe & Boucher, 2010) are devoid of the universal motives of twentieth century revolutionary politics. They rather *over-identify* with the hysterical demands of a particular identity group and use those grievances to give unrealistic promises across all social classes. It is identical that in the novel, 'the Big Man' gradually gained support from the established institutes including the aristocratic and newly emerged business classes to successfully run a 'reactionary-modernist' regime and was able to manipulate the most developed modern characteristics such as media and technology to reach his target.

The term 'fragility' represents the fact that the existing postcolonial structure becomes helpless when the totalitarian master claims legitimacy to control all the aspects of modern life-world. According to Žižek (2001), the obedience derives from an elementary authoritarian 'wisdom' which convinces us of the fact that the human nature is fundamentally weak and corrupted where correction has to be done by a strong master. It is only such strong figure who can control man's antisocial impulses. But the postmodern totalitarian master goes a bit further than the traditional authoritarian in which the former allows (or permits) its subjects not only to 'obey' his orders but 'enjoy' performing the duty (Žižek, 2001). The transgression is even, in our permissive times, not only appropriated but encouraged (Žižek, 2002a), according to the novel, to kill 'those who could read and write' or do business (Naipaul, 2002). At the same time, unlawful acquisition of businesses

owned by non-locals or any other evil was justified under 'radicalized' nationalism which demarcated insider-outsider dichotomy. The symptom of socio-cultural exclusion based on identity politics of those who do not fall into new categorization as a symptom could never make postcolonial politics universal. The brutal killings also symbolize the returning to tradition; desire to claim that the primitive values of African tribal still applicable to expel the enemy. It also confirms that returning to the fantasy of the bush can bring back the lost harmony of their society. Totalitarian ruler often promotes to look back at the origin of a certain historical and/or discursive past and encourages a nostalgic revisit to the past to justify and legitimize the banality of the present. In the novel, for example, the irrational murders committed against the foreigners is justified through particularized (not universalized) words 'necessary', 'our way', 'radicalized' and 'nationalized'. Such return in a totalitarian regime is based on the Discourse of the Master (Wonyosi, 1981) that promises the 'final perfection for humankind'. Based on such discursive and ideological element, as observed by Žižek, totalitarian rises from within the fragile coordinates of liberal framework (Žižek, 2011) and this development is examined through the events depicted in the novel. It will also review Žižek's view, "culture itself is nothing but a halt, a break, a respite in the pursuit of barbarity" (Žižek, 2011, p. 6) to contextualize the banality of violence against 'foreigners' in the novel. To apply the theoretical insights abovementioned, the novel *A Bend in the River* appears to provide rich empirical and ethnographic evidence as micro-political examples in an African context. The rise of authoritarianism from a traditional aboriginal context, the gradual collapse of bourgeois

democratic values, subject's unquestioning obedience to the irrational call and the superego enjoyment of the new totalitarian master, terrorized political subjects and the deteriorating institutionalized liberalism are all exemplarily illustrated in the novel. This example creatively developed by V.S. Naipaul gives a universal model for any postcolonial country which can 'produce' imaginary enemies under conspiracy theory; secretly plotting against the indigenous to 'steal' their enjoyment. This situation sadly generated an unhealthy socio-political environment for the *Others* to make a major human exodus.

2. METHODOLOGY

Selected evidence in the novel *A Bend in the River* by Naipaul will be interpreted with the use of theoretical discourse developed by Zizek Studies. The analysis experiments how Zizekian tools can be used to interpret postcolonial literary texts in exemplifying the symptomatic rise of totalitarianism. By taking some contextualized dialogues and events in the novel this interpretation will review how the political totalitarianism is grounded in a phallogocentric metaphysical closure to encompass all the aspects in the life-world to legitimize its rise and existence, free from any ethical and ontological edifice. The Zizekian toolbox will testify how the postcolonial politics and literature must go one step further to deviate itself from identity politics (Eagleton, 1997; Jameson, 1986) and embrace the universal emancipatory discourse in order to prevent 'the ignorance' that sustains the potential for such symptom.

3. RESULTS

The novel *A Bend in the River* displays the rise of totalitarian symptom from the very

postcolonial liberal framework. The fragile existential nature of the postcolonial subjects and the lack of patriarchal order could not prevent the rise of totalitarian politics that exploits the nationalistic power-play in this imaginary African context. Naipaul successfully capitalizes on the character 'The Big Man' who rapidly rises to power by manipulating the psychological insecurity and anti-modern tendencies of this transitional postcolonial state. As displayed by Naipaul's de-territorialized perspective that is 'extimately' intimate to his Eurocentric gaze, the ultimate destiny of identity politics leads to totalitarianism undermining all the universal emancipatory hopes in the twentieth century.

4. DISCUSSION

a. Contextualizing *A Bend in the River*, Postcolonial Politics and Naipaul:

The novel *A Bend in the River*, first published in 1979, is considered to be 'one of greatest novels about the process of "becoming" (as opposed to "being") a nation, especially after the colonizing powers have departed' (Lowe, 2011) from their crown colonies. At the same time, the above 'becoming' is narrated by the author whose inner concerns are most touchingly revealed in this novel. Naipaul has 'brilliantly reimagined', according to the Guardian book review (MacCrum, 2015), the fictional landscape that conjures 'a hellish vision of the developing world's endemic dislocation'. It further says that in the novel Naipaul echoes the memories of a journey that he made to Kinshasa in 1975. However, the true context of history of this Central African country that inspired Naipaul to write this novel remains unnamed. But as a familiar fictional feature for Naipaul, structurally speaking, the central character moves from periphery to the centre metaphorically

signifying the organic historical flow of postcolonial history in which the subjects always unconsciously dream to be under the surveillance gaze of the master as a pre-condition of their existence. It is within this flow that Naipaul observes the archeology of the destiny of a postcolonial nation. However, his main character Salim, 'a man without a side', is the first-person, and central focal point through which the author positions himself to reveal the chaotic and degrading human condition in this geo-spatial territory that experienced the rise of yet another post-independent archetypical African dictator. Against the known historical tide from periphery to centre, paradoxically, Salim travels backwards. Through his ancestral roots of slave trading (Naipaul, 2002) Salim walks back into the bush. The deeper into the jungle Naipaul drives more illiterate, chaotic and violent Africa becomes. But he just drives through "bush and more bush" (Naipaul, 2002, p.3) to eagerly embrace his "new life" (Naipaul, 2002, p. 4). Naipaul uses the same slave metaphor to describe his own revisit to Africa. He says, "Like the slave far from home, I became anxious only to arrive. The greater the discouragement of the journey, the keener I was to press on and embrace my new life" (Naipaul, 2002, p. 4). However, reviewing Naipaul's backward journey into the African bush, Richard Kelly (1989) notices that "he [Naipaul] has exposed the terrifying fragility of life that lies behind the false ideas and seductive dreams of a more perfect home in the past, a safe house in the wood" (Kelly, 1989, p. 1). As a prelude to the novel *A Bend in the River* Naipaul writes an essay titled 'A New King for the Congo: Mobutu and the Nihilism of Africa' in 1975 to the *New York Review of Books* (cited in Kelly, 1989, p. 132). In the novel, Naipaul (2002)

cleverly penetrates the rhetoric and propaganda architecture of Mobutu's government in Zaire to expose his "self-aggrandizement, greed, and terror" (p. 132) engendered by personal obsession. Mobutu worked for the Congolese National Army and became a general. He seized power in 1965. Then he changed his name from Joseph Mobutu to Mobutu Sese Seko which sounded more African than the former. He ruled (or rather owned) Zaire as a medieval king who is more or less similar to an African chieftaincy primarily representing the tribal sexual virility (Naipaul, 1989, p. 133) and irrational authority. Mobutu's rise to power proves one significant failure in the postcolonial world; its inability to free from the past. As Kelly (1989) mentions, "Despite the attempts of the Europeans to civilize Africa and despite African nationalists following in the footsteps of European corruption, 'Everyone feels the great bush at his back. And the bush remains the bush, with its own logical life' " (p. 134).

Mobutu as 'great African nihilist' wanted to *recreate the pure logical world of the bush* by refusing to borrow a conscience, a soul or a language (Kelly, 1989). As portrayed in 'the Big Man' in the novel, an anonymous African dictator, Naipaul depicts how Mobutu makes the mass to worship him, fear him, and go along with his fantasy. With this superb political observation, what makes Naipaul different from other postcolonial contemporaries qualifying him to the most appropriate to investigate the implication of tradition in postcolonial identity politics is his perspective and how he geographically locates himself in the whole picture. In the novel *A Bend in the River* Naipaul maintains an *insider-outsider* perspective where he places himself as an 'outsider' who is in a more privileged position to observe the inside than

the insiders (Lindbeck & Snower, 2001). Though Naipaul is geographically distant from the postcolonial reality, he constantly maintains an imaginary over-proximity with what he departed from. This paradox is identified by Zizek as 'extimacy' (Myers, 2003) where 'the externalized content' (the postcolonial reality) keeps coming back to Naipaul as an intimate inner essence. In this strategy, he maintains a Zizekian objective detachment towards the world in which he lives since one cannot properly "see the world if you are part of it" (Myers, 2003, p. 12). He favors the rational secular impulses of the modern colonization project while objectively suspecting the catastrophic elements that can rise from it. He bravely exposes the imperialistic motives of the colonial masters in a very dialectical manner which reminds us of a very popular statement once made by Walter Benjamin (1969), "there is no document of civilization which is not at the same time a document of barbarism" (p. 256). Naipaul (2002) examines the dialectic of colonization as follows.

"But the Europeans could do one thing and say something quite different; and they could act in this way because they had an idea of what they owed to their civilization. It was their great advantage over us. The Europeans wanted gold and slaves, like everybody else; but at the same time they wanted statues put up to themselves as people who had done good things for the slaves. Being an intelligent and energetic people, and at the peak of their powers, they could express both sides of their civilization; and they got both the slaves and statues" (p. 19).

From the chaotic tribal and frenzied nationalistic background, towards the end of the novel, the democratic edifice of the novel slowly collapses into the call of totalitarian

master. The sustaining ideological fantasy always demanded a 'patriarchal father figure' who can restore Law and order while secretly giving permission (*permitted enjoyment*) to violate it (Myers, 2003). This situation is termed as 'enjoying Law' where obscene permissiveness is granted which gives surplus enjoyment (Dean, 2006). In so doing a totalitarian leader not only wants others to follow him but makes others to actively love him (Zizek, 2001). The totalitarian master is enlarged and presented as the bearer of a 'second body' which carries the sublime object of ideology. The subjects are convinced that there is always more than himself, for example, he is made of some 'special stuff' derived from some origin which gives him a special right to rule. As Sharpe and Boucher (2010) note, "such ruler uses his sublime-ideological mandate in this discourse as an accorded special, even sublime authority" (p. 92). In case of 'the Big Man', the President of Naipaul's novel, his portrait was presented to people as someone *bigger* than the others. The novel says, "With local people the President was always presented as a towering figure" (Naipaul, 2002, p. 262). He is elevated to become "more than himself" where others are made to believe that they are "so small you can scarcely see them" (p. 262). His image that is politically displayed everywhere is "bigger than everybody else's every day" (p. 262). The essence which elevated him to be more than himself gives him the legitimacy to control everything.

Subsequently, the novel proceeds to evidence how irrationally the process of nationalization coiled and back by the President himself gained momentum, as observed by an ordinary country man, Metty. "The President made a speech a fortnight back. He said he was radicalizing and taking away everything from

everybody. All foreigners. The next day they put a padlock on the door” (Naipaul, 2002, p. 299). Under radicalization, Salim who was the proprietor of his own business became the manager. When Salim lost his business, out of alienation, he turned to earn quick money through illegal means in order to get out of this country- according to the author; honourable people became first-time law breakers. One result of the radicalization is to convert people to break the law for survival or to face irrationality through irrationality itself. When people become transgressive, violating law, then only the totalitarian ruler can function as a benevolent master who forgives your sins, asks for you to carry on with your immorality and then ask for obedience (while demanding more authority to control your immoral superego). This is a totalitarian trap which postmodern liberal structure could so far not evade.

When people pay homage through brutal carnage, it is part of the jouissance of the act. The killing is done without any regret for another cause; not only just to make the President happy but to ‘excite’ him so as to get excited in return. Naipaul witnesses how this perversion continues, “Through people’s courts they were going to do the killing better this time and ‘everybody will have to dip their hands in the blood’ ”(Naipaul, 2002, p.322). Further, “it is going to be terrible when the President comes...He must know they’re preparing something for him here” (pp.322-323).

The price people have to pay to a totalitarian master is infinite in terms of symbolic exchange. The price also includes the royal blood that gives the necessary justification for such regime to be ‘unique’ amongst the

ordinary or elevate above the ordinary. This feature can clearly be found in above mentioned Emperor Boky (Bokassa-Emperor-for-Life in Central African Republic) as portrayed in the African Play Opera Wonyosi in which ruler carries ‘the blood of the Kings’ and ‘not ordinary’ (Soyinka, 1981). The fake revolution, egalitarianism and nation building of Boky (Clingham, 1998) are all part of the ritualistic play that is ‘staged’ for the public to believe. Zizek terms this as an institutional ritual where everyone is made to believe in it. It is not compulsory for people to believe in it, they can pretend to practice the rituals of believing nevertheless, “Traditional authority was based on what we could call the mystique of the institution. Authority based on its charismatic power on symbolic ritual, on the form of the Institution as such...” (Zizek, 2002b, p. 249).

Returning to organic brutality of their tribal-primitive existence is ideologically sustained by the institutional ritual of believing in the ‘uniqueness’ and the perverse ‘benevolence’ of the totalitarian master who ‘allows’ the people to unleash their obscene fantasies.

The liberal-bourgeois principle of rational authority is transformed to irrational and unconditional authority in the post-liberal totalitarian context. In other words, bureaucratic knowledge in the previous system becomes ‘madness’ which operates ‘by itself’ without referring to a decentered point (Zizek, 2005) to symbolically justify its authority. As a result, such authority may not tolerate universal agencies which stand for justice, human rights or freedom of expression etc. or any other bodies which pass judgments about Law and Order. It would easily find an externalized ‘enemy’ or ‘traitor’ who conspires to ‘steal’ the essence of the nation (which it derives mostly from a nostalgic

history). The gradual isolation, change in language policy, re-structuring the colonial education and governance (so called radicalization), policies to return to tradition and intolerance in criticism by external bodies are symptomatic political developments in such a context. The character Salim, as a trader who travels into the interior African setting gradually experiences the stages of above developments. The changes in the indigenous African characters such as Metty or Ferdinand in the wake of authoritarianism under nationalistic banner can be understood as 'unconscious obedience to the irrational call of the Master' (that of the Big Man falsely represented as the big Other; the Law); an element that is inherent in every human being. The discussion in this paper focuses on how the subjective macho- sadistic drive within us is successfully utilized by the Master under such context.

Though it is a dangerous paradox, the reason for man's return to historicity, which is always a narration of the victor who "legitimizes his victory by presenting the previous development as the linear continuum leading to his own triumph" (Zizek, 2008, p. 93), is to relieve himself from the anxiety and tension generated by encountering secularism. History (or in other words 'tradition') will comfort man in transition with its interpretive potential that guarantees its subjects on continuity and identity (Habermas, 1975). Tradition has a double function here; it can analytically dissolve the validity claims that cannot be 'discursively redeemed; and it can be 'living' in a nature-like manner to shape our consciousness. According to Zizek (2008),

The postmodern anhistorical stasis, on the other hand, is torn between repetition qua suspension of movement by means of which we "synchronize" our menaced position with

that of our predecessors, and between repetition qua aced position with that of our predecessors, and between repetition qua nostalgia, the proper object of which is not image of the past but rather the very gaze enraptured by the image-nostalgia always relies on such a reflective turn (p.93).

He further notices that what is fascinating about the gaze is that it is still "able to immerse itself 'naively' in the etheric image of the lost past" (p.93). It is the nostalgia which demands the subjects in traditional societies to travel backwards and find comfort. At the same time, there is also a drive to 'repeat' the events and conditions in past once more (for an example, recreating the days of a particular King or Queen). But such a revisit is completely challenged by the values promoted by consumerism. A common value such as 'simplicity' that a community derives from a particular history is always negated by the constant demand by the Capitalist market to consume more, buy new goods, change old life style and be part of the global culture etc.

The empirical evidence in the selected works by V.S. Naipaul displays how the horror of authoritarianism and fundamental tendencies gradually overtake the life-world of individuals, disregard indeed some most intimate relationships and how individuals become obedient subjects to the command of unseen irrational authority. Traditional societies are the most tragic subjects of this irrational subjugation because of their inherent fragility in rationalization of the unconscious demand to 'obey'. This situation can be identified as a global symptom of developing nations in the transitional context from tradition to modernity after prolonged colonial rule, where communities are not fully absorbed by the cognitive preparation towards civilization and secularism. The pedagogical

institutes that should undertake this 'preparation' were either not organically made to accomplish such a task (they simply wanted to produce 'low skilled workers' to run the colonial administrative machine) or could not complete its mission due to the abrupt termination (the White Master's withdrawal from subject countries). The works of Naipaul stand as strong ethnographic texts to illustrate this symptomatic and tragic development which envelops most Middle Eastern countries, a significant amount of African blocks, Latin African nations and, arguably, the entire South Asian contexts (including some parts of South East Asia). Hence, this research is devoted to illuminate the literary evidence in the works by Naipaul as strong post-independent evidence of inherent vulnerabilities of traditional societies in the wake of their transition to modernity.

b. A Bend in the River and the Rise of Totalitarianism:

For many critics, *A Bend in the River* can be considered as one of the best novels written by Naipaul. It is a novel that not only places its ontology in the geo-spatiality between modernity and primitivity but exposes Naipaul's "creative tension between an urge to depart from his roots and an urge to return to them" (Park, 1996, p.177). Set in a post-colonial African context in Zaire, Naipaul fictionally deals with Mobutu, the then President who is transformed to be the new King in the country. Moving away from the liberalist democratic frame he elevates himself to be very influential and omnipresent among the ordinary by self-propagating his image. For example, putting his photographs everywhere in the city (Feder, 2001) the Big Man wants to appear 'grander' than his European counterparts. Though he often highlights a bright future and dignity for Zaire

the superficiality of his speech seems contradictory and hypocritical (Eid, 2000). The contradiction between discursive politics (the place of utterance) and practice (difference) is understood as a common symptom in postcolonial politics, but the very 'gap' between these two is the strategic space of the totalitarian master in which he denies universal emancipatory politics. Though the totalitarian master promises 'difference' by trying to introduce 'more difference than difference' he makes sure that the existing situation remains the same. Hence *The Big Man* justifies the reactionary insurrection and popular nationalism that aim at the ethnic other in the name of 'change' and 'difference' (the new Africa), but this very localized gesture destroys the universal revolutionary potential of their struggle. The ethnic politics that theorizes expulsion of all the foreigners does not bring any justice for the disadvantaged mass but rather leads the whole effort to the cold water of isolationism.

In this frozen political atmosphere, the intellectuals also play a negative role in the face of this deadly rise of authoritarian political syndrome. The elites in the Domain display their negligence when they are not serious enough about the way the Big Man develops his political cult within the nationalistic slogans. While socializing with their own members, the learned elites simply ignore the well designed fantasy political project launched by the Big Man.

As the initial gesture towards the rise of totalitarianism (Arendt, 1976; Zizek, 2002a), it is intellectual negligence that modern history has experienced on many occasions. According to Wijesinha (1998), "The tragedy, as Naipaul shows in his account of the domain, and of the intellectuals who write papers in support of the Big Man's historical

extravagances, is that those who ought to see it as a duty to prick the bubble instead join together in inflating it further. And this is not as a result of fear, which would be understandable if regrettable, but springs from the need for comfort and the hope of reward. The consequence is that the monster grows too large to be readily controlled, and when the country begins to crack up no easy solution is available” (1998, p.35). The role of intelligentsia in the face of anti-democratic gestures by dictatorial regimes is the key eye-opener in *A Bend in the River*. Therefore, in line with totalitarian examples in the world, Naipaul offers a very strong universal fictional background as to how negligence leads to total destruction.

Salim, the protagonist of the novel whose perspective is through which the novel is written, has been almost a father to Ferdinand. Ferdinand’s mother is a tradeswoman coming from distanced tribal land who does not want her child to live in the world she was born to. According to the descriptions by the novelist, the origin of the Ferdinands belongs to one of those entities discarded by the modern project. He, therefore, has to travel from the ‘unknown world’ to the known since he belongs “to many islands of nature and tradition survived in modernity” (Sharpe & Boucher, 2010, p.142). As the novel poetically illustrates, they want to go away from the timeless pathways from the River. Though modernity and secularism were global developments, still there were sections that did not experience the surprising societal changes it brought forwards. Even the changes that occurred during colonialism could only partially influence the traditional social order and the biases in tradition, in such entities, mostly remained intact or unchanged. Their life style, beliefs, ideologies and superstitions continued from the pre-modern to the modern.

Those who were not fully cognitively integrated to the modern rational world nostalgically desire to travel backwards to the psychological comfort of the past escaping from the complexities of modernity. The totalitarian masters promptly promise to ‘materialize’ such fantasies for them.

The depiction of woman in a community mirrors the primordial psychology of that community. The description below about Zabeth, Ferdinand’s mother, is an examples as to how she survives by hiding her beauty as a woman in a business career where she has to travel a long distance. Rather than feeling free in her existence, she reverts to a ‘pre-modern’ (primitive) method to become ‘unattractive’ among men so that “no one molested her” (Naipaul, 2002, p. 10). In the same text Naipaul (2002) describes this as follows,

“There was something else about Zabeth. She had a special smell. It was strong and unpleasant, and at first I thought-because she came from a fishing village- that it was an old and deep smell of fish. Then I thought it had to do with her restricted village diet. But the people of Zabeth’s tribe whom I met didn’t smell like Zabeth. Africans noticed her smell. If they came into the shop when Zabeth was there they wrinkled their noses and sometimes they went away” (p.10).

Her act of ‘distancing’ or alienating herself from primitive patriarchal society, as far as her existence is concerned, is self-degrading and ideological. In this manner, she could fit into the existing status quo while not being a part of it. The above self-negation is reflected in Metty’s claims: “Zabeth’s smell was strong enough to keep mosquitoes away” (Naipaul, 2002, p.11). Though she naturally possesses a fleshy body that can attract men in this continent, she (may be unwillingly) denies to

be the object-desire of man while carrying on her tradeswoman role with the patriarchal order. Further, the novel also describes the tribal background from which both Zabeth and Ferdinand emerge to the current postcolonial world. Her disguised and degraded (fake) personality does not stop her son going to the 'world' beyond the tribal boundaries. Hence Zabeth's inner motive is to mobilize beyond the traditional order to embrace modernity. It is this paradoxical position between the uncertainty, insecurity, and the anxious 'ideological distance' towards her present existence and the sustaining fantasy towards modernity that could be exploited by the totalitarian master.

The truth behind her disguised being is to transform her child to be more 'human' and 'civilized' or, in other words, "something better for her son" (Naipaul, 2002, p.41). She entered Ferdinand to a school in the city and boarded him in Salim's place because she thought Salim being a foreigner and "English speaking as well, someone from whom Ferdinand could learn manners and the ways of the outside world" (p.41). Her desire indicates that she wanted her son to be with someone who is 'civilized' or at least knows how to be civilized. Zabeth wants her son to move away from the hard 'African life'.

It seemed to me natural that someone like Zabeth, living such a hard life, should want something better for her son. This better life lay outside the timeless ways of village and river. It lay in education and the acquiring of new skills; and for Zabeth, as for many Africans of her generation, education was something only foreigners could give (Naipaul, 2002).

Zabeth was aware of the civilizing potential within education in transforming individuals

into civilized beings, rupture from nature. The civilizing potential in education is illustrated where societies transform into advanced stages through higher cognitive levels achieved via education, which is always acquired with the help of an external agency (foreigner). Though she has seen more stylish people than Salim in the town, she senses 'the difference' in Salim as a person who can transmit the basic values in modern way of life to her son.

The tragic nature of local politics is that 'the outsider' who can transform the inner nature of Africans could not survive in this magical land. A Bend in the River shows that the rise of ethnocentric 'nationalization' across Africa was meant to take up every property that belonged to foreigners of non-African origin, a category Salim belongs to. It is done without properly investigating into the cost and benefit of such take over. Perhaps the traders are historically viewed skeptically and the conspiracy theories can easily work with them. What this process finally meant was under new political re-structuralization, every aspect of the life-world was influenced by the new 'unquestionable authority' which is the "hidden truth of the discourse of the pre-modern masters" (Sharpe & Boucher, 2010, p.92). Finally, from the perspective of the victim, the functioning of the totalitarian symptom is displayed at its best when Salim's business was taken over by Theotime under the new system. "It was strange. He wanted me to acknowledge him as his boss. At the same time, he wanted me to take allowances for him as an uneducated man and an African. He wanted both my respect and my tolerance, even my compassion" (Naipaul, 2002, p.308). Salim was mentally 'tortured' by the fact that he is 'supposed' to be there physically and witness the downfall of his own business

through the (mis)-management of an uneducated local. He is made to be present in a place which is 'actually' not his and is expected to be 'remorseful' to something that is alienated to him. The true nature of totalitarianism is that people need to pretend to believe in the rotten system in power even though they don't really need to relate it. One has to act as if he or she does not recognize the true evil in the political body.

Another feature of fundamentalist totalitarianism is the anti-educational motive which bans critical thinking and inquiry (Hapugoda 2015). This aspect is largely evident again in *A Bend in the River* which reiterates, "They are going to kill everybody who can read and write, everybody who ever puts on a jacket and tie" (Naipaul, 2002, p.322). Apart from the anti-Imperial resistance towards colonial education, there is an obvious element of returning to the pre-modern social primitivism where, instead of rational enlightenment, mystification of the life-world becomes a practice. In eliminating the outsiders or *ethnic others* the political followers are granted a sadistic permission to violate all universal laws about humanity and deploy banal evil upon the externalized other. The novel clearly evidences that people outside Naipaul's (2002) small circle in the Domain were not fully human who knows the "worth of the other man" (p. 136). People from other tribes are slaughtered like 'animals' according to pre-modern tribal beliefs which now go hand in hand with nationalistic slogan and anti-Imperialistic sentiments. "They haven't done anything to you in jail. That's only because it hasn't occurred to them" (2002, p.319). The above statement reveals that Salim's life entirely depends on how the locals 'feel' about him but not as a result of whether he is judged on any transparent legal

grounds. Irrespective of being a foreigner or an indigenous person, one's actions must be judged by a neutral party with reasonable evidence. In this light of death of reason (reason being something which should be inculcated through education), the symbolic entity or the modern social order in the post-colonial world has seriously been damaged by the 'irrational call of the primordial master'.

5. CONCLUSIONS

Naipaul has once said, "To arrive at this sense of a country trapped and static, eternally vulnerable, is to begin to have something of the African sense of the void. It is to begin to fall, in the African way, into the dream of a past-the vacancy of river and the forest" (cited in Kelly, 1989, p.135). So, the major turning point in this African community towards totalitarian symptom is marked by its initial gesture to fall into the dream of the past. From that nightmare they wake up to a violent present. Apparently the 'void' is never filled by the primordial master's cunning resuscitation of irrational fantasy of the past. This return is always a dangerous political symptom. The novel *A Bend in the River* evidences the symptomatic rise of totalitarian master from within the fragile postcolonial political structure and proves that returning is not at all a logical solution. Exploiting the existing insecurity and uncertainty towards secular modernity as well as the identity politics of the postcolonial nations, the totalitarian master ideologically promises a 'short circuit' to evade the present chaos and inconsistency of those nations. The above political reality is successfully and symptomatically portrayed in Naipaul's novel, a feature which makes the novel a strong empirical reflection for the failed project of decolonization.

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INVESTIGATING THE POSSIBILITY OF MIXING FOOD AND YARD WASTE FOR AN EFFECTIVE COMPOST PRODUCT AT AN EXISTING PILOT-SCALE COMPOSTING PLANT

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ABSTRACT

Composting is a natural biological process that reduces the waste stream into a product that can be used as a conditioner. The existing Pilot-Scale composting plant at General Sir John Kotelawala Defence University (KDU) totally utilizes yard waste for its function. However, a large amount of food waste is also being generated from the kitchen of the University. The main objective of this research was to investigate the possibility of mixing food and yard wastes in the process of composting to determine the optimum ratio between food and yard waste for an effective compost product. In addition, the effect of certain parameters on the effectiveness of composting process, sand content, particle size, and the weight and volume reduction during the composting process was investigated. The research was conducted at the existing Pilot-Scale composting plant at KDU premises. Different ratios of yard and food waste were mixed together to determine the most appropriate ratio between yard and food waste for effective compost product. The results of the study revealed that the parameters measured during the research were within the standard range when the percentage of food waste varies between 0% and 30% by volume. The most effective ratio between food and yard are 83% and 87%, respectively. Therefore, the existing Pilot-Scale composting plant at KDU can be modified by utilizing a mixture of food and yard waste to produce effective compost product.

KEY WORDS: *Compost, Food waste, Yard waste, Optimum ratio*

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1. INTRODUCTION

Generation of solid waste is a significant problem in most of the developing countries (Eheliyagoda & Prematilake, 2016). Solid Waste Management is the one thing just about every city government provides for its residents. While service levels, environmental impacts and costs vary dramatically, solid waste management is arguably the most important municipal service, and it serves as a prerequisite for other municipal actions (Hoornweg & Bhada-Tata 2012). Recycling is one of the Solid Waste management processes used in all around the world. There are two methods of recycling of organic wastes, i.e. aerobic digestion and anaerobic digestion of organic wastes. Composting is an aerobic digestion process used most commonly in the world.

Composting is the option that, with few exceptions, best fits within the limited resources available in developing countries where the biogenous waste is the main fraction in the public waste collection. (Rouse et al., 2008; Binner, 2016; Cofie et al., 2016). Technical guidelines on Solid waste management in Sri Lanka (p. 16) defines composting is the controlled biological decomposition of organic solid wastes materials under aerobic conditions. Also it is a process of letting nature transform organic materials into a material with environmentally beneficial applications. The process uses various microorganisms such as bacteria and fungi to break down the organic compounds into simpler substance. By properly managing air, moisture and nutrients, the composting process can transform large quantities of

organic material into compost in a relatively short time.

Compost is an organic soil conditioner that has been stabilized to a humus-like product that is free of viable human and plant pathogens and plant seeds. It does not attract insects or vectors, can be handled and stored without nuisance, and is beneficial to the growth of plants. There are different composting methods available around the world. Turned windrows method is the most common composting method in Sri Lanka (CEA, 2016). All of the compost plants operated under the Pilisaru project which was implemented by the government of Sri Lanka in the year 2008 as a solution for the municipal solid waste, uses a low cost, static windrow-turning composting system. (CEA, 2016)

Kotelawala Defence University (KDU) has a Pilot-Scale composting plant which also uses windrow method. It uses only yard waste for the composting process. However, a large amounts of food waste are also being generated from the kitchen of the University. The possibility of using both yard waste and food waste for the composting process for an effective compost product was investigated in this research. The effectiveness of the composting process is dependent upon the environmental conditions present within the composting system, i.e. oxygen, temperature, moisture, material disturbance, organic matter and the size and activity of microbial populations. Traditionally, it tended to be a low-cost process with most applications being for single and low-density development. Organic decomposition naturally occurs in

soils and composting artificially creates this soil environment. This process, which normally takes several months, can be speeded up and controlled using various techniques.

There are some specific guidelines for aerobic composting process in Sri Lanka, according to the technical guidelines on solid waste management in Sri Lanka which is published by Central Environmental Authority. When considering about the parameters that effect on the composting process, each parameter has an optimum value for an effective composting. Also there are some specifications for Compost from Municipal Solid Waste and Agricultural Waste (Sri Lanka Standard 1246: 2003).

Main objective of this research is to identify the optimum ratio between yard waste and food waste to achieve the efficient compost product. In addition, the effect of certain parameters, such as moisture content, pH, and temperature on composting process was also determined during the research. Further, the percentages of volume and weight reduction, sand content and the particle size were also determined for each sample.

With proper control of moisture, temperature and aeration, a composting plant can reduce the volume and weight of raw waste materials. Composting generally results in a 50 to 70 percent reduction in volume and a weight loss in the order of 40 to 80 per cent. Some of the shrinkage and weight loss is due to the transformation of loose, bulky material into finely textured compost and the loss of CO₂ and water to

the atmosphere. During the process, nitrogen is lost to the atmosphere as ammonia (NH₃). In addition, the greenhouse gases, carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) are emitted. Despite some losses, composting does retain most of the nutrients provided by the raw material and stores them as stable organic compounds.

2. METHODOLOGY

2.1 PREPARATION OF SAMPLES

The yard waste collected within the KDU premises and the leftover food discharged from the KDU kitchen were used for all the experiments for this research. Ten different ratios of both garden and food waste were mixed together by their volume as shown in table 1, and those mixtures were left for aerobic digestion by providing required conditions for the process.

Table 1 - Mixing ratios of garden and food waste

Mixt ure no:	Garden waste		Food waste	
	%*	V** (l)	%*	V** (l)
1	100	150	0	-
2	90	135	10	15
3	80	120	20	30
4	70	105	30	45
5	60	90	40	60
6	50	75	50	75
7	40	60	60	90
8	30	45	70	105
9	10	15	90	135
10	0	-	100	150

*=Percentage, **= Volume

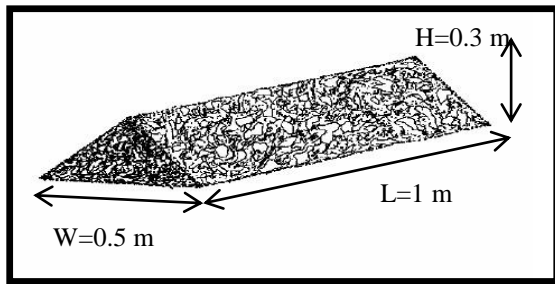


Figure 1 - Dimensions of windrow used for the experiment

2.2 MEASUREMENTS OF PARAMETERS

Relevant measuring instruments such as DO meter, and pH meter were used to test the conditions such as oxygen content and pH value. Selected parameters measured during the process are temperature, moisture content, pH value and the oxygen content.

Methods of measurements are as follows;

1. Moisture content was measured by weighing a known amount of waste sample that was taken from the mixture before and after drying.
2. Temperature was measured using a temperature probe in pH meter, always in identical locations.
3. pH was measured using a pH meter. The probe will be inserted into the identical locations.

All the measurements were taken twice a week in two locations of the profile, in the depths of 0.25, 0.50 and 0.75 m from the top. With the reduction of volume of piles, the measurements were taken from mid depth of the profile in three locations. The average values of each parameter were determined by using measured values.



Figure 2 – Measurement of Parameters

Initial and final weight and the volume of each mixture were measured and recorded to determine the percentages of weight reduction and volume reduction respectively. In addition, sand content and particle size of the digested samples were determined. For that, sieve analysis and sand content test were conducted in the KDU laboratory.

Turning was done twice a week to provide required air to the piles and moisture content of each pile was maintained by watering.



Figure 3 – Manual turning of compost samples

3. RESULTS AND DISCUSSION

3.1 VARIATIONS OF PARAMETERS WITH THE TIME

3.1.1 VARIATION OF MOISTURE CONTENT

According to Figure 4, moisture content variation of each sample is within the limits

(45% – 65%). Therefore, the effect of moisture content is same for each sample.

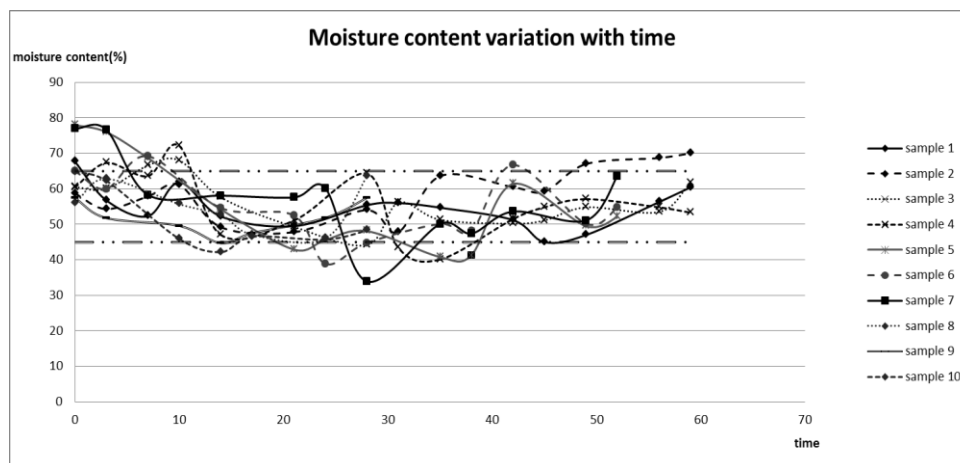


Figure 4 - Moisture content variation with time

3.1.2 VARIATION OF TEMPERATURE

Figure 5 shows the temperature variation of composting samples. In cold composting method, the temperature does not exceed 30°C. Initial temperature of each sample is around 27°C - 30°C (atmospheric temperature). Except the sample 1, all other samples have temperatures higher than

30°C within the 1st week and then the temperature value gradually decreases to 30°C. After the 1st week, the temperature slightly varies around 30°C. The reason for these variations is that in normal practice, composting begins at ambient temperature (mesophilic range) and progresses to and through a thermophilic phase, followed by a descent to the mesophilic level.

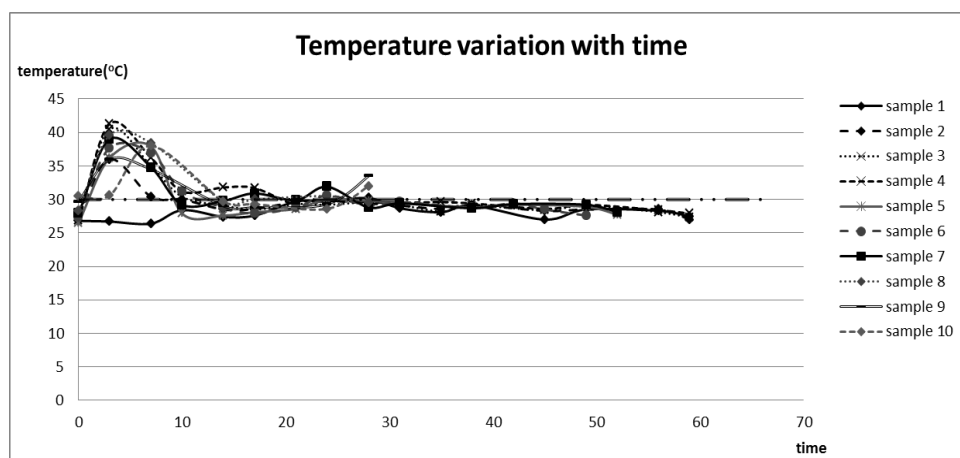


Figure 5 - Temperature variation with time

3.1.3 VARIATION OF pH VALUE

By maintaining oxygen content, temperature and moisture content values of each sample variation of pH was determined along with the time. Figure 6 shows the variation of pH values in each sample within the duration of composting compared to the limit of 5.5 – 8.

Samples 1, 2, 3 and 4 show a similar kind of variation in pH. Initially those curves have a drop in pH. However, after a 2 week period of composting process, it soon begins to rise to levels as high as pH 9.0-10.0. The initial drop reflects the synthesis of organic acids. The acids serve as substrates for succeeding microbial populations. The subsequent rise, in turn, reflects the utilization of the acids by the microbes. Initial drop of pH in sample 4 around day 10 is much higher than that of the other 3 cases. That means the formation of acids in sample 4 is higher than that of the other 3 samples. In the mid of the 3rd week, again pH drops down to 7 and again it rises up to pH 9.0-9.5 at the start of the 4th week. Again, it shows formation of acids and utilization of acid by the microbes. After completing an 8 week period of

composting, the pH comes to 7.0 and the sample becomes neutral. At this stage compost samples become suitable for the plant growth.

Sample 5 has a different kind of variation than all other samples. It shows several drops and rises in pH in a systematic way. However, the drops are smaller compared to the rises in pH. By gradually increasing the pH, it reaches up to pH 9.0 at the end of the 5th week and after the 6th week it drops down to pH 7.5.

Sample 6 and 7 have almost similar kind of variation in pH. Initially they have pH around 4.0 due to higher percentage of food waste than in previous samples. At day 14 both reach to pH 10.0 due to the utilization of acids by microbes. This peak value was reached by the samples 6 and 7 earlier compared to the sample 1- 4. Again, they drop in pH down to 4.0 due to formation of acids and subsequently it increases. After completing 6 weeks, they reach pH 7.5.

Sample 8, 9 and 10 have relatively low pH values around 4.0-5.0 throughout the period due to the higher percentage of food waste. Formation of acids in the samples 8, 9, 10 is much higher than in that of other samples.

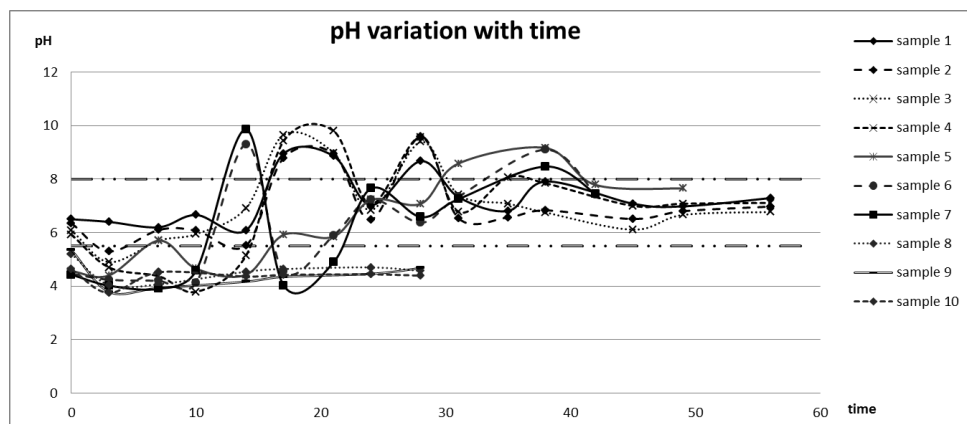


Figure 6 - pH value variation with time

3.2 VOLUME AND WEIGHT REDUCTION

According to Table 2, percentages of volume reduction of sample 1 to sample 7 are varied around 85% and sample 8, 9 and 10 have around 90% of volume reduction. Expected volume reduction in composting is within the range of 50-70%. All the samples exceed the 80% reduction.

garden waste only, the percentage of weight reduction is very less compared to the other samples. The percentage of weight reduction gradually increases with the increment of the ratio of food waste. Sample 1 - 4 have a 10% gap within each sample whereas samples 4 - 7 have smaller increments in percentage of weight reduction.

Table 2 demonstrates the weight reduction percentages of each sample. When we use

Table 2 - Volume and Weight reduction percentages

Experiment no	Initial volume (m ³)	Volume after digestion (m ³)	Initial weight (kg)	Weight after digestion (kg)	Percentage of volume reduction (%)	Percentage of weight reduction (%)
1	0.15	0.02	10.36	4.761	86.7	54
2	0.15	0.0235	15.7	5.645	84.3	64
3	0.15	0.0225	20.47	5.445	85	73.4
4	0.15	0.0215	28.86	4.12	85.7	85.7
5	0.15	0.019	22.21	2.861	87.3	87.1
6	0.15	0.023	34.36	3.195	84.7	90.7
7	0.15	0.0255	47.25	4.445	83	90.6
8	0.15	0.018	63.9	4.336	88	93.2
9	0.15	0.015	74.2	3.552	90	95.2
10	0.1	0.007	56.4	2.334	93	95.3

3.3 SIEVE ANALYSIS

Residue percentage increases with the increase of the ratio of food waste. The residue percentages of each sample are shown in Table 3. Sample 1 to 5 have less residue percentages of 10-15%. The percentages of residues of samples 8,9,10 increase due to the agglomerate of food waste particles. When increasing the food waste percentage of the mixture, the void spaces in the sample are reduced. Due to that, an anaerobic condition could occur within the sample. Also, an unpleasant

odour is released with the increment of percentage of food waste in the mixture. That may also result in the conglomeration of food particles with the increment of bacterial operation within the sample. It is not a characteristic of effective composting. According to the sieve analysis samples 1-5 are more effective than samples 6-10.

Table 3 - Residue percentages

Experiment no	Initial weight of sample (g)	Weight of residues (g)	Residue percentage (%)
1	100	10.9	10.9
2	100	14.1	14.1
3	100	13.6	13.6
4	100	9.1	9.1
5	100	16.3	16.3
6	100	21.7	21.7
7	100	20.6	20.6
8	100	33.9	33.9
9	100	40.2	40.2
10	100	63.2	63.2

3.4 SAND CONTENT

Sand content of final product should be less than 10% by mass, according to the Specifications for Compost from Municipal Solid Waste and Agricultural Waste (Sri Lanka Standard 1246: 2003). Except sample 1, others have sand content less than 10% according to the Table 4.

Table 4 - Sand content percentages

Experiment no	Initial weight of sample (g)	Weight of sand (g)	Sand content percentage (%)
1	100	11.5	11.5
2	100	3.2	3.2
3	100	2.7	2.7
4	100	3.9	3.9
5	100	3.2	3.2
6	100	3.5	3.5
7	100	9.1	9.1

8	100	1.4	1.4
9	100	1.8	1.8
10	100	1.5	1.5

Sand content percentages of all the samples are not very high. All are within the acceptable range except sample 1. However, we can see that with the increase of garden waste percentage in the sample, the percentage of sand content increases.

4. CONCLUSIONS

The results of the study revealed that, when the food waste percentage of the mixture increases, the void spaces are reduced. Due to that, an anaerobic condition can occur within the sample. That may result in the conglomeration of food particles. That is not a characteristic of effective composting. Also, an unpleasant odour comes into existence with the increment of percentage of food waste in the mixture. They were not effective due to the conglomeration. It seems that, the samples having higher percentage of food waste than 70% in the mixture are not effective under normal conditions. It may require special conditions and controls. The parameters that were measured during the research were within the standard range when the percentage of food waste varied between 0% and 30% by volume. The most effective ratio between food and yard wastes was 30% and 70% by volume. In addition, the average weight and volume reduction of the samples were 83% and 87%, respectively. Therefore, the existing Pilot-Scale composting plant at KDU can be modified by utilizing a mixture of food and yard

waste to produce effective compost product.

5. ACKNOWLEDGEMENT

Authors would greatly acknowledge the Vice Chancellor of General Sir John Kotelawala Defence University for granting permission to carry out experiments at the Pilot-Scale composting plant at the University. Further, authors would like to acknowledge the Technical Staff of the Department of Civil Engineering of KDU for their assistance during the field experiments.

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Technical Guidelines on Solid Waste Management in Sri Lanka.

KDU Journal of Multidisciplinary Studies

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