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Editorial

Sabaragamuwa University Journal is aimed at publishing and promoting multidisciplinary research covering the areas of Agriculture, Science and Technology, Social Sciences and Humanities and Management Studies. The articles published in the current volume comprised of research findings and knowledge base generated from all these disciplines. Articles submitted to the journal through the regular submission process and selected papers that have been submitted to Sixth International Conference of Sabaragamuwa University are included in this volume.

In this volume, there are two articles which cover topics of metacognitive elements and motivational factors leading to the improvement of English language learning skills of undergraduates; The article “Ascertaining requisite metacognitive elements of input through the exploration of language learners cognitive characteristic” is based on a study that was conducted using Engineering undergraduates to identify metacognitive components for learning English as a Second Language (ESL). The article “Investigation of L2 Motivational Self System: A Comparative Study of Undergraduates from Displaced and Resettled Regions in Sri Lanka” focuses on investigating the key motivational factors that affect English learning activities of rural and war-affected (resettled) university students. There are two articles which cover the areas of literature. The articles “Dirge of the Fallen Woman in European Literature: when religion turns sour and evil to make the innocent female soul suppressed” and “Heideggerian ‘Out-of-Joint’ Situation and New Horizons in Postcolonial Literature: Interpreting the Zizekian ‘Extimacy’ in The Mimic Men by V.S. Naipaul” provides new insights in these areas of literature.

Continuous application of inorganic fertilizers has been found to reduce soil organic carbon content, reduce nutrient balance, deficiency of secondary macronutrients and micronutrients. Integrated nutrient management incorporates the use of various sources of plant nutrients to improve soil quality and crop productivity. Among the two articles representing the discipline of Agriculture, the article “Effect of Integrated Nutrient Management on Green Pod Yield of Chilli (Capsicum annuum L.) cv MIPC-01” discusses the outcomes of a study investigating the effect of combined application of organic manures with recommended inorganic fertilizers to evaluate the best combination of applications on green pod yield of chilli cv. MIPC-01. Storage conditions have a significant impact on the quality of the stored food commodities. Exploration of the ideal conditions of storage is essential for preventing food wastage. The article “Influence of Storage Temperature on the Quality Parameters of Wheat Flour during Short Term Storage” discusses the findings of a study carried out to evaluate the influence of storage temperature on the quality of wheat flour during short-term storage.

There are three articles which cover the discipline of Science and Technology; Chronic Kidney Disease of unknown aetiology (CKDu) is one of the major health issues in Sri Lanka. The article “Drinking Water Quality on Chronic Kidney Disease of unknown aetiology (CKDu) in Ulagalla Cascade, Sri Lanka” represents the outcome of a study to evaluate the drinking water quality of Ulagalla cascade in Anuradhapura district in relation to factors associated with CKDu. The Study of body movements and the dynamic properties of exercise apparatus are important to minimize the execution errors and maximize performance in Gymnastic. The paper “Enhancement of Gymnastic Movements with Utilizing Strain of Parallel Bar” focus on a study of long swing movements in Gymnastic using parallel bars by optimizing elastic energy to complete movements artistically. Neighborhood characteristics play a significant influence on the living conditions of inhabitants in cities. Therefore, selection of best locations based on systematic analysis of available fundamental civic services in the neighborhood is vital to have a healthy life. The article “Web-based Decision Support System to evaluate the living conditions: A case study of the Colombo city” discusses an outcome of a study which used hotspot analysis and Network Analysis extension of ArcGIS to extrapolate best locations for inhabitants in the Colombo city.

As the Editor in Chief, I would like to thank all who contributed to make this volume completed within a limited time. I specifically thank all reviewers and editorial board members of the journal for devoting their valuable time for reviewing and editing the articles. I am grateful to Vice-chancellor of the Sabaragamuwa University of Sri Lanka, Prof Sunil Shantha and Director of the Centre for Research and
Knowledge Dissemination (CRKD) of Sabaragamuwa University, Prof Nirmali Wickremarathna for their support. Dr Sadeera Bandara, Mr. M. Hapugoda and Ms W.A.K.Amitha spent many hours of dedicated work throughout the production process of the journal and I sincerely thank them for their support. I also thank Mr. R.L Dangalla and Mr Prasad Iddamalgoda for their support. Finally, I thank all the scholars who sent articles to the journal to share their new findings with academics in their respective fields. Sabaragamuwa University Journal is a nonprofit academic journal and articles from all the disciplines covered by the journal are welcome for publication in the future volumes.

Professor JMCK Jayawardana
Editor in Chief
Ascertaining Requisite Metacognitive Elements of Input through the Exploration of Language Learners’ Cognitive Characteristics

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Abstract

Cognitive theory emphasizes language learning as a conscious and reasoned thinking process involved in the use of deliberate learning strategies. Exploration of the cognitive characteristics of learner provides benchmarks to define metacognitive components required, thus easing the planning of input in an English as Second Language (ESL) classroom. In view of espousing deliberate learning strategies in input, this study identifies due metacognitive components for ESL input upon diagnosing the cognitive characteristics of learners. The research questions include, what cognitive strategies learners do possess, what correlative natures are visible in cognitive strategies in learner possession, and which metacognitive components are to be espoused in ESL input. Proposing a questionnaire aligned with the taxonomy of metacognition, its viability for investigating prevalent learner cognitive/metacognitive characteristics is tested. The survey among 110 engineering undergraduates provides qualitative data about learner traits reflective of metacognitive behaviors. Responses were collected in a Likert scale corresponding to a defined metacognitive scale, and the cumulative means of the responses against each aspect of metacognition are stratified in a radar chart forming the learner portfolio of metacognitive strategy in use. Correlative tests are executed among prevailing cognitive traits seeking evidences for the unified nature of learner metacognitive behaviours. Results proved the prevalence of metacognitive strategies through evidences of learners’ metacognitive feelings and judgements besides a proven correlation among planning, monitoring and control behaviors towards enabling metacognitive feelings/judgements. Precision of the diagnostic tool and the cohesive visibility of the metacognitive portfolio remain significant results with opportunity for further research.

Key words: Cognition, ESL Input, Learner characteristics, Metacognition, Portfolio

Introduction

Saville-Toike (2012) makes the distinction between mother tongue (L1) acquisition and Second Language (L2) learning in the following context. L1 is the mother tongue acquired during early childhood (mostly before 3 years old). It is acquired in the process of growing up with the people who speak the same language. If an individual or a group of them learns another language ensuing L1, it is the second language [Saville-Toike, 2012].

Over the centuries to the date, learning or acquiring language has been a stimulus for many researchers and they have seen the issue in three distinct perspectives. Behaviorists perceive this phenomena in the stimulus-response base as “Say what I say” to be the approach for language acquisition. Innatist observation of the language acquisition is: “It’s all in your mind” as they base Language acquisition Devise (LAD) and Universal Grammar (UG) in their approach. Interactionists consider language acquisition as a result of “A little help from my friends” as they reside in the paramount importance of interaction [Lightbrown & Spada, 2006]. In a review of the three perspectives, Mohamad & Rashid (2018) admit to the fact that none of these three theories alone can suffice to help learning or acquisition but all three in combination [Mohamad & Rashid, 2018].

However, first language acquisition is seen implicit as it is extracted from experience rather than explicit rule teaching. Yet, learning L2 needs explicit learning. Krashen (1982) makes the distinction between implicit acquisition and explicit learning of L2 in his input hypothesis. In Krashen’s theory, Second Language Acquisition (SLA) is identical to L1 acquisition that comes naturally as a result of implicit processes occurring while the learner is receiving comprehensible input [Krashen, 1982].

The distinction is that when the cognitive system of a learner whose mother tongue or first language being something else than the languages/he intends to learn/acquire, there can possibly be coinciding and/or contradicting stimuli between the cognitive system configured for the first language which is in the learner’s possession. Thus the approaches to second language teaching should locate their philosophies on the prevalent cognizance of intended learners on their own cognitive system. Emphasizing this view for future research Doughty & Long (2003) claim that in order to properly address the SLA issues, studies of implicit and explicit language knowledge inclusive of: SLA, applied linguistics, cognition, consciousness, learning, education, and brain must proceed in consort within the broader inquiries of cognitive science and cognitive neuroscience [Doughty & Long, 2003].

In order to provide a comprehensible input as prescribed by Krashen (1982) to foster SLA, while obeying to the suggestion to combine all three theories (behaviorism, innatism and interactionism) of language acquisition, the present study endeavors to materialize a cog-
### Table 1: Tabulated taxonomy items of metacognition with questionnaire items

<table>
<thead>
<tr>
<th>Category</th>
<th>Super category</th>
<th>Subcategories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metacognition</td>
<td>1 Knowledge of cognition</td>
<td>1.1 Declarative metacognitive knowledge (knowing the self) 1.1.1 Knowledge of self 1.1.2 Knowledge of task &amp; context 1.1.3 Knowledge of strategy</td>
</tr>
<tr>
<td></td>
<td>1.2 Procedural metacognitive knowledge (Knowing How)</td>
<td>1.2.1 Knowledge of self &amp; others 1.2.2 Knowledge of task &amp; context 1.2.3 Knowledge of strategy</td>
</tr>
<tr>
<td></td>
<td>1.3 Conditional metacognitive knowledge (knowing when, where, why)</td>
<td>1.3.1 Knowledge of self &amp; others 1.3.2 Knowledge of task &amp; context 1.3.3 Knowledge of strategy</td>
</tr>
<tr>
<td></td>
<td>2 Regulation of cognition</td>
<td>2.1.1 Monitoring &amp; control 2.1.2 Self-regulation 2.2.1 Metacognitive Feelings 2.2.2 Metacognitive Judgments</td>
</tr>
<tr>
<td></td>
<td>2 Regulation of cognition</td>
<td>2.1. Monitoring &amp; Executive Functioning 2.2 Metacognitive Experiences</td>
</tr>
</tbody>
</table>

The diagnosis of learner cognitive characteristics in advance to planning the cognitive and metacognitive elements.
ments of in the English as Second Language (ESL) input is considered a pivotal step in input planning. Attempts of diagnosing the prevalent cognizance of learners in advance of the exposure to ESL learning experience are of much limit. This is perhaps a consequence of ESL practitioners’ adherence to learning outcomes as the central concern in ESL input planning which naturally forces them to overlook the significance of diagnosing the prevailing status of cognition of the learner. The objective of this study is to deliberate the need of diagnosing the significance of learner cognition prior to planning the input of second language teaching and to propose a tool viable for diagnosing such learner traits relevant to ESL context.

The area of investigation of the present study should not be misconceived with diagnostic language assessments (DLA) which refers to the processes of identifying test-takers’ or learners’ weaknesses, as well as their strengths, in a targeted domain of linguistic and communicative competence and providing specific diagnostic feedback and guidance for remedial learning.

The aim of the present study is to locate a diagnostic test capable of discovering the existing cognitive traits of the learners thus capacitating the ESL input planner to discern due metacognitive elements in ESL input to nurture learners’ cognitive status towards metacognitive learning. In this view the study concerns two concepts namely, cognition and metacognition. Metacognition in definition is about cognition of oneself on his own cognitive phenomena. The higher order construct is metacognition and the foundation in which it is constructed is cognition.

Langford (1986) describes cognition as ‘constant flow of information’. The American Heritage Dictionary of the English Language (2000) defines cognition as “the mental process of knowing, including aspects such as awareness, perception, reasoning, and judgment”. Metacognition in contrast is the consciousness of one’s own abilities, for example, a child understands that he/she is able to read. The distinction is that by making use of metacognition people can regulate their learning processes. It refers to how the task is understood and how solutions are evaluated and monitored.

In other words, the domain of metacognition includes knowledge and awareness of process of knowing and the monitoring and control of such knowledge and processes [Flavell, 1976, Flavell et al., 1993, Schraw, 2001].

Learners’ cognizance of their own cognition has been a stimuli for research as early as 1949 as Witkin (1949, 1978) identified them as learner characteristics. Witkin considers learner characteristics as characteristic modes of functioning of highly consistent and pervasive nature in perceptual and intellectual activities. Learner characteristics are seen as traits of the possession of learners which are distinguished from learners’ states that can be influenced easily [Witkin, 1949, Witkin, 1978].

Learner characteristics evaluate a wide spectrum of learner traits of personal, academic, social and cognitive dimensions from which the present study falls within cognitive dimension of the learner characteristics. The cognitive dimension of the learner characteristics considers how the learner perceives, remembers, thinks, solves problems, organizes and represent information in brain. Guilford in 1967 considers cognitive learner characteristics as intellectual abilities which perceives along three dimensions: operations, content and products. As Guilford’s definition operation includes: cognition, memory, divergent production, convergent production, and evaluation while content being visual, auditory, symbolic, semantic, and behavioral. The production in his organizing includes units, classes, relations, systems, transformations, and implications [Guilford, 1967].

The amalgamation of specific instructional approaches for specific learner characteristics began in 1970s with Cronbach and Snow’s model (1977) of Aptitude Treatment Interactions which presumes that optimal learning is the result of the instruction being perfectly matched to the learner’s aptitudes. Their model held the fact that certain instructional strategies will be more or less effective for different individuals depending upon the individual’s specific abilities such as aptitude [Cronbach & Snow, 1977].

Among many approaches to merge learner characteristics, especially the cognitive characteristics in instructional contexts, the approaches to instruct metacognition and apprenticeship to metacognitive phenom-

Table 2: An example of Likert options corresponding to the metacognitive scale.

<table>
<thead>
<tr>
<th>Metacognitive Scale</th>
<th>Value</th>
<th>Example: Q 3.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utter-Negative</td>
<td>-2</td>
<td>No I never do evaluate my improvement.</td>
</tr>
<tr>
<td>Negative</td>
<td>-1</td>
<td>I don’t try evaluating my improvement</td>
</tr>
<tr>
<td>Neutral</td>
<td>0</td>
<td>I don’t know whether I do assess or not</td>
</tr>
<tr>
<td>Developing</td>
<td>+1</td>
<td>Yes, I do assess my improvement</td>
</tr>
<tr>
<td>Positive</td>
<td>+2</td>
<td>Yes, I always do assess in regular intervals</td>
</tr>
</tbody>
</table>

| Positive +2 | Yes, I always do assess in regular intervals |
| Neutral 0   | I don’t know whether I do assess or not |
| Developing +1 | Yes, I do assess my improvement |
| Negative -1 | I don’t try evaluating my improvement |
| Utter-Negative -2 | No I never do evaluate my improvement. |
Table 3: Correlation between Planning and the ability for distinguishing strategies.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent variable</th>
<th>P-correlation</th>
<th>Significance (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I usually plan myself and list out what I should do to achieve my language goals</td>
<td>I can distinguish strategies to achieve my goals of language learning</td>
<td>0.392**</td>
<td>0.000</td>
</tr>
</tbody>
</table>

N=110

Correlation is significant at the 0.01 level (2-tailed).

Table 3 shows the correlation between planning and the ability to distinguish strategies. The correlation coefficient is 0.392**, indicating a significant positive relationship at the 0.01 level (2-tailed). This suggests that planning is associated with the ability to distinguish strategies, highlighting the importance of planning in language learning.

The present study has aimed at clearing the fuzzy doubts in delineating a starting point for ESL input planners to espouse cognitive apprenticeship and metacognitive elements in input, considers exploration of the following issues.

Having reviewed via all these literature, it became clear that the apprenticeship to metacognitive strategies through ESL input is of promising nature for its constructive impact on language acquisition. Pressley (2000) prescribes that if metacognition is obviously of particular relevance to poor students. The three principles from the literature for successful cognitive and metacognitive instruction include: embedding metacognitive instruction in the content ensuring connectivity, informing the usefulness of metacognitive activities urging an extra effort, prolonged training to guarantee the application of metacognitive activity [Pressley, 2000].

Having spotted the significance of incorporating metacognitive skills in ESL input obliging to the prescriptions of Pressley (2000), the present study considers the vitality of diagnosing existing cognitive characteristics of the learner as such can assist as the benchmarks to guide the incorporation of due cognitive and metacognitive skills.

The present study has aimed at clearing the fuzzy doubts in delineating a starting point for ESL input planners to espouse cognitive apprenticeship and metacognitive elements in input, considers exploration of the following issues.
a. What metacognitive strategies are students already aware of in learning ESL?

b. What correlative natures are visible in cognitive strategies in learner possession?

c. Which metacognitive domains should the learners require in prolonged apprenticeship?

Methods

The central objective of the survey remains diagnosing the existing cognitive characteristics of the learners thus enabling the instructional designer to decide on a starting point to espouse strategies to uplift cognitive and metacognitive apprenticeship of learners. The study entails a secondary objective to investigate the aspects of metacognition possessed by the learners and possible correlative natures of the constituents of metacognition. Being considerate of what metacognitive strategies are students aware of in learning ESL, which strategies do they perceive as relevant for their studies, and which cognitive/metacognitive domains should the learners require prolonged apprenticeship the study proposes a questionnaire aligned with taxonomy of metacognition by Tarricone (2011) which provides a theoretical framework of the cognitive traits possessed by learners.

Development of the Research Tool, Sampling & Validating the Tool

In search of an optimum tool for the investigation of learner cognitive characteristics, the researcher worked out an agenda on observing the learners in his ESL classroom of 35 students. The key assumption of the observation plan was that the learner behavior is the consequence resulted owing to the cognitive characteristics and experience of the learner in language classroom. Five distinct aspects/areas of the learners’ behavior have been traced in these observations. They include: learner perceptions about the experience in the English language classroom, learner preparations for the language learning task, execution the mission of learning, learner interactions with peers, and the way in which learners accept/relate the results of their interaction. Having framed such aspects/areas of learner behaviours in the category, sub-category and super-category items of the taxonomy of metacognition, the researcher formulated queries for each of the items. The tabulated taxonomy items of metacognition with questionnaire items given in Table 1 illustrates the alignment of questionnaire with the taxonomy.

Such questions were tested in a structured key informant interview among 14 students selected on the following basis.

Considering the observation on individual learners and their socio, demographic and language proficiency aspects, three groups of students were selected for key informant interviews. Four students each from among the learners who possessed the greatest and the lowest confidence over English medium were considered for group A and B consequently thus aligning with purposive sampling. Group C which had six students has been randomly selected from the class avoiding the members of group A and B categories. The learners of B and C groups had difficulties in understanding questions raised, thus a translation of the question is offered for them and they were allowed to answer in their mother tongue (Sinhalese). These 16 learners were interviewed with the draft questionnaire allowing them to answer freely for each of the items of inquiry. Such answers given for each of the queries were recorded and categorized afterwards to form the five or seven scale Likert options against each query.

Having set the questionnaire with Likert options, the three groups of learners were requested to respond them and their answers were validated with the answers they offered in the interview. The validated questionnaire with Sinhalese translation (of both questions and Likert options) has been executed with 110 engineering undergraduates of University of Moratuwa. The sample for this investigation is selected from the population of 800 new entrants to the Faculty of Engineering as explained below.

The entire intake (800) of the Engineering Faculty undergoes ESL sessions under the Department of Languages in parallel classes. The Department of Languages at the University of Moratuwa considers 35 to 40 students in a class to be the optimum learner population for an ESL class thus the entire batch of students in ESL sessions are in 35 to 40 students’ groups in many parallel classes. The sample for the questionnaire administration consisted of three such classes wherein the researcher undertook teaching thus assuring 35 to 38 learners in each from among twenty three such classes who underwent the same material. The sample thus was selected randomly from among mixed ability groups of learners irrespective of their gender, ethnic or demographic concerns.

Data Analysis Process

Each query in the questionnaire has been provided with descriptive Likert options corresponding to a defined metacognitive scale for the learners to choose from. Such Likert options are indicative of the states of cognitive characteristics possessed by the learners and they are scaled as -2, -1, 0, +1, +2 range thus aligning within the metacognitive scale. Once the learner opted any of the statuses it adds marks either as positive or negative thus placing the metacognitive sensitivity of the learner in right place of the scale. Score ‘0’ in the scale reflects the indifference to metacognitive phenomena while scores (-1), (-2) reflect diminishing attention towards metacognitive phenomena. Scores ‘1’ and ‘2’ reflect growing adherence towards metacognitive phenomena. This has applied to all the elements of metacognitive taxonomy and the sample’s cumulative marks are
Table 4: Correlation between to-do list with Evaluation of the Plans and amend strategies.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent variable</th>
<th>P-correlation</th>
<th>Significance (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I make a ‘to do list’ including the strategies I’m using for each sub task</td>
<td>I evaluate my improvement towards achieving my goals</td>
<td>0.353**</td>
<td>0.000</td>
</tr>
<tr>
<td>I usually evaluate my strategies and amend/correct them</td>
<td>0.490**</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>I evaluate my improvement towards achieving my goals</td>
<td>I usually evaluate my strategies and amend/correct them</td>
<td>0.454**</td>
<td>0.000</td>
</tr>
</tbody>
</table>

N=110

Correlation is significant at the 0.01 level (2-tailed).

Figure 1: Portfolio of Prevailing Metacognitive Knowledge and Skills

calculated for each component of the metacognition. The portfolio is composed by considering the aggregate of the marks gained by the learner sample. The example query of the questionnaire and the cognitive traits reflective of metacognitive scale illustrated in Table 2 provides the method in a nutshell.

For the analytical clarity and precision, such data are coded corresponding to the metacognitive scale values elaborated in Table 2 assuring the analyzability using Statistical Package for the Social Sciences (SPSS) version 19.00 which is an up-to-date platform for statistical analysis.

The cumulative means of the sample responses against each query with corresponding aspect of metacognition are stratified in a radar chart thus forming the portfolio of metacognitive strategy in use among learners.
Table 5: Correlation: knowing constructive causes, being shrewd on how they emerge & skill to stimulate them.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent variable</th>
<th>P-correlation</th>
<th>Significance (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do know what causes do constructively effect on my mission.</td>
<td>I do know how those positive causes emerge.</td>
<td>0.274**</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>I do know how to stimulate such positive causes.</td>
<td>0.237*</td>
<td>0.016</td>
</tr>
<tr>
<td>I do know how those positive causes emerge.</td>
<td>I do know how to stimulate such positive causes.</td>
<td>0.498**</td>
<td>0.000</td>
</tr>
</tbody>
</table>

N=110

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Results and Discussion

Portfolio of Cognitive/ Metacognitive characteristics

The summary of findings of the entire questionnaire survey at a portfolio level is illustrated in the radar graph in Figure 1. The chart indices metacognitive knowledge and skills possessed by the learners in each sub category level of the taxonomy of metacognition. The objective of forming the portfolio of prevalent metacognitive awareness and skills is to identify the existing skills with the learners while detecting the areas that need further emphasis and training through ESL input components. The area covered black line graph with colours indicate the prevalence of metacognitive behaviors as found from the learner responses. Covering the highest contour of the radar graph is the objective of ESL learning mission. The residual lines of the sample statistics and the distance between such residual points to the highest contour of the radar indicate the areas to be considered in ESL input components. In the radar graph, the levels in which metacognitive behaviors prevail are indicated through the rubric given below.

The legend descriptors of the Figure 1 consists colour codes. The white coloured center (0 to 0.1) in the radar graph indicates the total absence of metacognitive knowledge or skills while the territory coloured in yellow (0.1 to 0.2) indicates the embryonic signs of metacognitive knowledge and skills awakening. The sample of learners in the study has no record of lagging in or around these areas of poor metacognitive signs.

Amber coloured area leading from 0.2 to 0.4 range indicates developing symptoms of metacognitive skills and knowledge which needs further orchestration to sustain and lead towards the periphery of the radar chart. The least average earned by the sample of learners in the survey lags at 0.302 which specifies the knowledge of strategy possessed by the learners. This subcategory of metacognition being a component of metacognitive knowledge alarms us the need of espousing content in the ESL input targeting the enhancement of such knowledge dimensions of metacognition. The content and the frequency of such material have to be dominating in the ESL input as it remains the least equipped dimension of metacognition.

Establishing signs of metacognition range from 0.4 - 0.6 and they are marked in light green colour. Monitoring and control subcategory lags within this range with 0.473 score along with metacognitive feelings subcategory rests in the outer border with 0.6 score. Both these subcategories belonged to metacognitive skills of the taxonomy of metacognition. These two subcategories ask for greater attention in the prospective ESL input as they are to be indoctrinated with emphasis in the teaching learning process.

The components of metacognition that has an established status are positioned within scores 0.6 to 0.8 within dark green contours. Most of the subcategories such as: declarative knowledge of strategy, procedural knowledge of self and others, procedural knowledge of task and context, conditional knowledge of strategy belonged to the metacognitive knowledge dimension rest within this positive state of established nature. Self-regulation and metacognitive judgements belonged to the domain of metacognitive skills also rest in this range of established stage of metacognition. In composing the ESL input, these components of established nature are to be induced in introductory and application nature.

Certain subcategories of metacognition, namely, declarative knowledge of self, conditional knowledge of self and others and conditional knowledge of task and context, all belonged to metacognitive knowledge dimension rest in perfection range of the metacognitive indicator coloured in light blue. These aspects of metacognition can be induced in the strategy content of the ESL input upon the demand of communicative activity.

The portfolio of prevalent metacognitive knowledge and skills hence provides the base for determining metacognitive strategy in the ESL input. The portfolio thus serves as the guideline for determiner of the
dosage and the due level of emphasis relevant to the metacognitive strategy component of ESL input.

**Specific Outcomes**

The study beyond its central concerns was able to unveil several implications relevant to ESL context and such are discussed herein. Data has been gathered for the purpose of distinguishing prevalent metacognitive strategy inventory of the learners. Such data of correlative nature allows the study to ascertain certain ground realities relevant to the context of ESL in the research field. Thus a correlative analysis is performed for such data of confident nature for establishing correlations. Pearson correlation coefficient formula is used in analyzing data with the view of discerning any relationship exist between learners’ confidence over each skill of the language and their impact on other skills of the language. The correlation can vary from -1 (perfect negative correlation) through 0 (no correlation) to +1 which is a perfect positive correlation. The significance value indicates (p-value) the nature of importance for the validity of the hypothesis. If the value is less than 0.01 the relationship is significant which convinces the fact that there exists a relationship between the two variables (or null hypothesis is rejected).

**Learners’ planning behavior and the ability for strategy distinguishing**

Correlation statistics are taken between the two variables: I usually plan myself and list out what I should do to achieve my language goals and I can distinguish strategies to achieve my goals of language learning. Table 3 shows how closely the two variables relate to one another.

Despite the relationship between learners’ planning and learners’ ability for distinguishing strategy being not considerably strong as per Table 3, the data indicates that there exists a correlation between the two. The correlation table figures convince that when the learner plans more his ability to distinguish the strategy is enabled mostly. This nature of relationship is vital for the fact that in metacognitive apprenticeship, a learner who is trained to establish a planning behavior can yield strategy discerning skill in result.

**Possession of a to-do list with Evaluation of the Plans and improve strategies**

Correlative statistics of having a ‘to do list’ and the learner’s tendency for amending the strategies and the correlation between evaluating the strategies and the learner’s tendency for amending strategies are as follows.

The positive correlation of 0.35 in the Correlation Table 4, is a significant indicator of the relationship which establishes the fact that, having a ‘to do list’ leads a learner to evaluate strategies towards achieving goals. The strongest correlation exists in the table 0.49 between having a ‘to do list’ and the propensity of evaluation lead to amend strategies is indeed a finding of grandeur. When a learner possesses a checklist of strategies and targets it leads him to evaluate the learning process, thus enabling the learner to empower decision making for amending the strategies to reach perceived goals. It is evident that the learners’ evaluation of strategies also has a strong positive relationship on enabling the learner to amend/alter strategies towards achieving learning goals.

**Knowing Constructive Causes, shrewdness on emergence of causes and astute for stimulating them**

In the higher levels of metacognitive behavior, a learner encounters the metacognitive feelings that lead to metacognitive experience. A learner with the ability to distinguish constructive causes for his mission of learning do possess the caliber for extending such skill to gain shrewdness on how such causes emerge which can be led further to stimulate such causes. Having hypothesized that these variables possess a relationship, a correlation test is performed. The table (Table 5) of correlation statistics show the possible relationships.

As per the Table 5 statistics, those with significant correlation values establish the hypothesis that there exist a relationship between knowing the constructive causes and the knowledge of how such causes emerge. The correlation established thus is slightly strong since the P correlation coefficient value being .27. The correlation between knowing the constructive causes and knowing how to stimulate them stands a positive one with a P correlation coefficient value equivalent to 0.24.

The most convincing aspect of the relationship is that once the learner knows how positive causes emerge s/he possesses a reasonable astute for stimulating them. This relationship is evident in 0.49 positive correlation value displayed between the two variables.

**Knowing negative Causes, shrewdness on emergence of causes and astute for hidering them**

A learner with the ability to distinguish negative causes exactly, upon its emerging s/he can extend that knowledge to hinder/overcome such causes. The null-hypothesis in such is that there exist no-relationship between the variables. The Table 6 of correlation statistics show the results of the correlation test.

The significant correlation values shown in Table 6, against each correlation test establish the hypothesis that there exist relationship between knowing the negative causes and knowing how such causes emerge. The P correlation 0.29 establishes that it is slightly strong. The correlation between knowing the negative causes and knowing how to overcome them, stands a more positive relationship with a P correlation coefficient value equivalent to 0.32. The relationship between knowing
Table 6: Correlation: knowing negative causes, being shrewd on how such causes emerge & skill to hinder them

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Dependent variable</th>
<th>P-correlation</th>
<th>Significance (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do know what causes do adversely effect on my mission.</td>
<td>I do know how those adverse causes emerge.</td>
<td>0.0288**</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>I do know how to overcome and control such negative causes.</td>
<td>0.315**</td>
<td>0.001</td>
</tr>
<tr>
<td>I do know how those adverse causes emerge.</td>
<td>I do know how to overcome and control such negative causes.</td>
<td>0.529**</td>
<td>0.000</td>
</tr>
</tbody>
</table>

N=110

**Correlation is significant at the 0.01 level (2-tailed).

how negative causes emerge and how to overcome them is very strong owing to the 0.53 P correlation coefficient value. The observation is that once the learner knows how negative causes emerge s/he possesses an assured astute for taking actions to overcome them.

Conclusions

Findings of the study linger sequestered among other researches in cognitive approaches to language teaching perhaps for its exclusivity in terms of the nature of investigation. The absenctia of studies published in the particular domain is thus considered both a limitation of the study as these findings are unable locate within other researches in the focus, and the object as such gap of literature provides the reason for the present study. The study reached the conclusions drawn below from the findings of the study.

The survey data proved that learners are intrinsically aware of almost every level of the metacognitive behaviors and strategies in learning ESL while the witnesses on students’ congruity with self-tenable strategies establishes the higher metacognitive sense possessed by the sample. The diagnosis provided witnesses for the prevalence of strategies of highly metacognitive nature among learners with instances in which learners find themselves capable of metacognitive feelings and judgements with regard to the use of strategies of metacognitive nature.

The mapping of Portfolio of metacognitive traits of the learners serves as a cornerstone guideline for the ESL input planner to determine metacognitive components for the input calibrated for learner cognition.

The correlation analysis establishes that there exists links among planning, monitoring and control behaviors towards enabling metacognitive feelings and judgements. This correlation analysis achieves tenable evidences for the three conclusions arrived. The sample of learners concerned shows the proofs of prevalence of metacognitive strategies within their learner-self. Prevalent metacognitive strategies of learners manifest signs of learners’ ability to retain self-tenable strategy. The correlative nature among these strategies being positive admits that a vital relationship exists between the perception of right strategies and learners’ use of them.

The portfolio (of prevalent metacognitive knowledge and skills) provides the base for determining metacognitive strategy in the ESL input. The portfolio thus serves as the guideline or determiner of the dosage and the due level of emphasis relevant to the metacognitive strategy component of ESL input. The questionnaire aligned with taxonomy of metacognition proved to be of definite viability to deploy in the investigation of prevailing metacognitive skills among learners which will serve as a tool of ESL needs analysis.

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Dirge of the Fallen Woman in European Literature:
When Religion Turns Sour and Evil to Make the Innocent Female Soul Suppressed

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Abstract

This paper examines the portrayal of the fallen woman depicted in French and English literature with close reference to Denis Diderot’s *The Nun* (La Religieuse-1760-96) and Thomas Hardy’s *Tess of the D’Urbervilles* (1891). Denis Diderot’s *The Nun* is an excellent historical novel which endeavors to show the functioning of the European families during an era when the Catholic Church and Christian faith had ample power over the rhythm of life, family inheritances and marriage. It paints with great vivacity the cry of a young girl who had to enter into the cruel, inhuman world of religion against her will but with abnegation. Similarly, Thomas Hardy’s *Tess of the D’Urbervilles* depicts the downtrodden rights of the women in Victorian era and their distress occurred due to the society, family and the Catholic Church. Tess who is as the same age as of Suzanne in *The Nun* goes through a similar pain and distress and both of them break down under the weight of tough conditions in life. The church which is expected to be the cure, stands as a whammy in these young girls’ lives. The aim of this paper is to analyse the way the distrust of Roman Catholicism was depicted in 18th century French novel and in its 19th century English counterpart. What more, this study focuses on the influence of 18th century French literature over the 19th century English literature and how Denis Diderot’s portrayal of Catholic Church is reflected in Hardy’s *Tess of the D’Urbervilles*.

Key words: Church, English Literature, French Literature, Religion, Women

Introduction

Denis Diderot’s *The Nun* and Thomas Hardy’s *Tess of the D’Urbervilles* are clearly depict the social and religious injustice appeared in the 18th and 19th centuries. It was an era when women were suppressed by their family, society and religion. Being the weaker sex, at times, they had to obey the sexual and social differences and their fate was decided either by their family, society or by the religious institutions. In his novel, Denis Diderot reveals a universe little known to the general public, today as yesterday, which deserves a close look because there are hidden unsuspected human sufferings. Similarly, Thomas Hardy’s *Tess of the D’Urbervilles* reveals the plight of a young girl who was always oppressed by the poverty of her family, who never got the opportunity to educate herself and who was a victim of sexual violation and religion. This study analyses how Diderot and Hardy brought out social and religious “realism” to the world through their novels.

This research work contains a comparison between two major literary work of French and English Literature. The French novel *The Nun* and the English novel *Tess of the D’Urbervilles* belong to two different centuries. The question is how both these novels portray their main protagonists and depict the theme of religious injustice on fallen women. The intention is to seek whether these two novels contain any similarity or the former has influences on the latter.

In this discussion of the “Fallen Woman” and the religion’s influence on them, Subbamma’s famous book-let *Women: Tradition and Culture* is taken into account as it denotes the position of women in the society: “The woman has been relegated to the second place, oppressed by society and religion and dominated by man” [Subbamma, 1985]. The 18th century French society and Victorian society contained different social layers and women of each social layer had different positions. Shiman (1992) and Harvey (2003) describe that women of each social position had their own duties and responsibilities with some limited rights. Amelia Mason in *The women of the French Salons* [Mason, 1891] reveals how independent, educated and stubborn daughters of high and bourgeois French families were sent to convents for refuge and Diderot further adds that the illegitimate daughters were also sent to convents as refugees. Elizabeth Whitelegg in her oeuvre, “The Changing Experience of Women” further elaborates that women of lower class who had no means of support for living, had to go outside, earn their living and for then face social violence [Whitelegg, 1989]. Alexander Walker brings out the concept of “Natural Law” and he holds the idea that the reason behind this pathetic situation of women is that they are “little capable of reasoning, feeble and timid” and as a result, they “require protection” [Walker, 1840]. Both Diderot and Hardy make strong criticisms on church and religion and they marvelously portrayed their innocent and charming heroines. Goulbourne in his introduction to Denis Diderot’s *“The Nun”* states that “Diderot was no stranger in satirizing the nun’s and convents to aviaries” [Goulbourne, 2005]. In the credit of Hardy, Miles says: “A woman in Hardy’s
hands could be made to bear a weight of suffering whose inflictions transcend the personal and move through human to sublime; he never found the same true of a male character” [Miles, 1979]. Both Diderot and Hardy question the existence of religious institutions in the society as they offer nothing more than pain to womanhood.

**Methods**

The methodology used in this research is the qualitative method where the analysis is given the priority. This study seeks the similarities and the differences between two major literary works of the European literature. Therefore, “The Nun” by Denis Diderot and “Tess of the D’Urbervilles” by Thomas Hardy are used as the primary sources and as secondary sources, the criticisms and the commentaries of the critics, reviews and journal articles are referred. The major intention of this study is to provide an analysis on how the 18th century French novel and 19th century English novel together portrayed a social canker in that era and the influence of 18th century French literature over 19th century English literature. Therefore, the aforementioned two books have been thoroughly studied and the extracts which depict the agony of main two protagonists due to religious and social injustice have been selected for the analysis. These extracts reveal the point of view of the authors and how they reacted to the social issues of the eras they represent. The phenomenological approach is followed when analysing the data and the evidence which reveal the existence of religious institutions in the society, religion turns sour and evil to make the innocent female soul suppressed.

**Results and Discussion**

**Women in 18th century French society and 19th century Victorian society**

18th century French society and 19th century Victorian society had many similarities as well as many differences in many aspects. Both these periods are conspicuous in European history as they hold out the biggest historical transition ever. The period of 18th century marks an ample change in French society as well as in economy. A powerful wealthy class was born in France and this class started challenging the cultural and social monopoly of the aristocracy. The aristocratic and religious imperialism was largely threatened due to the expansion of new trades with French colonies and the French revolution which took place in 1789. The church hierarchy was facing a continuous battle as the Catholic Church was weakened by the high and low clergy conflicts and State and Jesuits conflicts.

The women were still considered the weaker sex and the society, religion and men had power over their lives. This sexual discrimination was not only apparent in European countries like England and France, but it was a pestering canker all over the world anon. For instance, women were acutely detested by most of the clergy in Mexico and they had least rights in the society. Mexican anthropologist, Fernando Benitez, remarks in his book, *Demons in the Convent*, that the Archbishop of Mexico, Francisco de Aguiar y Seijas (1680-1698) disgusted women extremely that they were not even allowed at the church or the convent at his presence [Benitez, 1998].

The French convents in 18th century were also similarly administered and most of the French women were banned into convents for variety of reasons. The noble and bourgeois families were never willing to provide a dowry for their illegitimate daughters as well as the daughters who could not marry off due to their too independent and defiant characters. Therefore, they were sent to convents as it would result positively in the matrimony of their other children. It is indeed an injustice but that was the maximum justice the parents could do for akin daughters. And the convents which are called “les couvents” in French were ready to provide welcome refuge to women who were not fortunate to experience the real essence of their youth. In the acclaimed monograph, *The women of the French Salons* (1891) Amelia Mason finely elaborates the plight of the 18th century women and their exploited rights. She remarks that the women who could not gain the matrimonial comfort ended up accommodating themselves at the convents: “The fashion of the period furnished a peaceful and dignified refuge for women, when their beauty waned and the “terrible forties” ended their illusions. To go into brief retreat for penitence and prayer was at all times a graceful thing to do, besides making for safety. It was only a step further to retire altogether from the scenes of pleasure which had begun to pall. The convent offered a haven of repose to the bruised heart, a fresh aim for drooping energies, a needed outlet for devouring emotions, and a comfortable sense of security, not only for this world, but for the next” [Mason, 1891].

Furthermore, the poor, lower class French women had no alternative except working hard to gain their living. Their lamentations were not apprehended by the religious and the governing hegemony of the society. The social violence had mounted to the peak that the people were awfully suppressed and in line of fire.

It is this history which grounded the novel “La Religieuse” - “The Nun” by Denis Diderot in 18th century. He harshly criticised and satirized the inhuman behavior of the Catholic Church and convents which were unable to provide any consolation to wounded human souls. These enlightened thoughts of universal equal rights for individuals, women and children were a powerful cause.
behind the French revolution (1789) and a large number of deprived women who suffocated due to social injustice also took part in the revolutionary crowds. The 19th century Victorian society was not much different from the 18th century French society though 19th century was the principle transitional period of England. The irony is that the period of 19th century was named in British Monarch Queen Victoria’s name but the women in Victorian era were not at least given their major rights and privileges. Victorian women had immense financial and sexual disadvantages. They were never considered equal with men and men had power over women and home. The reason for this inequality is that there were many religious restrictions on women and it was believed that men’s right to have power is “divinely ordered”. As Robert Filmer (1680) argued, “monarchy was a natural institution, to be traced back to the Biblical account of Eden, to the sovereignty over his family given to Adam” [Schochet, 1988]. According to this claim, men were considered to possess complete authority over women in the family. While some thinkers like Jean-Jacques Rousseau and Immanuel Kant justified this “natural law”, the writers like Denis Diderot and Thomas Hardy strongly rejected the gender inequality and “the intention of nature”. The term “intention of nature” was used in that era to mean that the women are physically weaker than men and this weakness leads to women’s eternal inferiority in the society. And the cause behind this severe sexual discrimination in the society was none other than the religious institutions themselves. The parody of this situation is “do people need a religion to create discrimination or to eradicate discrimination from the society?” Abominably, the majority of the social problems in the aforementioned European societies were created by the church and the affiliated religious institutions.

What more, the situation of women in the Victorian society differed according to their social class and status. The aristocratic women had more independence, freedom and power in the society than the middle class and lower class women. The upper-class women lived as “members of a collective household with many familial supports” [Shiman, 1992]. Marriage was the principle aim of the lives of aristocratic families and it was an alliance of powers for them. The Victorian middle class women were not allowed to work, as Harvey comments: “The Victorian middle class image of women were culturally controlled. They were denied political and economic power, and were expected to conform to the idea of separate spheres for men and women” [Harvey, 2003]. Lower class working women owned a pathetic life because of their lower standards of living and shortage of money. The members of the working class families were dependent on each other. Working class women were occupied in factories, mines, domestic service, garment industry and many other labour work to make a living. Likewise, they were constantly misused and sexually exploited by men. Thomas Hardy’s heroine Tess in Tess of the D’Urbervilles along with her poor familial condition is the most appropriate elaboration on the suffocation of the working class in the Victorian society. The poor working class women had no means of support to gain their living except making use of themselves. They had no right on education, power and higher social condition. Elizabeth Whitelegg in her oeuvre, “The Changing Experience of Women” (1989) also depicts that “the poor, the illiterate, the economically and politically powerless of the past operated according to values which fully justified the employment of women outside home” [Whitelegg, 1989].

The life conditions of both 18th century French women and 19th century Victorian women had so much in common and they all went through the same agony. There was no authority to speak in favor of them and women were an isolated ensemble in both societies. 19th century Victorian society was confronted by many changes due to the industrial revolution and it is a fact that the French revolution which took place in 18th century had ample influences on the industrializing Victorian society.

The “Fallen Women” in “The Nun” and “The Tess of the D’Urbervilles”

“Women”, who were perpetually labelled the “Weaker Sex” in 18th century French society and 19th century English society, were compelled to bear excessive pain, negligence and suffocation offered by the so-called “divine” society composed by religion and men. Women’s lives were most likely to get ruined if something unrighteous happened as all the social norms and laws were formed against them. All the more, “natural law” was against women and they had to surrender men under their physical power. A renowned Scottish physiologist and encyclopaedist of the time Alexander Walker (1779-1852) asserts his view regarding the physical differences between men and women, “It is evident that the man, possessing reasoning faculties, muscular power, and courage to employ it, is qualified for being a protector; the woman being little capable of reasoning, feeble and timid, requires protection” [Walker, 1840]. Under these circumstances, women were easily trapped and wrecked under the weight of constraining conditions of life. And these wrecked women are the “fallen women” whose dirge was always muffled and whose lives finally encountered a tragic doom.

In a period when no one came forth to speak in favor of French women, the eminent philosopher and encyclopaedist in 18th century, Denis Diderot disclosed his liberated views regarding the rights of women. Diderot wrote the French novel “La Religieuse” (1760) which was later translated into English as “The Nun” to unfold a real life experience of another young French woman who is called Marguerite Delamarre. The story of “The Nun” flows in the form of “memoirs” of a nun who has got escaped from a cloister. Her recollections re-
veal the darker side of the convent life in 18th century France. The central character of *The Nun* was Suzanne Simonin who was forced to enter the Catholic Convent by her mother because of her illegitimate birth. And the mother did not want Suzanne to share the heritage of her other daughters. Suzanne was obliged to pay off her mother’s sins by devoting herself for religious life which she never wished for. Her account of her first vow-taking reveals that she behaved like an automaton and her heart and the mind were not engaged in the religious act: “They did whatever they wanted with me throughout this morning, which has never been real to me, as I never knew how long it lasted. I have no idea what I did or what I said. I must have asked questions, and I must have replied and made my vows, but I have no memory in doing so” [Goulbourne, 2005]. Just like her other sisters and many other young girls in her acquaintance, she also wished a life full of marital happiness. In contrary to all her wishes and dreams, she gained nothing more than atrocious cruelty and hypocrisy from her destined religious life. The only amiable person she meets in her convent life was the Mother Superior of her very first convent; the Convent Sainte-Marie. When she asks Suzanne what she wants to be in her life, she answers “Everything, except a nun. I don’t want to be it and I will not be (…)” [Diderot, 1983]. Her acute dislike towards the religious life makes her run into any extend to gain liberation. Her Mother Superior made several efforts to make her accept what she was offered by the fate: “These words may surprise you: may God preserve you from ever finding out how true they are. Sister Suzanne, the good nun is the one who brings with her into the cloister some great sin to expiate” [Goulbourne, 2005]. Here, the question which strikes the reader is “Is Suzanne truly sinned?” She inherited an illegitimate birth from her mother and the sarcasm is that, instead of the mother, the society punishes Suzanne by snatching away her individual freedom. And it is a universal fact that, if there is someone in this world who could better comprehend the pain of a child, that’s is his/her mother. As for Suzanne, her mother expects her daughter to comprehend her pain and redeem her sins by sacrificing her whole life for religion: “don’t make your dying mother suffer; let her go to her grave in peace so that she may tell herself, as she’s about to appear before the judge of all things, that she has atoned for sin as far as she could, so that she can reassure herself that, after she is dead, you won’t make trouble for her family and you won’t lay claim to rights that aren’t yours” [Goulbourne, 2005]. These cruel words of twisted logic make the reader detest Suzanne’s mother for her inhumanity.

When Suzanne could not gain any relief from her family nor from her convent, she sued in the law courts to be released from her vows which was also dismissed for some unrelated and irrelevant reasons. Thus, she was imprisoned and treated like an animal when her second sadistic Mother Superior got to know about her intended law suit. In accordance with all these incidents depicted by Diderot, the reader perceives that “fallen women” like Suzanne were afflicted in every way. In the latter part of the novel, Diderot directs the readers’ attention towards another hidden aspect of the society, “same-sex intimacy”. Nevertheless, this novel is not an ambiguous attack on lesbianism but it contains a liberal vision of same sex desire. It is noteworthy that the third Mother Superior’s sexual climaxes were presented subtly and sympathetically in the novel though at a time Suzanne declares her dislike towards her third Mother Superior’s sexual interests: “Oh! Monsieur, you simply cannot begin to imagine how devious these Mothers Superior are!” [Diderot, 1983]. The circumstances were such that Suzanne could never made her mind to spend the rest of her life in the convent. Her prime aim was to acquire freedom.

Similarly, Thomas Hardy’s *Tess of the D’Urbervilles* depicts the image of “Fallen Woman” by portraying the main protagonist “Tess”. Like Denis Diderot, Thomas Hardy also looks sympathetically at the problems of women in his époque. Hardy’s remarkable heroine Tess’s character can be compared to that of Denis Diderot. Both Tess and Suzanne are naive young ladies. However, their social classes are different, both of them go through similar agony due to the social and religious injustice. Tess belongs to the lower working class family though in the very beginning of the novel Tess’s father boasts of his family name “Durbeyfield” stating that they are descendants of noble Durbeyfield bloodline. Ironically, this misleading information was given to him by the parson of their village church and belatedly, this backbiting leads to the misery of Tess’s innocent life.

Much the same Diderot’s Suzanne, Hardy’s Tess owns a tragic downfall in life because of her mother. After getting to know about the ancestry of their agnate “Durbeyfield”, she sends Tess to a hazard; to the hands of Alec D’Urberville. Independent, spirited Tess was destroyed by Alec and Tess blames her mother for being delinquent and not educating her of the possible dangers a young girl could encounter in life: “Why didn’t you tell me there was danger in menfolk’? Why didn’t you warn me? Ladies know what to fend hands against because they read novels that tell them of these tricks: but I never had the chance of learning in that way, and you didn’t help me [Hardy, 1994].

Tess gets sexually exploited by Alec and gives birth to an illegitimate son named “Sorrow”. Tess was not given permission to baptize her child despite her Christian upbringing. She recognizes the injustice of religion when the village parson told her that she cannot give her child a Christian burial. She had to do her son’s funeral rights by herself and even the burial site which was allocated for newborn was in the corner of the graveyard beside the graves of murders, thieves and other bad characters. Subbama in her note on oppressed women clarifies that: “Religion has condemned women to slavery from
birth onwards. Society has restricted the development of her personality. Man has suppressed her talents. It is a pity that we have not realized that it is not woman alone but entire humanity that will suffer on account of oppression of women” [Subbaamma, 1985].

All in all Tess’s love life, though she involved in a genuine romantic relationship with Angel Clare, he was not ready to accept her when she revealed him of her forced sexual violation. Angel Clare’s similar voluntary confession on his early relationship was forgiven by Tess but unfortunately at the very moment, when Tess made her confession, she was brutally rejected since he expected a “Pure Woman” in Tess: “You were more sinned against than sinning, that I admit I forgive you, but forgiveness is not all” [Hardy, 1994]. Hither, Hardy attacks the man and the social attitudes of the society he belonged to. Is it justifiable to call Tess sinned, when men had accumulated innumerable sins in their accounts? Hardy satirizes men’s conventional attitude towards women and double moral standards and cruel social laws. Angel could not bear Tess’s relationship with Alec because he considered Tess as the symbol of purity: “You were one person; now you are another . . . the woman I have been loving is not you” [Hardy, 1994]. He loved Tess for the woman he saw in her and not her moral qualities. Nevertheless, Tess loved Angel for his moral qualities she saw in him: “I thought, Angel, that you loved me-me, my very self? If it is I you do love, O how can it be that you look and speak so’? It frightens me! Having begun to love you, I love you for ever-in all changes, in all disgraces, because you are yourself. I ask no more. Then how can you, O my husband, stop loving me?” [Hardy, 1994].

Apart from being educated and civilized, Angle Clare is still captive to social conventions and customs. If a man and a woman involve in the same blunder, how can the society blames only the woman more sinned than the man? Who has created these stereotypes and double moral standards? Hardy blames none other than the social institutions and the religious establishments for the sufferings and miseries of women like Tess.

At the time of Diderot and Hardy, the religion projected the views of “natural law” to the general public and religious establishments involved in creating stereotypes according to their wills. Neither Diderot, nor Hardy blames Christianity at any point. They only criticized the harsh and cruel people attached to the religious establishments and their atrocious views which they wanted to establish as conventions and laws in the society. When looking at the protagonists and the instances created by Diderot and hardy, one could assume that Diderot’s work had made some influence on Hardy. Proving this idea further, Taylor’s book titled Hardy’s Poetry claims that Hardy used to read Diderot, “The most telling example is perhaps Diderot’s elaboration of the image in D’Alembert’s Dream, which Hardy would have known through his careful reading of Morley’s Diderot and the Encyclopaedists” [Taylor, 1989]. It is evident that Hardy did not copy Diderot but the circumstances around him and his society made him produce Tess of the D’Urbervilles which might have got nourished by his readings of Diderot. The major similarity between the two novels The Nun and Tess of the D’Urbervilles is that none of the heroines could gain bliss in their lives and their lives got doomed because of the same cause: Religion!

Conclusion

Both The Nun and Tess of the D’Urbervilles are powerful literary works of the European literature which depict the double standards of the society and religion. The religion which is supposed to be the relief for humans appear as a sour and evil establishment which leads to the misery. In this study, the attention is directed towards women who got fallen and suppressed because of the Catholic Church. Suzanne in The Nun and Tess in Tess of the D’Urbervilles spend a tragic life due to the social and religious oppression. This is not simply the story of Suzanne and Tess but the story of many other innocent girls who got victimized in the 18th century French society and 19th century Victorian Society. A woman’s life is her own to what extent she wants with it. The social and moral condemnation had no right to decide on her life. The social and political freedoms are her rights. This work of research would leave a thought to the readers of Asian and third world countries as the 21st century is not yet free from tragedies take place in women’s lives due to the power of social and religious authorities.

It is indisputable that both these novels contain some major similarities and it is feasible that Hardy had got inspired by Denis Diderot’s realistic literary approach. Denis Diderot offered the realistic novel “The Nun” to French literature at a time when French writers not much practiced the literary approach: “realism”. Thus, Hardy is considered the dominant figure of realistic English literature. Considering many of the similarities of both these literary oeuvres, we may assume that Diderot’s masterpiece made some influence on Hardy. Ostensibly, both Diderot and Hardy pursue the literary realism and hence it is evident that 18th century French novel has some influence on the 19th century Victorian novel.

References


URL:https://www.abebooks.com/servlet/BookDetailsPL?bi=19615055175&searchurl=tn%3Dla%2Breligieuse%26sortby%3D17%26an%3Ddenis%2Bdiderot&cm_sp=snippet_-_srp1_-_title4


Mason, A.R. (1891) The women of the French salons, New York: Century. URL:https://babel.hathitrust.org/cgi/pt?id=coo1.ark:/13960/t5t73014j


Drinking Water Quality on Chronic Kidney Disease of Unknown Aetiology (CKDu) in Ulagalla Cascade, Sri Lanka


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Abstract

Chronic Kidney Disease of unknown aetiology (CKDu) is one of the major health issues in Northern part of Sri Lanka that recorded highest mortality and morbidity rates. The main responsible reason for the CKDu has not yet been identified and hence many scientists have suggested number of certain risk factors where the CKDu-mfo (CKDu multi-factorial origin) term derived. However it relates with certain drinking water quality parameters strongly. This study was focused on evaluating the drinking water quality of Ulagalla cascade in Anuradhapura district with admixture to CKDu. Thirty wells and twenty tanks were selected as sampling locations for groundwater (GW) and surface water (SW) respectively from the cascade. Water quality parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, Sodium (Na+), Magnesium (Mg2+), Calcium (Ca2+), Potassium (K+), Arsenic (As2+), Lead (Pb2+), Cadmium (Cd2+), Ammonium Nitrogen (NH4+-N), Nitrate Nitrogen (NO3--N), alkalinity, Sulphate (SO42-), Chloride (Cl-) and Phosphate (PO43-) were analysed and observed parameters were compared with drinking water quality standards. In GW turbidity, Mg2+, Cd and As were not significantly different from the maximum permissible level (p>0.05) while SW has shown significant difference only for the turbidity (p<0.05). Both well and tank water samples from Thodamaduwa were polluted by Cd which exceeded the maximum permissible level standards. It was recorded as averages of 0.15, 0.13 and 0.019 ppb for 3 identified polluted wells in GW and 0.01ppb in tank water. Accordingly the study it can be suggested that cumulative levels of heavy metals (such as Cd) may be aggravating the CKDu in the Northern Central Parts in Sri Lanka.

Key words: Chronic Kidney Disease of unknown aetiology, Surface water, Ground water, Drinking water quality, Drinking water quality standards

Introduction

The dry zone of Sri Lanka is well-known as the cradle of island’s hydraulic civilization with the foremost kingdom, Anuradhapura. The adjustable environmental conditions with land availability in dry zone have become the key reasons to this agricultural extent throughout the area. Average annual rainfall in the dry zone is generally 1000mm mostly from October to December and has a dry period from late May to September [Burt & Weerasinghe, 2014]. The tank cascade system (TCS) is the most advanced water conveyance mechanism developed to overcome water scarcity problems in dry zone from the ancient irrigation history [Mahatantila et al., 2008]. Water in tanks is generally used for agricultural and domestic purposes including drinking [Jayawardena, 2015]. As TCS is a connected series of tanks organized within a micro catchment, the head water tank is principally nurtured from rainfall and river conversion while the irrigation channels distributing water through downstream [Bandara, 1985]. Tail end tank of TCS may significantly polluted as a result of intensive application of agrochemicals in paddy fields that were not evident in ancient time [Kumari et al., 2013]. As a result of polluted water intake, there is some health concerns reported from the people inhabited in the dry zone.

With reporting huge number of patients with a diseased kidney due to non-recognized reasons and by extending that statistic drastically during past two decades, the dry zone gained more advertisement of government, public and private and academic organizations. It is been suggested that CKDu can be oriented through very long agricultural history of the dry zone as it is very common farmers or agricultural labourers.

Chronic Kidney Disease of unknown aetiology (CKDu) is one of the greatest problem in north central province (NCP) which recorded highest mortality and morbidity rates and recognized reasons were unknown [Ratnayake et al., 2012, Noble et al., 2014]. CKDu is very aggressive disease with absence of certain responsible causes and very common among men (proportion of male: female is 3:1) who are in approximately the age of 40-60 years, and most of them are farmers or agricultural labourers. Dialysis or kidney transplant are the only medical solutions for this disease. The cost of dialysis of CKDu patients has become a severe problem on the government health authorities [Chandrajith et al., 2011a]. Consequently, nearly 80% of these patients ultimately die from kidney failure within the first two years [Misra & Saxena, 2012].

During last two decades, mortality and morbidity rates have been increasing progressively, due to kid-
### Table 1: WHO (fourth edition) and SLS standards for drinking water

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum permissible level</th>
<th>WHO (Fourth edition 2011)</th>
<th>Maximum permissible level</th>
<th>SLS (614: 2013)</th>
<th>Maximum permissible level</th>
<th>Accepted</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5 - 8.5</td>
<td>6.5 - 8.5</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Electrical Conductivity (µS/cm)</td>
<td>-</td>
<td>-</td>
<td>1500*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Dissolved solids (mg/L)</td>
<td>600</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbidity NTU</td>
<td>-</td>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity (mg/L)</td>
<td>500</td>
<td>200</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (mg/L)</td>
<td>100**</td>
<td>100</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium (mg/L)</td>
<td>30</td>
<td>30</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium (mg/L)</td>
<td>200</td>
<td>200</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride (mg/L)</td>
<td>250</td>
<td>250</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorus (mg/L)</td>
<td>5</td>
<td>2</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrate Nitrogen (mg/L)</td>
<td>50</td>
<td>50</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonium Nitrogen (mg/L)</td>
<td>0.5</td>
<td>0.2</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphate (mg/L)</td>
<td>250</td>
<td>250</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic (mg/L)</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium (mg/L)</td>
<td>0.003</td>
<td>0.003</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead (mg/L)</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*EC is not interpreted for drinking water in WHO or SLS standards. Hence the study used the standard value from [http://www.google.lk/url?sa=t&source=web&cd=10&ved=0ahUKEwiqn9Xy-bTbAhVJhbwKHRIOCpoQFggkMAE&usg=AOvVaw3GBXHTkDWpYNh3HeDHlxt](http://www.google.lk/url?sa=t&source=web&cd=10&ved=0ahUKEwiqn9Xy-bTbAhVJhbwKHRIOCpoQFggkMAE&usg=AOvVaw3GBXHTkDWpYNh3HeDHlxt)

** Interpreted as Hardness of water in WHO fourth edition.

*EC is not interpreted for drinking water in WHO or SLS standards. Hence the study used the standard value from [http://www.google.lk/url?sa=t&source=web&cd=10&ved=0ahUKEwiqn9Xy-bTbAhVJhbwKHRIOCpoQFggkMAE&usg=AOvVaw3GBXHTkDWpYNh3HeDHlxt](http://www.google.lk/url?sa=t&source=web&cd=10&ved=0ahUKEwiqn9Xy-bTbAhVJhbwKHRIOCpoQFggkMAE&usg=AOvVaw3GBXHTkDWpYNh3HeDHlxt)

** Interpreted as Hardness of water in WHO fourth edition.

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**Figure 1:** Prevalence of CKDu in Dry zone (1A: Regions where recorded patients with CKDu, 1B: Traditional hotspots and the spreading of CKDu with time.)
Table 2: Sampling locations for SW

<table>
<thead>
<tr>
<th>Tank No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Thodamaduwa</td>
</tr>
<tr>
<td>T2a</td>
<td>Ulagalla</td>
</tr>
<tr>
<td>T2b</td>
<td>Ulagallamahawewa</td>
</tr>
<tr>
<td>T3</td>
<td>Manakkulama</td>
</tr>
<tr>
<td>T4</td>
<td>Wagayakulama</td>
</tr>
<tr>
<td>T5</td>
<td>Karabayagama</td>
</tr>
<tr>
<td>T6</td>
<td>Pudukkulama</td>
</tr>
<tr>
<td>T7</td>
<td>Diwulwewa</td>
</tr>
<tr>
<td>T8</td>
<td>Periyakulama</td>
</tr>
<tr>
<td>T9</td>
<td>Athiniwetumuwewa</td>
</tr>
<tr>
<td>T10</td>
<td>Ulankulama</td>
</tr>
<tr>
<td>T11</td>
<td>Itikattiya</td>
</tr>
<tr>
<td>T12</td>
<td>Ihalawewa</td>
</tr>
<tr>
<td>T13</td>
<td>Kudaitikattiya</td>
</tr>
<tr>
<td>T14</td>
<td>Maradankadawala</td>
</tr>
<tr>
<td>T15</td>
<td>Halmillewa</td>
</tr>
<tr>
<td>T16</td>
<td>Settikulama</td>
</tr>
<tr>
<td>T17</td>
<td>Heemukgama</td>
</tr>
<tr>
<td>T18</td>
<td>Galwiharawewa</td>
</tr>
<tr>
<td>T19</td>
<td>Pahalawewa</td>
</tr>
</tbody>
</table>

Table 2: Sampling locations for SW

Dry zone has been reported highest prevalence rates in North Central Province, Eastern Province and Uva province. When counting on the reasonable causes for CKDu, several studies have proven that there should be a profound relationship between drinking water quality and CKDu [Wanigasuriya, 2012, Chandrajith et al., 2011a]. People from dry zone mainly acquire water from tanks and dug wells for agricultural purposes for their domestic and agriculture purposes. Ulagalla is a small cascade that extended in Maradankadawala and Thirappane areas with 20 small tanks and 1100 farming families. They are acquiring drinking water from tanks/reservoirs (1%), shallow dug wells (92%) mostly as well as tube wells (7%) in some circumstances [Jayaselara et al., 2013]. The population is vulnerable to unknown diseases as the area is being used for agricultural practices with heavy use of agrochemicals and fertilizer which is being transporting through those water resources for hundred years. So the water quality should be checked for the potential of CKDu of that area.

Ulagalla cascade is one of the prominent cascades in Anuradhapura district with twenty small tanks highly utilizing for agricultural purposes and still no any study has been conducted to evaluate water quality in the cascade with relevant to CKDu. Hence the present study has been conducted to characterize the surface water (SW) and ground water (GW) quality with CKDu in mentioned cascade. The aim of the study was to evaluate the GW and SW quality parameters and its subsequent comparison with World Health Organization, [WHO, 2011] and Sri Lankan Standards for potable water (SLS 614, 1983) related to CKDu in “Ulagalla Cascade” in Anuradhapura district, North Central Province, Sri Lanka.

Even if numerous studies have been conducted in Sri Lanka, the main responsible reason for CKDu is not yet identified. Hence many of the scientists and researchers have suggested number of certain risk factors where the CKDu-mfo (CKDu multi factorial 3 origin) term derived. CKDu-mfo described combination of two or more of risk factors and its synergistic effect could be accountable for CKDu [Wimalawansa, 2015].

Kidney disease with recognized causes are absent is named ‘Chronic Kidney Disease of Unknown aetiology’ (CKDu) and believing it is due to two or more factors, CKDunfo term is being using for this disease. Especially the areas such as Medawachchiya, Padaviya, Kebitigolawa, Medirigiriya (North Central Province), Nilawewa (North Western Province), Dehiatalkandiya (Eastern Province) and Giradurukotte (Uva Province) were highlighted as threatened areas [De Silva et al., 2011]. Among two districts of NCP (Anuradhapura and Polonnaruwa) Anuradhapura has affected more and the disease is on the increase [Abeygun. & Wick., 2014]. In 2012 the number of patients has further increased to 8000 [WHO, 2012]. In Anuradhapura District alone 18,000 cases of CKDu were reported with over 200 deaths recorded annually [Abeygun. & Wick., 2014]. For Anuradhapura, Polonnaruwa and the whole country in 2007, CKD had been the 1st, 2nd and 9th leading cause of death respectively [Fernando, 2011].

Figure 1 shows the prevalence of CKDu in Dry zone area, regions with highest number of patients and newly recognized hotspots of that critical issue. The affected area covers around 17,000 km² and with a population of near 2.5 million in which over 95% live in rural areas [Wimalawansa, 2014].

Several risk factors were suggested during the last decade, to assume the occurrence and aetiology of the CKDu in the NCP [Wanigasuriya, 2012], but origin of the disease is still in problem and in the search [Gunatilake et al., 2014]. Causes such as overuse of pain killers, use of cheap aluminium cookware, habit of illegal drugs and alcohol, leptospirosis, smoking, petrochemical contamination, unsafe working conditions, longterm consumption of contaminated water and food, genetic susceptibility, lack of safety measures when using agrochemicals, Ayurveda medicines, and previous inci-
Table 3: Monitored water quality parameters and methods of analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method of analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH and Electrical Conductivity (EC)</td>
<td>Multi parameter analyser (HACH HQ40d)</td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td>Multi parameter analyser (EUTECH PCD650)</td>
</tr>
<tr>
<td>Na⁺, K⁺, Mg²⁺, Ca²⁺, Pb²⁺, Cd²⁺</td>
<td>ICP-OES(Thermo ICAP 7400)</td>
</tr>
<tr>
<td>Ammonium nitrogen</td>
<td>4500NH F phenate method(APHA 1998)</td>
</tr>
<tr>
<td>Nitrate nitrogen</td>
<td>Salicylic acid method(APHA 1998)</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>Acid base titration(APHA 1998)</td>
</tr>
<tr>
<td>Phosphate</td>
<td>Ascorbic acid method (APHA 1998)</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Turbid meter (EUTECH TN-100)</td>
</tr>
</tbody>
</table>

Dentists of snake bites were reported [Wanigasuriya, 2012, Wimalawansa, 2014]. Harmful agricultural practises, including excessive and indiscriminate use of toxic agrochemicals (fertilizers, pesticides, and weedicides), lack of safety measures when using agrochemicals, intake of contaminated water from paddy fields and from contaminated ground water wells, have led to the increase of this widespread disease in NCP [Wimalawansa, 2014, Chandrajith et al., 2011a, Chandrajith et al., 2011b, Daily mirror, 2013]. Regardless of this deadly disease, many farmers in NCP practised to use excessive amounts of agrochemicals long term to get higher yields [Wimalawansa, 2014]. Harshness or high amount of fluoride in water, use of cheap aluminium cookware, ionicity in drinking water are suggested as multi factorial causes for this disease [Kumari et al., 2016]. Among these factors drinking water related factors were discussed and argued by literature.

Drinking water quality parameters are apparently related with the occurrence of the CKDu [Kumari et al., 2016, Abeygun. & Wick., 2014]. Most of the agrochemicals (weedicides, insecticides, and fungicides) contain very high concentrations of Cadmium (Cd²⁺), Arsenic (As³⁺) and other heavy metallic substances [Keil, 2011, Illeperuma, 2000]. Through the studied which have been conducted in dry zone, Sri Lanka, Cd²⁺ and As³⁺ were supposed as risk factors for CKDu [Mendis, 2011]. Drinking water and rice contaminated with As³⁺ has been identified as the key motives for CKDu and through the theory, As³⁺ is being bio-accumulating in human bodies [Dharmawardana et al., 2015]. Water hardness plays a great role to support heavy metals by cation exchange capacity while fertilizer runoff has increased the ionicity of ground water (Wanigasuriya, 2012). Toxins ingested from food and water, direct absorption of toxins due to uncaring management of agrochemicals, extended exposure to toxins and pollutants from drinking water are assumed as most reasonable risk factors [Dharmawardana et al., 2015].

The quality of drinking water is powerful environmental factor that determine the health of human. Therefore, the WHO and various national agencies have introduced drinking water quality standards that specify the permissible chemical, microbial and radiological characteristics of safe water (Table 1). Major drinking water sources of NCP people are 92% shallow dug wells, 7% tube wells, 1% reservoirs [Jayasekara et al., 2013]. Most of the tested drinking water quality parameters are higher than the WHO recommended levels in NCP. However, within the NCP, small compartments of CKDu non-prevalence sectors also exists [Wanigasuriya, 2012].

![Study Area-Ulagalla cascade](image)

Methods

Ulagalla cascade is a prominent cascade located in Anuradhapura district with twenty small tanks and highly utilizing for agricultural purposes [Kumudumali et al., 2016]. It is located in DL1b agroecological region (Dry zone Low country) of Sri Lanka. Total number of farm families living in the study area was approximately 1100 and the total land area is about
25km². Maradankadawala and Thirappane (figure 2), areas of Ulagalla cascade were selected for the sampling locations for both GW and SW.

Water samples were collected from all the 20 tanks (Table 2) for SW (T) and randomly selected 30 GW wells (Figure 3) for ground water (U) in Ulagalla cascade in Anuradhapura.

The total area of the cascade was divided into 1 km² grids and one well to represent each grid was purposely selected from above mentioned villages to evaluate the quality of GW (thirty wells located in uplands). Availability of GW was assessed by measuring the depth to GW and the depth of well from the surface during three months of period.

The water samples were transferred into 250 mL clean polyethylene bottles after rinsing three times with the water to be sampled and labelled. Two water samples were collected from each sampling points once a month during three months (July, August and September). These bottles were tightly closed, labelled and transported to the Laboratory of soil and water science, Department of Agricultural Engineering and Soil Science, Faculty of Agriculture, Rajarata University of Sri Lanka. All the samples were stored below 4C temperature in a refrigerator.

All the water samples were filtered by using number 01 Whatman filter papers for further chemical analysis to evaluate all the cations, anions and heavy metals. Samples were stored below 40C and Table 3 shows the analysis methods for selected water quality parameters.

Geographical Information System (GIS) has been used for the study as a tool for storing, analysing and displaying spatial data. Once the input data was imported as a point layer into ArcGIS 10.1, geo-database was created to generate the maps of spatial distribution of selected ground water quality parameters. Interpolation is the process of predicting unknown values using the known values in the vicinity. Point based Inverse Distance Weighted (IDW) interpolation method was used to produce spatial distribution of GW quality variables. GIS is helpful to developing solutions for water resources problems for assessing water quality, determining water availability, preventing flooding, understanding the natural environment and mapping water resources on local or regional scale [Ferry et al., 2003].

To evaluate measured drinking water quality parameters of GW and SW t test (one sample t test and two sample t test) was performed by using Minitab statistical software package.

Results and Discussion

Water quality parameters have been tested for both GW and SW in the Ulagalla cascade and recorded in Table 4. Obtained results had been comparatively discussed with the results obtained from previous studies to the dry zone by analysing same parameters in Kumari et al. (2016) and Chandarjith et al. (2011b). pH in GW has varied between the range of pH 6.7-8.7 and in the SW it was 5.8-8.2. When compared with the drinking water quality guideline values [SLS 614, 2013, WHO, 2011] 96.66% of GW wells and all the SW bodies (100%) were below the maximum permissible level, yet suitable for drinking purpose. Significant difference from one sample t test was observed for GW and SW (p<0.05).

Electrical Conductivity (EC) in drinking water is related to the presence of water salinity and ion (both cations and anions) content. Water hardness can be the reason for highest EC in water. EC in GW has varied from 427.10 µS/cm to 2590.67 µS/cm and EC of SW has varied from 94.25 µS/cm to 806.33 µS/cm in Ulagalla cascade. Based on world accepted standards for EC, 16.66% of GW wells and none of SW tanks were exceeded the maximum permissible level, then not suitable for drinking purpose. Obtained p values for one sample t-test of the recorded p value and SLS standards were 0 for both GW and SW. Kumari et al. (2016) reported the highest average EC values of GW in CKDu non prevalent areas. According to the Kumari et al. (2016) EC in GW were varied from 131.4pS/cm to 556 µS/cm in dry zone. Their maximum EC value of GW was below than the maximum EC value of GW in Ulagalla cascade. Chandarjith et al. (2011b) were documented highest average GW EC value as 3400 µS/cm thus, that value was comparatively higher than the average GW EC of Ulagalla cascade. According to the Kumari et al. (2016) average EC of SW was varied from 96.2 µS/cm to 299.0 µS/cm.

Water has the ability to dissolve a wide range of in-
### Table 4: Recorded values for each parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Observed values (GW)</th>
<th>Observed values (SW)</th>
<th>Maximum permissible level (MPL) for drinking water (WHO, 4th edition)</th>
<th>MPL for drinking water (SLS 614:2013)</th>
<th>Wells that recorded as not suitable for use</th>
<th>Tanks that recorded as not suitable for use</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO$_4^{2-}$</td>
<td>1.3370</td>
<td>116</td>
<td>250</td>
<td>250</td>
<td>All wells were below the MPL (Highest U13)</td>
<td>All tanks were below the MPL (Highest T3)</td>
</tr>
<tr>
<td>As$^{3+}$</td>
<td>0.030.44</td>
<td>0.020.19</td>
<td>10</td>
<td>10</td>
<td>All wells were below the MPL (Highest U1)</td>
<td>All tanks were below the MPL (Highest T12)</td>
</tr>
<tr>
<td>Pb$^{2+}$</td>
<td>1.768.85</td>
<td>0.592.8</td>
<td>10</td>
<td>10</td>
<td>All wells were below the MPL (Highest U13)</td>
<td>All tanks were below the MPL (Highest T5)</td>
</tr>
<tr>
<td>Cd$^{2+}$</td>
<td>U180.15; U190.13; U200.01</td>
<td>T10.01</td>
<td>3</td>
<td>3</td>
<td>All wells were below the MPL, however U18, U19 &amp; U20 have reported Cd</td>
<td>All tanks were below the MPL, however T1 has reported Cd</td>
</tr>
<tr>
<td>PO$_4^{3-}$</td>
<td>0.181.05</td>
<td>0.080.18</td>
<td>5</td>
<td>2</td>
<td>All wells were below the MPL</td>
<td>All tanks were below the MPL</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>33.33162.5</td>
<td>10.4270.83</td>
<td>200</td>
<td>200</td>
<td>All wells were below the MPL</td>
<td>All tanks were below the MPL</td>
</tr>
<tr>
<td>NO$_3^{-}$</td>
<td>0.078.35</td>
<td>0.121.97</td>
<td>10</td>
<td>50</td>
<td>All wells were below the MPL (Highest U17)</td>
<td>All tanks were below the MPL (Highest T19)</td>
</tr>
<tr>
<td>NH$_4^{+}$</td>
<td>0.070.13</td>
<td>0.070.24</td>
<td>0.5</td>
<td>0.2</td>
<td>All wells were below the MPL (Highest U6)</td>
<td>All tanks were below the MPL (Highest T19)</td>
</tr>
</tbody>
</table>
organic and some organic minerals or salts such as K\(^+\), Ca\(^{2+}\), Na\(^+\), HCO\(_3\)^-, Cl\(^-\), Mg\(^{2+}\), SO\(_4^{2-}\) etc. These minerals produced undesirable taste and diluted colour in the appearance of water. In Ulagalla cascade average TDS values of GW was varied from 111.43 mg/L to 1718.33 mg/L. According to the drinking water stan-
standards, 43.33% wells were exceeding the MPL while 60% of wells including U10 (highest), U1, U6, U13 and U22 exceeding MPL for SLS standards. According to the Kumari et al. (2016) from a different previous study for same catchment, TDS in GW was varied from 65.9 mg/L to 311 mg/L and average TDS in SW was varied from 40.2 mg/L to 141.53 mg/L. The maximum TDS values reported in Kumari et al. (2016) were below than the maximum TDS values of our study for GW and SW in Ulagalla cascade. According to their study all the sampling locations were below the safe limit thus, suitable for drinking purpose. Therefore, these results were not accordance with the present results from our study for Ulagalla cascade. In Ulagalla cascade significant difference (GWp=0.026 and SWp=0) has observed between GW and SW (p<0.05).

Turbidity is the relative clarity of the water that reduces the transmission of light. Turbidity of GW in Ulagalla cascade was varied from 0.92 NTU to 20.85 NTU and in the SW it was varied from 1.62 NTU to 313.19 NTU (p for GW=0.305 and p for SW=0.063 for SLS standards, 2 NTU). According to the SLS drinking water quality guideline value 50% of GW locations and 95% of SW tanks were exceeded the maximum turbidity level. Based on world acceptable laboratory guideline values 26.67% of GW locations and 53.33% of SW tanks were exceeded the maximum permissible turbidity level. Thus, doubtful for drinking purpose. Significant difference was not observed between GW and SW.

In Ulagalla cascade, observed Na\(^+\) concentration was varied from 16.42 mg/L to 221.41 mg/L in GW and from 7.51 mg/L to 81.54 mg/L in SW. Based on the WHO and SLS guideline values 13.33% of GW locations were exceeded maximum permissible Na\(^+\) value while all the SW locations were below the safe limit. In Ulagalla cascade highest average Na\(^+\) concentration was noted in GW while lowest average Na\(^+\) concentration has recorded in SW. There was a significant difference between standards and observed values of GW and SW (p<0.05) as p for GW=0 and p for SW= 0). According to the Kumari et al. (2016) average Na\(^+\) concentration in GW was varied from 11.39 mg/L to 38.18 mg/L. Highest Na\(^+\) concentration value of their study was almost less than the average Na\(^+\) concentration in Ulagalla cascade. Thus this result was not accordance with Kumari et al. (2016). Chandrajith et al. (2011b) has been reported 1910 mg/L in their study. It was almost higher than the average Na\(^+\) concentration of GW in Ulagalla cascade. According to the Kumari et al. (2016) average Na\(^+\) concentration in SW was varied from 10.54 mg/L to 27.85 mg/L in their study. It is almost lower than the average Na\(^+\) concentration in SW of Ulagalla cascade.

Ca ions (along with Mg ions) create the hardness of water, though no health-based guideline standards are interpreted for drinking water. However, the public acceptance for hardness is 100-300 mg/L and generally accepted as 100 mg/L by considering other dependable factors such as pH and alkalinity [WHO, 2011]. The Ca\(^{2+}\) concentration in GW of Ulagalla cascade was varied from 12.27 mg/L to 120.76 mg/L (average= 50.49 mg/L) and in SW Ca\(^{2+}\) concentration was varied from 8.86 mg/L to 41.25 mg/L (average= 25.68 mg/L). According to SLS guideline value, 10% of GW locations and based on the WHO guideline, 13.34% of GW locations were exceeded the maximum permissible levels respectively (p for GW= 0 and p for SW= 0). There was a significant difference between GW and SW (p<0.05). According to the Kumari et al. (2016) Ca\(^{2+}\) concentration in GW of their study was varied from 10.3 mg/L to 30.54 mg/L. That value was lower than the observed values in Ulagalla cascade. In addition, they have recorded high Ca\(^{2+}\) concentration in the GW of CKDu non prevalent areas. Based on the both SLS and WHO guideline value, all the SW bodies were below the maximum permissible Ca\(^{2+}\) concentration level hence, suitable for drinking purpose. According to the Kumari et al. (2016) Ca\(^{2+}\) concentrations was varied from 9.12 mg/L to 30.79 mg/L. Maximum average Ca\(^{2+}\) a concentration of their study was lower than the maximum average Ca\(^{2+}\) concentration value of Ulagalla cascade.

Mg\(^{2+}\) concentration in GW of Ulagalla cascade was varied from 2.9 mg/L to 110.05 mg/L. Based on the observed values 33.33% of GW were exceeded the WHO and SLS maximum permissible levels (p for GW=0.468 and p for SW= 0). According to the Kumari et al. (2016) Mg\(^{2+}\) concentration in GW locations of their study was varied from 2.63 mg/L to 23.43 mg/L. These values were lower than the maximum Mg\(^{2+}\) concentration value of Ulagalla cascade. Furthermore, Chandrajith et al. (2011b) has recorded average Mg\(^{2+}\) concentration in GW of their study as 1280 mg/L and it was very higher than the Ulagalla cascade value. In the SW of Ulagalla cascade Mg\(^{2+}\) concentration was varied from 1.39 mg/L to 23.55 mg/L. Based on the SLS and WHO guideline values all the sources were below than the maximum level hence all were suitable for drinking. According to Kumari et al. (2016), Mg\(^{2+}\) concentration in GW locations of their study was varied from 2.95 mg/L to 14.98 mg/L. These values were lower than the maximum Mg\(^{2+}\) concentration value of Ulagalla cascade.

Cl\(^-\) concentration in GW of Ulagalla cascade was varied from 50 mg/L to 1176.67 mg/L. Based on the guideline values 33.33% of GW locations were exceeded safe limit. According to the Kumari et al. (2016) Cl\(^-\) concentration in GW of their study was varied from 15 mg/L to 53.33 mg/L. These values were lower than the highest Cl\(^-\) concentration value in GW of Ulagalla cascade (p for GW= 0.411 and p for SW= 0). Also Chandrajith et al. (2011b) were recorded the average Cl\(^-\) concentration in GW of their study was 688 mg/L. Cl\(^-\) concentration in SW was varied from 20 mg/L to 280 mg/L. 5% of SW locations were exceeded the safe limit. Kumari et al. (2016) have reported the Cl\(^-\) concentration in SW was varied from 13.33 mg/L to 25.0 mg/L respectively.
These values were almost lower than the average Cl⁻ concentration values of Ulagalla cascade. There was a significant difference between GW and SW (p<0.05).

SO₄²⁻-concentration in GW of Ulagalla cascade was varied from 1.33mg/L to 70mg/L and SO₄²⁻-concentration in SW of Ulagalla cascade was varied from 1mg/L to 16mg/L (p for GW=0 and p for SW=0). In Ulagalla cascade PO₄³⁻- concentration in GW was varied from 0.18 mg/L to 1.05 mg/L and PO₄³⁻-concentration in GW was varied from 0.08 mg/L to 0.18 mg/L. There was a significant difference between standards and observed values of GW and SW (p<0.05) as p for GW was 0 and p value for SW was 0. Alkalinity in GW was varied from 33.33 mg/L to 162.5mg/L, while the average alkalinity in SW was varied from 10.42 mg/L to 70.83 mg/L (p for GW= 0 and p for SW=0). Based both guideline values, all the GW locations and SW bodies were below the maximum permissible levels of SO₄²⁻, PO₄³⁻ and alkalinity. There was a significant difference between GW and SW (p<0.05) for SO₄²⁻, PO₄³⁻ and alkalinity respectively.

Observed NH₄⁺-N concentration in GW was varied from 0.07 mg/L and 0.13 mg/L and in the SW it was varied from 0.07 mg/L to 0.24 mg/L (p for GW= 0 and p for SW=0) in the Ulagalla cascade while the average NO₃⁻-N concentrations of GW was varied from 0.07 mg/L to 8.35 mg/L and average NO₃⁻-N concentrations of SW was varied from 0.12 mg/L to 1.97 mg/L (p for GW= 0 and p for SW=0). Based on the WHO and SLS guideline values all the GW locations and SW bodies were below the maximum permissible levels of NH₄⁺-N and NO₃⁻-N.

Pb²⁺-concentration in GW of Ulagalla cascade was varied from 1.76 µg/L and 8.85 µg/L and Pb²⁺-concentration in SW of Ulagalla cascade was varied from 0.59 µg/L and 2.80 µg/L (p for GW= 0 and p for SW=0). All the GW and SW locations were below the maximum permissible levels of SLS and WHO drinking water quality guideline values. Chandrathith et al. (2011a) have observed 0.957 µg/L of average Pb concentration in their study. Pb²⁺-concentrations in Ulagalla cascade were higher than that literatures results. Surface and groundwater contamination by Pb²⁺ can be happened due to excessive use of agrochemicals [Katz et al., 1999]. In some fertilizers and weedicides that have been using in agriculture, reported maximum dangerous levels of Cd²⁺, As³⁺ and Pb²⁺. Ulagalla cascade area is a highly agriculture area and ensured for using those agrochemicals for higher harvest. In addition, it is important to mention that As and Cd excretion in urine were significantly higher in healthy people living in the CKDu endemic area however, Pb²⁺ was significantly lower [WHO, 2012]. However, it can concentrate in human tissues and bones through bio-accumulation.

In Ulagalla cascade Cd²⁺ has detected in three wells (U18, U19 and U20) and one SW tank T1 (Thodamaduwa). Cd²⁺ concentrations of these water bodies were 0.15 µg/L, 0.13 µg/L and 0.01 µg/L in U18, U19 and U20 respectively. In T1 tank average Cd²⁺ concentration was 0.01 µg/L. All these observed values were below the maximum permissible guideline values. One sample t test results were given as p value for GW was 0.285 and p value for SW was 0.

As³⁺ concentration in GW in Ulagalla cascade was varied from 0.03 µg/L and 0.44 µg/L and As³⁺ concentration in GW and SW in Ulagalla cascade was varied from 0.02 µg/L and 0.19 µg/L (p for GW= 0 and p for SW=0). All the sources were below the maximum permissible level of SLS and WHO drinking water quality guidelines. There was no significant difference of the As³⁺ concentration between GW and SW. Long term ingestion of arsenic contaminated drinking water may effect to peripheral vascular diseases and to peripheral nervous system (Gunathilake et al. 2014). Jayasumana et al. (2011) has strongly argued that As³⁺ in pesticides can be combined with the hardness in water to form the calcium arsenate and when calcium arsenate transported to kidneys, it can cause severe kidney damages. Wasana et al. (2016) have suggested total As³⁺ in water cannot be considered as the causative factor for the incidence of CKDu though they have observed As levels below the maximum permissible levels of SLS and WHO guidelines.

Observed measurements were graphically analysed by using ArcGIS and the GIS maps were prepared for spatial distribution of water quality parameters. Figure 4 will represent those GIS maps for each parameter throughout the area.

References


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Effect of Integrated Nutrient Management on Green Pod Yield of Chilli

(Capsicum annuum L.) cv MIPC-01

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Abstract

A field experiment was conducted to study the effect of combined application of organic manures with recommended inorganic fertilizers (RIF) and to find out the best combination of applications on green pod yield of chilli cv. MIPC-01 (Mahailluppallama Kahudawali Selection). The following five treatment combinations viz. T1- No fertilizer (control plot), T2- 100% RIF, T3- 50% RIF + 15 t ha⁻¹ cattle manure, T4- 50% RIF + 15 t ha⁻¹ cattle manure + 250 kg ha⁻¹ partially burnt paddy husk, T5- 50% RIF + 15 t ha⁻¹ cattle manure + 500 kg ha⁻¹ partially burnt paddy husk were laid out in a Randomised Completely Block Design and replicated four times. The measurements related to growth and yield parameters were taken using destructive random sampling method. The results revealed that among the tested fertilizer combinations, there were significant differences (p<0.05) in plant height, root length, number of flowers, average numbers of pod per plant and pod length compared to the control treatment. The application of 50% RIF, 15 t ha⁻¹ cattle manure along with 500 kg ha⁻¹ partially burnt paddy husk produced higher number of pods per plant (10.50 and 24.50) and average pod weight per plant (40.42 g and 90.16 g) over the control treatment at 120 and 150 DAT (days after transplanting) respectively. It is concluded that application of 50% RIF with 15 t ha⁻¹ cattle manure and 500 kg ha⁻¹ partially burnt paddy husk is the best combination to obtain higher green pod yield of chilli.

Key words: Cattle manure, chilli, green pod yield, inorganic fertilizer, partially burnt paddy husk

Introduction

During the past few decades, intensive farming has been practiced to increase crop yield per unit area. Excessive amounts of inorganic fertilizers are generally applied to vegetable crops to obtain higher yield. Continuous cultivation of soil using inorganic fertilizers has been implicated in reduction of soil organic carbon and organic matter, nutrient imbalance, deficiency of secondary macronutrients and micronutrients [Osundare, 2004]. Therefore, the use of organic manures is beneficial to the soil in terms of alleviating soil acidity, enhancement of soil physical properties and nutrient status [Ano & Agwu, 2005]. Conversely, the application of organic manures only cannot fulfill the requirement of crop nutrients. Integrated nutrient management incorporates the use of various sources of plant nutrients. Productivity and nutrient status of crop product increases efficiently without sacrificing soil productivity of future generations [Jayaraja & Khan, 2010].

Chilli (Capsicum annuum L.) is one of the important cash and condiment crop widely grown in Sri Lanka for dry chilli production and also a part of the chilli crop is harvested as green pods. The average extent under green chilli was around 8,218 ha and the annual production of chilli in Sri Lanka was 50,717 Mt in 2015/2016 Maha season [Department of Census and Statistics, 2016]. Currently in Sri Lanka, chilli production is generally depending on the inorganic fertilizer however chilli production using organic manures is also timely required due to the problems associated with inorganic fertilizer [Dahanayake et al., 2012]. Appropriate quantities of the available organic and inorganic sources should be integrated to develop the best combination of the both fertilizers for accomplishing quantity and quality in chilli [Ran et al., 2015].

It is therefore necessary to obtain locally available, cheap and environmentally good materials that can be applied with integration for chilli production. Cattle manure is commonly used organic manure for crop cultivation and it consists of macronutrients mainly nitrogen (N) 20.7%, potassium (K) 0.15% and phosphorus (P) 0.42% [Omogoye, 2015] with other micronutrients that can be utilized by the chilli plants to overcome nutrition deficiencies. Partially burnt paddy husk has the ameliorative properties due to high content of potassium and additional nutrients which have immense potential for amending soil while those with relatively higher carbon content [Mila, 2013]. Biochar produced from rice husk is very porous in its structure, non-hazardous and having a large internal surface area [Ahiduzzaman & Islam, 2016]. Hence, an investigation was undertaken to study the effect of combined application of cattle manure and partially burnt paddy husk with inorganic fertilizers on growth and green pod yield.
Table 1: Mean root length of chilli plants grown under different fertilizer combinations.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Root length (cm)</th>
<th>At 30 DAT</th>
<th>At 60 DAT</th>
<th>At 90 DAT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>6.23d</td>
<td>8.38c</td>
<td>8.93c</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>7.13cd</td>
<td>8.83c</td>
<td>12.98b</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>8.05bc</td>
<td>10.43b</td>
<td>14.35ab</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>9.48ab</td>
<td>11.68a</td>
<td>15.80a</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>9.58a</td>
<td>12.25a</td>
<td>15.70a</td>
<td></td>
</tr>
</tbody>
</table>

F test P < 0.01 P < 0.01 P < 0.01

The data represents means of four replicates.
Mean values in a same column having the similar letter/letters indicate not significant differences at 1% level of significance by DMRT.

T1- No fertilizer (Control plot), T2- 100% Inorganic fertilizers, T3- 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹), T4- 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹) + partially burnt paddy husk (250 kg ha⁻¹), T5- 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹) + partially burnt paddy husk (500 kg ha⁻¹).

Methods

Location and experimental details

The experiment was carried out at In-Service Training Institute, Karadiyanaru, Sri Lanka, in the maha season 2015 - 2016. The soil type of this site is reddish brown earth. The chilli (Capsicum annuum L.) cv. MIPC was used in this experiment. The plot size was 180 x 180 cm. Seedlings were arranged at a spacing of 45 cm 30 cm (one plant / hill). This experiment was carried out using a Randomized Completely Block Design and replicated four times. The treatment combinations are given below.

Treatments

T1- No fertilizer (control plot) T2- 100% inorganic fertilizers (As recommended by the Department of Agriculture, Sri Lanka) T3- 50% inorganic fertilizers + cattle manure (15 t ha⁻¹) T4- 50% inorganic fertilizers + cattle manure (15 t ha⁻¹) + partially burnt paddy husk (250 kg ha⁻¹) T5- 50% inorganic fertilizers + cattle manure (15 t ha⁻¹) + partially burnt paddy husk (500 kg ha⁻¹).

Agronomic practices and Statistical analysis

All the agronomic practices except to fertilizer applications were done as recommended by the Department of Agriculture, Sri Lanka. Growth and yield measurements of plant height, root length, average number of flowers, average pod length, number of pods per plant and average pod weight per plant were taken using destructive random sampling method. Collected data were analysed using SAS 9.1 portable version (SAS Institute Inc. Cary, NC, USA) and the treatment means were compared by using Duncan’s Multiple Range Test (DMRT) at 1% and 5% significant levels.

Table 2: Number of flowers produced per chilli plants grown under different fertilizer combinations at 85 and 120 DAT.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Number of flowers</th>
<th>At 85 days</th>
<th>At 120 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>1.75c</td>
<td>5.50b</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>3.75bc</td>
<td>6.50b</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>7.25a</td>
<td>8.75ab</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>5.25ab</td>
<td>10.25ab</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>7.50a</td>
<td>12.75a</td>
<td></td>
</tr>
</tbody>
</table>

F test P < 0.01 P < 0.05

The data represents means of four replicates.
Mean values in a same column having the similar letter/letters indicate not significant differences at 5% level of significance by DMRT.

T1- No fertilizer (Control plot), T2- 100% Inorganic fertilizers, T3- 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹), T4- 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹) + partially burnt paddy husk (250 kg ha⁻¹), T5- 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹) + partially burnt paddy husk (500 kg ha⁻¹).

Results and Discussion

Plant Height

It was observed that the combined application of organic and inorganic fertilizers had a significant influence on the vegetative growth of the chilli crop. The results
revealed that the lowest plant height of 12.58 cm and highest height of 67.73 cm were observed in T1 - No fertilizer (Control plot) and T5 - 50% RIF + cattle manure (15 t ha\(^{-1}\)) + partially burnt paddy husk (500 kg ha\(^{-1}\)) at 30 and 90 DAT respectively as shown in Figure 1. These results indicated that the mixing cattle manure and partially burnt paddy husk had significantly (p<0.05) increased the plant height during growth period.

Nitrogen is an important element required for successful plant growth [Liu, 2014]. Optimum nitrogen must be added either in organic or inorganic forms for better growth and development of chilli plants. The nitrogen uptake by plants can be increased by increasing concentration of different types of nitrogen fertilizers. Organic manures activate many species of living microorganisms which may stimulate the plant growth and absorption of nutrients [Arisha et al., 2003] and such organisms require nitrogen for their multiplication [Ouda & Mahadeen, 2008].

On the other hand, the application of organic manure alone could not increase the vegetative and reproductive growth of chili plants as they release nutrients at a slower rate. According to the literature survey, application of inorganic fertilizer alone is also less effective than the combined application of organic and inorganic fertilizers. These might be the reasons for highest plant height observed in this combination at 90 DAT. The result was in conformity with the finding of [Jose et al., 1988] in the integrated use of urea and poultry manure resulted in a higher nutrient uptake and plant growth. This finding is also in accordance with [Ullah et al., 2008] who also observed increased plant height when use the inorganic fertilizers combined with cattle manure and poultry manure.

### Average Root Length

Root length is an important crop parameter as it is a dynamic structure for water and nutrient uptake for plant growth. The average root length of chilli plants was significantly (p<0.01) influenced by the different fertilizer combinations used in the present experiment as indicated in Table 1. The result showed that the lowest root length (6.23 cm) was recorded from plant grown in T1 (control plot) and the highest value (9.58 cm) was obtained in T5 at 30 DAT. The reasons for the results obtained may be that the combined application supplies the macro and micro nutrients continuously. At 60 DAT, the lowest average root length of 8.38 cm and highest length of 12.25 cm were observed in T1 and T5 treatments respectively. However, the highest mean root length of plants which were grown in T5 was not significantly differed (p<0.01) with T4 where the average root length of 11.68 cm was recorded.

At the 90 DAT, maximum mean root length of 15.80 cm was recorded in T4, followed by 15.70 cm in T5 and 14.35 cm in T3 while minimum root length of 8.93 cm was recorded in chilli cultivated without using any fertilizers. The observations agree with findings reported by [Iyamuremye & Dick, 1996] who stated that organic materials can enhance phosphorous availability, improve
Table 3: Average pod length and number of pods per chilli plants grown under different fertilizer combinations at 120 and 150 DAT.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Average pod length (cm)</th>
<th>Number of green pods per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120 DAT</td>
<td>150 DAT</td>
</tr>
<tr>
<td>T₁</td>
<td>2.30d</td>
<td>2.35d</td>
</tr>
<tr>
<td>T₂</td>
<td>2.97cd</td>
<td>2.85c</td>
</tr>
<tr>
<td>T₃</td>
<td>3.60bc</td>
<td>3.43b</td>
</tr>
<tr>
<td>T₄</td>
<td>3.90ab</td>
<td>4.30a</td>
</tr>
<tr>
<td>T₅</td>
<td>4.53a</td>
<td>4.73a</td>
</tr>
</tbody>
</table>

The data represents means of four replicates. Mean values in a same column having the similar letter/letters indicate not significant differences at 5% level of significance by DMRT. T₁: No fertilizer (Control plot), T₂: 100% Inorganic fertilizers, T₃: 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹), T₄: 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹) + partially burnt paddy husk (250 kg ha⁻¹), T₅: 50% Inorganic fertilizers + cattle manure (15 t ha⁻¹) + partially burnt paddy husk (500 kg ha⁻¹).

phosphorous recovery or result in better utilization by plants. Organic materials add carbon source into the soil that provides substrate for microbial growth and their subsequent activity. Decomposed organic materials improves the nutrient cycling and nutrient availability to the plants especially nitrogen and phosphorous which boost root development and subsequently vegetative growth of plants. Our finding is further supported by [Rahman et al., 2012] who found that applications of biocompost, cow dung compost with NPK fertilizers significantly enhanced the number of roots and the length of the roots of chilli plants.

Average Number of Flowers

The numbers of flowers produced per chilli plants were increased at different growth periods after transplanting. From the data, it showed that there were significant differences observed in numbers of flowers at 85 and 120 DAT as shown in Table 2. The number of flowers per plant was significantly (p<0.05) influenced by different combination of the fertilizers (Table 2). Plants grown without added any forms of fertilizers (T₁) produced minimum number of flowers among the all treatments while the maximum number (7.5) was recorded in T₅ at 85 DAT. The levels of inorganic and organic fertilizer incorporation had significant effect on number of flowers per plant. Production of minimum number of flowers per plant might be due to inadequate supply of essential macro and micro nutrients for their growth and flower production.

The number of flowers produced per chilli plants were increased at 120 days growth period than that at 85 days. The minimum number of flowers (5.50) per plant was produced by treatment T₁ while the maximum number of flowers (12.75) per plant was noted in T₅. In both growth periods, the lowest value was obtained in T₁ (control plot). It might be due to inadequate supply of essential macro and micro nutrients for flower production. On the other hand, application of inorganic fertilizer alone may affect the soil health, which in turn may affect flower production. Therefore, the combined application of cowdung, partially burnt paddy husk and inorganic fertilizers may supply the macro and micro nutrients timely for flowering and their growth in chilli. The finding is supported by [Ullah et al., 2008], who noted the highest flower formation per plant in egg-plant when applied cow dung with inorganic sources of nutrients.

Average Pod Length

Average pod length was significantly (p<0.01) influenced by amalgamation of the fertilizers at 120 and 150 DAT (Table 3). Plants grown without any fertilizer (T₁) showed minimum pod length of 2.30 cm while the maximum length (4.53) was recorded in T₅ at 120 DAT. Minimum and maximum pod length of 2.35 cm and 4.73 cm was noted in T₁ and T₅ respectively at 150 DAT. It might be due to adequate supply of available macro and micro nutrients from cattle manure and partially burnt paddy husk for the pod formation and their development. Our findings are accordance with [Appireddy et al., 2008] where the number of fruits per plant and fruit yield was significantly higher under integrated nutrient management compared with organic nutrient supply in chilli. Similar experimental results were also stated with [Singh & Kumar, 1999], who reported that highest fruit setting percentage and number of fruits per plant of chilli was found, when the fertilizer was applied both from organic and inorganic sources.
Table 4: Average green pod weight per chilli plant grown under different fertilizer combinations at 120 and 150 DAT.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Average pod weight per plant at 120 and 150 DAT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At 120 days</td>
</tr>
<tr>
<td>T_1</td>
<td>0.88d</td>
</tr>
<tr>
<td>T_2</td>
<td>8.75c</td>
</tr>
<tr>
<td>T_3</td>
<td>29.56b</td>
</tr>
<tr>
<td>T_4</td>
<td>25.57b</td>
</tr>
<tr>
<td>T_5</td>
<td>40.42a</td>
</tr>
</tbody>
</table>

The data represents means of four replicates. Mean values in a same column having the similar letter/letters indicate not significant differences at 5% level of significance by DMRT. T_1: No fertilizer (Control plot), T_2: 100% Chemical fertilizer, T_3: 50%chemical fertilizer + cow dung (15t/ha), T_4: 50%chemical fertilizer + cow dung (15 t/ha) + partially burnt paddy husk (250 kg ha^{-1}), T_5: 50%chemical fertilizer + cow dung (15t/ha) + partially burnt paddy husk (500 kg ha^{-1}).

The increase in the pod weight per plant in the partially burnt paddy husk added treatment along with cattle manure, and other inorganic fertilizers might be due to that the biochar produced from partially burnt paddy husk might improve the soil health and improve soil fertility. The combined application of organic manures and inorganic fertilizers may provide the nutrients on appropriate time and also could maintain the proper condition for flowering, fruiting and their growth. This finding is supported by [Shelke _et al._, 1999], who found the highest fruit yield in eggplant with substituting of 60 % urea N by poultry manure. Thus, combination of organic and inorganic fertilizers could produce better yield than inorganic fertilizers alone. The present result agreed with previous findings obtained in onion [Abbey & Kanton, 2004, Gambo _et al._, 2008] and tomato [Babajide _et al._, 2008].

Number of pods per plant

The average number of pods per plant is an important yield component to achieve high green chill yield. The average numbers of pods per chilli plants that were grown in different inorganic and organic fertilizer combinations were increased at 150 DAT than those at 120 DAT. It seemed that pod formation in chilli plants were positively influenced by sources of nutrients applied in this experiment. The maximum number of pods per plant (10.75) was recorded in T_3, in which 50% of inorganic fertilizer and 15 t ha^{-1} cattle manure were added. However, it did not show any significant different (p>0.01) with T_5 where the average numbers of 10.5 pods per plants were observed at 120 DAT. This results in conformity with [Kendaragama, 1999] who observed similar results in response of tomato and chilli to application of organic materials.

Green pod weight per plant

The result revealed that there were significant (p<0.01) differences observed in the average pod weights produced per chilli plant at 120 DAT and 150 DAT (Table 4). The minimum pod weight (0.88 g) per plant at 120 days was produced in T_1 while the maximum average pod weight per plant (40.24 g) was recorded in T_5. In both periods (120 DAT and 150 DAT), the lowest values were obtained from the control plot. This might be due to the nutrients released by the cattle manure along with partially burnt paddy husk that would have contributed for the highest pod weight per plant along with the nutrients from inorganic fertilizer.

The results revealed that incorporation of the organic fertilizers such as cattle manure and partially burnt paddy husk with inorganic fertilizers leads to increase plant pod yield of chilli. A relatively high chilli yield was recorded in the pods added with recommended inorganic fertilizers alone as compared to control (no any fertilizer added plots) while combined application of the organic and inorganic fertilizers tested in this study increased chilli yield. The integrated application of 50% recommended inorganic fertilizers + 15t ha^{-1} cattle manure along with 500kg ha^{-1} partially burnt paddy husk gave the highest green pod yield of chilli. However, it is imperative to conduct further investigation for several seasons with different combinations of treatments as the effect of organic manures and partially burnt paddy husk to help in making recommendations to the farmers.

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Enhancement of Gymnastic Movements with Utilizing Strain of Parallel Bars

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Abstract

Gymnasts use a special movement pattern for particular long swing movements to gain optimum elastic energy of parallel bars to complete long swing movements artistically. Therefore it is essential to study body dynamics as well as the dynamic properties of exercise apparatus to minimize the execution errors. In the present study, performance of long swing movement under the parallel bars by national level gymnast of China (mass 50.4 kg) were evaluated. The time history of middle points of wooden bars and all joint angles were measured using a system of ten high speed cameras (100 Hz). The ViconT40 digitizing software was used to find all coordinates of reflective markers (14 mm) which were attached on parallel bar-gymnast system. Based on the overall readings, a 3D mathematical model for the parallel bars apparatus was developed using four damped spring-mass model ($K_x = 28601 \, \text{N.m}^{-1}$, $K_y = 10830$ and $K_z = 19101 \, \text{N.m}^{-1}$) with linear displacement-force characteristics. A gymnast (50.4 kg) applied maximum horizontal force ($F_x = 584 \, \text{N}$) to perform ‘long swing double tucked saltos’ to upper arm support on the parallel bars. In this time, the particular vertical force ($F_z$) and arm angle ($\alpha$) with X-axis are 488 N and 73°3’ respectively. This 3D model can demonstrate dynamic properties of the parallel bars interacting with any long swing movement for any gymnast.

Key words: Dynamic Stiffness, Gymnastic, Long Swing, Model, Parallel Bars

Introduction

The performance on long swing elements on parallel bars is a critical aspect in the Men’s Artistic Gymnastics (MAG). This event often increases the difficulty value by players in competitions. Therefore, players pay more attention to the body coordination during the entire long swing movements on wooden parallel bars. When the player reaches the vertical position under the bars, player gains maximum amount of kinetic energy. Hence flexible bars bend and store some of player’s energy in response to his actions (in Figure 1). The player gets some of stored elastic energy just before releasing the bars/grips. This energy is most effective to complete long swing elements on the bars artistically. Though most players use common techniques to learn long swing elements, they have to use special body coordination in response to elastic energy of the bars, because parallel bars’ movements clearly interact with joint torques of gymnast’s body resulting linear and angular momentums. In addition, the tops of the metal posts also interact with long swing movements. Therefore, gymnasts need to consider not only movements of wooden parallel bars but also how tops of metal posts movements interact with the long swing elements to enhance their particular performance.

The elastic properties of parallel bars apparatus play a dominant role in designing artistic gymnastic elements in world class championships and Olympic Games. Players are always searching for the best places of parallel bars to initiate their high difficulty elements on bars. The parallel bars apparatus consists of two bars that are held parallel to, and elevated above, the ground by a metal supporting framework. Usually these wooden parallel bars are composed of wood with outer coating of wood [FIG, 2009]. Therefore, players use strain of parallel bars and metal posts to generate precise force application for routings on the bars. A player will design his routings based on four different element groups such as swinging skills in a support position, a hanging, an upper arm position and ends with a dismount from either the bars or the side of the wooden parallel bars [FIG, 2017]. Judges mainly evaluate performance of exercises considering of ‘difficulty values’ and ‘execution errors’. If the player is not able to identify the strain of the bars to initiate his high difficult elements on the bars, more execution errors will be occurred through his routings.

Figure 1: Graphics sequence of an elite gymnast performing with important phases (1 to 8) of ‘forward giant swing backward double salto tucked to upper arm hang’

Artistic gymnastic movements which start with long swing under the parallel bars are highly difficult movements compared to other movements of parallel bars.
Figure 2: Model for dynamic movement of Parallel bars with three spring-dampers and two point masses \( m_A \) and \( m_B \) where \( K_1, K_2 \) and \( K_3 \) are spring constants and \( C_1, C_2 \) and \( C_3 \) are corresponding viscosity coefficients of masses. \( M_c \) is attached to mass \( m_B \) (at the middle point of a wooden bar) using length \( l \) and massless wire. \( M_c \) oscillates on YZ plane surface with \( \theta \) angular displacement at time \( t \). O is an initial position of a top of metal posts and it represents origin of coordinates. F is always moving on sagittal plane with \( m_A \) and AF parallel to OY axis. DE = 230 cm, VD = VE and D is moveable point on YZ-plane. F can move on the sagittal plane of the parallel bars. LM represents a wooden bar at \( t = t \) in the dynamic situation.

Figure 3: Camera set-up (ViconT40) for data collection viewed from above

Figure 4: Solid and dashed lines represent acceleration and displacement of \( m_B \) in y direction respectively.

Figure 5: Acceleration (solid line) and displacement of \( m_B \) in z direction

Most Olympic players perform highly executed elements on parallel bars without any execution error. That indicates that they know how to get the maximum
of elastic energy to complete elements on parallel bars. Therefore, the study of "how elastic energy of bars support gymnasts to perform correctly executed elements on parallel bars in artistic gymnastic?" will help to enhance the players' performance. Though artistic gymnastic elements have been performed by gymnasts taking advantage of elastic energy of parallel bars, they are unable to identify optimum time at which the maximum elastic energy is transferred to a particular movement of gymnastic element. Therefore, most gymnastic players face several difficulties (release phase, momentary phase and injury) to read correct techniques of gymnastic elements. In preparatory period, coachers inform their players to "push" the bars or "pull" the bars, but coaches and players cannot predict the exact value of force and its direction and the time at which it should be done. Hence, gymnast has to get more preparations to perform correctly executed high difficulty elements on parallel bars. To solve this problem, we have designed a 3D mathematical model for parallel bars in a dynamic situation. Hence players and coaches can identify the precise force application relevant to the artistic gymnastic element on parallel bars.

**Methods**

A 3D mathematical model was designed using four massless spring dampers and two point masses to observe the dynamic properties of wooden bars. This model was hypothesized for parallel bars. Height of the parallel bars from the mat is 175 cm. The Kene's procedure [Levinson & Kane, 1985] was used to derive the system’s dynamical equations. In the first part of this study, a pendulum was attached to the middle point of a wooden bar and the oscillations on frontal, sagittal and transverse planes were observed. In the second part of the research, a national level gymnast of China performed four repetitions of a long swing movement on the middle of parallel bars. Hence, kinematic and kinetic values were calculated using Matlab R2014b software and estimated the parameters of spring dampers of mathematical model. Finally, the pattern of dynamic force variation of the middle points of the parallel bars due to the particular long swing movement was calculated.

**Mathematical Model of Parallel Bars**

The 3D mathematical model of parallel bars is mainly designed for long swing elements (as in Figure 1). The movements of tops of four metal posts and wooden parallel bars for long swing elements are still not experimentally verified to that how much they influence the performance. The 2D model that indicated the motion of the metal posts in the x-direction (see Figure 2) is very small (<±1cm) compared to much larger gymnast body movements in the sagittal plane [Linge et al., 2006]. We have seen that the tops of metal posts motion in x-direction is not considerably small specially for long swing elements.
Table 1: Results of Parameter Identification of $K_y$ and $C_y$

<table>
<thead>
<tr>
<th>Subject (M) [kg]</th>
<th>$m_A$ [kg]</th>
<th>$m_B$ [kg]</th>
<th>$K_y$ [N.m$^{-1}$]</th>
<th>$C_y$ [N.s.m$^{-1}$]</th>
<th>RMS [N]</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1.02</td>
<td>5.001</td>
<td>10830</td>
<td>8.975</td>
<td>87.35</td>
</tr>
</tbody>
</table>

Therefore, the middle points of the wooden parallel bars and tops of metal posts movements in three directions were considered to design 3D model for parallel bars’ apparatus. The high bar dynamics in the horizontal and vertical directions were represented by linear spring model [Michael & Maurice, 2007]. Four massless spring-dampers and two point masses (A and B in Figure 2) were used to represent parallel bars’ dynamic movements from any direction relevant to the long swing elements.

The Kane’s method [Levinson & Kane, 1985] was used to derive (Appendix A) following dynamic equations 1 and 2 for above arrangement in Figure 2. $T_1$ and $T_2$ are spring-damper forces which are representing the dynamic forces in y and z directions respectively.

$$T_1 = K_x x + C_x \dot{x} + F_x,$$  \hspace{1cm} (4)

$$T_2 = K_y y + C_y \dot{y} + F_y$$ \hspace{1cm} (5)

and

$$T_3 = K_z z + C_z \dot{z} + F_z$$ \hspace{1cm} (6)

$F_x$, $F_y$ and $F_z$ are the constant values in each model of the spring dampers. Where $K_x$, $K_y$ and $K_z$ are the stiffness constants and $C_x$, $C_y$ and $C_z$ are the constant damping parameters.

![Figure 10: Variation of dynamic force ($F_x$) on middle point A of a wooden bar for artistic gymnastic element in Figure 1](image)

$$T_2 = (m_A + m_B + M_C) \ddot{y} + M_C l \left[ \cos(\theta) \ddot{\theta} - \sin(\theta) \dot{\theta}^2 \right]$$  \hspace{1cm} (1)

$$T_3 = (m_B + M_C)(g + \ddot{z}) - M_C l \left[ \sin(\theta) \ddot{\theta} + \cos(\theta) \dot{\theta}^2 \right]$$  \hspace{1cm} (2)

Similarly, the dynamic equation 3 was derived considering oscillations of $M_C$ on XZ-plane. The equation 3 represents the horizontal movements of middle point of wooden bars.

$$T_1 = \frac{1}{2} \{ (m + m_B + M) \ddot{x} + M L \left[ \cos(\phi) \ddot{\phi} - \sin(\phi) \dot{\phi}^2 \right] \}$$  \hspace{1cm} (3)

Model equations: Vertical (z direction) and horizontal (x and y directions) spring-damper forces are modelled as

Figure 11: A gymnast (50.4 kg) applied maximum horizontal force ($F_x$=584 N) to perform an artistic gymnastic element as in Figure 1 and vertical force ($F_z$) is 488 N. Arm angle ($\alpha$) with X-axis is 73° 3’ on XZ-plane.

**Data Collection and Data Processing**

Reflective markers (14 mm) and ten high speed camera set up (ViconT40, 100 Hz) were used to observe the time history of the attached markers on parallel bars (in Figure 3) and subjects. The coordinates of the necessary markers were calculated using ViconT40 digitizing software. A 31 kg pendulum was attached to the middle point of a wooden bar using a thin, non-elastic cable. The oscillations on frontal, sagittal and transvers planes were observed. This experiment was repeated for a 50 kg mass pendulum in the same manner. Considering lateral oscillations of pendulum (Appendix ), dynamic equations 1 and 2 were formulated. Four reflective markers were attached around the equator of pendulum to observe the time history of its center of mass. In the second part of the research, a national level gymnast of China (50.4 kg) performed four repetitions of a long swing movement: forward giant swing backward double salto tucked to upper arm hang, under four different
Table 2: Results of Parameter Identification of $K_z$ and $C_z$

<table>
<thead>
<tr>
<th>Subject(M) [kg]</th>
<th>$m_A$[kg]</th>
<th>$m_B$[kg]</th>
<th>$K_z$[N.m$^{-1}$]</th>
<th>$C_z$[N.s.m$^{-1}$]</th>
<th>RMS[N]</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1.00</td>
<td>5.00</td>
<td>19101</td>
<td>10.9</td>
<td>204.9</td>
</tr>
</tbody>
</table>

Table 3: Results of Parameter Identification of $K_z$ and $C_x$

<table>
<thead>
<tr>
<th>Subject(M) [kg]</th>
<th>$m_A$[kg]</th>
<th>$m_B$[kg]</th>
<th>$K_z$[N.m$^{-1}$]</th>
<th>$C_z$[N.s.m$^{-1}$]</th>
<th>RMS[N]</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1.00</td>
<td>5.00</td>
<td>28601</td>
<td>3.9496</td>
<td>0.00019</td>
</tr>
</tbody>
</table>

conditions on the middle of parallel bars. Time histories of all joints of player in dynamic movements were observed using attached markers.

Data Analysis

Parameter Estimations

Parameters $m_A$, $m_B$, $K_i$, and $C_i$ (where $i = \{x, y, z\}$) were estimated using least squares curve fitting (Mathlab14b software) of the formulated spring-damper forces in equations 1, 2 and 3 with their model linear spring-damper forces in equation 4, 5 and 6. Static elastic coefficients of wooden bars were considered for initial values of $K_y$ and $K_z$ to start the estimations$^1$. The acceleration of gravity is taken to be $g = 9.81$ m.s$^{-2}$. Parallel bar height has been kept as 175 cm from mat.

Model Validation

For validation of parallel bars model, experiment was repeated for each 31 kg and 50 kg pendulums. Hence, estimated values represent similar elastic properties of bars as shown in Table 1, 2 and 3. Also, this experiment was repeated in the same manner for another height of parallel bars (185 cm). In this time, we observed $K_x$, $K_y$ and $K_z$ as $27633$ N.m$^{-1}$, $10198$ N.m$^{-1}$ and $19512$ N.m$^{-1}$, respectively.

Kinematics of Model

Figure. 4, 5 and 6 show components of accelerations of mA, mB and MC in dynamic equations 1 and 2. Figure 7 shows angular acceleration of mass mA, mB and MC on XZ-plane. Basic calculation steps have been introduced in Appendix.

The Figure 8 and Figure 9 show spring damper forces (dashed lines) and their model values (solid lines). Height of the parallel bars from the mat is 175 cm.

Results and Discussion

The norms of the International Gymnastic Federation demand vertical midpoint stiffness are to be within the range of $19,000-27,400$ N.m$^{-1}$ [FIG, 1996, FIG, 2016, Linge et al., 2006]. In this study, it found the optimum value for vertical midpoint stiffness ($K_z$) in the dynamic situation using 50 kg pendulum. We got it in vertical direction as $19,101$ N.m$^{-1}$. The 3D Model of parallel bars estimated other stiffness values for the x direction (parallel to the initial position of a wooden bar) and the y direction as $28,606$ N.m$^{-1}$ and $10,830$ N.m$^{-1}$, respectively. Though the 2D model was designed assuming that the metal posts' movements in the x direction are negligible, we observed that the stiffness values for the x direction ($28,606$ N.m$^{-1}$) considerably influenced the long swing movements on parallel bars (see Figure 10). Present study shows special body position in the movement pattern which is near to the second place of sequence in Figure 1 (see Figure 11), is very critical, because the mass 50 kg gymnast can pull the parallel bars in the x-direction to make around 2.2 cm displacement of top of the posts ($-2.3 \text{ cm} < x < +2.3 \text{ cm}$) for three repetitions of the element in Figure 1. In this time, gymnast applied a $584$ N force to pull a wooden bar. Hence, gymnast can pull the bars at the bottom of the parallel bars to generate maximum vertical displacement of the middle point of the bars to store maximum amount of elastic energy in wooden bars. Generally, gymnasts know that part of elastic energy will help to lift them above the bars. Therefore, gymnasts do more preparation in long period to gain more energy from the bars. For a solution of this matter, gymnast can design their movement pattern (sequence 1 to 8 in Figure 1) considering the behavior of the new parallel bars model in Figure 2. International Gymnastic Federation (FIG) has introduced and recommended 175 cm standard height of parallel bars from the mat for FIG recommended artistic gymnastic competitions from 2009 to 2016. New Men’s Artistic Gymnastics (MAG) code of points in 2017 indicates that the new height of the parallel bars is as 185 cm from the mat. This 10 cm increment of height of parallel bars helps to gain more elastic energy from the bars and metal posts. This directly influences the performance of element. In this study, values of spring constants $K_x$ and $K_y$ of 3D model reduced significantly for 185 cm height of parallel bars from the mat.

Conclusion

The 3D parallel bars model can demonstrate how gymnasts can use dynamic force to complete a ‘forward giant swing backward double salto tucked to upper arm hanging on bars with arm support’ movement us-

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$^1$International Gymnastic Federation. (2016) FIG Apparatus Norms, Standard Specification for Parallel bars (IV-MAG 5)
ing all three dynamic stiffness values. This 3D model can demonstrate dynamic properties of any long swing movement for any gymnast.

Acknowledgements

We would like to express our thanks to former Gymnastic Olympic Champion (2008) Mr. Yang Wei and Dr Li Shaping for their valuable inputs about the long swing gymnastic movements. Also, our thanks go to a research team in Sports Engineering Department in WSU for assistance during data collection.

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DOI: https://doi.org/10.1123/jab.23.4.300


Appendix A

The Kene’s procedure [Levinson & Kane, 1985] was used to derive the system’s flowing dynamical equations 1 and

\[ \begin{align*}
\text{OA} &= x \ a_1 + ya_2, \\
\text{OB} &= x \ a_1 + y \ a_2 - z \ a_3 \quad \text{and} \\
\text{OC} &= x \ a_1 \ + [y+t \ \sin(\theta)] \ a_2 - [z+l \ \cos(\theta)] \ a_3
\end{align*} \]

Velocities:

\[ v^{mA} = \dot{x}a_1 + \dot{y}a_2 \]
\[ v^{mn} = \dot{x}a_1 + \dot{y}a_2 - \dot{z}a_3 \]
\[ v^{Mc} = \dot{u} + [\dot{y} + l \ \cos(\theta)\dot{\theta}]a_2 - [\dot{z} - l \ \sin(\theta)\dot{\theta}]a_3 \]

Partial velocities:

\[ \begin{align*}
v_1^{mA} &= \frac{\partial v^{mA}}{\partial x} = a_1 \\
v_1^{mn} &= \frac{\partial v^{mn}}{\partial x} = a_3 \\
v_1^{Mc} &= \frac{\partial v^{Mc}}{\partial x} = a_1 \\
v_3^{Mc} &= \frac{\partial v^{Mc}}{\partial z} = a_3 \\
v_2^{mA} &= \frac{\partial v^{mA}}{\partial y} = a_2 \\
v_2^{mn} &= \frac{\partial v^{mn}}{\partial y} = a_2 \\
v_2^{Mc} &= \frac{\partial v^{Mc}}{\partial y} = a_2 \\
\end{align*} \]

Resultant forces:

\[ \begin{align*}
R_1 &= R_{mA} = -T_2a_2 - (T_3 + m_{AG})a_3 \\
R_2 &= R_{mn} = F \sin(\theta)a_2 + [T_3 - m_{BG} - F \cos(\theta)]a_3 \\
R_3 &= R_{Mc} = -F \sin(\theta)a_2 + [-m_{CG} + F \cos(\theta)]a_3
\end{align*} \]

Generalized active forces:

\[ F_i = \sum_i (v_i^p \cdot R_i) \]
\[ F_1 = v_1^{mA} \cdot R_1 + v_1^{mn} \cdot R_2 + v_1^{Mc} \cdot R_3 \\
F_1 = 0 \]

Similarly,

\[ F_2 = v_2^{mA} \cdot R_1 + v_2^{mn} \cdot R_2 + v_2^{Mc} \cdot R_3 \\
F_2 = -T_2 \]
\[ F_3 = v_3^{mA} \cdot R_1 + v_3^{mn} \cdot R_2 + v_3^{Mc} \cdot R_3 \\
F_3 = -T_3 + m_{BG} + Mg \]

Generalized inertia forces:

\[ F_1^* = v_1^{p} \cdot R_1 + v_1^{p} \cdot R_2^* + v_1^{p} \cdot R_3^* \]
\[ R_1^* = m_A \{ \dot{x}a_1 + \dot{y}a_2 \} \]
\[ R_2^* = m_A \{ \dot{x}a_2 + \dot{y}a_2 - \dot{z}a_3 \} \]
\[ R_3^* = M_C \{ \dot{x}a_1 + (\dot{y} + l \ \cos(\theta)\dot{\theta} - l \ \sin(\theta)\dot{\theta}^2)a_2 - (\dot{z} + l \ \sin(\theta)\dot{\theta})a_3 \} \]
\[ \begin{align*}
F_1^* &= (m_A + m_B + M_C)\ddot{x} \\
F_2^* &= (m_A + m_B)\ddot{y} + M_C[\ddot{y} + l \ \cos(\theta)\dot{\theta} - l \ \sin(\theta)\dot{\theta}^2] \\
F_3^* &= 0 + m_B \ddot{z} + M_C[\ddot{z} + l \ \sin(\theta)\dot{\theta} - l \ \cos(\theta)\dot{\theta}^2] \\
\end{align*} \]

Dynamic equations:

\[ \begin{align*}
F_1 + F_1^* &= 0 \\
\ddot{x} &= 0 \\
F_2 + F_2^* &= 0 \\
T_2 &= (m_A + m_B + M_C)\ddot{y} + M_C[\cos(\theta)\ddot{\theta} - \sin(\theta)\dot{\theta}^2]
\end{align*} \]
$$F_3 + F^*_3 = 0$$
$$T_3 = (m_B + M_C)(g + \ddot{z}) - M_C[\sin(\theta)\ddot{\theta} + \cos(\theta)\dot{\theta}^2]$$

(2)

Appendix B

Following calculations were done by considering pendulum movements in YZ-plane. Smooth curve fitting gives \(z\) as a function of time \(t\) in dynamic movement with minimum RMS value 0.0071. \(z\) can fit as

\[
z = Ae^{-bt}\sin(\omega t + \phi) + C
\]

where \(A = 0.00645, b = 0.01, \omega = 5.4496, \phi = -0.823\) and \(C = 0.0228\). Therefore, second derivative of \(z\) in terms of \(t\) can derive as

\[
\dddot{z} = (b^2\omega^2)(z - C) - 2A\omega e^{-bt}\cos(\omega t + \phi).
\]

Similarly, \(y\) can fit as

\[
y = Ae^{-bt}\sin(\omega t + \phi) + C
\]

where \(A = 0.025901, b = 0.01991, \omega = 2.70672, \phi = 2.2403, C = 0.00021\) and RMS value 0.0371. Therefore, second derivative of \(y\) in terms of \(t\) can derive as

\[
\dddot{y} = (b^2\omega^2)(y - C) - 2A\omega e^{-bt}\cos(\omega t + \phi).
\]

Smooth curve fitting of \(\dddot{x} = 0.00386e^{-0.1871t}\sin(2.7296t - 6.28) - 0.04294\) and \(\dddot{\phi} = 0.3868\sin(2.752t - 3.1492) + 0.0105\) were done by optimizing parameters of 50 kg pendulum oscillations in XZ-plane. RMS values of them are \(1.77\times10^{-3}\) for \(\dddot{x}\) and \(1.81\times10^{-4}\) for \(\dddot{\phi}\).
Heideggerian Out-of-Joint Situation and New Horizons in Postcolonial Literature: Interpreting the Zizekian ‘Extimacy’ in *The Mimic Men* by V.S. Naipaul

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Abstract

Though Naipaul’s geo-spatial dislocation from periphery to centre generates an optical distance that helps observe postcolonial reality objectively, he simultaneously attaches to the reality that he initially left behind. This can be termed ‘ex-timated’ fictionalization, where the inner is intimately ex-centred with outer. This sense rises from Naipaul’s territorial dislocation that does not indicate a decisive ontological detachment from the postcolonial reality that he is alienated with. His de-territorialization is unable to fully embrace the new metropolitan reality and forget the former completely, as shown mainly in fictional characters i.e. Salim (*A Bend in the River*) and Ralph Singh (*The Mimic Men*). This review considers *The Mimic Mento* explore this postcolonial situation, even though the symptom is visible even in his other novels, where major characters are positioned between tradition and modernity that emerged from post-colonial reality. While accepting the fact that his repetitive literary revisits to postcolonial Asia and Africa could provide the objective reality within the failed project of decolonization, a Zizekian analysis suggests that Naipaul could not effectively elevate himself from his Heidaggerian ‘out-of-joint’ situation and exploit his ‘homelessness’ to discover a better reality. Instead, he is ex-timately confined to an ‘ex-static’ (or ex-centric) postcolonial situation that leaves him in the deadlock of ‘de-personalized objective narrations’ and ‘situational consciousness’ of Third World reality. Instead, he is ex-timately confined to an ‘ex-static’ (or ex-centric) postcolonial situation that leaves him in the deadlock of ‘de-personalized objective narrations’ and ‘situational consciousness’ of Third World Literature. On the basis of the said *extimated alienation* of Naipaul’s existential literary endeavor, this review suggests that to understand the postcolonial situation better, Zizek’s idea of extimacy is of substantial significance.

Key words: Extimacy, ‘Out of Joint’ Situation, Slavoj Zizek, Postcolonial Literature, V.S. Naipaul

Introduction

Many critics consider V.S. Naipaul to be one of the most significant novelists in contemporary post-colonial literature. Naipaul is popularly known as a person who looks at the postcolonial reality from an outsider’s perspective [Chakraborty, 2011; Cader, 2008, Cudjoe, 1988, Feder, 2001, Joshi, 1994, Kelly, 1989, Park, 1996, Wijesinha, 1998] though he is more than an outsider. His fictional and other works deeply engage in what can be termed as the formation of ‘identity politics’ [Hall & Gay, 1996, Hardt & Negri, 2000, Habermas, 2006] of the postcolonial subject after the Empire. Though he ‘de-territorializes’ his focal point from the Third World periphery to the center, Caribbean Islands to London metropolitan, he effectively uses the very same geo-political shift to articulate the complex postcolonial existence in a vast geo-political terrain cross Asia and Africa. Naipaul spatiotemporally revisits the colonial landscape to (re)narrate the subjectivity of the postcolonial man and his struggle to re-invent a new identity in a territory which his European masters once exploited and then left behind. It can also be said that he (and many other postcolonial writers) re-projects the miserable experience of the postcolonial man to the exotic fantasy of the European reader. However, by so doing he ‘universalizes his displacement’ for a global readership while criticizing the post-independent nations for their backwardness and ‘incapability of self-renewal’, not forgetting to blame the British narcissism of their ruthless exploitation, cultural superiority and racism. In this context, Naipaul is appreciated for his contribution to postcolonial literature that illuminates the conditions of postcolonial life which suffer from cultural dislocation, alienation and loss of identity. The deep sense of subjectivity and psychological dependency and the unhealed wounds of imperialist humiliation that never set the postcolonial man free even after the so-called independence are his recurring themes. In many of his texts, Naipaul also emphasizes the significance of education in changing the transitional postcolonial man when he or she steps into modernity by getting rid of centuries old subjectivity.

Naipaul travels in between the postcolonial world and London metropolitan and advantageously uses his experiences to compose his fictions. However, the postcolonial in-between situation has elevated him as a renowned postcolonial writer. The truth is that the above in-between transposition itself is his literary limitation. It can therefore be argued that he was never free to discover something that is neither postcolonial nor metropolitan. This means that when he ‘de-territorialized’ himself from the postcolonial Caribbean, he has never been fully ‘out-of-joint’1 from his original

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1This phrase was borrowed from Slavoj Zizek’s popular text...
setting. However, to contextualize this ‘out-of-joint’ situation and the element of ‘extimacy’ in Naipaul, more attention must be paid to how he constructs his fictional reality in his novels. Naipaul’s postcolonial reality is nothing new in comparison to the other postcolonial writers. It is full of political chaos, barbarism, nationalistic slogans, third world dictatorial regimes, identity politics based on individual identity crises. Though he leaves this bitter reality, like Ralph in The Mimic Men, the psychological bondage brings him back to the same reality which he reproduces in his novels. Though he locates himself far away from the above reality, this reality becomes ‘externally intimate’ to him. In other words, postcolonial experience that he leaves behind suddenly becomes his real inner core that he catharses through his fictions which are widely known as the best postcolonial writings [Park, 1996, Kelly, 1989, Cader, 2008, Hapugoda, 2015]. So, his centre is ex-centric with the inner postcolonial life despite his central existence is geographically located in the London metropolitan. Hence, this ‘in-between-ness’ (transposition between London and postcolonial world) is the very limit of his long and prestigious literary career.

It seems that even Naipaul fictionalizes his experiences by returning to his own postcolonial life despite he left it long time ago. So, his failure to invent ‘something new’ in his metropolitan life can be detected within this deadlock of his estimated postcolonial nostalgia which he eagerly projects to his international readers who seeks nothing but the fantasmatc otherness in exotic Asian and African geographies. It can be argued that Naipaul and many other postcolonial writers are never free from providing stories of exotic horrors in the Third World to cater to the fantasmatc gaze of the European (Western) masters [Dolar, 1998]. The failed political projects and rising despotism that Naipaul is interested in the Third World are a rich source for such fantasmatc content which forever desires to keep the subject at that level. Since the primitive and irrational subject in the East caters to the Western fantasy, since fantasy-object always sustains its desire, the Western master did not want to change its fantasy-object entirely (the deadlock of impossibility from Master’s point of view). The only thing was that the Western Master somewhat ‘modernized’ primitives so that he could desire it more and exploit it more. Naipaul stands right in between two paradoxical historical forces. Hence his tedious literary effort unfolds in two significant directions. First, he tries to understand how the West projects its fantasy towards the East (the colonized Third World) while exploiting them, and second, how the East saw the Western other as an ‘intruder’ who tries to destroy their historical harmony (essence) while also unconsciously welcoming them to offer the conditions of societal modernization. It is this ambiguous and paradoxical position that made many postcolonial critics to claim Naipaul was either ‘Eurocentric’ or catering to the gaze of the Western other.

The Mimic Men written in 1967 is widely considered as Naipaul’s own political autobiography. As the title signifies, it reveals how the postcolonial men, who are deprived of their own identity, imitate and reflect the life-style and world views of the former colonial masters. The novel establishes an important landmark in Naipaul’s own literary career while also capitalizing on his de-territorialized experiences in London which he geographically chooses for the start of his literary journey. Living in totally dissimilar worlds, after moving from the Caribbean Island to London metropolitan but still reflecting on what he left behind, Naipaul projects the reality of people in the newly independent postcolonial nations to a reader who is interested in reading the agony of those nations which have lost ‘order’ mostly during the decolonization process. While searching for ‘law and order’ for the postcolonial world, Naipaul in his novels such as A Bend in the River (1979), Guerillas (1975) and in the travelogue Among the Believers (2002) foresees that it has no future in the near horizon and confirms that the former colonial master is never going to help it. The future is totally in the hands of those who run the power game now in those nations and they have to be really smart to break the stagnation. They should stop catering to the European gaze which unconsciously demands irrational, barbaric and mysterious existence from them, which is legitimized through identity politics. This means that the ‘inner core of the European fantasy’ about the Oriental man, as a distant other, is structured in a manner that he is organically subjective to the despotic practices in dealing with power. In line with this fantasy projection, Naipaul depicts in his novels that the postcolonial world is gradually falling into the trap of the despotic master deviating from rational Enlightenment heritage. The Mimic Men is a preliminary example that displays how the postcolonial ex-

On Belief (Thinking in Action) (2001). [Zizek, 1997, Zizek, 2001] often uses this reference in his essays to mean that man does not have a previous ‘home’ out of which he is ‘thrown into’ this world. Though there is a Gnostic tradition which believes that our Soul has been thrown into a foreign inhospitable environment, the horizon of our being, according to Zizek, is always a dislocated one and it is this dislocation situation that constitutes the primordial condition of our being. He says, ‘Heidegger points the way out of this predicament: what if we effectively are ‘thrown’ into this world, never fully home in it, always dislocated, “out of joint”, and what if this dislocation is our constitutive, primordial condition, the very horizon of our being? What if there is no previous home “home” out of which we were thrown into this world, what if this very dislocation grounds man’s ex-static opening to the world?’ [Zizek, 2001].

The word ‘extimacy’ in Lacanian psychoanalysis is made with combination of two words; ‘externally’ and ‘intimate’. The word ‘ex-timacy’ first appears in Jacques Lacan’s text [Lacan, 1992] The Seminar, Book VII. The Ethics of Psychoanalysis. (trans. Dennis Porter). Detailed explanation of this concept by the Zizekian School is found in Tony Myers’ Slavoj Zizek (2000). This concept means that the centre of the subject is outside or that the subject is ex-centric to the outside. In other words, the real is as much inside as outside. To explain this a bit further, the subject (in this case Naipaul) can be considered to be ‘constituted by a ‘loss’, by the removal of itself from itself, by the expulsion of the very Ground or essence from which it is made’ [Myers, 2000].
istential crisis, its schizophrenic psychology and paranoia, historical nostalgia and the feeling of insecurity seek comfort in identity politics that erupts under the banner of nationalism. It is perhaps the best Naipaulian novel to show the postcolonial fantasy about his former white master still holds the kernel of the subjectivity of the postcolonial man and is therefore always ex-centric to his present existence. Similarly, the fantasy to return to a historical essence again causes his subjectivity further restricting his ‘out of joint’ freedom.

Methodology

This paper uses the critical hermeneutic approach to interpret the novel The Mimic Men to discover how the Heideggerian ‘out-of-joint’ situation and Zizekian ‘extimacy’ [Zizek, 2001, Zizek, 2002, Zizek, 2011] operate in the context of postcolonial literature that is presented by Naipaul. The analysis will mainly concentrate on the transposition of the main character Ralph Singh who is located between historical gaze of his own past (Asiatic horseman) and the gaze of the colonial master who sets standards for his existential situation. Hence, in contrast to the general inside-outside dialogue that prevails among critiques on Naipaul, this interpretation attempts to examine the true (dis)location of the narrator. Selected dialogues and descriptions that support the development of the conditions of ‘extimacy’ and ‘out-of-joint’ in the main character Ralph Singh will be chosen for the analysis. Hence, the textual evidences that articulate historical and political anxieties in Ralph when he is caught in postcolonial Isabella will be paid more attention to while the sections that illustrate his existential crisis and ‘un-freedom’ in London will also be focused on. Those evidences are hermeneutically interpreted to expose how Ralph’s existential crisis in London metropolitan drives his psychology towards historical nostalgia. It further investigates how the historical memory of lost glory inspire identity politics and how Ralph Singh gets imprisoned in a paradoxical political transposition of the ‘gaze’ of the master while also becoming a subject of his own fantasized historical gaze. Ralph who fictionally represents Naipaul in this biographical novel shows the very ‘unfreedom’ that Naipaul encountered during his transposition between the postcolonial world and London metropolitan. Hence, using the Zizekian toolbox and critical hermeneutics this review attempts to argue that the ex-timated situation or the ‘ex-centric limit’ that Naipaul displays can be universalized to articulate the very politico-aesthetic limit of postcolonial literature. It takes into account selected sections of the novel The Mimic Men for fictional evidence and the main character Ralph Singh for psychoanalytical evidence to support above argument.

Results and Discussion

The True Location of the Narrator

The hermeneutic analysis of the text The Mimic Men and its main character Ralph Singh reveals that there is a parallax between the author’s real life evidence and Ralph’s no-place-ness in both Isabella and London. Naipaul literarily revisits his postcolonial despite his fixed existence in London but Ralph finds his London life as meaningless as his failed country Isabella. Since there is an autobiographical element to consider in analyzing the characters Naipaul and Ralph, the major similarity can be found in the fact of inescapable nostalgia that they both suffer from. Ralph carries a fantasy of an ancient Asiatic horseman who freely and gloriously rides northwards, a fantasy of perfection, yet Naipaul wants evidence from the postcolonial world to detect its deadly failures, a dream of imperfection. Ralph’s fantasy derives from a pre-colonial world which, often in the postcolonial world, is politicized in order to be re-actualized to replace the present failure and humiliation. This is exactly the dream that is shared by Browne and Deschampsneuf who encouraged Ralph to witness it before entering politics. Since dreams of utopia are always political, the postcolonial fantasy of pre-imperialist unpolluted landscape, despite the biases of their feudal past, is highly a political one. But Naipaul is stuck within the remnants of the failed imperialist project in the postcolonial world yet he exposes its present misery, political failures, anti-modern motives and totalitarian symptoms back to the European reader. When he reveals ‘the suppressed histories’ of those nations in Asia and Africa Naipaul offers nothing radical as a viable alternative for those who struggle there whereas Ralph at least carries an unrealizable fantasy of glory. Hence, there is a parallax in the transposition of locations and the imaginary destinations of these two personalities. In this context, the following points are as the new theoretical and literary interpretations of this review.

Inside and Outside as One Entity

Naipaul is made by a fundamental loss of his own rootlessness and dislocation from his originality with which he maintains a degree of nostalgic, unconscious relationship though this particular nostalgia is not visible to the outside. From a psychoanalytical point of view, it is from this loss his creativity originates. On the other hand, he maintains a fair distance with the above (lost) reality to gain an objective picture of the ground. It is this optical distance that Naipaul gains through his de-territorialized geo-spatial shift to London but his ‘reality’ was always ‘grounded’ elsewhere. According [Myers, 2000], this ground (reality) must remain ‘outside of the subject for the subject to retain its consistency as a subject’. This means that Naipaul becomes ‘Naipaul’ whom we now know because of his Ground of postcolonial Indo-Caribbean entity that he once left behind but continued to write about as an ex-
Myer (2000) illustrates, ‘you can see everything except... analytical sense, his inner is attached to the outer. As the ‘mirror’ called postcolonial world itself. In a psycho-way to see himself as Naipaul is strictly determined by situated external to himself or, in other words, the only theory of ‘ex-timacy’, his core or the centre is always an ‘unattached observer’ [Walsh, 1973], according to the productive dialogue’. Though Naipaul is identified as come closer to each other and engage themselves in a as follows, ‘with each revisit the man and the writer revisits to as a ‘man’ is the externalized Ground through which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial reality which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial reality which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial reality which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial reality which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial reality which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial reality which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial reality which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial reality which his inner journey is made as a ‘writer'. The postcolonial reality that Naipaul is alienated with rather ‘subject and object are implicated in each other-the subject is the object outside of itself’ [Myers, 2000]. What is implied by this ‘unity’ is that ‘the subject is no longer opposed to the object’, rather ‘subject and object are implicated in each other-the subject is the object outside of itself’ [Myers, 2000]. The postcolonial reality that Naipaul is alienated with (and he leaves from) and the same reality that he later revisits to are un-detachably ‘one’ phenomenon; it is a revisit to his own interiority that he externalized long time back. In other words, the interior that Naipaul revisits to as a ‘man’ is the externalized Ground through which his inner journey is made as a ‘writer’. The outcome of this internal revisit is his complex postcolonial narratives that composite universal accounts of the postcolonial world which receive higher critical insight. The phenomenon resulted from this union between man and writer is effectively phrased by [Chakraborty, 2011] as follows, ‘with each revisit the man and the writer come closer to each other and engage themselves in a productive dialogue’. Though Naipaul is identified as an ‘unattached observer’ [Walsh, 1973], according to the theory of ‘ex-timacy’, his core or the centre is always situated external to himself or, in other words, the only way to see himself as Naipaul is strictly determined by the ‘mirror’ called postcolonial world itself. In a psycho-analytical sense, his inner is attached to the outer. As Myer (2000) illustrates, ‘you can see everything except the part of you that does the seeing- your own eyeball. The only way you can see your eyeball is by looking in a mirror where it is outside of yourself’. The validity of his epistemological position is that not only what Naipaul sees as reality (outside of eyeball) can be empirically validated for scholarly purposes but he himself is ultimately revealed through what he is seen by him (his own eyeball itself). If the subject (Naipaul) is ‘thrown into’ some in-between-ness, then he can easily become self-identical not only with the reality from which he ‘was thrown’ but with what he is ‘thrown into’. He is identical with the reality that he has externalized once or, in the guise of this very opposite, he finds himself outside himself. So, what the reader finds in his texts as his inner self is reader’s own outside.

The ‘Ex-timacy’ in Naipaul’s De-territorial Alienation

Though Naipaul’s geo-spatial distance helps portraying the postcolonial reality objectively, he, on the other hand, becomes a subject of his own reality that he left behind. So, his existential ‘centre’ has always been nothing but the postcolonial world itself. Naipaul uses this fantasy transposition to express his experiences from an ex-centric (his center is externally internal) point of view, by travelling to the third world (outside) to discover his own dislocation and alienation (inside) from his metropolitan and return (estimated inside that is ‘out there’) to re-narrate them. He was never ‘free’ from this transposition of dual location but able to produce some memorable account of postcolonial existence using the very same paradox. This situation can be termed as an ‘ex-timated’ fictionalization where the inner fantasy is intimately ex-centred with the outer. What becomes then problematic is that his territorial dislocation does not indicate a decisive ontological or aesthetic detachment from the postcolonial reality that he is alienated with. The de-territorialization has been unable to fully embrace the new metropolitan reality and forget the former completely, as shown in the fictional characters like Ralph Singh (The Mimic Men) and Salim (A Bend in the River) and others. While accepting the fact that his repetitive literary revisits to the postcolonial Asia
and Africa could provide an objective reality within the failed project of decolonization, a Zizekian analysis suggests that Naipaul could not effectively elevate himself from his Heidggerian ‘out-of-joint’ situation [Zizek, 1997, Zizek, 2001] and exploit his ‘homelessness’ to discover a better aesthetic-existential integrity for his fictions. Instead, he is ex-timately confined to an ‘ex-static’ (or ex-centric) postcolonial situation that leaves him in the deadlock of ‘de-personalized objective narrations’ and ‘situational consciousness’ of Third World Literature [Jameson, 1986]. On the basis of the above extimated alienation that exists within Naipaul’s existential literary endeavor, this review suggests that the postcolonial situation can be more meaningfully contextualized by using Slavoj Zizek’s idea of extimacy [Zizek, 2011] and it will in turn add more sophistication to the existing literary criticism and textual analysis.

Figure 1 illustrates the transcendental position of the ‘intimated outside’ of the ‘extimated inside’ of a subject and it show that even though the centre seems inside it is always in motion between inside and outside.

Figure 1 graphically shows how the Naipaulian inner essence is intimately positioned outside to his metropolitan inside but it always communicates with the post-colonial world for his inner need to catharsis what he traumatically experienced there. The intimate object within the inside can be named in psychoanalytical terms ‘the deeper inside’ which Naipaul attempts to represent through that object is the torturing psyche of his body that struggles to reveal some inner truth. In The Mimic Men, Ralph Singh could never recover from his traumatic postcolonial experiences even if he wanted to escape from the disorder in the Third World. Similarly, Salim in A Bend in the River is never free from his intimate attachment with the chaotic African entity called Zaire which he was reluctant to leave till the last moment. Both Ralph and Salim (like Naipaul himself) retroactively ‘visualize’ about the traumatic world they left behind (may be with a guilt consciousness). Naipaul lives through these visualizations which ultimately reflect in his writings. It is this transcendentWal topological figure who moves between London and postcolonial world is what the reader sees in Naipaul’s fictions and travelogues. In other words, what Naipaul represents is the estimate center that all postcolonial subjects carry in their existence. So, in between London (the dream land of snow) and the chaotic territories of Africa and Asia, there is an imaginary third estimate place (to slightly alter what Sudipta Chakraborty, 2011 notices in her PhD thesis) that combines the two extremes and makes a totality. When Naipaul feels that he is a stranger to both worlds, it can be argued that he represents this third unknown place (transcendental entity) that reduces the tension in his in-between-ness and produces anaesthetic and objective neutrality while making a readable postcolonial reality in his hands.

Transposition of the Gaze or Un-freedom

The postcolonial subject becomes, in his aesthetic experience, a prisoner either of his native world or of his new world. Mostly, they are unable to break away from this extimated transposition to discover something radically different from both worlds. This becomes symptomatic not only when Naipaul decides to move to London but when he universalizes it through some of his major fictional characters like Ralph Singh and Salim. At the same time, his other novels and travelogues too provide similar evidence. Ralph is caught in between the memories of his ancestral past and the values of the modern metropolitan life which he finally found meaningless. He assumes that his tradition is looking at him through a celestial eye, the gaze of the dead paternal signifier, when he opts to live in a modern-urban setting. But he longed to be in London to escape from the chaos and disorder in Isabella Island, assuming that the former master could offer him security and guidance; mistakenly the gaze of the European master. This interchangeable transposition of gaze is applicable to Salim too in A Bend in the River where his ‘spatiotemporal’ existence in Congo could never provide a sense of belongingness. Instead, Salim thinks that his life is somewhere else, his future wife waits in London or he is far away from civilization etc. though his real business is in the ‘bush’ to which he made an anxious reverse journey.

This transcendent situation illustrated in Figure 2 can be termed as the very deadlock in postcolonial literature or its situational consciousness. The psychological inferiority and servitude in the postcolonial subjects, intensified by the global neo-colonial Empire building led by America, did not disappear even after so called ‘independence’. The ontological gap further widened during the post-capitalist stage when it constantly threatened the traditional societies in the postcolonial world making their life further complex and miserable. In this juncture, the noteworthy postcolonial authors such as Wole Soyinka, Hanif Kureishi, Salman Rushdie, Arundhati Roy or Nuguib Mahfouz use to project the miserable conditions (historically given situation) of their present existence to the former white masters despite some of them were either physically or existentially absorbed to the capitalist metropolitans. None of them were ‘fully free’ or ‘out-of-joint’ from the given conditions of postcolonial existence to produce something remarkable or path-breaking (‘elevated works’) to overtake the twentieth century writers in the canon. Thereby, it can be concluded that the postcolonial authors were unable to create a genre of ‘modern literature’ that is more creative, imaginative and existential than twentieth century classics which breaks free from their ‘national situation’ and does not remind the European readers ‘of outmoded stages of our own first-world cultural development’. So, the ex-timated transposition and the de-territorialization, the very strength of Naipaul, is the

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3This figure (1) originally appeared in google images yet it actually corresponds to the following blog site: http://ideologyatitspurest.blogspot.com [Tupinambá, 2017]
very limit of his literary journey.

**Ralph Singh: Deadlock between Metropolitan and Traditional Landscape**

When it comes to Third World postcolonial politicians, with their inability to construct something path-breaking to come out from the existing socio-economic deadlock due to their dead spirit and psychological bondage to the former master, there seems to have no hope in the horizon for those nations. Despite their local popularity as leaders and success in mobilizing mass, much like Ralph’s socialist movement, post-independent politicians were unable to bring in radical changes. They lacked the psychological assurance and guarantee to do so in so far as they could never recoil from their permanent resignation to their own schizoid ego. Though they are ‘aware’ of the gravity of the political realities that they encounter, they are not authentically ‘affected’ by bloody racial divisions or never truly sensitive to the burning economic issues. Metaphorically, Ralph finds solace in aimlessly riding to the end of the empty world and further retreating to the infinite emptiness itself. His subconscious urge to recover from his ‘shipwrecked situation’ drives him, rather than eliminating his past, further to the empty world of his Asian ancestors. His withdrawal as a Third World politician had a tremendous impact on the progress and futurism that can rise from this Ralph Singh’s ambivalence and ‘elitist dilemma’ towards modernity. The corruption and ignorance in the J.R. Jayewardene regime whom he compares to the Big Man in *A Bend in the River* (1979) made the monster grows from the given circumstances of immensely challenging nature. Yet the feeling of ‘betrayal’ overwhelsms him [Naipaul, 2002a]. He is not ready to conceive and adapt to the new realities after independence with which he has to evolve. There is a greater mismatch between his representation and country’s expectations. It is accurate to say that ‘His political career effectively ends even before he fails on his mission to London on behalf of his government’ [Deodat, 1979]. Ralph cannot represent ‘anything’ because virtually he does not belong to anywhere. From his melancholic mood; he withdraws further into the anachronistic images of ancestry or the vanishing values of English life. As can commonly be detected in many post-independent elites, the failure to embrace the complexities in modernity is the major symptom in Ralph Singh too. Ralph says, “my irresponsibility extended to even myself” and feels “physically limited” [Naipaul, 2002a] to make a fresh start even though he wants to be a free man. Hence he remains unanswered to his own burden of responsibility for the others (for the country). Then he does not know what is to be a free man in the free world and where to begin, ‘What this action will be I cannot say. I used to think of journalism; sometimes I used to think of a job with the UN. But these were attractive only to a harassed man. I might go into business again. Or I might spend the next few working on a history of the British Empire’ [Naipaul, 2002a]. It seems, at a superficial level, Ralph is gambling with his future with wide range of choices but these are all ‘forced-choices’ that are pre-determined by his postcolonial condition itself. That is why he feels ‘limited’ in his existential new beginning. This ontological uncertainty resembles the very ‘de-centeredness’ or the ‘direction-less-ness’ of the post-independent politicians after they ‘earned’ so called independence from the colonizers.

Ralph is a reminder of many post-independent politicians in the failed Third World. He quickly runs away too large to be controlled. The Big Man is the next radical development that can rise from this Ralph Singh’s ambivalence and ‘elitist dilemma’ towards modernity.

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4 As [Wijesinha, 1998] points out in relation to Sri Lankan post-independent experience, there is a need to fundamentally alter the symptomatic attitudes of those who hold governmental responsibility ‘if there is to be any progress’. The corruption and ignorance in the J.R. Jayewardene regime whom he compares to the Big Man in *A Bend in the River* (1979) made the monster grows from the given circumstances of immensely challenging nature. Yet the feeling of ‘betrayal’ overwhelsms him [Naipaul, 2002a]. He is not ready to conceive and adapt to the new realities after independence with which he has to evolve. There is a greater mismatch between his representation and country’s expectations. It is accurate to say that ‘His political career effectively ends even before he fails on his mission to London on behalf of his government’ [Deodat, 1979]. Ralph cannot represent ‘anything’ because virtually he does not belong to anywhere. From his melancholic mood; he withdraws further into the anachronistic images of ancestry or the vanishing values of English life. As can commonly be detected in many post-independent elites, the failure to embrace the complexities in modernity is the major symptom in Ralph Singh too. Ralph says, “my irresponsibility extended to even myself” and feels “physically limited” [Naipaul, 2002a] to make a fresh start even though he wants to be a free man. Hence he remains unanswered to his own burden of responsibility for the others (for the country). Then he does not know what is to be a free man in the free world and where to begin, ‘What this action will be I cannot say. I used to think of journalism; sometimes I used to think of a job with the UN. But these were attractive only to a harassed man. I might go into business again. Or I might spend the next few working on a history of the British Empire’ [Naipaul, 2002a]. It seems, at a superficial level, Ralph is gambling with his future with wide range of choices but these are all ‘forced-choices’ that are pre-determined by his postcolonial condition itself. That is why he feels ‘limited’ in his existential new beginning. This ontological uncertainty resembles the very ‘de-centeredness’ or the ‘direction-less-ness’ of the post-independent politicians after they ‘earned’ so called independence from the colonizers.

Ralph is a reminder of many post-independent politicians in the failed Third World. He quickly runs away too large to be controlled. The Big Man is the next radical development that can rise from this Ralph Singh’s ambivalence and ‘elitist dilemma’ towards modernity.
and distances him further from that territory; very origins of his fear. Then Ralph longs to be in London to get away from his neurotic attachment, location of the memories of his ancestral failure and to ‘relocate’ himself in a land of success. Though he “longed to leave” [Naipaul, 2002a], he was never fully aware of what ‘leaving’ truly means as to how it can ‘break’ someone’s roots and open up new pathways towards freedom. His freedom was always restricted by his attachment to the old fantasies that derived from his past. His father’s withdrawal to the jungle in search of the lost glory and beauty in of his country had a tremendous impact on his psychology. When Browne and Descampsneuf’s encouraged Ralph to discover Isabella he finally decided to enter politics to actualize the ideal land that his father as well as Browne and Descampsneuf’s nostalgically dreamt of. When he realized that postcolonial politics in Isabella could never materialize the fantasy ideal, he then decided to go back to London. Within this geopolitical shift Ralph never finds a solution for his existential anxiety which he tries to release through female bodies he came across in London metropolitan. His sexuality becomes a cathartic recovery for the sense of loss, no-place-ness and dislocation that he was suffering from. He uses those females, both Leini and Sandra, for his maternal signifier of his guideless and directionless

Ralph lacks the most needed ‘radicalness’ to make a free choice in this new radically free situation. From a psychoanalytical perspective, this mostly refers his psychological bondage to liberate himself from traditional cultural life-worlds [Wells, 2014] to embrace new conditions of emancipation. The postcolonial middle class are the ones who are most reluctant to give up not only their own traditions, customs and rituals but the outdated Victorian values imposed on them during colonization. Ralph, representing the same middle class, needs courage to give up the burden of history and to take up the universal responsibility to improve the living conditions of his countrymen after independence. The novel shows that he is not ‘trained’ (or prepared) to enjoy such creative freedom. However, it is also true that such cognitive preparation itself can restrict ‘freedom’ but the creative energy and forwardness have to spring up from a broader understanding to traverse such freedom. The loosing equilibrium and the structural breakdown are further evidenced by his inability to establish and maintain intimate relationships; from Sandra to the fat prostitute. So, his failure is two folds, public and private, political exile as well emotional deadlock. This failure is metaphorically signified by ‘home’; his Roman mansion at a private level and country at a public level. At both levels, his presence at ‘home’ becomes problematic; his national belongingness glues himself to nationalistic roots while distancing him from his European fantasies at a personal level. He is a dislocated alien in his own family ‘home’ yet not fully identifying with its traditional values [Cader, 2008]. Then he seeks another ‘home’ to settle down to. When he relocates himself in London, another geo-spatial ‘home’ away from his chaotic native ‘home’, again he becomes ambivalent.

New Life Confronting Old Fantasies

The failure in ‘After the Event’ is also relevant to understand Ralph’s personal life. His real failure starts with his own crisis after meeting the new metropolitan realities. It is therefore important, within the context of this review, to note how Ralph Singh comes to terms with the new socio-cultural realities in this strange but dreamy land. After his arrival to London (after the Event) he starts naively comparing things, light in the tropics and the artificial lights in London, low night sky in London and the night succeed the day at tropics, famous names and places in London and nothingness in his home city, etc. At the same time, he encounters the complex secular life in London, homosexuals, bisexuals, party girls who are willing to share their erotic life, girls who are willing to come to his apartment, etc. Ralph for a moment indulges in this life in the first section of the novel. He was not prepared or ready to embrace this new life when the memories of his father’s ancestry started troubling him. Instead of accepting the present conditions in his new urban life he found that “there was no one to link my past, no one to note my consistencies and inconsistencies. It was up to me to choose my character, and I choose the character that was easiest and most attractive” [Naipaul, 2002a]. He chose to be ‘indifferent’ amidst those famous names and empty streets in the city, while also being amazed to see the ‘London Girls’, drunken parties, open sexuality, mostly ‘observed’ from the ‘basement’ of Lieni’s boarding house. Despite his dream of snow, Ralph starts to feel detached from the London environment too and this detachment is the beginning of his deeper existential deadlock that never sets him free. The true existentialism is all about the total freedom from alienation but Ralph live in an existential imprisonment between London dream that erupts from modern urbanization and home nostalgia that derives from Asiatic glory and heritage.

About the confused worlds in between, Ralph once said, “So, already I had made the double journey between my two landscapes of sea and snow. To each, at the first parting, I thought I had said goodbye, since I had got to know each in my own way but was little like the tourist trying to summon up a response to the desired object which, because it is too well known, leaves him cold. So too it was with London later” [Naipaul, 2002a]. If Ralph did not truly belong to any of these landscapes, then he can be contextualized in a Zizekian (Heideggerian) situation called ‘no-place-ness’ where he loses the gaze from these two symbolic entities. This means that neither tradition nor the London life is observing his behavior and expecting him to commit to either of these ends. In short, there is no celestial camera (eye in the sky) that observes him. The real problem with Ralph is that the transposition between these two contrasting landscapes never makes him symbolically free
to ‘re-invent’ something brand new; something truly different from both these territories. On one hand, Ralph becomes a defeated, shipwrecked soul in the London metropolitan life and the third world looks at him as a Eurocentric personality. On the other hand, London may conceive him as stranger who can never get adapted to their modern urban life while Isabella understands him as a betrayer of her Asiatic tradition and the past glory of the riding horseman. Within this paradox, when he thinks to settle down in the metropolitan life, he becomes then caught in his past life. Then when he goes back to Isabella to seek his nostalgic past, he longs to be in London. Still his bondage (tie) to the Asiatic heritage remains unbroken (reminds of Fromm’s metaphor ‘mother’s womb’) despite his radical territorial shift yet it does not provide a strong ontological link for him to relate to the present.

His [Ralph’s] failure in marriage, sex, politics, and business - his twenty years of parenthetical existence that denied the truth of his fantasies-can at last be controlled and given shape in words, paragraphs and chapters. The memoirs enable Singh to re-create himself in language, leaving him with “the final emptiness” that the author experiences upon the completion of a major work’ [Kelly, 1989]. About the main character Ralph and Naipaul himself, about the failed fantasy in both of them, what is noticed by Richard Kelly (1989) is that the overwhelming emptiness that leads to a degree of defeat. Rather than becoming melancholic in the new confused reality what Ralph (and Naipaul) should have attempted to do is to create ‘something’ out of their own nothingness that is given to him as a precondition of their in-between existence. Theologically, according to [Zizek, 1996], “the miraculous emergence of a new symbol against the background of the void of the Thing” can be termed as creatio ex nihilo.5 It is true that wherever he goes he encounters an intolerable nothingness but the very void that prevails everywhere is the very condition that man (even God) experienced from the very beginning of his being in the world. God created the world out of nothing and was the precise precondition of ‘before the beginning’ (before beginning the world) prior to his Creation. The inherent situation for man (and for God) is the very nothingness out of which he was created and ‘thrown into’ this world. What must be remembered is the thing that he creates out of nothing in turn always

5 The phrase creatio ex nihilo derives originally from Latin which means ‘creation out of nothing’. As often used by Slavoj Zizek, this refers to teleological fact that ‘for God had to create the world he first had to create nothing’ [Pound, 2008]. Without an original nothingness God did not have a space to fill his creation with. According to Marcus Pound, “God had to create first ‘a vacated space’ for creation itself to subsequently fill. This was achieved by God’s founding act of contraction, a withdrawing into himself, reducing his essence to an immeasurable point from which there appears a place of possible separation” [Pound, 2008]. Tracing back the religious origin of before the Beginning of this world, this gesture evidences the fact that there must be a preliminary and an original ‘nothingness’, ‘vacuum’, ‘void’ or ‘no place’ for a thing to start (or to be). Hence, the ‘no-place-ness’ is nothing strange to humanity.

Therefore, in true existential terms, Ralph should not have worried too much about the emptiness that is around him. Compared to the divine madness ‘before the beginning’, he must accept the feeling of anguish and despair as a positive human condition that has the potential to regenerate a new man out of him. Instead of getting caught in the ‘situational consciousness’ of the postcolonial reality or of the chaotic existence in the London city life, Ralph must sweat to go one further step to discover something brand new that essentially surpasses both realities that he is familiar with. In case of Naipaul too, a new form of aesthetic literature and a brand new existential integrity was possible when his limitless freedom in the ‘no-place-ness’ (de-territorialized ‘out-of-joint situation’) is concerned. If The Mimic Men deals with Naipaul’s own problem, especially that of ‘the disassociation of a man from the simplicity around him’ [Kelly, 1989], despite he denies a close kinship with the narrator, the application of the positive side of alienation and dislocation (as shown by [Zizek, 1993]) becomes universal both in relation to the author and narrator who undergo a similar phenomenological situation. Either in the postcolonial world or in the metropolitan reality one must be courageous enough to undergo the situation of nothingness that is predominantly prevalent around him. It is true that both worlds do not offer a meaning to his existence. But ‘tarrying with the negative’ [Zizek, 1993] is the biggest and the most challenging task of modern humanity. The impossibility in traversing nothingness is the deadlock that both Ralph and Naipaul encounter in their lives.

This situation is somewhat insightfully cited by Paul Theroux (1972) where he says, “He [Naipaul] is in his own words ‘without a past, without ancestors’, ‘a little ridiculous and unlikely’. His is a condition of homelessness. It has the single advantage of enabling him to become a working resident as much resident in India as anywhere else and allows him a depth of insight that is denied the metropolitan. For the rootless person, every country is a possible temporary home; but for Naipaul, there is no return, either to a past or a place” [Theroux, 1972]. The sense of belonging to nowhere is signified in Theroux’s ‘temporary home’ but for Ralph Singh ‘returning to ancestry’ is a possible option and it is where Naipaul becomes different from his fictional character. Theroux forgets to mention that ‘a working resident who does not have a fixed home’ itself makes him a universally metropolitan citizen but Naipaul did not seem to hundred percent accept this ultimate vacancy and the freedom that this vacuum generated in his career. Through this ‘no place’ context, as a colonial migrant and an interpreter of English culture and society as well as an interpreter of the Third World
Naipaul has acquired an authoritative position in the literary world but it is doubtful to say whether he could be fully free to generate an existential postcolonial literature that is liberated from its usual despair and melancholia of the loss and nostalgia. The question remains unanswered, given his characters who are caught between modernity and tradition and given that there is no clear ontological break from the familiar postcolonial discourse, whether Naipaulian literature too is imprisoned in the contemporary framework of ‘situational consciousness’ that repeatedly reproduces the postcolonial master-slave dialectic and its phenomenology. Though Theroux says that Naipaul is a man ‘without a past, without ancestors’, his constant revisits to the postcolonial reality proves that he is not entirely broken free from his own past, from the ontological link, his own reality and ‘his own home’.

Quoting Henry Lefebvre, Sudipta Chakraborty defends Naipaul’s in-between situation and says, “configuring the past and present in an imaginary symmetry is also central to Naipaul’s ontological needs as a migrant subject of the metropolitan “center”’. In Lefebvre’s view, there could be no past totally lost to the present as it is difficult to imagine a perpetually “present” space in complete disregard of its roots in the past” [Chakraborty, 2011]. Past epistemologically reflects in the present in formulating the fictional reality of Naipaul’s postcolonial ontology that creates a totality in his in-between existence. Rather than an ontological break, what can be found in Naipaul is a continuation of the past (postcolonial experiences during his childhood and later revisits) in an imaginary landscape. This is true for his fictional character Ralph. A new ontology always springs from a gap that is created from a broken heritage and a historical lineage which Ralph still could not experience before or after his arrival to metropolitan. In simple words, he did not have a ‘guide’ for an ontological mapping of the new surrounding. Ralph says, “there was no one to link my present with my past, no one to note my consistencies and inconsistencies. It was up to me to choose my character, and I chose the character that was easiest and most attractive” [Naipaul, 2002a]. His parents could not link these two elements nor could his Isabella education. Even his intimate relationship with Sandra was of no use in this establishment of connection between past and present and thereby between fantasy and reality. The ‘missing link’ (which according to Žižek, 2002) is “not only epistemological but primarily ontological” [Žižek, 2002] between past and present is what makes his life miserable. And this where the two fantasy worlds started overlapping over one another where the ancestral horseman (fantasy) started haunting in his mind when he was adrift with Leni in the London metropolitan (reality). Ralph says, “Both of us adrift in London, the great city. I with my past, my own darkness, she no doubt with hers” [Naipaul, 2002a].

Then Ralph shifted the landscape. He returned to Isabella. About this de-territorialization, he says, “I linger now on this moment of arrival more than I did at the time. This return so soon to a landscape which I thought I had put out of my life for good was a failure and a humiliation” [Naipaul, 2002a]. Though he first thought that this tainted island was not made for him and he did not belong to this landscape, with the restlessness in the metropolitan life, he quickly decided otherwise. With no other option, he returned to his primary fantasy. Ralph once says, “I could never feel myself as anything but spectral, disintegrating, pointless, fluid” [Naipaul, 2002a]. In this withdrawing gesture, he even mythically seeks luck in Sandra whom he did not feel any intimate closeness in his life with. The abyss of fantastmatic that he revisits in Isabella to is obvious here. The use of a female metaphor highlights the fact that his defeated ontology seeks refuge in a motherly console by returning to an exotic landscape that can heal his ‘modern’ wounds very much like loving Sandra’s exotified ‘painted’ breasts. Departing from the confused life in London and accepting a new, ready-made life in Isabella, Ralph thinks that his life “had changed” [Naipaul, 2002a] dramatically but he soon realizes that others have different judgements about this life. His visitors used to criticize the narrowness of the island life.

“The absence of good conversation or proper society, the impossibility of going to the theater or hearing a good symphony concert” [Naipaul, 2002a] were the complaints from his ‘civilized’ friends. In addition, ‘Sandra battled on with her North London tongue’ signifies that there is a serious mismatch when it comes to life conditions in Isabella. She once said, “I suppose this must be the most inferior place in the world” [Naipaul, 2002a].

He then developed an interest in Negros in Isabella as pointed out to him by Deschampsneufs who says that the only hope for Isabella lay in the large-scale settlements of Asiaties. When the modern world was fast moving towards rational education, economic prosperity through technology and globalized setting deviating from local fantasies, Ralph thinks of (re)writing the Isabella history with the picturesqueness of the Negro slave population and their civilizational virtues. This mostly occurs to him “during the moments of stillness and withdrawal which came to me in the days of power” [Naipaul, 2002a]. Through (re)writing and (re)visiting history, Ralph’s nostalgic longing ‘to return to the past’ becomes obvious in the following statement, “I am like that child outside a hut at dusk, to whom the world is so big and unknown and time so limitless; and I have visions of Central Asian horseman, among whom I am one riding below a sky threatening snow to the very end of an empty world” [Naipaul, 2002a]. He tries to escape from a ‘deep, silent shame’ caused through generations of failures to a “homeland of Asiatic and Persian Aryans” [Naipaul, 2002a] which he visualizes over the bare mountains as far away as the North Pole. Then amidst the obvious failures, his narcissist fantasy projection towards his own ego becomes stronger when he
He further hangs on to the same dreamy Aryan land, “Chieftaincy among mountains and the snow had been my innermost fantasy. Now, deeply, I felt betrayed and ridiculed. I rejected the devotion that was offered me. I wished to fly, to begin afresh, lucidly” [Naipaul, 2002a]. Within the withdrawal from modern London life to the fantasy land of horsemen, Ralph tries to rediscover his delirium that cuts off from the actual life conditions and confirms the existence in his own specific world. The conjoining of spiritualism and positivism [Deleuze & Guttardi, 2000] that his father was trying to find in Hinduism becomes another ego-centric phenomenon for Ralph too when it comes to his rediscovery of spiritualism in the Asiatic phantasmatic. Nationalism was a good ideological vehicle for the purpose of seeking and rediscovering this lost glory, the lost essence or the lost fantasy. In the novel, the complex London reality quickly disappears and his old fantasy starts dominating as an avatar of his own soul. That is where Ralph keeps on refocusing on his own ego where the repeating I could restore his ability pronounce the hollowness that he (and his father) was experiencing. This neurotic symptom [Deleuze & Guttardi, 2000] starts affecting not only his unconscious but his practical (political) life. Such patience, according to [Deleuze & Guttardi, 2000], “becomes apathetic, narcissistic, cut off from reality, incapable of achieving transcendence” [Deleuze & Guttardi, 2000]. The Asiatic horsemanship and the glory of the past, spiritualism in Hinduism repeat several occasions in the novel. This neurotic ‘return’ is further materialized by Ralph’s father’s over-identification with Hindu sanyasi tradition while Ralph over-identifies with historical idealism of the Asiatic horsemen. Wherever these subjects received their education from or wherever they travelled, this ontological drawback and the deadlock of fantasy are the true failure of decolonization.

Homelessness as a New Opening

What if Ralph, as a politician who represents a Third World postcolonial nation, could attain a situation of total freedom; that he is fully free from all gazes or celestial cameras? What if his situation offers him an ‘absolute and unconditional freedom’ to choose whatever he wants for the sake of his own people (and for himself)? But could the postcolonial individuals understand this new form of freedom that was given to them? Could they realize that the force of colonization could detach them from tradition while the process of decolonization (post-independence) gave them a precious situation to reinvent themselves in a brand new universe? The postcolonial authors are in the opinion that things started deteriorating after the white masters left the former colonies and they project our present misery to the same European eye through postcolonial literature. Most importantly, the major postcolonial authors such as V.S. Naipaul, Salman Rushdie, Arundhati Roy, Wole Soyinka and Hanif Kureishi structure their literature in such manner that our follies, anti-democratic moves, religious chaos, barbarism, obstinacy and irrational authoritarianism (even totalitarianism) are reduced to some mysterious desire that always seek anti-enlightenment motives which are projected towards catering to the phantasmatic of the European reader. So, we are forever prisoners of the European gaze and the situation of vacancy that was created by abandoning us by the white masters was never effectively utilized as a new opening to create a brand new form of existential and aesthetic literary genre.

What if the abandonment of the white master itself is a new condition of freedom where, despite neo-colonial economic dependencies, the indigenous can make absolutely free choices? Do they realize that the postcolonial man ‘betrayed’ this opportunity because of some imaginary homeland of nostalgic nature? Because of their paranoia for failure and the sense of insecurity coupled with isolationism, they wanted a new form of subjectivity, legitimacy and acceptance from their former masters who tamed them for centuries and made their psychology dependent. This is the fundamental failure symptomized by Ralph in The Mimic Men. As Hegelian slaves, they were always afraid to experiment something new because they were scared of failures (or afraid of errors). According to Zizek, one must make free choices despite their inner potential of making serious mistakes. He says, “the error is immanent to the truth” [Zizek, 2005] and “the fear of error is error itself” [Zizek, 2005]. Despite the fact that failure is the first step towards success, it so happened because they were never trained to take risks by their own and experiment something truly new. They could only mimic what the white masters were doing centuries back and never occurred to overtake them in their own feet. Instead of hanging onto useless nationalization or welfare liberalization as imposed by the former colonizers, knowingly or unknowingly, the postcolonial politicians were offered a magnificent opportunity to ‘choose’ their own actions after independence. They did not try to ‘choose the impossible’ but resolved to mimic what the masters wanted.
them to choose. To choose what is already there to be chosen is always ‘a forced choice’ or, in other words, a choice already pre-conditioned for them to choose is not a choice at all [Zizek, 2011].

Conclusion

The semi-autobiographical novel The Mimic Men provides strong evidence about the ‘no-place-ness’ of a postcolonial subject whose existential crisis ends up in a deeper involvement in identity politics which is a common symptom in the postcolonial world. Though Ralph Singh leaves Isabella and settles in London, he never seemed to be ‘free’ to invent something path-breaking; something more existential and profound; something more modern that demarcates a radical break with the tradition. In a gesture of ‘returning to the past’ he revisits his nostalgic Asiatic fantasy when his existential crisis deepens in London. As far as this psychological returning to his primary fantasy is considered as ‘returning to an intimated core’, his interior becomes nothing but the postcolonial world itself. Based on this ‘deteriorritorialisation’ and re-narrating the reality on the basis of this geo-spatial shift, his memoirs and rewriting history can be compared to Naipaul’s own postcolonial ontology and writings. It can therefore conclude that the above ‘externalized intimacy’ is the ontological literary limit of many postcolonial authors. It has been rather difficult for them, including the most prestigious of them V.S. Naipaul, to use the very condition of alienation to create a more aesthetic and existential literature that can replace the present situational consciousness. Caught unconsciously in a form of master-slave dialectic, Naipaul and other postcolonial writers cater to the European fantasmatistic of their metropolitan readers. It is where subjectivity unconsciously enters into postcolonial fiction, and the unencompassible Otherness begins. For instance, the moment in which Naipaul starts projecting his postcolonial reality to the European gaze, his imaginative and creative energy to produce a brand new reality (different from that of his postcolonial experience or of the metropolitan existence) stops there. This means that they are never fully ‘out-of-joint’ from the world that they once left behind.

References


Influence of Storage Temperature on the Quality Parameters of Wheat Flour during Short Term Storage

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Abstract

Among cereals grains, wheat has high potential to produce gluten protein that imparts strength and elasticity to the dough that influences the texture of bakery products. Storage temperature has been shown to affect the quality attributes of wheat flour but only a few research studies were conducted to assess the influence of storage conditions on wheat flour properties. Therefore, a study was carried out to evaluate the influence of storage temperature on the quality characteristics of the wheat flour during short term storage. The freshly milled wheat flour from Prima Ceylon Private Ltd, Trincomalee were stored for 8 weeks at room temperature (35°C and the Relative Humidity of 50-60%) and air conditioned temperature (27°C and the Relative Humidity of 60-70%). The quality characteristics such as moisture, wet gluten, gluten index and ash content and biological characteristics of weevils count and total bacterial count of flour samples were evaluated at 2 weeks interval during the storage period. Moisture content decreased significantly (p<0.05) with the storage duration at both storage temperatures. Visco-elastic properties such as wet gluten and gluten index of flour samples decreased during storage and more markedly affecting the flour quality at room temperature storage. Biological and microbiological characteristics were influenced by storage temperature since the water activity was the main factor influencing their survival. Based on the study, the quality characteristics of wheat flour were better preserved during storage at air conditioned temperature of 27°C with 60-70% Relative Humidity compared to room temperature of 35°C with 50-60% Relative Humidity.

Key words: Gluten, rheological property, storage temperature, wheat flour

Wheat (Triticum aestivum) is one of the most commonly grown food crops in the world. Wheat was a key factor enabling the emergence of city-based societies at the start of civilization because it was one of the first crops that could be easily cultivated on a large scale, and had the additional advantage of yielding a harvest that provides long-term storage of food [Delcour & Hoseney, 2010]. The storage time and conditions have an influence on the technological quality of wheat and result in modifications of the flour parameters [Hrušková & Machova, 2002]. Milling is the process separating germ from bran and grinding the germ to produce. Milling aims to separate the anatomical parts of the kernel to produce flour with minimal inclusion of bran particles. White flour is made from the endosperm only. Flour composition and functionality determine product quality. A total of 57% of processed wheat flour is used in the baking and confectionery industry, 16% is used for domestic consumption, 17% for dough, 12% for cookies and 2% for the production of drugs, glue and animal feeding [Chang & Ferrari, 2014]. Wheat flour is a dynamic product with both constituent and functional requirements. The uses of flour are many and varied. Wheat flour contains high amount of starches, which are known as polysaccharides. The kinds of flour used in cooking include all-purpose flour, self-rising flour, and cake flour including bleached flour. Constituents such as protein and ash generally dictate the end-use of flour. The higher the protein content the harder and stronger the flour, and the more it will produce crusty or chewy breads [Stone & Morell, 2009]. The important quality parameters for wheat flour performance are moisture, wet gluten, gluten index, ash, weevils count and flour microbiology. The last parameters are the indicators of milling performance and flour quality of the wheat flour. Wheat flour quality is directly related to the wheat gluten formed by mixing the flour with water and with the use of appropriate application of mechanical work to form a visco-elastic network [Raza et al., 2010], whose structure is the basis for bakery and pasta products.

Gluten is a plastic-elastic protein fraction of wheat flour responsible for physical dough properties. It has been generally accepted that any increase in total protein content of the flour results in an increase in gluten content. It is important to note that the quantity of protein or gluten is not a measure for gluten quality. Gluten quality is characterized by the degree of extensibility and elasticity [Hoseney et al., 1986]. Technologists consider gluten as the functional part of dough which influences many product qualities. Although oat, rye, barley and triticale have gluten proteins in their nutritional composition, only wheat has sufficient amounts (8-20%) for the formation of a strong gluten network, which differentiates it from other cereals [Dendy & Dobraszczyk, 2009]. The quantity and quality of gluten is among the main parameters to be investigated in order to determine the quality of the
baked product. Therefore, in this present study efforts have been made to evaluate the changes occur in the parameters determining the quality of wheat under different storage temperatures.

**Methods**

**Sample Preparation**

This study was carried out at the Prima Ceylon (Pvt.) Limited, Chilinabay, Trincomalee. This company is milling wheat grain into wheat flour and distribute throughout Sri Lanka. Freshly milled wheat flour samples of 500g were placed in polypropylene bags of 20 x 10 cm and automatically vacuum packed using a sealing machine (Model: 400 T) in a way that no contaminants or insect infestations were allowed. The flour samples were stored for 8 weeks at room temperature of 35°C at the RH of 50-60% and at air conditioned temperature of 27°C at the RH of 60-70%.

**Evaluation of Physico-Chemical Quality Parameters of Wheat Flour**

**Moisture Content**

The wheat flour sample of 500 g was mixed thoroughly to get a uniform distribution of flour. The metal moisture cans were taken and weighed in an analytical balance (Mettler AE 200). Uniformly mixed 10g sample was taken in the moisture cans and the cans were placed in the oven at 130°C for 1 hour. The dry weight was recorded after cooling the cans in the desiccator for 15 minutes tills the cans are cooled.

**Wet Gluten Content (Glutomatic Method)**

Test chambers were assembled with metal sieves between persplex tube and perforated stainless steel bottom. The sieve was moistened thoroughly to achieve a capillary water bridge which prevents the water loss. Sample of 10 g was taken in test chambers; 5 ml sodium chloride salt solution was pipetted into the test chamber, and gently shaken to spread the mixture evenly allowed to be washed in gluten machine for 5 minutes. After the washing the test chamber was lowered and the washed wet gluten was taken and it was allowed for centrifugation for 1 minute. The centrifuged wet gluten was weighed and weight was converted to percentage multiplying by 10.

**Gluten Index**

Wheat flour samples of 10 g were taken in gluten test chambers and 15 ml sodium chloride salt solution was added. The contents were allowed to be washed in glutomatic machine for 5 minutes. After that, the washed wet gluten was taken and it was allowed for centrifugation. The wet gluten was taken from the centrifugation cups in a way that the portion remained inside the cup separately and the gluten which leaked outside the cup separately. Both portions were weighed and the gluten index was calculated.

**Ash Content**

Clean ash crucible was taken and their weights were recorded using a digital balance (Mettler AE 200). A flour sample of 5 g was taken in the crucible and the crucibles were placed in the electric muffle furnace at 600°C for 6 hours. Later the crucibles were cooled in a desiccator and weighed to get the ash weight of the flour.

**Biological Tests**

**Weevil Test**

The flour sample was subjected to sieving by 250 micrometer pore sized sieve. After that number of weevils present in the sieve was noted.

**Total Bacterial Count**

Microbial evaluation is essential part of food safety. Confidence in the food safety and integrity of the supply of good quality wheat flour is an important requirement for consumers. For microbiological test all sample were used in triplicate form. Microorganisms present in the flour samples were enumerated by mixing the sample solution with an agar media and incubated to form visible separate colonies. Potato Carrot Agar (PCA) media was used to investigate the bacterial population in this study. The Petri dishes were arranged for each dilution of flour sample \((10^1, 10^2 \text{ and } 10^3)\). Sample of 1 ml from each dilution tubes was pipette out and inoculated in petri dishes according to serial 10-fold dilution. Then about 15 20 ml PCA media was poured into the petri dishes and they were rotated first clockwise then anticlockwise. The culture was incubated under 350°C for 2 days and the colonies were counted by placing the petri dishes in colony counter.

**Results and Discussion**

**Physico-Chemical properties**

The results of the physico-chemical parameters with regard to the moisture, gluten index and ash of wheat flour sample under different storage temperatures are presented in Table 1.

**Moisture Content**

Grain moisture is one of the most important factors affecting the quality of flour. As evidenced by the results of the study in Table 1, the storage temperature has a significant effect on the proportion of flour moisture. The initial moisture content of the fresh milled flour was 13.6%. However, after 8 weeks, the moisture content of these samples was decreased to a 12.2% under room temperature storage and 13.0% under air conditioned storage, respectively. The moisture losses were low during air conditioned storage than room temperature storage. This may be due to high storage temperature that led to the evaporation of moisture from the part. It was reported by [Fellers & Bean, 1977] that the mois-
Influence of Storage Temperature on the Physico-Chemical Parameters of Wheat Flour

Table 1: Influence of Storage Temperature on the Physico-Chemical Parameters of Wheat Flour

<table>
<thead>
<tr>
<th>Storage Duration (Weeks)</th>
<th>Moisture (%)</th>
<th>Gluten Index</th>
<th>Ash (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R/T</td>
<td>A/T</td>
<td>R/T</td>
</tr>
<tr>
<td>0 (Fresh)</td>
<td>13.6\textsuperscript{b}</td>
<td>13.6\textsuperscript{b}</td>
<td>94.17\textsuperscript{b}</td>
</tr>
<tr>
<td>2</td>
<td>12.8\textsuperscript{ab}</td>
<td>13.2\textsuperscript{a}</td>
<td>92.25\textsuperscript{ab}</td>
</tr>
<tr>
<td>4</td>
<td>12.9\textsuperscript{ab}</td>
<td>13.2\textsuperscript{a}</td>
<td>92.07\textsuperscript{ab}</td>
</tr>
<tr>
<td>6</td>
<td>12.8\textsuperscript{ab}</td>
<td>13.1\textsuperscript{a}</td>
<td>91.07\textsuperscript{a}</td>
</tr>
<tr>
<td>8</td>
<td>12.2\textsuperscript{a}</td>
<td>13.0\textsuperscript{a}</td>
<td>90.01\textsuperscript{a}</td>
</tr>
</tbody>
</table>

R/T - Room Temperature 35°C and RH 50-60%
A/T - Air Conditioned Temperature 27°C and RH 60-70%
Values are means of triplicates.
Treatment means in a column having common letter(s) are not significantly different by DMRT 5%.

Cereal chemists are aware that not only quantity but also quality of gluten protein is an important component in producing good quality products. Thus, determination of gluten content is required to assess the quality of the wheat flour. The gluten index of the fresh milled samples decreased from 94.17% to 90.01% at room temperature storage and 94.17% to 92.19% under air conditioned storage. Storage at room temperature and duration significantly \((p<0.05)\) affected the gluten index of the wheat flour. The gluten index is the measure of gluten elasticity \([Raugel et al., 1999]\). Since the gluten content is the other important factor determining the baking purpose of the flour (flours with low gluten values are for cookies and biscuits purpose, flours with medium gluten content for cakes production and flours with high gluten values are for bread making purpose). If the gluten index is high that means the proportion of gluten released through the sieve is low indicating that the gluten quality is strong and strength is high. Under refrigerated storage conditions, the gluten index decreased during storage however, the changes was not significant \((p>0.05)\) from the initial value. Therefore, aging of flour caused the gluten index to show a steady decrease, thus the gluten quality remained unchanged during refrigerated storage of flour for 8 weeks. A high gluten index above 95% indicates strong gluten, while index values lower than 60% indicate flours too weak for bread production \([Violeta & Georgeta, 2010]\).

Wet Gluten Content

Among the wheat flour quality parameters, gluten strength is one of the important characteristics determining the industrial use of the flour for bread, cakes and pasta. As shown in the Figure 1, wet gluten content was affected by storage temperature and relative humidity.

The initial wet gluten content of the fresh milled samples was 39.5%. After 8 weeks of storage, the wet gluten content of the flour samples was dropped to 38.1% under room temperature storage and 39.2% under air conditioned storage, respectively. Under refrigerated conditions, the wet gluten content decreased during storage however, the changes was not significantly different \((p>0.05)\) from the initial gluten content of the wheat flour. Based on the values of the wet gluten, the quality of the wheat flour was not significantly affected during refrigerated storage of 8 weeks. \([Jennifer, 2013]\) reported that high temperatures \((>35°C)\) decrease the gluten quality as the gluten protein become less elastic and more brittle during storage at elevated temperatures for more than 2 weeks. As pointed out by \([Amjad, 1990]\) that the bad effect of high temperatures on the gluten due to increased break ties hydrophobic, which leads to bad influence on the strength of gluten.

Ash Content

The initial value of ash content of the fresh milled samples was 0.508g and it was increased up to 0.517g under room temperature storage and 0.51g under air conditioned storage, respectively. However, these increments are not significant. But at the end of 9th week the ash content of the flour sample stored under room temperature decreased to a lower value than the ash content under air conditioned temperature. That means under room temperature storage flour is bleached by the high temperature due to oxidation of lipids. So the ash content gets lower value.

Biological Quality Parameters

The weevil counts and total bacterial count under different storage temperatures are presented in Table 2.
Table 2: Influence of Storage Temperature on Biological Quality of Wheat Flour

<table>
<thead>
<tr>
<th>Storage Duration (Weeks)</th>
<th>Weevil Count</th>
<th>Total Bacterial Count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R/T</td>
<td>A/C</td>
</tr>
<tr>
<td>0 (Fresh)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

R/T - Room Temperature 35°C and RH 50-60%
A/T - Air Conditioned Temperature 27°C and RH 60-70%
Values are means of triplicates.

Figure 1: Influence of Storage Temperature on Wet Gluten Content of Wheat Flour

R/T - Room Temperature 35°C and RH 50-60%
A/T - Air Conditioned Temperature 27°C and RH 60-70%
Values are means of triplicates.

Weevil Test

According to the result from Table 2, the weevils were not observed in samples even after 8 weeks of storage under both storage temperature conditions. However, it is recommended that storing flour samples under air conditioned storage with the temperature below 15°C would give the best results and improve the shelf life of the wheat flour with acceptable quality [Kent & Evers, 1993].

Total Bacterial Count

The effect of temperature on flour bacterial count mainly depended on the flour moisture content at that time. It is proved from the past researches that the water activity plays a key role in the microbiology of flour, it is important to relate the flour moisture content to flour microbiology. The different storage temperatures influenced the bacterial count of flour samples differently. The initial bacterial count of flour was 470 at 13.6% moisture content. The results confirmed that both the storage temperature and storage time did not have a significant influence on the bacterial count of flour sample. The bacterial counts of sample were very low under both storage conditions from initially but the bacterial population at the end of 8th week under room temperature is lower than that in the air conditioned storage. Normally the bacterial population of the fresh milled sample should be in the range of 1000 to 100,000 per gram [Jennifer, 2013]. But the bacterial populations of flour samples under two different storage were lower
than 1000. This means that the microbial quality of the flour is good following 8 weeks storage.

Conclusions

The quality of the wheat flour is the main consideration of the wheat grain millers and bakers to get a high quality end product with a maximum keeping quality. The tested storage temperatures significantly influence on the moisture contents of the wheat flour during storage. Gluten index reduced during storage at both temperatures and this was more pronounced in the flour stored at room temperature of Room Temperature 35°C and RH 50-60%. The ash content was not significantly affected by the temperatures and the storage duration. There were no weevils observed in samples stored under both temperatures. The storage temperatures significantly influence the quality parameters of wheat flour and play significant role in aging process of the flour. It is important to take preventive measures for maintaining the gluten content unchanged and to safeguard the flour quality unaffected. Therefore, the freshly milled wheat flour could be recommended to store under air conditioned temperature of 27°C with 60-70% RH to maintain the flour quality characteristics at optimum level for better baking quality and to extend the shelf life.

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Investigation of L2 Motivational Self System: A Comparative Study of Undergraduates from Displaced and Resettled Regions in Sri Lanka

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Abstract

This study investigates the motivation profile of the L2 undergraduates in the disadvantaged communities in Sri Lanka based on L2 Motivational Self System. Undergraduates from rural and war affected resettled areas were considered as disadvantaged learners due to the lack of human and physical resources for their learning. The large scale questionnaire study was conducted among 918 Sri Lankan public university science undergraduates. They were non-English major students who voluntarily participated for the questionnaire survey. The collected data were analysed using the Structural Equation Modelling and models were developed to emphasise the key motivational factors. The results of the Structural Equation Modelling indicated the ideal L2 self as the strongest causative factor for learning English among rural and resettled undergraduates. The findings of the study reveal the strong ideal L2 self among the disadvantageous undergraduates in Sri Lanka. This study can be used for the theoretical and pedagogical implications, and future research in the similar Asian and South Asian contexts.

Key words: Displaced Learners, English Learning Motivation, Ideal L2 Self, Social Goals

Introduction

English learning motivation has been discussed in different contexts and raised the important consideration of the learner differences. Anyhow, English learner motivation based on the economical, regional and political issues seemed to be critical in the current English as a Second Language (ESL) world [Elabbar, 2016, Kormos & Kiddle, 2013, Lamb, 2012, You & Dörnyei, 2016]. More importantly, the factor identification of Sri Lankan undergraduates motivation to be made by prioritising history, national policies, environmental displacement, urban and rural di\-\vations and civil war experiences [Canagarajah, 2005, Davis, 2015, Liyanage, 2014].

The distribution of urban and rural population has greater implications for the methodologies of L2 motivation studies since there is a marked difference between learner ability yet when English is offered as a subject in universities, few students are motivated to perform well in the subject. Presently, there are studies in motivation within the qualitative tradition that seem to reveal far more about the concerns of the researcher and learner self than focusing on the learnability issue and then there are those within the quantitative tradition who often appear more concerned with statistical rigour and innovative procedures than the human stories behind their numerical data. This study provides a broader motivational perspective of the Sri Lankan science undergraduates by considering the regional differences and communal differences.

Recent studies have revealed that science postgraduate students’ English proficiency is inadequate [Raheem et al., 2007]. Specially, due to Sri Lanka’s structural dependency on the centres for research, for the communication of knowledge and advanced training from the developed countries [Altbach, 2005] English is highly valued. Presently, Sri Lankan science students have to heavily depend on the scientific publications of English speaking countries, because the world’s leading scientific publications are dominated by them [Tardy, 2004]. Sri Lankan science undergraduates’ lack of English competency is markedly seen through their inability to connect with the new scientific and technological innovations of the globalised world. One example is that Sri Lanka’s medical professions failed to transfer new scientific technology during the tsunami relief operation in 2005 [Baldsing, 2013]. Thus science undergraduates as the future gatekeepers of transferring new scientific knowledge to the Sri Lankan community need to be equipped with sound scientific knowledge and communication skills that are largely built in English. For that, an investigation into the English learning motivation of the science students is compulsory. Presently, no large scale quantitative study on the factors that affect the L2 motivation of Sri Lankan science undergraduates has been conducted. Existing studies have focused on identifying the importance of English and employability of graduates [Hayes, 2010, Punchi, 2001, Raheem et al., 2007, Raheem & Wijetunge, 2009, Ratwatte, 2012, Wedikkaraige, 2009, Weerasekara, 2014] but they have not involved large scale population sampling such as this. Any study has hardly looked at urban and rural and war affected factors. Currently, Sri Lankan science undergraduates’ English learning motivation cannot be simply identified through a common model due to the huge urban and rural disparity of the country. Sri Lankan undergraduates who are coming from rural and war affected areas have lacked
the opportunities to improve their English fluency due to the civil war, natural hazards and poverty. Further, the gulf between education policy and practice in Sri Lanka remains wide and mostly unbridged due to the lack of funds and political interference [Liyanage, 2014]. This situation has contributed to a lack of human and physical resources for rural schools and its population over time. Specially, 6.7% of rural learners attained the mastery of English compared to 21.6% of urban learners [UNICEF, 2013]. The failure of division of human and physical resources caused to marginalise and widen the gap between urban and rural [Davis, 2015, Liyanage, 2014]. According to the educational statistics, the rural and war affected schools belonged to the “uncongenial” or “very uncongenial” condition due to the lack of infrastructure and facilities [Ministry of Education, 2013]. Majorly, unequal distribution of teachers and lack of teachers make these learners more vulnerable [Davis, 2015, Liyanage, 2014]. Furthermore, the tsunami disaster (2005) and civil war (1983-2009) affected these rural learners’ education severely. Their education was disturbed by the closure of schools, displacement of families, distance to the schools, lack of transport, shortage of teachers and educational facilities and poor living conditions in resettled locations [UNICEF, 2013]. In addition, the Structural Adjustment Policies implemented by the Sri Lankan government in 1977 limited the education expenditure to less than 2% of the Gross Domestic Product. This has also caused the declining of quality of education and increased the urban and rural disparities in the education [Liyanage, 2014]. Specially, the war affected learners’ English learning was discouraged by the “Tamil only policy” for nearly three decades and they became more vulnerable due to the tsunami hazard in 2005. In fact, the disparity between urban and rural is wide in their English learning due to the lack facilities and teachers, although sufficient studies have not been conducted to address the real context of those issues. These have implications for their English in the university and academic performance when English happens to be the medium of instruction. There is also a need to gauge from the grassroots themselves the type of English that is being valued by Sri Lankan rural and war affected science undergraduates.

Researchers often found the impact of weak English competency to handicap the Sri Lankan science undergraduates in the academic performance and future career [Raheem et al., 2007, Raheem & Wijetunge, 2009, Weerasekara, 2014]. Weerasekara et al. (2014) stated that students find problems in understanding lectures, practicals, demonstrations and communication at the university and this has strong implications for their final grading. Thus, English learning motivation is crucial to their academic performance in the university and the future professional career of the Sri Lankan science undergraduates. Given that English has become the Lingua Franca of sciences in the modern era [Tardy, 2004], effective communication skills in English remain compulsory for undergraduates in general and science undergraduates in particular. Presently, Sri Lankan science undergraduates are lacking communicative skills even in their mother tongue [Baldsing, 2013] and the situation is worse for English which is recognised as the second language but rarely spoken in some parts of the island.
One of the bigger challenges in understanding learner motivation specific to a particular setting would be the need to relate the learner to the social context in which he/she exists. In this matter, the study of motivation has often focused on motivation as an individual goal [Kormos et al., 2011], communal or family goals [Csizér & Kormos], performance goals and personal interest; where some learners were either motivated not due to the specific reasons and this often affected the learner’s performance over time. In recent years, greater consideration has been given to the dynamic, social nature of motivation, looking at how motivation changes over time and in response to social context [Islam et al., 2013, Prasangani & Nadarajan, 2015]. The primary aims of this study is to adopt a research framework that uses both the learners’ psychological factors and social factors. It also seeks to respect previous research coming from a variety of perspectives in the social sciences. Many of the advances in L2 motivation theory have resulted from research concentrating on a single aspect of the motivation process but in this study the researcher wishes to contribute to building a model that considers the broader picture of language learning motivation, displaced learner motivation and war affected community’s motivation. Presently, a number of factors such as Ideal L2 self [Dörnyei, 2009]; motivated learning [Taguchi et al., 2009]; ought to L2 self [Taguchi et al., 2009]; attitudes toward L2 learning [Papi, 2010]; attitudes toward L2 community [Islam et al., 2013] motivate learners to learn and master English. Here educators and society value motivation in learning for its own sake as well as for its long term contributions. This includes integrative and instrumental motivation which have consequences for the individual learner’s self-esteem, confidence, career and academic achievement. The literature on motivation may be plenty spanning from preschool to private English language education, but the bigger challenge is to understand how the learner motivation specific to a particular setting relate to the learner’s social context in which he/she exists. In this matter, this study focuses on motivation as individual goals, regional goals and communal goals.

In covering the factors that motivate Sri Lankan undergraduates, decisions have had to be made about which areas to prioritise since history, national policies and environmental displacement have created differences between urban and rural population for decades and the learning environment is making it necessary to identify the similarities and differences between learner factors and learner ability [Canagarajah, 2005, Davis, 2015, Liyanage, 2014]. In making decisions about the rural and urban learner population every effort has been made to stay as close as possible to the Sri Lankan government’s classification of the urban and rural based on the regional divisions [Department of Census and Statistics, 2011]. The distribution of urban and rural population has greater implications for the methodologies of L2 motivation studies since there is a marked difference between learner ability and yet when English is offered as a subject in universities, few students are motivated to perform well in the subject. At present, there are studies on the issues of learnability and statistical models than the true stories behind the data. This study provides a broader motivational perspective of the Sri Lankan science undergraduates by considering the regional differences and communal differences.

This study attempts to find empirical evidence for the rural and war affected (resettled) university students’ motivated learning behaviour and factor effects. More specifically the following research questions will be addressed by the study.

1. What are the key motivational factors affect for the English learning motivation of the rural learners?

2. What are the key motivational factors affect for the English learning motivation of the displaced and resettle learners?

The primary objective of the study is to use the L2 Motivational Self System to investigate the relationships between the L2 learner’s self and social factors that influence in English language learning.
Gardner’s (1985) pioneering socio-educational model has highlighted integrativeness as the key motivator of L2 motivation. However, Gardner’s (1985) model has questioned lately due to the difficulty of explaining L2 motivation via integrativeness. Dörnyei (2009) reformulated Gardner’s study and developed a new model to explain L2 motivation based on the learner self which was more meaningful for the globalised L2 learners. Dörnyei’s (2009) L2 Motivational Self System has greater relevance for the Sri Lankan ESL context due to the changes happened after the globalisation.

Dörnyei conducted a large scale study of 13,000 Hungarian learners to find the L2 motivation of the global English learners. This study reformulated the integrativeness and instrumentality as “ideal L2 self” and “ought to L2 self”. Dörnyei (2009) designed the L2 Motivational Self System including ideal L2 self, ought to L2 self and learning experiences as a result of the longitudinal Hungarian study.

Methods

Data were collected from a motivation questionnaire based on Dörnyei’s L2 motivation self-system. The collected data of 918 students from two Sri Lankan public universities were analysed. Table 1 provides the demographic profile of the participants. The sample comprised of urban (n= 538) and rural (n= 380) undergraduates from various science programs. There were more female participants (55%) compared to male participants (45%). The present study used Strctural Equation Modelling as the major statistical method to create the models for Sri Lankan undergraduates based on the regional and communal differences.

Results and Discussion

The model in Figure 1 established the ideal L2 self to be the strongest causative factor for learning English in Sri Lanka. In accordance with the results, chi-square was significant at p<0.001 due to sample size. The model fit measures of Goodness of Fit (GFI) 0.921, Root Mean Square Error of Approximation (RMSEA) 0.043, Standardized Root Mean Square Residual (SRMR) 0.075, Root Mean Square Residual (RMR) 0.078, Comparative Fit Index (CFI) 0.919 and Adjusted Goodness of Fit (AGFI) 0.895 met the traditionally accepted measures. Further, the model has established a good fit with the norms × 2 of 2.672. Interestingly, the model also indicated a significant difference between the urban and rural youths behaviour with rural youths displaying a very strong ideal L2 self compared to urban youths at 0.89 and 0.35 respectively to the motivated learning. In other words, there is a positive relationship between the ideal L2 self and motivated learning behaviour.

The second SEM model looked at war affected and non-war affected students’ motivated learning behaviour (See Figure 2). In accordance with the results chi-square was significant at p<0.001 due to sample size. The model fit measures of GFI (0.918), RMSEA (0.044), SRMR (0.090), RMR (0.085), CFI (0.911) and AGFI (0.891) met the traditionally accepted measures. Although SRMR value is higher than the accepted cut off value of 0.08, its value is below 0.10 which does not indicate problems for the model [Hair et al., 2014]. Further, the model has established its good fit with the norms × 2 of 2.812.

The data indicated significant differences between war affected versus non war affected youths. The ideal L2 self remained the strongest causative factor for learning English for all. The youths whose came from war affected regions demonstrated a stronger ideal L2 self compared to the non-war affected youths. Social goals remained an equally strong factor for war affected learners suggesting that social milieu had not affected learner’s motivation for learning English.

The third SEM model relates factor effects for the motivated learning of rural Tamil and Sinhala (see Figure 3). The results of chi-square was significant at p<0.001. The model fit measures of GFI (0.849), RMSEA (0.055), SRMR (0.091), RMR (0.090), CFI (0.876) and AGFI (0.813) met the traditionally accepted measures. In accordance with the results the ideal L2 self was seen as the strongest causative factor for learning English amongst both groups. However, the rural Tamil L2 learners relationship between ideal L2 self and motivated learning compared to the rural Sinhala L2 learners was much higher at 0.85 compared to the Sinhala speakers which was only 0.65. In terms of social goals and the ideal L2 self, the Sinhala learners were greater than Tamil learners as 0.72 compared to 0.62. However, the relationship between social goals and motivated learning for the Tamil learners suggest a negative correlation suggesting the Tamil learners and the rural population in general did not associate social goals with doing well in English as necessarily translate into gainful employment. The scars of the war may still be a bitter reminder for many of these young people. In terms of attitudes, the rural Tamil L2 learners indicated a stronger relationship between performance goals and attitudes towards learning English at 0.61 compared to Sinhala learners who only show a 0.16 correlation. In terms of performance goals and attitudes towards the L2 community, both rural communities seem to demonstrate a high coefficient at 0.66 and 0.55. In terms of attitude towards the L2 community and motivated learning, the coefficient value was at 0.27 for the Tamils compared to 0.07.

Taken together, all three groups continued to demonstrate the ideal L2 self to be the strongest causative factor for Sri Lankan undergraduates. Also, performance goals, social goals, ideal L2 self, attitudes towards learning English, attitudes towards the L2 community contributed to motivated learning.

Sri Lankan science undergraduates’ ideal English speaking self showed significant difference due to the regional variation. Interestingly, the results indicated
the strongest ideal L2 self among the rural science undergraduates ($\beta = 0.89$). This is in contrast with the other Asian motivation studies conducted in Indonesia [Lamb, 2012] and China [You & Dörnyei, 2016] where they found a strong ideal L2 self among the urban learners and weak ideal L2 self among the rural learners due to the limited resources and exposure. This might be because in Indonesia and China English is a foreign language, but in Sri Lanka English is a second language and also it is a Link Language for the inter-ethnic communication. Further, English learning has a significant historical setting in Sri Lanka compared to the settings of Indonesia and China. Added to that the selection of the science undergraduates may cause to have a different result in Sri Lankan context.

In Sri Lankan context rural learners seem to be different from the other Indonesian and Chinese English learners due to the historical learning experiences they gained from the British colonial period (1796) onwards. From the British period onwards the linguistic capital of English happened to be a limited resource for the rural learners and it was a “prestigious language” of urban elites. Further, the rural community had been disconnected from the social, economic and cultural capital of the country due to the lack of English fluency [Bailey, 1998]. Further, they were “marked” as inferior among the urban elites [Fernando, 1977]. This continuous demarcation and marginalisation led rural learners to form strong ideal L2 self, or need of communicating in English because they have realised that English competency is the only way up for the social mobility of Sri Lanka since English happened to be the linguistic capital of the country.

Additionally, the recent ethnic violence they have experienced during their schooling have created some necessary conditions to motivate their English learning due to the various guises of capital attached to English and English is the only way to move up in the society. However, for Sri Lankans English happens to be the only way up and out. Further, it cannot be denied that the reason that the majority of rural Tamil and Sinhalese asylum seekers choose English speaking Australia and Canada as their destinations is because of this valuation of cultural capital. This would also be a fine reason to have a strong ideal L2 self.

In addition, the globalisation and information technology revolution had changed rural learners’ anti-English attitude of considering English as a weapon or “kaduwa” (sword) of oppression [Kandiah, 1984], because English became the global language [Dörnyei & Ushioda, 2011] and language of their own to express their feelings among the community members rather than a “colonial baggage” [Bernaisch, 2012].

Further, the expansion of the usage of mobile phones and social media (especially Facebook) among the young generation in Sri Lanka also caused the strong ideal L2 self. In fact, they have realised English is the only key to connect with the global community and information technology.

Added to that, the compulsory English medium instruction in higher education also brought about their strong ideal L2 self, because in Sri Lanka science students have to follow the compulsory English medium. In fact, to retrieve advanced and new scientific information English happens to be the only way. Additionally, science students’ desire to go overseas for postgraduate studies and work also remarkably influences for their ideal L2 self, because they lack ample science postgraduate opportunities in Sri Lanka.

Moreover, rural learners realised the inadequacy
of the vernacular languages to survive in the local and international contexts due to English functions as the economic and symbolic capital of the country [Canagarajah, 2005]. From the British colonial period onwards English happened to be the symbolic and economic capital of the country, eventhough the nationalistic movements occurred against the dominance of English and protect the national languages. English proficiency enables people to gain lucrative positions in the country after the independence [Rajandran, 2009, Senaratne, 2009]. Furthermore, the introduction of the “liberal economic policy” (1977) and “link language” policy in 1987 further confirmed the symbolic importance of English in the country to gain economic success and social success, because government sector jobs are limited and English dominated private sector started to dominate the economy of the country. Thus English happened to be the economic and symbolic capital of the country and rural learners cannot deny its importance.

Added to that the strong English speaking self or ideal L2 self of the rural science undergraduates implies their English learning goal. Specially, they lack the supporting family background and supporting school learning environment to improve their English. In fact, they expect to accomplish their English learning goal in the university and the failure of achieving the goal may handicap their future opportunities and country’s development. Thus, finding is critical for the pedagogical practice of the country, because this uncovers the context specific local knowledge [Canagarajah, 2009] of the Sri Lankan rural English learners’ need. This knowledge is vital in motivating the English learning further by “knowledge partnering” [Eversole, 2015] rather than importing foreign models. In fact, pedagogical practice should be framed to protect and maintain the ideal L2 self of the rural learners to achieve their expected learning goals.

Furthermore, Sri Lankan science undergraduates’ English learning needs are different due to the war torn and non-war torn of the country. In general, for both groups the ideal L2 self appears to be the strongest causative factor for their English learning motivation, but notably war affected and rural Tamil science undergraduates have stronger ideal L2 self compared to the non-war affected science undergraduates. A majority of these learners came from the Tamil monolingual community that was caught in between the globalisation era and the military rule. Further, their parents and siblings probably lost the socio-economic and educational opportunities of the country compared to the rest of the other non-war affected community. Added they faced bitter experiences, deprivations and difficulties during the civil war period of the country. There was awareness on English learning but there was no development of English teaching during the civil war period [Canagarajah, 2005]. Specifically, these learners did not meet the national requirements of the Sri Lankan education system. Within such a circumstance English happens to be the only way for these learners to rise from the ashes by gaining the socioeconomic power of the country. This situation has created a strong ideal L2 self among the war affected science undergraduates. Thus for these war affected learners learning English is the only way up to gain the empowerment of the country. Further, they have realised the invalidity of the Tamil diaspora due to the loss of military power and naturally they were motivated to English learning due to the empowerment attached to it. Further, they have realised the possibility of challenging the disadvantaged social conditions with English education. Specifically, the caste based rigid social mobility among the Tamil community [Canagarajah, 2008] is a big challenge for them.

Further, these participants were schooling during the civil war period in northern and eastern areas of Sri Lanka. During this period they were subjected to the Tamil monolingual regional policy and restricted to the usage of “pure Tamil” [Canagarajah, 2005]. Thus these learners had limited opportunity to learn English. On the other hand, the military war caused the displacement of civilians, disruption of education, unspecified number of deaths and injuries, including children, teachers and their family members. As a result of the war, up to 300,000 people were held in refugee camps [Save the Children, 2013]. Thus, civil war has done unlimited psychological and physical damages for these learners. Furthermore, after the end of civil war in 2009 these learners had to face the challenges of global and local requirements of English. In one way English happened to be the key for “nationism” of Sri Lanka to create the harmony between the inter-ethnic communities [Lim, 2013, Rajandran, 2009] and in the other way English is the economic and symbolic capital of the country [Canagarajah, 2005].

In addition, English could be a weapon for the war affected Tamils to defend themselves against the majority language [Annamalai, 2004] of Sinhala. English proficiency would be able to provide them the opportunity to gain the economic capital and empowerment of the country. Thus for them Sinhala is an invader and English is a “protector” or “virus protection system” [Schifffman, 2005] to survive in the Sri Lankan linguistic, economic, political and social context.

Further, war affected learners have motivation to learn English, because the universities located in the other parts of the country conducted all science degree courses in English, they have to sit for the competitive examinations in English, and they have to communicate with the majority of the country by using English. In fact, English happens to be the compulsory medium to proceed their activities in the country.

These factors critically influence the formation of a strong ideal L2 self or speaking self of the war affected science undergraduates. Specifically, the effects of the civil war and their minority condition in Sri Lanka motivate them to learn English. In addition, war affected
and rural Tamil science undergraduates’ attitudes toward learning English is also higher than the non-war affected learners. This might be because these learners have to depend on the classroom learning experiences due to the lack of their parents’ support. Further, the Tamil monolingual policy during the civil war period totally restricted the wider exposure to the English language. Thus they value classroom learning more than the non-war affected learners. This has demonstrated in the descriptive analysis via the favourable attitudes toward classroom learning experiences.

Furthermore, war affected and rural Tamil science undergraduates’ attitudes toward L2 community have a contribution to their English learning motivation. This shows their favourable attitudes toward the English speaking countries like Australia, Canada, United Kingdom and etc. where they can seek the educational and professional opportunities. They see these countries as their future success in education and profession. In fact, they see these countries and people as global leaders. They may believe that migration is a solution to gain the economic and social capital they lack in the country and English as a “source of empowerment” [Canagarajah, 2008] for them. This context motivates the war affected learners to learn English more than the non-war affected learners.

In addition, war affected and rural Tamil learners’ performance goals are higher than non-war affected learners. This is because these learners have to compete with the non-war affected majority of the country in every aspect of life. Since they understood English as their “protector” they try to be fluent more to survive in the country by defeating the socioeconomic and political barriers.

The findings related to the war affected learners cannot be denied in the education policy and language policy planning of Sri Lanka. This local knowledge reflects the true feelings and needs of these learners who suffered socially, economically and politically from the British colonisation onwards. Thus knowledge partnering and community partnership are essential for social innovation of Sri Lanka to heal the damages of the history and work together as a plural society. Further, at this stage it is worthwhile to pay special attention to the applicability of the existing university English courses to meet the needs of war affected science undergraduates because short term (30 hours) university course seemed to be inadequate for these learners.

**Conclusion**

This study used L2 Motivational Self System to investigate the factors affect for the L2 science undergraduates’ English learning motivation based on their regional and communal differences. The Ideal L2 self is established as the strongest causative factor for learning English amongst rural and war affected Sri Lankan science undergraduates. Social goals remained as an equally strong factor. Besides that, performance goals, social goals, attitudes towards learning English, attitudes towards the L2 community appeared as the contributing factors for undergraduates generally. In sum this study highlighted the stronger ideal L2 self among the Sri Lankan undergraduates from disadvantageous regions including rural and war affected (resettled).

**References**


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Appendix - Motivational Questionnaire

Motivated Learning

1. If an English course was offered for my course at the university, I would like to take it.
2. If an on-line English course was offered for my course at a western (US/UK/Australia) university or in western institute (British council, US embassy, Australian High Commission and etc.) during my course, I would like to take it.
3. I am prepared to spend a lot of effort in learning English for my major subjects.
4. I think that I am doing my best to improve English at the university.
5. I would like to improve my English via social media.
6. I enjoy learning English from reading magazines and newspapers.
7. I enjoy learning English from listening to English songs.
8. I enjoy learning English from watching English movies.
9. If I have access to English-speaking TV stations (Dialog/Peo TV) and movies, I would try to watch them often.
10. I really want to improve my English at the university.

Ideal L2 Self

11. I can imagine myself studying in a Sri Lankan university where all my courses are taught in English and spoken in English.
12. I can imagine myself writing e-mails/letters fluently in English.
13. The things I want to do in the future involve English.
14. I often imagine myself as someone who’s able to speak good English.
15. I want to be the kind of Sri Lankan who speaks English fluently.
16. I see myself one day communicating in English with western speakers.
17. Studying English is important to me because I would like to become close to L1 (US/British/Australian & etc.) speakers of English.
18. Studying English is important to me because I would like to become close to L2 (Sri Lankan/Malaysians/Indians & etc.) speakers of English.

Ought to L2 Self

19. I have to study English, because, if I do not study it, I think my parents will be disappointed with me.
20. My parents believe that I must study English to be an educated person.
21. It will have a negative impact on my academic, professional and social life if I don’t learn English.
22. University students are required to learn English well.

Social Goals

23. Studying English is important to me in order to attain a higher social respect in Sri Lanka.
24. Studying English can be important to me because I think it will someday be useful to have a good job and/or to earn money in Sri Lanka.
25. Studying English can be important to me because someday it will be useful in business communication in most of the English speaking countries.
26. I have to study English; otherwise, I think I cannot be successful in my profession.
27. Studying English is important to me because I don’t want to be seen as a less educated person in Sri Lanka.
28. Knowledge of English would help Sri Lankans to represent country in a better way before other nations globally.
29. Knowledge of English language is necessary for Sri Lankans to benefit from the scientific development in the world.
30. Competency of English language is necessary for me to contribute to the national development of Sri Lanka in a better way with the international community.

Mastery Goals

31. Studying English is important to me to be a well-informed person in Sri Lanka.
32. Studying English is important to me so that I can broaden my outlook about the world.
33. Studying English is important to me so that I can read English books, newspapers, or magazines in my working place.
34. Studying English is important to me because an educated person is supposed to be able to speak good English.

Performance Goals

35. I have to learn English because it is compulsory to obtain my degree.
36. I have to study English in the university because I don’t want to get bad marks in it at university.
37. Studying English is important for me because I think I’ll need it for further studies on my major.
38. Studying English is necessary for me because I don’t want to get a poor score or a fail mark in English proficiency tests (IELTS/TOEFL).

Attitudes Towards Learning English

39. I like the atmosphere of my university English classes.
40. My English course should be in the first year.
41. My English course should be in the second year.
42. My English course should be in the third year.
43. I find learning English is really interesting at the university.
44. My university English teachers make lessons really interesting.
Web-based Decision Support System to Evaluate the Living Conditions: A Case Study of the Colombo City

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Abstract

Colombo city hosts almost eight hundred thousand people from various parts of the world and it is one of the fastest growing cities in the Asian continent. The city subjects to heavy migration because of urbanization. Due to this reason, the living conditions also vary from place to place in the city. The immigrants are often concerned about their mobility and accessibility to different civic services. Hence, selection of a living area becomes an important factor for an inhabitant physically, mentally and financially. However, systematic methodology has not been implemented to evaluate these living conditions. This study explicates utilizing of hotspot analysis and Network Analysis extension of ArcGIS to extrapolate crime and the accessibility to six fundamental civic services including education, healthcare, public parks, shopping centres and emergency response (fire fighting and ambulance) from different neighbourhoods of the city. Weighted overlay approach is utilized to aggregate above the criteria and find the most inhabitable neighbourhoods in the city. The study indicates the best area as “neighbourhoods with least crime and easiest accessibility to all mentioned fundamental services”. Accessibility to each civic service is calculated by the service area and converted to a raster data which further aggregates them into a single raster using the above mentioned weighted overlay approach. After exporting the graphical model as a python script, the system is further developed to handle and return the dynamic influence rate based on the user inputs and ultimately the user obtains results for the best area. Then, the generated map automatically gets uploaded into the geo-server and the users can view the final liveability map on a dedicated web platform. Based on the approaches such as network analysis, multi criteria evaluation and decision support system, this study assists in selecting a neighbourhood on the basis of selected criteria by a particular user and also helps urban planners to identify design gaps in urban areas related to each criteria.

Key words: Decision Support System, Living conditions, Network Analysis, Web GIS, Urban planning, Accessibility analysis

Introduction

Developing countries in the world are undergoing a rapid urbanization process. According to the report presented by United Nations Department of Economic and Social Affairs (2014), 54% of the world population lives in urban areas and that percentage is expected to be increased upto 66% by 2050. Majority of the expected urban growth will be found from the developing countries of Asia and Africa. In the context of Sri Lanka, Colombo city is the most populated city in the country. Figure 1 demonstrates the growth of population over the previous census years which illustrates a steady increase in the population within the Colombo Municipality area. However, since the 2012 census enumeration was done based on normal residency, the population in 2012 appears to have decreased by 85,786 persons between 2001 census and 2012 census.

As a result of the population growth, populated areas are expected to face numerous challenges in meeting the fundamental needs of urban population such as housing, infrastructure, transportation, energy and employment as well as education and health care. Due to the huge competition for limited resources, the urbanization process causes adverse effects towards society. Rapid migration and housing construction result in overcrowding and spreading of slums, which cause serious issues like poor sanitation, poverty, increasing of crime rates and unemployment rate. On the other hand, the demand for vital natural resources is increasing and cause environmental sustainability problems due to population growth.

Accessibility to the civic services and clean environment is a factor that inhabitants usually consider when selecting a place to live. According to Raghaven-dran (2001), selection of living areas becomes a vital factor as it affects a person physically as well as emotionally. Penchansky & Thomas (1981) defined the accessibility as “a concept representing the degree of fit between the client and the system”. According to the work of Aday & Anderson (1974) travel distance is a physical barrier for healthcare accessibility. Zhu et al. (2005) mentioned that accessibility represents the ease with which activities may reach from a given location by means of a particular transportation system. Inouye & Berry (2008) analysed the elements related to bike-way infrastructure close to schools for a case study of three middle schools in Washoe country Nevada by using the GIS system. To evaluate the geographic accessibility using GIS several models are used including Euclidian distance, Thiessen polygons and cost path Analyses [Brabyn & Skelly, 2002]. Kalogirou & Foley (2006),
formed the approachability to the Irish acute hospitals along with the support of a GIS framework. They conducted this research corresponding to the Hanly report, which was modelled by the Irish government to regroup the major, general and local hospitals. Ohta et. al. (2007) have followed the Analytical Hierarchy Process (AHP) and GIS to upgrade the geographical approachability to the neurosurgical hospitals in Japan for the aged people.

In the method followed by Zhu et al. (2005), they made use of the multi criteria analysis (MCA) approach in order to evaluate the approachability to various factors for housing development. They interviewed 500 residents and briefed their responses to measure the average score of every factor and its ranking. According to the results of housing approachability criteria, a particular

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**Figure 1:** Colombo Municipal Council population growth (Source: Department of Census and Statistics, 2012)

**Figure 2:** Research study area (Source: GIS unit of Colombo Municipal Council, 2017)
conclusion formula was developed with the support of a multi-criteria analysis tool developed by JavaAHP.

Even though many people have conducted research on assessing living conditions and introduced many methodologies to evaluate living conditions, one of the common drawbacks is that the weight for each criterion is based upon analysing a particular questionnaire. On the other hand, using a questionnaire to collect data may have several disadvantages. Respondents may not be 100 percent truthful with their responses as they attempt to protect privacy and protect personal identity. Since living conditions are specifically based on personal requirements, individual decision making based on a sample dataset is neither acceptable nor reasonable. Therefore, in order to get an unbiased result for the living conditions, influence rate of each criterion should be dynamic according to the individual user requirement. According to Jankowski (1995), the role of GIS in spatial decision-making should aid the decision-maker in designating priority weights to the criteria, to evaluate the feasible alternatives and to visualize the results of his/her choice.

Web-based GIS systems is a type of distributed information system, having at least a server and a client, where the server is a GIS server and the client is a web browser, desktop application, or mobile application. Web GIS trend has been emerged for years and significantly reached to a whole new level. According to Szukalski, (2015) It’s no longer is the question “if” or “when” to embrace Web GIS, the question now is “how” to leverage the new opportunities and workflows it enables. Zhang et al. (2015) developed a prototype Web-based Decision Support System for watershed management. They have used distributed hydrological models to evaluate the effectiveness of reducing non-point source pollution. Higher Secondary Education Board of Nepal use GIS as a tool for Educational DSS to manage information of half a million students [Banskota, 2009].

King Abdul Aziz university hospital and King Faisal Specialist hospital has established Saudi national diabetes registry. Subhani & Al-Rubeaan, (2010) designed the registry with the goal to provide information of the extent and diabetes types, complication and treatment in the Kingdom. The registry is a web-based GIS system which offers data about the patients and their geographical location.

The concept, which lies behind this study, was borrowed from the study of Raghavendran (2001) which is extended here. He utilized a MCA to develop a Decision Support System (DSS) to upgrade the residential apartments located in the city of Chennai in India. He took the use of ten points and ranked them on a scale of ten variations. These factors consist of the approachability to city centre, education, railway stations, bus stations and health care services. The research also considered the convenience of some services such as groundwater, metro and sewerage system. The result of Raghavendran’s study is a DSS, which opens the horizons to buyers and sellers in making immediate and appropriate decision in choosing a site for a home. As explained above one of the drawbacks in this methodology is that the weights are specifically based on a sample of users. Therefore we have implemented the decision support system in such a way that users can change the influence of each criteria based on his/her
Table 1: Important fields in network dataset

<table>
<thead>
<tr>
<th>Field name</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-way</td>
<td>Represent traffic flow direction. Values in this field are FT, TF, and NULL.</td>
</tr>
<tr>
<td>– FT</td>
<td>Vehicles flow toward digitized direction</td>
</tr>
<tr>
<td>– TF</td>
<td>Vehicles flow opposite to digitized direction</td>
</tr>
<tr>
<td>– NULL</td>
<td>Vehicles flow both directions</td>
</tr>
<tr>
<td>Class</td>
<td>Represent class of the road. In here 3 main types.</td>
</tr>
<tr>
<td>– Primary</td>
<td></td>
</tr>
<tr>
<td>– Secondary</td>
<td></td>
</tr>
<tr>
<td>– Local</td>
<td></td>
</tr>
<tr>
<td>SHAPE_length</td>
<td>Represents road segment length in meters. This field used to evaluate length based analysis (Shortest path between two points)</td>
</tr>
<tr>
<td>Time</td>
<td>Represents number of seconds require to travel certain road segment</td>
</tr>
<tr>
<td>Address</td>
<td>Represents name of the roads.</td>
</tr>
</tbody>
</table>

requirements. Finally, the user can visualize the results based on his/her unique requirements. According to research done by Zamorano et al. (2009) ArcGIS network analyst extension effectively model transport base spatial analysis. Therefore, DSS was implemented by using ArcGIS network analyst extension as the core ArcGIS library to assess the accessibility to the educational facilities, health care facilities, markets, shopping malls and emergency services like fire and rescue services, ambulance services whilst multi criteria evaluation use to aggregate service area maps to find the best areas in the city. In this study, the term “Best” refers to the area which is accessible from the particular services defined by the user on the web environment. There could be number of services that cause liveability of inhabitants and these services differ from person to person. Based on different researches carried out in this field, certain services have been more prominently highlighted than the other services. Hence, these highlighted services have been used as parameters for the study.

Methods

This study is based on the methodology of accessibility analysis to different civic services and then aggregation of the results from accessibility analysis to interpret the “best” areas in the city. Nevertheless, the term “Best” does not explain being a qualitative term yet it varies from person to person. Albeit, this study prefers to use the term “Best” that indicates the area with the most accessibility to all the civic services.

Study area

Colombo is the largest and the fastest growing city in Sri Lanka and is also known as the financial and the commercial capital of the country. Colombo’s geography is a combination of water and land. According to CIA’s (Central Intelligence Agency) world fact book (2018), the city has many canals and in the heart of the city there is a 65-hectare (160 acre) distinctive Beira Lake, which was used for centuries by colonists to defend the city. Besides, it has many environmental issues including coastal degradation from increased pollution; freshwater resources being polluted by industrial wastes and sewage runoff, inadequate waste disposal and air pollution. According to 2012 census enumeration report, Colombo municipal council area is about 37.29 km², with a population of 561314 and a population density of 13364 people per km². As illustrated in Figure 2, Colombo Municipal Council (CMC) is divided into 5 major administrative districts which are further divided into 47 wards for administrative purposes.

Criterion Identification

When considering the living conditions every person has his/her own requirements and priorities for choosing a neighbourhood for living. Also, it is essential to get information about peoples’ necessities for defining a suitable neighbourhood for living. Therefore, a public survey was conducted to get the first-hand information on peoples choices. Current study mainly takes reference from the studies done by previous researchers to identify criterions for the analysis.

According to the public survey results, most people are interested to live in a low crime neighbourhood. By researching the crime rates and statistics for various areas, people can learn more about the safety of a town or neighbourhood. Therefore, crime statistics were taken as a criterion in this research.

Raghavendran (2001) conducted a survey in India to get the choices of people to locate a place for a housing project. The field survey results demonstrated that peo-
people are more concerned on proximity to educational services and hospital services. Zhu et al. (2005) conducted a similar questionnaire in Singapore and got priorities for selecting a housing location. Results of the questionnaire demonstrated, 8 different criteria far more important than other. These services included shopping centres, health care public transport, banks, schools, community centres, post offices and parks. ESRI, et al. (2008) used GIS to analyse the approachability to green areas in Leicester city to various ethnic and religious communities. They made use of the network analysis to contrast between the green spaces accesses by different religious groups with benchmark standards for the delivery of green spaces in United Kingdom.

However, according to the human geography experts, certain services like emergency services, health care and educational services are more important and common for everyone. Therefore, the most common services that are important to everyone on daily basis (Schools, Green spaces, Hospitals, Emergency services) were considered in this research work. On the other hand, a number of services were kept limited due to unavailability of primary data (Noise, Traffic density, public transport, air quality). Most importantly, the current study provides a Decision Support System for the users to evaluate living conditions. In addition to existing criterion, users can make the analysis more sophisticated by adding additional criterions.

**Data preparation**

Source datasets used in this research are courtesy of various government organizations, such as Survey Department of Sri Lanka, Colombo municipal council, Ministry of Health etc. Before extracting information from source maps, all hardcopy maps were scanned and georeferenced to remove geometric errors.

**Road network**

Linear features like transport networks were represented as line features in GIS environment. In node-arc topological data models, a node established at every point where two line features of same feature class or different feature classes intersect. ESRI (Environmental Systems Research Institute) has introduced another data model known as Network data model. In this data model transport networks are represented as separate network data sets. Mainly three data sources were associated for creating a network data model with ArcGIS. They are junction, turn features and edges. Edge feature source is represented by line feature class, junction feature sources by point feature class and a turn feature explicitly models a subset of possible transitions between edge elements during navigation [ESRI, 2009]. The network data model of ArcGIS incorporates advanced connectivity model that can represent complex scenarios, such as multimodal transportation networks. Table 1 demonstrates most important fields that is required to develop a network data model. Even though it is possible to build a network data model without these fields, the final results obtain from such network data
Table 2: Characteristics of layers used in the study

<table>
<thead>
<tr>
<th>Dataset name</th>
<th>Description</th>
<th>Type</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road network</td>
<td>Feature class</td>
<td>Vector</td>
<td>Polyline, Represent streets</td>
</tr>
<tr>
<td>Hospitals</td>
<td>Feature class</td>
<td>Vector</td>
<td>Point, Represent hospitals locations</td>
</tr>
<tr>
<td>Schools</td>
<td>Feature class</td>
<td>Vector</td>
<td>Point, Represent schools locations</td>
</tr>
<tr>
<td>Fire and rescue station</td>
<td>Feature class</td>
<td>Vector</td>
<td>Point, Represent fire stations</td>
</tr>
<tr>
<td>Ambulance stations</td>
<td>Feature class</td>
<td>Vector</td>
<td>Point, Represent ambulance locations</td>
</tr>
<tr>
<td>Shopping malls</td>
<td>Feature class</td>
<td>Vector</td>
<td>Point, Represent major shopping malls</td>
</tr>
<tr>
<td>Green spaces</td>
<td>Feature class</td>
<td>Vector</td>
<td>Point, Represent location of public parks (centroid) and other green spaces</td>
</tr>
<tr>
<td>Crime</td>
<td>Feature class</td>
<td>Vector</td>
<td>Area, Represent reported crime in each area</td>
</tr>
</tbody>
</table>

model will not be accurate. As an example, if there is no information about “one-way” restrictions then network analyst extension will consider all roads are traversable both directions.

Crime data

CMC is under 3 police zones (Colombo North, Colombo Central and Colombo South) which monitored by 22 police domains. Due to the higher level of security, actual positions of the crime incidents were not provided by police domains. Due to large number of police stations, accurate area controlled by each police station could not be obtained. Therefore thissen polygons were generated to indicated areas that is controlled by each police station. Then these thissen polygons were categorized to 4 equal intervals based on the total crime reported in 2016.

Civic services

Colombo being one of the major cities in Sri Lanka has a well distributed network of health care services. Hospitals are categorized as government, private, armed forces and prison. Hospitals that relate to prison and armed forces only allow patients from their own agencies. Hence these hospitals were not considered and a total of 24 hospitals were taken into consideration in this research. Out of the 24 hospitals, 13 hospitals belong to the government sector and 11 to the private sector. In Sri Lanka, the types of educational institutions available are schools, universities and private tuitions. The above mentioned educational services belong to the government, semi-government and private sector. In this study only national schools which offer education from grade I to grade XIII were considered because they are the institutions funded by the government. Primary, junior secondary and collegiate schools are not considered due to incomplete grade levels.

There are certain emergency response services that a person may require at any time of the day. Out of them, the most important services are the ambulance services and the fire-fighting services. Therefore, these services are very time critical [ESRI, 2007]. The minimum response time of these services may save a lot of financial loss and human lives. These two services are functioning under various private and public authorities. The fire and rescue services are carried out solely by Colombo Municipal Council fire and rescue division. They are covering the whole CMC area with only six sub stations. All the major private and government hospitals in CMC area provide ambulance services to the public. In addition to that, government launched a new ambulance service free of charge in collaboration with the government of India. Table 2 demonstrate characteristics of every dataset used in the network dataset model.

Parameter values

The fundamental factor for the study is the “Travel time”. Varying time intervals have been used to analyse which areas of the city are closer to the world standards approachability to a particular service. Travel time was considered as the impedance factor in this research since CMC area is densely populated and also one of the highest traffic density cities in the country. In the case of a medical emergency, time is a critical factor. Survival rates for certain varieties of medical emergencies are based upon brisk response of well-trained medical personals. According to Figure 3 the time between the beginning of the heart attacks and administration of the definitive care proved to have a pronounced effect on survival.

According to the study of Mayer (1979), if the travel time exceeds 12 minutes, 17% of the victims lived long enough to be admitted in the hospital and 6% survived to be discharged. With a travel time of 6 minutes or less to the definitive care, 52% survival rate has been observed.
Based on the CPR timeline on Figure 3 it is more logical to assign initial time interval within 3 minutes to reach a definitive medical care, since brain damage is unlikely within that time period. Therefore this research considers time intervals of 180 seconds (3 minutes), 300 seconds (5 minutes), 480 seconds (8 minutes) and greater than 480 seconds to reach a definitive medical care.

There is a stage of every fire where the speed of the fire increases drastically, which is known as “flash over”. The Flash over occur when the room temperature reaches 600°F to 700°F [Kennedy & Kennedy, 2004]. According to Mansfield fire fighters, flashover may typically appear less than 4 minutes. Hence, a location of a neighbourhood can be considered as a safe zone if Fire trucks can arrive before the flashover (4 minutes). Therefore, this research considers time intervals of 3 minutes, 5 minutes and 8 minutes.

**Accessibility Analysis**

Service area calculation has been used to evaluate accessibility for each criterion in this research. With the ArcGIS Network Analyst extension, you can find service areas around any location on a network. ESRI (2009) defined, a network service area is a region that encompasses all accessible streets (i.e. streets that are within specified impedance). In this study, service area was calculated according to the parameters described in Table 3.

Output of the network service area is a polygon layer, usually polygons around each facility overlap with other polygons, properties of service area layer allows to define instructions for these overlapping polygons. As illustrated in Figure 4, there are three ways for polygon generation, they are non-overlapping, overlapping and merge by breaks.

The first minor objective of current study is to recognize only the locations accessible within a certain time frame and it is not essential to check each facility and its corresponding service area. Therefore, the third option (Merge by break value) was used in this research.

**ArcGIS weighted overlay model**

In order to aggregate criteria most researches have used Weighted Sum analysis or Weighted overlay analysis and weights which obtained from a questionnaire. In this research weighted overlay analysis was selected rather than using weighted sum analysis, because weighted sum analysis does not allow rescale values. Then generated weighted overlay model was exported into a python script to integrate with web-based Decision Support System.

**Web-based Decision Support System**

Most of the researchers who carried out studies on finding “best area” for living are based on the results obtained from the public. Therefore, implementing a user-friendly decision support system is the only solution to the problem. By a decision support system user can change the importance of each criteria according to their preference and generate an independent result rather than a bias result based upon the questionnaires.

Graphical User Interface (GUI) was generated using “Page” application. PAGE is a drag-and-drop python GUI generator which resembles Visual Basic. It allows to easily create GUI windows containing a selection of Tkinter (Tkinter is the standard Graphical User Interface library for python) widgets. All client-side processing activities are performed using exported ArcPy modules. ArcPy is a site package that builds on (and is a successor to) the successful ArcGIS scripting module. According to ESRI (2009), ArcPy goal is to create the cornerstone for a useful and productive way to perform geographic data analysis, data conversion, data management, and map automation with Python. GeoServer is a software server based upon Java, providing facilities to users to
Table 3: List of parameters and evaluations criteria

<table>
<thead>
<tr>
<th>No</th>
<th>Parameter Name</th>
<th>Evaluation criteria</th>
<th>Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hospitals</td>
<td>Time (Seconds)</td>
<td>180 360 600</td>
</tr>
<tr>
<td>2</td>
<td>Ambulance</td>
<td>Time (Seconds)</td>
<td>180 300 480</td>
</tr>
<tr>
<td>3</td>
<td>Fire fighting</td>
<td>Time (Seconds)</td>
<td>180 300 480</td>
</tr>
<tr>
<td>4</td>
<td>Shopping malls</td>
<td>Time (Seconds)</td>
<td>300 600 900</td>
</tr>
<tr>
<td>5</td>
<td>Green spaces</td>
<td>Distance (meter)</td>
<td>400 1000 1500</td>
</tr>
<tr>
<td>6</td>
<td>Schools</td>
<td>Distance (meter)</td>
<td>1500 2500 3500</td>
</tr>
</tbody>
</table>

Figure 7: Results of the closest facility analysis

visualize and manage geospatial data. After preparing a workspace to store all the maps related to the research, shapefiles were uploaded into the workspace by giving all the resource information (Layer name, Coordinate Reference Systems and Bounding Boxes).

In this research, a separate web platform was also prepared to visualize the data in an interactive way. Most of the interactive capabilities in this web platform were programmed with leaflet JavaScript library. Leaflet is an open-source JavaScript library specially used for mobile-friendly interactive maps and designed with performance, simplicity and usability in mind. Figure 5 outlines the approach which used to develop the Decision Support System by integrating multi-criteria analysis and Web-GIS.

Results and Discussion

Accessibility analysis

The first objective of this research is to determine the service gaps of the neighbourhoods based on the unavailability of civic services. In order to archive the first objective, service areas have been calculated using ArcGIS network analyst extension. The accuracy and the reliability of accessibility analysis were based on the data layers used in the research.

Road network

CMC is an urban area which has a complex road structure with twin roundabouts, one way roads, and two-way dual carriageways. In order to model road network accurately roundabouts have been digitized as it is connecting all roads into a single node.

CMC is a very populated area with high traffic density. Therefore travel time was used as impedance when performing the accessibility analysis. Thus, interpreting travel duration to each road segment is a critical factor in the accessibility analysis. Travel speed of connecting roads in between twin roundabouts was assumed same as the speed of the roundabout.

Green spaces

A total of forty seven green space locations have been included in this research that are accessible by people. One of the major issues that have been faced during digitizing the green spaces is that these features are
normally area features but when performing network analysis, extension only accepts facilities as a point feature. Therefore centroid of each green space have been implemented and used as facilities for the network accessibility analysis. In this research, accessibility is calculated considering U turns and One-way restrictions. When considering the accessibility for green spaces people often travel on foot rather than by vehicles. Also a standard of half-mile has been identified as a reasonable distance to walk to a park [Sherret, 1979].

In order to model the accessibility to green spaces more accurately, entrances to the green spaces can be used. Also there are certain instances where the green space has multiple entry points. In such cases by including all those entries as point features the accuracy of the analysis can be improved. Due to the limited time frame it was unable to collect entry points to all green spaces by visiting these places.

Fire and Rescue services

A total of six fire and rescue stations are there all over the CMC jurisdiction. It has been observed that majority of the CMC area is not accessible within three minutes. Also there are certain neighbourhoods which are not accessible even within eight minutes from stations. According to the statistics, only 11% of total land cover is accessible within 3 minutes and 40% of total land cover is over 8 minutes of accessibility from nearest service station which is way over the flashover. Overall around 70% of the total land cover is in potential to get affected from a fire critically.

According to the distribution of fire and rescue services, eastern part of CMC jurisdiction has much more potential to be affected from a fire. There are certain locations which are highly potential to catch a fire but are also spatially situated near to a fire or a rescue station. Studying the past fire eruption which marked in Figure 6, it has been validated that this area has been highly affected by fires. Based on the analysis Borella North, BorellaSouth, Dematagoda, Gothamipura, Grandpass South, Kettarama, Kirula, Kirulapone, Maligawatta East, Naranahenpita, Nawagampura, Pampankada East, Pettah, Sammanthranapura and Wanathamulla GN divisions have high potential to be critically affected in case of a fire eruption.

Based on the accessibility of markets and shopping malls more than 80% of total land cover is accessible within 300m from a shopping centre. These major shopping centres are well distributed. As illustrated in Figure 7, the service areas of some shopping centres are reduced due to road restrictions, even though they are spatially located in close proximity.

Analysis result of ambulance services demonstrates an interesting pattern which indicates that most of the ambulance services are clustered around Central Colombo. Due to the traffic restrictions and being a dual carriageway, the service areas of certain ambulance stations decreased even though they are spatially located in close proximity. As an example, ambulance from Castle Street hospital can only cover a very small part within 3 minutes of standard time frame (left image of Figure
However, by adding connections between dual carriage ways, the service area of ambulance can be increased (right image of Figure 8).

The main reason to limit connections between dual carriage ways is to decrease the road traffic but in emergency situations this may cause life threat to patients. However, both above problems can be minimized by allowing the use of connecting roads only for emergency vehicles. Investigating crime in CMC jurisdiction has been an arduous task due to high-security reasons. Also obtaining data related to crime needs high security clearance from Inspector General of Police. Detailed reports of crimes which include location, type, date and time of crime etc. are available in police stations of the relevant area. Police headquarters has data available only for the total reported crimes in each year based on the crime type. The control domain map of each police station is available in relevant police stations, which include 21 police stations. Due to limited time period it was difficult to obtain maps of each police domain. Therefore, as an alternative solution, thissen polygons were generated in each police station and assumed as police domains.

Web-based Decision Support System

The most excellent feature of this decision support system is that it supports real-time decision making with intuitive interfaces. The results from questionnaire showed that DSS can meet demands of users to find out the best neighbourhoods in cities. In addition, the prototype DSS is scalable which developers can add more and more data sets for the analysis. But for this research only seven most important criteria have been used.

One of the setbacks in the system is that the system is implemented as a thick client solution where all the processing functions can be performed on the client side. Therefore, performance of DSS depends on the hardware of the client-side. Also one of the major reasons to implement the system as a thick client solution is that geo server does not support publishing of geo-processing services like Arc Server. In order to minimize the use of commercial software and the gap between commercial and open source software, the system was implemented as a thick client where all the processing activities were performed on the client side.

All data sets related to the DSS is stored in geo server which is useful for regular updating and therefore the users can always perform analysis with up to date datasets. Unlike in commercial software, open source softwares have certain disadvantages such as lack of technology support and rapid building up.

In addition to visualizing the generated map on web browser, a shape file of the final map was generated on the local storage where users can perform other analysis using software related to GIS. Implemented DSS does not depend on the study area and it can be applicable and implementable on any environment or a neighbourhood to evaluate the living conditions.

User interface

In order to improve the user friendliness of decision support system, a separate user interface in Figure 10 was implemented to change the influence percentage of each criterion for the final result based on the user requirement.

Current percentage in Figure 9 represents an addition of each criterion which is updated on the change of each scale. In order to generate the final map, current
percentage should be maintained 100%. If users try to generate a map without maintaining 100% a warning message will appear mentioning to maintain 100% total influence.

The main components of the web map are represented in four colour boxes in Figure 11.

1. Red color box
   (a) Represents the Scale of the map window in km and miles.
2. Green color box
   (a) Represents an overview of the suburban areas of the map window.
   (b) Represents geographical coordinates of the position of cursor on map.
3. Yellow color box
   (a) Searching capability based on open street map data
      - When a user hovers on the magnifier icon on the map window a search box will be appeared and then the users can enter the location based data and search it on the map.
4. Blue color box
   (b) Map legend for included layers
      - When a user clicks over the legend icon, legend for each map layer appears and users can obtain legend information.
      - Figure 12 illustrates the legend information for markets and shopping malls service areas.
      - By sending the Get Legend Graphic request to geo server, legend for each graphic layer can be obtained.
(c) Map layers
   - Figure 13 represents the base map layers and overlay map layers which are available for visualization (Accessibility maps for different civic services and crime maps).
   - Also users have the ability to switch the base map layer into a satellite view and street view.
   - By switching on-off every layer, users can compare locations on the base map.
Maps were retrieved into the browser by sending a GetMap request to the geoserver.

4. Blue color box
   (a) 1st column: Uses to digitize map objects on webmap as point line and polygon.
   (b) 2nd column: Uses to go to the previous zoom levels and home zoom level.
   (c) 3rd column: Uses to zoom in and zoom out.
   (d) 4th column: Uses to edit or delete the created map object.
   (e) 5th column: Show user’s current location on map based on network data.

Figure 14 represents a sample output according to the user defined influence rates on Graphical User Interface of DSS.

As explained by most of the researches and studies, stakeholders have significant influence on the accomplishment of any project. This is extremely important in certain incidents such as when the stakeholders are various individuals and are not associated with same establishment. Due to different stakeholders having different requirements, it is necessary to recognize and engage these stakeholders as early as possible (during system designing). In this case, three major stakeholders have been identified: system developers, urban planners and public users, all relying on different parts of DSS. System developers are concerned on the efficiency and effectiveness of the DSS; urban planners are concerned on the effective land use planning based on the accessibility analysis results whilst general public is concerned about the information of the living conditions. To fulfill these requirements, technologies such as Web GIS, Desktop GIS have been utilized. This DSS is in the earliest stage of an implementation cycle. Prototype of DSS has been implemented mainly for the purpose of demonstrating living conditions based on user requirements. Hence, current system is not a fully equipped DSS.

The future versions of DSS will be enhanced to a fully functional decision support system for urban planners to simulate the change of service area when proposed civic service stations are added. As an example, how service areas can change if an emergency service station is added to the existing system. Currently, the DSS consists of two main parts as desktop and browser. By integrating desktop into the browser users will not have to use a desktop application. This can be accomplished by implementing the system as a thin client solution. Also, this will reduce the application processing time because all the processing activities are performed on the server side. Therefore processing speed does not depend on the client side and the hardware will receive the final output.

**Conclusion**

The main objective of this research is the implementation of a decision support system to evaluate the living conditions based on the user requirements. In order to achieve the main objective, 3 minor objectives were identified.

The first minor objective was to determine the ser-
vice gaps in the cities based on the unavailability of services. According to the results of each criterion, it is found that only school services and markets service areas are well distributed within the CMC jurisdiction and all other civic services have a poor distribution in CMC jurisdiction. Therefore, in order to improve the living conditions of each part of the CMC, new service stations for hospitals, green spaces and emergency services should be established by conducting a proper research. It has been observed that, apart from establishing new stations, service areas can be improved by doing simple modifications for the existing road networks (For Ambulance and Fire and Rescue services) and relocating existing service stations to other places.

The second objective was to develop a DSS to evaluate the living conditions based on the user requirements. By integrating ArcPy, python and geo server as a geographical data server, desktop decision support system was implemented. There are certain advantages with the implemented DSS:

1. DSS is implemented with cloud computing technology
2. User friendly GUI largely enhance user experience
3. Can be implemented to any area by expanding data sources

The final objective was to develop a dedicated web platform to link desktop decision support system to compare generated final liveability map and service area maps on a base map layer. The web platform is implemented by open source JavaScript libraries. With implemented DSS users can view generated liveability map on a web browser and compare with different base map layers including Satellite view maps and street view maps.

References


Sherret, A. (1979) BART’s First Five Years; Transportation and Travel Impacts. Peat, Marwick, Mitchell & Co.: San Francisco
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