

INNOVATION AND
TECHNOLOGY
FOR
SOCIETAL
TRANSFORMATION

Proceedings of the 4th Technical University of Kenya International Conference

*Nairobi, Kenya
21st to 23rd February 2018*

Editors:

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ISBN 978-9966-132-24-6



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All the papers in these conference proceedings are the outcome of the 4th Technical University of Kenya International Conference on Innovation and Technology for Societal Transformation held in Nairobi on 21st to 23rd February 2018. All the papers have been subjected to double-blind peer review.

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The Technical University of Kenya International Conference (4th : 2018 : Nairobi, Kenya)

Innovation and Technology for Societal Transformation / editors: Fiona Mbai, Tom Kwanya, The Technical University of Kenya.

ISBN: 978-9966-132-24-6

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A Publication of The Technical University of Kenya

Printed in Nairobi, Kenya

Table of Contents

PREFACE	vi
FOREWORD	viii
Role of Technology in Societal Transformation	1

Section One: BUSINESS AND ENTREPRENEURSHIP 4

Influence of Geographical and Concentric Diversification Strategies on Performance of Kenyan Universities	5
Hotel Guests' Attitudes towards Tourism Training in Middle Level Colleges in Kenya	28
Management of University-Based Business Incubators as Tools for Entrepreneurship Growth and Development in Kenya	46
Influence of Reverse Logistics on Procurement Performance in the Sugar Industry in Kenya	54

Section Two: ENGINEERING AND SPACE SCIENCES 63

Space Weather and its impact on our technology dependent society: A case study on Ionospheric scintillation over Kenyan Airspace	64
Definition and Analysis of Alternative Electric Power Generation Scenarios in Kenya	78

Section Three:

ENVIRONMENTAL PROTECTION, RENEWABLE ENERGY AND CLIMATE CHANGE 108

- Abundance and Identity of Red Spider Mite Species on Brachiaria Grass in Kenya and its Worldwide Comparative Phylogeny... 109
- Verification of Plant Spacing for KME-08-04, KME-08-05, KME-08-02 and KME-08-06 Cassava Varieties... 121
- Violet Tree Appropriate Technology Natural Botanical Pesticide for Eco-Friendly, Effective Pest Control for Enhanced Environmental Sustainability... 128

Section Four:

FOOD SECURITY AND SAFETY 139

- In vivo anti-plasmodial activity and toxicity of crude plant extracts from Kenya, against *Plasmodium berghei* in BALB/c mice... 140
- Micronutrient Deficiencies among Young Children: A Review Paper on the Effectiveness of the Home Grown School Meals (HGSM) Programme in Kenya... 154
- The Utilisation of Pineapple Peels in the Production of Fibre-Rich Bread... 161

Section Five:

INDIGENOUS KNOWLEDGE SYSTEMS 173

- An Analysis of Music Idioms of the *Kiringongo* in Popular Band Music... 174
- Human Diversity and Indigenous Knowledge Systems: Challenges for Higher Music Education... 193
- Traditional Rainmaking in Scholarly Literature: A Bibliometrics Analysis... 203

Section Six: **MEDIA, SOCIETY AND GOVERNANCE** **213**

Role of the Mainstream Media in Kenya’s Electoral System towards Social Responsibility: Special Focus on the August 2017 Presidential Election	214
‘Sheng’ Language as a Tool for Disseminating Reproductive Health Knowledge using Community Media: A case of Ghetto Radio	228
Indigenous Democracy on Digital Platforms: The Adaptability of Social Media in African Political Dialogues	246

Section Seven: **TEACHING AND LEARNING TECHNOLOGIES** **260**

Harnessing New Media for Teaching and Learning Communication Skills: Possibilities and Challenges at the Technical University of Kenya	261
The Intersection of Multiple Intelligences in Musical Performance	280
Use of E-learning Technologies for Teaching Foreign Languages at the Technical University of Kenya	293

PREFACE

Investment in Science, Technology and Innovation (STI) remains imperative for sustainable economic development and social progress as articulated in the United Nations Sustainable Development Goals (SDGs), African Union's Vision 2063, and the national development blueprints such as Kenya's Vision 2030. This is because STI is the cog that turns the wheel of societal transformation through innovative products, systems and services. Thus, STI provides the means to respond to global developmental and societal challenges emanating from disasters, poverty, famine and disease.

The role of multidisciplinary research and development (R&D) in fostering STI and sustainable development cannot be overemphasised. Meaningful, relevant and sustainable R&D requires scientific and technological institutions to collaborate with enterprises to develop and disseminate innovations which generate developmental impact in real life. This collaboration facilitates the use of knowledge in patents and prototypes, research papers, and networks to develop solutions for real life challenges in society and foster sustainable development.

The chapters in these proceedings were presented and discussed at the 4th Technical University of Kenya (TU-K) International Conference held on 21st to 23rd February 2018 at Sarova Panafric Hotel in Nairobi, Kenya. The theme of the conference was "*Innovation and Technology for Societal Transformation*". The delegates discussed current opinion and development in regional and global emerging technologies as well as their actual or potential impact on societal development. The conference also included discussions on policy issues that contribute to hindering seamless integration of innovation and technology into policy and developmental goals. Against this backdrop of policy influence on technological advancements in academia and industry relationships, the conference provided a suitable platform to nurture university-industry partnerships. It also provided a forum to explore how these relationships relate to the wider spectrum of productive and sustainable university-industry links.

TU-K continues to be at the centre of technological education, training and research in the region. In furtherance of this spirit, the conference provided a platform to discuss recent progress made in R&D that will form the basis for both revolutionary and evolutionary societal innovation for sustainability. TU-K

is committed to conducting impactful research that influences relevant policy and practice towards sustainable development in the real world. This publication serves the purpose of communicating these research findings to the academic community as well as players from the public, private and development sectors in Kenya and beyond.

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FOREWORD

The content of this book is intended to provoke further discussion on the role that technology can play in the sustainable transformation of indigenous and rapidly-urbanising settlements characteristic of developing economies, countries, and nations in Africa. Published literature on technology and society often lacks references to African contexts. Thus, the discourse here focuses on Kenya given that content of the book arises from papers presented during the 4th instance of the Technical University of Kenya International Conference series.

The 4th Technical University of Kenya International Conference featured a number of guest speeches covering a range of issues such as

- role of technology in societal transformation;
- role of technology in ensuring food security;
- complexities of techno-economic development in the context of constrained governance;
- implementation of new urban agenda; and
- information and communication technologies for advancement of higher education.

Section 1 of the book broadly deliberates on business and entrepreneurship issues, especially concerning the role of universities and skills training institutions in fostering economic and social development. The first chapter considers the influence of concentric diversification of academic programmes on the performance of universities in Kenya, while the second chapter examines the role of middle level colleges in training and skills development for hotels and tourism sector of the Kenyan economy. The third chapter discusses the role of university-based business incubators in fostering economic development, while chapter four presents a case study of the influence of technology on logistics and procurement performance in the sugar sector in Kenya.

In Section 2 of the book, the role of technology in engineering and space sciences is briefly examined. In this regard, the fifth chapter examines the occurrence of ionospheric scintillation and the resultant temporary loss of GPS reception in the region. The discourse in chapter six focuses on the increasingly important matter of mixing primary sources of energy for power generation in Kenya, while concerns about renewable energy sources, environmental protection and climate change are

discussed in Section 3 of the book. Comparisons of seasonal grass mite infestations over different regions of the country are presented in chapter seven, and the optimum plant spacing for new cassava varieties is discussed in chapter 8. The influence of chemical pesticides on farming practices is discussed in chapter 9. The issues of food security and safety are examined in Section 4, especially regarding the extraction of herbs, and the inclusion of such extracts to increase food quality. A review on the effectiveness of home-grown school meals on the nutrition of young children is also presented.

Section 5 of the book includes a discourse on the role of technology in the preservation and promotion of indigenous knowledge systems, as well as commercialisation of indigenous knowledge. The discussions are particularly focused on indigenous music and knowledge in rain-making. Issues concerning the role of technology in community development and governance are discussed in Section 6. The presentations include case studies on the ethical and social responsibilities of mainstream media to deploy pertinent technologies to properly educate and inform respective communities and the polity in general. On the basis of three case studies, the seventh and final section of the book provides an examination of the role of information and communication technologies on teaching and learning at higher educational institutions in Kenya.

It is worth emphasising that this book contributes to published literature on technology and society in an African context. Of course, it would be remiss not to acknowledge the sponsors and organisers of the 4th Technical University of Kenya International Conference who have provided the impetus for the preparation and production of this book. In this regard, the initiative of the Vice-Chancellor of the Technical University of Kenya, Prof. Ing.-Dr. F.W.O. Aduol is recognised together the indomitable spirit of Professor Fiona Mbai in hosting a successful conference, as well as editing the manuscripts with Professor Tom Kwanya. Finally, by providing the content of this book, it is really the authors and reviewers who have made this contribution to our current knowledge about innovation and technology for societal transformation in the context of Kenya.

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Role of Technology in Societal Transformation

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Technology and society are intertwined. During the Stone Age era, humans invented and used tools to enhance their hunting and gathering ways of life. The sequence of industrial revolutions bears testimony to the intertwined relationship between technology and society. It is intriguing that Albert Einstein is credited with saying that he “fears the day that technology will surpass our human interaction; [arguing that] the world will [then] have a generation of idiots.” According to Heidegger (1977),

Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology.

The intertwined relationship between technology and society continues to evolve as human societies transform into nation states, countries and economies. Following from Solow (1956) Nobel Prize winning, “...contributions to the new theory of economic growth...”, the global developmental trend leads to the widely acknowledged view that science, engineering, technology, and innovation (SETI) are crucial to economic development (see also, more recently, the discourse by Ruano-Borbalan [2017]). Drori (1993) called for a re-assessment of the hierarchical relations between science, technology and economic development, while Fischer *et al.* (2005) presented evidence on their assessment of socio-economic and climatic change impacts on agriculture.

There is evidence as to the mirror relationship between the growth rate of the global economy and the rate of technological development, while differences in levels of SETI correspondingly manifest as differences in total productivity between countries. Whereas the globalisation imperative has forced open most economies

such that less developed countries are purportedly benefitting from technological innovations sourced from developed nations, however, this has concomitantly widened the gap between rich and poor countries.

With increasing recognition and exploitation of systems of innovation, the consensus is that technology, in its various forms, is vital to the growth and competitiveness of firms, economic transformations of nation states, and the hope for sustainable development of global systems. Although Kalam (2004) emphasises that “... technology is the engine which is capable of leading the nation towards growth and prosperity...”, however, Narasimha (2008) briefly outlined the disruptive effects of the rapid expansion of science and technology infrastructure on India’s economic structure. Such disruption notably encompasses the conundrum of concurrent increase in prosperity and income inequalities.

Despite the relentless parade of new technologies (Manyika *et al.*, 2013), technology will not necessarily “...solve all of our problems, but it can be a powerful tool, particularly when combined with social, financial, policy, institutional, and business model innovations.” (cf: Kalil in Hill Allison [2017]). Technology may exist either in the form of knowledge/knowhow, or process/method/technique, or product/service offering, or any combinations of these forms. These various forms of technology are ubiquitous and inescapable thereby fuelling, igniting and driving societal transformations in indigenous, urbanising and urban settlements. See, for example, the account by Biffi (2012) regarding the integration of technology with Afghanistan’s oral heritage traditional culture, in order to deliver messages that are vital to socio-political and economic development.

In a broad sense, society encompasses cultural, economic, environmental, socio-political, and technological subsystems. Thus, an interpretation of societal transformation is that it involves a longitudinal and interdependent (but, not necessarily congruent) process of extensive transformation of culture, economy, environment, polity and politics, and technologies. Yes, extrapolating from Asaro (2000), technology transforms society in as much as society transforms technology! The primary requirement of the transformational process is that the coexistence of both the old and new forms of the respective subsystems must reinforce towards a direction that leads to sustainable development.

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Section One:
BUSINESS AND
ENTREPRENEURSHIP

Influence of Geographical and Concentric Diversification Strategies on Performance of Kenyan Universities

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Abstract

The general objective of this study was to investigate the effect of geographical and concentric diversification on the performance of Kenyan universities. The study adopted a survey design and ten accredited universities were purposefully sampled. Data was collected using questionnaires and interview guides. The reliability and validity of the instruments was confirmed to be satisfactory through a pilot study and the use of Cronbach's alpha coefficient. A full study targeting 116 respondents was then conducted and a response rate of 84.5% achieved. Data was analysed using descriptive and inferential statistics and discussed under various themes. Normality test was conducted on the dependent variable using Q-Q test. Scatter plots were used to check for systematic pattern of the scatter points. Line of best fit was drawn for further establishment of the goodness of fit. Variables were subjected to Analysis of Variance and multiple correlations between the independent variables (geographical and concentric diversifications) and dependent variable (university performance). From the findings, the study revealed that concentric diversification has a significant influence on the performance of universities in Kenya compared to geographical diversification. Findings of this study may benefit policy makers and stakeholders in the higher education sector in Kenya especially in formulating policies that guide various management practices and strategies adopted by the management of the institutions.

Keywords: Geographical Diversification, Concentric Diversification, University Performance

Introduction and Background

Higher education plays a pivotal role in the global social economic development. While the developed world enjoys a higher quality and accessibility to higher

education, Africa lags behind with low university enrolment and ranking. According to the African American Institute Report of 2015, while return on investments in higher education is highest in Africa at 21%, only 6% of the young people in sub-Saharan Africa are enrolled in institutions of higher learning. However, there is some hope considering that the same report observes that universities in many African countries are experiencing a surge in their enrolments.

According to Schuetze and Mendiola (2012), the market in higher education has become predominant throughout the world. The state and academic oligarchies have ceased to be the primary forces behind the coordination of these systems. Levy (2002) observed that private higher education markets have arisen at dizzying pace, to the extent that, in many countries, most of the growth in enrolment has occurred in private institutions of higher learning. The private sector in Kenya is instrumental in supplementing government efforts of providing services in the education sector (Government of Kenya, 2012). Through public private partnerships, faith-based groups are the leading private investors in Kenyan university education. According to the Government of Kenya, this is a mutual collaboration between the government and the private sector that helps to reduce public spending as well as increase access, equality, and equity in the provision of education. Further, it has been observed that the private sector is the fastest-growing segment of higher education, a trend Abagi (2006) attributes to the Government of Kenya's strategy of promoting private institutions of higher education to meet the increasing public demand.

The success of the Education for All (EFA) movement in fostering enrolment in primary and secondary education in Kenya as evidenced by the free primary education and subsidised secondary education initiative has increased the pressure for higher education to expand in the country. This trend referred to as the "pipe-line effect" (Goedegebuure & Meek, 1997) is the reason why primary and secondary levels of education are fast expanding and a growing proportion of high school graduates are joining higher education institutions. This demand has led universities in Kenya to diversify into different academic programmes and open several campuses to take advantage of the huge "market" of their services. While this is a commendable trend, it has been linked to a myriad of challenges facing Kenyan universities with different stakeholders, including government agencies, taking different measures to overcome them.

Statement of the Research Problem

Schuetze and Mendiola (2012) contend that there is a global trend of exponential diversification by universities resulting in inherent management challenges such as slow decision-making processes and internal bureaucracy. These impacts negatively on the performance of these institutions (Emerson, Helena & Mario, 2011). Bratianu, Reinhardt, and Almsan (2010) also note that the new trends, especially the move towards diversifying, have challenged the traditional organisational structures and strategies of these institutions. The common view of these scholars is that the management challenge facing contemporary universities is the multiplicity of roles they have assumed and the extraordinary increase in the number of subject fields. As a result of growth and expansion, the university environment has become complex. In Kenya, this has been exacerbated by the universities opening several campuses in most urban centres away from their main campuses with the view of increasing their enrolment and revenue. There is a general observation that most of these campuses are located in small centres with poor infrastructure. Some universities share facilities or are too close to other business establishments including but not limited to pubs, restaurants and retail outlets. This makes the environment unsuitable for learning thereby compromising the quality of education.

Concentric and geographical diversification by universities has also complicated the coordination and control by universities considering that some of the universities have too many campuses distributed all over the country and sometimes outside the country, thus, posing considerable management challenges. These challenges are evidenced, for instance, in the Republic of Kenya's Education Sector Report, in the year 2013/14 to 2014/15, twenty-four (24) University campuses in Nairobi County were inspected for compliance with the minimum standards and eight (8) recommended for closure. One public university had a total of 13 campuses and in January 2016 the Commission of University Education ordered 10 of them to be closed affecting tens of thousands of students. While the government has made interventions, the trend of intensive geographical and concentric diversification strategies and their possible effect on quality of higher education need to be investigated.

To enhance performance of institutions of higher learning, university managers should apply best management practices, techniques and principles that have been

researched and tested in the context of institutions of higher learning (Middlewood & Lumby, 1998; Hintea & Loessner, 2005). However, there is limited literature available focusing on the management of universities and particularly regarding diversification as an expansion strategy and its effects on the primary constructs of measuring performance of universities. This study therefore, sought to bridge the identified gap by investigating the influence of geographical and concentric diversification as growth strategies on the performance of universities in Kenya.

Contextual Definition of Terms

Concentric diversification is the development beyond the present product and market but still within the confines of the industry in which an organisation operates (Kotler & Keller, 2009). In the context of universities, concentric diversification can be perceived as setting up of different academic programmes and offering them at different levels of certificates. For example, most universities in Kenya offer diplomas, undergraduate and post graduate courses in diverse disciplines.

According to Martin (2007), geographical diversification is the entry to new national or geographical territories or integration of cross-border institutions to the already established institution of higher learning. Knight (2004) argues that there are a myriad of educational activities by various institutions in the current education industry that are part of international academic linkages, agreements, or international commercial trade initiatives.

Performance in any organisation context refers to the quality of process or end product with both quantity or quality considerations (Postma & Zwart, 2001). It is a consequent of accomplished strategy implementation (Arthur, Strickland, & John, 2010).

Research Methodology

The study adopted a survey design considering that it allows for easy sampling and given that the findings from the studied sample were intended to be generalised on the targeted population. The study population was the entire top and middle level management of all accredited universities. Top and middle level managers were targeted as they were considered most likely to be involved in drafting, implementing and evaluating strategies aimed at improving their university performance. Considering the heterogeneous nature of the population, the study used purposeful sampling technique, where ten universities were selected. The study

used questionnaires to collect data from the respondents. A pilot study was done to test on clarity or ambiguity of the questions and make judgement on their validity and reliability. From the piloted data and preliminary analysis, the reliability of the instruments was satisfactory especially after necessary amendments. A full study targeting 116 top and middle level managers was then conducted and a response rate of 84.5% attained. The study relied on SPSS for analysing data. Data was analysed using descriptive and inferential statistics and discussed under various themes. A normality test was conducted on the dependent variable using Q-Q test. A line of best fit was drawn for further establishment of the goodness of fit. Variables were subjected to Analysis of Variance and multiple correlations between the independent variables and dependent variable to determine the kind of influence between the two independent variables (geographical diversification and concentric diversification) and the dependent variable (university performance).

Data Analysis and Discussion of Findings

A total of 116 questionnaires were distributed and 98 were returned. This represented a response rate of 84.5% which was considered good for analysis (Babbie, 2002).

Period of Service of Respondents at their Universities

The study found out that a majority (52.0%) of respondents had served their universities for over 5 years; 31.6% had an experience of between 2 and 4 years; and 16.3% had worked for less than 2 years in the universities. This implied that most of the respondents had the prerequisite information and knowledge about their organisations especially on the various diversification strategies adopted by their respective universities and an opinion on whether they have influenced the university's performance or not.

Position/Rank of the Respondents in their Universities

The study sought to know the positions of the respondents in their respective universities. Table 1 shows that the majority of the respondents were HoDs, and lecturers at 25.5%; DVCs were at 6.2%; Deans were 9.2%; VCs were 2%; Registrars were 3.1%; Administrators were 8%; Chief Librarians were 3.1%; and the remaining 17.4% represented others in various middle and top-level management positions as indicated in Table 1. This implies that the study captured the view and opinions from a wide range of respondents with diverse managerial roles and responsibilities in their respective universities.

Table 1: Position/Rank of Respondents at University

Rank/Positions of the Respondents	Frequency	Percentage
Dean of Students	1	1.0
Heads of Department	25	25.5
Senior Lecturer	8	8.2
Lecturer	17	17.3
DVC Administration	2	2.0
Vice Chancellor	2	2.0
Administrator	8	8.2
MBA Research & Examinations Coordinator	1	1.0
Deputy Director	1	1.0
Accountant	4	4.1
Program Manager	1	1.0
Quality Assurance Manager	1	1.0
MBA Academic Director	1	1.0
Academic Director	1	1.0
Dean of Faculty	8	8.2
Director Research	1	1.0
University Chaplain	1	1.0
DVC Academics	4	4.1
Procurement Manager	1	1.0
IT Manager	2	2.0
Chief Librarian	1	1.0
Registrar	3	3.1
Finance Director	3	3.1
Chaplain	1	1.0
Total	98	100.0

Highest Level of Education of the Respondents

The study sought to find out the highest level of education of the respondents considering that the level of education was likely to have an influence on their capacity to sufficiently respond to the questions. From the responses, the majority (45.9%) had a postgraduate level of education; 44.9% had a graduate; 8.2 % had Diploma; and a small fraction of 1% had other forms of qualifications. Considering that the majority of the respondents had postgraduate and graduate level of education, they were considered to have adequately responded to the questions.

University Age

The study investigated the period of existence of the university that participated in the research. The majority (85.7%) of the universities were 15 years old and above; 7.1% were between 10 and 15 years old; 3.1% were between 5 and 10 years; while those between 1 and 5 years were 4.1%. While the majority of the studied universities are more than 15 years, the study managed to include universities that are at different ages and, therefore, likely to be at different stages of their diversification. This representation strengthened the study given the findings reflected ideas and opinions from different categories of universities in terms of age of existence.

Reliability Test Using Cronbach's Alpha

Cronbach's alpha type of reliability co-efficient was used taking a value of 0.7 or higher to be sufficient (Sekaran, 2003; Castillo, 2009). This test was conducted on the two variables which included; geographical diversification strategy, concentric diversification strategy and the dependent variable (performance). All the variables were found to be reliable at Cronbach's alphas of .693, .686 and .876.

Test for Outliers Using Box Plot

In order to test for the presence of outliers a box plot test was used. The output is shown in Figure 1. From the figure, one can conclude that the data for the dependent variable was normally distributed as no presence of outliers was observed.

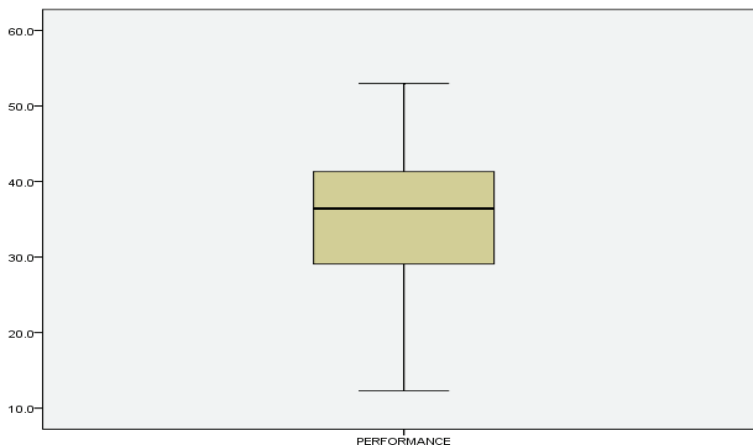


Figure 1: Box plot to test for the presence of outliers

Normality Test on the Dependent Variable (University Performance)

In order to make inferences, from an analysis, assumption of a normally distributed dependent variable is important. A Q-Q test for normality of the independent variable (performance) generated the results shown in Figure 2. From the figure, the data plot shows a very small deviation from the normal line thus a high level of normality

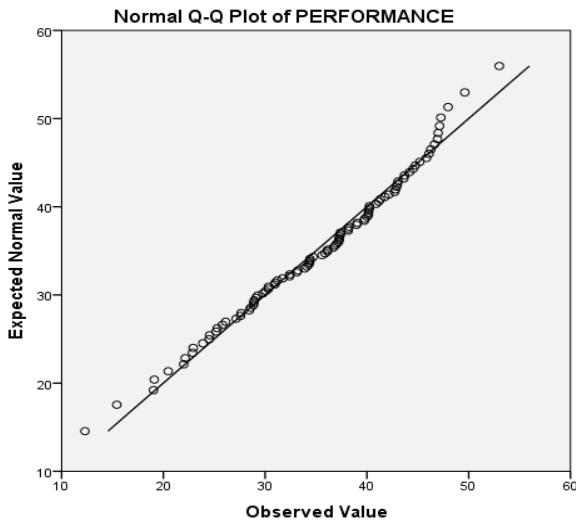


Figure 2: Normality Test on the Dependent Variable (Performance)

Descriptive Statistics of the Dependent Variable

The study sought to establish the level of performance of universities in Kenya. In order to achieve this, the respondents were asked to rate the performance of their universities on various performance indicators. Table 2 gives a summary of their ratings. For instance, on student population, the majority (63.3%) of respondents rated their performance as either average or good. 21.4 % of the respondents considered their student population as being very good while 15.3% indicated that their student population was either poor or fair. On asset base, the majority (65.1%) of the respondents rated their asset base as being either good or very good while 32.7% considered their asset base as being average. Only 11.2 % rated their asset base as either poor or fair. On number of permanent academic staff, half (50%) of the respondents rated their universities as good while 30.6% considered their number of permanent academic staff as being average. 9.2% rated their institutions as either poor or fair on

number of permanent academic staff and another 10.2% rated their universities as being very good on their performance on the number of permanent academic staff.

Asked to rate their universities' performance on the number of accredited programmes offered, a majority (66.3%) of the respondents rated this as either good or very good. 26.5% rated this component at average while 5.1% and 2% rated it as fair and poor respectively. On number of university branches, the majority (44.9%) of the respondents rated their universities as either good or very good. 22.4% rated their universities as average while 19.4% and 13.3% rated this component as fair and poor respectively. On technological capacity as a performance indicator, 63.3% of the respondents rated their universities at good or very good. 27.6% rated their universities as being average in technological capacity while 7.1% and 2% rated this component as fair and poor respectively. In general, 64.6% of the respondents rated their university performance as either good or very good. 24.5% rated them as average while 8.1% and 3.2% rated them as fair and poor respectively. The ratings on performance are summarised in Table 2.

Table 2: Descriptive Statistics on Performance

Statements Indicating performance	Percentage response (%)					Total %
	Poor	Fair	Average	Good	Very good	
Student population	4.1	11.2	24.5	38.8	21.4	100.0
Asset base	1	10.2	32.7	39.8	16.3	100.0
Number of permanent academic staff	1	8.2	30.6	50	10.2	100.0
Number of permanent non-academic and support staff	1	7.1	28.6	50	13.3	100.0
Number of accredited programs offered	2	5.1	26.5	36.7	29.6	100.0
Average revenue	3.1	11.2	43.9	30.6	11.2	100.0
Number of Campuses/branches of the University	13.3	19.4	22.4	33.7	11.2	100.0
Quality of academic programs	1		11.2	50	37.8	100.0
Relevancy of academic programs to the market		2	12.2	54.1	31.6	100.0
Quality of Infrastructure/facilities		5.1	22.4	37.8	34.7	100.0
Study environment		1	18.4	39.8	40.8	100.0
Employee retention rate	3.1	15.3	35.7	33.7	12.2	100.0
Quality of employees		5.1	17.3	50	27.6	100.0

Statements Indicating performance	Percentage response (%)					
	Poor	Fair	Average	Good	Very good	Total %
Average number of graduates		7.1	18.4	61.2	13.3	100.0
Technological capacity	2	7.1	27.6	48	15.3	100.0
Participation/involvement in national/ international interuniversity activities e.g. games, contests, workshops	3.1	7.1	19.4	37.8	32.7	100.0
Average	3.2	8.1	24.5	43.2	21.4	100.0

Descriptive Statistics on Concentric Diversification

The respondents were asked to rate the extent to which various statements on concentric diversification strategy apply to their universities. The responses are summarised in Table 3. On the range of academic programmes, the majority (68.5%) of respondents indicated that either to a large extent or a very large extent their universities offer a wide range of academic programmes while only 7.2% were of the opinion that they do not or to a little extent they offer a wide range of academic programmes. 23.5% rated this component as being to a moderate extent.

On whether the university offers different levels of academic programmes, the majority (77.6%) were either of the opinion that to a large extent or to a very large extent their universities offered different levels of academic programmes. Only a small percentage of 1% and 2.1% expressed the opinion that either not at all or to a small extent their universities offer different levels of academic programmes. There were 19.4% who expressed the view that their universities offered different levels of academic programmes only to a moderate extent. Further, on the statement whether there is high interdependency between various academic departments, projects and programmes, 62.2% indicated that there is high interdependence between the departments. Only a small percentage (6.1%) was of the opinion that there is no or very little interdependency between various academic programmes. 31.6% were of the opinion that there is interdependency between various departments, projects and programs to a moderate extent.

Finally, on the statement on whether the university offers academic programmes in partnership with other academic institutions, a simple majority (41.8%) indicated that their universities offer academic programmes in partnership with other academic institutions either to a large extent or to a very large extent. 23.5% rated this statement as being the case to a moderate extent while an equal percentage of

17.3% indicated it as not at all or only to a little extent.

On average, the majority (65.9%) of the respondents confirmed that their universities have adopted concentric form of diversification and another 23.3% indicated it as being to a moderate extent while a minority of 11.9% indicated that either not at all or to a little extent their universities have adopted concentric form of diversification.

These findings confirmed that universities in Kenya have generally adopted concentric form of diversification by offering a wide range of academic programmes at different levels of and initiating partnerships with other academic institutions. This finding is in line with the position of Varghese and Puttmann (2011) that due to demand for higher education, institutions of higher learning have diversified into different forms of post-secondary education. From the interviews conducted, it was evident that almost all the universities have diversified their academic programmes by offering a variety of courses at different levels with the main aim of enhancing university growth and sustainability.

Table 3: Descriptive Statistics on Concentric Diversification

Statements Reflecting Concentric Diversification	Percentage Response (%)					Total %
	Not at all	Little extent	Moderate extent	Large extent	Very large extent	
We offer a wide range of academic programs	3.1	4.1	23.5	45.9	23.5	100
The university offers different levels of academic certificates e.g. certificate, Diploma, Bachelors, Masters, Doctorate etc	1	2.1	19.4	38.81	38.8	100
There is high interdependency between various departments, projects and programs	1	5.1	31.6	44.9	17.3	100
The University offers academic programs in partnership with other academic institutions	17.3	17.3	23.5	26.5	15.3	100
Average	5.6	6.3	23.3	40.6	25.3	100

Correlation and Regression Analysis on Concentric Diversification and Performance

Pearson Correlation on Concentric Diversification and Performance

Pearson correlation was conducted to determine the level of correlation between concentric form of diversification and performance. As shown on Table 4, $r = .464$, which implies that there is a medium significant (P-value = 0.000) level of correlation between performance and concentric diversification.

Table 4: Correlation of Performance and Concentric Diversification

Correlations			
		Performance	Concentric Diversification
Performance	Pearson Correlation	1	.464
	Sig. (2-tailed)		.000
	N	98	98
Concentric Diversification	Pearson Correlation	.464	1
	Sig. (2-tailed)	.000	
	N	98	98

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

Line of Best Fit Performance/Concentric Diversification

In order to determine how well the model fits the data in question, it was deemed necessary to draw the line of best fit given that it is a key indicator of the predictive accuracy of the model (Anderson *et al.*, 2002). From Figure 2, one can observe that there is some variation away from the line of best fit but still the positive correlation between the performance of universities in Kenya and level of concentric diversification is evident.

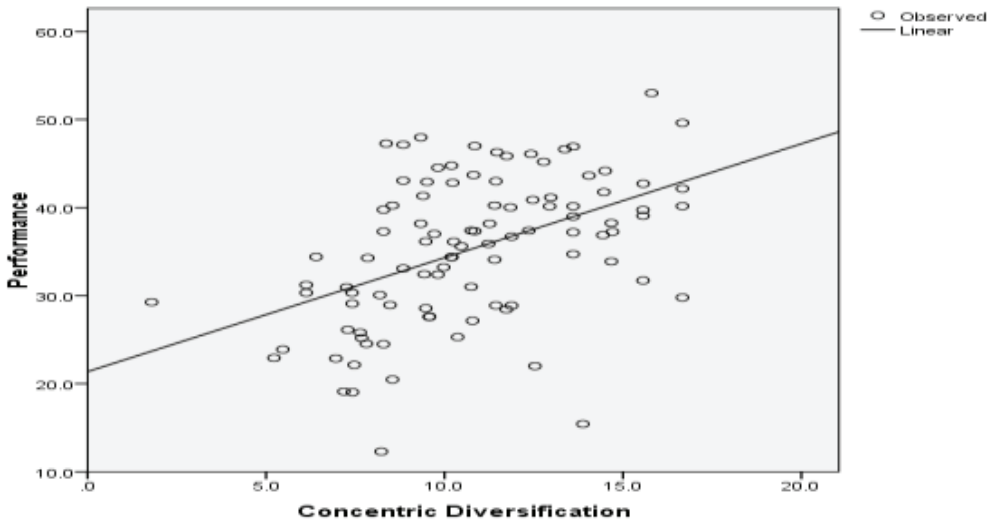


Figure 2: Line of Best Fit on Performance /Concentric Diversification

Regression Analysis on Concentric Diversification and Performance

The regression analysis on concentric diversification and performance depicts a relationship in which $R^2 = .216$ which means that 21.6% in the corresponding change in performance of universities in Kenya can be explained by a corresponding unit change in the level of concentric diversification as shown in Table 5.

Table 5: Model Summary for Concentric Diversification

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.464 ^a	.216	.207	7.39866884

ANOVA for Concentric Diversification and Performance

ANOVA was done as summarised in Table 6 which shows that F statistic = 26.393 and the P value = .000 hence the model can be described as being statistically significant considering the P value is less than 0.05.

Table 6: ANOVA for Concentric Diversification and Performance

ANOVA						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1444.743	1	1444.743	26.393	.000
	Residual	5255.069	96	54.740		
	Total	6699.812	97			

Beta Coefficients on Performance/Concentric Diversification

A test on the beta coefficients of the resulting model summarised in Table 7 shows t value as 5.137 and the P value of .000 which is less than 0.05 hence the conclusion that the model is statistically significant.

Table 7: Beta Coefficients on Performance/Concentric Diversification

Coefficients						
Model	B	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		Std. Error	Beta			
1	(Constant)	21.370	2.805		7.618	.000
	Concentric Diversification	1.294	.252	.464	5.137	.000

From the findings summarized in Table 5, 6, and 7, the study concluded that there is a significant positive correlation between concentric diversification and performance of universities. These findings are in line with the view of other scholars who postulate that organisations which adopt a concentric form of diversification are characterised by a fast rate of growth and that the degree of relatedness of organisational activities is a reflection of exploitation of particular capital, human or other assets which endow the organisation with cost advantage hence improved performance. Oyedijo (2012) established a similar relationship between concentric diversification and performance.

Influence of Geographical Diversification on Performance of Universities in Kenya*Descriptive Statistics on Geographical Diversification*

The respondents were asked to rate various statements that are likely to confirm geographical form of diversification. The results are summarised in Table 8. On the question if the university has expanded to new geographical markets, a simple

majority of 37.7% rated this as being the case either to a large or very large extent; 28.6% rated it as being the case to a moderate extent; while 33.6% rated it as either not at all or only to a little extent.

On the statement that the university has a presence in more than one county, 34.7% of the respondents rated it as true either to a large or very large extent; 19.4% marked it as being true to a moderate extent; while 32.7% indicated that their universities have no presence in other counties and 13.3% rated this indicator as being so to a little extent.

Regarding if the university has entered into some form of partnerships with institutions from other countries, 48% of the respondents indicated that their universities have some form of partnerships with institutions from other countries; 21.4% rated this as being true to a moderate extent while 30.6% were of the opinion that their universities have no any form of partnerships with institutions from other countries or only true to a little extent. On the statement that some of the university members (staff or students) have been recruited from other countries, 56.1% of the respondents confirmed it as being the case either to a large or very large extent. 25.5 % rated it as being true to a moderate extent while 2% and 16.3% rated it as not the case only to a small extent.

On average, 44.2% confirmed statements on geographical diversification as applicable to universities in Kenya either to a large or very large extent. 23.7% rated them at a moderate extent, 15.6% rated them as not applicable, while 16.6% rated them as applicable only to a little extent. From the averages, one may conclude that geographical diversification is one of the forms of diversification strategies adopted by universities in Kenya though this is only to a moderate extent as indicated on Table 8. Varghese and Puttman (2011), observe that diversified institutions are characterised by, among other characteristics, having a presence in different geographical locations as well as different groups of students and staff drawn from different geographical regions. This finding was also confirmed during interview with some of the university managers that some of the universities have opened branches in different regions. The common trend observed is having a campus in a city and town centres targeting working clientele interested in part-time studies.

Table 8: Descriptive Statistics on Geographical Diversification

Respondents Opinion	Percentage Response (%)					Total %
	Not at all	Little extent	Moderate extent	large extent	very large extent	
Statements Reflecting Geographical Diversification						
The university has expanded to new geographical markets	17.3	16.3	28.6	25.5	12.2	100
The university has a presence in more than one county	32.7	13.3	19.4	26.5	8.2	100
The university has entered into some form of partnerships with institutions from other countries	10.2	20.4	21.4	27.6	20.4	100
Some of our university members (staff, students) have been recruited from other countries	2	16.3	25.5	34.7	21.4	100
Average	15.6	16.6	23.7	28.6	15.6	100

These findings on geographical diversification correspond with those of other scholars that the education sector has embraced interregional and cross-border higher education (Knight, 2004). This view is shared by Bratianu *et al.* (2010) that universities are becoming, more than ever, mediums of regional and cross-border relationships and continuous regional and global flow of people. Martin (2007) refers to geographical diversification as the entry to new nation territory or integration of cross-border institutions to the already established institutions of higher learning. Martin further observes that cross-border institutions of higher learning are becoming important in terms of size and prestige, especially in some of the developing countries. The findings of this study confirmed that this is the trend among universities in Kenya.

Correlation and Regression on Geographical Diversification and Performance

Pearson Correlation on geographical diversification and performance

The study further opted to do a Pearson correlation analysis to determine the level of correlation between geographical diversification and performance. As summarised in Table 9, $r = .310$ shows that there is a small level of correlation between performance and geographical diversification holding other factors constant. This model is significant considering that p value is less than 0.05.

Table 9: Correlation of Performance and Geographical Diversification Strategy

Correlations			
		Performance	Geographical Diversification
Performance	Pearson Correlation	1	.310
	Sig. (2-tailed)		.002
	N	98	98
Geographical Diversification	Pearson Correlation	.310	1
	Sig. (2-tailed)	.002	
	N	98	98

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

Line of Best Fit on Performance/Geographical Diversification

In order to determine if the model fits into the data in question, it was considered important to draw the line of best fit given that it could indicate the nature of predictive accuracy of the model. From Figure 3, one may observe that while there seems to be some small correlation between geographical diversification and performance of universities, there is a very high variation of the plots from the line of best fit.

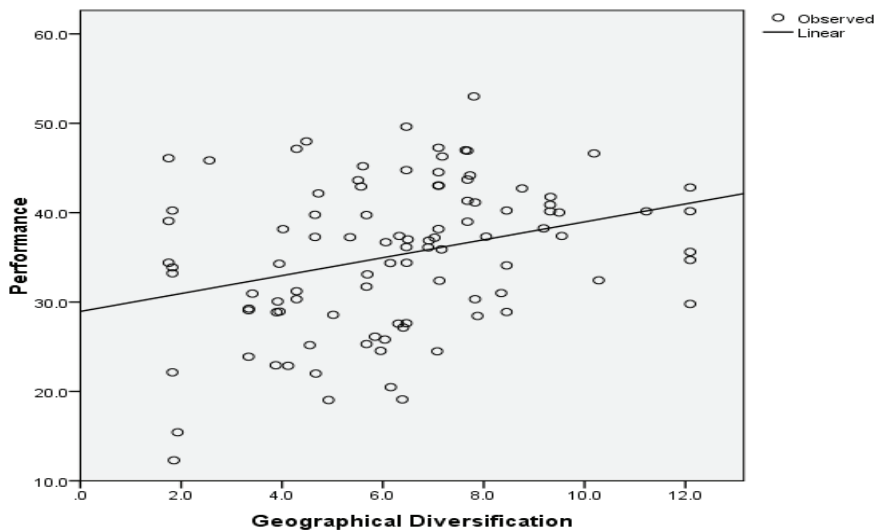


Figure 3: Line of Best Fit on Performance /Geographical Diversification

Using Regression Analysis to Determine the Relationship between Geographical Diversification and Performance of Universities in Kenya

Regression Analysis method was used to determine the relationship between geographical diversification and performance of universities in Kenya. The regression analysis depicted a relationship in which $R^2 = .096$ which means that 9.6% in the corresponding change in performance of universities can be explained by a corresponding unit change in geographical diversification as shown in Table 10.

Table 10: Model Summary for Geographical Diversification

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.310 ^a	.096	.087	7.94320522

ANOVA Test Performance and Geographical Diversification

ANOVA was done and the results as presented in Table 11 showed that there is a positive linear relation between geographical diversification and performance where $F(1, 98) = 10.187$ and the P value = .002 hence the model is statistically significant considering that the P value is less than 0.05.

Table 11: ANOVA for Performance and Geographical Diversification

ANOVA						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	642.739	1	642.739	10.187	.002
	Residual	6057.073	96	63.095		
	Total	6699.812	97			

Test of Beta Coefficients on Performance/Geographical Diversification

A test on the beta coefficients of the resulting model summarised in Table 12 shows t values of 3.192 and the P value of .002 which is less than 0.05 hence a conclusion that the model is statistically significant.

Table 12: Beta Coefficients on Performance/Geographical Diversification

Coefficients						
Model	B	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		Std. Error	Beta			
1	(Constant)	28.951	2.133		13.573	.000
	Geographical Diversification	1.002	.314	.310	3.192	.002

Regression between the Independent and Dependent Variable

A regression analysis between the independent variables (geographical diversification and concentric diversification) and the dependent variable (performance of Kenyan universities) was carried out and the findings are presented in Table 13, Table 14 and Table 15. From the Model Summary Table 13, R^2 in model 1 is .235 meaning that the independent variables (geographical diversification and concentric diversification) contribute 23.5% to the total variability in the dependent variable (performance of Kenyan universities).

Table 13: Model Summary of Independent Variables and the Dependent Variable

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.485 ^a	.235	.219	7.34554891

a. Predictors: (Constant), Geographical Diversification, Concentric Diversification

The ANOVA Table 14 shows that the p-value was below the 5% threshold at Sig. = .000. Hence, the null hypothesis that there is no significant influence of the independent variables (geographical diversification and concentric diversification) on the performance of Kenyan universities was rejected.

Table 14: ANOVA Table of Independent Variables and the Dependent Variable

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1573.889	2	786.944	14.585	.000 ^b
	Residual	5125.923	95	53.957		
	Total	6699.812	97			

a. Dependent Variable: Performance
b. Predictors: (Constant), Geographical Diversification, Concentric Diversification

From the Coefficient Table 16, Geographical Diversification was not statistically significant and therefore, the optimal model is;

Table 15: Coefficient Table of Independent Variables and the Dependent Variable

Model		Coefficients ^a			t	Sig.	
		B	Unstandardized Coefficients				Standardized Coefficients
			Std. Error	Beta			
1	(Constant)	20.065	2.910		6.896	.000	
	Concentric Diversification	1.129	.272	.405	4.154	.000	
	Geographical Diversification	.488	.316	.151	1.547	.125	

a. Dependent Variable: Performance

Discussion of Findings, Conclusion and Recommendations

The findings as derived from the responses and analysis confirm that most universities in Kenya have adopted geographical and concentric forms of diversification. From the research findings, a significant majority of the studied universities offer a wide range of academic programmes at different levels including diploma, bachelor's, master's and doctorate. Further, it was evident that most of the universities have established branches at different geographical locations and or partnered with other international institutions to offer academic programmes. This finding is in line with the position of Varghese and Puttmann (2011) that due to the demand for higher education and desire for growth and sustainability, institutions of higher learning have diversified into new products. Varghese and Puttman (2011) also observe that diversified institutions are characterised by, among other attributes, having a presence in different geographical locations and different groups of students and staff drawn from different geographical regions. The research established that there exists some relationship between geographical diversification and performance of universities in Kenya though it is not a very strong relationship. The research findings further revealed that concentric diversification has a significant influence on the performance of Universities in Kenya. The findings on the influence of concentric diversification on performance were similar with the position of other scholars such as Hogun (2003) and Oyedijo (2012) who postulate that concentric diversification has a significant positive impact on an organisational performance.

The study recommends that as universities in Kenya seek to expand and find ways to financially sustain themselves, it is imperative that they interrogate the potential and actual effects of the two forms of diversification on their primary objectives which are to conduct research and offer quality education for social economic development. Considering that concentric diversification was found to have a strong effect on the performance of universities in Kenya, universities are encouraged to focus more on diversifying concentrically and strengthening their academic programmes. The management of universities in Kenya should focus less on expanding through opening several branches and campuses as this may not necessarily add significant value to their core businesses and general performance.

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Hotel Guests' Attitudes towards Tourism Training in Middle Level Colleges in Kenya

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Abstract

The aim of this study was to explore tourism sector's human resource training and development in Kenya which depends on middle level colleges (MLCs). There has been no study to assess the manifestation of MLC trainees in tourist hotels under the universal changing tourism environment in Kenya. Hence, the current study, specifically, endeavoured to determine the relationship between variables accessible in the hotel (amenities, customer care, cognition, effectiveness and efficiency) and satisfaction levels of services offered to hotel guests by tourism trainees in the hotel industry. The study adopted a descriptive research design primarily targeting hotel guests. A total of 116 questionnaires were administered randomly to hotel guests from 21 randomly selected hotels in Nairobi for the study. Data was collected using questionnaires and interviews and was analysed using descriptive and inferential statistics. The findings revealed that most hotel guests were satisfied with front office staff services since it was the only service related to each of the four available variables in hotels and which implied that hotel guests were influenced by the employees' warm welcome, friendly nature and better knowledge in attending to other needs. Further, the information centre in the front office gave hotel guests full information about the hotels. The study recommends that the government should coordinate all the MLCs offering training programmes on tourism to ensure quality graduates able to support tourism promotion and development. Finally, further study should be undertaken to determine security of hotel guests (amenities) relating to individual needs.

Keywords: Middle Level Colleges, Hotel Guests, Tourist Hotels, Tourist Training Programmes

Introduction

Tourism is a key pillar of Kenya's national economy which is contributing more than ten per cent of the country's Gross Domestic Product (GDP) and providing a source of livelihood to millions of Kenyans (GoK, 2015). According to the World Bank (2012), lack of quality hotels in a country hurts tourism development. Although success has been recorded in the tourism sector in Kenya, sustaining this success requires safeguarding of existing tourism resources and quality human resource training in MLCs (KNBS, 2013).

Travel and tourism in 2011 globally employed about 8.7 percent of total employment, generating 9.1 percent of total gross domestic product and visitor exports generated US\$1,170.6 billion (5.3 percent of total exports). In developing countries, tourism stimulates various investments and generates revenue to the government (WTTC, 2012). In Kenya, travel and tourism contributed 13.7 percent of the GDP and 11.9 percent of the total employment (WTTC, 2012). Additionally, through its multiplier effect, tourism has led to growth of industries such as hospitality, transport, accommodation, entertainment, travel agencies and related services, health and training, among others, that are directly associated with it. Due to competition, hotel guests in Kenya are not getting quality satisfaction from products being offered and as such, hotel guests are switching to other countries like Zimbabwe, Botswana, Swaziland, Tanzania and Uganda which offer similar tourist attractions (World Bank, 2010).

Tourism is a vibrant sector confronted with varied issues like insecurity, lack of professionalism, effects of globalisation as well as changes in technical development and ecological environment (UNWTO, 2000). Consequently, there is need for the advancement of training and the enrichment of qualifications (Anne-Mette & Steen, 2001). Attitudes are formed through one's socialisation process which forms values and beliefs during an early age of children-hood and later shaped by family and religion among others. Such socialisation process affects individual attitudes towards services offered by tourist hotels.

Problem statement

In current years, tourism industry in Kenya is undergoing an acute shortage of skilled trainers who are responsible for imparting quality training to learners serving in hotels. Unfortunately, many unskilled persons are finding their way to tourism hotels (GoK, 2007). Unless quick solutions are found, the tourism and hospitality

sector will find itself struggling to compete with other developed countries like South Africa and France leading to poor performance in the hotel industry. Despite this, the study is important in assessing the attitudes of hotel guests towards tourism training in MLCs and the implications on tourism development in Kenya. Therefore, the need to review such curricula to make them relevant to the hotel industry thereby enabling the delivery of quality services to hotel guests is imperative. This will help to reduce the gap between what is learnt in MLCs and what is required by the hotel industry. Training in modern tourism enterprises has to inculcate the necessary skills required to develop the efficiency and enrich the industry environment such as technology, quality improvement, product development and tourist satisfaction (Ng'ang'a *et al.*, 2013). The main objective of this study was to assess hotel guests' attitudes towards the services and performance of middle level colleges' tourism trainees working in tourist hotels in Kenya.

Literature Review

Attitudes of Hotel Guests towards Services in Tourist Destinations

In the tourism industry, certain skills have been identified as cross-functional. These include skills like human relations, communications, and courtesy and among others (WTO, 1997). The hotel guests interact with MLCs trainees when they are being offered accommodation, tour guides and others services in the hotels.

Employees create and deliver tourism products or services at the point of consumption. The expectations for service standards and performance depend on the employees' training and education in order to provide quality experiences since tourists judge the experience holistically during the visit (WTO, 1997). Many tourism services are technologically complex; few are able to judge the technical quality of the service experience provided by staff (Law, 2002). Although, MLCs have incorporated technology in their curricula, hotel guests appreciate the importance of technology in delivering services like booking or ticketing. According to Deming (1982), high quality of services, provide a greater market share and enhance competitiveness among hotels. Such qualities include access, communication, competence, and courtesy. Problems associated with staff like unacceptable treatment of hotel guests, drunkenness and slow performance of services (Law, 2002), affect competitiveness of hospitality facilities and services.

Studies have shown that tourist satisfaction ranges from cultural trips (Ross & Iso-Ahola, 1991) to particular destinations (Joppe *et al.*, 2001). In such a case, for

hotels to be competitive, their staff should be trained to ensure quality services to hotel guests. According to Johnson *et al.* (1995), there are two types of satisfaction namely transaction-specific satisfaction, concerned with individual satisfaction of a particular service experience; and also cumulative satisfaction, which is hotel guests' total consumption experience with a service. Cumulative satisfaction is relevant when focusing on the tourist's evaluation of their overall experience at a destination (Foster, 1998). Therefore, it is advisable that the curricula delivered by MLCs should include both types of satisfaction in order to provide the same services with no disparities in service delivery. Satisfaction is measured by how well leisure activities are perceived to fulfil the basic needs and motives by the guests (Crompton & Love, 1995).

Hotel Guests' Perspectives of Destinations

The information needed for the hotel guests comes from various marketing promotional mix such as travel brochures, personal experience and media (Wang & McLee, 2011). Service quality depends on the visitor satisfaction. This is the indicator of quality services offered by the trainees (Williams *et al.*, 2010). There are two forms of satisfaction, namely; tourist's personal satisfaction judgment and overall experience, not individual experience (Spreng & Page, 2003).

Hotel guests form expectations about a hotel from marketing promotions. The marketing dynamics lure the tourist to a hotel and will affect the hotel according to the hotel guests' attitudes. Individual satisfaction is influenced by global factors which are beyond the hotel (Foster, 1998). Satisfaction is the assessment of the experience the tourist is looking for in the hotel (Wagar, 1966) while the quality of experience results from a service provider and managements' contribution by providing the inputs required for the services.

The experience is created by the hotel guests through physical and social settings in terms of attitudes, skills, equipment and among others (Williams *et al.*, 2010) while quality experience are the attributes brought to the hotel by hotel guests. According to Herzberg (1966), quality of experience is classified as a motivational or hygiene factor which encourages hotel guests positively to do something in a hotel. On the other hand, hygienic factors do not encourage things to happen but if overlooked, will disappoint the tourist to travel to a destination. For example, if there is no water, it will not discourage a tourist from travelling but will encourage a tourist to choose a different hotel. Professionalism, effective skills, efficiency, and courtesy are characteristics that depend on education and training in order to satisfy hotel

guests (WTO, 1997). Training and education becomes viable and influential in raising the professionalism needed in the tourism industry like business, hospitality, management and, among others, to provide quality services (Becton & Graetz, 2001). Various studies have shown that hotel guests view quality of service as a top priority (Barsky & Labagh, 1992). For staff service, quality attributes includes “politeness and friendliness of staff”, “efficiency in check-in/out” and “helpfulness of staff” to hotel guests (Choi & Chu, 2000).

Factors Influencing Hotel Guests’ Satisfaction with Services Offered by Tourism Destinations

According to Cooper *et al.* (1996), there is a vicious cycle here; better trained and paid staff offer services to hotel guests leading to greater productivity to the hotel, making the hotel and the country richer, thus benefiting hotel guests, staff and residents. Hotel guests’ return reinforces the cycle as satisfaction is recognised as a post-purchase construct which is related to how a tourist likes or dislikes a service or product after experience (Woodside & Lysonski, 1989). Pizam *et al.* (1993) explain that tourist satisfaction is the result of comparison between a tourist’s experience and expectations at the destination visited. The hotel guests depend on the quality of trainees from MLCs being empowered to work effectively in the industry which leads to more hotel guests to the country, more hotels are developed and finally more MLCs are registered for tourism courses.

Satisfaction is the post-consumption evaluation which is consistent with prior belief and expectations of the consumers of services and products. Dissatisfaction is the outcome when the confirmation of what was believed and expected before purchase does not take place (Law, 2002). In the consumerist gap analysis of travellers’ satisfaction (Figure 1) adopted from Law (2002), A_o = what the tourist anticipates at the time of purchase, which can be low or high and E_o = experience. Therefore, $A_o = E_o$, and this is a measure of management success. E_w = satisfaction from the tourist, and refers to compliments from the hotel guests to the staff. E_y = when hotel guests are not satisfied. $T_1, T_2, T_3, \text{ etc.}$ = time when satisfaction occurred and what should be done by that time and how far the degree of dissatisfaction has gone. E_1 = rise in dissatisfaction while E_2 = what the tourist expected (Law, 2002). If the gap between E_1 and E_2 is reduced through proper training by MLCs, then tourist satisfaction will be high. In the study, the elements in Figure 1 are used to help the researchers to assess the satisfaction of hotel guests with the services rendered by MLC trainees and/or graduates.

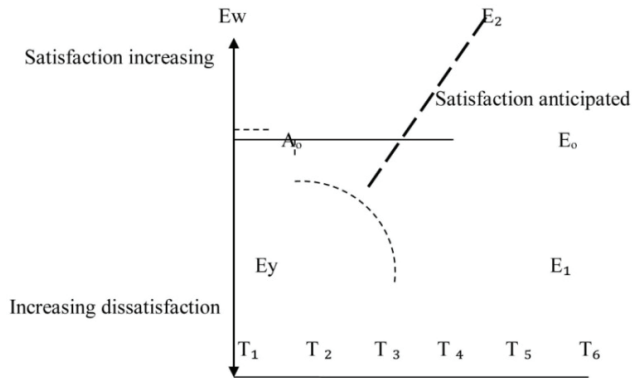


Figure 1: The consumerist gap model

Source: Adopted from Law (2002)

Methodology

The study adopted descriptive and exploratory research designs which required the use of a questionnaire survey to collect data from sampled hotel guests. The questionnaire survey generates information by use of different tools (Orodho & Kombo, 2002) while exploratory research design explores different phenomenon under study through literature reviews, analysing experiences and insight-stimulating examples (Kothari, 2010) to enhance service delivery to hotel guests.

The study used convenient sampling method to select the 21 hotels for the study which makes more than 50% of the registered tourist hotels (Appendix 1). The study targeted hotel guests present in the selected hotels (Appendix 1) in order to assess their attitudes towards the performance and services offered by MLCs trainees/graduates (Appendix 1). (www.tripadvisor.com/Tourism-9294207-Nairobi-vacations.html). Twenty-one (21) hotels were selected for the study where eight hotel guests per hotel were targeted totalling to a sample size of 168 selected through convenient sampling. The convenient sampling was used because the population was 1,164,100 hotel guests per year in 82 hotels for a 10% representation (www.tripadvisor.com/Tourism-9294207-Nairobi-vacations.html). The technique was used to select hotel guests who were willing to fill the questionnaire as hotel guests are less willing to engage in research (Sitati, 2007).

The study purposively targeted the 5,539 MLCs trainees/graduates in Nairobi because according to the Ministry of Education (GoK, 2007, CDLT, 2010), it has

30% of the registered MLCs in the country. Trainees from MLCs were selected from those taking tourism training courses. The convenient sampling was used to select administrators in charge of 16 MLCs to provide the trainees' enrolment registers which were used to generate random numbers using MS Excel 2010. The sample of size for trainees was determined by the average of the results of Krejcie and Morgan Table for 5,539 MLC trainees to reduce sampling error giving a sample of 326. In addition, purposive sampling was used to select 10% of the trainees for piloting. A total number of 32 trainees were selected for pilot study. Data was collected using two different questionnaires, for the guests the questionnaire was administered by waiters and drivers as they interact with the guests while questionnaire for the trainees was administered by researchers' assistant after getting clearance from the MLC administrator. The questionnaires were analysed by using software SPSS.

Results and Discussion

Hotel Guests' Attitudes towards Services and Performance of Hotel Trainees/Employees

Hotel guests expressed their opinions on hotel employees using a 5 pointer Likert scale ranging from 1=Very Poor to 5=Excellent (Table 1). As can be seen from Table 1, the management staff services and front office staff services had the highest rated percentage by hotel guests. Most hotel guests (64.7%) rated the service offered by the management staff as very good and excellent with only 16.3% rating them as poor and this significantly varied between the respondents ($\chi^2=40.638$; $df = 4$; $p = 0.000$; Table 1). The service by the front office staff was rated as very good and excellent by 62.1% of the tourist respondents while 20.7% rated them as poor and this significantly varied between the respondents ($\chi^2=50.379$; $df = 4$; $p = 0.000$; Table 1).

Table 1: Satisfaction levels of hotel guests in relation to services offered by hotel staff

Type of service offered	Very poor		Poor		Good		Very good		Excellent		χ^2	df	p-value
	f	%	f	%	f	%	F	%	f	%			
Management staff services	7	6.0	12	10.3	22	19.0	29	25.0	46	39.7	40.638	4	0.000*
Front office staff services	11	9.5	13	11.2	20	17.2	53	45.7	19	16.4	50.379	4	0.000*
Waiters services	7	6.0	8	6.9	37	31.9	39	33.6	25	21.6	40.379	4	0.003*
Room attendants services	7	6.0	20	17.2	25	21.6	40	34.5	24	20.7	24.086	4	0.001*
Tour guides services	17	14.7	17	14.7	20	17.2	33	28.4	29	25.0	9.345	4	0.005*
Drivers services	17	14.7	11	9.5	31	26.7	36	31.0	21	18.1	17.966	4	0.001*
Food/chefs services	15	12.9	14	12.1	30	25.9	26	22.4	31	26.7	11.500	4	0.002*

*Significant level at 0.05

Commonality Factor values analysis

An analysis was undertaken to determine the common variance in the data structure. This was after four factors were extracted from each component with the highest values after reduction, namely “the hotel meets promise of promotion and advertisement at 85.6%” and “the hotel has modern equipment/facilities at 89.6%”. The lowest items in the four variables were eliminated for example “hotel employees understand visitor’s specific needs at 34.1%” (Table 2).

Table 2: Commonalities of feelings of how hotel services are sharing variances of the variables

Commonalities	Initial	Extraction 1	Extraction 2
Amenities:			
The hotel has modern equipment/facilities.	1	0.896	0.892
The hotel is safe and secure place	1	0.607	0.659
Hotel has diverse accommodations, facilities and excellent services.	1	0.433	0.416
Hotel employees understands visitors specific needs	1	0.341	Item removed
Customer care:			
The hotel has arranged tourist information centers	1	0.484	0.494
The hotel gives value for money experience	1	0.386	0.399
The hotel meets promise of promotion and advertisement	1	0.856	0.865
The hotel shows sincere interest to answer visitors' questions	1	0.788	0.794
Cognition:			
Hotel employees shows warm welcome and hospitality to visitors	1	0.569	0.584
Employees of the hotel are friendly	1	0.742	0.772
The hotel has well behaving and friendly drivers	1	0.322	Item removed
Employees in the hotel have competence and problem solving skills	1	0.421	0.461
Effectiveness and Efficiency:			
The hotel is neat and clean	1	0.486	0.491
The hotel provides variety of menu with excellent service.	1	0.346	Item removed
Visitors will get prompt services in the hotels	1	0.514	0.566

Relationship between variables and satisfaction of the hotel guests

The seven types of services offered to the hotel guests were then compared with four satisfaction variables. The means were differentiated using One-way ANOVA. Customer care had five variables except 'room attendant services' and 'drivers' services' while cognition also had five variables except 'management staff services' and 'waiters' services' variables (Table 3). The results showed that both customer

care and cognition had the highest number of services while the other two variables had only four types of services. The variable 'amenity' was significantly related to 'front office service', 'room attendant services', 'tour guide services' and 'food/chefs services'. 'Effectiveness and efficiency' variable showed significant relationship with the variable 'management staff service', 'front office staff service', 'waiter services' and 'drivers service' (Table 3).

The highly rated type of service that was used for satisfaction by hotel guests in the four variables was front office service while management staff services, waiters' services, room attendant service and drivers' service respectively were rated the lowest.

Table 3: Relationship between Hotel Guests' Satisfaction and the Variables

Services	Agreement		Amenities		Customer care		Cognition		Effectiveness and Efficiency	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. Management staff service	Statistics	F=1.83 p=0.133		F=4.65 p=0.185	F=1.60 p=0.281		F=5.14 P=0.001			
	Very poor	4.620	0.81	4.540	0.36	4.604	0.84	4.346	0.56	
	Poor	4.552	0.79	4.440	0.48	4.300	0.86	3.689	0.89	
	Good	4.583	0.68	4.200	0.55	4.512	0.89	3.854	0.66	
	Very good	4.600	0.64	4.152	0.66	4.556	0.75	3.697	0.58	
	Excellent	4.612	0.60	4.102	0.54	4.565	0.94	4.684	0.69	
2. Front office staff service	Statistics	F=4.85 P=0.007		F=3.12 P=0.314	F=3.54 P=0.354		F=3.96 P=0.014			
	Very poor		0		0		0		0	
	Poor	4.685	0.56	4.521	0.36	4.654	0.54	3.874	0.21	
	Good	3.254	0.64	4.511	0.54	4.600	0.36	3.979	0.65	
	Very good	4.202	0.59	4.423	0.51	4.512	0.74	3.885	0.54	
	Excellent	4.785	0.61	3.895	0.42	4.358	0.85	3.875	0.48	
3. Waiters service	Statistics	F=2.64 P=0.009		F=3.69 P=0.078	F=2.68 P=0.254		F=3.68 P=0.028			
	Very poor		0		0		0		0	
	Poor	4.696	0.54	3.589	0.97	4.654	0.65	3.887	0.64	
	Good	4.684	0.68	3.587	0.54	4.687	0.74	3.948	0.54	
	Very good	3.651	0.35	3.987	0.65	4.541	0.54	3.784	0.64	
	Excellent	4.563	0.65	4.015	0.47	3.879	0.91	3.874	0.51	

Services	Agreement	Amenities		Customer care		Cognition		Effectiveness and Efficiency	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
4. Room attendants service	Statistics	F=6.57 P=0.001		F=2.58 P=0.054		F=5.45 P=0.001		F=2.154 P=0.264	
	Very poor		0		0		0		0
	Poor	4.021	0.56	3.687	0.89	4.565	0.84	3.784	0.56
	Good	3.213	0.57	3.451	0.64	4.549	0.61	3.945	0.43
	Very good	3.854	0.44	3.145	0.71	3.987	0.51	3.845	0.64
5. Tour guides service	Excellent	4.621	0.65	3.954	0.61	4.025	0.85	3.981	0.41
	Statistics	F=14.3 P=0.001		F=9.64 P=0.001		F=13.5 P=0.001		F=0.68 P=0.561	
	Very poor	4.784	0.54	3.587	0.78	4.689	0.56	3.942	0.65
	Poor	4.564	0.87	3.785	0.69	4.5124	0.96	3.947	0.84
	Good	4.008	0.66	3.484	0.45	4.687	0.54	3.964	0.56
6. Drivers service	Very good	3.889	0.56	3.198	0.63	3.987	0.63	3.789	0.84
	Excellent	3.879	0.59	3.745	0.54	4.251	0.84	3.989	0.45
	Statistics	F=2.68 P=0.154		F=1.069 P=0.515		F=5.12 P=0.002		F=3.24 P=0.654	
	Very poor	4.985	0.64	3.874	0.78	4.689	0.65	3.974	0.35
	Poor	4.560	0.67	3.458	0.65	4.687	0.51	3.657	0.54
Very good	Good	3.898	0.46	3.745	0.49	3.987	0.61	3.457	0.64
	Very good	4.254	0.54	3.894	0.64	4.615	0.54	3.947	0.59
	Excellent	4.545	0.49	4.0124	0.45	4.681	0.96	3.847	0.54

Services	Agreement		Amenities		Customer care		Cognition		Effectiveness and Efficiency	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
7. Food/chefs service	Statistics		F=14.5 P=0.001		F=5.64 P=0.006		F=6.25 P=0.003		F=2.19 P=0.315	
	Very poor	4.685	0.54	3.987	0.36	3.987	0.85	3.954	0.79	
	Poor	4.674	0.51	3.784	0.65	3.587	0.47	3.812	0.78	
	Good	4.785	0.66	3.457	0.54	3.874	0.61	3.987	0.56	
	Very good	4.625	0.84	3.975	0.63	4.485	0.54	4.451	0.79	
Excellent	4.658	0.65	3.878	0.84	4.293	0.68	4.012	0.54		

Satisfaction of hotel guests

Independent sample t-test was used to test the means (Table 4).

Table 4: Satisfaction of hotel guests

Variables	Trainees			
	Mean score	%	t	p-value
Amenities	4.365	26	-0.836	0.462
Customer care	3.894	23.2	-1.237	0.340
Cognition	4.253	25.4	-2.421	0.036
Effectiveness and efficiency	4.264	25.4	-1.351	0.451

Discussions

Tourism services are important for tourism development and satisfaction. These results show that hotel guests rated the ‘management staff’ as either excellent or very good (Table 1) which could be attributed to increased level of training and quality to attract hotel guests. The ‘management staff’ service is influenced by two variables namely ‘customer care’ which is a support service in a management function of leading and motivating of staff to guarantee the best customer service by handling complaints and queries and sorting security issues and ‘effectiveness and efficiency’ which are indicators of the quality of services offered to hotel guests. The finding agrees with Cooper *et al.* (1996) who explain that the role of management which operates through some functions such as staffing, controlling and motivation is to plan and develop strategies at destinations for tourist satisfaction, while Dhamodharan *et al.* (2010) assert that development of an organisation is based on innovative labour force, technology, quality management, and customer satisfaction. Kotler (2003) adds that the ‘management staff’ under ‘customer care’ has to provide information necessary for the hotel guests, which involves, public relations, communication skills among others.

Usually, the first impression, to a tourist is provided by the front office. In this study, “front office” service was rated by majority very good (Table 1). The front office staff act as a mirror to the hotel by virtual of the services they offer to the hotel guests for example, attending them, giving direction, answering questions about the hotel among others (Table 1). With the information gathered by the hotel guests concerning the quality of services offered by the hotel, encourages the tourist to come back again to the same hotel and give a reference to other hotel

guests who could like to visit the country. The study corresponds with the findings in Hong Kong by Yeung and Leung (2007) that front office staff be aware of their responsibility and be trained and equipped when dealing with hotel guests in the hotels.

Factor loading scores confirmed areas of satisfaction across factors associated with amenities, customer care, cognition, effectiveness and efficiency (Table 3). On average, most hotels had modern equipment/facilities, provided a variety of menu with excellent service, among others in the hotels. The results concurred with the findings by Giles and Campbell (2003) that shortage of relevant and appropriator skills among the employees' leads to poor services to hotel guests in the hotel. Therefore, the guests are interested in the modern equipment and facilities in hotels and to get prompt services in the hotels, all this call for quality training for MLCs trainees to give quality services to the guests in the destinations, which leads to increased numbers of tourists visiting the country as well as increased number of registered MLCs to provide quality training for the industry.

Conclusion

The study concludes that while the services by MLCs trainees were highly ranked, there is need for hotels to enhance quality and modern facilities for the enjoyment of guests as well as quality training for quality performance in the hotels since tourism industry is dynamic with increasing expectations.

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APPENDICES

Appendix 1: Guests' Hotels within Nairobi's Central Business District

1) Norfolk Hotel	2) Ole Sereni Hotel
3) Panari Hotel Nairobi	4) Red Court Hotel Nairobi
5) Safari Park Hotel and Casino Hotel	6) Sankara Hotel Nairobi
7) Sarova Panafric Hotel	8) Sarova Stanley Hotel
9) Serena Nairobi	10) Silver Springs Hotel, Nairobi
11) Tribe Hotel	12) Utalii Hotel
13) Windsor Golf Hotel and Country Club	14) Nairobi Serena Hotel
15) Collingham Gardens	16) Crowne Plaza Nairobi
17) Fairview Hotel	18) Hemingways Nairobi
19) Heron Hotel	20) High Point Hotel
21) Hilton Nairobi	22) Holiday Inn Nairobi
23) Impala Hotel	24) Intercontinental Hotel
25) Jacaranda Hotel	26) Karen Blixen
27) Kenya Comfort Hotels Suites	28) KiviMilimani Hotel
29) Kwaliti Hotel	30) Laico Regency
31) Meltonia Luxury suites	32) Nairobi Safari Club

Source: *Kenya Association of Hotels and Keepers and Caterers Hotel, Restaurant and Entertainment Guide, 2009.*

Management of University-Based Business Incubators as Tools for Entrepreneurship Growth and Development in Kenya

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Abstract

The importance of enterprise growth around the globe has been well recognised and documented by many scholars. Studies have reported that the potential contribution of enterprise growth to employment and income has been generally recognised. Entrepreneurs are widely recognised as the prime movers of economic development; the people who translate ideas into action. However the startup failure rate, particularly in Kenya, is still very high and the desired growth levels are yet to be achieved. Consequently, some scholars and policy makers have turned to business incubators and, particularly, university-based business incubators as a possible boost to enterprise growth through nurturing start-ups. This study sought to investigate the management skills of university-based business incubators managers in Kenya. It was conducted using a descriptive research design. Five active university-based business incubators in Kenya were investigated with a specific focus on forty seven (47) graduated incubates and five (5) managers from the said incubators. The study used a semi structured questionnaire and interview as its main data collection tools. A combination of tools was used to analyse the data because whereas some aspects of the study are qualitative others are of a quantitative nature. The study established that the managerial skills (conceptual, interpersonal and technical skills) of managers of university-based business incubators have a significant positive correlation to success of the incubators and growth of their incubates. The study recommends, among others, that the government through the Ministry of Education and management of individual universities set up more university-based business incubators given the positive potential effect they have on enterprise growth. The existing university-based business incubators also need to be expanded and enhanced given the high demand from potential incubates. This will enable them to accommodate more incubates and possibly create an increased number of successful start-ups.

Keywords: Incubators, Start-ups, Managerial Skills, Entrepreneurship

Background

Business incubation is a business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services. These services are usually developed or orchestrated by incubator management and offered both in the business incubator and through its network of contacts. A business incubator's main goal is to produce successful firms that will leave the programme financially viable and freestanding (NBIA, 2013). Overall, business incubators provide local, on-the-spot diagnosis and treatment of business problems, dramatically lowering the early-stage failure rate of start-ups. This concept is particularly important for start-ups considering their fragility. According to several empirical studies, approximately half of all new entrants survive less than five years (Mwobobia, 2012).

University-Based Business Incubators

Interest in the university sponsored business incubators stems from the significant potential of the concept. The concept holds out the possibility of linking talent, technology, capital, and know-how to leverage entrepreneurial talent; accelerate the development of new technology-based firms; and speed the commercialisation of technology (Bathula, Karia & Abbott, 2011). Universities are particularly well equipped with the resources to parent new ventures. They are dedicated to advancing knowledge in key scientific, engineering, management, and social sciences. They have highly skilled and motivated student labour which can be obtained at a relatively low cost. They also have many well-equipped laboratories and a host of other facilities that can be shared (for example, computers, libraries, media access, and so on).

Some leading universities have taken initiative to establish university-based incubators. These are aimed at empowering students to be self-employed upon graduation thereby reducing pressure on the ever thinning employment space and the chronic unemployment in Kenya (Marwanga, 2009). Universities with incubator facilities in Kenya include Strathmore University (@iBizAfrica), Kenyatta University (Chandaria Business Innovation and Incubation Centre), University of Nairobi (C4D Lab), JKUAT (Kuza Incubation Centre, Nairobi Industrial and Technology Park), Mount Kenya University (Business Incubation Centre), Technical University of Kenya (Business/Technology Incubation Unit) and KCA University (KCA Business Incubator). However, this study focused on only five currently active university-based business incubators, that is, those university-based

business incubators that are currently operational and are currently admitting and supporting start-ups.

Statement of the Problem

Scholars have looked into the relationship between university-based business incubators and enterprise growth. It was noted that there is a positive contribution of incubators to growth of enterprises in China (Chandra & Chao, 2011). On the other hand, a study in Nigeria concluded that incubators had failed in their primary objective of turning out a steady flow of successful enterprises majorly because of their poor management (Adegbite, 2001). Several managerial challenges are faced by incubators based in academic institutions. These include lack of planning and clear vision whereby in many instances universities start incubation centres without a proper needs assessment and market analysis, or merely because other universities are doing it (Salman & Majeed, 2009). It becomes a conventional symbol for a university to have an incubator. These incubators are later used as a means of boosting strong relationships with the industry whereas in reality, industries were never analysed or involved in the decision making process while taking these initiatives.

A study in Pakistan revealed that the most serious managerial challenge facing university-based business incubators is that of undercapitalisation of in-house university resources which includes faculty, students and laboratories. Faculty's lack of involvement is due to the lack of incentives as they are expected to get involved voluntarily. This involvement is besides their teaching assignments. Therefore, it is taken as a burden by many of the faculty members and they prefer to stick to their teaching jobs. The result is a complacent faculty, settled in a comfort zone of academic environment, distant from the outside world activity. Students could bring creative energy which is a pivotal element of entrepreneurial environment and that too at a lower cost than the external help. Yet no significant student internship initiative was found in the majority of the academic incubators. Expensive and valuable equipment available in university laboratories also often remains inaccessible to the incubated enterprises (Salman & Majeed, 2009).

Literature Review

Managing university-based business incubators could be looked at as managing different interest interests of different parties, all valid as proposed by the Stakeholder Management Theory (Freeman, 1984). In Freeman's classic definition, a stakeholder is any group or individual who can affect or is affected by the

achievement of the organisation's objectives. The term "stakeholder firm" is to denominate organisations that seek a broad inclusive definition of objectives and optimise a sense of fairness in several stakeholder groups. Proponents of this argument claim that for a stakeholder firm to be viable over time, it must demonstrate its ability both to achieve the multiple objectives of the different parties and to distribute the value created in ways that maintain their commitment (Kochan & Rubinstein, 2000).

The success of university-based business incubators could be measured by the extent to which they achieve various objectives touching on various stakeholders (Salman & Majeed, 2009). The objectives may include number of enterprises created; survival rate of the incubated enterprises; jobs created; research commercialised; overall profitability of the incubator; improvement in the university-business links; faculty/student involvement; and refinement of the entrepreneurial skills of the start-ups' management. These objectives represent various stakeholders including the government, incubated enterprises, university, business community and the general society.

A competent incubator manager should possess various attributes. These include broad entrepreneurial experience and specific knowledge in aspects of small business, marketing, finance, and technology management; sound knowledge of the professional technical community and a wide network of contacts; computer literacy, and excellent communication and interpersonal skills; good counselling and teaching capabilities; and unqualified integrity, dynamic leadership, and unsurpassed energy (Lalkaka, 1997). To attract and sustain such competent managers requires an attractive compensation package, including participation in any equity/royalty arrangements with tenants.

The proper training of incubator management in developing countries usually comprises: in-country orientation for the selected managers on the local facilities and services and the mission of the incubator within the community; a visit by local sponsors abroad to see first-hand the role of incubators and their own responsibilities; hands-on apprenticeship for the managers at a comparable incubator abroad; continuing training at home to upgrade needed skills and through participation in regional and international seminars; and setting up a national association of technology parks and incubators and linking up to the international associations (Lalkaka, 1997).

Some scholars have proposed what they call a "proactive incubator management" approach to deal with the identified managerial challenges in university-based

business incubators. The approach involves diversification of income resources of academic incubators by introducing project management teams, fully utilising in-house resources such as faculty, student interns, and laboratories, offering financial incentives, and doing commercial development projects and ensuring professional standards (Salman & Majeed, 2009).

University-based business incubator managers need to possess conceptual skills especially because they are responsible for establishing goals and selecting sponsors. The first step for the manager is to make a realistic assessment of the profile of the local entrepreneur and the gaps in knowledge, facilities, and functions that the incubator must be designed to fill. This forms the base of a good business plan, which then serves to mobilise broad sponsor support, raise finance, market, and monitor performance of the incubator. Another planning decision to be undertaken by the manager is on the incubator focus. That is: should the incubator cater mainly to one discipline, such as software development, or should it cover a wider range? The single subsector focus has the potential for better cooperation and competition among tenants, perhaps some expensive research facilities provided for shared use, and more concentrated technical assistance from the incubator management. But in most situations, the reservoir of potential local businesses in a single technology is limited and the capital investment needed to equip a special-purpose incubator is too high to justify this. Furthermore, the diversity of disciplines can itself add value to interactions among tenants (Xu, 2010).

University support inevitably comes along with intervention. This may be open or subtle. The university may provide space while a lecturer could be the incubator manager. While treating the incubator as a “centre” or department of the university or government agency may be expedient, the two cultures are different, the negative perceptions are significant, and the bureaucratic constraints are many. The preferred legal persona could be a non-profit corporation, transformed later to an autonomous company (Bathula *et al.*, 2011).

Interpersonal skills encompass the way a manager relates with other people, including the ability to motivate, facilitate, coordinate, lead, communicate, and resolve conflicts (Pieper, 2007). Effective managers are cheerleaders, facilitators, coaches and mentors. They build through people. Effective human skills enable incubator managers to unleash incubates’ energy and help them to grow (Sorenson, 2006).

University-based business incubator managers also require technical skills. Technical skills include mastery of the methods, techniques and equipment

involved in specific functions such as engineering, manufacturing or finance. They also include specialised knowledge, analytical ability, and the competent use of tools and techniques to solve problems in that specific discipline (Rue & Byars, 2004). Incubator managers particularly require technical skills in finance and performance management (Hackett & Dilts, 2004).

Given the increasing attention given to business incubation facilities in Kenya as earlier noted in this study, and the fact that most of the current body of research is based in developed countries, this study aimed to contribute knowledge on the Kenyan university-based incubators.

Research Methodology

The study adopted a descriptive research design targeting top managers and graduated incubates of five active university-based business incubator in Kenya, namely, Strathmore University (@iBizAfrica), Kenyatta University (Chandaria Business Innovation and Incubation Centre), University of Nairobi (C4D Lab), Mount Kenya University (Business Incubation Centre), and KCA University (KCA Business Incubator). These are the university-based business incubators that are currently operational and are admitting and supporting start-ups. The study adopted a census approach. This was in consideration of the small number of active university-based business incubators in Kenya and their graduated incubates. In total, the study had fifty-two (52) respondents consisting of five (5) incubator managers and forty-seven (47) graduated incubates from across the five incubators. Primary data was collected using self-administered semi structured questionnaires and interviews for both categories of respondents.

Study Results

The level of managerial skills among the university-based business incubator managers was found to have a significant 0.227 positive effect on entrepreneurship growth and development. A majority (78.7%) of respondents agreed that the incubator management was visionary with a clear plan and goals for the incubator. A majority (70.2%) of the respondents were also of the view that the incubator management was competent in start-up management. Most (70%) of the respondents also agreed that the incubator managers possessed wide networks and had good interpersonal skills. Simple majority (55%) of respondents noted that the managers were good at mentoring and counselling incubates and spent

adequate time with incubates. A majority (63.8%) of the respondents said incubators employed periodic report submission by graduated incubates as their monitoring and evaluation mechanism. However, 34.0% of the respondents said the incubators did not monitor nor evaluate their graduated incubates. Less than half (42.8%) of the respondents strongly felt that incubators managers were doing well in fundraising for the incubates in their incubators.

Conclusion

University-based business incubators are still a fairly new concept in Kenya and most universities are yet to set up such incubators. Based on the findings of the study, it can be concluded that the existing university-based business incubators in Kenya are in good hands as far as their management is concerned. They are led by visionaries who are competent and well networked. The managers are however not very strong in funds mobilization and also in monitoring progress of graduated incubates.

Recommendations

Universities need to get the management of their incubators right if they are to play a positive role in the growth and development of start-ups in Kenya. They need to have managers with the right knowledge, attitude and skills to successfully run the incubators and provide the envisioned support to start-ups.

The number of university-based business incubators is very small with only five universities having active business incubators. Individual university management and the Ministry of Education should set aside resources and enact policies for more universities to start business incubators. The existing university-based business incubators also need to be expanded and enhanced given the high demand from potential incubates. This will enable them to accommodate more incubates and possibly create an increased number of successful start-ups.

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Influence of Reverse Logistics on Procurement Performance in the Sugar Industry in Kenya

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Abstract

The study aimed to determine the influence of reverse logistics on procurement performance in the sugar industry in Kenya. This study was based on Sustainability Theory, Resource Dependency Theory and Ethics Theory. The study adopted a cross sectional survey research design conducted in 11 sugar factories in Kenya (4 parastatal companies and 7 private companies). The study purposively selected stores department, purchasing department and finance department to constitute its sample frame. 132 respondents were then selected from the selected departments randomly. Primary data was gathered through structured questionnaires. Data collected was cleaned and analysed both descriptively and inferentially. Descriptive analysis was used to describe the research variables; reverse logistics and procurement performance while inferential analysis was used to test the relationship between the research variables. The study findings showed that reverse logistics has a strong positive effect on procurement performance as shown by the R Square value of 0.627 implying that the independent variables account for 62.7% of procurement performance. These study findings enrich literature on reverse logistics and procurement performance, stimulate further studies in the areas, and could be adopted for decisions and policy formulation.

Keywords: Reverse Logistics Strategy, Procurement Performance

Introduction

The general objective of the study was to explore the influence of reverse logistics on procurement performance of the sugar industry in Kenya. Reverse Logistics has continued to attract increased attention; mainly as a result of consciousness to issues with the environment, environmental laws coupled with emerging awards and recognitions (Blumberg *et al.*, 2010). Reverse logistics networks have some generic

characteristics related to the coordination requirement of two markets, supply uncertainty, returns disposition decisions, postponement and speculation (Amemba *et al.*, 2013). It encompasses events in returns flows, initiated at customer's point backwards to suppliers and manufacturers along the supply chain. Redesigning logistics networks to accommodate product returns and remanufacturing and re-use of such parts and components can often be profitable and is assuming greater importance in business as well as in research (Tibben, 2002).

According to Lysons (2012) the procurement function is to manage the process used for the purchase of goods and services by the organization. Quality production, good inventory management, timely delivery of raw materials to the factory and distribution of finished goods are vital determinants of procurement performance in any manufacturing concern. This also encompasses both financial and market performance (Mukopi & Iravo, 2015). Lawson (2008), indicates the procurement performance measures as cost, quality, time, supplier performance and customer satisfaction which captures the essence of the procurement function performance.

Amaratunga and Baldry (2002) suggest that performance is a key driver to improving quality of services while its absence or use of inappropriate means can act as a barrier to change and may lead to deterioration of the purchasing function. Measuring the performance of the purchasing function yields benefits to organizations such as cost reduction, enhanced profitability, assured supplies, quality improvements and competitive advantage as was noted by (Batenburg & Versendaal, 2006).

Chaves and Chicarelli (2006) argue that reverse logistics leads to improved operations. Improved operations lead to increase in the amount of goods delivered on time, decrease in inventory levels, decrease in scrap rate, increase in product quality, increase in product line and improved capacity utilization (Ninlawan *et al.*, 2010). In addition, it leads to reduced labor cost, increased productivity, increased visibility of associate performance, increased facility throughput and improved service levels (Spiers, 2010). Ongombe (2012) studied reverse logistics and competitive advantage among water bottling companies in Nairobi. The study concluded existence of strong and significant relationship between reverse logistics practices and competitive advantage.

Statement of the problem

The sugar industry in Kenya is an important contributor to the agricultural sector which is the mainstay of the economy and supports livelihoods of at least 25% of

the Kenyan population. According to Kenya's Sugar Directorate, locally produced sugar remains uncompetitive with the cost of production at about \$600 USD per ton which is higher than anywhere else in the Common Market for Eastern and Southern Africa (COMESA). Local sugar production is also limited by poor crop husbandry practices, low access to inputs, poor transport infrastructure, and delayed payments to farmers. The sugar industry in Kenya suffers from limited value addition and diversification, high cost of inputs and low competitiveness. Despite these challenges, the industry has high potential for employment creation. The awareness of reverse logistics in the agricultural sector continues to increase though the sugar sector in Kenya has not devoted much time and effort to the management and implementation of reverse logistics through the determination of the current trends and best reverse logistics practices. The sugar-sector stakeholders are yet to adapt reverse logistics which could be a key factor in cost reduction. This situation possibly results from a lack of support from management and business partners who refuse to spend more after investing large amounts of capital to set up the facility and infrastructure development of the factories.

Much effort needs to be put in place especially on the reverse logistics policy in order to improve the return process since rebuilding and remanufacturing conserves a considerable amount of resources.

Theoretical Framework

This study integrates information from Sustainability theory, Resource dependency theory and Ethics theory. According to resource dependence theory (RDT), firms seek to reduce uncertainty and manage dependence by purposely structuring their exchange relationships, establishing formal and semiformal linkages with other firms. Through interdependence, firms can synergistically combine their own resource sets with the complementary resources of their partners and thus develop a resource bundle that is unique and hard to imitate (Harrison et al., 2001). In the reverse logistics context inter-organizational collaboration is even more important for managing the internal and external coordination and cooperation to have the system successfully implemented throughout the whole supply chains (Zhu *et al.*, 2010).

Murphy (2012) defines reverse logistics as the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point

of origin for the purpose of recapturing or creating value or proper disposal. Hazen *et al.* (2001) identified three practices of reverse logistics; reuse, remanufacture and recycle. Reuse is where the customers return unused product back to the seller, normally the retailer. When this happens, the products are reintroduced into the supply chain. Reuse also includes return of reusable packaging materials. When products are returned to retailers, the products return to the organization through reverse logistics. Remanufacture on the other hand involves repair, refurbishing and overhauling an item to revive the original product. Recycle involves recovering all returned materials and products to reintroduce value into the products. A study carried out by Zhu *et al.* (2005) concluded that to stay competitive in the market, managers should improve their environmental compliance that has been setup by the authority, address the environmental concern of the customer and mitigate the environmental impact of their products and services. With the increasing concern for environmental protection issues, reverse logistics has become one of the most important concepts for various industries to practice. However, the magnitude and impact of reverse logistics varies by industry and channel position (Tibben, 2002).

Jharkharia and Shankar (2005) indicate that a lack of awareness about reverse logistics is one of the barriers to its implementation. Moreover, Cain (2008) finds that there is a considerable effect of reverse logistics on a company; thus, higher awareness should be generated on the importance of reverse logistics. Sharma *et al.* (2011) also suggest that the awareness of reverse logistics could bring economic benefits by recovery of the returned product for use.

Methodology

This study adopted a cross-sectional descriptive survey research design. Descriptive survey is used to collect data (Mugenda and Mugenda, 2003) and make deductions about a population at a given time (Lavrakas, 2008). The target population of this study included all the 11 sugar factories licensed by the KSB as at March 2012. The study focused on both the private and public licensed sugar factories. The public sugar factories include Nzoia, South Nyanza, Muhoroni and Chemelil while the private sugar factories include Mumias, West Kenya, Sukari Industries, Butali, Kibos, Transmara and Sony. Purposive sampling was employed to select; stores department, purchasing department and finance department. From each department in each factory, 4 respondents were randomly selected from the 4 levels (one at management, one middle management, one ordinary and subordinate). Therefore, the study constituted 132 respondents. A pilot test was conducted before

the actual data collection. 13 questionnaires were administered to the respondents for the pre-test. Content validity test was conducted by seeking expert opinion from senior researchers. Reliability test was conducted through computation of Cronbach alpha. The values higher 0.7 were obtained for all variables with an overall score of 0.831. Primary data was collected through self-administered questionnaire. Questionnaires were preferred since they are easy to analyze and save time in data collection (Oso & Onen, 2011).

The researcher issued 132 questionnaires to the respondents, 105 questionnaires were duly filled and returned in time for analysis. This gave a response rate of 74.5% which is adequate for analysis. Data was checked for completeness, errors, and coded for analysis. Descriptive analysis was used to describe reverse logistics and procurement performance while inferential analysis; correlation and regression analyses were carried out to establish the nature of the relationship that existed between variables.

Findings

From descriptive analysis, alternatives available to recover products, product parts, and materials were explored and established as minimisation 22(20.5%), recycling 57(54.5%), policy 26(25%). These findings were reflected by Stock and Lambert (2001) who indicated that the handling of returned and salvaged goods, and the manner of disposing scrap are the major concerns of reverse logistics. Waste disposal and removal within the supply chain is also involved. The implementation of reverse logistics is necessary to implement the product return policy and to address the rising concern of the public on environmental issues. Some of the waste from sugar factories include sugarcane bagasse, waste water and filter cake. The sugarcane bagasse can produce a sustainable renewal energy source while the filter cake may be used as fertilizer and fuel. The government should therefore review the double taxation policies that are currently functional and provide affordable and long-term finance to sugar factories. The factories should also aim to reduce material costs through the supply of raw materials to the farmers. Zelibst *et al.* (2009) conclude planning and implementing a suitable reverse logistics network could bring more profit, customer satisfaction and a nice social picture for the companies.

The study found out that the physical location of facilities and transportation links need to be chosen to convey used products from their former users to a producer and to future markets again. Majority 99 (88%) of the respondents indicated that

transportation of goods performance had improved by the time of research. 94 (87%) of the respondents indicated that reprocessing of returned products performance had improved. Majority 79 (75%) of the respondents agreed that recyclable packages performance had improved. The fact that the respondents perceived the supply chain strategies as adequate to a high extent shows that the systems in place within the various organizations supported the needs of their organizations.

Table 1 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	.693 ^a	.627	.61	.519

Table 2 ANOVA^b

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	61.495	4	2.173	13.174	.000 ^a
	Residual	3.417	96	.087		
	Total	64.912	97			

Table 3 Coefficients^a

Model	B	Std. Error	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
			Beta				
1	(Constant)		0.512	0.162		1.142	.022
	Recycle		1.237	.541	.521	2.738	.001
	Remanufacture		.859	.368	.713	2.335	.002
	Repair		1.281	.471	.689	2.720	.001
	Waste disposal		1.271	.343	.621	2.433	.042
a. Predictors: (Constant), Recycle, Remanufacture, Repair and Waste disposal							
b. Dependent Variable: Procurement performance							

From table 1, $R^2=0.627$ implies that Reverse logistics account for 62.7 percent of the variations in procurement performance. $F = 13.174$; $P = 0.000 > \alpha = 0.05$ in table 2, indicates that there is a significant relationship between procurement performance and reverse logistics.

All the predictor variables were found to significantly affect procurement performance at $p=0.05$. The values; 0.521, 0.713, 0.689 and 0.621 indicate the

contributions of recycle, remanufacture, repair and waste disposal on procurement performance respectively. The positive coefficient values indicate increase in procurement performance with increase in the predictor variables which implies a linear regression equation;

$$Y = 0.512 + 0.521X_1 + 0.713X_2 + 0.689X_3 + 0.621X_4$$

Where; Y-Procurement Performance, X₁-Recycle, X₂-Remanufacture, X₃-Repair, X₄-Waste disposal

Practical Implication

From the findings of this study, the study concludes that there is a direct strong positive relationship between reverse logistics and procurement performance within the sugar industry in Kenya. The importance of reverse logistics was explained as related to cost, procurement and productivity. The findings analysed the alternatives available to recover products, product parts, and materials such as minimization, recycling and policy. The researcher recommends that the management of the sugar manufacturing companies should view reverse logistics as a strategic variable that can be used to achieve improved environmental management, competitive advantage and procurement performance.

Academicians will find conclusions out of this study to be profound on researchers' knowledge in the field of study with additional insights to execute more research gaps and issues in this field of reverse logistics. To the industry it will provide insights on reverse logistics aspects and assist in integrating environmental thinking into procurement performance. To policymakers this study will serve as a guide when making policies regarding reverse logistics. Further study should be conducted on the role of top management in adoption of reverse logistics practices and the supporting role of organizational culture in the adoption of reverse logistics.

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Section Two:
ENGINEERING AND
SPACE SCIENCES

Space Weather and its impact on our technology dependent society: A case study on Ionospheric scintillation over Kenyan Airspace

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Abstract

Space weather refers to the variations in space environment with those between the sun and the earth being relevant to us most. This includes mainly energetic particles and electromagnetic radiation which reach the earth and its vicinity and impacts systems and technology in orbits and on the surface of the earth. Adverse conditions in space environment can cause disruption of our very critical technological infrastructure leading to a variety of socioeconomic losses. The socioeconomic impact of severe space weather includes both direct industry specific effects and the collateral effects of space weather driven technology failure on dependent infrastructure and services. Satellite technology which is widely used by civilians in much diverse application relies on Global Navigation Satellite System (GNSS) positioning data and is extremely exposed to effects of space weather. Satellite signals transit through the ionosphere which induces additional delay time to the signals and thus compromising their integrity to the users. These effects are worse at low latitude regions such as Kenya. Ionospheric scintillation over the low latitude regions on GNSS signals follows a regular diurnal and seasonal variation that is driven by the formation of large scale equatorial depletions which form post-sunset via the Rayleigh-Taylor instability near the magnetic equator. Using transionospheric radio signals such as those of GNSS, we can monitor and quantify scintillation occurrence on a regional basis in near real time. The spatial distribution of scintillation events can give information on the exact locations in the sky where scintillation causing structure are located and can thus form a basis for now-casting and forecasting of scintillation for real time relay of the information to the potential users. Using scintillation monitors over the Kenyan region, we present a case study of scintillation impact on our satellite technology over the Kenyan airspace.

Keywords: Space weather, Low-latitude, Ionosphere, Scintillation, GNSS

Introduction

The sun emits highly conducting plasma at supersonic speeds of about 500 kms⁻¹ into the interplanetary space as a result of the supersonic expansion of the solar corona. This plasma is called the solar wind and it consists mainly of electrons and protons, with an admixture of 5 percent Helium ions (Baujmann & Trautmann, 1997). Because of its high conductivity, the solar magnetic field is frozen in the plasma and drawn outward by the expanding solar wind. The solar wind plasma cannot easily penetrate the terrestrial magnetic field and so when the solar wind hits on the Earth's magnetic field, it is slowed down and deflected around it. Earth remains protected from the direct solar wind impact by its magnetic shield which spans into a region called the magnetosphere. However, when the solar wind particles impinge on the terrestrial magnetic field, they occasionally leak into the earth's lower atmosphere at the poles. This leads to an observed glow at the poles known as aurora. The term Space Weather is used to refer to the set of physical and electromagnetic processes and effects that occur on the sun, and ultimately interact with the earth's magnetosphere, atmosphere and surface. With the growth of the electric power industry, the development of telephone and radio communications, growing dependence on space-based communication and navigation systems; the vulnerability of modern society and its technological infrastructure to space weather has increased dramatically.

During adverse space weather conditions mainly associated with intense geomagnetic storms, the auroral oval moves to lower and more densely populated latitudes where rapidly varying ionospheric currents associated with the aurora can produce direct current flows commonly known as Geo-Magnetically Induced Currents (GICs) in the electrical power grids. The GICs can overload the grid leading to severe voltage regulation problems and potentially a wide spread power outage. GICs can equally cause intense internal heating in extra-high-voltage (EHV) transformers putting them at risk of failure or even permanent damage. A case in history on this effect was recorded during March 1989 when storm related GICs caused a voltage depression in the Hydro-Quebec (Ngwira *et al.*, 2003; Love *et al.*, 2016; Knipp, 2015; Gaunt, 2016). Other sectors/services that are also directly affected by adverse space weather conditions are: spacecraft operations, airline operations and space based positioning, navigation and timing using Global Navigation Satellite Services (GNSS) such as the GPS. Airline operations for instance are worst affected during severe space weather particularly in the Polar Regions where

satellite communication cannot be used. In such regions flight crews mainly rely on high-frequency (HF) radio to maintain communication with airline company and air traffic control. Such HF are highly degraded during storms times where the solar energetic particles primarily protons increase the density of ionised gas which in turn affects the ability of radio waves to propagate and can result in a complete radio blackout (Kintner *et al.*, 2007). In other regions where satellite signals are accessible, space weather still remains a major source of error to GNSS. In extreme cases, it has the ability to deny access to GNSS due to a variety of space weather effects; and most important being the ionospheric scintillation phenomenon.

Ionospheric scintillation refers to the twinkling of radio signals when they pass through turbulent ionosphere. A turbulent ionosphere is characterised by instabilities and irregularities in the plasma that forms the ionosphere. Under normal space weather conditions these irregularities are mainly dominant at the auroral zones due to the sharp and spatial gradients and the equatorial regions due to the plasma up flows that occur around dusk (Hapgood, 2017; Jia and Morton, 2015). The propagation of radio waves through a turbulent ionosphere leads to rapid variations in the phase and amplitude of the GNSS signals. If this effect is so rapid, then the receiver is most likely to lose lock on the phase of the signal and hence will no longer provide position and time data (Paznukhov *et al.*, 2012). The equatorial plasma irregularities often named as plasma bubbles are mainly dominant in the Africa sector during Northern summer months while neighbouring regions (Atlantic and India) are void of bubbles during this time. It has also been shown that the plasma bubbles persist longer in Africa than other regions (see Stolle *et al.*, 2008). This fact has been a motivating factor for ionospheric research in Africa and was started during the International Heliophysical Year (IHY) 2007 (Thompson *et al.*, 2007) and early before that through research collaborations such as the Africa Universities and Boston College with the Air Force Research laboratory (AFRL). These collaborations within the African continent have resulted into a number of permanent GPS monitoring equipment to spur ionospheric research (Carrano *et al.*, 2006).

The equatorial ionosphere remains special due to the specific configuration of the geomagnetic field, which points nearly horizontal, and together with its typical variations in the zonal electric field results besides plasma bubbles, has a characteristic feature such as the Equatorial Ionisation Anomaly (EIA). The EIA is characterised by a depression in ionisation densities (or trough) at the geomagnetic

equator and two peaks (crests) on either side of the equator at about 15° magnetic latitudes and the equatorial electrojet (a thin ribbon of strong eastward electric current flowing along the magnetic equator). The characterisation of the electron density state over this region is largely connected with these phenomena. Kenya as a country is located at the southern crest of the equatorial anomaly and remains a classic location for studies on ionospheric scintillation impact on satellite technology (see Olwendo *et al.*, 2016; Ngwira *et al.*, 2013; Olwendo *et al.*, 2013). In this work we present results from observation within the Kenyan region on ionospheric scintillation phenomenon that indicates how vulnerable the region is to satellite signal degradation.

Scintillation Observations over Kenyan Airspace

GNSS services are continuously available on global scale and thus offer a great opportunity for ionospheric research since they can be tracked through many points of the ionosphere continuously. Even though the GNSS signals equally suffers the scintillation effects; because of the spread spectrum properties of the signal tracking through disturbance is always made possible with a reasonably wide bandwidth tracking loops. Under these wide bandwidth tracking loops scintillation parameters can be extracted. Ionospheric scintillation can be quantified in terms of scintillation index S_4 . S_4 is essentially a normalised standard deviation of the signal intensity averaged over 60 s. The S_4 index defines the strength of amplitude scintillation and is defined by the algorithm below (Kintner *et al.*, 2007):

$$S_4 = \frac{\sqrt{\langle I^2 \rangle - \langle I \rangle^2}}{\langle I \rangle} \quad (1)$$

where I represents the detrended signal intensity.

Over the Kenyan region, a number of scintillation receivers have been operational since 2009 under the wider collaboration of the Boston College and Africa universities. In this work we present results related to scintillation observation made from a scintillation receiver located at the University of Nairobi. The strength of scintillation events does correlate well with the background electron density distribution in the local ionosphere (see Olwendo *et al.*, 2012). Characterisation of the ionisation state of the upper atmosphere can be inferred from the measurements of ionospheric Total Electron Content (TEC) where TEC is an integration of the plasma density from the ground station to the GPS satellite at $\sim 20,000$ km altitude.

Derivation of TEC from GNSS observables have become a standard method for ionospheric diagnostics (Misra & Enge, 2006). Over the East Africa region there are over 12 stations (IGS) from which TEC can be retrieved. Ionosphere being a dispersive medium; imparts on trans-ionospheric satellite signals group delays and phase advances which is proportional to the Total Electron Content (TEC) along the ray path of the signal commonly called the Slant TEC (STEC). The group delay is given by;

$$\Delta t = 40.30 \frac{TEC}{cf^2} \quad (2)$$

where f , is the frequency of the signal in Hz and c , is the speed of light in m/s. The STEC is the number of electrons in a column of 1 m^2 cross section centred on the ray path, from the GPS satellite to the GPS receiver Using the TEC observations from all the stations around the region, we developed a regional map of background electron density by interpolation and extrapolation. Then using Adjusted Spherical Harmonics expansion technique, we computed TEC at any latitude or longitude from the GNSS observations according to the following mathematical expression (Opperman *et al.*, 2007);

$$TEC(\lambda, \phi) = \sum_{n=0}^N \sum_{m=0}^n \bar{P}_{nm} \cos(\phi) [a_{nm} \sin(m\lambda) + b_{nm} \cos(m\lambda)] \quad (3)$$

where λ is the sun-fixed longitude, ϕ is the co-latitude, \bar{P}_{nm} are the normalised associated Legendre functions, a_{nm} and b_{nm} are the spherical harmonic coefficients estimated from a weighted least squares solution, n and m are the degree and order of the spherical expansion respectively.

Observations, Results and Discussions

The results of the observations are presented and discussed in this section

Diurnal and Annual variations in Scintillation observations

The diurnal variations in scintillation index for the date 2012-04-28 have been presented by a plot in Figure 1. Significant scintillation events that can adversely impact on navigation systems are those associated with S4 values greater than

0.3 while values greater than 0.5 are considered as intense scintillation events. Values in the range of 0.1 to those below 0.2 are considered as noise and are not necessarily due to ionospheric turbulence. In Figure 1 the red circles represent S4 values greater than 0.3.

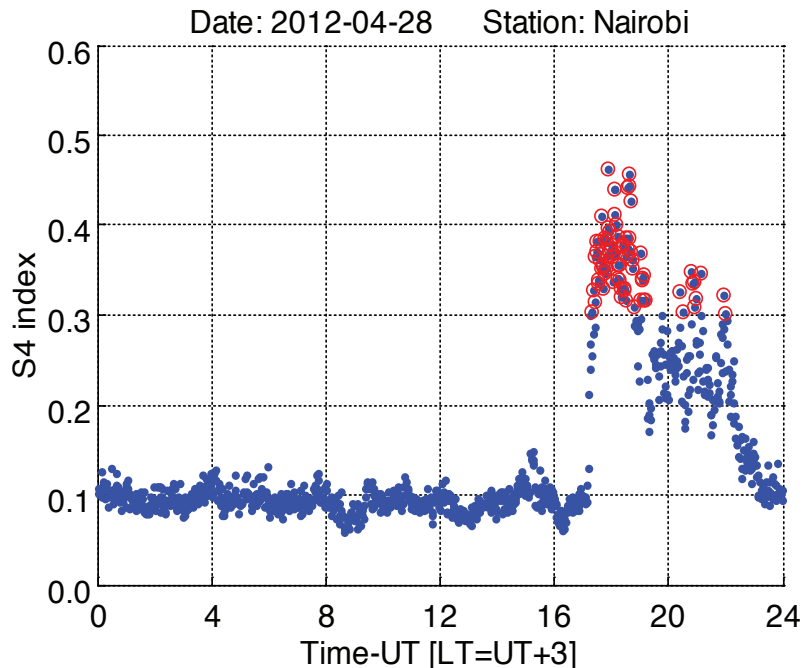


Figure 1: Scintillation observations from ASCINDA GPS scintillation receiver located in Nairobi

Typical scintillation events are observed both in the normal ('quiet') and under geomagnetic conditions. The occurrence of scintillation events remains extremely unpredictable and occurs nearly every other night. As shown in the Figure 1, scintillation event captured on this day began at about 17:00 UT (20:00 LT) and did occur for more than three hours going beyond 21:00 UT (beyond local time midnight). In Figure 2 we show day to day events during the night hours for a period spanning over two weeks during the months of March and April 2012 based on observations made over Nairobi station. As shown in Figure 2, there were only four days over the period when no scintillation was noticed. Scintillation starts few hours (1 to 2 hours) after sunset and may proceed till just before 02:00 LT as shown in Figure 2.

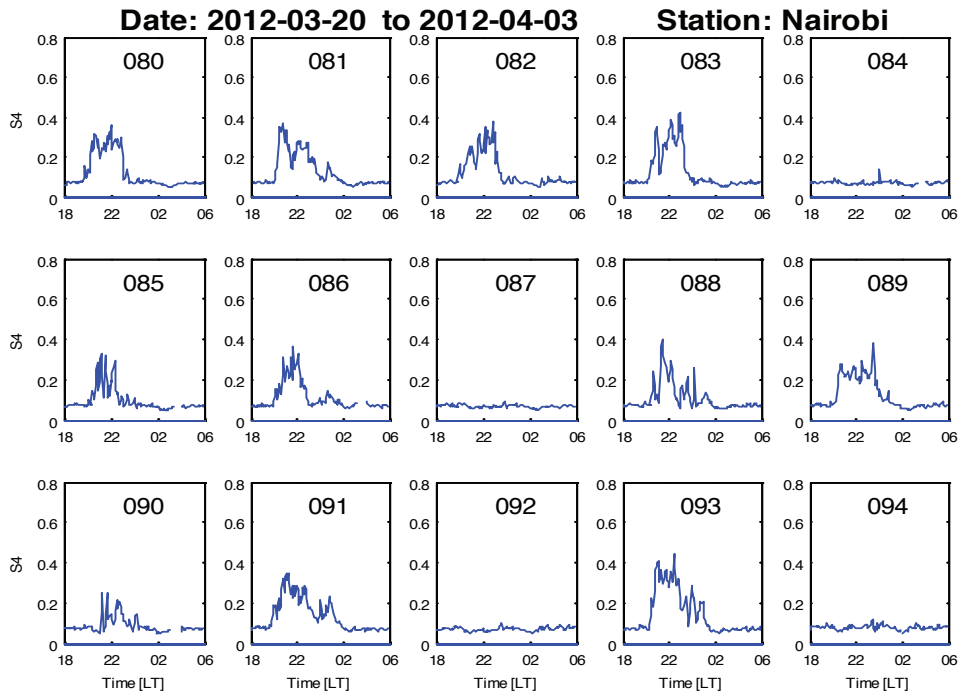


Figure 2: Temporal variation of scintillation intensity index observed during days 80 to 94 of 2012 over Nairobi station. The time axis starts from post sunset local time at about 18:00 hr. The local time at Nairobi is approximately Universal Time minus 3 hours.

From Figures 1 and 2, scintillation observations depict similar diurnal trends in fluctuations in the S4 values. A part from the regular diurnal trends, strong fluctuations in S4 index values follow strong seasonal variations whereby the events which peaks in equinoxes are at their lowest levels during the solstices. In Figure 3 we represent yearly and diurnal variations in scintillation observations for the period 2009 to 2012. The dark blue color in Figure 3 indicates missing data which mainly occur in 2008 and after December 2012. The stripes on the Figure 3 are indications of traces of multipath effects due to change in satellite orbit over time. Scintillation events are predominantly observed between the year 2011 and 2012. The maximum fluctuations peak a few hours after 17:00 UT and are mainly present in the equinox months of March-April and September-October in the two years

with significant events. The low scintillation levels in the years 2008 to end of 2010 are attributed to the low solar activity phase during the same period.

Several authors credit the generation post sunset ionospheric irregularities leading to scintillation occurrence to the Rayleigh Taylor instability mechanism (see Heelis, 2004). Scintillation events are also closely linked with the occurrence of well-developed Equatorial Ionization Anomaly (EIA) crest and it is at the edges of the anomaly crest where steep electron density gradients occur which manifest as GPS scintillation when the satellite signals pass over them.

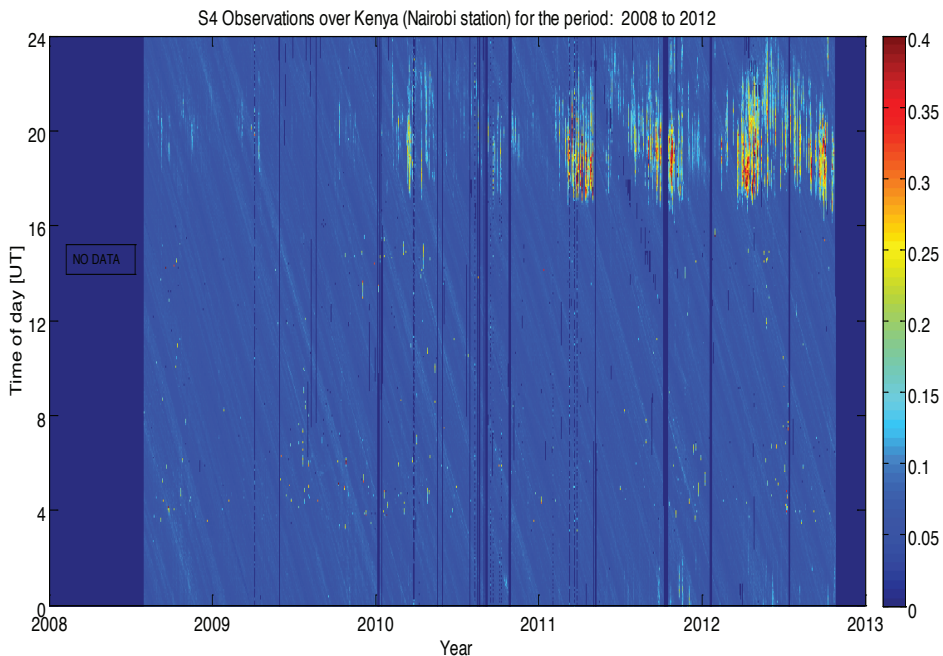


Figure 3: Diurnal and annual variations in S4 index for the period 2009 to 2012. The color bar represents the S4 values and the dark blue regions represent no data available.

The EIA crests are regions of enhanced background electron density that persists some hours after post-sunset local time. TEC maps to show the background electron density have been developed using Adjusted Spherical Harmonics technique based on equation (3) using the data sets from IGS receiver over the Eastern African region. Figure 4 does show a TEC image from which the levels of background electron density can be analysed and in Figure 5 we show the Ionospheric Pierce

Points (IPP) trace of the satellite tracks from which the TEC data was retrieved for generating the TEC image. As indicated in Figure 5, the densely populated IP satellite trace does justify our interpolation technique for TEC imaging over the region as a better approximation to the overall background TEC coverage. The high electron density noticeable after 18:00 UT (\sim 4 hours after local sunset) are regions associated with the formation of the southern EIA over the East African region. The night time background enhancements in TEC are associated with the vertical F region drift which are known to be large and upward during sunset local time due to pre-reversal enhancement, PRE (Galav *et al.*, 2010). Under the influence of enhanced vertical drift at the equator, the F region plasma is lifted further up and this slows its decay and hence the high levels in total electron content that lasts till after midnight.

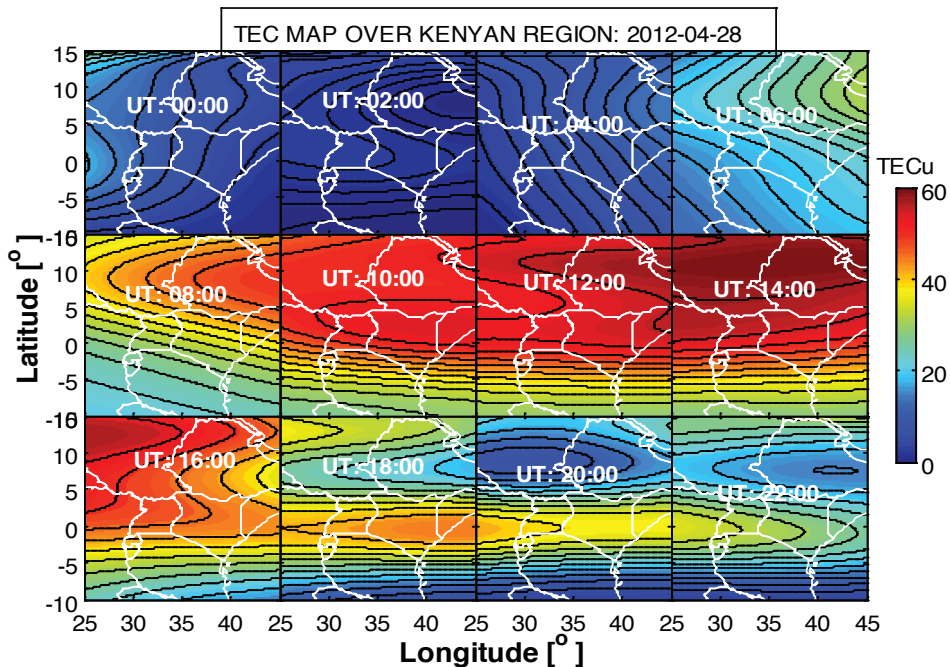


Figure 4: TEC maps generated in two hourly increments over the East African region on 28th April 2012. The times indicated on the maps are in UT.

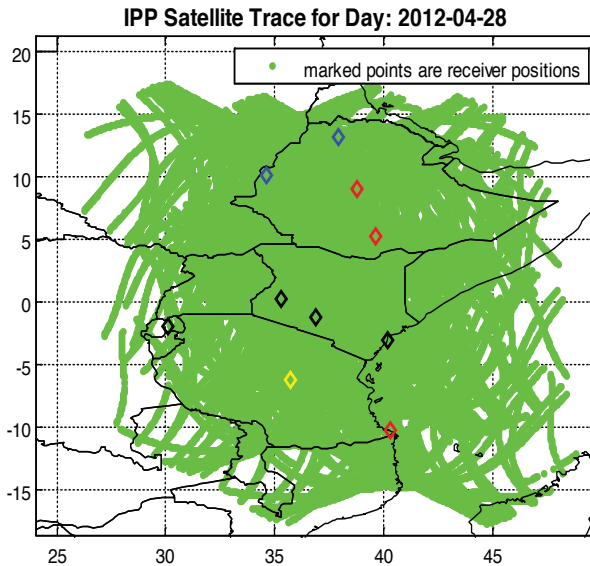


Figure 5: IPP coverage over the East African region on 2012-04-28

The scintillation events observation made in this work can all be explained as follows: the uplifting of the ionosphere caused by the post sunset enhancement of the zonal electric field increase the coupling of the flux tubes in the F region with the lower ionosphere and this allows sufficiently a fast growth of the Rayleigh – Taylor instability. As a result, an intrusion of plasma density depletions or bubbles into the topside ionosphere occurs that contain plasma density depletions that cause rapid fluctuations in S4 index when the satellite signal propagates across the regions of plasma depletions.

Scintillation Impact on Navigation when using the GPS

GPS satellite signals are usually refracted by the dispersive ionosphere leading to ranging errors which are dependent on both the signal frequency and the amount of Ionospheric TEC along the line of sight. The ranging errors cause by Ionospheric TEC affects the positioning accuracy on the GPS users. While it is possible to mitigate on ionospheric effects on GPS positioning applications through differential techniques and through ionospheric models; some errors still do persist in regions where steep gradients or localised irregularities in electron density exist. Such regions we have seen are associated with scintillation events. To quantify the effects of scintillation events on GPS precise point positioning;

we have computed the observed vertical (along the latitude) and horizontal (along the longitude) positioning errors for a fixed GPS receiver during the moments of intense scintillations events of date 28th April 2012 (ref. to Figure 1) between the times 18:00 to 21:00 UT. In Figure 7 we show the polar plot of the position path in azimuth-elevation coordinate and scintillation levels represented by a 5-min interval for all the GPS satellites tracked on 2012-01-28 with S4 index values greater than 0.2. The radius of the circles show the variation of scintillation intensity based on the value of S4 values. The polar plots in Figure 7 does show variability of the equatorial ionospheric irregularities are in spatial and temporal orientation over the station in Nairobi and its effects on GPS links.

Ionospheric conditions with only TEC varying smoothly may have minimal impacts on single point positioning accuracies, with differentials techniques such as those used in DGPS. However precise differential positioning applications may be affected and ambiguity resolution limited. As seen from Figure 6, the positioning errors in the latitudinal and longitudinal variations in meters; for the period 18:00 to 21:00 UT were observed in the range of 0.5 m and 1 m. This situation can be worse during geomagnetic storms. The temporal and spatial properties of these irregularities as seen in Figure 7 are demonstration on how scintillation events span a wide coverage. This does impact on nearly all the GPS links over a wide region. We can see that on this particular day, ionospheric irregularities causing scintillation were mainly on the far north of the station and also seem to be dotted nearly over the entire region apart from the western side. Therefore; the temporal and spatial variability on the irregularities becomes an important consideration when designing regional networks for Real Time Kinematics applications. Such applications include for example real time forecasting of scintillation events to the users.

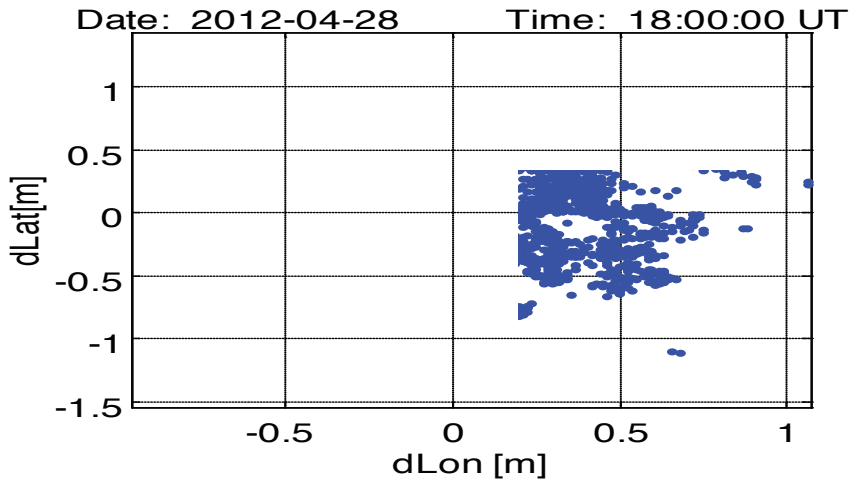


Figure 6: DGPS errors along the latitudes and longitudes with respect to a reference position marked with the red triangle.

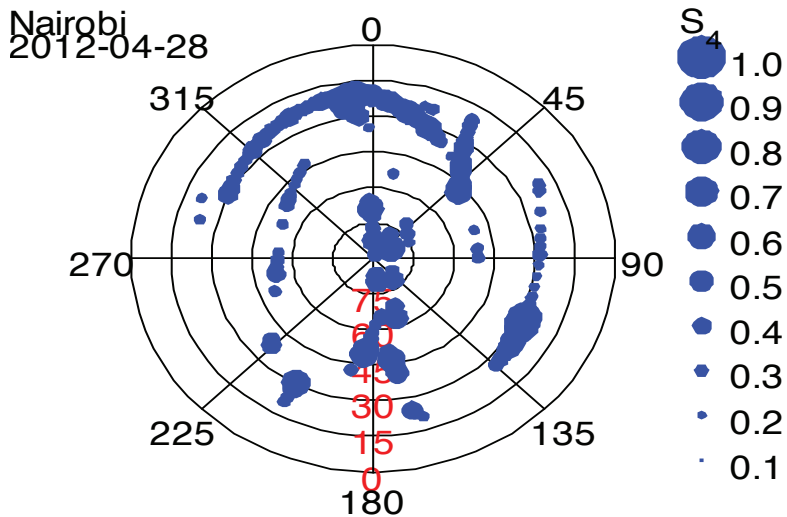


Figure 7: Polar plots with scintillation intensities for S4 index values greater than 0.2 for the entire day of 2012-04-28

Conclusion

In this work we have demonstrated how current GPS-based navigation and positioning systems are vulnerable to space weather and specifically to the ionospheric density irregularities that affect the propagation of the signals from the GPS satellites to the receiver on the ground. Such irregularities are a routine occurrence near the equator. Scintillation events on the GPS satellites produce ranging errors and can result in the temporary loss of GPS reception.

The presence ionospheric irregularities and high background TEC that forms after post-sunset local time at the low latitude does affect precise differential positioning applications and also limits the ambiguity resolution. Systems that use single frequency receiver without augmentation are vulnerable to even minor ionospheric disturbances in TEC. While several regions have created proper mitigation on ionospheric status to help project the induced errors, over the low latitude regions in African sector, this is yet to be realised. The paucity in long term knowledge on the ionospheric scintillation occurrence still remains a bottle neck to implementation of any prediction model over the region.

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Definition and Analysis of Alternative Electric Power Generation Scenarios in Kenya

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Abstract

The Open Source Energy Modeling System (OSeMOSYS) - an optimization model for long term energy planning- is used to develop the energy system model for Kenya's power sector over the period 2014 - 2040. The model considers twenty-six different electric power generation technologies that are set to compete against each other to supply the demand of electricity at the lowest possible cost. Two different scenarios are analyzed with varying electricity demand growth, electrification rates, capacity constraints, investment constraints and greenhouse gasses emission limits. For both the scenarios there is a strong evidence of a dominant role by geothermal technologies for grid power and photovoltaic power plants complemented by distributed diesel generation or independent generation.

Keywords: Decarbonization, Energy System Modeling, Least Cost Energy Production, OSeMOSYS, Energy Model of Kenya

Introduction

Sub-Saharan Africa is rich in energy resources, but poor in energy planning and implementation. The economic growth in Kenya after faltering in 2008 has steadily picked, reaching 5.8% in 2016 to place Kenya among the fastest growing economies in Sub-Saharan Africa (The World Bank, 2017). However, severe shortage of essential electricity infrastructure is undermining efforts to achieve more rapid socio-economic development. It is stated that there is a clear link between poverty reduction and access to energy services (UN-Energy, 2005; World Bank, 2005). The emerging need for investment in the energy sector of Kenya is preceded by the above understanding, hence modelling of the power sector and analysis of the different pathways for electrification in Kenya.

The purpose of this paper is to present a critical analysis of the implications of different energy policies. This is achieved by developing the energy model using the

latest modeling tool which investigates the fuel usage & investment requirements in certain power generation, technologies to meet the demand of electricity while minimizing cost. The model employed determines in which technologies to invest and how to use the available capacity in order to satisfy all the specified demands.

Using the scenario based modeling approach two scenarios are analyzed first 'GoK Policies Scenario' which involves the implementation of government policies and the other called the 'New policies Scenario' defined in line with the development objectives of International Energy Agency (IEA).

Literature Review

The Least Cost Power development report published by the Government of Kenya (Kenya Vision 2030, Republic of Kenya, 2011) analyses the implication of three different scenarios of electricity demand growth. The study uses the WASP model to develop the system expansion plan over the period of 2010-2030. Research done by Nandi Moksnes (Moksnes, 2017) analyzes low and high demand scenarios dividing the demand between the grid and the off grid using two modeling tools namely; OnSSET and OSeMOSYS. Furthermore, research published by the East Africa Power Pool (Ea Energy Analyses, Energinet.dk, 2014) uses BALMOREL to simulate scenarios of the East African countries including Kenya.

However most of these previous models (Kenya Vision 2030, Republic of Kenya, 2011) significantly overestimated the demand of electricity and overlooked the investment constraints. Moreover, political intentions for the Kenyan electricity sector are not taken into account (Moksnes, 2017).

This paper presents a model of electricity sector considering a realistic electricity demand growth and taking into account the socio-economic constraints and the political intentions of the government of Kenya for the development of electricity infrastructure.

Model

The model used to calculate results presented in this paper is based on the Open Source Energy Modeling System (OSeMOSYS), a tool designed to inform the development of local, national and multi-regional energy strategies (Moksnes, 2015). The motivation behind the use of OSeMOSYS instead of more commonly used MARKAL and TIMES is that the code is relatively straightforward, elegant and transparent and can be tailored to the specific problem at hand.

The model is driven by exogenously defined demands for energy services. These can be met through a range of technologies which exploit a set of resources, defined by their potentials and costs. The policy scenarios may impose certain techno-economic constraints and pollutant emission limits.

The OSeMOSYS model is disaggregated into several functional components referred to as ‘blocks’ (Howells, 2011). For the purpose of this paper, OSeMOSYS is divided into six functional blocks as illustrated in *Figure 1*. The model calculates the optimal flows of energy carriers that play in the production sector, converted through a network of transformation technologies to supply the demand in order to meet set objectives. To achieve this, the model differentiates between ‘Fuels’ and ‘Technologies’. Energy carriers and services are designated as ‘Fuels’. Each Fuel represents a specific energy carrier or a group of similar energy carriers. Additionally, fuels are produced, transformed and used by technologies. The ‘technologies’ represent; energy producing, energy transforming and energy consuming systems. The reference energy system of the model is illustrated in Appendix C.

A. Objective

Minimize cost: $\text{sumTotalDiscountedCost } [r,y]$

The objective of the model is to estimate the lowest net present value (NPV) of an energy system to meet given demand for energy or energy services. The nomenclature is explained in Appendix B.

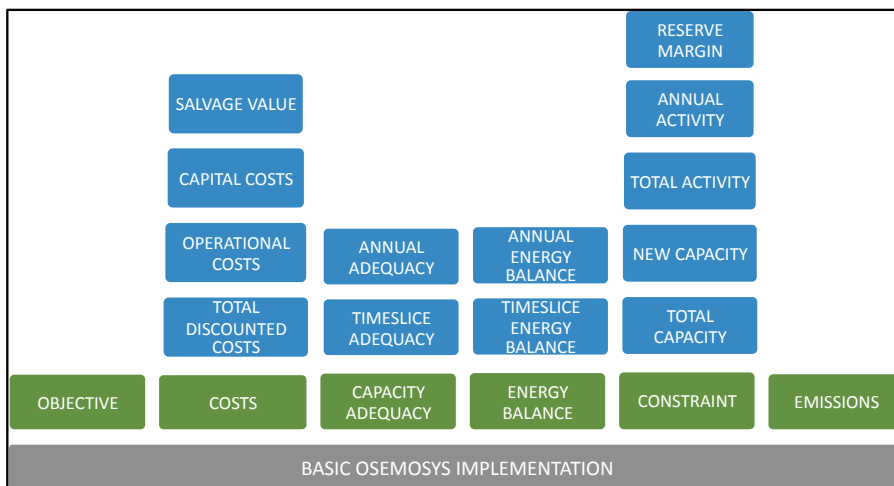


Figure 1: OSeMOSYS functionality blocks (Howells, 2011)

B. Costs

$$\begin{aligned} \text{TotalDiscountedCostByTechnology}[r,t,y] = & \text{DiscountedOperatingCost}[r,t,y]+ \\ & \text{DiscountedCapitalInvestment}[r,t,y]- \\ & \text{DiscountedSalvageValue}[r,t,y] \end{aligned}$$

The investment in a technology and its activity is specified by three kinds of costs. First, a technology is assigned a capital cost. These costs are calculated on an annual basis and are determined by the level of new installed capacity by a per-unit cost to determine the capital investment into new capacities. Second, OSeMOSYS uses salvage costs to calculate the salvage value of technologies that have exceeded their operational life or are being replaced. Thus, the salvage value is determined by; the year of installment, the operational life and a globally defined discount rate.

Third, there are operational costs for each Technology, divided into variable and fixed costs. The total annual operating costs are discounted back with a globally defined discount rate to the first year modeled to make costs comparable. The model assumes the sinking fund depreciation method by default. A global discount rate of 8% (Kenya Vision 2030, Republic of Kenya, 2011) is assumed for the model calculations. Finally, the discounted operating costs are then summed up with the discounted capital investment and salvage value to get the total discounted costs for each technology.

B. Time Slice Capacity Adequacy

$$\begin{aligned} \sum(l)\text{RateOfTotalActivity}[r,t,l,y] * \text{YearSplit}[l,y] & \leq \sum(l) \\ \text{TotalCapacityAnnual}[r,t,y] * \text{CapacityFactor}[r,t,l,y] * \text{YearSplit}[l,y] * \\ \text{AvailabilityFactor}[r,t,y] * \text{CapacityToActivityUnit}[r,t] \end{aligned}$$

All technologies are expected to have a capacity sufficient to account for their production, transformation or consumption activities or use over all time slices of the modeling period. The capacity is de-rated by a capacity factor, and the fraction of the year for which the technology is available. The de-rated capacity of any given technology is constrained to be greater than its activity in a certain time slice.

C. Annual Capacity Adequacy

$$\begin{aligned} \text{RateOfTotalActivity}[r,t,l,y] & \leq \text{TotalCapacityAnnual}[r,t,y] * \\ \text{CapacityFactor}[r,t,l,y] * \text{CapacityToActivityUnit}[r,t] \end{aligned}$$

Total annual capacity for a technology is determined by the addition of the accumulated new capacity and residual capacity in each year of the modeling period (Howells, 2011). The de-rated capacity of the technology is constrained to be greater than or equal to their rate of activity over each year of the modeling period.

D. Annual Energy Balance

$$ProductionAnnual[r,f,y] \geq$$

$$UseAnnual[r,f,y] + AccumulatedAnnualDemand[r,f,y]$$

The annual production of a certain fuel (energy carrier) is calculated by the sum of annual use of that fuel by the technologies and its exogenously defined annual demand. Since the analysis does not consider the trade of electricity i.e. electricity imports and exports, the additional terms of electricity trade are ignored.

E. Time slice Energy Balance

$$Production[r,l,f,y] \geq Demand[r,l,f,y] + Use[r,l,f,y]$$

Production of a certain fuel in each time slice is greater than the sum of use of the fuel by technologies and the demand of the fuel in the corresponding time slice.

F. Reserve Margin

$$DemandNeedingReserveMargin[r,l,y] * ReserveMargin[r,y] \leq$$

$$TotalCapacityInReserveMargin[r,y]$$

For a specified collection of technologies, there should be enough capacity to provide a reserve margin for a specified set of fuels in a certain time slice.

G. Total Capacity Constraint

$$TotalAnnualMaxCapacity[r,t,y] \geq TotalCapacityAnnual[r,t,y] \geq$$

$$TotalAnnualMinCapacity[r,t,y]$$

The total annual capacity of a technology is the sum of new and residual capacities. It is constrained to be within the maximum and the minimum capacity limits defined for that technology each year over the modeling period.

H. New Capacity Constraint

$$TotalAnnualMaxCapacityInvestment[r,t,y] \geq NewCapacity[r,t,y] \geq$$

$$TotalAnnualMinCapacityInvestment[r,t,y]$$

To take into account the investment constraints the investment in new capacity of a technology for each year is limited by the above parameters. The New capacity of a certain technology is constrained to be within the maximum and minimum capacity investment limits for the corresponding technology.

I. Annual Activity Constraint

$$\begin{aligned} TotalTechnologyAnnualActivityUpperLimit[r,t,y] &\geq TotalTechnologyAnnualActivity[r,t,y] \\ &\geq TotalTechnologyAnnualActivityLowerLimit[r,t,y] \end{aligned}$$

The annual activity or use of a technology is constrained to be within the upper and the lower bounds of the annually allowed activity limits.

J. Total Activity Constraint

$$\begin{aligned} TotalTechnologyModelPeriodActivityUpperLimit[r,t] &\geq \\ TotalTechnologyModelPeriodActivity[r,t] &\geq \\ TotalTechnologyModelPeriodActivityLowerLimit[r,t] \end{aligned}$$

The activity of a technology over the complete modeling period is controlled by the above parameters and is constrained to be within the defined limits of maximum and the minimum activity limits.

K. Emissions

$$ModelPeriodEmissions[r,e] \leq ModelPeriodEmissionLimit[r,e]$$

The total emissions (CO₂, NO_x etc.) over the modeling period from the energy systems (fuels & technologies) modeled are limited using the parameter Model Period Emission Limit.

L. Renewable Energy

$$\begin{aligned} TotalREProductionAnnual[r,y] &\geq REMinProductionTarget[r,y]^* \\ RETotalProductionOfTargetFuelAnnual[r,y] \end{aligned}$$

The minimum share of production from renewable energy technologies is defined for each year. The total energy production from renewable energy each year is constrained to meet the set target for that year.

Model Specification

A. Regional Disaggregation & Modelling Period

The whole country of Kenya is modelled as a single region. As earlier mentioned, this paper does not consider trade of electricity between Kenya and neighboring countries, and the modeling period considered falls between 2014 and 2040.

B. Fuels & Technologies Disaggregation

Fuels are the energy carriers which have a specified demand and have to be met by the model. The technologies consume and produce fuels. Conventional fuels (Table.A2. Appendix A) used in power plants -Diesel, Natural gas, Coal etc. - as well as the electricity produced by the power plants is considered as fuel.

The technologies both use and produce energy. The power plants (technologies) are considered to be energy transformers. The extraction or import of fuels is also modeled as technologies. This model considers twenty-six different power generation technologies including the fossil fuel based power plants, nuclear power plants, renewable technologies & independent power generation technologies as listed in Table.A1. Appendix A.

C. Time Disaggregation

While OSeMOSYS uses most data on an annual basis, it also offers a much more detailed approach with respect to time periods and time dependent data (Konstantin Löffler, 2017). A year is divided into several “time slices” in order to take into account variation of demand during certain time periods on a daily or monthly basis.

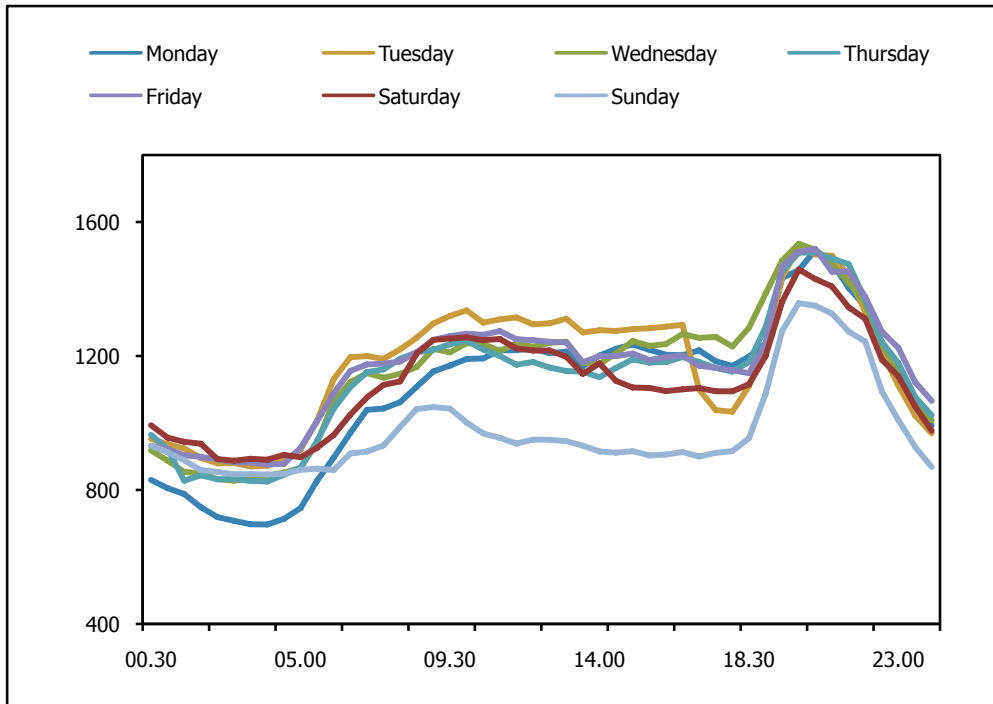


Figure 2: Daily average national generation demand (MW) for 2016. (Kenya Power & Lighting Company Ltd., 2017)

The daily generation demand for Kenya is almost constant during the daytime, reaches its peak during the evening hours and is lowest in the night as illustrated in Figure 2. Accordingly, a day is divided into three time slices, 12 hours' day time, 8 hours' night time and 4 hours' peak time.

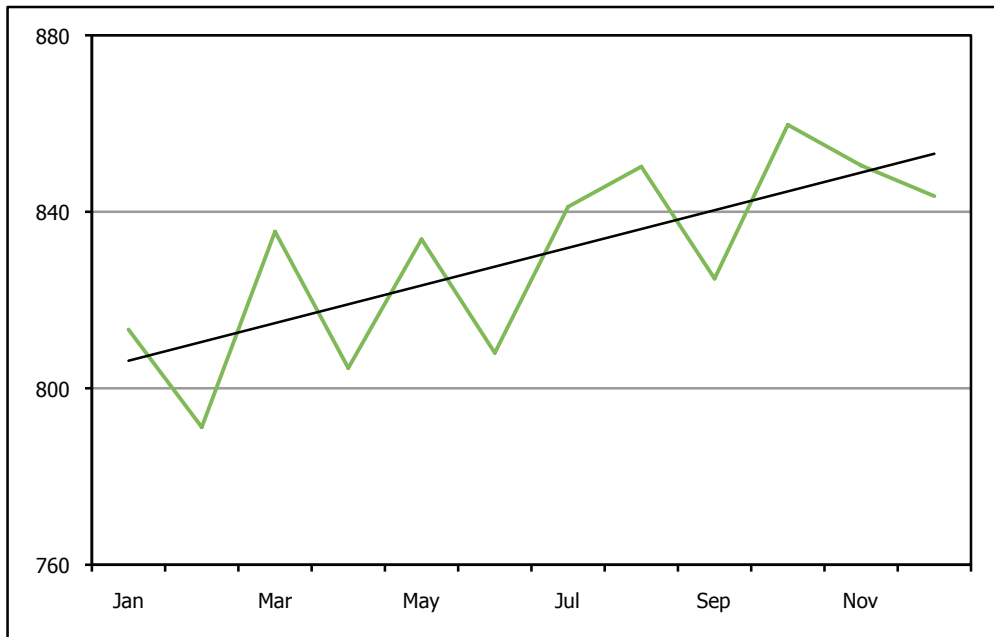


Figure 3: Monthly average national generation demand (MW) for 2016. (Kenya Power & Lighting Company Ltd., 2017)

Seasonal changes do not have a significant effect on the generation demand during the whole year; however, the generation demand varies on a monthly basis and has a growing trend mainly due to continuing increase in the electrification rates of Kenya. Hence the year is divided into twelve time slices, with each month weighted on the basis of actual number of days within that month. In total each year of the modeling period is divided into 36 time-slices (12 months and 3 per day).

D. Investment Restrictions

To model the Kenyan energy sector as accurately as possible, investment restrictions are introduced for the years 2014-2017, being the period for which the data on installed capacities are available. The residual capacities are introduced in the model as the upper limits for the investments during this period.

E. Emissions

The emissions considered in this model include the NO_x and CO₂ emissions. NO_x emissions for fossil fuel based power plants are listed in Table 1 (Mittal, 2012).

Table1. NOx Emissions for Fossil Fuel Based Power Plants

Power Plant	NOx Emissions (g/kWh)	NOx Emissions (kton/PJ)
Coal	4.4	1.222
NG	1.04	0.289
Diesel	13	3.611

The CO₂ emissions (kton/PJ) are calculated on the basis of type and quality of fuel (Ching-Yi Emily Hung, 2009).

1) Coal

There is commercially viable coal reserve in the Mui Basin situated in Kitui County. The coal has been analyzed and found to range in ranking from lignite to sub-bituminous with calorific values between 16 and 27 MJ/kg (Ministry of Energy & Petroleum, 2014). This paper assumes the Carbon content of indigenous coal to be 0.60kgc/kgcoal of coal and a heating value of 22,000 kJ/kg.

$$(CO_2)_{coal\ in} = 0.60kg_c \times \frac{44kg_{CO_2}}{12kg_c} = 2.2 \frac{kg_{CO_2}}{kg_{coal}}$$

$$(CO_2)_{coal\ in} = \frac{2.2 \frac{kg_{CO_2}}{kg_{coal}}}{22000 \frac{kJ}{kg_{coal}}} = 10 \times 10^{-5} \frac{kg_{CO_2}}{kJ} = 100 \frac{kton_{CO_2}}{PJ} \quad [1]$$

Hence 100 kton CO₂ production [1] is considered for every Peta-Joule of energy from indigenous coal.

Coal imported into Kenya is mostly bituminous, with a carbon content of 0.65kgc/kgcoal and heating value of 28,000kJ/kg. (Ministry of Energy & Petroleum, 2014)

$$(CO_2)_{coal\ imp} = 0.65kg_c \times \frac{44kg_{CO_2}}{12kg_c} = 2.38 \frac{kg_{CO_2}}{kg_{coal}}$$

$$(CO_2)_{coal\ imp} = \frac{2.38 \frac{kg_{CO_2}}{kg_{coal}}}{28000 \frac{kJ}{kg_{coal}}} = 8.5 \times 10^{-5} \frac{kg_{CO_2}}{kJ} = 85 \frac{kton_{CO_2}}{PJ} \quad [2]$$

Hence 85 kton CO₂ production [2] is considered for every Peta-Joule of energy from imported coal.

2) *Natural Gas*

Natural gas has 74% carbon by weight and a heating value of 54,000kJ/kg (Heat Values of Various Fuels, 2016).

$$(CO_2)_{natural\ gas} = 0.74kg\ C \times \frac{44kgCO_2}{12\ kg\ C} = 2.71 \frac{kg_{CO_2}}{kg_{natural\ gas}}$$

$$(CO_2)_{natural\ gas} = \frac{2.71 \frac{kg_{CO_2}}{kg_{NG}}}{54000 \frac{kJ}{kg_{NG}}} = 5.0 \times 10^{-5} \frac{kg_{CO_2}}{kJ} = 50 \frac{kton_{CO_2}}{PJ} \quad [3]$$

Hence 50 kton of CO₂ production [3] is considered for every Peta-Joule of energy from natural gas.

3) *Oil*

Kenya recently discovered small amounts of commercially viable oil reserves but the production and use of indigenous oil is still being explored. Kenya's electricity sector relies considerably on imported crude oil and distillates. Most of the oil imported in Kenya is from Abu Dhabi and Saudi Arabia. This paper assumes that oil being used for the electricity generation in power plants is imported distillate oil consisting 87% by weight carbon content with a heating value of 45,000kJ/kg (Heat Values of Various Fuels, 2016).

$$(CO_2)_{oil} = 0.87kg\ C \times \frac{44kgCO_2}{12\ kg\ C} = 3.19 \frac{kg_{CO_2}}{kg_{oil}}$$

$$(CO_2)_{oil} = \frac{3.19 \frac{kg_{CO_2}}{kg_{oil}}}{45000 \frac{kJ}{kg_{oil}}} = 7.0 \times 10^{-5} \frac{kg_{CO_2}}{kJ} = 70 \frac{kton_{CO_2}}{PJ} \quad [4]$$

Hence 70 kton of CO₂ production [4] is considered for every Peta-Joule of energy from oil.

4) Renewables

Non-fossil fuel based technologies such as; wind, photovoltaic (PV), hydro, biomass [1] and nuclear are often referred to as “low carbon” or “carbon neutral” because they do not emit CO₂ during their operation i.e. no direct emissions. However, they are not “carbon free” as CO₂ emissions -indirect emissions- do arise during other phases of their life cycle such as extraction, construction, maintenance and decommissioning (Ching-Yi Emily Hung, 2009). In this model neither the direct nor the indirect CO₂ or NO_x emissions for the renewable technologies were considered. Also the contribution of indirect emissions to the annual CO₂ or NO_x emissions from non-renewable technologies was ignored.

F. Renewable Energy

The model considered the following power generation technologies as renewable energy technologies.

- i. Concentrated solar power.
- ii. Solar photo-voltaic technologies.
- iii. Wind power plants.
- iv. Geothermal power technology.
- v. Biomass power plants.
- vi. Hydro power plants.

The government’s or the international agencies set targets for the uptake of renewable technologies in the energy mix imply planned investments in the aforementioned technologies.

G. Fuel Price Projections

In real terms, crude oil prices in 2016 were at their lowest levels since 2004, and natural gas prices were the lowest since prior to 1990 (US Energy Information Administration, 2017). Both prices are projected to increase over the projection period *Figure 4*. However, as the world is reducing its dependence on oil we also examine the situation in which the prices of crude are lower than projected ones.

1 Biomass is considered a renewable energy source when the utilization rate is equal to, or lower than the capacity of production (biological capacity of renewal). The energy exploitation of renewable biomass is a CO₂-neutral (or almost neutral) process.

Natural Gas prices are highly dependent on the domestic resource availability and technology. Considering that Kenya by far has little discovered natural gas reserves we also examine the implication of higher NG prices than projected ones.

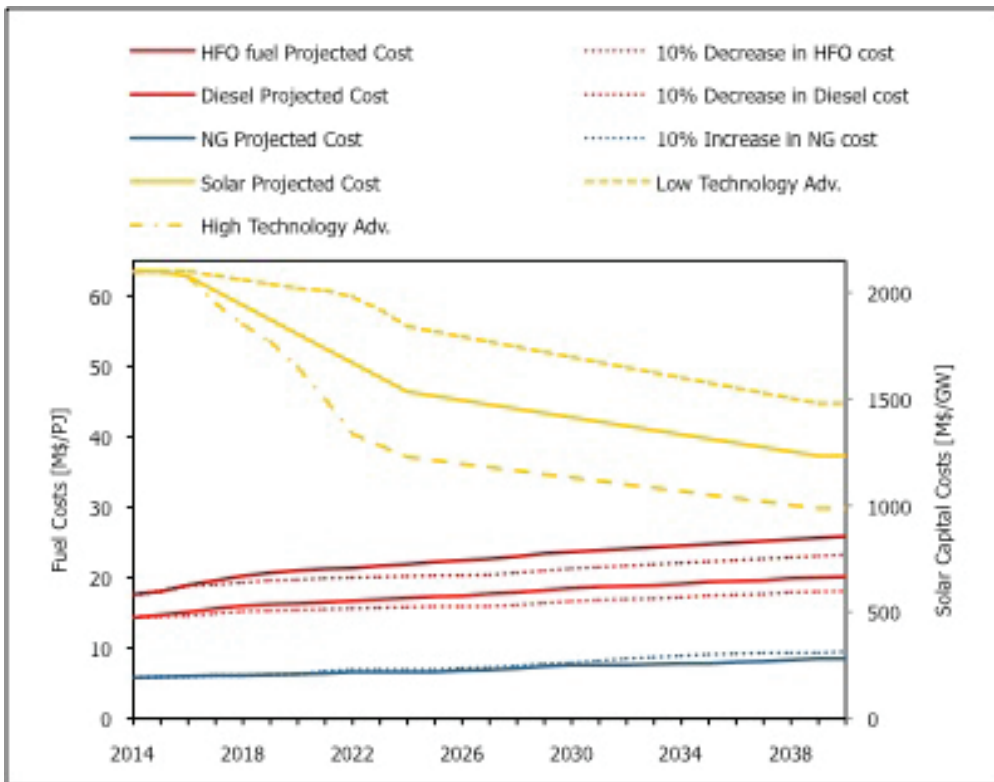


Figure 4: Fuel price projections and possible variations. (US Energy Information Administration, 2017)

The capital cost of solar power plants is expected to decrease over time as the technology matures. To carry out the sensitivity analysis a high and low advancement in solar technological cost is also shown in the *Figure 4*.

Scenarios

Two scenarios are considered for the analysis, Government of Kenya (GoK) Policies Scenario and New Policies Scenario. GoK policies scenario follows the Kenyan government policies for development of the electricity sector as described in recently published reports such as Vision 2030 (Kenya Vision 2030, Republic of

Kenya, 2011), 'Republic of Kenya - 10 Year Power Sector Expansion Plan 2014-2024' (Ministry of Energy & Petroleum, 2014) & National Energy Policy (Ministry of Energy & Petroleum, 2014) projections. New Policies scenario is defined based on the demand projections by International Energy Agency (IEA, 2014).

A. GoK Policies Scenario

Demand for electricity is expected to grow considerably for GoK Policies scenario, as the connectivity and specific consumption increases. The objective of the demand forecast is to provide a sound basis for the power system expansion planning. The electricity demand forecasts carried out for Kenya regularly overestimated demand when compared to actual demand growth in medium term period. They also exceeded by far the forecasted growth rates for similar African countries. The demand forecast for GoK policies scenario, presented in *Figure 5* is very much realistic and takes into account the wide range of largely ambitious government plans and less challenged flagship project developments (Lahmeyer International GmbH, 2016). To extrapolate the data, the forecasts have been linearly adjusted from their corresponding previous year (2035) projections to exhibit a 9% annual demand growth rate towards 2040.

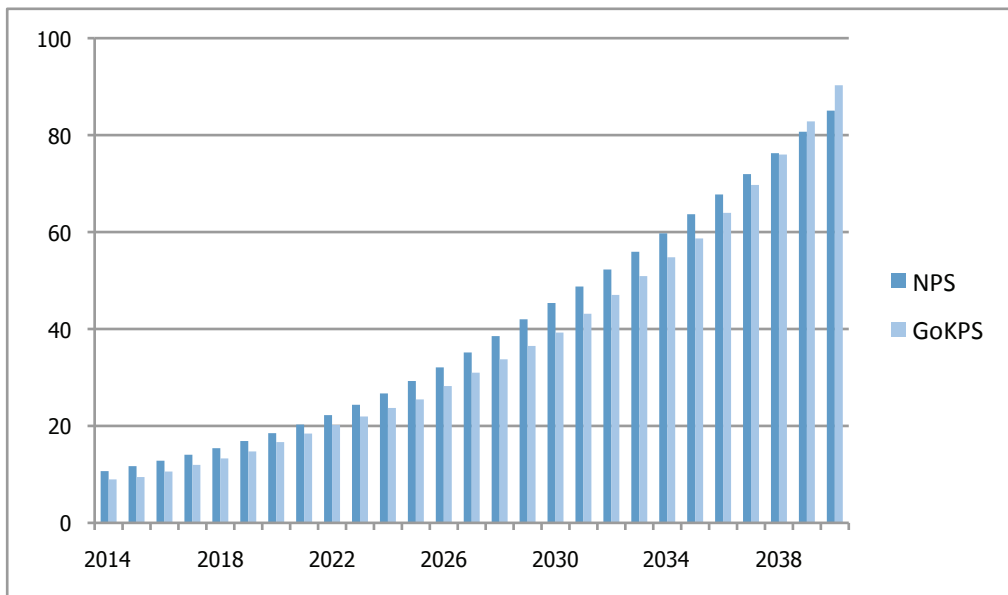


Figure 5: Electricity Demand Growth (TWh) in Two Scenarios

The current energy mix for Kenya *Figure 6* has a large share of renewable energy technologies. The energy production during the period 2014 to 2017 has been dominated by renewables which mainly comprise of hydro and geothermal power generation technologies. The renewable technologies account for more than 64% of the total installed capacity. In the OSeMOSYS model the amount of renewable energy technologies is determined by given residual capacities for the modeling period 2014 to 2017. For the period 2017 to 2040 a renewable energy shares minimum of 50% of the total energy production is considered for “GoK policies scenario”.

Investment restrictions are introduced for the period of 2014 to 2017 to model Kenyan electricity sector as accurately as possible. The available generation capacity during this period leaves largely unsatisfied the total demand for electricity in the country.

The investment plans of government in Nuclear energy are also taken into consideration. A 4,000 MW of Nuclear energy power plant investment is considered during the modeling period. The first nuclear plant of 1,000MW is expected to be commissioned in 2022. Additional units of 1,000MW each are expected to be commissioned in 2026, 2029 and 2031 (Ea Energy Analyses, Energinet.dk, 2014). Moreover, the government’s intention to develop geothermal power generation capacities is also taken into account.

B. New Policies Scenario

In this scenario, the growth of Kenya’s national economy is assumed to boost electricity demand in industries while at the same time efficient use of energy is considered. Electricity demand rises due to; increase in population, per capita consumption, the increase in electrification rate and consistent economic growth.

The annual electricity demand growth rate of 9.6% (IEA, 2014) is considered until 2030, which reduces to below 6% towards 2040 as the country’s population growth rate reduces and less number of new connections are added. Electricity access improves in both urban and rural areas in the New Policies Scenario, but urban electrification rates continue to be higher and, on average, business and households in urban areas consume more electricity. By the end of the modeling period 100% electrification rate is assumed for the population in urban areas while for the population in rural areas an electrification rate of 75% is assumed.

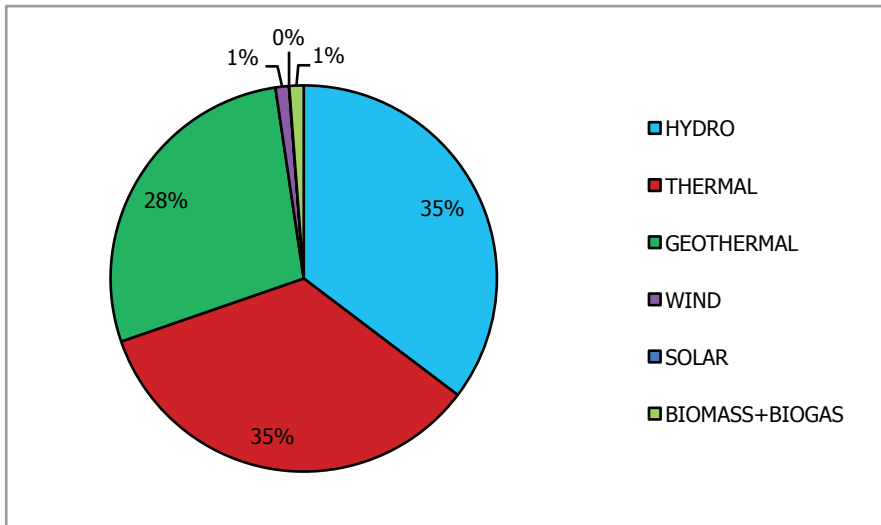


Figure 6: Current power generation technologies mix (Kenya Power, 2017).

The share of renewables in the new policy scenario is considered to be a minimum of 44% in 2040. No investment restrictions are applied to the model and the political intentions of government to invest in a particular technology are ignored in this scenario.

Results

The 44.8 million population of Kenya in 2014 roughly doubles to 80.09 million in 2040. (<https://www.populationpyramid.net/kenya/2040/>). The high population growth rate of Kenya complemented by increased energy consumption per capita creates an ever increasing demand for energy and energy services. Table.2. shows the specific consumption of electricity in both scenarios. The specific consumption in GoK policies scenario increases consistently while in the New Policies scenario a sharp increase is seen in the start of the modeling period while it slows down towards the end because an energy efficient consumption is assumed. Also electrification rate in the country increases rapidly with large number of new connections being added each year. The analysis of scenarios is provided below.

A. GoK policies scenario

The annual energy production starting from 32 PJ in 2014 as shown in *Figure 7* increases to roughly 325 PJ in 2040 in order to meet the demand of electricity.

Historical actual production of electricity from different technologies are shown prior to 2017 which shows a dominant electricity production from hydro and geothermal technologies. (Kenya Power, 2017).

Table 2: Specific Consumption in Two Scenarios

Years	Population	GoK Policies	New Policies
	x1000	kWh/capita	kWh/capita
2020	52,187	319	354
2030	65,412	600	694
2040	80,091	1127	1062

A major portion of the energy production through the modeling period is provided by the geothermal power plants which accounts for 18% of the total installed capacity in 2040 *Figure 11*. Geothermal is seen as most suitable candidate for base load expansion. The annual capacities of hydro power plants which include; small hydro, dam hydro and run-of-the-river hydro power plants decrease steadily over the model period due to degradation of power generation capacities. No new investment in the hydro power plants is observed (*Figure 8*) because of the high capital costs associated to the development of these technologies. However residual capacity of hydro-power plants contributes to the energy production during the modeling period. The share of hydro in the energy mix reduces from 35% in 2017 (*Figure 6*) to 2% in 2040 (*Figure 11*). Natural gas single cycle gas turbines provide the backup capacity (about 18% of the total installed capacity in 2040). The government's intention of investment in Nuclear energy accounts for almost 8% (4000 MW) of the final energy mix. Production of electricity from Nuclear power plants start in 2022 offsetting the energy production from other technologies.

Table 3: Carbon Intensity of Electricity Production

Years	Population	GoK Policies	New Policies
	x1000	tones CO ₂ / GWh	tones CO ₂ / GWh
2020	52,187	46.47	204.38
2030	65,412	77.47	120.12
2040	80,091	43.75	49.09

The solar photovoltaic technology boasts the major portion (43%) of the total installed capacity (*Figure 11*) in 2040. The share of annual energy production (*Figure 7*) from PV technologies increase steadily over the modeling period as the costs

associated with the development of new capacity reduces. Solar PV is observed to contribute a major share towards power generation from off grid technologies.

Diesel distributed generation technology complements the off-grid power generation from solar at times when the solar energy is not available. A share of 10% (Figure 11) of total installed capacity is observed in 2040.

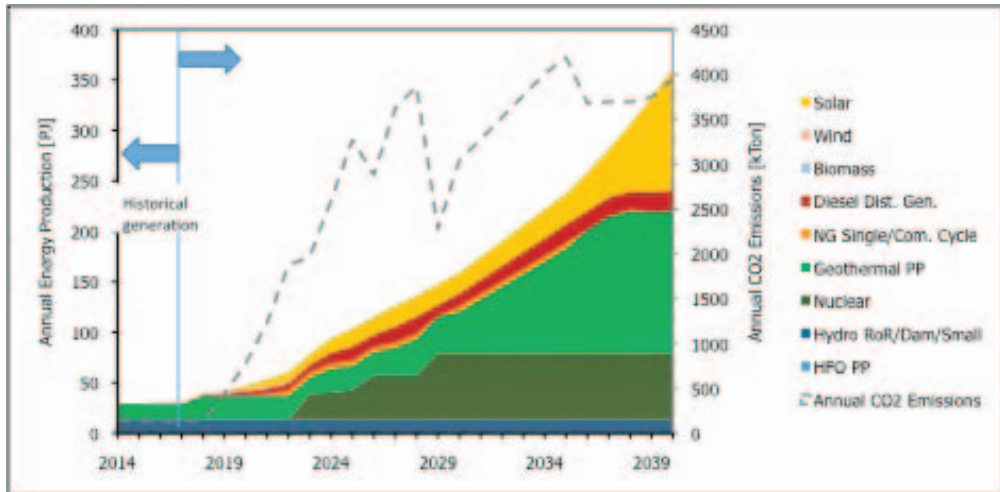


Figure 7: Annual energy production (PJ) & annual total CO₂ emissions (kTon). GoK policies scenario.

CO₂ emissions show an increasing trend in Figure 7 with sudden depressions observed when the new capacities of nuclear power plants are commissioned. The carbon intensity for electricity production is shown in Tab.3 and is well below the EU 28 average of 340 tonnes CO₂/GWh (AlbertoMoro, 2017).

Annual new capacity investment (Figure 8) illustrates the trend of growing investment required in the electricity sector, starting from approximately 0.3 GW in 2015 reaching to more than 3 GW in 2040. More investment in nuclear technology is seen in the beginning with solar clearly overtaking other technologies towards the end of the modeling period.

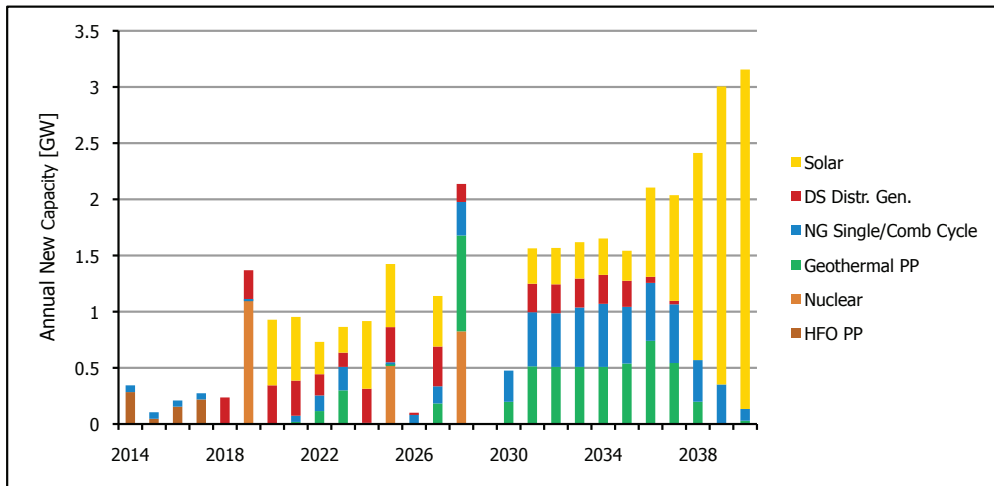


Figure 8: Annual new capacity investment (GW). GoK policies scenario.

B. New policies Scenario

The annual energy production for the new policies scenario is illustrated in *Figure 9*. In this case the estimated demand is lower than that for the GoK policies scenario. Since no restrictions are placed on the model and the government policies for investment in a particular technology are ignored, the model chooses the technologies which produce electricity at the minimum cost to meet the demand without any constraints. The energy production in this scenario is largely dominated by geothermal power plants producing 62% of the total energy production (*Figure 9*). Geothermal power plants account for 26% of the total installed capacity in 2040 (*Figure 12*). The residual capacity of hydro-power plants as seen in the previous case contribute to the annual energy production but its share decreases in successive years as no new capacity investment in this technology is seen (*Figure 10*). A large share (27%) of Natural gas single cycle and combined cycle power plants is also observed (*Figure 12*) as it provides the major backup capacity and peak capacity. It is interesting to note that the energy mix excludes the nuclear power generation technology in this scenario as it is not the cheapest option in Kenyan context.

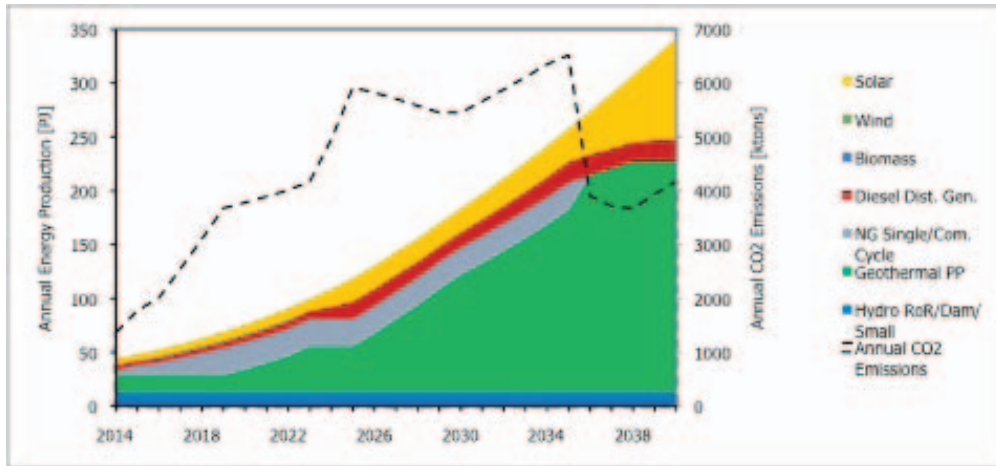


Figure 9: Annual energy production (PJ) & annual total CO₂ emissions (kton). New policies scenario.

The PV technologies in both urban and rural areas are preferred especially in the latter part of the modeling period. This is mainly because costs related to the PV technologies are assumed to continuously decrease over time owing to an increase in efficiency of PV technologies, reducing the size of the PV panels/kW hence material costs. Improvement in fabrication techniques is also predicted to reduce manufacturing costs significantly. Solar photovoltaic technology becomes increasingly important technology in the energy mix contributing 34% of the total installed capacity in 2040.

A distributed generation capacity of Diesel power plants (11%) is observed which complements the off-grid power generation from solar PV technologies.

The new capacity investment graph (Figure 10) shows the annual capacity additions to the existing capacity in order to satisfy the increasing demand. A high investment in the first year of the modeling period is observed in order to compensate the wide gap that exists in the demand of electricity and the supply capacity. The capacity additions increase each year but reduce towards the end of the modeling period as an efficient consumption of electricity and reduction in the growth rate of population is assumed.

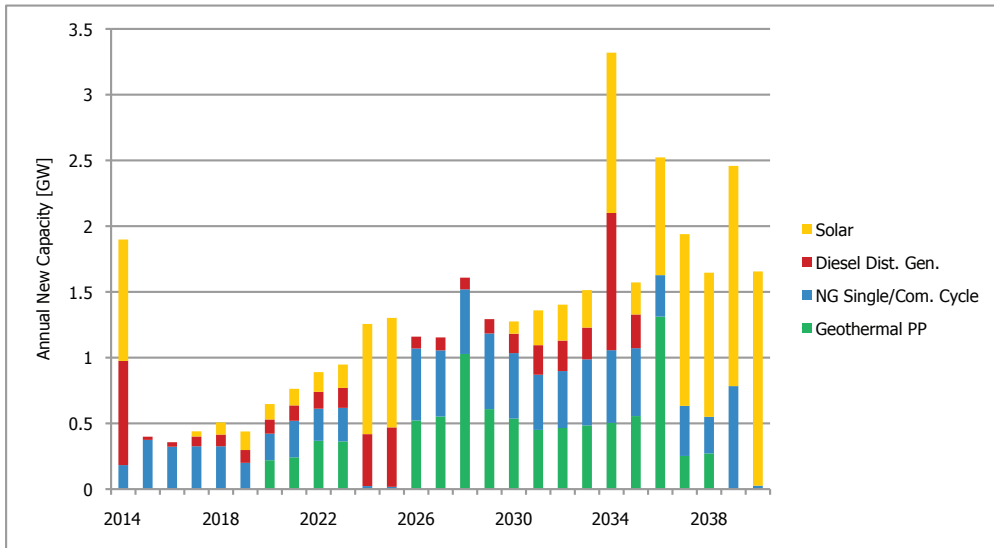


Figure 10: Annual new capacity investment (GW). New Policies Scenario.

The CO₂ emissions (Figure 9) increase as the power production from Natural gas power plants is increased. Towards the end of the modeling period the power production from Natural gas power plants is taken over by geothermal hence a decline in CO₂ emissions is observed. The carbon intensity in this scenario is mentioned in Tab.3.

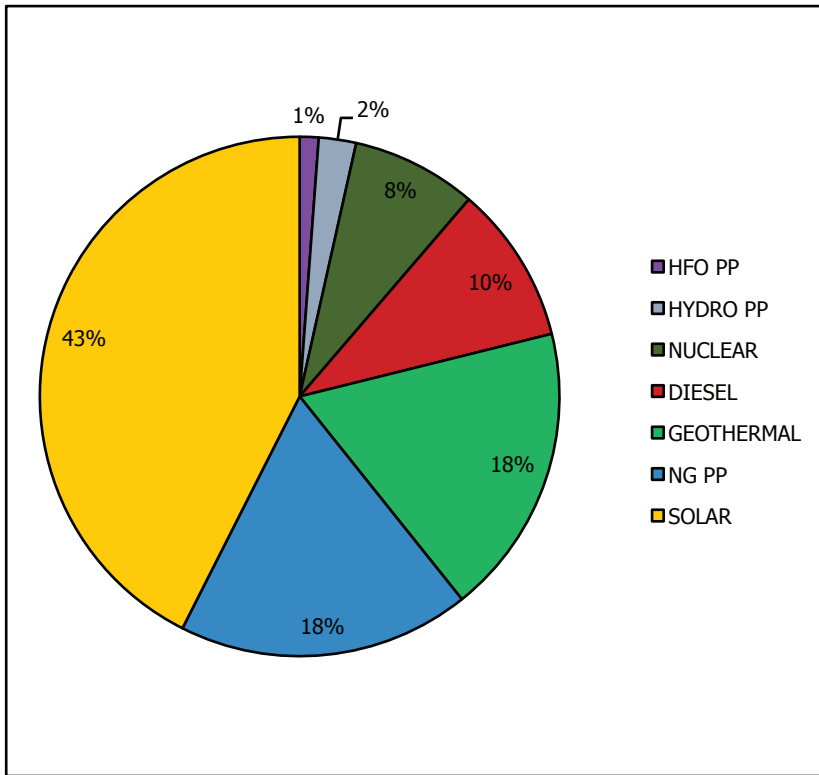


Figure 11: Power Generation Technologies mix GoK Policies Scenario.

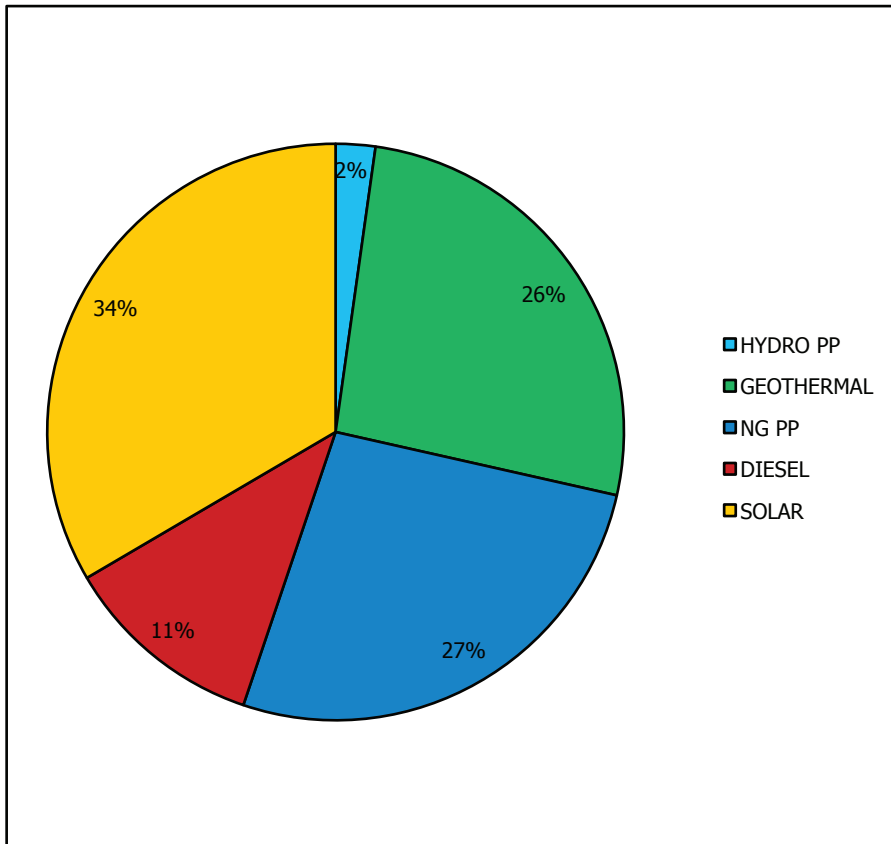


Figure 12: Power generation technologies mix New Policies Scenario.

Discussion

The paper analyzed the implications in two different scenarios of electricity demand and government policies on the future generation capacities, CO₂ emissions and annual new capacity investments. The analysis of scenarios highlight the importance of geothermal energy for base load power generation and solar-PV power plants complemented by distributed diesel power generation for off-grid electrification in Kenya.

Geothermal energy is the clean and cheap source of energy. Kenya is endowed with massive geothermal resource potential estimated close to 12000 MW (Energypedia). Geothermal plants generally operate as base-load generators with capacity factors

comparable to or higher than conventional generation. Capital costs are very site-specific, varying significantly with the characteristics of the local resource system and reservoir. Thus, high potential of geothermal resource in Kenya and its comparatively low cost of utilization make it very competitive for power production.

The high Global Horizontal Irradiation is observed towards the North Western and towards the southern and eastern side of the country comprising of coastal region. These regions are relatively densely populated compared to the Northern and the North Western regions. Hence the use of solar technology in these regions for power generation purposes is economically viable.

Power generation capacities in both the scenarios comprise largely of renewable technologies accounting for 71% in GoK policies scenario and 62% in New Policies scenario.

A sensitivity analysis was performed on the most uncertain parameters. The possible variation of the fuel costs of Natural gas and Oil from the projected one as shown in *Figure 4* was used for the sensitivity analysis. Also the variation of cost of solar-PV because of low and high technological advancement is considered for sensitivity analysis.

It is observed that increase in the natural gas fuel prices have a little effect on Annual capacity while a decreased oil prices (US Energy Information Administration, 2013) favor considerably the distributed diesel power plants which complement the development of off-grid solar-PV. A high technological advancement in solar-PV will lead to reduced costs hence more capacity investment in this technology while offsetting the capacity of geothermal and natural gas power plants on the contrary higher cost than projected of solar-PV will increase the share of geothermal, natural gas power plants in the overall energy mix.

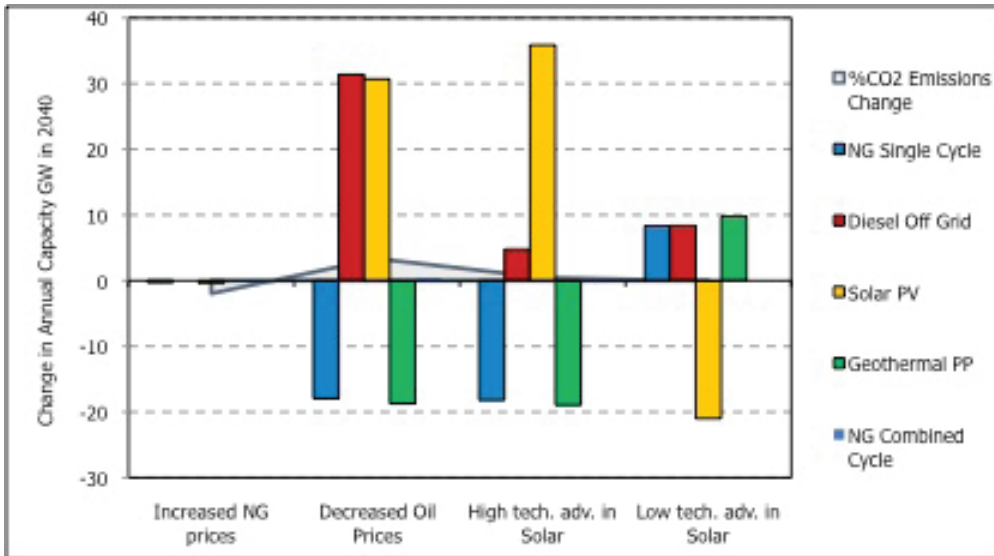


Figure 13: Sensitivity Analysis

Conclusion

Access to affordable clean sources of energy especially electricity access is an issue of core importance in policy making for governments in Africa and the international organizations. The energy modeling techniques help in analyzing scenarios that may emerge as result of different policies of both governments and international institutions. Because of the ambitious development objectives of Kenya or the universal energy access goal by 2030 of the United Nations, it's nowadays, more than ever, of utmost importance to improve the reliability of the energy modeling tools in order to provide the best technical support to the decision makers. This work hopes to contribute to this goal both by providing an assessment of the scenario that might emerge because of government and IEA policies and a critical analysis of impact, the variation in key input parameters could have on the main outcomes of the energy modeling.

In order to satisfy the acutely growing demand for electricity in Kenya a huge investment is required in the power generation, transmission and distribution sectors. The results clearly emphasize the need to further develop the geothermal power generation because of its abundant potential in Kenya. Solar photo-voltaic modules widely being used in rural Kenya provide the most cost-effective solution

to satisfy the demand for electricity in areas far from the grid. Solar PV systems are expected to become popular and compete with the on grid technologies as the technology matures and the costs related to generation and storage sharply decrease. However, provision of stable, reliable and flexible supply of electricity requires increased connectivity to the grid.

Acknowledgments

Mr. C, Ndungu	Kenya Power & Lighting Company
Mr. I. Mwathi	HIVOS International
Ms. T Hu	China National Nuclear Cooperation
Ms. B Kandie	Kenya Electricity Generation Company
Mr. B.Muchiri	Kenya National Bureau of Statistics

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APPENDICES

A. Appendix A

The technologies and the fuels considered in the OSeMOSYS model are listed in this section.

Table.A1. Electricity Generation Technologies considered in the OSeMOSYS model

No.	TECHNOLOGY DESCRIPTION
1	Biomass Combined Heat & Power (CHP) plant
2	Coal power plant
3	Diesel power plants (100kW, Industry) Off- Grid Power Generation
4	Diesel power plants (1kW, Rural, Residential/Commercial) Off- Grid Power Generation
5	Diesel power plants (1kW, Urban, Residential/Commercial) Off- Grid Power Generation
6	Diesel power plants (Utility)
7	Geothermal power plant (Single Flash)
8	Oil fired gas turbine OIL Single Cycle Gas Turbine
9	Small hydro power plant (SHP)
10	Dam hydro power plant
11	Run-of-river hydro power plant
12	Natural gas (Combined Cycle) NGCC.
13	Natural gas (Single Cycle) NGSC
14	Concentrated Solar Power CSP (Without storage)
15	Concentrated Solar Power CSP (With storage)
16	Concentrated Solar Power CSP (With gas firing)
17	Solar Photovoltaic Power Plant (Utility Scale)
18	Solar Photovoltaic Power Plant (Roof top, Rural), Off- Grid Power Generation
19	Solar PV with storage (1 hr, Rural) Off- Grid Power Generation
20	Solar PV with storage (2 hr, Rural) Off- Grid Power Generation
21	Solar PV (Roof top, Urban) Off- Grid Power Generation
22	Solar PV with storage (1 hr, Urban) Off- Grid Power Generation
23	Solar PV with storage (2 hr, Urban) Off- Grid Power Generation
24	Wind (Onshore, 20% CF)
25	Wind (Onshore, 30% CF)

26	Nuclear Technology
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Table A2 Fuels Considered as Input to Power Generation Technologies

No.	FUELS
1	Natural Gas (Imported & Indigenous Extraction) ¹
2	Coal (Imported & Indigenous Extraction)
3	Diesel (Imported & Indigenous Extraction)
4	Heavy Fuel Oil (Imported & Indigenous Extraction)
5	Nuclear fuel 'Uranium' (Imported)
6	Biomass (Indigenous Extraction)

Appendix B

The nomenclature and the units used in this paper are explained in this appendix.

Table B1 Nomenclature

No	NAME	DESCRIPTION	SYMBOL
1	Emissions	The EMISSION (CO ₂ , NO _x) to be accounted for.	e
2	Technology	The TECHNOLOGYS modeled.	t
3	Fuels	The FUELS used.	f
4	Year	The YEARS modeled.	y
5	Time slice	The TIMESLICES, each of which combines a fraction of the year with specific load and supply characteristics.	l
6	Region	The REGIONS that are to be modeled. Kenya is modeled as one region	r

Table.B2. Units

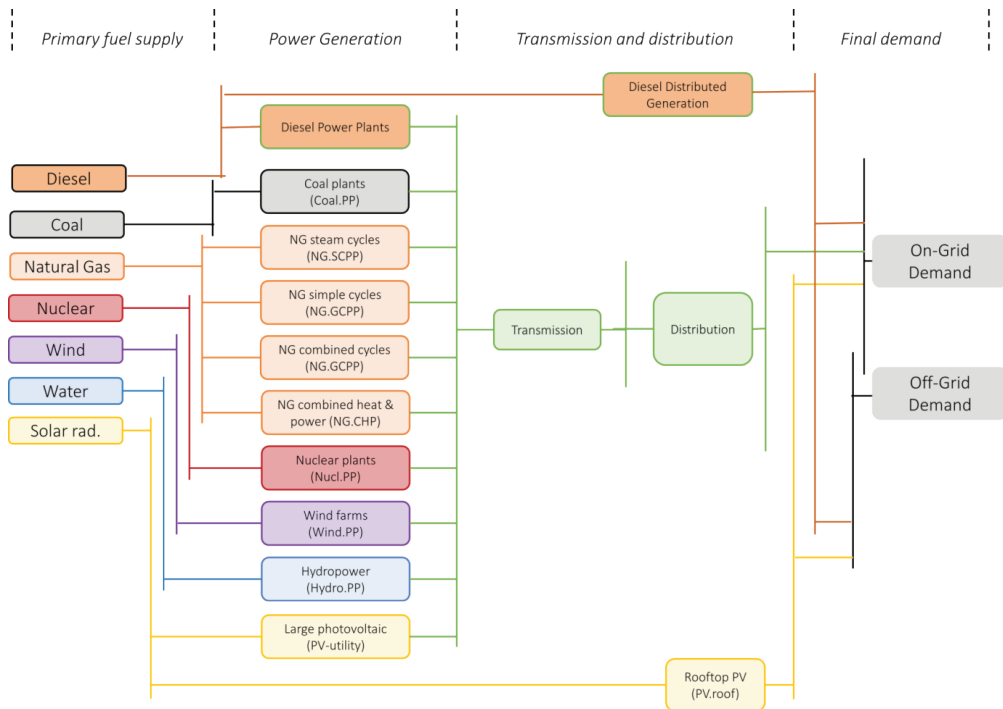
No.	UNIT	DESCRIPTION
1	MW	Mega Watts (10 ⁶ Watts)
2	GW	Giga Watts (10 ⁹ Watts)
3	kWh	Kilo Watt Hours (10 ³ Watt hours)
4	MWh	Mega Watt Hours (10 ⁶ Watt Hours)
5	GWh	Giga Watt Hours (10 ⁹ Watt hours)
6	TWh	Tera Watt Hours (10 ¹² Watt hours)
7	PJ	Peta Joules (10 ¹⁵ Joules)

8	MJ/kg	Mega joules per kilogram
9	kJ/kg	Kilo Joules per kilogram
10	kton	Kilo tones (10 ³ tones)

Appendix C

Reference energy system:

Network of lines represent the fuels while blocks represent energy producing, transforming and consuming technologies.



Section Three:
ENVIRONMENTAL
PROTECTION,
RENEWABLE ENERGY
AND CLIMATE
CHANGE

Abundance and Identity of Red Spider Mite Species on Brachiaria Grass in Kenya and its Worldwide Comparative Phylogeny

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Abstract

The re-introduced *Brachiaria* grass in Kenya offers a vigorous and nutrient-rich forage option. Pest invasion on introduced *Brachiaria* grass cultivars in Kenya by red spider mite (RSM) indicates considerable damage during the dry season. This leads to low forage yield and quality loss. A survey on the level of mite infestation and specimen collection on various *Brachiaria* grass cultivars was carried out in August and October 2016 in coastal lowlands, eastern, central and western regions of Kenya. DNA-based identification was carried out using universal primers of ITS2 and COI gene regions. The abundance and damage by RSM was severe in eastern and western areas of the country with cvs. Marandu and Mulato II showed the highest level of infestation. BLAST results from the NCBI database revealed the red spider mite species damaging *Brachiaria* grass in most parts of Kenya to be *Tetranychus urticae* (Koch.). The countrywide sequence samples did not show much genetic difference at in-country sites but wide divergence from other world geographic regions.

Keywords: *Brachiaria*, red spider mite, identity, forage, Kenya

Introduction

Agro-pastoral systems in Kenya have limited livestock feed sources of nutritional quality (Ghimire *et al.*, 2015). The newly re-introduced *Brachiaria* grass in Kenya is reported to provide high quality forage for increased milk production (Muinga *et al.*, 2016). During the last four years, *Brachiaria* grass varieties sourced from South America and introduced in Kenya were devastated by unknown red spider mite

(RSM) species during the dry season lasting between two to four months. The RSM species could only be assumed to be any of the red species of the polyphagous species of genus *Oligonychus* or *Tetranychus*. In order to develop control measures or management options, it was important to identify the mite species.

Spider mite species can be misidentified when only morphological identity is considered (Ehara, 1999; Matsuda *et al.*, 2013). Nevertheless, new emerging molecular techniques have been tested and could be reliably used to identify species where morphological expertise is not available. On morphology, an experienced taxonomy expert is required to correctly identify these pest mites after tedious slide mounts of the specimens (Ehara & Gotoh, 1996; Wauthy *et al.*, 1998; Ehara, 1999).

Recently, various DNA markers have been developed for diagnostic identification of species of the Tetranychidae species (Matsuda *et al.*, 2013). The two main genomic DNA regions recently targeted to identify *Tetranychus* species from other taxa of red spider mite species are the internal transcribed spacer (ITS2) rRNA gene region of the long fragments consisting 714-817 bp and cytochrome oxidase I (COI) of the mitochondria of 900bp (Matsuda *et al.*, 2013). Cryptic species among both *Tetranychus* and *Oligonychus* genera which bear the red appearance exist. Thus, the aim of the current work was to elucidate the true identity of the red mite species attacking *Brachiaria* grass in Kenya using molecular tools and explore infestation levels on cultivars and site regions.

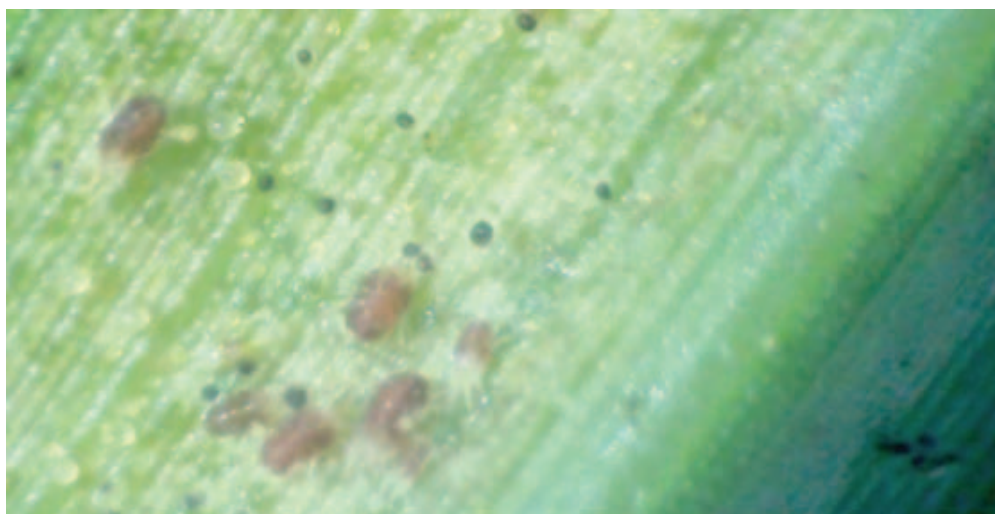
Materials and Methods

Field mite survey

The survey on mite abundance on *Brachiaria* grass was carried out in seven sites located in different agro-ecological zones of Kenya (Table 1). These sites were Nairobi (Uthiru), Katumani and Ithookwe on the east; Eldoret, Kitale and Alupe on the west, Ol Joro Orokin central highlands; and Mtwapa in the coastal lowlands. The grass cultivars *B. brizantha* cv. MG4, *B. brizantha* cv. Marandu, *B. brizantha* cv. Xaraes, *B. ducebens* cv. Basilisk, *B. hybrid* cv. Mulato II, *B. brizantha* cv. Piata and *B. hybrid* cv. Cayman were established in plots of 5 x 4 m in 4 replications. Spider mite count samples were taken from 10 randomly selected leaves per plant of the net plot targeting a single spot population (Figure 1). In each grass variety a single colony was identified and with the aid of a pouter device individual mites were collected from four replicates and preserved in 100% alcohol vials for later molecular analysis.

Table 1: Brachiaria sample sites and their respective agro climatic conditions

Site	Altitude (m asl)	Mean temp range (°C)	Annual rainfall (mm)	AEZ description
Nairobi (Uthiru)	1882	17-21	1200-1600	Cool-wet
Katamani	1600	16-20	600-800	Warm-dry
Ithookwe	1160	22-24	800-1200	Warm-wet
Eldoret	2153	16-18	1200-1600	Cool-wet
Kitale	1894	18-20	1200-1600	Cool-wet
Alupe	1189	22-24	1600-2000	Warm-wet
Ol Joro Orok	2393	14-16	1200-1600	Cold-wet
Mtwapa	15	24-30	1200-1600	Hot-wet

**Figure 1:** Red spider mit ecolony (Mag.x40)on Brachiaria grass

DNA extraction

Four single female mites from the collected leaf sample were randomly used for DNA extraction according to protocol by Matsuda *et al.* (2013). The DNA was extracted using Qiagen Kit (DNeasy Blood & Tissue Kit) where single mites were crashed in 1.5ml centrifuge tubes homogenised with Buffer ATL (100ul), added Proteinase K-enzyme (10ul) for about one hour in 56.3 °C hot-water bath. Addition of Buffer AL (100ul), absolute alcohol (100ul), with sample DNA cleaning was carried out as per Qiagen protocol. Final elution of 50ul gDNA was acquired for the PCR optimisation process on the selected ITS2 (rDNA) and COI (mtDNA) gene regions.

PCR amplification

The primers used for the selected regions of rDNA and mtDNA are shown in Table 2. The ITS region optimum amplification was achieved at 94 °C for 3 minutes' initial denaturation, followed by 35 cycles of further denaturation at 94 °C (45 seconds), annealing at 52.5 °C (1 minute) and extension at 72 °C(1 minute). A further extension of 10 minutes at 72 °C was allowed on the master cycler for final elongation. Similarly, the COI region optimisation was carried out at 94 °C for 3 minutes' initial denaturation, and followed by 35 cycles of further denaturation at 94 °C (1 minute), annealing at 56.9 °C for 1 minute and extension at 72 °C for 1 minute. A further extension of 10 minutes at 72 °C was carried out for final elongation. The PCR products were separated in 1.5% agarose gel and purified with GeneJet PCR Purification kit (Thermo-Scientific) of Bioneer Co., eluted with pure water of 40ul and kept at -20 °C for next step of sequencing.

Table 2: Primers used on polymerase chain reaction (PCR) amplification of internal transcribed spacer 2 (ITS2) and the cytochrome c oxidase subunit I (COI) regions

Primer name		Sequence (5' to 3')	Reference
ITS2 region			
rDO2	Forward primer	GTCGTAACAAGTTTCCGTA	Hinomoto & Takafuji (2001)
HC2	Reverse primer	ATATGCTTAAGTTCAGCGGG	Navajas et al. (1994)
COI region			
CIJ-1718	Forward primer	GGAGGATTTGGAAATTGATT	Simon et al. (1994)
COI REVA	Reverse primer	GATAAAACGTAATGAAAATG	Gotoh et al. (2009)

DNA sequencing and alignment

PCR products of both ITS2 and COI were successfully sequenced by use of Bioneer-3730xl sequencer. The forward and reverse sequences of both ITS and COI regions were trimmed and assembled by use of CLC Main Workbench (Version 7.8) software. BLASTs of nucleotide sequences were carried out on the NCBI database to determine species identity by match percentage levels. Later MEGA6 software was used to align by ClustalW for pairwise and multiple alignments as well as calculate diversity distances of sample nucleotide among close related accessions from NCBI databases.

Different lowercase letters within sites denote significance ($p < 0.05$) difference of mite densities. Likewise, different superscript upper case letters within rows denote significant among cultivars.

Red spider mite identity

Sequence lengths of ITS2 and COI were between 850 and 1060 bp respectively which were subjected to NCBI BLASTs. Sequence similarity matches of 88-90% were scored on COI region, indicating the mite species to be *Tetranychus urticae* (Koch.) with divergence distance levels ranging from 0.105 to 0.136 from other world site populations (Table 4). The nearest COI region genetic population from NCBI-worldwide database was that of Tunisia of 0.105 divergence distance. Comparison of within country populations, of ITS2 region divergence ranged from 0 to 0.046 among the sites of Kitui, Uthiru (Nairobi), Alupe and Mtwapa. The red spider mite sample on cassava at Mtwapa in coastal Kenya was also found to be *T. urticae*, and of closely related genetic relationship to another in-country site of Kitui. The Kenya *T. urticae* closest nucleotide genetic similarity was that of China, Spain and France, of divergence levels of 0.111, 0.182 and 0.184, respectively.

Comparative gene trees

The COI region showed two supported clades of *T. urticae* phylogenetic relationships (Fig.2). The first clade had sub-clades 1a, 1b and 1c of samples from Japan-Mexico-Iran, China and Kenya, respectively. Another Japan nucleotide appeared grouped in the second clade (Clade 2) together with populations from other countries like Brazil, Spain, France and Canary Islands. It was noted that the Kenyan sample sequences had no intra-population divergence on the COI and appeared to belong to one clade. The comparative ITS2 region of Kenya and other world database indicated two distinct phylogenetic clades (Figure 3). The Kenya population grouping appeared to be a mixture of two genetic materials, though of low genetic divergence of Sub-clades 1a and 1b. Mtwapa, Katumani (Kam) and some Kitui populations were clustered together in Sub-Clade 1a while Kitui, Alupe and Uthiru (ILRI-BecA, Nairobi Campus field) nucleotides were grouped in Sub-Clade 1b. Other world nucleotides from Japan, Spain, China, Canary Islands and Brazil showed distinct genetic difference from Kenya populations, hence in a different clade.

Table 4: Pairwise distances of mitochondrial cytochrome oxidase subunit I (COI) and internal transcribed spacer 2 among other nearest nucleotide NCBI databases of *Tetranychus urticae* (Koch) of worldwide scope

Region	Sequence code	MG4:Ke	Basil:Ke	Mara:Ke	Xara:Ke	Bz	Tun	Spn	Jpn	Mxc	Iran	Frc
COI	MG4:Ke	-	0	0	0	0.133	0.105	0.136	0.125	0.125	0.122	0.129
	Basil:Ke	0	-	0	0	0.133	0.105	0.136	0.125	0.125	0.122	0.129
	Mara:Ke	0	0	-	0	0.133	0.105	0.136	0.125	0.125	0.122	0.129
	Zara:Ke	0	0	0	-	0.133	0.105	0.136	0.125	0.125	0.122	0.129
	Bz	0.133	0.133	0.133	0.133	-	0.047	0.008	0.056	0.029	0.014	0.008
	Tun	0.105	0.105	0.105	0.105	0.046	-	0.049	0.029	0.029	0.023	0.047
	Spn	0.136	0.136	0.136	0.136	0.003	0.049	-	0.059	0.059	0.059	0.008
	Jpn	0.125	0.125	0.125	0.125	0.056	0.029	0.059	-	0.029	0.029	0.056
	Mxc	0.125	0.125	0.125	0.125	0.029	0.009	0.013	0.056	-	0.009	0.013
	Iran	0.122	0.122	0.122	0.122	0.013	0.023	0.049	0.029	0.029	-	0.013
Frc	0.129	0.129	0.129	0.129	0.008	0.049	0.056	0.056	0.056	0.056	-	
ITS	Sequence code	Xara:KT:Ke	Mul:IKM:Ke	MG4:UT:Ke	Mara:KT:Ke	Cobra:KT:Ke	Cass:MP:Ke	Piat:Al:Ke	Bz	Spn	Jpn	Frc
	Xara:KT	-	0.005	0.000	0.046	0.000	0.000	0.005	0.189	0.189	0.189	0.189
	Mul:IKM	0.003	-	0.003	0.046	0.000	0.000	0.008	0.185	0.182	0.185	0.184
	MG4:UT	0.000	0.003	-	0.046	0.000	0.005	0.005	0.189	0.187	0.189	0.189
	Mara:KT	0.046	0.043	0.046	-	0.046	0.044	0.048	0.232	0.232	0.232	0.232
	Cobra:KT	0.000	0.003	0.000	0.000	-	0.005	0.005	0.189	0.189	0.189	0.189
	Cass:MP	0.005	0.002	0.005	0.044	0.005	-	0.008	0.187	0.187	0.187	0.186
	Piat:Al	0.005	0.008	0.005	0.005	0.005	0.009	-	0.191	0.189	0.191	0.187
	Bz	0.189	0.185	0.189	0.232	0.189	0.187	0.191	-	0.002	0.011	0.002
	Spn	0.189	0.182	0.187	0.232	0.189	0.187	0.189	0.003	-	0.014	0.005
	Jpn	0.189	0.185	0.189	0.232	0.189	0.187	0.191	0.003	0.014	-	0.009
	Frc	0.189	0.184	0.189	0.232	0.189	0.186	0.187	0.002	0.005	0.003	-

Key: MG4:Ke = variety MG4-Kenya, Basil:Ke = variety Basilisk-Kenya, Mara:Ke = variety Marandhi-Kenya, Xara:Ke = variety Xarac-Kenya, Bz = Brazil, Tun = Tunisia, Spn = Spain, Jpn = Japan, Mxc = Mexico, Frc = France, Xara:KT:Ke = Xarac-KT:Ke = Xarac Kitini, Mu II KM = Malato II Katumani, MG4:UT = MG4-Uthiru,

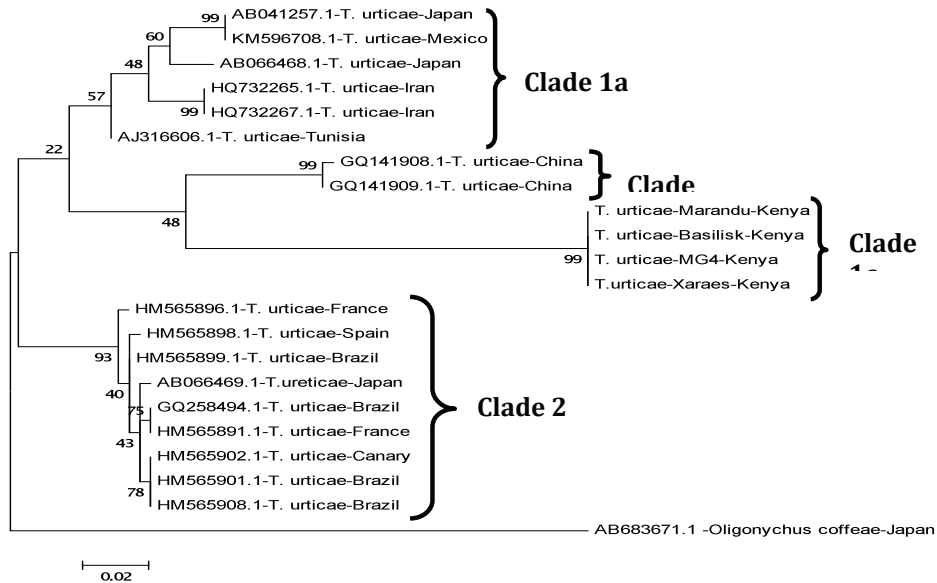


Figure 2: Maximum Likelihood (ML) tree based on cytochrome c oxidase subunit I (COI) nucleotide divergences of *Tetrazychnus urticae* (Koch) on varied Brachiaria grass cultivars in Kenya and genetic differences among related databases from NCBI. Bootstrap values based on 1000 replications are shown at branch nodes.

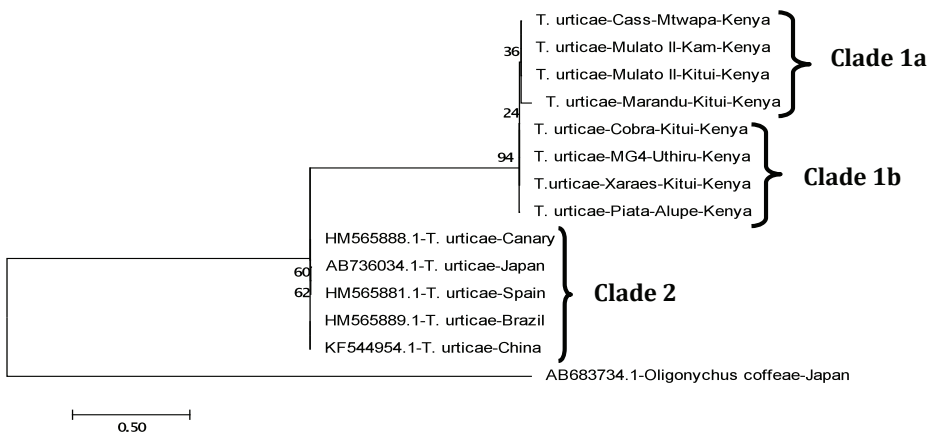


Figure 3: Maximum Likelihood (ML) tree based on internal transcribed spacer (ITS2) nucleotide divergences of *Tetrazychnus urticae* (Koch) on varied Brachiaria grass cultivars in Kenya and genetic distance differences among related databases from NCBI. Bootstrap values based on 1000 replications are shown at branch nodes.

Discussion

Brachiaria grass mite infestation levels at the different sites appeared to be highest where dry spells persistent for long similar to findings on cassava green mite (Mutisya *et al.*, 2015). Highest infestations were observed on grass cultivars Marandu, Mulato II and Basilisk. Cultivars showing least damage were Piata, and MG4. Sites noted for highest damage of brown-broached leaves were Katumani, Kitui and Alupe corresponding to the high temperature regimes at the sites. The cool wet site of Ol Joro Orok was found to have no mite infestations probably due to low temperature and high precipitation. Likewise, the warm-humid Mtwapa site was completely free of the mite infestation although cassava plants found next to the Brachiaria plots were infested with red spider mites. No clear explanation of *T. urticae* preference of cassava leaf tissue to Brachiaria grass was deducible from literature in that warm-humid environment.

The BLAST (matching algorithm) method gave quick results on species identity as reported by Lv *et al.* (2014). The results of the DNA sequence analysis showed that the polyphagous *T. urticae* was the mite pest damaging Brachiaria grass in Kenya. The species has diverse crop host and was also identified as the red spider mite on cassava at Mtwapa in the coastal lowlands of Kenya.

The nearest genetic closeness of Kenya *T. urticae* was found from the phylogeny tree to be that of Tunisia, and correctly so being in the same continent. The phylogeny analysis results showed that the far distant Brazil nucleotide could be treated not related from where the grass was re-introduced from. Hence, the *T. urticae* ought to be viewed as being in the country before introduction of the Brachiaria grass and that the samples analysed could not be assumed to represent all mite population in the country. The countrywide distribution of *T. urticae* populations on different localities of Kitui, Katumani, Alupe, Uthiru (Nairobi) and Mtwapa did not reflect much nucleotide genetic difference even on the ITS region. This could be explained by the fact that the pest mite is polyphagous on both wild and cultivated crops (Gotoh *et al.*, 1993; Yano *et al.*, 1998). It can also be hypothesized that dispersal of the mite by various activities from one area to another is highly variable as persons move across with green plant materials for consumption or planting. This could not have been accounted for by the quarantine regulations at national and international level due to the conspicuous way farmers exchange planting materials from one region of the country to another. Considering *T. urticae* biological potential for fast colonisation of plant species and the optimum

conditions in existence in places where *Brachiaria* grass is grown, high damage levels will continue to be experienced in specific warm localities in Kenya. An approach of suppressing mite damage would encompass manipulation of pasture production field conditions and integration of biological and cultural techniques as applied in cassava (Mutisya *et al.*, 2015; Molo *et al.*, 2016).

The present work took roughly less than one week from sample sequencing to carrying out of sequence BLASTs on NCBI database and identifying the mite species. This presented an ideal approach to identify pest species fast and with little difficulties to the untrained morphological taxonomist of spider mite species (Naivajas *et al.*, 1994; Navajas & Fenton, 2000).

Disclosure statement

No potential conflict of interest was reported by the authors.

Acknowledgements

This work was supported by the BecA-ILRI Hub through the Africa Biosciences Challenge Fund (ABCF) program. The ABCF Program was funded by the Australian Department for Foreign Affairs and Trade (DFAT) through the BecA-CSIRO partnership; the Syngenta Foundation for Sustainable Agriculture (SFSa); the Bill & Melinda Gates Foundation (BMGF); The UK Development for International Development (DFID) and the Swedish International Development Cooperation Agency (Sida).

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Verification of Plant Spacing for KME-08-04, KME-08-05, KME-08-02 and KME-08-06 Cassava Varieties

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Abstract

With the release of new varieties for coastal lowlands, it was observed that some of the varieties closed their canopy very early in the season hence hindering some agronomic practices such as weeding. A study was therefore carried out to determine the optimum plant spacing for the new varieties. Four varieties: Shibe, Karemba, Tajirika and Nzalauka were evaluated alongside four plant population densities of 13,333; 10,000, (control), 8,000 and 6,666 plants per hectare. The treatments were laid out in a split plot design with cassava varieties as the main plots and different plant spacing as the sub-plots. The results indicated that Shibe variety recorded significantly ($P < 0.05$) higher number of roots per plant than the rest of the varieties. The variety also showed significantly ($P < 0.05$) higher total number of roots than the rest of the varieties and Nzalauka showed significantly ($P < 0.05$) higher total number of roots than Tajirika but not Karemba. Plant spacing significantly ($P < 0.05$) influenced the number of roots per plant, total number of roots but not marketable root yield. The number of roots per plant increased with increase in spacing or decrease in population. The spacings of 1.00 x 1.25 m and 1.00 x 1.50 m recorded significantly ($P < 0.05$) higher number of roots per plant than the control. The spacing of 1.00 x 1.50 m recorded significantly lower total number of roots per plant than the control. There were no significant ($P < 0.05$) differences among various plant spacing as regards marketable root yield per hectare. This implies that farmers can continue using the spacing of 1 x 1 m even for the new cassava varieties.

Keywords: Agronomic Practices, Cassava Variety, Plant Spacing, Total Number of Roots, Marketable Root Yield

Introduction

Cassava (*Manihot esculenta* Crantz) is grown widely in sub-Saharan Africa even in areas which receive only 600mm of rainfall in three months of the year (Hahn, 1994). In Kenya, it is grown in diverse agro-ecological zones in western, eastern, central and coastal regions. The crop is widely grown in the Coastal lowlands of Kenya which produces 30% of the country's total production (Kariuki *et al.* 2002). The crop is grown in all the five agro-ecological zones (AEZs), namely the Coastal lowlands (CL) 2, 3, 4, 5 and 6. However, cassava is most important in CL2, CL3 and CL4 AEZs which occupy a strip of about 30 km wide along the coastline. The yield of cassava depends on a number of key factors such as climatic condition, type of soil, the cultivar or variety selected for its cultivation along with good farm management practices. In the coastal region cassava is important for food security, generating income and industrial application. Cassava is the second important crop after maize (Kariuki *et al.*, 2002) and its leaves are used as vegetables. Storage roots are sold fresh at the farm gate or at the local markets to generate income for many small-scale farmers. Storage roots are also processed into sun dried and deep fried cassava chips. Since the roots and leaves are available all year round, cassava is also an important food security crop, especially in drought-prone areas.

Cassava has the potential for partial or complete replacement of maize as an energy source in the manufacture of animal feeds in Kenya (Makokha, 2002). Cassava has a higher energy yield per hectare (50 million kJ) than maize (33 million kJ) (Bruinsma *et al.*, 1985). Despite its importance as a food, income generating and industrial crop, cassava productivity is estimated at 8 t ha⁻¹ (MOA-CP, 2007), which is below the estimated potential yield of 90 t ha⁻¹ (Cock *et al.*, 1979). The low productivity is due to constraints such as inadequate planting materials, the low yielding potential of popular cultivated varieties, poor agronomic practices, unfavourable climatic conditions, pests and diseases (Kariuki *et al.*, 2002). The constraints on yield potential, pests and diseases were addressed through a breeding programme where six high yielding and disease tolerant varieties were developed and released to farmers in 2008. However, these varieties were developed and tested under a standard spacing of 1 x 1 m (10,000 plants ha⁻¹) irrespective of growth habit of the varieties. Response from farmers and our visual observations revealed that some varieties were not fitting in the recommended spacing of 1 x 1 metres since they closed the canopy too early to allow crop management practices such as weeding and cropping systems such as intercropping. This also affected the

adoption of the varieties by farmers since most of them intercrop cassava with other crops. Varieties with straight and upright stakes might also require closer spacing than 1 x 1 m. A study was therefore carried out to verify the optimum plant spacing of new varieties. The objectives of the study were to determine the optimum plant population for the new cassava varieties; and whether the optimum population is variety specific.

Materials and Methods

The study was carried out at the Kenya Agricultural and Livestock Research Organization Research Centre at Mtwapa (Lat. S 03° 56.184'; Long. E 039° 44.183') from 2011 to 2013. The study site has an altitude of 15 m above sea level and is in the agro-ecological zone described as the coastal lowland 3 (CL3) (Jaetzold and Schimdt, 2006). The soils at the site are loamy sands, with a pH of 6.9. They are deficient in macro-nutrients, especially nitrogen (Mureithi *et al.*, 1995) and phosphorus (FURP, 1994; Saha and Muli, 2002), and have low organic matter content and cation exchange capacity (FURP, 1994). The mean annual rainfall for the site is 1200 mm, with about 75% of it falling during the long rain season. The mean monthly minimum and maximum temperatures are about 22 and 30°C, respectively.

Four cassava varieties were evaluated under a standard row spacing of one metre and within row spacing of 0.75, 1, 1.25 and 1.50 metres leading to plant populations of 13,333; 10,000, (control), 8,000 and 6,666 plants ha⁻¹ respectively. The four varieties were KME-08-04, KME-08-05, KME-08-02 and KME-08-06. The varieties were given the following respective local names: Shibe, Karemba, Tajirika and Nzalauka. The plant spacing of 1 x 1 m was used as a check. The experimental design was a split plot with cassava varieties assigned to main plots and plant spacing as sub-plots. The treatments were replicated three times.

Land preparation by tractor and planting by hand were carried out during the month of April each year. Stem cuttings of 20 cm long were planted at 45° angle in respective plots. Plots consisted of eight rows of cassava and the net plots comprised of six rows. The rows were six metres long. Weeding was carried out three times during the whole crop growth period of 12 months. Harvesting was done by uprooting the whole plant in all six rows of the net plot with the exclusion of the end plants in each row. Data was recorded for: number of plants harvested, number of roots per plant, total number of roots, number of marketable roots per plant and

marketable root yield per hectare was derived. Agronomic data was subjected to analysis of variance using the linear model:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \gamma_k + (\alpha\gamma)_{ik} + \epsilon_{ijk}$$

Where

$i = 1, \dots, a$ indexes the main plot levels

$j = 1, \dots, b$ indexes the blocks (replications)

$k = 1, \dots, r$ indexes the subplot levels

The variance associated with $(\alpha\beta)_{ij}$ (Error 1) is used to test the main plot effects.

The variance associated with ϵ_{ijk} (Error 2) is used to test the subplot and interaction effects.

The differences among treatment means were compared using Fischer's Protected LSD test at $P \leq 0.05$

Results and Discussion

The performance of the four cassava varieties under different plant spacing is summarised in tables 1 and 2. The data presented is for the combined three-year study period. There was no significant interaction between the variety and the plant spacing. Therefore, the main effects of the two factors are presented separately. Shibe variety recorded significantly ($P < 0.05$) higher number of roots per plant than the rest of the varieties (Table 1). However, no significant ($P < 0.05$) differences were observed among the rest of the varieties. The number of roots per plant is an important yield component in cassava since it has a bearing on the final yield (Silva *et al.*, 2013). Significant differences were also observed among the varieties as regards total number of roots per plant. Variety Shibe recorded significantly ($P < 0.05$) higher total number of roots than the rest of the varieties and Nzalauka showed significantly ($P < 0.05$) higher total number of roots than Tajirika but not Karembo. There were no significant differences observed among the varieties as regards marketable root yield per hectare (Table 1).

Table 1: Effect of cassava variety number of roots per plant, total number of roots per plot and fresh cassava yield per hectare

Cassava Variety	Parameters			
	Number of roots per plant	Total number of roots	Number of marketable roots per plant	Marketable root yield per hectare
SHIBE	12.3 ^a	324.9 ^a	4.6 ^a	29.8 ^a
NZALAUKA	9.7 ^b	253.0 ^b	3.2 ^a	23.8 ^a
TAJIRIKA	8.6 ^b	202.4 ^c	4.2 ^a	27.1 ^a
KAREMBO	8.3 ^b	221.4 ^{bc}	3.6 ^a	23.5 ^a
LSD	1.59	39.27	2.65	7.54

^{bc}Means followed by the same superscript are not significantly different ($P \leq 0.05$) within the column

Plant spacing significantly ($P < 0.05$) influenced the number of roots per plant, total number of roots but not marketable root yield (Table 2). This observation is in agreement with the findings of Silva *et al.* (2013) and is attributed to below and above ground competition between plants for light, water, nutrients, and space (Cahill, 2002). The number of roots per plant increased with increase in spacing or decrease in population. The spacing of 1.00 x 1.25 m and 1.00 x 1.50 m recorded significantly ($P < 0.05$) higher number of roots per plant than the control. This was expected because with lower planting densities, there is a surplus of production factors (water, nutrients, and light), and a tendency for increased yields of roots, stems, and leaves. As planting densities increase, competition for those factors increases and, beyond a certain density, which varies with the trait being evaluated, yield values decrease (Silva *et al.*, 2013).

There was no significant difference between the control and 1.00 x 0.75 m spacing as regards the number of roots per plant. The spacing of 1.00 x 1.50 m recorded significantly lower total number of roots per plant than the control. This is attributed to lower number of plants contributing to the total root number per plot. The spacing of 1 x 1.5 m revealed significantly ($P < 0.05$) higher marketable root per plant. This is contrary to the observation on total number of roots and is attributed to larger roots for wider spacing. There were no significant ($P < 0.05$) differences among various plant spacing as regards marketable root yield per hectare.

Table 2: Effect of plant spacing on number of roots per plant, total number of roots and marketable root yield.

Plant within row spacing	Parameters			
	Number of roots per plant	Total number of roots	Number of marketable roots per plant	Marketable root yield per hectare
0.75 m (13,000 plants)	8.2 ^b	280.8 ^a	2.6 ^b	24.9 ^a
1.00 m (10,000 plants)	9.0 ^b	256.6 ^a	3.4 ^b	23.4 ^a
1.25 m (8,000 plants)	10.7 ^a	253.8 ^a	3.5 ^b	30.0 ^a
1.50 m (6,666 plants)	10.8 ^a	210.6 ^b	4.9 ^a	25.9 ^a
LSD	1.59	39.27	1.26	7.54

^{abc}Means within a column followed by the same superscript are not significantly different ($P \leq 0.05$)

Conclusion

The current cassava planting spacing recommendation of 1 x 1m in pure stand is also applicable to the new cassava varieties.

Acknowledgement

The authors are grateful to the Director KARI for funding the work through Eastern Africa Agricultural productivity Project. We thank the Centre Director, KARI-Mtwapa for provision of facilities. Thanks to Dau Mwakina for trial management and data collection.

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Violet Tree Appropriate Technology Natural Botanical Pesticide for Eco-Friendly, Effective Pest Control for Enhanced Environmental Sustainability

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Abstract

The use of natural botanical pesticides has been prompted by the need to reduce and mitigate greenhouse gases that are brought about by chemical pesticides. Merits of natural botanical pesticides outweigh those attributable to chemical pesticides. Violet tree is newly emerging in promoting environmental sustainability through conservation agriculture, an eco-friendly appropriate technology which has greatly spurred increased agricultural production in Makueni County. This research adopted a descriptive survey design through desktop information analysis and field visits conducted by the researcher in collaboration with KEFRI, NEMA, Ministry of Agriculture and KFS officials. The target population was 165 small scale farmers growing horticultural crops, fruit crops that represented 55% and 135 cereal farmers that represented 45%. They were sensitized on environmental benefits of using Violet tree as a natural botanical pesticide for effective pest control in order to reduce emission of greenhouse gases that cause global warming and are carcinogenic. The key research objective was to identify the merits of natural botanical pesticides and their varieties, to sensitize local farmers on the environmental benefits of natural botanical pesticides and encouraging adoption of natural botanical pesticides to reduce emission of greenhouse gases in order to combat global warming. 55% of the respondents opined that natural botanical pesticides were eco-friendly in terms of reducing environmental pollution while 45% of them suggested that consultative policy forums should be held to sensitise local farmers on the use of natural botanical pesticides and conduct Environmental Impact Assessment and Audits. 20% of participants cautioned against introduction of alien species when using natural botanical pesticides while 80% respondents observed that natural botanical pesticides were cost effective. 50% of the NEMA officials recommended the use of

natural botanical pesticides as a mitigation measure that was necessary to deal with environmental degradation caused by pollution. 50% of the lead researchers observed that the use of natural botanical pesticides has improved food security.

Keywords: Botanical pesticide, appropriate technology, conservation agriculture, environmental sustainability, natural.

Introduction

Violet tree is an affordable, locally available way of doing organic farming, post-harvesting cereals preservation. Violet tree has multipurpose uses encapsulating, firewood, charcoal, live fencing, bee forage, ornamental aesthetics for landscaping, fibre production and edible cholesterol free natural vegetable oil extractable from its seeds. The discourse on the use of natural botanical pesticides for environmental sustainability is guided by sustainable development goals number 3, 6, 12, 15 and 17. Agricultural crops are under constant assault by insect pests, making insecticides essential to reduce losses. Consequently, synthetic insecticides such as organophosphates are important, effective tools in modern crop management.

When farmers used pesticides there was little understanding of how dangerous and long-lasting these chemicals are. It was only later that the degree to which these pesticides remain in the environment was discovered. Many plant species produce substances that protect them by killing or repelling the insects that feed on them.

In Kenya, the natural Violet tree botanical pesticide and pyrethrum are intensively cultivated pesticidal plants. Botanical pesticides are considered as one of the safest and the most environmentally friendly biopesticides which have substituted the highly toxic and harmful chemical pesticides.

Natural botanical pesticides are widely used for public sanitation such in mosquito and cockroach extermination in household care, in agricultural activities such as control and prevention of army worms, maize stalk borers, locusts and in industrial disinfestations in both developed countries and in Kenya.

Kenya is one of the world's main producers of botanical pesticides such as violet tree and pyrethrum these account for 70%-90% of the world's share. Its highest annual production volume was 18,000 tons and the global production of natural botanical pyrethrum pesticide in 2014 was 8,800 tons of this Kenya's production only accounted for 358 tons (Senju Development Kenya Limited, 2014).

Due to increasing public awareness of environmental protection, market demands

for environmentally friendly pesticides made of natural botanical violet tree and pyrethrum their production has exceeded 21,000 tons annually. The Kenya government has brought in external partners and experts to conduct further research on natural botanical pesticides and develop the natural botanical pesticides for sustainable environmental management and development.

A research survey conducted by Senju Development Kenya Limited (2014) specialising in scientific research of natural botanical revealed that more than 1,500 pesticides are registered in the world, and more than 300 of these are commonly used.

Table 1: The distribution of the pesticides in developed countries

Country	Year	Pesticide Usage (Tonnes)
USA	2007	275,000
France	2013	63,000
Spain	2013	45,000
Britain	2013	34,000
Italy	2013	54,000
Japan	2013	51,000

Source: Senju Development Kenya Limited (2014)

Literature Review

Growing public concern over potential health hazards of synthetic pesticides and also steep increase in cost of cultivation coupled with low profit making by farmers has led to the exploration of eco-friendly pest management tactics (Khater, 2012). The plant kingdom is recognized as the most efficient producer of chemical compounds, synthesizing many products that are used to defend plants against different pests (Isman & Akhtar, 2007). In fact, most biopesticides had the advantage of higher selectivity and non-target biological safety (Khater, 2012). The plant materials proved to be a good antifeedant, inhibiting the further growth of the larva. The topical treatments resulted in abnormal growth of the pest larva Usha Rani (2008). Isman (2006) reported the botanical insecticides, deterrents, and repellents as insect control agents. A study by Khalif (2007) explains that in indigenous knowledge in farming negative aspects of technology transfer and dissemination of information between indigenous farmers and extensionists were discussed by Salas (1994).

It has been noted that close engagement with farmers is essential and if indigenous farmers' knowledge is at stake then research intervention is crucial to learn more and document findings through practice Drinkwater (1994). Long and Villareal (1994) pointed out that farmers are a heterogeneous group and apply different techniques in solving farming problems depending on ecological, socio-cultural, market and economic conditions. Segura (2004) stated that studies on bioecology and management of insect pests have been conducted for decades, yet the rate of adoption of crop protection technology by small scale farmers is very low.

Norris (2003) has redefined the integrated pest management concept as follows: IPM has several interpretations, in the beginning it was used to describe the use of insecticides in a way that is compatible with the biological control of insects.

Norris (2003) explained the principle integrated pest management strategies used for managing pests, and classified them as follows: Prevention, which intends to prevent the arrival and establishment of pests in areas and on the crop that is not yet infested; Temporary alleviation, which employs specific control tactics and targets of localized pest outbreaks. This strategy requires cooperation of different people with different specializations such as experts of diseases and mobile insect pests; this strategy is not agreed among scientists; however, Perkins (1982) called it total pest management instead of eradication because of its deficiency in ecological foundation. Benbrook (1996) also defined integrated pest management as indicating the process for determining if pest management is needed to determine when the pest population level becomes intolerable and to know what level of action should be taken. Rappaport (1992) further explained integrated pest management as a strategy that prevents the increment of insect numbers to levels where quantity and quality of the crop are destroyed, and which develops protection mechanisms of the existing natural controls as well as the combination of cultural practices with carefully chosen sprays. Harris (1998) conducted survey in Kenya and Ghana and found that the use of chemical pesticides was extensive while the use of natural botanical pesticides was limited. But most farmers in the surveyed area (73% in Kenya and in 83% in northern Ghana) had some knowledge of natural botanical pesticides pest control strategy but the actual use of these alternatives was minimal.

Problem Statement

Tacio (2009) observed that, while modern agriculture produces high yields, more often than not, it is not sustainable. Expensive seeds and farm chemicals eat into

profit while pesticides upset the natural balance between predators and pests, and chemical poison groundwater and rivers. Chemical pesticides pose the following environmental hazards: they lower quality and safety of agricultural products; cause air, water, soil pollution and long-term damage to the ecosystem; threaten the health of humans and animals; they possess highly toxic organophosphorus pesticides; and contain heterocyclic and cephalosporins toxins. On the contrary, natural botanical pesticides have low residual effect and are biodegradable; they are highly efficient, broad spectrum and hard to create resistance for pests and are safe to humans and livestock.

There are up to 3 million acute unintentional chemical pesticide related illnesses and injuries annually and 200,000 deaths annually from unintentional chemical pesticide poisoning UNEP (2017). Environmental and health problems caused by chemicals have become an international concern. The use of chemical pesticides involves certain risks because of their poisonous character. Farmers and their members are most vulnerable to these risks. They can easily come into contact with the pesticides, for example, when mixing the chemicals to apply on crops.

Theoretical Framework and Conceptual Framework

Torres (2012) concluded that integration of natural enemies and pesticides for pest control farming was a core component of integrated pest management. Biological control of pests through the conservation of natural enemies in agricultural production relies on practices that simultaneously minimize the negative effects of agronomic practices especially the use of synthetic pesticides to control arthropod pests. They are considered the first biotic plant defense against herbivory, but the inclusion of biological control as part of integrated pest management programs is limited by the negative impact of broad spectrum pesticides.

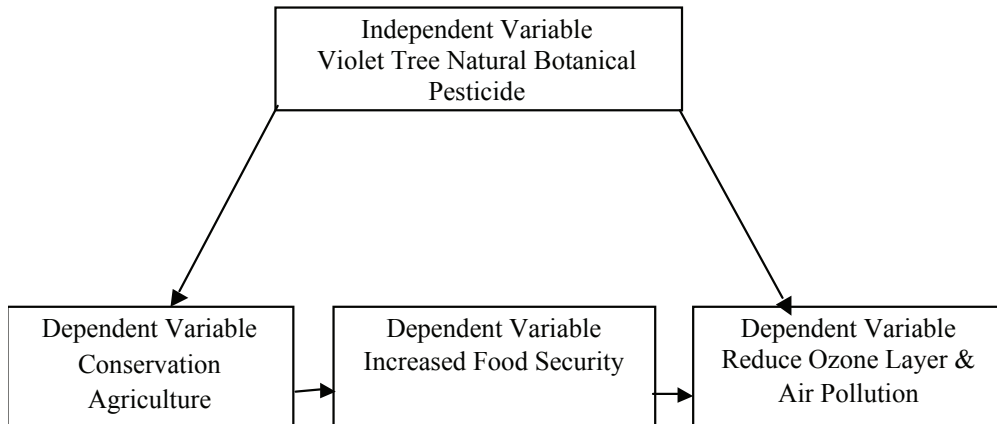


Figure 1: Conceptual Framework

Methods and Materials

The research objective was to sensitize local farmers in Makueni Sub-County on the environmental benefits of using Violet tree natural botanical pesticide for environmental sustainability to significantly reduce greenhouse gas emissions to combat global warming.

The research took place in Makueni sub-county which is located in Makueni County. This research adopted the descriptive survey design through desktop information analysis and field visits conducted by the researcher in collaboration with KEFRI, NEMA, Ministry of Agriculture and KFS officials as well as randomly administering 300 questionnaires to NEMA, KEFRI, Ministry of Agriculture, KFS officials and local farmers. The suitability of this research design for the study was that it enabled the research to determine and report the efficacy of using Violet tree botanical pesticide to enhance environmental sustainability. It also enabled the researcher to precisely measure and report the characteristics of the phenomena under investigation scientifically.

The target population target population was 165 small scale farmers growing horticultural crops, fruit crops that represented 55% and 135 cereal farmers that represented 45% and were sensitized on environmental benefits of using Violet tree as a natural botanical pesticide for effective pest control in order to reduce emission of greenhouse gases that cause global warming and are carcinogenic.

Table 2: Distribution of the target respondents

Agency	Number of Respondents	Management Level
NEMA	50	Senior Managers
KEFRI	50	Lead Researchers
Ministry of Agriculture	50	Field Officers
KFS	50	Policy Makers
Local farmers	100	Local farmers
TOTAL	300	

The sampling frame was obtained from NEMA, KEFRI, Ministry of Agriculture, KFS officials. Stratified random sampling was used to obtain 300 elements for the study. This is because the population comprised of different types of elements. Simple random sampling was used to select 10 elements from each stratum.

Results and Discussions

55% of the respondents opined that natural botanical pesticides were eco-friendly in terms of reducing environmental pollution while 45% of them suggested that consultative policy forums should be held to sensitise local farmers on the use of natural botanical pesticides and conduct Environmental Impact Assessment and Audits. 20% of participants cautioned against introduction of alien species when using natural botanical pesticides while 80% respondents observed that natural botanical pesticides were cost effective. 50% of the NEMA officials recommended the use of natural botanical pesticides as a mitigation measure that was necessary to deal with environmental degradation caused by pollution. 50% of the lead researchers observed that the use of natural botanical pesticides has improved food security.

Conclusions

Environmental sustainability is both a collective and individual responsibility. Therefore, innovative eco-friendly natural resource management solutions ought to be embraced to combat climate change through the use of natural botanical pesticides. Natural botanical pesticides are cost effective and are readily biodegradable, they are also eco-friendly and are therefore best for use to enhance organic farming since they are not harmful to human health and animals or marine life in Kenya & globally. Botanical pesticides are considered as one of the safest and the most environmentally friendly biopesticides which have substituted the highly

toxic and harmful chemical pesticides. In addition, it is always very crucial that close engagement with farmers is essential and if indigenous farmers' knowledge is at stake then research intervention is crucial to learn more and document findings through practice. This has greatly enabled farmers to embrace integrated pest management, biological pest control, conservation agriculture as well as natural botanical pesticides for environmental sustainability. Food security is a key concern as part of the Big 4 agenda in Kenya. Being cognizant of the above facts has enabled to adopt smart farming through use of safe natural botanical pesticides to increase food crop yields.

Merits of natural botanical pesticides outweighed those attributable to chemical pesticides. Violet tree is a newly emerging thing in promoting environmental sustainability through conservation agriculture an eco-friendly appropriate technology which has greatly spurred increased agricultural production. Moreover, natural botanical pesticides such as the Violet tree and pyrethrum have contributed to green economy by helping to reduce ozone depleting substances. The discourse on the use of natural botanical pesticides for environmental sustainability is guided by sustainable development goals number 3, 6, 12, 15 and 17 as well as the multipurpose uses of Violet tree extracts. It is an affordable, locally available way of doing organic farming, post-harvesting cereals preservation. Violet tree has multipurpose uses encapsulating, firewood, charcoal, live fencing, bee forage, ornamental aesthetics for landscaping, fibre production and edible cholesterol free natural vegetable oil extractable from its seeds.

Chemical pesticides pose the following environmental hazards: they lower quality and safety of agricultural products; cause air, water, soil pollution and long-term damage to the ecosystem; threaten the health of humans and animals; they possess highly toxic organophosphorus pesticides; and contain heterocyclic and cephalosporins toxins. On the contrary, natural botanical pesticides have low residual effect and are biodegradable; they are highly efficient, broad spectrum and hard to create resistance for pests and are safe to humans and livestock. Farmers and their members are most vulnerable to these risks. They can easily come into contact with the pesticides, for example, when mixing the chemicals to apply on crops.

Natural botanical pesticides are widely used for public sanitation and health such in mosquito and cockroach extermination in household care, in agricultural activities such as control & prevention of army worms, maize stalk borers, locusts and in industrial disinfestations in both developed countries and in Kenya. Due

to increasing public awareness of environmental protection, market demands for environmentally friendly pesticides made of natural botanical violet tree and pyrethrum. Growing public concern over potential health hazards of synthetic pesticides and also steep increase in cost of cultivation coupled with low profit making by farmers has led to the exploration of eco-friendly pest management tactics.

Farmers have full embraced practical strategies which include but not limited to integrated pest management strategies used for managing pests, and classified them as follows: prevention, which intends to prevent the arrival and establishment of pests in areas and on the crop that is not yet infested such as in fall army worm infestations, locusts, maize stalk borers and weevils. Temporary alleviation, where farmers have practically employed specific control tactics and targets of localized pest outbreaks. This strategy requires cooperation of different people with different specializations such as experts of diseases and mobile insect pests such as Agrovet personnel, botanists and entomologists. Integration of the use of natural botanical pesticides with community based natural resource management has substantially and significantly enhanced environmental sustainability and in turn this has led to proliferation of food crop yields in rural Kenya eliminating hunger locally.

In addition, farmers applied biological control of pests through the conservation of natural enemies in conservation agriculture and production that relied on practices that simultaneously minimized the negative effects of agronomic practices especially the use of synthetic pesticides to control arthropod pests.

Recommendations

- It is important to integrate the use of natural botanical pesticides with community based natural resource management to enhance environmental sustainability.
- All technical institutes should conduct further research on natural botanical pesticides to build the capacities of all technical institutions to enhance environmental sustainability through cost effective ways of conservation agriculture.
- All technical institutes should formulate policies for the use of natural botanical pesticides to focus on harnessing regional and global partnerships to provide a robust platform monitoring and evaluation the positive effects of organic farming on natural resource management.

- All technical institutes should partner with the Ministry of Environment and work towards inculcating values and skills in natural resource management to awaken people's environmental awareness and consciousness for environmental sustainability.
- There should be collaborative efforts between the Ministry of Environment and the stakeholders to sensitise the citizenry on the use of natural botanical pesticides for farming.
- All Kenyan TVET institutions should always endeavour to proffer creative solutions to local farmers to help embrace use of natural botanical pesticides and shun chemical pesticides.

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Section Four:
FOOD SECURITY AND
SAFETY

In vivo anti-plasmodial activity and toxicity of crude plant extracts from Kenya, against *Plasmodium berghei* in BALB/c mice

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Abstract

Communities in the developing world use herbal medicines to treat various infectious diseases. In malaria endemic areas communities treat fevers by use of popular plants such as *Warbugia ugandensis*, and *Ajuga remota*. Unfortunately, scientific analysis to confirm anti-malarial potential and toxicity of the phytomedicines is lacking. The study evaluated toxicity and anti-plasmodial activity of *Rubia cordifolia*, *Harrizonia abyssinica*, *Leucas calistochys* Olive and *Sanchus schwein furthii* L. The study assessed parasitaemia suppression, behaviour change and mortality of *Plasmodium berghei* infected BALB/c mice treated with herbal extracts. Approximately 1×10^5 - 1×10^6 parasitized erythrocytes with *Plasmodium berghei*, were inoculated into seven week old naïve BALB/c mice. On the fourth day, mice were treated with four plant extracts *S. Schwein furthii*, *R. cordifolia*, *H. abyssinica*, and *L. calistochys* dispensed in three concentrations; 25mg/kg, 50mg/kg, and 100mg/kg twice daily for 4 days using four-day suppressive test to determine the percent inhibition of parasitaemia and mortality. Extracts of *R. Cordifolia* and *S. Schwein furthii* had higher anti-plasmodial activity against *P. Berghei* parasites with values of 82.4 % ($P = 0.001$) and 78.6% ($p = 0.003$). Treated mice with the above extracts survived up to day 15 just as the controls. The percentage parasitaemia reduction in mice treated with extracts of *H. Abyssinica* and *L. calistochys* also showed values of 65.1% ($P = 0.011$) and 59.1% ($P = 0.04$) respectively. Aqueous extracts of *R. cordifolia*, and *S. Schwein furthii* had higher parasite suppressive effects on *P. berghei* LD₅₀ doses of <10mg/kg were observed. *H. Abyssinica* and *L. calistochys* had moderate parasite suppressive effects with LD₅₀ doses ranging between 10mg/kg and 100mg/kg. The aqueous extracts of *R. cordifolia*, and *S. Schwein furthii* were more efficacious with highest parasitaemia suppression

on *Plasmodium berghei* infected BALB/c mice in low LD50 doses of <10mg/kg/day.

Keywords: Toxicity, herbal extracts, Suppression, Plasmodium, Malaria, Herbal Medicine

Introduction

The most impressive developments in the history of medicine is the emergence of the Peruvian (Cinchona) bark (Rubiaceae) coupled with its pharmacologically active substance, - the quinine. Quinine is a classic anti-malarial drug found in the bark of a tree that is native to South America (WHO, 2004; Coleman *et al.*, 2004). Drug resistance developed against chloroquine leading to policy shift replacing with it sulfadoxine/pyrimethamine. Introduction of ACT treatment brought relieve that did not last long as resistance to Artemisinin based drugs has been reported in South East Asia. This serious situation necessitates rapid and radical search for new anti-malarials.

Although over 80% of the African population uses traditional medicines in the management of diseases including malaria, there is lack of scientific validation to confirm anti-malarial potential of used herbal medicines. This study was conducted to evaluate the toxicity, *in vivo* anti-plasmodial activity of extracts, parasitaemia suppression, mortality and behaviour change in infected BALB/c treated with crude plant extracts. In the study BALB/c mice were used to assess toxicity of *R. cordifolia*, *H. abyssinica*, *L. calistochys* and *S. schwein furthii*.

Materials and Methods

Crude herbs used for *in vivo* testing

Four medicinal plants, *R. cordifolia*, *H. abyssinica*, *L. calistochys* and *S. schwein furthii* were found to possess anti- plasmodial activity during *in vitro* studies were processed for *in vivo* testing in BALB/c mice.

Plasmodium berghei cultures in BALB/c mice

Plasmodium berghei (ANKA) used was obtained from Institute of Primate Research IPR), Karen, Kenya. Laboratory bred 7-week old naive male and female BALB/c mice with an average weight of 25grams were used to propagate and maintain the parasites. 120 (One Hundred and Twenty) mice were maintained in an animal care facility at the IPR, Karen.

Toxicity tissue processing for histo-cytopathological studies

Thirty-six laboratory-bred naïve male and female BALB/c mice, seven weeks old with average weight of 26.5 grams, were randomly picked and grouped into 6 cages of four mice each cage and were labelled for easy identification. In each cage the four mice, were each treated with different concentration of herbal extract for dose levels (1000 mg/kg, 500 mg/kg and 200 mg/kg, 100 mg/kg), of four extracts namely, *R. cordifolia*, *H. abyssinica*, *L. calistochys* Oliv. and *S. schwein furthii*. One group was not treated (positive control) and another group was treated with *Artemisia annua* herbal extracts (Negative control). The treatment procedure was effected by inoculating 0.2ml of the extract suspension from insulin-syringe (gauge 27) into a mouse and was repeated with doses of 100 mg/kg, 200 mg/kg and 500 mg/kg and 1000 mg/kg intra-peritoneally for four extracts but the positive control group was injected with water. Mice were observed for 14 days for physical appearance, appetite, fur texture; weight loss, behavioural change, and death. After 14 days the remaining mice were sacrificed and their tissues including; brains, livers, spleens and kidneys carefully dissected out, harvested and fixed in bouin's liquid, embedded in paraffin wax and cut into 3 to 5µm thick sections and then stained with safranin.

In vivo parasite assays of aqueous and methanol herbal extract of *S. schwein furthii*, *R. cordifolia*, *H. abyssinica* and *L. calistochys* Olive.

Thirty experimental naïve BALB/c mice, seven week-old males and females weighing an average of 26.5grammes were inoculated intra-venously through the tail with approximately between 1×10^5 - 1×10^6 parasitized erythrocytes in volumes of 0.2 ml inoculums. Mice were randomly picked and grouped into 6 cages of four mice each and labelled for easy identification. On the third day, parasitaemia levels were determined using the Giemsa stain method which ranged between 1.2-5.3%. Four-day suppressive test method described by Peters *et al.* (1974), a standard test commonly used for anti-malarial screening, and the determination of percent inhibition of parasitaemia and mortality. Four groups of mice were treated with four concentrations of the four herbal extracts at a dosage of 0.5mls of four different concentrations (100mg/kg, 50mg/kg and *Sanchus schwein*, 25mg/kg, and 0mg/kg body weight) once daily for four days. The fifth group received standard anti-malarial (*Artemisia annua*) as (positive control) while the sixth group received physiological saline (Negative control). During post-treatment with plants extracts, clinical parameters such as weight, daily behaviour and parasitaemia were monitored for 14 days.

Findings

Table 1: Mortality and exhibited behaviour of BALB/c mice treated with aqueous extracts

Herbal extracts (Drug) LD ₅₀ extract	Mortality (n/N)* 100	Exhibited Behaviour change
<i>Rubia cordifolia</i>	0/4	No sign of abnormal
<i>Harrizonia abyssinica</i>	2/4	Oliguria
<i>Leucas calistochys</i> Olive	4/4	Oliguria, weight fluffly fur, anaemia,
<i>Sanchus schwein furthii</i>	0/4	Fluffy fur.
<i>Artemisia annua</i> L.	0/4	Normal behaviour.
Control (Negative)	4/4	Fever, agility, fluffly fur, weight loss.

*Mortality is defined as n/N , where n is the number of dead mice and N is number of mice in each group

Table 2. Mean parasitaemia suppression in *P. berghei* infected BALB/c mice due to crude extracts

Herbal extracts LD ₅₀	Dosage tested mg/kg/day	Final Parasitaemia (%)	Suppression (%)
<i>Leucas calistochys</i> Olive	100	4.07	29.83
<i>Sanchus schwein furthii</i>	100	2.31	60.15
<i>Rubia cordifolia</i>	100	4.07	29.83
<i>Harrizonia abyssinica</i>	100	3.02	47.93
<i>Artemisia annua</i> L	100	0.64	88.97
Control (Negative)	0	4.88	0

*Mortality is defined as n/N , where n is the number of dead mice

N is the number of mice in each group (4). LD₅₀ Dose inhibiting 50% growth of parasites. Parasitaemia suppression was calculated as:

$$S = 100[(A-B)/A]$$

S = Suppression A = Mean Parasitaemia in Negative control

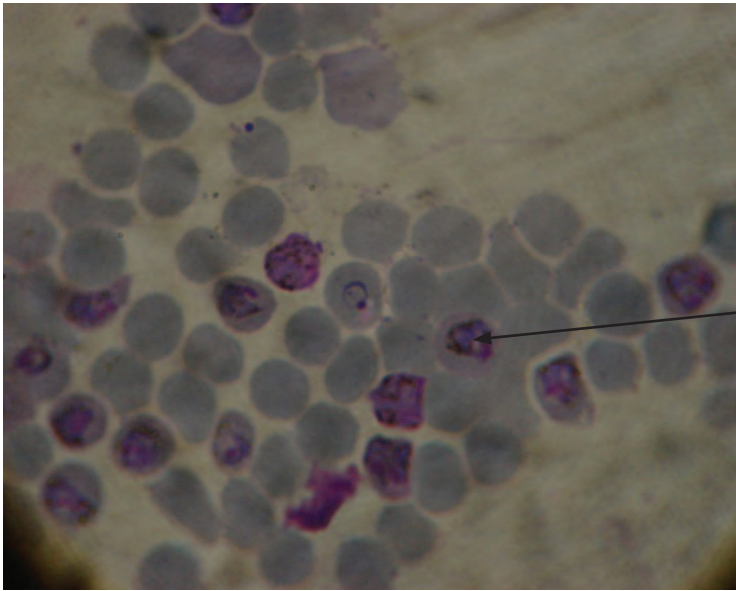
B = Parasitaemia in the test group

Mortality and exhibited behaviour of BALB/c mice treated with aqueous extracts

Results showed mice inoculated with 1000mg/kg and 500mg/kg body weight of the extract did not survive beyond 24 hrs. The animal's behaviour changed shivered, developed bulged eyes, raised fur and lost appetite. By day 7 all mice administered with 500mg/kg body weight of crude extract had died except for those inoculated with *L. calistochys*. 50%, (2/4) of the animals survived by day seven and continued till day 14. At the end of the experiment only negative control animals were surviving at 1000mg/kg body weight.

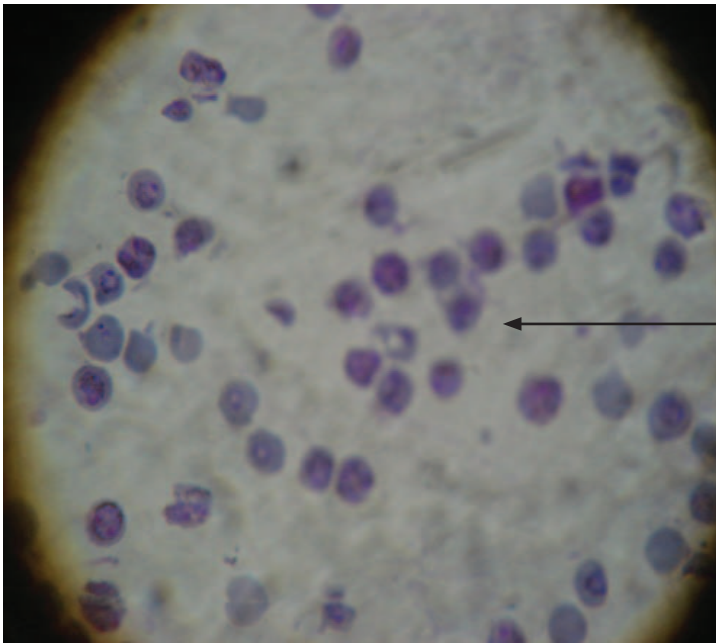
Suppression and mortality of Plasmodium berghei infected BALB/c mice treated with aqueous extracts

Table 2 shows the mean parasitaemia and percentage suppression for *P. berghei* in therapeutic regimen of the four plant extracts. Extracts of *S. Schwein furthii* displayed highest parasitaemia suppression at 2.31% which corresponded to 60.17% and all the mice survived up to day 14 just as the positive control. There was significant difference in anti-plasmodial activity of *S. Schwein furthii* extracts ($P = 0.003$). Aqueous extracts of *H. abyssinica* displayed 47.93% inhibition over the same period of time. Suppressive activity of *R. cordifolia*, and *L. calistochys* were similar at 29.83%. Analysis of results of dosage 100mg/kg/day showed that *R. cordifolia* and *S. Schwein furthii* had higher percentage parasitaemia suppression with values of 82.4 % ($P = 0.001$) and 78.6% ($p = 0.003$). Suppression with extracts *H. Abyssinica* and *L. calistochys* showed values of 65.1% ($P = 0.011$) and 59.1% ($P = 0.04$) respectively. Aqueous extracts of *R. cordifolia*, and *S. Schwein furthii* with LD50doses of <10mg/kg showed a significant difference on parasitaemia suppression as compared to *H. Abyssinica* and *L. calistochys* treatment with four concentrations of *S. Schwein furthii* herbal extracts. Plate's 1.1a to 1.4b shows comparative slides derive from tissues of an infected mouse before and after treatment with four concentrations of *S. schwein furthii* herbal extract



Blood from infected mouse showing heavy parasitaemia

Plate1.1a. parasitized red blood cells (reticulocytes) from BALB/c mouse infected with *Plasmodium berghei*.



Blood from infected mouse showing low parasitaemia

Plate 1.1b. Reticulocytes of BALB/c mice infected with *Plasmodium berghei* on treatment with *S. schweini furthii* extract.

Mortality rate of mice after treatment with aqueous crude extracts

Table 1 shows that 75% mortality by day 4 post-treatment while 100% of mice treated with *L. calistochys* extracts survived until day seven post -treatment. Mice treated with *L. calistochys*, extracts 100% survived until day seven post -treatment, 25%, day eight. 100% mice treated with *S. Schweini furthii* extracts survived until day six post -treatment and only 25% to day nine post-treatment. 100% of mice treated with extracts from *H. abyssinica* survived until day three post -treatment, 75% survived to day five post-treatment and 25% till day eight. *H. abyssinica*, was least protective herb since only 25% of the animals were surviving by day 5 post treatment as compared to 100% percent of mice treated with herbal extracts from *S. Schweini furthii* and *L. calistochys* survived by day 6 post treatment. All mice (100%) treated with *S. Schweini furthii* survived by day 7 post treatment and 25% survived until the end of the experiment in day nine (9). This suggests that *S. Schweini furthii* was the most protective medicinal plant of the four experimental herbs.

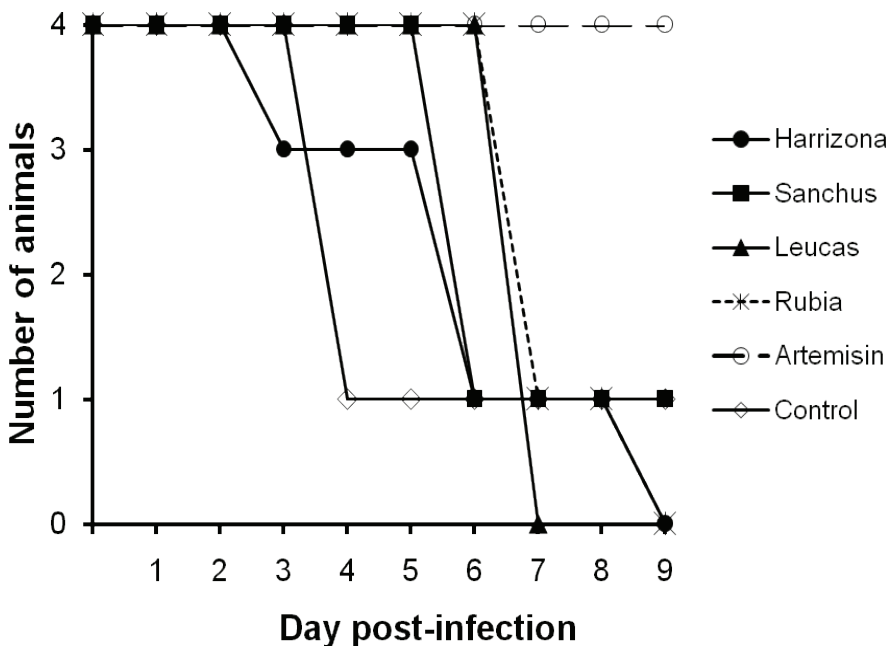


Figure 1 Mean mortality curve of *Plasmodium berghei* ANKA infected mice in chemotherapeutic regimen with plant extracts.

Plates from histo-cytopathological tissues from *P. berghei* infected BALB/c mice treated of herbal extracts of *L. calostachys*.

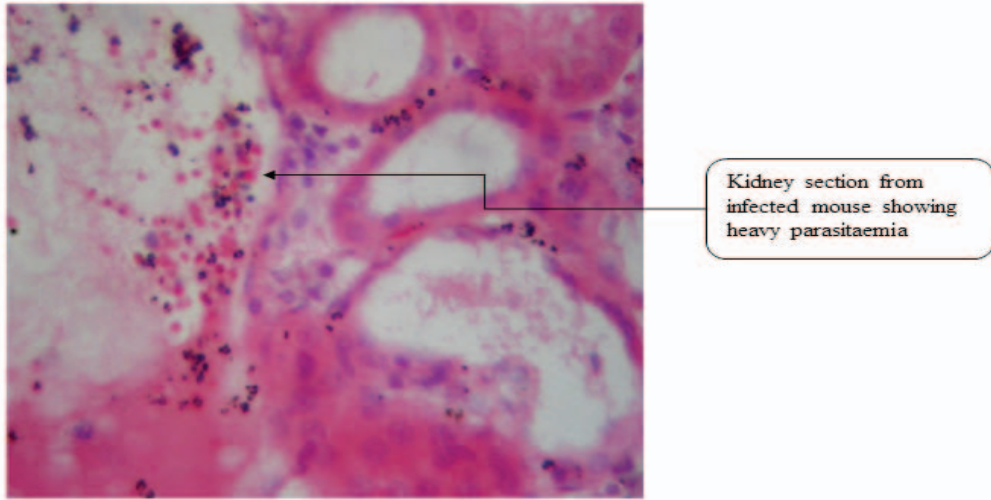


Plate 1.2a. Cyto-histopathological sections of kidney infected with *Plasmodium berghei* showing high parasitemia

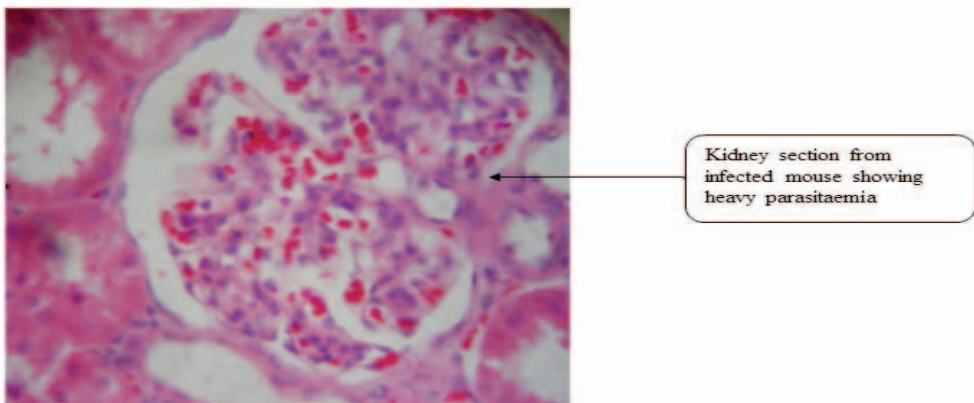


Plate 1.2a. Cyto-histopathological sections of kidney infected with *Plasmodium berghei* showing high parasitemia

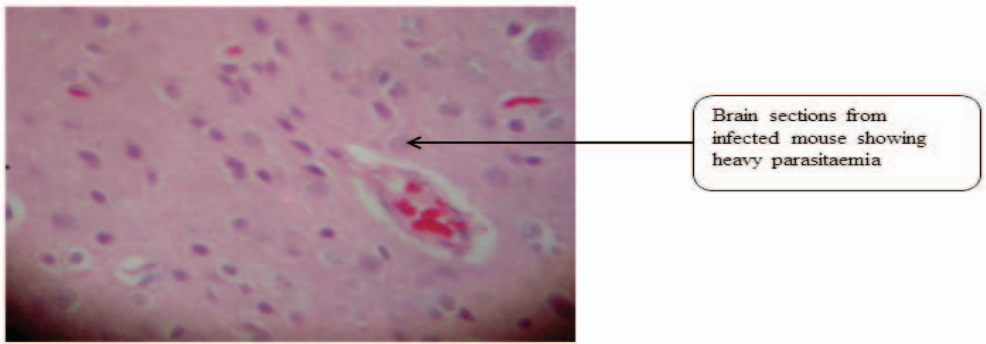


Plate 1.3a Cyto-histopathological section of brain tissue showing heavy parasites of *P. berghei*

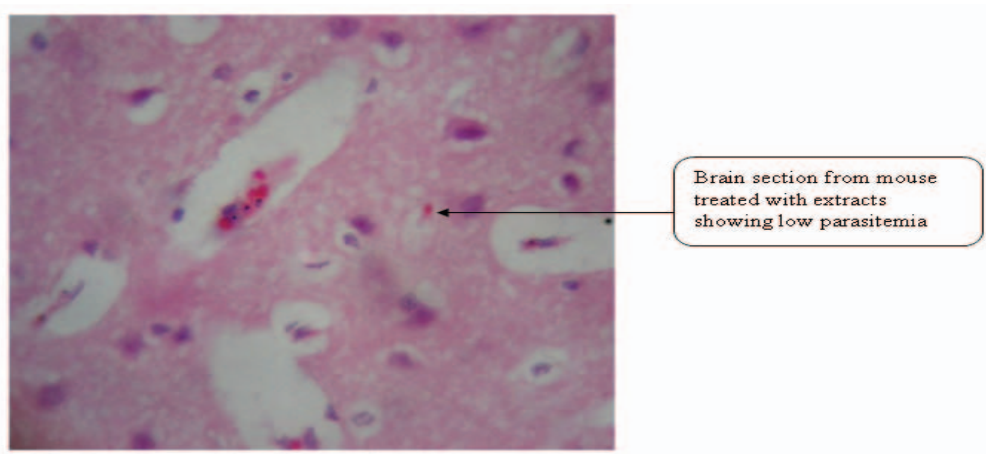
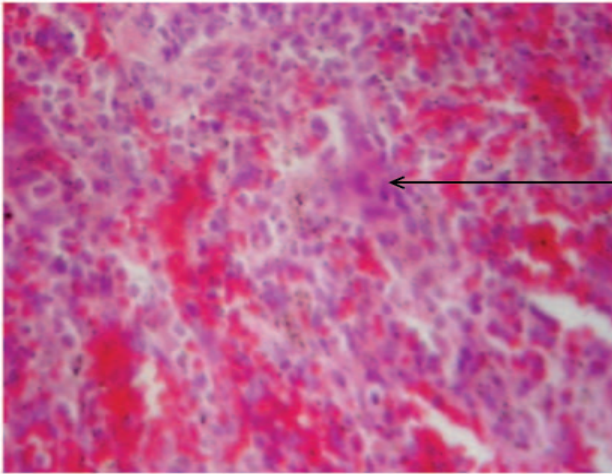
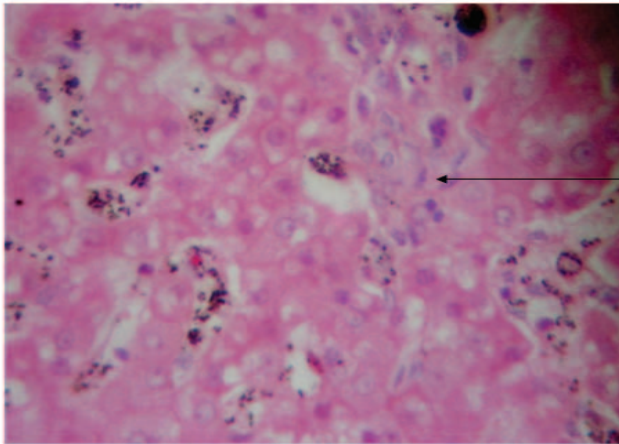


Plate 1.3b Cyto-histopathological section of brain tissue from mice treated with *S. Schwein furthii* showing reduced parasitemia



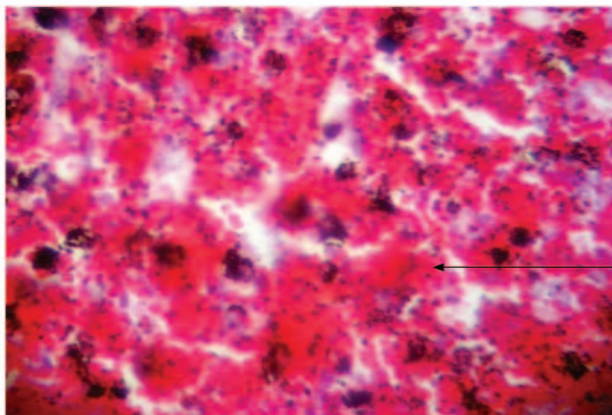
Spleen sections from infected mouse heavy parasitaemia tissue

Plate 1.4a Cyto-histopathological section of spleen infected mice showing heavy parasite of *P. berghei*.



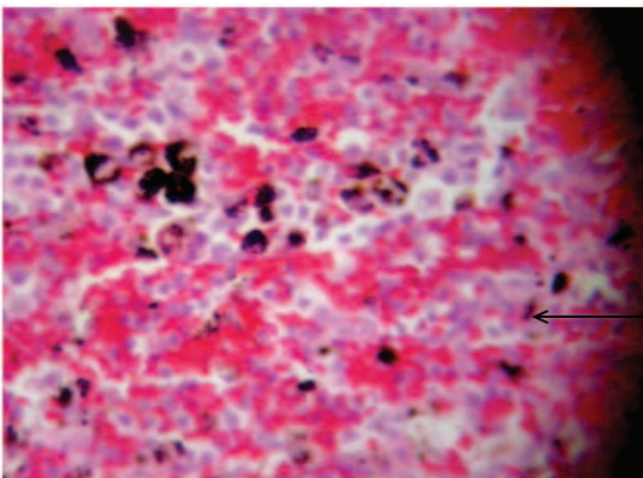
Spleen section from mouse treated with extracts showing low parasitemia

Plate 1.4b Cyto-histopathological section of spleen from mice treated with *S. schweini* showing reduced parasitaemia.



Liver sections from infected mouse showing heavy parasitemia

Plate 1.5a Section of liver from infected mice showing heavy parasite of *P. Berghei*



Liver section from mice treated with extracts

Plate 1.5b Cyto-histopathological section of liver from mice treated with *S. schwein furthii* showing reduced parasitemia

Discussions

In vivo anti-plasmodial activity and parasite inhibition of herbal medicines

Results on Table 1 shows that *P. Berghei* infected mice treated with the extracts of *R. cordifolia*, *H. abyssinica*, *L. calistachys* and *S. schwein furthii*, had parasitaemia significant change from those in the control animals. Mice treated with extracts

had longer survival correspondent with significant suppression in mice either on day 4 or 7 post infection, whereas all mice of untreated control died between days 4-10. 100% of mice treated with *R. cordifolia* and *S. schwein furthii* and 50% of mice treated with *H. abyssinica* and *L. calistochys* extracts survived up to day 15 and 21 far beyond the survival of the controls. The lethal dose (LD_{50}) of the test substances is three times more than the minimum effective dose (MED), the substance is considered a good candidate for further research.

Despite widespread use of the herbs in various herbal remedies, the toxicity of the remedies to humans has not been documented. Intra-peritoneal administration of high dosages on BALB/c mice, produced multiple organ toxicities including the kidneys, liver, lungs and brain. Results obtained by Muthaura, 2007 on safety and toxicity of herbal extracts indicate that some herbs which showed a high anti-plasmodial activity also indicated toxicity in high doses. This is the trend shown by the four herbal extracts tested for toxicity using BALB/c mice in this study. Aqueous extracts were more active *in vivo* with BALB/c mice and these findings are in agreement with those obtained by (Oketch – Rabah, 2003; Muthaura *et al.*, (2007).

Toxicity and mortality of experimental mice treated with extracts

The results on mortality Figure 1 demonstrate that tissue toxicity of ethno-medicines. Mice treated with extracts *S. schwein furthii*, *R. cordifolia*, and *L. calistochys* Olive, 100mg/kg body weight survived until day five post –treatment. Mice treated with *S. schwein furthii* 100% survived by day seven post treatment and 25% survived until the end of the experiment in day nine. Estimation of LD_{50} gave a value of 10 mg/kg in mice. The study demonstrated that there was no tissue toxicity of ethno-medicines in mice when consumed in low quantities of less than 100mg/kg body weight however signs of toxicity were observed when consumed in large quantities of over 100mg/kg body weight. Toxicity studies conducted using herbs like *Croton mubango* and *Nauclea po beguinii* in Democratic Republic of Congo (Mesia *et. al.*, 2005) have shown similar outcomes. The LD_{50} of the extracts in conjunction with photo-micrographs of histo-pathological stained tissues gave a good picture of the toxic characteristics of the four herbal plants. This is of immense importance; in view of the large scale consumption of ethno-medicines for treatment of malaria should be a matter of concern.

Mortality and exhibited behaviour of BALB/c mice treated with aqueous extracts of *S. Schwein furthii*, *R. cordifolia*, *H. abyssinica*, and *L. calistochys* Olive

Results indicate that mice inoculated with 1000mg/kg body weight of the extract did not survive beyond 24 hours. The animals shivered, developed bulged eyes, raised fur and lost appetite. By day 7 all mice administered with 500mg/kg body weight of crude extract had died except for those treated with *L. calistochys*. Half (50%) of the animals administered with *L. calistochys* survived by day seven and some survived till day 14. All the animals administered with 200 and 100 mg/kg body weight survived until day 7. On day 14 only control animals and those administered with *A. annua* and *R. cordifolia*, showed normal behaviour. Mice administered with 200 and 100 mg/kg of survived at 25% and 50% respectively exhibited oliguria (Table 1). This results show that *L. calistochys* was the least toxic while *S. Schwein furthii*, and *R. Cordifolia* were the most toxic having killed all the mice at 100mg/kg body weight.

Conclusion and Recommendation

Considering the potential toxicity of crude herbal extracts practitioners should be educated on this important finding especially when they recommend usage of herbs as part of a complex regime. Tissue toxicity of ethno-medicines is likely to occur in human beings who use large quantities for prolonged time therefore medicines be consumed with caution. Research should be conducted to isolate the specific components of the plant responsible for the toxicity in order to standardize the plant preparation for therapeutic benefit. All herbs used for treatment and chemoprophylaxis should undergo toxicity testing

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Micronutrient Deficiencies among Young Children: A Review Paper on the Effectiveness of the Home Grown School Meals (HGSM) Programme in Kenya

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Abstract

Micronutrient deficiencies, particularly iron and Vitamin A, are unacceptably high among young children in Kenya. About 76% and 74% of pre-school children are deficient in Vitamin A and iron, respectively. This affects cognitive development, lowers school performance, limits adult productivity, reduces immunity and eventually contributes to high burden of infant and child morbidity and mortality. The major factors contributing to high malnutrition in Kenya include increasing food insecurity, as a result of recurrent droughts and rising food prices; poor dietary diversity and poor access to fortified foods; inadequate quantities of food; diseases and other underlying factors like poor hygiene, childcare and feeding practices, and low access to nutrition knowledge and services. There is also widespread promotion and use of inappropriately constituted cereal and legume mixes. In order to adequately realize children's right to basic nutrition, as entrenched in the constitution of Kenya, acceleration of nutrition interventions is necessary. The HGSM programme targets primary and pre-primary school children enrolled in schools located in semi-arid areas, food insecure areas, as well as areas with low education indicators and high levels of malnutrition. This review article will provide an overview of the HGSM programme scenario in the food security sector, the problem, micronutrient deficiencies, strategies/methods of implementation, effectiveness of the HGSM and recommendations.

Keywords: Micronutrient Deficiencies, Food Security, Home Grown School Meals.

Introduction

Micronutrient deficiencies particularly iron and Vitamin A are unacceptably high among young children in Kenya; about 76% and 74% of pre-school children are deficient in Vitamin A and iron, respectively (Lesly *et al.*, 2016). Many households cannot afford an adequate diet and nutrient-dense foods for young children are not readily available. These factors are compounded by inappropriate feeding and childcare practices and a high disease burden. Nationally, an estimated 26% of children are classified as chronically undernourished (KDHS 2014).

Micronutrient malnutrition or “hidden hunger” is common in populations that consume poor-quality diets that lack in diversity as their habitual diet is often lacking these nutrients (Shetty, 2011). Diets deficient in micronutrients are relatively high in intakes of staple food and cereal crops, but low in consumption of foods rich in bioavailable micronutrients such as animal and marine products, fruits, and vegetables. Globally, micronutrient deficiencies affect close to two billion people with vitamin A, iron, iodine, and zinc, commonly being referred to as micronutrients of public health significance (Black *et al.*, 2008). According to the national micronutrient survey carried out in Kenya in 2011, Vitamin A deficiency (VAD) and Iron Deficiency Anemia (IDA) were found to be highest in preschool children while Zinc deficiency was found to be on the rise among the under-fives with a prevalence of 80.4% (KNMS, 2011)

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. This requires a nutritionally diverse diet (GOK, 2011). According to a humanitarian report done by UNICEF (2017), 2.7 million People in Kenya are food insecure, 1.1 million being Children. Access to food is an on-going issue. The Economic Review of Agriculture (2011) indicates that 51% of the population lacks access to adequate food. In fact, in some regions per-capita food availability has dropped by 10 percent over the last three decades (WFP, 2013). Cost of Food inflation averaged 11 percent annually from 2010–2014, with peaks of up to 26 percent. Food availability in the arid areas is constrained by poor roads and long distances to markets, whilst communal conflict exacerbates food insecurity. Food poverty ranges between 60 percent and 90 percent, and households headed by women are the most vulnerable (MOEST, 2015).

The Government of Kenya is committed to improving the livelihood of its citizens as demonstrated by policy and legislative steps undertaken. The Kenya Constitution

(2010), Chapter 4, which expressly guarantees all Kenyans their economic, social and cultural rights including basic rights to health, education, food and decent livelihoods. The Vision 2030 aims to transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by the year 2030. Under its economic and social pillars, the Vision 2030 further emphasizes the enhancement of productivity of crops and livestock, incomes, and food security and nutrition. This therefore led to the introduction of school feeding programs by the government.

National Policies on Nutrition

Government policies on nutrition provide a roadmap for the implementation of school meals in Kenya. These are based on the fact that the government of Kenya is committed to ensuring school children are well nourished, healthy and are able to learn. These policies include:

- a) The food and nutrition security policy (2011) where the government recognizes that school meals contribute to reduced hunger, which helps children to concentrate on their studies. School meals are also recognized in the same section as a tool to address specific micronutrient deficiencies in school age children, particularly iodine and iron, which directly affect cognition and can affect school performance.
- b) The national nutrition action plan (2012-2017) further establishes as its 7th strategic objective as to “promote appropriate nutrition for school children and adolescents”;
- c) The national school health policy (2009, under revision), developed jointly by moest and ministry of health, recommends the provision of balanced school meals in all Kenyan schools.

School Meal Strategy

School feeding programs have been implemented in Kenya since the 1980's with varying degrees of success. They are primarily used to increase the enrolment and retention of rural children in school (Langinger, 2011). Subsidized meal programs have played an integral part in realizing the country's goal of universal primary education (UNESCO, 2005). In an effort to transition toward a more sustainable and nationally integrated alternative, the Kenyan government introduced the Homegrown School Feeding Program (HGSFP) in 2009 whose approach is aimed at prioritizing direct purchase from local smallholder farmers, embedding schools meals planning with health and nutrition education, and ensuring that school

meals are both nutrition-sensitive and culture-sensitive, thus respecting dietary habits whilst providing adequate intake of macro and micronutrients for all school children. Under the HGSM, the government disburses funds directly to schools and provides valuable guidelines on key aspects such as the nutritional composition of food baskets, adequate procurement processes and monitoring and evaluation (Langinger, 2011).

In the HGSM programme, children receive a midday hot meal, which is prepared from food commodities procured with funds provided by the Ministry of Education. The typical daily ration per child consists of 150 grams of cereal, 40 grams of pulses, and 5 grams of oil and 2 grams of salt. This strategy emphasizes provision of hot meals for the schoolchildren. It sets requirements for a standard school meal to meet one third of the macro and micronutrient needs of school children. It also promotes the link between health and nutrition education for school age children to make nutritious informed food choices through their lifecycle (SNMS, 2016)

Effectiveness of the HGSM

The Home-Grown School Meals Programme has proved to be efficient despite diverse challenges in the implementation. The decentralized option of direct cash transfer to schools, based on the number of pupils enrolled at each school, has been able to feed children in different regions and enabled the government to strengthen efficiency, accountability and implementation, increasing local ownership. In general, the benefits of School Feeding Programme are far reaching. Evidence shows that school feeding programmes increase children's educational achievement so as to improve their potential future productivity and earnings, alleviate short term hunger which improves children's cognitive functioning and attention span, improves nutritional status of children by providing them calories and nutrients in addition to their regular diet, enhance enrolment in school and better educational outcome (Alderman *et al.*, 2006).

However, in some instances the programme has not been very effective. A study conducted to test the efficacy of the HGSP in Kinango Sub-county of Kwale County in Kenya, shows that the programme has not achieved its objectives. Food security has not improved among the community members. The locals still depend on rain fed agriculture and poor farming techniques leading to low harvests. The local hardly harvest enough to last them the whole year hence they have to rely on food aid from organizations like Red Cross, World Vision, and Government relief among other food donor agencies (Karisa & Orodho, 2014).

Another study by (Weru, 2011) in Kathonzi, Makueni County revealed the biggest challenge facing implementation was the rising food costs and drought. This study shows that there is a positive impact on both access to education and retention of pupils in school due to the increasing enrolment of pupils over the years in schools with HGSMP as opposed to those schools without. They also registered fewer dropouts. It also emerged that the main cause of dropouts was hunger which when addressed by the HGSMP checked the dropout rates. Although the issue of immediate hunger was addressed, “hidden hunger” is still a major concern because the HGSMP provides a diet that lacks in vegetables and fruits to supply the necessary vitamins and minerals and therefore not meeting the micronutrient requirements.

Conclusion

The government of Kenya recognizes that School Nutrition and Meals is a strong tool to increase nutritional intake, meet and promote healthy eating habits and value local cultures and ingredients. Malnutrition in childhood affects school enrolment, retention and overall performance and may even constrain the thorough development of children’s potentials. Good nutrition is therefore essential to realize the learning potential of children and to maximize returns to educational investments. Poor diet is a common source of “hidden hunger”. Diets based mostly on staple crops, such as maize, wheat, rice, and cassava, which provide a large share of energy but relatively low amounts of essential vitamins and minerals, frequently result in “hidden hunger”. Published literature on impact of school meals programmes in alleviating micronutrient deficiencies in children is scanty. Although the government has put in place policies regarding the HGSMP a gap still exists on the effectiveness of the programme in addressing micronutrient deficiency in children.

Recommendations

Kiamba (2013) recommends that School Meals Programmes should ensure nutritional content and impact of the ration by considering:

- a) Proper storage to mitigate nutrient loss
- b) The season of the year; nutrient content differs by season
- c) Proper preparation and cooking methods to mitigate nutrient losses
- d) Good health; Health of children affects nutrient utilization (i.e., deworming children is a complementary activity)

- e) Developing nutrition standards for school children (nutrition requirements and foods at school to partially meet them)
- f) Nutrition education messages to increase the consumption of a diversified diet by all in the family. Provide information to parents that school meals should not substitute for what children are receiving at home.

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The Utilisation of Pineapple Peels in the Production of Fibre-Rich Bread

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Abstract

Dietary fibre is that part of plant material in the diet which is resistant to enzymatic digestion. The diets rich in fibre such as cereals, nuts, fruits and vegetables possess medical or health benefits including the prevention and treatment of several diseases. Dietary fibre can be used in various functional foods like bakery, drinks, beverages and meat products. Influence of different processing treatments (like extrusion-cooking, canning, grinding, boiling, frying) alters the physico-chemical properties of dietary fibre and improves their functionality. In this study, fibre extraction and application in the production of high fibre bread was designed to ensure functionality is upheld after processing. After processing, the functionality of the fibre-antioxidant activity in terms of total phenolics in high fibre bread was not fundamentally affected thus rendering the bread to fall into a functional food category. In this study, the total phenolics concentration in the high fibre bread was 61µg gallic acid equivalents (GAE)/g of bread. This was an acceptable amount having used 10g of fibre with approximately 25000µg GAE phenolics into the 400 grams' bread formulation. In regard to the product qualities and acceptability, sensory tastes were done using randomly selected respondents within the university who all judged the product to be of superior quality compared to the majority of commercially available breads in the region. The use of pineapple peels (a waste by-product from pineapple industry) for food is a good way to relieve the environment of green gas emission burden resulting from their rotting at dump sites. This would be possible if bakeries would be encouraged to adopt the use of pineapple peels in their bakery products, especially bread. Apart from being an environment-friendly venture, the use of peels in foods adds a health value to them.

Keywords: Fibre Bread, Pineapple Peels, Bakery Products, Dietary Fibre

Introduction

The dietary fibre market is highly competitive, with cereals providing the major source for commercial products. Spiller (1986) observes that dietary fibres from fruits have a higher proportion of soluble dietary fibre and bioactive associated compounds compared to those from cereals.

Pineapple is one of the most important fruits in the Kenya as most of its production is used in juice processing. Other than being processed into juice, pineapple may be consumed as canned sliced, chunks, dice, or fruit salads, concentrates and jams (Salvi & Rajput, 1995; Tochi *et al.*, 2009). Frozen storage of slices is also an alternative method for pineapple preservation (Bartolomé *et al.*, 1995). By-products obtained from industrial processing represent 25-35% of the fruits, and the shell is the major constituent.

Pineapple peels have been used to produce alcohol, citric acid, vinegar, bromelain, wine, sugar syrup, wax, sterols, and cattle feed (Joseph & Mehadeviah, 1988; Salvi & Rajput, 1995; Tochi *et al.*, 2008). There is increasing interest to find new sources of dietary fibre (such as mango fruit, passion fruit, algae) with specific bioactive constituents that may add new healthy properties to the traditionally commercialised products (Larrauri *et al.*, 1996a; Baquera & Bermúdez, 1996; Bobin-Dubigean *et al.*, 1996).

Functional foods that have elevated phenolic antioxidant and dietary fibre level are in high demand by consumers because of the health benefits they are believed to offer. Among the most common foods in which fibre is added include wheat products. Interestingly, wheat products are a common food along the Kenyan coastal strip. This is because most of the foodstuffs prepared in the region constitute wheat in one way or another. Because of their diversity and popularity, bakery products have found use as carriers of functional food ingredients. Bread, in particular, is an important staple food consumed globally, consisting of wheat flour, salt, fat and yeast. As such, this study sought to extract fibre from pineapple peels and apply the extracted fibre in the preparation of high-fibre bread. This had a two pronged benefits; to the farmers of pineapples whose revenue base would increase, and to the consumers of the bread who would have a healthy functional bread product.

Dietary fibre (DF) has been classified as plant material that possesses medical or health benefits including the prevention and treatment of diseases. In fact, DF is the subject of two of the six specific health claims permitted in the US Nutritional Labelling

and Education Act (1990) due to its beneficial effects in reducing risk of cancer and coronary heart disease (Best, 1991). This notwithstanding, dietary fibres promote beneficial physiological effects including laxation, blood cholesterol and glucose attenuation (AACC, 2001). The beneficial effects of dietary fibre (DF) for human health have been widely reported (Champ & Guillon, 2001; Reddy, 1982; Schneeman, 1998; Tarpila *et al.*, 1978) with recommendations for consumption ranging from 30 to 45g per day (Schweizer & Wursch, 1991; Spiller, 1986; Stephen, 1981).

However, for DF to meet the demands for preventing some diseases through eating, it must meet certain criteria. Larrauri (1999) identified the criteria for the “ideal dietary fibre” to meet this condition. Among the requirements an “ideal dietary fibre” should meet include:

1. Have no nutritionally objectionable components;
2. Be as concentrated as possible so that minimum amounts can have a maximum physiological effect;
3. Be bland in taste, colour, texture and odour;
4. Have a balanced composition (insoluble and soluble fractions) and adequate amounts of associated bioactive compounds;
5. Have a good shelf life that does not adversely affect that of the food to be added;
6. Be compatible with food processing;
7. Have the right, positive image in the eyes of the consumer with regard to source and wholesomeness;
8. Have the expected physiological effects; and
9. Be reasonable in price.

However, despite the positive development, negative effects have been observed when unprocessed lignocelluloses materials, such as cereal bran or vegetable pulp, are added to formulations for baked goods by a loss of baked volume and a gritty texture (Dubois, 1978; Titcomb & Juers, 1986). Lignocelluloses materials do not hydrate well and hence do not soften or integrate well with dough or batter (Gould *et al.*, 1989a; Gould *et al.*, 1989b). Improved hydration properties of lignocelluloses materials were demonstrated after treatment with alkaline hydrogen peroxide (AHP) (Banerjeet & Car, 2012; Gould, 1989). This process not only reduces much of lignin content but also the stirring, which is an integral part of the process,

opens the structure by mechanical shear, making available free hydroxyl groups of cellulose to bind with water. Application of AHP to wheat straw allowed its application without loss of baking performance or sensory quality (Jasberg *et al.*, 1989a; Jasberg *et al.*, 1989b). Alkaline peroxide pre-treatment is more effective at solubilising lignin and improving digestibility than alkali treatments, another form of mild pre-treatment (Karagoz *et al.*, 2012).

Larrauri *et al.* (1994) reported on the composition of pineapple waste product (ends, shell, and core) obtained from the pineapple fruit processing industry. Studies by Larrauri *et al.* (1997) found powder from pineapple fibre to contain a higher antioxidant activity (AA) as compared to commercial fibres from lemon, apple and orange. AA is a health-promoting property derived from the bioactive compounds with DF (Larrauri *et al.*, 1996b). This property makes the use of pineapple fibre as a better food ingredient than commercial fibre from lemon, apple and orange which have little or no AA.

Materials and Methods

Chemicals and materials

The chemicals and materials were obtained locally. These included: Pineapple peels, milling machine (blender), magnetic stirrer, pH meter, NaOH, H₂O₂, HCL, and Package polyethylene bags.

Methods

Alkaline Hydrogen Peroxide (AHP) Fibre Pretreatment and extraction

This method was performed at room temperature and atmospheric pressure. Four different concentrations of pre-treatment solutions were used for the experiment. Pre-treatment solutions were prepared by mixing different concentrations of NaOH with equal volume (100 ml) and different volumes of 99% hydrogen peroxide (H₂O₂) as follows:

Pre-treatment solutions	NaOH concentration	99% (H ₂ O ₂) volume
T1	100ml of 1.25 mol/L	+ 10 ml
T2	100 ml of 2.5 mol/L	+ 7.5 ml
T3	100 ml of 5 mol/L	+ 5.0ml
T4	100 ml of 7.5 mol/L	+ 2.5ml

Pineapple peels were sliced into small pieces approximately 1cm square and thoroughly blended using a domestic blender. To 1g of the peels, 10ml of the pre-treatment solution was added to aid in blending. In total, 50g of peels with 500ml of the pre-treatment solution were done and transferred to 1000ml beakers for further processing. Under constant stirring (90 rpm) using a magnetic stirrer, the mixtures maintained at a pH range of between 11.2 to about 11.8 were kept at room temperature for 24 hours for further degradation to bring about delignification thus improving its hydration properties. The mixtures were immersed in 10% HCl for 8 hours, washed with tap water twice and heated at 50°C for 24 hours and then kept in a sun drier until reach to a constant weight. Final milling was done and the fibre extract (Figure 1) stored in sealable polythene bags until applied in baking.

Both the treated and the untreated fibres were analysed for Total Dietary Fibre (TDF) composition following the AOAC-enzymatic gravimetric method as reported by Tochi *et al.* (2009). Briefly, dried samples were gelatinised with heat stable α -Amylase solution, and then enzymatically digested with protease and amyloglucosidase to remove the protein and starch that may have been present in them. Ethanol was added to precipitate the Soluble Dietary Fibre and the residue, and then it was filtered and washed with ethanol and acetone, before being dried and weighed. Half the samples were analysed for protein and the other half for ash before calculating the TDF following the method of James (1995). This procedure was used to determine the effect of AHP treatment on the fibre. The extraction and determination of total polyphenols and tannins was done according to the method of Tochi *et al.* (2009). The values are reported as $\mu\text{g g}^{-1}$ Gallic Acid Equivalents (GAE).

Once the fibre had been prepared, baking test were carried out in which between 1-10% dietary fibres of various particle sizes of AHP treated fibre was added to the bread formulation in order to minimise bias by having a bread with traits as close as possible to the commercially purchased breads. Four different recipes were used to prepare the fibre bread with a slight modification of the AHP treated fibre. The loaves were blind-tasted for their appearance, texture and eating qualities in comparison to the control sample (bread baked for commercial purposes) by a panel of expert bakers to identify the sample with qualities closest to the control sample. Once the right sample was identified, four trials were made using the identified recipe to ensure a consistent product was in place. The study employed a researcher assisted questionnaire consisting of Likert-type questions on a scale of

one to five. The first part sought to adduce the level of the respondent's appeal for the quality of the fibre bread against the control sample while the second sought their demographic information.

A pre-test was carried out on the instruments by three expert judges. Further, an under-cleaved pre-test on a small group of subjects within university was carried out to establish whether there were possible ethical problems that had been overlooked, whether the research questions were appropriate for the selected variables and whether the length of the questionnaire was appropriate for the intended respondents. Content validity was carried out to test whether the instruments fairly and comprehensively covered the items they purported to cover, and ensure that all the intended tenets such as attributes of quality and appeal were represented in the questionnaire. To test the internal consistency of the variables, the study used Cronbach's alpha coefficient. The pineapple quality scale had a Cronbach's reliability ($\alpha = 0.682$). The reliability was deemed appropriate as it was above 0.67 as suggested by (George & Mallery, 2003; Tavakol & Dennick, 2011).



Figure 1: Milled extracted pineapple peels fibre

Two areas were proposed within the university precincts; that had the highest representative traffic of all the Pwani population as data collection points. Breads representing each of the two samples (the test sample and the control respectively)

were trimmed to remove the crust then cut into equal small cubes. This was divided into four separate tight fitting containers for each sample. The set of containers (one representing each sample) were left in their original state ready for the blind taste. They were then marked appropriately as sample A₁, A₂, A₃ and A₄ (for the test sample) and B₁, B₂, B₃ and B₄ for the control. The first samples A₁ and B₁ consisted of crusts; A₂ and B₂ consisted of internal flesh; A₃ and B₃ constituted of a crust attached to flesh, same to sample A₄ and B₄.

Respondents were randomly sampled when they passed by the stand. To avoid repeat responses, a screening question; “have you participated in this study yet?” was asked. A total of 221 questionnaires were returned. This was a response rate of 89.5% of the intended sample size of 247 respondents.

Results and Discussion

The gallic acid equivalents and the total dietary fibre for the processed fibre extracts and unprocessed raw pineapple peels fibre are given in Table 1. The results which were not significantly different show that there was no destruction of important dietary components following the extraction and processing of fibre. However, on application of the fibres in the baked bread products, those processed using solutions T3 and T4 had an after taste that food tasters did not approve of. Though the fibre extracted using T1 did not have any after taste, it was felt that the processing did not change the fibre to conditions where it was able to hydrate easily and hold water. In subsequent fibre extraction processing, the solution T2 was used with other conditions remaining constant.

The findings revealed that most of the respondents rated their level of satisfaction lowest for the following attributes of the fibre bread: unbearable after-taste (n=95, 43.0%) and crumbly texture (n= 44, 19.4%). This implies that there was no trace of after taste detected by majority of the respondents who tasted the fibre bread. Additionally, a crumbly texture was not identified in the bread. In as much, most of the respondents rated the fibre bread favourably in terms of its external features. The majority of the respondents felt the colour of its crust was brick red (n = 116, 52.5%) and it had a better bloom (n = 103, 46.6%). In terms of the bread's internal appearance, the majority of the respondents felt the loaf had well distributed flesh (n = 101, 45.7%) which had a high volume (n = 102, 46.2%). This implies that both the internal and external appearance of the bread was of high quality as it met the ideal qualities looked for in bread.

A greater proportion of the respondents felt the surface of the bread was soft (n = 123, 55.7%) and the internal texture (n = 113, 51.1%) was spongy. This implies that both the internal and external texture of the bread had a high quality as it met the ideal texture looked for in bread.

Other important facets when adducing the quality of bread include aroma, mouths feel and flavour of the bread when eaten. The majority of the respondents felt that the aroma (n = 114, 57.6) of the bread was good, the bread felt soft (n = 123, 55.7%) when one placed it in the mouth and had better flavour (n = 119, 53.8%) when eaten.

The study further sought to establish the demographic dimensions that could influence the respondents' preference of the fibre bread. A comparison between the different facets of the respondent demographic traits in relation to their preference of fibre bread then formed the basis of the study. The demographic traits were viewed in relation to their gender, age, occupation and level of education. To this end, an ANOVA test was run to find out if there was a statistically significant impact of the respondents' demographic traits in relation to their appreciation of FB.

ANOVA test Results

The test established that at 0.05 significance level, gender (0.465), age (0.316), education level (0.301), and occupation (0.617) did not have significant influence on the respondents' perception of FB. The null hypothesis that there is no significant difference between gender, age, level of education and their occupation was accepted as depicted in Table 2. This implies that the demographic background of the respondents had no effect on their appreciation of the fibre bread. As such, in the event that FB was to be launched within Pwani University, there was a high likelihood it would be very popular as there would be a ready market from all demographics.

Summary, Conclusion and Recommendation

The findings of the study revealed that the pineapple fibre bread was palatable and appreciated by the majority of the respondents. Unlike the utilisation of other fibres, the pineapple fibre did not affect the aeration of the dough. As such, pineapple fibre can be extracted for utilisation in bread making. In addition, the majority of the respondents were in agreement that the quality of the fibre bread

was more superior to the conventional bread. It is therefore recommended that the populace is encouraged to consume pineapple fibre bread as it may increase the dietary fibre in their diets hence increasing healthy eating through digestion. It may also offer an alternative use for the otherwise discarded pineapple fibre thereby increasing the value of the locally grown pineapples by enabling the local farmer to gain additional income through its sale. Future studies need to establish whether the same fibre uses can be expanded for use in many more flour based products.

Table 1: Total dietary fibre mg/g and total Polyphenols $\mu\text{g/g}$ (GAE) for processed fibre

Fibre processing method	Total Dietary Fibre mg/g	Total Polyphenols $\mu\text{g/g}$ (GAE)
T1-Processed	414 \pm 0.12	59.4 \pm 0.18
T2-Processed	426 \pm 0.32	61 \pm 0.32
T3-Processed	422 \pm 0.21	60.2 \pm 0.12
T4-Processed	417 \pm 0.52	64 \pm 0.41
Unprocessed	432 \pm 0.78	62.5 \pm 0.32

Table 2: ANOVA results for the respondent's rating of the pineapple fibre bread against the commercially bread

Contextual characteristics		Sum of Squares	df	Mean Square	F	Significant*
Gender	Between Groups	.126	1	.126	.535	.465
	Within Groups	51.311	218	.235		
	Total	51.436	219			
Age	Between Groups	1.114	4	.279	1.190	.316
	Within Groups	50.322	215	.234		
	Total	51.436	219			
Education level	Between Groups	1.146	4	.287	1.225	.301
	Within Groups	50.290	215	.234		
	Total	51.436	219			
Respondents occupation	Between Groups	.911	4	.228	.969	.425
	Within Groups	50.525	215	.235		
	Total	51.436	219			

*Significant at 0.05

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Section Five:
INDIGENOUS
KNOWLEDGE SYSTEMS

An Analysis of Music Idioms of the Kiringongo in Popular Band Music

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Abstract

This paper is part of an on-going research which focuses on the preservation of traditional music idioms of the kiringongo within popular music. A preliminary survey indicates that the kiringongo, a wooden barred-idiophone, is commonly played by the Chonyi sub-group of the Mijikenda. Popular music has been observed to include traditional music instruments from various communities. This demonstrates an occurrence of transfer of music idioms from their original context to a new one and may imply the inclusion of music idioms of particular instruments within popular musics. This paper highlights music idioms of the kiringongo which are present in popular band music. The main objective of this study is to establish ways in which the kiringongo's music idioms are preserved within contemporary music thereby facilitating continuity of the voice of the kiringongo. The research is guided by the theories of change and continuity. This ethnographic research was carried out in Kilifi and Nairobi counties with the respondents being players of the kiringongo and popular band musicians. The study further interrogated music from both groups. This study hopes to create a structure for upholding the essence of traditional music in present-day music terms. The study should also inform policy on preserving music towards safeguarding the intangible cultural heritage as well as the revitalisation of the various aspects of such heritage.

Keywords: *Indigenous Music, Cultural Heritage, Identity, Cultural Transformation*

Introduction

Music performance is a tradition that has been observed among human beings situated in different parts of the world. In Africa, music performance has been interpreted as an activity that is embedded in life's occurrence. The function of music is to communicate messages which facilitate harmonious coexistence in the society. The messages are passed through various media within the musical body.

Music performance in the African context incorporates various art forms such as singing, playing instruments, dancing, masquerading and dramatizing (Stone, 2008). The media used during music performance are unique to the communities involved.

Music's idioms as well as identity may penetrate beyond its indigenous context. Idiom refers to rhythmic, melodic and tonal characteristics of *kiringongo's* music. Identity implies specific people who are authentically associated with the music. Permeation may be as a result of factors such as globalisation and migration of people. A change in culture leads to change in the music. A precursory survey indicates that music performed in urban centres includes instruments from various ethnic communities. The presence of those instruments within the soundscape also raises concern about cultural transformation. The music idioms of the instruments transferred to the urban centres' stage may be present within the music performed.

Music instruments have been seen to be a key component in performance. The instruments enable participants to pass on cherished cultural practices. As part of culture, the music performed may depict certain characteristics and idioms which are unique to a particular group of people. The instruments used may be indicative of the music traditions practised over a long period of time. Aranzadi (2010) argues that musical instruments are an intrinsic part of culture accompanying people as an essential factor in shaping the identity preserved through memory.

Among the instruments used in the performance of African music is the xylophone. Music instruments museum online (2011) classifies the xylophone as a 'percussion idiophone' because it has a set of 'percussion sticks' in a range of different pitches combined into one instrument with the sounding components in one plane. This study is concerned with music idioms of the *kiringongo*, a wooden-barred xylophone, commonly played by the Chonyi sub-group of the Mijikenda.

Traditional Music Instruments in the Popular Music Context

The rise of popular music in Africa has seen the continent's traditional music instruments being included in popular genres. It has been observed that popular music artists experiment with the traditional music instruments with the aim of including them in the popular genre. Kubik (1981) illustrates this with the example of the *lukeme*, a lamellaphone found in Northern Uganda, performed "guitar style". This kind of music practice encouraged musicians to create sub-genres of popular music that had features of the traditional music's instruments.

Performance practices have been altered in these popular contexts from the way the instruments are used in the indigenous context. Omolo-Ongati (2006) states that artists play the *orutu* while imitating the guitar within a band performance. Whereas in the traditional context the *orutu* is played with the actual player doubling its melody by singing, the instrument is amplified using modern technology, due to bigger audiences (Omolo-Ongati, 2006). Omolo-Ongati (2006) further states that the *orutu* artists sometimes use two fiddles in harmony at the interval of a third, a practice that has been borrowed from popular guitar music where two vocalists call at an interval of a third.

The traditional instruments involved in popular music include those that accompany them in the indigenous setting. Omolo-Ongati (2006) points out that the *asili* (Luo aerophone) and *oporo* (horn) are incorporated in the band music performances. These are given new roles in the new performance context. There is an evident occurrence of cultural integration as the new roles merge with the ones observed in the indigenous context.

Within modern life, under such labels as tradition, authenticity, modernity and universality, music is transformed into an instrument of the political and cultural struggle waged by the groups it represents (Kayhan, 2014). Music instruments used in such contexts symbolise cultural heritage of a specific group of people. Through them, music achieves its purpose of communication despite the changes that it may have faced.

In the Kenyan context, music embraces traditional and contemporary idioms of sacred and secular genres of song and instrumental expression (National Music Policy, 2015). The xylophone is occasionally spotted in performances at educational institutions, and in the annual cultural, drama and music festivals. However, it is not restricted to the indigenous setting and has permeated the sonic environment of various other media – adapted media.

The xylophone is continually used away from its indigenous performance space due to certain processes that occur. Kim (2017) explains that cross-cultural music making can be both rooted and mobile. The local and global, the national and international, the familiar and new, the social an individual, and so on, permeate each other in the cross-cultural field with an ever-changing point of reference throughout this process (Kim, 2017).

This current study reveals that the *kiringongo* is played alongside popular band instruments such as the guitar, keyboard and drum set. This survey indicates that the xylophone plays accompaniment roles within the ensemble. Each of the performances has notably unique nuances with the xylophone's idioms standing out appropriately.

Traditional Music Idioms in Popular Music

The practice of fusion in performance of African music has been prevalent since the twentieth century. This was brought about by influence from missionaries and colonialists who came to Africa to spread Western European religious practices as well as to explore the continent for natural resources. Roberts (1968) explains that in the 1950s and 1960s, there emerged in Kenya a number of styles which can be categorised as “pop”. “...Traditional music is also “popular” and there is a zone in which “pop” and a form of “modern traditional” meet” (p. 53). This fusion calls for careful consideration of the old and new musical idioms using the available media.

Traditional music may be preserved through performance in modern music genres such as the popular music types. The idioms of traditional music could be presented using media other than the ones in the indigenous setting. The processes involved in composing and performing new music within a soundscape play the main role in preservation of the traditional music idioms. Ekwueme (1976) posits that preservation does not necessarily negate continued growth and expansion and that this system keeps African traditional music alive and continuously growing and developing. Music artists persistently experiment with their works with the aim of meeting their audience's needs.

Features of the instruments involved play crucial roles in ensuring proper merging of the musical idioms. These include the scales to which they have been tuned. Music composed using scales of traditional instruments has characteristics that ought to be integrated with the music of the other (foreign) cultures. This blending welcomes the foreign while retaining the traditional idioms thus leading to an aspect of preservation. Kubik (1981) notes that many of the East African musical forms which are regarded today as traditional show some influence of the diatonic scale imported with church and school music.

Besides the process of creating music, performance is crucial in ensuring that preservation as a process is achieved. The soundscape provides different conditions for artists to present their music. Coplan (1982) states that continuity and change

in performance must be regarded as aspects of overall processes of urbanization and adaptation. In tandem with this, Okumu (2001) alludes to the notion that the genre of popular music has elements in common with other musics around Africa hence syncretism and appropriation easily enabled identification of styles and types that were similar in form and performance trends. The processes of implanting these elements onto the soundscape facilitate performative preservation of traditional music idioms.

Omolo-Ongati (2006) observes that the idea and concept that informs traditional music genres are increasingly being eroded by modern trends in the society and modernists look at such new developments as a way of preserving the traditional music through performance in re-contextualised settings. This concern indicates that there is a need to incorporate the remaining traditional music resources in modern music performance contexts, while ensuring that the traditional idioms remain outstanding.

Preservation of traditional music idioms calls for a keen approach in music and performance practice. Every change in culture is reflected in the musical arts of a particular society. Omolo-Ongati (2006) explains that artists should look for techniques that would not interfere with the style or idiom of the music but would still appeal to the contemporary audiences. Preservation of music idioms could hence be achieved with these in mind.

In tandem with Omolo-Ongati (2006) and Idolor (2007) suggest that only specific aspects which project African musical peculiarities should be adapted. Idolor (2007) calls for composers, arrangers, researchers, broadcasters and performers to be conscious of the African musical identities and protect them accordingly.

Relocation of the *kiringongo* from its traditional context indicates occurrence of inevitable change. According to Zake (2000), the *kiringongo* is tuned to a pentatonic scale. Music created from that scale thrives in the popular music fabric that has the diatonic and other scales. Moreover, music idioms of the *kiringongo* which are its rhythmic patterns, melodic nuances and other tonal characteristics may fit in the popular music genre.

This paper highlights music idioms of the *kiringongo* which are present in popular band music with a view to establishing the continuity of indigenous music practice in order to preserve the traditional music idioms.

Theoretical Framework

This paper is guided by the theory of continuity as stated by Nettl (2005), which states that radical change in a system of music whose new form can definitively still be traced in some way to the old is more easily illustrated as there is both a constant population and at least some stable element of the music to establish the continuity. Music is a dynamic form of art which is directly influenced by its immediate culture. Despite any cultural effects that may present themselves, there are aspects of music which remain conspicuous.

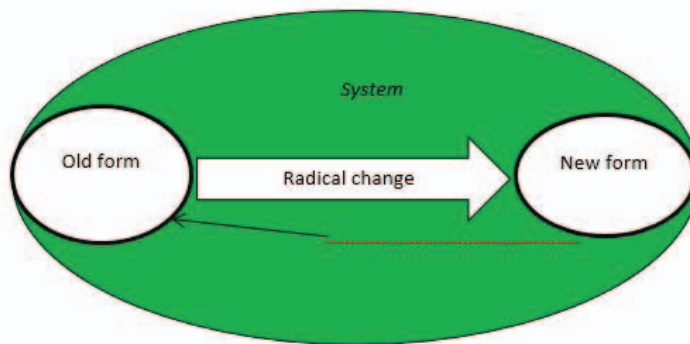


Figure 1: Theory of Continuity (Nettl, 2005)

Methodology

This study used a qualitative descriptive research design to investigate the voice of the *kiringongo* as presented in the soundscape. It examined popular music in selected bands through a historic*al analysis of transition and infusion of the *kiringongo*'s idioms from the traditional context to modern popular band music. This was with the view that people in the society use music on the basis of the meaning it has for them with the connotations being a product of their interaction. Whereas music in the indigenous context has been observed to be functional, it plays the major role of entertainment in the soundscape.

The population in this study consisted of musicians who perform in specific bands and selected music recordings. The sampling techniques employed were purposive and stratified sampling. Purposive sampling was used to identify the groups that perform popular music within the soundscape of Nairobi County. Purposive

sampling was important because it guided in distinguishing the music idioms of the *kiringongo*.

From the selected popular music genres, a sample that portrayed the *kiringongo* idioms was collected for the research. This was achieved through stratified sampling in order to accommodate the appropriate repertoire within those bands.

This study used both secondary and primary data. An interview schedule was used for collecting primary data from band musicians. This solicited information was on how the musical idioms of the *kiringongo* are realised in the bands' music. An observation schedule was used to describe video and audio stimulated data. This instrument was appropriate as it served the purpose of collecting primary data during the interviews and concerts that the researcher attended. A music analysis schedule was also developed in view of the variables identified in the literature review to help the researcher in dissection and description of audio stimulated data. This instrument was relevant for analysis of both the primary and secondary data.

This study used recording devices during performance sessions and the interviews. There were three research assistants. The research assistants played specific roles in capturing of relevant content using those devices; one of them took photos while the others took video recordings. The research also used stationery to record data as indicated in the observation schedule. The stationery used included pencils, eraser and a note book. These tools were relevant for capturing the primary data for analysis. The data captured provided a background for comparison with the secondary data.

Data collection involved the researcher booking appointments with sampled respondents in order to carry out interviews. An interview schedule was used during the separate meetings with popular band musicians. An observation schedule was used during concerts and the interview sessions. The researcher collected recordings of music of the *kiringongo* used a music analysis schedule to examine the data.

This study used qualitative analysis techniques. The study collected data in text and audio form. The data was transcribed for analysis. Data in the observation schedule and the music analysis schedule was aligned as per the objective. These have been analysed in narrative. The qualitative data was presented through explanations and the quantitative data in tabulations and narration.

Findings

The respondents were asked to identify the types of music that they perform. All respondents alluded to drawing their music from the Mijikenda people. 50% of the respondents stated that they perform *senganya*, *mwanzele*, *chechemeko*, *chela*, rock, ragga, *mwanzele-rock* and *mwanzele-ragga*. The other respondents mentioned that the band performs *mwanzele*, rumba and benga. 33% of the respondents mentioned a genre identified as *nzele* and explained that it was derived from *mwanzele*, a style performed among the Giriama, Chonyi and other Mijikenda sub-groups. 16.7% stated that they perform *ndundiko*. The presence of *senganya*, *mwanzele*, *chechemeko*, *chela* and variants of *mwanzele* indicates an aspect of continuity. The genres identified in the study were noted as having an origin among the Mijikenda.

The respondents were asked to identify the instruments that they played in the bands. All respondents identified the keyboard, bass guitar, lead guitar, drum set, flute, alto saxophone, trumpet, trombone, vocals, shakers, *ndonga* and *kayamba*. 50% of the respondents further indicated that they included the *kiringongo*. Other instruments identified by respondents who used the *kiringongo* were *bung'o*, *chivoti*, *lungo*, *chapuo*, *mchirima*, *msondo* and *nzuga*. Adaptation of the *kiringongo* in the band facilitated the continuity of tonal features as its tuning (Figure 2 and Scale) indicated a chasmatonic-hemitonic pentatonic scale similar to that of the marimba found in the indigenous setting.

The respondents were asked how they created the rhythms of *kiringongo* music in the bands. All respondents referred to the rhythms played in the traditional setting as a core component in their recreation within the bands settings. This factor alludes to continuity of rhythmic idioms of music of the *kiringongo* from the indigenous setting. The respondents further explained that the shakers, triangle as well as the hi-hat played the parts of the *kayamba* and *ndema* in the bands. 50% of the respondents stated that the drum-kit player derives his rhythmic patterns from the body movements of dances of music of the *kiringongo* in the traditional setting. This reiterates the continuity of rhythmic idioms initially expressed through choreography yet transferred to instrumental elements of the bands. The other respondents stated that they used the rhythm in *mwanzele* as a guide in composition of *nzele*. This cross-reference highlights a pivot aspect of continuity of rhythmic idioms of music of the *kiringongo*.





The respondents were asked whether they merged the rhythms of *kiringongo* music with those of the other types of music. 50% of the respondents answered in the




affirmative. Those respondents were further asked how they achieved that. They pointed to the transition from one style to another as the most crucial part of the fusion. 33.3% of these respondents expounded that the transition was guided by a modification of the accompanying rhythmic patterns. They exemplified a change from *mwanzele* to rock as being successful due to an initial guidance by the kick rhythm. 16.7% of those respondents further stated that the electric guitar in the band would be used to complete the full sound of the rock genre. Those respondents further alluded to fusing the rhythms of *kiringongo* music with those of ragga, rock and taarab. The rest of the respondents stated that they do not fuse the rhythms but create the new genre identified as *nzele*. Those respondents who created the new genre alluded to changing the meter and tempo of *mwanzele* from a moderately fast compound one to a slower simple meter.

On integrating the melodic sounds of the xylophone, the respondents were further asked how they would ensure that the *kiringongo* and the band instruments play in the same key. 50% of the respondents stated that they would play short melodies on specific notes that were in sync with the keyboard and guitars. Either the keyboard or the guitars would then accompany the *kiringongo* in that case. 33.3% of the respondents suggested constructing instruments such as the guitar or keyboard then tuning them to the *kiringongo* in order to be able to perform in the same key. All respondents stated that in order for the *kiringongo* to be fused in the band, the player would be given a timeframe to perform freely with the accompaniment of the percussion. These responses point out the various ways of adapting music idioms of the *kiringongo* within the band thus ensuring continuity of their production.

The respondents were asked to identify the bands' instruments that are crucial in bringing the musical characteristics of the *kiringongo*. All respondents stated that the drum-kit, shakers and triangle are important for the rhythmic section. For the melodic characteristics, the respondents alluded to the keyboard being set to sound like the marimba. 50% of the respondents stated that they substitute the keyboard with their *kiringongo*, and therefore able to incorporate the melodic sounds of the xylophone within the band. Transcribed popular band music of the *kiringongo* had the idioms shown in Table 1.




Table 1: Selected popular band music's idioms







WORK	MUSIC IDIOMS			
	RHYTHMIC ELEMENTS			MELODIC ELEMENTS
	TIME SIGNATURE	NOTE VALUES	GROUPING OF NOTES	INTERVALS
<i>Vinani Nzele</i>	4 4	Quaver Dotted Quaver Crotchet Semiquaver Demisemiquaver		Major second Minor second Major third Minor third Perfect fourth Perfect fifth Unison
<i>Kazungu</i>	4 4	Quaver Dotted Quaver Crotchet Semiquaver		Major second Minor second Major third Minor third Perfect fourth Perfect fifth Unison
<i>Hawe Risa</i>	4 4	Quaver Dotted Quaver Crotchet Semiquaver		Major second Minor second Major third Minor third Perfect fourth Perfect fifth Unison
<i>Tsangirani Ajeni</i>	12 8	Quaver Semiquaver Crotchet		Major second Minor third Perfect fifth Minor sixth Unison

WORK	MUSIC IDIOMS			
	RHYTHMIC ELEMENTS			MELODIC ELEMENTS
	TIME SIGNATURE	NOTE VALUES	GROUPING OF NOTES	INTERVALS
<i>Kaya</i>	12 4 8 4	Quaver Semiquaver Crotchet		Major second Major third Perfect fourth Perfect fifth Unison
<i>Tsawe</i>	12 4 8 4	Quaver Semiquaver Crotchet		Major second Minor third Perfect fifth Minor sixth
<i>Mwembe</i>	6 8	Quaver Semiquaver Crotchet		Compound major second Major second Perfect fourth Perfect fifth Major third Minor third Unison

Music idioms of the *kiringongo* were derived from the idioms identified in Table 2.

Table 2: Music idioms of the *kiringongo*

WORK	MUSIC IDIOMS			
	RHYTHMIC ELEMENTS			MELODIC ELEMENTS
	TIME SIGNATURE	NOTE VALUES	GROUPING OF NOTES	INTERVALS
<i>Vinani Nzele</i>	**4	Quaver		Major second
<i>Kazungu</i>	4	Dotted Quaver		Major third
<i>Hawe Risa</i>	derived from 12 8	Crotchet Semiquaver		Minor second Minor third Unison

WORK	MUSIC IDIOMS			MELODIC ELEMENTS INTERVALS
	TIME SIGNATURE	NOTE VALUES	GROUPING OF NOTES	
<i>Mwembe</i>	6	Quaver		Major second
	8	Semiquaver Crotchet	 	Major third Minor second Minor third
<i>Tsangirani Ajeni</i>	12	Quaver		Major second
	8	Semiquaver Crotchet	 	Major third Minor second Minor third
<i>Kaya</i>	12 4			Major second
	8 4			Major third Unison
<i>Tsawe</i>	12 4			Major second
	8 4			Minor third Perfect fifth Minor sixth

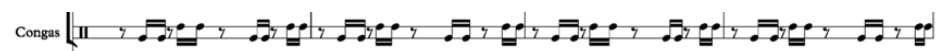
A further analysis of the music was conducted as below:



Excerpt 1: Rhythm of hi-hat in 'Kazungu', bars 53 to 56

Excerpt 1 highlights a rhythmic pattern that is in simple time. The rhythm is in 4/4. The pattern incorporates quavers and semiquavers.

This pattern is presented in variations that incorporate rests as indicated in excerpt 2 and 3:



Excerpt 2: Rhythm of the Congas in 'Kazungu', bars 54 to 56

Excerpt 2 shows a rhythmic pattern in simple time. The rhythm is in 4/4. This pattern includes quaver rests and semiquavers. The excerpt further indicates a

change in pitch after every two semiquavers.



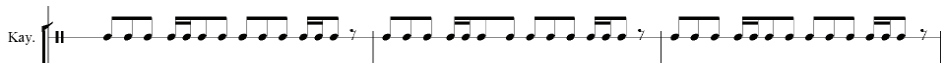
Excerpt 3: Rhythm of the Congas in 'Vinani Nzele', bars 3 to 6

Excerpt 3 shows a rhythmic pattern in simple time. The rhythm is in 4/4. This pattern includes quaver rests and semiquavers. The pattern indicates a tie between the beats, implying syncopation.



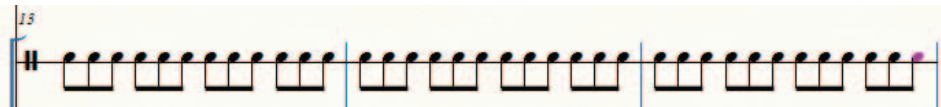
Excerpt 4: Rhythm of tambourine in 'Kaya', bars 4 to 6

Excerpt 4 shows a rhythmic pattern in compound time. The rhythm is in 12/8. This rhythmic pattern includes semiquavers and quavers.



Excerpt 5: Rhythm of kayamba in 'Tsangirani Ajeni', bars 7 to 9

Excerpt 5 shows a rhythmic pattern in compound time. The rhythm is in 12/8. This pattern includes quavers, semiquavers and quaver rests.



Excerpt 6: Rhythm of the marimba in 'Tsangirani Ajeni', bars 13 to 15

Excerpt 6 shows a rhythmic pattern in compound time. The rhythm is in 12/8. This pattern incorporates quavers.



Excerpt 7: Rhythm of marimba in 'Kaya' bars 65 to 67

Excerpt 7 shows a rhythmic pattern in compound time. The rhythm is in 12/8. This pattern includes crotchets, dotted crotchets and quavers. Some quavers in the excerpt are tied to dotted crotchets, implying syncopation.



Excerpt 8: Anacrusis in ‘Kazungu’, bars 1 to 4

Excerpt 8 is in common time. The excerpt underlines the aspect of anacrusis. The pattern involves a quaver rest and two semiquavers.

An analysis of notes of the *kiringongo* used by ‘Afro Simba’ band revealed that it is tuned to a chasmatonic-hemitonic pentatonic scale. This scale is mirrored on a single plane.



Scale of the *kiringongo* in ‘Afro Simba’ band

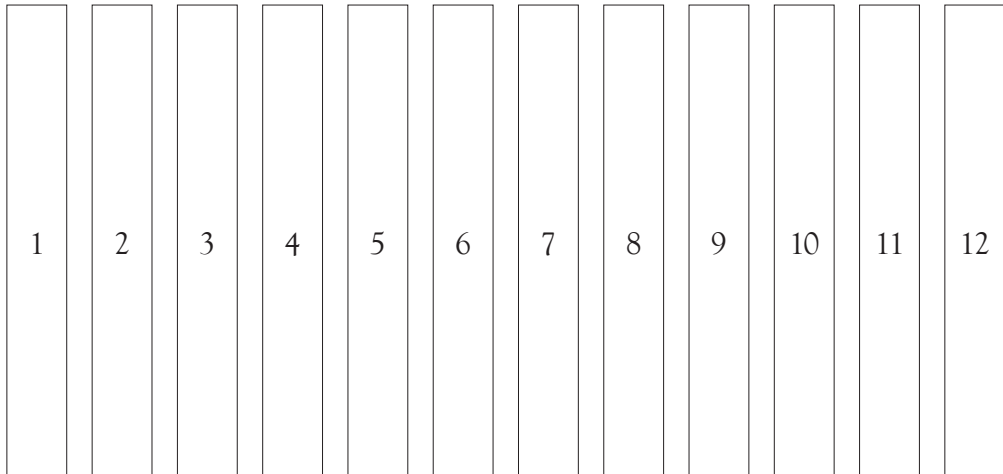


Figure 2: Bars of the *kiringongo* in ‘Afrosimba’ band

Table 3: Melodic intervals of the *kiringongo* in 'Afro simba' band

BARS	INTERVAL
1-2	Minor third
2-3	Minor third
3-4	Major third
4-5	Major second
5-6	Minor second
6-7	Unison
7-8	Minor second
8-9	Major second
9-10	Major third
10-11	Minor third
11-12	Minor third



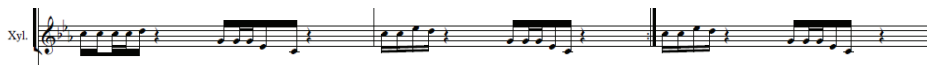
Excerpt 9: Major second on the marimba in 'Tsangirani Ajeni', bars 10 to 12

Excerpt 9 highlights an interval of major second between E flat and F.



Excerpt 10: Major third on the *kiringongo* in 'Mwembe'

Excerpt 10 shows the interval of a major third between D and B flat.



Excerpt 11: Minor second on the xylophone in 'Hawe Risa', bars 14 to 16

Excerpt 11 highlights the interval of a minor second between E flat and D.



Excerpt 12: Minor third on the *kiringongo* in Mwembe, bars 26 to 29

Excerpt 12 indicates the interval of a minor third between C and A.



Excerpt 13: Unison on the kiringongo in ‘Mwembe’, bars 30 to 34

Excerpt 13 shows the intervals of unison.

The transcribed works revealed that ostinatos were common in the music.

16 [2.] [C] *mf* 2

21 [D] *p*

24 [1.] BRIDGE

27 [2.] [E]

Excerpt 14: Ostinato on xylophone in ‘Hawe Risa’, bars 16 to 28

From the observations made:

Music of the *kiringongo* was performed in an organised concert by Afro Simba band. The performance space was a set stage with the ensemble incorporating the *kiringongo*, maracas, tambourine, congas, trumpet, keyboard, electric guitar, bass guitar, drum set, *ndonga*, *kayamba*, *chivoti*, *lungo* as well as singers. The songs performed were *Kaya*, *Mwembe*, *Tsangirani Ajeni* and *Tsawe*. The drum-kit player meticulously played various rhythmic patterns in each performance. Players of the *kayamba*, *ndonga*, *lungo*, *tambourine* and *maracas* appeared to pay attention to the drum-kit player then fit in their rhythmic patterns appropriately.

During performance of *Kaya* and *Tsangirani Ajeni*, the singers had their feet moving simultaneously with their hips and shoulders slightly shaking. These movements were in synchrony with the rhythm of the hi-hat, *kayamba* and *ndonga*. The rhythm heard from the percussive instruments was in 12/8 time with slight changes. The sound of the *kiringongo* was heard from the keyboard.

The *kiringongo* was played during performance of *Mwembe*. The *kiringongo* player alternated between performing on the marimba and *ndonga*. The *kiringongo* was played only with accompaniment of the guitar, *kayamba* and the drum-kit. The rhythm heard was in 12/8 time.

The *kiringongo* used in Afro Simba band had twelve wooden bars.



Figure 4: The Kiringongo, Courtesy of Band 1

Traditional music instruments may be used within popular band music. In other instances, the instruments are replaced with others that are within the bands. In either case, rhythmic, melodic and tonal characteristics of music of the *kiringongo* in the indigenous context are present within popular band music. On the concept of continuity by Nettl (2005), this study affirms the persistence of musical aspects despite a change in culture.

Conclusion

There are traditional music idioms of the *kiringongo* in popular band music. These music idioms manifest through various ways. They are thus actively preserved through performance. Music plays the role of ensuring the continuity of practice amid cultural transformation particularly amid the on-going 21st century globalisation phenomenon.

Recommendations

In light of the findings in this study, the following recommendations are made:

1. That musics from indigenous people of Kenya be provided with a platform that will give the culture bearers an opportunity to show case while educating about such cultures.
2. That music instruments from such cultures be preserved in various forms including constructing them using different resources that are readily available.
3. That policy reinforces the issue of preservation of music from indigenous areas of Kenya.

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Human Diversity and Indigenous Knowledge Systems: Challenges for Higher Music Education

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Abstract

This paper presents an analysis of the dynamics of human interactions and socio-cultural integration and their impact on indigenous knowledge systems with a view to interrogating their implication for the teaching and learning of music in institutions of higher education towards social transformation. Based on desktop analysis and the case of the music programme at the Technical University of Kenya (TUK), the paper lays emphasis on the concept of music as a body of knowledge and a way of knowing. Music's content spells out its processes from which ways of knowing and information dissemination are drawn. Indigenous knowledge is entangled in culture. In stable communities, shared concepts emanate from a common context. Whereas education is viewed as the community's way of socialising its young, the common goals and shared philosophy of a stable community facilitate the transfer of knowledge and skills to use that knowledge. Modern society, however, is characterised by human diversity because of various dynamics in human existence. This affects the structure and nature of society, and resultant culture, one of whose expressions is music. Music education takes place in formal, informal and non-formal contexts. As global cultural dynamics, relationships and mobility change, people's appreciation and application of music and their notion of music education transform in tandem with developments in culture. The diversity of human experiences, practices, beliefs, and preferences impact their cultural practices. These have implications for education. Anchored on constructivism, this paper explores higher education's integration of indigenous knowledge to ensure its relevance in a dynamic society and music's continuing role in social transformation through the content and process of music education.

Keywords: Cultural Diversity, Social Transformation; Indigenous Knowledge, Music Education

Contextual Information

The concept of music education is an ever evolving one. Time creates opportunities for reflection, changing the way we tackle issues. Our circumstances cause us to evaluate and interrogate. The notion of 'us' determines what we do, because it is our aspirations that dictate our objectives. The concept of 'us', our worldview, also informs our processes – our ways of doing what we do. This concept and our circumstances further contribute to what we employ to achieve these ends – our resources and materials. So, matters of identity, activities, objectives, methodologies and resources, the latter including learning materials - technology and human facilitators of learning - are significant as we consider the topic at hand.

The story of higher music education in Kenya begins at Kenyatta College in 1965 with the secondary school music teacher education programme. Soon, the subject became prominent at certificate (Teachers' Training Colleges) and diploma (Diploma Colleges) qualification levels. Whereas the former had all learners taking music irrespective of interest or prior knowledge, because Kenyan primary schools are staffed by generalist teachers, the latter offered music as one of the subjects under humanities, with admission pegged on a level of skills and knowledge.

When Kenyatta College became an education-specialising constituent college of the University of Nairobi, music became an important subject both at institutional and departmental levels. The chief programme for years was the Bachelor of Education (Arts) degree where music was studied as one of the teaching subjects, in combination with another arts-based subject, or as a double major. The arrangement worked successfully, until the education system threatened the employability of graduate music teachers. In 1999-2000 season, new programmes were developed, launching Bachelor of Arts in Music and Bachelor of Music degrees as Kenya's first attempts at training musicians (as opposed to music educators).

Several universities have since launched music programmes at certificate, diploma and degree qualification levels, in content areas as diverse as teaching and learning, performance, composition, technology and musicology. Whereas the initial programmes were very Eurogenic, with a bias to Western classical traditions, concepts and methods (Denyer, 1979), current curricula demonstrate the inclusion of African (Kenyan) content. The outcome of research into indigenous Kenyan music processes (Akuno, 1997; Andang'o, 2009; Mbeche, 2010; Mushira, 2010; Ondieki, 2010) also contributes to the adopted teaching and learning procedures and materials.

Human Diversity

In this paper, human diversity is viewed as a situation that presents individuals of varying backgrounds and cultural orientation. It culminates in multiculturalism, creating diverse situations that are to be navigated by education. The determinants of human diversity are multiple. History records mass movement of people from one region to another; so, migrations and settlements are key determinants of human diversity. Whereas some people relocate willingly, others are forced to 'leave home' and end up starting communities in new places. Wars, human trafficking, and famine are some of the extraneous factors that have led to mass migration of people, transporting a whole culture to a new geographic space.

Human diversity has several categories. Multiculturalism is the first manifestation of the diversity of peoples. This is the different ways in which people conduct their day-to-day businesses, forge and maintain relations, and develop and pass on values to socialise their young. The different experiences that we go through further provide contexts and content for our cultural expressions. Our economy and the things that give our existence meaning provide a rationale for (music) education. This leads to our various identities that determine and demand inclusion in and input into the definition of (music) education. Our tastes, tendencies and preferences are multiple yet legitimate and therefore need to be considered while planning for and delivering education.

Diversity is also a function of human abilities, capabilities and capacities. Though people are not equally endowed, all are capable of being productive. Notions of rights demand inclusion, hence educational principles and practices to cater for all learners (general education) and an education for specialised outcomes (professional). Moreover, developments in local and international laws and regulations, policies for education and its role in human and economic capital development present us with a diversity of contexts and formats for education, hence the terms formal, informal, non-formal, semi-formal, or quasi formal. These also lead to individuals re-engineering themselves, hence career shifts and transformation, leading to 'late/mature entry' learners in all disciplines, including in music, at higher education.

Indigenous Knowledge Systems

In its broadest terms, culture incorporates what we do, how, why and with what we do it. Our *raison d'être*, that which spells out who we are, is the backbone of our behaviour and relationships. There is a vast array of information that contributes to, dictates and regulates these activities and positions.

The information that makes up a people's existence is incorporated in units that contribute to and draw from each other. The relationships in communities, between individuals, between humans and deity, between humans and the environment, are part of this system of things that spell out what is indigenous to a community.

The systems are multidimensional and, from an academic perspective, cover knowledge and ways of transmitting it. The content, contexts and processes of teaching and learning are key components of a people's culture. They play a big role in determining who the people are, because that is how new members are socialised into the community.

Transdigital Cultures

Teaching and learning inform society, and contribute to, while drawing from, the people's way of life. Digital content and procedures influence what we do, the way we do it, and the way we access and perceive data. We have digital cultures that traverse our spaces. This is part of the growing human diversity that education must cater for. Indigenous knowledge systems are now invaded by new procedures of doing things (technologies) and the resulting products. These affect the way cultural content is disseminated in education, and how it is packaged for consumption. These impact the way music is taught in higher education, and what is taught in the name of music.

Conceptual Underpinnings

This paper is anchored on the concept of music as a body of knowledge with content and processes determined by the circumstances of its making. As a cultural expression, music is born of cultural moments, and serves cultural needs and ends. It is part of activities of socio-cultural significance that give it meaning and relevance and to which it contributes meaning and relevance. This is a symbiotic relationship that explains the nature of music as an event or activity. Music is also an object, a work of art, an aesthetic entity. Music is, however, first and foremost conceived of as sound, and is thus a concept. This three-mode view of music (Akuno, 2016) provides a broad lens for viewing the cultural phenomenon under reference - a concept, object and activity.

As a body of knowledge, it divulges the identity of its makers being a portrait of their existence. It further presents life in a virtual form, being not the reality of life, but an expression and reflection of that reality of life (Akuno, 2016). These two are because its content is born out of specific contexts.

The information contained in music is of both a cultural and aesthetic nature, and thus music is a complex system of knowing and communication. Being made up of various activities and symbols, it requires various senses to decode for its understanding. As an event, music is multimodal in its expressions. Indigenous music, for instance, captures the human attention first through sound, a combination of duration and pitch that result in melodies and harmonies, whose identity is further articulated through the types of instruments used, hence adding the quality of timbre to the definition of music. But it is also perceived in the actions of its performers, and the response of its audience, hence dance is a component of this expressions. Its production, within articulated contexts, reveals the employment of various devices, including costume, speech and technological contraptions, making the practice of music a multimedia event.

The learning of music in African cultures is primarily participatory. This requires that each learner engages in certain activities through which they make meaning of the event around them. Through playing a drum, a learner simultaneously develops performance skills while assimilating the aesthetics and technical concepts of the music played. Constructivism declares that learning, an active, constructive process, allows students to construct their own learning from the experiences and materials presented to them in a learning environment (Cooper, 1993; Ertmer & Newby, 1993). Life itself is the most inclusive learning environment, and the performance of life through music activities is a viable educational activity.

Music: Content, Concept and Process

In discussing the challenges to music education, this paper starts by laying out principles that define and explain what it is that constitutes music. This understanding underscores its place in human existence, and will help clarify its dynamics with respect to human diversity, and implications for education in and through music.

As a human activity, music presents itself in formats, processes and roles determined by its makers (and consumers). Human activity results in relationships, meanings and contexts that find expression in music. Music is more than just sound and/or practice. It is an expression of culture, so human diversity has significant impact on what we do as music, and how we perceive music. Multimusicality is the norm for many communities, thanks to modern technology and efficient information transmission processes. It challenges the traditional identification of music as belonging to specific peoples because of myriads of borrowed attributes. There are also diverse applications and appreciations of music.

Music is a cultural activity whose presentation shifts with the media in place. The issues around the generation, storage and dissemination of music are tied to a people's economy. This cultural ownership speaks to music production as both a creative process and a technological outcome. Modern technology, commercialisation and commodification of music (product and process) result in new art forms and ways of dealing with sound, which inform and transform the reason, mode, materials, venue and outcome of music education. With human diversity, there is an expanded range of activities and resources for music. The impact of technology, globalisation, inter-cultural borrowing and exchange, new techniques and activities involving music, new events that qualify to be 'music', recourse to multi-media activities that merge music with other expressions, all demand broad knowledge, skills and technologies of other arts, networks and collaboration.

Music Education: The TUK Model and Experience

The music programme at the Technical University of Kenya, designed to fit into the university's mandate of tooling the industry, leads to qualifications from certificate to doctoral degree qualifications. Built on the premise that every discipline and profession has technology that supports it, and the desire to turn every graduate into an entrepreneur, the programme contains technology and business knowledge and skills courses that prepare learners for the wider world of work and gainful employment. The course structure at undergraduate level is designed to inculcate pride in actual (hands-on) work with music sound and materials. Every student learns to create music, to talk about music, to see the insides of music and to disseminate the same, using traditional and modern (electronic) technology. Learning is built on both oral procedures where the example of a model is copied in the practical performing classes, and in discovery, where learners are led to make meaning of various music environments and activities, thereby constructing knowledge based on prior knowledge and developed capacities.

Traditionally, the communities' music expressions form the basis of music instruction. With access to cross- and trans-border cultures, and with the growth of the transdigital culture, the teaching and learning of music at TUK covers these emerging expressions to ensure that graduates can function globally. This is already evidenced in the way learners are able to fit into music-based activities at international conferences and festivals during the AMDP programme that saw students go to Zanzibar, Zimbabwe, Cameroon and Malawi on internship.

Challenges to Higher Music Education

Music education is the process of capacity building of individuals so that they can behave musically, a behaviour that follows the capacity to derive meaning from a musical stimulus. It is hinged on a concept or understanding of what music is. This being a human activity presupposes certain understood characteristics of humans, because it is a cultural event.

Several socio-cultural issues must be tackled by higher education for it to be relevant in all spheres of human development. Below are some with direct impact on music education.

Conceptualisation

The phenomenon we traditionally see as music changes with expansion of cultural horizons. The diversity of humans diversifies our conceptualisation. Therefore, the definition of music also changes. A friend once told me that for him music was *nyatiti* and Mozart. Today, the mass of mechanically and electronically generated sounds and the odd movements make 'music' even more complex.

Scholars use the term musical arts when considering the cultural spectacle that translates to 'music' (Herbst, Nzewi & Agawu, 2003). This principle allows for extra-cultural resources in conceptualising music. These must be accommodated in theorising, planning and delivering education through music and music education.

Contextualisation

Where is music practised and how? What media are used? How stable are these? The transdigital cultures are in a constant state of flux. New technology and media are developed at such a high rate that the product of their application and manipulation transforms equally fast. This has impact on the content of music education because the content, in terms of definitive elements of music, are context determined. The media of music change, influencing the sound of music, especially with respect to timbre. (Zake (1986) mentions the change in the tone quality of the *obokano* resulting from the use of a metal basin and nylon strings for resonator and strings respectively.)

Manifestation

The display of music - the aesthetic object, the work of art - has metamorphosed over the years because of philosophies, ideologies, the impact of technology and human

creativity. The diversity of humans in the (Kenyan) classroom implies a diversity of objects that qualify to be called music. This is imperative if the objectives of (music) education facilitating the enhancement and propagation of culture are to be achieved.

Manipulation

The traditional ways of making music assume traditional materials of making music. The human diversity brings with it innovative ways of handling the traditional materials. It further opens up opportunities for innovation of resources. The former includes keyboards that are now stepped on or hit with balls to produce music, the flutter on flutes, glissandos; while the latter presents even the now common electronic keyboard with pre-recorded sounds, where a full band sounds are generated from one finger action.

Conclusion and Way Forward

In the wake of the dynamics of culture pursuant to human diversity, it remains to state what culture is. This guides decisions on what is called music as well as the articulation and generation of philosophies, modalities and materials for teaching it. For a long time, higher music education in Kenya has been pegged on western classical traditions where both the cultural content and the delivery methods formed the core of what went on in teaching and learning. Recent research clears the path for tilting the curriculum towards a more Afrogenic curriculum, albeit still with a lot of European principles.

African music, and its instruction, is built upon an understood knowledge system shaped by the diversity of cultures in Africa. While there have been shared and common attributes to this music expression, chief of which has been its purely oral mode of delivery and its participatory practice, the presence of new expressions and new ways of expressing them impacts on the content of the music. This, an offshoot of the context of the music making, further complicates the processes of dissemination, teaching and learning.

For music education to successfully enable one to gain meaning in the presence of a music stimulus, and to behave musically, it should be designed to ensure the following are adequately managed:

Media of Music

The learners are socialised to master existing and open to appreciate emerging as well as create new media of music.

Multimusicality

In a multicultural world, training in music, the organ of culture, demands multicultural learners for the cultivation of cultural intelligence (Earley & Ang, 2003), learners are effectively multicultural. Learning should result in people's ability to function well in environments of diverse cultures. Music education that tools individuals to behave musically in a culturally appropriate manner looks towards developing multimusicality in learners, proficiency in multiple types of and systems of music with attendant cultures.

Methods of Delivery

Akuno (2016) indicates that the content of music provides guidance on how to teach it based on inherent processes. Due to the multiple concepts of music emerging from multiple contexts of its generation, methods of teaching will traverse the formal, informal and non-formal approaches. The transdigital cultures now add digital approaches to teaching and learning, ways that will bring music to learners' immediate access and experience.

Internationalisation

The UN conventions, national and international development plans and Kenya's constitution among others, place culture at the heart of policies that impact on conceptualisation, planning and implementation of (music) education. UNESCO Road Map for Arts Education (UNESCO, 2006) is a blueprint that provides guidelines on the implementation of arts education that is culture sensitive. Music education must also prepare learners for global citizenry. So, inculcation of international standards and concepts into the curriculum will go a long way in facilitating this.

Human diversity is an opportunity to diversify the content and concepts and processes of music education towards cultural relevance and effective socialisation of learners into the wider world of cultural practice and participation. The diverse music experiences will allow learners to construct their knowledge from the provided environment, making them relevant to the practice of music.

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Traditional Rainmaking in Scholarly Literature: A Bibliometrics Analysis

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Abstract

Traditional rainmaking is a form of magic or prayer through which human beings influence weather conditions to cause rain or drought so as to bless or curse a community. The purpose of this study was to analyse the quantity, quality and visibility of traditional rainmaking publications in scholarly literature. The author used bibliometrics to conduct this study. Bibliometrics is the measure of publications in terms of authors, affiliations, citations from other publications, co-citations with other publications, reader usage, and associated keywords. The data for this study was collected from Google Scholar using Harzing's Publish or Perish software. The data was analysed using VOSviewer software. The findings of the study revealed only 39 publications on traditional rainmaking. The majority (21) of these were journal articles. There were also nine (9) books and book chapters; eight (8) theses (one BA, two MA and five PhD); and one (1) conference paper. The oldest of these was published in 1978 while the latest was published in 2018. The major themes covered in the publications were rainmaking, climate change, conservation, adaptation and African traditional religion. The publications were mainly contextualised to southern Africa, Zimbabwe, Kenya and Tanzania. The publications drew low citations with 17 having no citations at all. No meaningful social network of the authors was observed. The findings of this study may be used to enhance the quantity, quality and visibility of scholarly publications on traditional rainmaking and other forms of indigenous knowledge as a means of leveraging their access, use and impact on socioeconomic activities in society. Traditional rainmaking, in particular, can be used to enhance community response to climate change and food security. No study known to the author has conducted a bibliometrics analysis of literature on traditional rainmaking. Therefore, this study is original in terms of its approach and coverage and is likely to generate new content in indigenous knowledge systems and management.

Keywords: Traditional Rainmaking, Scholarly Literature, Bibliometrics, Social Network Analysis, Citation Analysis

Introduction

Rainmaking is a deeply rooted tradition in a number of communities, especially in Africa. Traditional rainmaking is a form of magic or prayer through which human beings influence weather conditions to cause rain or drought so as to bless or curse a community. Akong'a (1987) explains that rainmaking could be a public event in which members of the community participated freely. He explains further that it could also be a private function led by known rainmakers able to diagnose the causes of either drought or too much rain and have the power to reverse the situation. Frazer (1942) explains that rainmakers were so influential that they could climb up the social ranks to be chiefs or kings in their communities. Were (1972) concurs with Frazer (1942) and cites a case where a Luhya ruler in Western Kenya was replaced by a foreigner - a Maasai - because he could not intercede and make rain during a devastating famine. Akong'a (1987) further suggests that rainmaking tradition may have emerged from the communities living in the arid and semi-arid regions as a means of coping with or mitigating unreliable and/or inadequate rainfall. Nonetheless, he acknowledges that rainmaking is also practised in some communities living in areas experiencing adequate rainfall. He says that in the latter case, rainmaking is a prestigious profession practised by elite's keen on helping or exercising control over their communities. Regardless of its history, rationale or practice, the emerging challenges in climate change is steadily turning people's attention to this traditional practice. In Kenya, the Akamba, Maasai, Meru, Kikuyu and Luhya are some of the communities practising traditional rainmaking in Kenya.

The Akamba community held special rituals and dances known in their language as *kilumi* to pray for rain during droughts. The prayers were led by rainmakers or prophets who were believed to have the power to redirect or predict rainfall. Accounts of the actual procedures during rainmaking rituals are varied. However, there is some level of consensus that *kilumi* generally began with libations and prayers followed by beating of drums, blowing whistles, shaking rattles, singing and intense, vigorous dancing. The community believed that unseen rainmaking ancestral spirits attended the dances. The participants therefore were obligated to make a n excellent performance to impress the spirits.

Korster (2011) and Akong'a (1987) explain that *kilumi* dances were also accompanied by sacrifices such as the blood of animals, milk, seeds, crops, beer or cooked food to appease the spirits. This is because droughts were considered as curses for

wrongdoing. Successful *kilumi* dances ended with celebrations as the community members expected a favourable response of rain from the spirits. Most *kilumi* rituals were public requiring the participation of all members of the community (Akong'a, 1987; Korster, 2011). Indeed, Akong'a (1987) explains that rainmaking occasions were chosen and announced in advance by old men or the rainmakers. The actual day was sacred and the members of the community were supposed to observe peace and purity; abstaining from quarrels and sex.

Another well-known rainmaking tradition in Kenya is practised by the Nganyi clan of Bunyore sub-tribe of the Luhya community living in Vihiga County, Western Kenya. It is believed that Nganyi, the patriarch of the clan was taught the art of rainmaking by an old lady from the neighbouring Nandi County. Other accounts, though agreeing that Nganyi was indeed taught the art by a foreign lady, suggest that the said lady was from Gwassu in Homa Bay County across Lake Victoria. As opposed to other rainmaking traditions, the Nganyi rainmaking power is only in the patriarch's family and is inherited by his kinsmen. These rainmakers practise their magic secretly - not even in the company of their heirs - only bequeathing the power when he is nearing his own death. For this reason, the details of the actual rainmaking process among the Nganyi family remain the guarded secrets of the rainmakers. The rainmakers are given livestock, money and other gifts to make rain to fall during drought or not fall during an important occasion such as a wedding or sports day. Akong'a (1987) reports that the apparent belief in the power of traditional rainmakers was exemplified during Kenya's independence celebrations in 1963 when a Nganyi rainmaker was invited to Nairobi to ward off any rainfall during the historic occasion. To date the belief that the rainmakers have the power and medicines to cause or repel rain is still rampant in Western Kenya. Similar practices have been reported among the Maasai, Meru and Kikuyu with minor variations. Nonetheless, they are similar in several respects and closely mirror the biblical story of Prophet Elijah who caused rain to fall in Israel after a devastating three-year drought.

Similar rituals and rites also happen in other countries in Africa such as South Africa, Zimbabwe and Tanzania. Mambondiyani (2016) in an article published by *Reuters* explained that the traditional practice is resurgent in Zimbabwe due to persistent and frequent droughts in the country. Rainmaking events in Zimbabwe are marked by singings, blowing whistles and ululations. The events are led by known rainmakers, elders or traditional leaders. In South Africa, rainmakers were

community leaders, sometimes tribal chiefs, who were believed to have mystical power over weather conditions (Dornan, 1927). During the 10th *International Conference on Knowledge Management in Organisations* held in Kaohsiung, Taiwan in 2013, the participants in a session on indigenous knowledge management confirmed that traditional rainmaking was practised in the Philippines, Malaysia and Indonesia. However, there is scanty literature on the practice in these countries.

Rationale and context of study

Indigenous knowledge (IK) is defined as the unique, traditional, local knowledge existing within and developed around the specific conditions of people indigenous to a particular geographic area (Grenier, 1998). IK is the local knowledge which is unique to a given culture and society. IK can also be perceived as the knowledge, innovations and practices of indigenous communities in matters related to agriculture, environmental management, medicine and health, among others. Therefore, IK is the anchor for survival and stability in indigenous communities and acts as the information base for local-level decision making in agriculture, health care, food preparation, education, natural resource management, and a host of other activities in rural settings (Warren, 1991).

Ocholla (2007) explains that in spite of its potential value, IK has been marginalised over the years thereby retarding its development and integration. He explains that IK may have been marginalised because of its nature as tacit knowledge which is not codified or systematically recorded and therefore difficult to transfer or share; it lives solely in the memory of the beholder and is mostly oral, meaning that unless transferred, it dies with the bearer; it is embedded in the culture/traditions/ideology/language and religion of a particular community and is therefore not universal and difficult to globalise; and it is mostly rural, commonly practised among poor communities and is therefore not suitable in multicultural, urban and economically provided communities. Marginalisation of IK has also occurred because families and communities are becoming increasingly disintegrated and globalised, a trend that may have stemmed from the push and pull of technologies, and the over-extensive supply of mass products, services and mass media gadgets and content to private spaces where IK once thrived.

Ocholla (2007) suggests that development and integration of IK may be achieved in six steps 1) identification and recognition; 2) validation and affirmation; 3) codification and documentation; 4) IK storage for retrieval; 5) IK transfer; 6) and

IK dissemination and use. This study focused on the dissemination and use of indigenous knowledge as a means of de-marginalising it. Taking the example of traditional rainmaking, the purpose of this study was to analyse the quantity, quality and visibility of scholarly publications on the practice. The specific objectives of the study were to analyse the number of publications on traditional rainmaking published in scholarly channels as well as their citations, access and use patterns.

Methodology

This study was conducted using bibliometrics methods. Norton (2001) defines bibliometrics as the measure of texts and information. He identifies the information associated with publications to include author, affiliation, and citations from other publications, colcitations with other publications, reader usage, and associated keywords. Bibliometrics is traditionally associated with the quantitative measure of documentary materials and embraces all studies that seek to quantify the process of written communication. Bibliometrics methods are used especially in studies of properties and the behaviour of recorded knowledge to analyse the structures of scientific and research areas and to evaluate the research activity and administration of scientific information (Wormell, 2001; Ungern-Sternberg, 1995). The data for this study was collected from Google Scholar. Using Harzing's Publish or Perish software, the author searched for the phrase "traditional rainmaking" to harvest all publications with that exact phrase either in their titles or content. The data was analysed using VOSviewer software.

Findings and Discussions

The data was collected on 15 January 2018. A total of 59 publications were initially harvested. After cleaning to remove duplications, typographic errors and irrelevant publications, 39 were identified as relevant for the study.

Quantity of publications

As stated earlier, only 39 publications on traditional rainmaking were found in Google Scholar. The majority (21) of these were journal articles. There were also nine (9) books and book chapters; eight (8) theses (one BA, two MA and five PhD); and one (1) conference paper. The oldest of these was published in 1978 while the most recent was published in 2018. Figure 1 shows the distribution of the publications over the years.

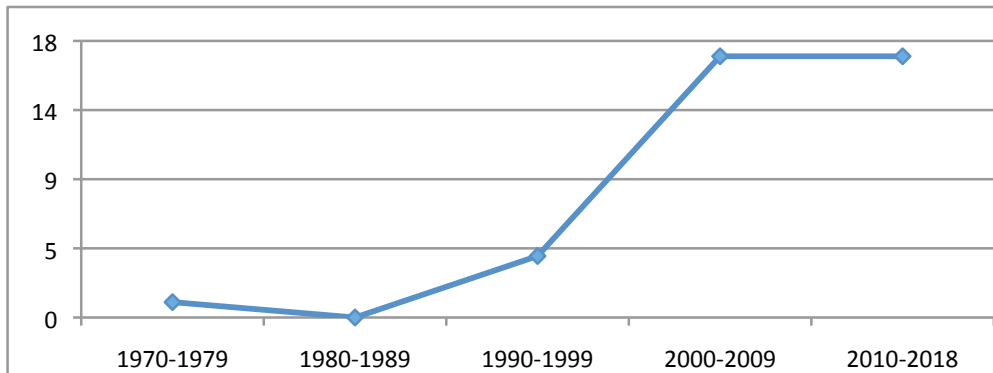


Figure 1: Publication distribution

Quality of publications

The quality of publications in this study was assessed based on citations. A book by P Zaleski and C Zaleski titled “Prayer: a history” published in 2006 was the most cited at 68 times. This was followed by a 2008 journal paper titled “Climate change during the iron age in the Shashe-limpopo basin, southern Africa” which was cited 58 times; a PhD thesis written by ME Murimbika in 2007 at University of Witwatersrand in South Africa (53 times); another thesis written by CE Farhadian in 2007 at the University of Cambridge (32 times); a book titled “Reinventing the Lacandon: Subaltern Representations in the Rain Forest of Chiapas” published by B Gollnick in 2008 (18); a journal paper on “Agroforestry systems for sustainable livelihoods and improved land management in the East Usambara Mountains, Tanzania” (17); and another journal article titled “The Role of ‘Dingaka tsa Setswana’ from the 19th Century to the Present” which was cited 14 times. 17 other publications were cited less than ten times. Notably, another 17 publications had not been cited at all. All the publications were cited a total of 314 times over the span of 40 years since the first publication in 1978. These citation patterns indicate a perception of low quality of the publications.

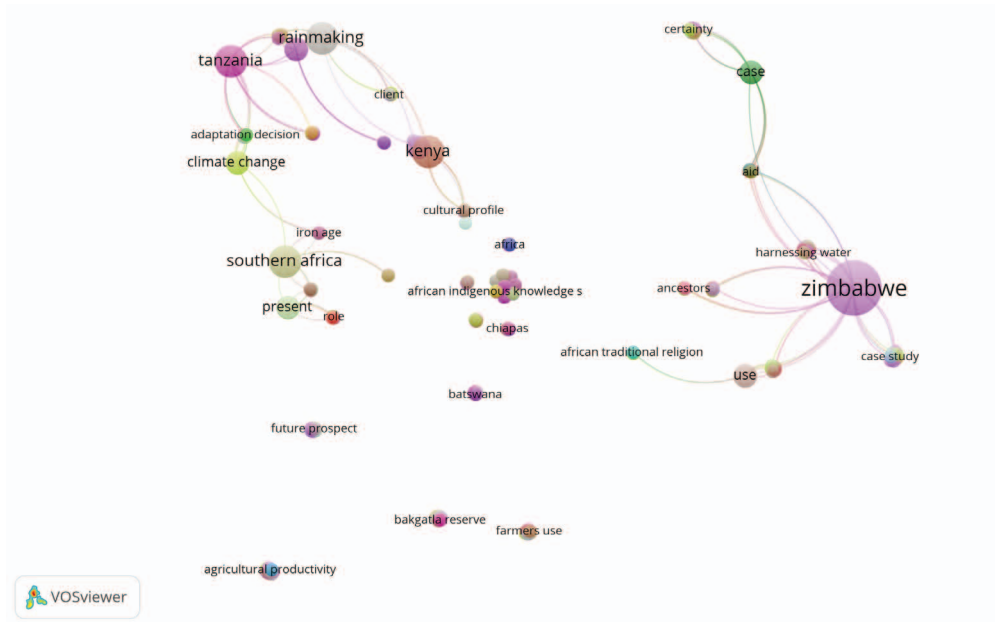


Figure 2: Analysis of themes of the publication

Figure 2 presents an analysis of the themes of the publications based on their titles. It is evident from the analysis that most of the publications were about or published in Zimbabwe followed by southern Africa, Tanzania and Kenya. The other prominent themes in the publications were rainmaking, climate change, African traditional religion, agricultural productivity and climate change adaptation. The prominent presence of the concept of case study indicates that a number of the publications were case studies.

Visibility of publications

The visibility of a paper is a major determinant of its usability. In the context of this study, visibility was perceived as the measure of ease of identification and access of the work. One clear determinant of visibility observed in this study is the channel of publication. The majority (30 out of 39) of publications were in the hands of commercial entities either as book or journal publishers. These publishers are interested in profits and have set exorbitant fees for accessing their publications. Only the theses and conference papers were available through open access platforms. Therefore, the author concludes that the publications were not adequately visible. This low visibility in turn limited the access, use and citation of the publications.

Social network analysis

Social network analysis (SNA) is the mapping and measuring of relationships and flows between people, groups, organisations, computers, and other entities. The nodes in the network are the people or groups while the links show the relationships or flows between the nodes. The strength of a network is determined by the number of nodes in it as well as the connections between them. A social network can be based on myriad relationship types. In this study, social networks of authors of the publications on traditional rainmaking was analysed based on co-authorship. From Figure 3, it is evident that there were no meaningful social networks of the authors of publications on traditional rainmaking. This finding indicates that so far, the authors work independent of each other. This may be because traditional rainmaking can be considered from diverse perspectives thereby drawing authors from different backgrounds who may not be interested in collaboration and networking with each other.

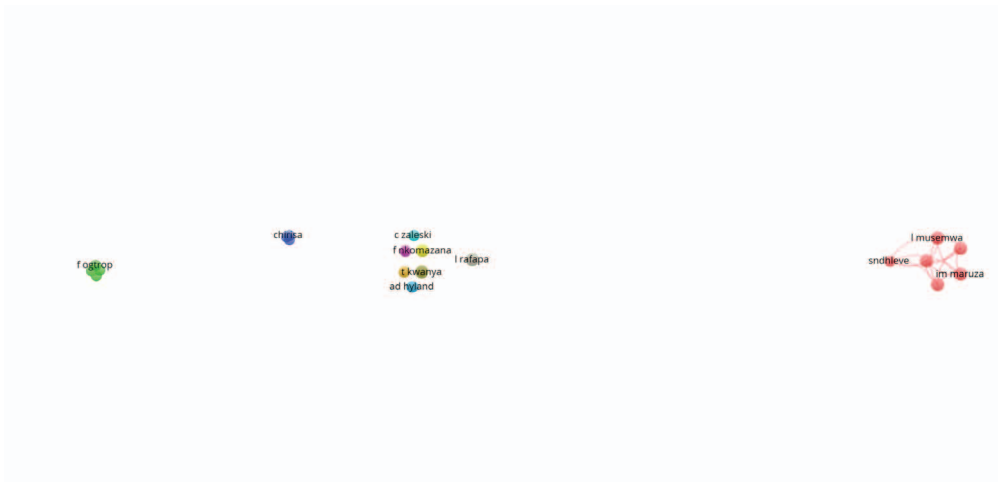


Figure 3: Social network analysis of the authors

Conclusion

From the findings of this study, the author concludes that with only 39 publications over 40 years, the presence of publications on traditional rainmaking in scholarly literature is low. Similarly, the quality of the publications is low considering that they have been cited a total of 314 times. The publications are controlled by commercial entities which have limited their visibility with exorbitant fees and other stringent

terms of access and use. There is need for strategies to enhance the quantity, quality and visibility of publications on traditional rainmaking in scholarly literature.

Recommendations

The following strategies may be used to enhance the quantity, quality and visibility of publications on traditional rainmaking in scholarly literature:

1. Stimulate interest in traditional rainmaking by de-stigmatising it and demonstrating its relevance especially as a response to the growing threat of climate change;
2. Nurture the collaboration between traditional rainmakers and scientific researchers to validate traditional rainmaking practices and claims;
3. Introduce traditional rainmaking concepts in the relevant academic programmes in disciplines such as information and knowledge management; environmental science; meteorology; and geography; among others;
4. Develop research programmes and increase the funding for multi-disciplinary, multi-institutional and cross-border projects on traditional rainmaking; and
5. Encourage authors of publications on traditional rainmaking to publish in open access channels to expand the reach and use of the publications.

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Section Six:
MEDIA, SOCIETY AND
GOVERNANCE

Role of the Mainstream Media in Kenya's Electoral System towards Social Responsibility: Special Focus on the August 2017 Presidential Election

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Abstract

This paper seeks to establish the social responsibility function of the mainstream media especially around ethical and professional guidelines. The research question is, "can the mainstream media be trusted to provide balanced, factual and objective information without any bias and subjectivity, or partisan interests on salient issues such as elections to help the Kenyan consumers make informed choices?" The paper is anchored on the assumption the mainstream media in Kenya has, over the years, not met its professional threshold when covering matters of national importance such as presidential election. The main objective of the paper is to establish if the mainstream media has adhered to professionalism as spelt out in the Code of Conduct for Journalists. The study used desk research to collate literature in line with its main objective. The focus was on the August 2017 presidential election. From the literature that was referred to, it was established that indeed the mainstream media failed to remain balanced, objective, factual and truthful in the way they covered the August presidential election and hence leaving the country more polarized and divided than ever. Thus, it failed in its social responsibility mandate. The paper concludes that in order to remain relevant to their core mandate, the media needs to adhere to their ethical and professional guidelines in discharging services to the Kenyan public. The media needs to play the role of uniting Kenyans during divisive electioneering periods as opposed to dividing them.

Keywords: Mainstream Media, Performance, Integration, Society, Politics, Ethics

Introduction

Kenya has a vibrant media, among the most respected in Africa. The media have continued to play a crucial role in the socio-economic development of the nation through disseminating information, holding a mirror to society, providing a platform for civic engagement, and holding the government to account.

Over the past year, the media have marked a major milestone in promoting democracy and good governance by holding the first-ever presidential debates just before the General Election in March. The series of debates provided an opportunity for Kenyans to analyse and scrutinise the candidates' performance records, election promises, and development plans. A number of new publications and broadcast programmes have been launched, helping to diversify the content available to the public.

The media industry continues to grow, taking advantage of new technologies and the people's increased access to better mobile and internet connectivity. As county governments came into being, the media responded with news gathering and content strategies that focus on the new regions.

However, over the last few years, the mainstream media in Kenya has come under sharp focus and put on the spotlight over how they have discharged mandate especially in relation to the manner in which they have covered salient issues such general elections. The media have been accused of abdicating their social responsibility role by being partisan, subjective, biased, and willingly withholding factual information on matters of concern such as general elections in Kenya; that are normally emotive, and more often than not, leave the country very polarized along ethnic and political lines after every five-year electoral cycle. The People's Choice Study that was conducted in America in 1940 found out that many voters make up their minds on whom they would vote for despite being exposed to certain media messages that advocate for certain politicians while the undecided seek guidance from opinion leaders. So the role of the mainstream media comes into focus (Media Watch, 2017).

The purpose of this paper was to explore the social responsibility function of the mainstream media in Kenya, especially around ethical and professional guidelines in reference to the way they report elections, more so the August 2017 presidential election; whose results were contested in the Supreme Court of Kenya and eventually nullified for failing to meet the threshold of a free, fair and credible election. The

research question that the paper sought to answer was whether the mainstream media could be trusted to provide balanced, factual and objective information without any bias and subjectivity, or partisan interests on salient issues such as general elections and guide the consumers of its content to make informed choices?

Background

This paper presents a theory of the influence of the mainstream media exert on society and cultural integration. It attempts to answer the question: What are the consequences of the media not playing its critical role in societal institutions and among diverse audiences that depend on it for decision making on salient issues that affect them such as elections? Thus, the paper tries to explore classical question on how the media affect society and help in social integration. Traditionally, the media have been conceived of as separate from society and culture; consequently, researchers tended to focus on the effect certain mediated messages had on individuals and institutions. For example: front-page headlines during an election campaign might be thought to exert influence on people's voting behaviour, advertisements to affect consumers' shopping preferences, and film content to affect the viewer's morals or to distract attention from matters of greater urgency or significance. Contemporary society is permeated by the media, to an extent that the media may no longer be conceived of as being separate from cultural and other social institutions (Nordicom, 2008).

An understanding of the importance of the mainstream media in modern society and culture can no longer rely on models that conceive of media as being separate from society and culture. Media are not simply technologies that organizations, parties or individuals can choose to use – or not use – as they see fit. A significant share of the influence media exert arises out of the fact that they have become an integral part of other institutions' operations, while they also have achieved a degree of self-determination and authority. The duality of this structural relationship sets a number of preconditions for how media messages in given situations are used and perceived by senders and receivers, thereby affecting relations between people. Thus, traditional questions about media use and media effects need to take account of the circumstance that society and culture have become mediatized.

Literature Review

The paper reviews literature that touches on the main objective; that is the social responsibility role of the mainstream media in social integration. It is important to note that the media does not operate in isolation; there are other players within the environment that may affect or dictate the way the media discharges their mandate.

Media Landscape in Kenya

Mbeke, Ugangu and Orlale (2010) posit that, as the case in any society, the development of media has over time been influenced by the social economic changes in Kenya. Mittulah (2012) opines that under President Jomo Kenyatta and Moi, government control of the media and media practice remained under tight control. The history of the Kenyan media in the 1970s and 1980s is filled with episodes of state interference, harassment and torture of journalists. This gave rise to media self-censorship where journalists gave certain stories a wide berth if they sensed that they would attract official anger. Media ownership at the time was restricted to the government, with the handful private investors playing safe.

The re-introduction of multiparty democracy in 1991 after a long stretch as a single party dictatorship heralded a major opportunity for the media. The ownership base expanded and media content became bolder. This progress has not, however been accompanied by more progressive legislation to entrench media freedom in the country. The 1990s saw spirited attempts, mainly by the government, to create laws that would curtail rather than expand media freedom (Green & Karolides, 2005).

The promulgation of Kenya's constitution in 2010 gave rise to new devolved units aimed at getting journalists to tell the devolution stories if only to hold the government to account. Consequently, there was considerable interest in evidence-based journalism. The process is ongoing and it is difficult at the moment to tell if the uptake has been consistent (Mbeke *et al*, 2010).

Media Ownership in Kenya

McQuail (2005), states that the earlier mass media of press and broadcasting were widely seen as beneficial (even necessary) from the conduct of democratic politics. Considering the fact that those who have the resources to own media organizations will always have the upper hand in terms of prominence in news, they also limit access to information and discourage active participation and dialogue.

The country, though generally poor by global standards, boasts of a high literacy rate and a dynamic economy that, according to Ismail and Deane (2008), has one of the most vibrant advertising markets on the continent and a population that voraciously consumes news and information. This description sums up the factors that have led to the evolution of the dynamic media landscape in the country.

Types of Media in Kenya

Ugangu (2012) explains that, broadly, the type of media in Kenya can be classified as private media, the public state broadcaster, community radio, the alternative press, international media, and new media. Another school of thought has tended to broadly categorize the Kenyan media into two types as mainstream and alternative media. Makokha (2010) attempts to compare the two terms as used locally in Kenya by noting, for instance, that the term “mainstream media” refers to those media channels that are accessible to the greatest proportion of the population because of certain similarities in their professional pursuits.

Thus, Ugangu (2012) is of the view that, according to this author Makokha (2010) mainstream media are also those that are perceived to be run professionally with a cadre of professionally trained journalists forming the core of their ranks in staffing. As a result of these attributes, mainstream media are therefore perceived as being ethical and professional in the way they operate. On the other hand, publications that reach only a small target group and are not published regularly have been referred to as alternative media. Alternative media are also generally perceived to care less about the norms of good journalism so that they will publish a story without due regard to accuracy of facts.

It is moreover important to note, as Makokha (2010) does, that developments in the media sector have interfered with the (formerly) clear-cut distinction between mainstream and alternative media. Each local language radio station, for instance, only targets a particular ethnic group, but together they reach a large portion of the Kenyan population. So when media targets a certain segment of the population with information, that should reach the general population, then they are failing in the social responsibility mandate because that kind of information delivery discriminates the audience that expects to make decisions based on what the media has projected to be important; in other words, play its agenda setting role in guiding those that depend on it for direction.

Media Policies in Kenya

This section looks critically on how the various types of media policies in Kenya have contributed to media operation; how the media collects information, plays the gate keeping role and eventually release information to the general public. What guides or dictates the action and with what consequences on the target audience? Some of the media policies have been retained by successive governments and used to gag the media whenever they feel the media is intruding into government operations.

Media policy includes formal controls of media operations such as laws governing copyright, protection of personal liberties, restrictions on contents, and official policies regarding allocation and revocation of frequencies and licenses. It can also include informal controls at operational level, such as Codes of Ethics and internal operating procedures relating to such aspects as standards of content, advertising rules (Dominick, 1994). They include the following:

Ownership and Control: The Policies that regulate ownership and control are important in order to create diversity and remove the concentration of media power from the hands of a few. A concentration of services in the hands of a small number of operators can hinder the free flow of objective and balanced news, commentary and debate in a democratic society. Media ownership and control rules are vital to ensure that a diversity of news and commentary is maintained. Limiting cross-ownership is especially important to promote diversity (Dominick, 1994).

Licensing: Media is a business like any other, and market controls are necessary, to govern the number of players, how they enter the market, and how operations take place. For instance, in broadcasting, policies relating to signal/band distribution/allocation are necessary to remove conflicts in business operations and other issues such as to avoid interference with security or aeronautical signals. Planning allocation and distribution is necessary also to assist the government preserve the public interest, such as national cohesion, security – by keeping track of the operators and their operations.

Standards on content: Media and communications services should reflect high level of professional standards and community expectations. Policies and regulation related to content and standards ensure that the media operates in an ethical manner, maintaining high professional standards, and observing the basic principles of news gathering and dissemination – fairness, accuracy, transparency

and decency (Owen 2008).

Preservation of the public interest: Media have a role to play in social order, and regulation and policies are needed to ensure that the media does not undermine the preservation of the public interest, but rather, play an active role in propagation of positive social norms. This includes preservation of national security and social cohesion, and promotion of what is good in society e.g. cultural identity. Absence of such regulation will lead to anarchy and social and civil upheavals. Such policies and laws also try to ensure that the nation's character, cultural identity is reflected in content; if left to the market alone, some culturally significant forms of national character and identity content, such as drama, documentary and children's programs, would be under-produced or lost completely (Constitution of Kenya 2010).

The Kenyan Constitution chapter 33, 34 and 35 of the 2010 guarantee freedom of expression, freedom of the media and access to information. However, these freedoms are subject to conditionality such as not extending to propaganda for war, incitement to violence, hate speech and advocacy of hatred and respect of other people's rights and reputations (Constitution of Kenya 2010).

Theoretical framework

The paper was guided by the normative theory of the press. Fourie (2005) argues that, normative theory of the media provides a yardstick against which media performance, accountability and quality could be measured and if need be, controlled. In other words, normative theory is concerned with the roles that media ought to play in society. Ugangu (2012) opines that these roles are defined variously, from one society to the other. These roles are defined variously, from one society to the other. The four theories of the press by Siebert, Peterson and Schramm (1956), for instance, identified 'freedom of expression' as an important tenet that sets one media system apart from another.

Some of the core questions embodied in normative media theory seek to address the type of content that media publishes the degree to which this concerns the public and how the media reflects different perspectives in society. Other concerns include perceptions about public interest and the reasons for this, definitions of public interest and the social responsibilities of the media (Fourie, 2005).

Normative theories are, however, significantly different from other theories. Baran and Davies (2000) point this out by noting that normative theories do not describe

things as they are, nor do they provide scientific explanations or predictions. Rather, they describe the way things should be. In other words, they set out an ideal by which some principles or values could be realized.

Additionally, normative theory provides understanding about the very organization of the media in legal and financial terms, and how this fundamentally touches on their core roles as carriers of values. Principles such as accuracy, objectivity and public sensitivity are thus emphasized by Ugangu (2012).

In any given society, there is always a multiple set of views regarding what the media ought or ought not to be doing and on how well they are performing (McQuail, 2005). Ugangu (2012) further points out that these views normally tend to be public, institutional or private. Seen from this point of view, normative theory of the media may therefore refer to ideas of 'right' and 'responsibility' which inform those expectations expressed by individuals and society at large.

Methodology

This study employed used key informant interviews to collect qualitative data from key respondents from mainstream media and one key political analyst. The respondents were identified through purposive sampling.

Research design is the strategy, the plan and the structure of conducting a research project (Carriger, 2000). Qualitative research is concerned with developing explanations of social phenomena. Hancock (2002) explains that qualitative research aims to help us understand the world in which we live and why things are the way they are. It is concerned with the social aspects of our world and seeks to answer questions about why people behave the way they do, how opinions and attitudes are formed, how people are affected by the events that go on around them, how and why cultures have developed in the way they have.

The study used descriptive research design in its approach to collect data. This was appropriate because the design would help provide answers to the questions of who, what, when, where, and how associated with the paper's research problem: that is how the media covered the 2017 presidential election that was later nullified by the Supreme Court of Kenya. Descriptive research is used to obtain information concerning the current status of the phenomena and to describe "what exists" with respect to variables or conditions in a situation and hence relevant to the study (Anastas, 1999).

The study interview guide to collect qualitative data from key informants who were identified using purposive sampling from two mainstream media based in Nairobi, County and one renown political analyst also based in Nairobi. . The qualitative research interview seeks to describe the meanings of central themes in the life world of the subjects (Hancock: 2002). The industry has recorded tremendous growth since independence in 1963. From only one broadcaster the Kenya Broadcasting Corporation Initially the Kenya Broadcasting Service), inherited from the colonial government – the country today boasts 386 FM radio frequencies, 46 in Nairobi alone, and 105 TV frequencies allocated to state and private operators.

From just a handful of publications at independence, the media now publish 19 daily and weekly titles across the country (www.informationcradle.com). Given time limitation and insufficient funding the researcher identified two leading media houses in Nairobi TV, online, radio and newspaper divisions to give a balanced view based on the diverse audiences they target with their diverse channels

Findings

The study obtained information form key informants and the information in line with study objectives as follows:

How the Media Covered August 2017 Presidential Election?

The responses are presented below verbatim.

“It is true; a number of issues came to fore on how the mainstream media covered the 2017 presidential election. Journalists played a critical role in negotiating political and electoral discourse however, what came out was that people questioned the professionalism of some of the members of the press.”

On whether the principles of professionalism were adhered to, this is what a political analyst said:

“Some people felt that adherence to the principles of truth and accuracy, independence, fairness and impartiality was wanting. There examples of journalists who were perceived to be partisan. For example, Kameme FM broadcasters, some KTN and Citizen anchors and reporters did not hide their preference for political parties and candidates they supported in the way they framed their stories. And that some journalists, including well known television anchors, revealed their political biases by seeming to favour specific candidates and parties.”

“Another issue that was raised was that some journalists blurred the lines between the personal and the professional. This was especially problematic on social media platforms. The impartiality expected of journalists was viewed as compromised when they openly expressed their political preferences and by so doing abdicated their social responsibility and professional role and failed their viewers who depended on them for truthful, objective and balanced information on the election outcome.”

“In addition, while media houses called on dozens of “experts” and “analysts”, many couldn’t make contributions that justified their titles. Television stations paraded what they called “eminent” and “super” panels who added no value to the viewers. Beyond being large in size, the panels were often thin when it came to substance.”

On the role of the media, a managing editor from another of the leading media houses in Nairobi felt that:

“The elections also came with a range of issues which demanded various levels of inquiry and analysis. The knowledge of many journalists didn’t always match these demands. At times coverage was shallow and not critically engaging. He pointed out that most media houses, contrary to what is known out there, they do not operate independently.”

“The story goes back to the 2007/08 bungled elections. The media at the time operated independently and had their own tallying mechanisms parallel to the then Electoral Commission of Kenya. The reporters who were based in various tallying centres did their own tallying and relayed the results to their respective newsrooms. However, following government interference, that led to shutting down of live coverage of electoral process, media houses were warned to stop vote tallying because that was not their role; that was an official body mandated to do the tallying. The minister for internal security came in strongly to control media operations and this affected the way the media behaved in the subsequent elections in 2013 and 2017 elections. Most of the reporters who were sent to the tallying centres across the country were not expected to do any tallying of votes but merely report on the process of the exercise. So all the figures that were broadcast live were obtained from the IEBC.

On whether the media played its social responsibility role, the editor had this to say:

“In an ideal situation, the media should be independent, objective and balanced in the way it discharging its mandate. However, other economic realities come into play, such as advertiser’s interests, media owners and government interests. The government owes many media houses huge chunks of money in advertising, which it uses to gag it. So under such scenario balance, objectivity and balance are sacrificed for economic survival.”

“Ethical considerations in individual editors also come into play where personal gain overrides professional interests, and under such circumstances, professionalism is sacrificed at the altar of personal interests.”

The political analyst had this observation:

“Competition appeared to be the main guiding point. Media houses attempted to outdo each other on who carried which hot story. Contrary to the promise that they would give their own tally, they all went to the Bomas of Kenya, the official IEBC tallying centre to get the figures, without any official verification. The media succumbed to IEBC threats of suing anybody who gave independent figures. The media failed in their professionalism as they appeared to favour the winning team and were eager to report the ‘hot’ story Jubilee win, without paying attention to the irregularities that were later raised by the NASA team, whose conferences were given a complete blackout by the mainstream media. Therefore when the Supreme Court of Kenya, later nullified the results, the media was left with ‘an egg’ on their faces because the focus was turned on their professionalism during the entire electoral process.”

Discussions

This paper sought to evaluate the role the media played in the 2017 presidential election. The findings pointed out a failure by the media in their professional mandate. The findings pointed out government interference on their operations. Now, the government’s authoritarian tendencies on broadcasting in Kenya and repression of media are anchored in the media regulatory bodies that are government-funded. The findings show that the Constitution of Kenya 2010 provides for freedom of the media (Article 34). This media freedom is not absolute and the constitution spells out the limitations while giving Parliament the power to enact legislation that will form a body that will set standards for media and monitor compliance to the standards.

Parliament, contrary to the constitutional provisions, enacted two pieces of legislation - The Media Council Act (2013) and The Kenya Information and Communications (Amendment) Act (2013). The supposedly independent body (now bodies) are the Media Council of Kenya (MCK) and the Communications Authority of Kenya (CA). The MCK is funded by Government while CA is established as a civil service organization, therefore Government. The two main pieces of legislation were meant to operationalize Article 34 of the constitution for self-regulation of the media. Being government controlled, the heavy control of government is manifested in the two pieces of legislation.

The mainstream media hence came on the spotlight on how they covered the August 2017 presidential election, given the fact that the results were nullified by the Supreme Court of Kenya because the entire electoral process was flawed and the media failed to play their social responsibility role by not pointing out the flaws in the entire process. For example, when the Supreme Court judges sought to know from the lawyers representing one of the respondents in the petition, the source of the figures that were being broadcast by the mainstream media, they responded, and I quote, “those were mere statistics,”! The question that begs an answer is, how could the media be party to a flawed process? Did they seek to verify the figures before broadcasting them? The answer is no? So then, did the media play its social responsibility role to the Kenyan public and the journalism profession? Again the answer is No. They therefore failed in their professional mandate and adherence to the professional code of conduct that demands that the media professionals adhere to truthfulness, factual accuracy, objectivity and balance. They instead adhered to the political interests of the media owners thereby sacrificing professionalism on the altar of political interests therefore strangling their professional soul and taking the country back to the dark days of unprofessional journalism. In so doing, they left the country more divided than ever. One of the key roles of the media is to play the role of social integration and here too, they failed Kenyans.

Conclusion

In conclusion, Kenya media practitioners lack a professional soul that should inform how sensitive they should carry out their professional mandate. There is need to strictly adhere to the code of conduct for journalists as they discharge their mandate especially on sensitive matters national interest such as general elections in Kenya. The Kenya Constitution 2010 guarantees freedom of expression for all; this should apply to how the mainstream media discharges its mandate; free of censorship and policing so that it can discharge its professional mandate. There is need for policies that discourages politicians from owning media houses because when they do, such media houses cannot discharge their mandate objectively.

What is sad about the findings by the Supreme Court was that the media, which was supposed to inform and educate the citizens failed in their social responsibility role. The media failed to point out the anomalies but were instead pointed out by Supreme Court.

Recommendations

The following are recommendations drawn from the findings of this study:

1. The government should follow the law when dealing with the media. The Constitution of Kenya 2010 and international statutes provide for freedom of the media.
2. Prior restraint of media has been a subject of debate since the time of John Milton (1644) and world practices of media freedom have clearly spelt out circumstances and nature of restraint. The government is expected to adhere to the best practices of media regulation.
3. Media Regulatory bodies should be independent and government agencies.

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'Sheng' Language as a Tool for Disseminating Reproductive Health Knowledge using Community Media: A case of Ghetto Radio

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Abstract

Community media are alternative medium to public commercial and social media. Alumuku (2006) opines that community media are usually understood as media that serve and belong to a community and produce content with specific community in mind. Radio is a common community media due to its influence, affordability and penetration. Unlike other media, radio does not require sole attention thereby always acting as a form of companion to listeners. In Nairobi (Kenya) there are three popular community radio stations; Koch FM in the Korogocho slum, Pamoja FM in Kibera and Ghetto FM radio in Ngara. Ghetto radio was launched back in 2007 as a community radio station within the Nairobi slum areas. The objective of the station was to provide a channel through which slum dwellers can tell their stories and empower the youth living in slum areas. This study focussed on 'Chanuka Dada' a radio show hosted by Jacky Waitthaka on Sundays from 11.00am-1.00pm. This programme is aired in 'Sheng language'; a corruption of English, Kiswahili and mother-tongue words. The show focuses on women empowerment living in slum areas specifically addressing issues affecting women such as rape, early pregnancies and abortion. This paper tries to establish whether the messages disseminated through the programme are understood as intended as the messages are in 'Sheng' language, whether the listeners of the program feel that the program serves their social transformational needs and the milestones that the program has made among the slum population in terms of enhancing reproductive health. Data was collected qualitatively through the use of interviews and a review of related literatures. Data was analysed thematically. Findings indicate that the program provides a platform for audiences in society to discuss their situation and get free expert advice. The station through the program also responds to issues that bedevil the local communities by creating awareness on people's rights.

Keywords: Sheng, Community Media, Reproductive Health, Community Radio

Introduction

Community media is understood as media that is intended to produce content for a specific community. They are normally small, low budget and non-profit making often run by volunteers from the community and sometimes owned by NGOs. This can be conceptualised in two ways; either as a media that serves people in the same neighbourhood or a media that serves people with a shared interest or identity. Opubor (2000) explains that community media should be viewed as an element of community communication. He further says that it serves the diverse needs of a particular community. Radio is the most common community media due to its affordability and low operational costs.

In Kenya there are several community radios, Ghetto radio is one of them. Ghetto radio was launched in 2007 as a community radio serving residents within Mlango Kubwa slums, it gained popularity and expanded to cover the whole of Nairobi and its environs. The station was set up to provide a channel through which slum inhabitants, artists as well as regular inhabitants could tell their daily life stories and also to encourage and empower the youth living in slum areas. To do this effectively, Ghetto radio's management had to settle for a language that identifies with the young generation living in their target areas. Ghetto radio settled on the use of Swahili slung popularly known as 'sheng' as the stations main language of information dissemination. 'Sheng' is a corruption of English, Kiswahili and mother-tongue words. Initially this code was developed by the youth to hide their communication from the elderly generation but its popularity has led to its use in other sectors of society. Examples include Politicians in Kenya who identify with the youth by using Sheng words such as: mahustler and masaferefer, the use of sheng worlds in advertisements such as 'Ni poa ku-chill' – it's safe to abstain and 'na kufeel' – I care for you in condom adverts or sheng phrases such as 'sakanya chapaa' and 'Ponyoka na pick-up' in sales promotions.

Language allows us to define and project our own personalities in the social world (Hall, 2005). It is through language that we are able to express our different views. Too and Barno (2016) points out that sheng is a popular language and can be used to bring about the desired change in society. Yule (2006) says that to understand the meaning of some written or spoken language we must understand the context in which they occur and some pre-existing knowledge of what would be the likely message as we work toward a reasonable interpretation of what the producer of the words intended to convey (p.113). The word 'Ghetto' is loosely translated

to mean 'slum' in the Sheng dialect. Most of the Ghetto radio programs have also been named in the Sheng dialect, for instance Brekko, a show which always airs on weekdays from 6:00 am - 10:00 am is shortened in slung for breakfast. Goteana is a show that airs from 2:00 pm- 4:00pm every day, the word Goteana means Hi (greetings). Sare Madree loosely translated means 'quit drugs' or 'give up drugs'. The show airs on Saturdays from 9:00 - 11:00am. This show focuses on encouraging the youth living in slum areas as well as the larger Nairobi to quit drug use. Chanuka Dada a show that airs on Sundays from 11:00 - 1:00pm focuses on women empowerment addressing issues such as rape, early pregnancies and abortion. Ghetto radio also has other entertainment shows and even broadcasts news in Sheng three times a day.

Background to the Study

In Kenya, information on health-related issues is disseminated through the media. The three types of media that could relay this information are radio, newspaper and television. However, women in the rural setup are unlikely to access information from print media due to high levels of illiteracy, hence they are likely to rely more on radio messages. Dagon (2001) however documents that international donor, governments and NGOs often concentrate on the use of the mass media yet media activities have a greater impact in the cities than in the rural areas (p. 9). According to Thomas (2006), the process of communication is critical in the implementation of health communication since it is often through the process that the right influence can be attained to improve health behaviour. Communication therefore should be geared towards empowering the audience by educating them and influencing behaviour change. Mass media play a significant role in shaping public perceptions on a variety of important issues, both through the information that is dispensed through them, and through the interpretations they place upon this information (Downing, 2004). An informed society makes informed decisions.

Community media, whether broadcast or online, are crucial to ensuring media pluralism and freedom of expression, and are an indicator of a healthy democratic society. As an alternative medium to public and commercial media, as well as social media, they are characterised by their accountability to, and participation of the communities they serve. They have a greater focus on local issues of concern and facilitate public platforms for debate and discussion. Community media ensure capacity building within communities as they are run for and by the community. These are media that provide an outreach mechanism for increased access to self-

expression and communication among rural and hard-to-reach populations. Such media allow communities a sense of ownership about their own development agenda, becoming self-empowered to publicly express opinion, debate issues, and promote the culture, history and language of their community. Sustainability among community media has been a problem; however, they must be encouraged through supportive policies and strategies, including legal recognition, fair access to spectrum and licensing, sustainable sources of funding and inclusion in considerations around digital transition. The concept of community media implies that for communities to be heard at national level, they have to be heard at grassroots level first. The potential to communicate and receive communication is a social good, which should be fair, universal and strictly equal. Curran and Gurevitch (1991) state that the full concept of citizenship presupposes an informed participant body of citizens, most generally, if we suppose there to be a right to communicate then it implies an equal individual claim to hear and to be heard. Similarly, Freire (1990) observes that the less people are consulted, the less democracy a nation has.

Community broadcasting seeks to foster debate about, reach consensus on and build solidarity in promoting and protecting human rights and achieving sustainable development, including peace and reconciliation. It acts as media for the flow of information to and from communities, on one hand, and the national and international levels, on the other hand (McQuail, 1994). It provides access to needed external information as well as advocacy on issues of concern, with relevant policy making levels informed by experiences at the community level and solutions generated therein. In a broader sense, community broadcasting enables greater participation by communities in national and international affairs. It has a dual role - that of a mirror (reflecting the community back at itself) and that of a window (allowing the outside world to look in at its experiences).

Fraser, Colin and Sonica Restrepo Estrada (2001) argue that community media provide a vital alternative to the profit oriented agenda of corporate media. They are driven by social objectives rather than the private, profit motive. Community media empower people rather than treat them as passive consumers and they nurture local knowledge rather than replace it with standard solutions. Ownership and control of community media is rooted in and responsible to the communities they serve, and they are suitable approaches to development, (Buckley, 2000). The nature and purpose of community media initiatives should be the most important determinants. Resource shortcomings of any kind can be addressed through alternative strategies. Buckley (2000) observes that democracy and communication

are inextricably linked, so much so that the existence or otherwise of certain forms of communications can be a measure of the limits to which democracy itself has developed or is held back.

Curran and Gurevitch (1991) state that the nature of community media is participatory and its purpose is the development of processes through public and private dialogue through which people define who they are, what they want and how they can get it. Community participation is thus seen as both a means to an end and an end in itself. The processes of media production, management and ownership are in themselves empowering, imbuing critical analytic skills and confidence about interpretations reached and solutions found. The medium chosen must, therefore, be one that enables, enhances and sustains community participation.

From the above considerations, it follows that the choice of media to be used in a local community is necessarily specific to that community. What works in one community may not work in another (Lesame, 2005). For example, gender and age are factors to be taken into account when discussing sexuality, but the manner in which they are taken into account differs across communities. Literacy levels, access to radio receivers in the community at large, familiarity with symbolism and other visual devices used in audio-visual media are other considerations. The choice of theatre, local language newspapers, radio or video - or any combination thereof - is and should be dependent on both internal and external factors (Besette, 2004).

Tufte (2005) comments that the use of entertainment-education (EE) as a communication strategy has been used to achieve several objectives; promoting individual behaviour change to supporting social change, enhancing social mobilisation, articulating people's participation and empowering minority or marginalised groups to collective action (p.160). The use of Sheng in different avenues in Kenya shows how the dialect has embraced innovation especially through its dynamism. It has been claimed that the unique features of the dialect give it the ability to change so as to meet the immediate communication needs of a particular group of people.

Statement of the problem

Communication of health messages requires to be disseminated in a way that the messages will be understood by the audience to elicit the desired behaviour change. Effective communication strategies can be used to influence the desired behaviour change in an audience. Ghetto radio is a community radio that has been using

Sheng to embrace grassroots-oriented community communication strategies to discuss health issues that relate to the people in slum areas in Nairobi. The focus of the study was to evaluate the effectiveness of the messages disseminated in the 'Chanuka Dada' aired by Ghetto radio given that the language of use during the show is Sheng and at times a mixture of English, Kiswahili and Sheng. The general research objective was to investigate the impact of the program 'Chanuka Dada' on community development. The specific objectives of the study were to:

1. Establish whether messages disseminated in the programme are understood by the audience as intended
2. Determine if the listeners of the program feel that it serves their social transformational needs
3. Identify the milestones that the program has made among the slum population since its inception.

The findings of this study are expected to assist media houses to establish better ways of disseminating reproductive health messages to audiences. It will also be helpful to the Ministry of Health, the Donor agencies and health facilities in fast tracking policies related to dissemination of reproductive health messages.

Literature Review

This section reviews various literature related to the topic of research.

Women's knowledge on reproductive health

Reproductive health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, in all matters relating to the reproductive system and to its functions and processes. Reproductive health therefore implies that people are able to have a satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so. Implicit in this last condition is the right of men and women to be informed and to have access to safe, effective, affordable and acceptable methods of family planning of their choice, as well as other methods of their choice for regulation of fertility which are not against the law, and the right of access to appropriate health-care services that will enable women to go safely through pregnancy and childbirth and provide couples with the best chance of having a healthy infant.

In line with the above definition of reproductive health, reproductive health care is defined as the constellation of methods, techniques and services that contribute to

reproductive health and well-being by preventing and solving reproductive health problems. It also includes sexual health, the purpose of which is the enhancement of life and personal relations, and not merely counselling and care related to reproduction and sexually transmitted diseases. Sexual and reproductive health has been captured under the Sustainable Development Goals as Goal 5 whose aim is to achieve gender equality and empower all women and girls. It aims to end all forms of discrimination against all women and girls everywhere through eliminating all forms of violence against all women and girls in the public and private spheres including sex trafficking, sexual exploitation, child marriage and female genital mutilation.

Unsafe sex is the second most important risk factor in the world's poorest communities. According to WHO (2000) every year, more than 120 million couples have an unmet need for contraception, 80 million women have unintended pregnancies (45 million of which end in abortion), more than half a million women die from complications associated with pregnancy, childbirth, and the postpartum period, and 340 million people acquire new gonorrhoea, syphilis, chlamydia, or trichomonas infections. Sexual and reproductive ill-health mostly affects women and adolescents. Sexual and reproductive health services are absent or of poor quality and underused in many countries because discussion of issues such as sexual intercourse and sexuality make people feel uncomfortable. The increasing influence of conservative political, religious, and cultural forces around the world threatens to undermine progress made since 1994, and arguably provides the best example of the detrimental intrusion of politics into public health. Wight, Plummer and Ross (2012) assert that poverty and poor education led villagers to talk about their lives fatalistically, particularly the poorest, least-educated, and women, frequently attributing things to God's will. This led to short-term decision-making, such as agreeing to get engaged or elope after a very brief meeting. In sexual encounters young people often focused on the immediate advantages of sex, rather than possible unwanted pregnancy or infection, even when these consequences were well known.

There are several possible explanations why women resort to short term decision making. Wight, Plummer and Ross (2012) assert that women's subordinate status and very limited economic opportunities were fundamental barriers to sexual behaviour change. Girls generally received less schooling than boys and less intellectual stimulation to enable them to learn about sexual health, analyse their

problems, and seek appropriate help. They go ahead to say that girls' socialisation to defer to their elders, in particular men, limited their self-efficacy to resist older men's sexual advances, for instance teachers. Their economic dependence on men meant some accepted unappealing marriages, married older men likely to have STIs, and/or were prevented from leaving husbands with extra-marital partners, or avoiding unsafe sex with them.

The mass media messages cannot singly influence behaviour change as Adam (p. 363) documents that Bandura "social persuasion" by itself will not succeed in bringing about adoptive behaviour and that the mass media is more effective when backed by complementary activities on the ground.

The role of radio in promoting reproductive health in Kenya

Media has a cardinal role to play in providing vital information to both the government and the general public, especially in relation to issues that confront women in areas reproductive health. According to Baran (2001) radio has changed its nature of its relationship with its audiences as it broadcasts an array of educative and entertainment programs. According to Baran (2001) FM radio attracts about twice as many listeners than AM station. This is because the FM (Frequent modulation) signal is wider, allowing the broadcast of better fidelity to the original sounds than the narrower AM (Amplitude Modulated). In Kenya, since the turn of the century there has been an influx of FM stations of which Ghetto radio is inclusive. Since its inception, radio has become an integral part of our culture as it touches the lives of almost everyone, every day. Radio is preferred as the most suitable medium because of the advantages it offers.

One can multitask (working at the same time listening) while using radio to get current news or emerging information pertaining reproductive health issues. Radio also is a cheaper channel of disseminating information to the public as compared to the TV. In addition, radio also reaches a large audience of a wide range of age, taste and gender. Radio is also able to penetrate the interior remote areas where the listeners may not have any alternative media.

Mass media performs three key functions: educating, shaping public relations, and advocating for a particular policy or point of view. As education tools, media not only impart knowledge, but can be part of larger efforts to promote actions having social utility. Since its inception, radio has become an integral part of our culture. In some way, it touches the lives of almost everyone, every day. Radio,

as a medium, offers a form of entertainment that attracts listeners while they are working, traveling, relaxing or doing almost anything (Hunt et al., 1982).

Mass media are tools for the transfer of information, concepts, and ideas to both general and specific audiences. They are important tools in advancing public health goals. The media is often people's first source of information. News coverage helps bring reproductive health information to men who may not be able to access it from the facilities or experts. It also helps confirm and reinforce the information that people receive from other sources such as relatives and friends. According to Downing (2004) mass media play a significant role in shaping public perceptions on a variety of important issues, both through the information that is dispensed through them, and through the interpretations they place upon this information.

Language in community media

Language used by community media is one that is easily understood by the audience. The language should enable the audience come to a common understanding about their issues. Gustafsson (2013) points out that language is a relevant factor as the youth identify themselves with the new generation where knowledge of English and Swahili are valuable (p.263). Lack of access to mainstream media influences the use of community media whose language should not only contain facts but should rather be entertaining. Gustafsson (2013) states that music is an important component of the community media content. Ghetto radio's use of Sheng makes it possible for the audience and the presenter to participate and share their experiences. Sheng is one of the most dynamic languages and that is why it is extremely hard to standardise as its vocabulary keeps on changing daily. The language used in community media should be able to cater for the interests of the community. Sheng dialect has been known to attract prestige among the youthful speakers. Yule (2006) opines that among the young speakers in the middle class, there is often covert prestige attached to many features of pronunciation and grammar (p. 210). According to Yule (2006) covert prestige is the hidden status of a speech style that has positive value for certain groups of the community.

Theoretical Framework

A research theory acts as a guide to a researcher in his/her work and as the lens through which the research gains insight into the phenomenon under study. Creswell (1994) argues that in qualitative research, one does not begin with a theory to test or verify but in consistence with the inductive model of thinking, a theory

may emerge during the data collection and analysis phase (p. 94). However, Heath and Bryant (2000) note that people naively construct and apply communication theories as they engage in daily communication activities. They further point out that knowledge of communication theory helps improve and makes the communication act better. Theories hence assist a researcher to adapt the findings to solve real problems in society. In any research, a theory can be used to achieve several functions; one as the one that underpins the research design, second as one that makes the subject under investigation apparent and thus acting as a lens and finally it may emerge as new knowledge by generation of a new theory especially in grounded studies.

Most theories that apply to health communication are behaviour/social change theories. There are several communication theories and, as Heath and Bryant (2000) put it, communication theories are maps which enable one to move through the environment with knowledge. A theory is needed because no matter how long or hard people examine any object of inquiry-communication in this case-it will not reveal itself (p. 4). However, social scientists are in agreement that one of the most important functions of empirical research is to contribute to development and refinement of theory (Frankfort-Nachmias, 1992). There are several theories that can be used to investigate and bring to focus reproductive health issues; fear appeals theory, social cognitive theory, the participatory theory, critical theory and feminist theory.

This study was grounded in the fear appeals theory. This theory by Witte (1992) assumes that fear motivates individuals to take action to reduce their apprehension about health issues. In 1992 Witte, through a study on Preventing AIDS through Persuasive Communications: A Framework for Constructing Effective, Culturally-Specific, Preventive Health Messages, came up with this theory. Fear can be used as a motivator for positive behaviour change. The theory holds that people are motivated to engage in activities that would minimise punishment and increase reward. Epistemologically, the theory holds multiple truths, as what may invoke fear in one individual may not be true for another. A situation may look more serious for some people and hence cause fear and lead them to make decisions to protect themselves or prevent negative consequences from occurring than to others. Ontologically, Fear Appeals Theory is based on free will and hence an individual chooses to take action based on the fear they feel. This theory was used in the study to examine how the communication strategies used in the program change the audience's behaviour.

Research Design and Methodology

Research design and methodology defines the premises under which research was carried out. It entails the methods, techniques and procedures by which data was generated. It is thus a guide of how the research was conducted. This study adopted a qualitative research approach. The qualitative data collected enabled the researcher to have multiple interpretations of the audiences' attitudes and perceptions in regard to reproductive health knowledge. These interpretations were partly based on the researcher's social context. The study population was all the listeners of ghetto radio who are inhabitants of Nairobi and the program presenters at Ghetto radio. The study was conducted in at 'Mlango kubwa' and Umoja Estates in Nairobi. From these, a target population of only listeners of the 'Chanuka Dada' program was identified as the target population.

The study employed purposive sampling strategies. Purposive sampling was used to select ghetto radio though there are many other radio stations that have programs on reproductive health. Purposive sampling was used also used to identifying the participants in the study. These were chosen on the basis of their relevance to the study. In this strategy, items for the study are deliberately selected by the researcher and his choice concerning the items remains supreme (Kothari, 2004). Lindlof and Taylor (2002) argue that most qualitative studies are guided by purposive sampling because sites or cases are chosen because there may be good reasons to believe that what is going on there, some process or concept, is critical to understand. Lindlof and Taylor (2002) say that random probability sampling is not the best for qualitative studies for two major reasons. First, qualitative studies do not produce data that can be subjected to statistical procedures that allow generalisation to a population. Secondly, social phenomena are studied for their own unique qualities; the question of whether or not it is normally distributed in a population is not an issue.

In-depth interviews were conducted with a view of gathering information about processes that cannot be observed effectively by other means. This enabled the researcher to access the internal states or phenomena in participants. The participants' attitudes, motivations, or beliefs are not measurable entities; they therefore require the researcher to engage the participant in a dialogue in order to realise them. The in-depth interviews assisted the researcher to gain knowledge about maternal child health among the rural women. Rubin and Rubin (2005, p. 6) confirm that unstructured interviews are also ideal because of flexibility that allows

wider exploration and generation of additional insights and data. They further comment that feminist researchers argue that a more open, loosely structured research methodology is necessary to learn about women, to capture their words, their concepts and the importance they place on events in their world. An interview should resemble normal conversations on which the interviewee influences exchanges and the interviewer may become a friend to the interviewee (ibid.). The data from interviews was used to describe the characteristics and variations of the responses. Information from interviews assisted to validate information obtained from reviewed literatures.

All the interviews were standardised so that all respondents were asked the same/similar questions. Face-to-face interviews provided helpful insights concerning reproductive health among slum women. Fifteen respondents were selected for the interviews through purposive sampling.

In addition to using data from primary sources, the researcher also used data from secondary sources such as journals, magazines and newspapers that discuss reproductive health matters.

Analysis of data collected from the study was done using thematic analysis and content analysis. According to Taylor and Lindlorf (2005), data analysis simply means labelling and breaking down raw data to find themes, concepts and propositions that exist in the data generated and give meaning to them. Monette (2005) says it is what unlocks the information hidden in the raw data and transforms it into something useful and meaningful. Thematic analysis was used to analyse primary qualitative data. Secondary qualitative data from the documents was analysed through content analysis. This involved reading and sieving the documents to ensure that the data that was relevant to the study objectives was documented. A preliminary examination of the data was conducted to ascertain the validity of the data and its application to the theoretical framework. This was also to develop conceptual categories assigned with codes. Frequencies were related to the source of data to establish the relationships and abstract the meanings. The findings from thematic and content analysis were compared and contrasted in order to make inferences and interpretations from the data. Triangulating several different data sources; data from qualitative and reviewed literature sources was done in an attempt to increase accuracy of the findings.

Findings and Discussions

There were 23 participants in the study were 23. Their ages ranged between 21-43 years. A majority (17) were female. To adhere to the ethical need for confidentiality the researcher used pseudonyms to identify the participants.

To have an understanding of how the audiences have been influenced through the 'Chanuka Dada' programme, the responses that correlated to the research objective as generated through interviews are presented below under the sub themes; language of disseminating knowledge, Social transformation among listeners of the programme and enhancement of reproductive health through the programme.

Languages of disseminating knowledge

The participants were asked to comment on the use of three different kinds of languages used (Sheng, English and Kiswahili) in disseminating reproductive knowledge. The findings revealed that most of the participants were of the opinion that the use of those three languages appealed to four different categories of people to listen the programme; those understand English, those who understand Kiswahili, those who understand Sheng and those who understand all the three languages. The nineteen respondents exuded confidence that the use of these languages makes both the literate and illiterate audiences are able to follow up and understand the programme. One participant, Edu said:

'The language used in the program fits all kinds of people; the literate and the illiterate, the rich and poor'

Five (5) of the participants were of the contrary view as they claimed the use of three languages confuses the audience. One of the participants; Eunice, 37 years old stated:

'they should use Kiswahili or English or Sheng but not mix because they 'mix' [confuse] people'

Social transformation among listeners of the programme

Responding to the question on the social transformational changes the programme has created among the slum dwellers and Nairobi residents in general, the participants had varied views. Some of the respondents said that it has created a lot of awareness among the slum dwellers. One of the respondents Scholstica/R22 says:

'listening to the program makes one be aware of his/her right and what steps to take when abused'

This shows that the programme succeeds in touching on issues that affect ordinary women in the slums. Chanuka Dada is a show that gives hope to the victims in society in society as part of the experts who come to the show discuss procedures that are to be followed in case one is victimised. Penina R/16 says:

'This program has hope, courage and insight to the girl child'

The show has also availed a platform for people to discuss their reproductive issues with other audiences. Oronje, Undie, Zulu and Crichton (2009) say that the mass media has the ability to disseminate information in a broad, timely, and accessible manner; it constitutes an important source of information for the general public and policymakers. They further add that as information providers, the mass media informs, educates, entertains, persuades, socialises, and markets commercial products, among other roles (p. 2). However, most of the maternal health information disseminated through radio has been termed as a non-participatory. Participatory communication is usually relevant in achieving rural development. It is a system of communication where problems of a community are discussed at community level and interactions between members are elicited. Obregon and Mosquera (2005) say that one of the participatory communication approaches is Community Organizing (CO) which is a problem-solving approach whereby the community is empowered with the knowledge and skills to identify and prioritise its needs and problems, harness its resources to deal with these problems and take action collectively.

The participants also claimed that the program avails free professional advice to people living in the slums who may not be able to pay up for the services. This is by inviting guests in the studio who are experts in various areas to talk about specific issues which may be of interest to the audience. The participants reported that they had benefitted from the program due to the various experts that are hosted who give advice that could have cost them much to acquire. One of the participants; Climentine/R13 said:

'It gives the listeners free advice through the various experts who are invited to the show'

Conversely, seven (7) of the participants did not believe that the program has socially transformed the general population. They say due to the use of various languages

within the same program, the audience get confused and switch off. In addition, they say that in spite the program being aired every Sunday, the same issues such as rape, domestic violence, early marriages and abortion are still being witnessed in the community of concern. Winskell and Enger (2005, p. 412) document that it is generally agreed that health communication through the mass media has great impact when it is reinforced through interpersonal channels. These channels include discussions, educational sessions, local theatres and songs and debates to generate emotional engagement thereby influencing behaviour change.

Enhancement of reproductive health through the programme

All the participants acknowledged that the show has ability to enhance reproductive health within the community in question. The show talks about issues others have shied from talking about as some of them are viewed as taboo and are not supposed to be talked about in public. Women are enlightened on various issues especially the ones that affect their motherhood. They are also given a platform to openly discuss issues that affects them and listen to what their colleagues have to say about the same.

Conclusion

The media faces challenges in the dissemination of health information due to lack of funds to enable them come up with programmes which promote family planning. Piotrow, Rimon, Merritt and Saffitz (2003) further point out that developing a successful program requires considerable preliminary time and effort to talk to the populations at risk, to listen to their concerns, to understand the local situation, to identify key audiences for various messages, to recruit qualified local staff, and to segment the population to address special needs.

From the researcher findings it is evident that messages aired through 'Chanuka Dada' program promotes awareness among women. This is because the messages are disseminated through a language (dialect) that the listeners associate with so much; the Sheng dialect. The youth are able to express what they are going through, their interests, their fears, hopes, expectations and feelings about certain issues in society through the 'Chanuka Dada' program. The language has enabled the youth to discuss issues that could otherwise have been considered an abomination and not fit to be talked about, however this code has even developed to an extent of being recognised by politicians, business people and health providers.

Radio messages have contributed significantly to reproductive health knowledge dissemination. Radio talk shows and invitation of experts to talk about various topics in a language that a certain group of audience understand enables them to significantly benefit. However, despite the radio messages, there is need to apply multiple avenues to tackle the issue of reproductive health.

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Indigenous Democracy on Digital Platforms: The Adaptability of Social Media in African Political Dialogues

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Abstract

There is persistence of social media influence in African Autocratic regimes despite the underdevelopment and frequent shut down of infrastructures that support the social media. This means that the impact of social media is not determined by technological infrastructure but rather by other factors in African societies such as ancient sociocultural practices. Ingram, (2011) observes that, although social media help activate the bonds between individuals enabling self-expression and information sharing that liberate them and lead to collective actions, they are not sufficient to cause persistent influence. Even with shared socioeconomic problems like unfair distribution of public resources and limitless-term rule of political elites, social media have not had similar political influence in sub-Saharan Africa as they have had in North Africa. This study's objective was to establish the link between ancient socio-cultural factors among individual social groups and the impact of social media in Africa. Through scheduled face-to-face interviews and discourse analysis of sampled material from gazette museums, the study established that social media has features that directly compare with indigenous African democracy, which eases its adaptation on the continent. Such features include: high level of inclusivity, emotional appeal, direct participation as well as ease of exit from a social group. In the African indigenous democracy, inclusivity was emphasised regardless of people's social status or gender (Henshroek Undated). This saw many women leaders on the continent prior to colonisation, including Cleopatra the ancient Egypt pharaoh. Indigenous African democracy had basic political unit called village assemblies, which loosely compare to WhatsApp groups. In the assemblies, an aggrieved member "left the group" physically departing or 'voted with his feet' by deserting the village to form another. This socio-cultural link with social media makes it popular in political dialogues, helping to expand the freedom of expression and hold the powerful in society accountable.

Keywords: Indigenous democracy, social media, adaptability, ancient socio-culture

Introduction

Historically, there is strong evidence that technologies are usually shaped and used by those in power to maintain their positions of power (Habermas, 1978:371; Unwin, 2012:3). These technologies are made for particular social, economic, political and ideological reasons. Feenberg (1991:41) observes that, although not independent of the people who make them, most technologies have unintended consequences whereby adaptive and culturally influenced people frequently find new and often very different uses of the technologies. The development of M-PESA money transfer in Kenya was for instance never envisaged by those who first designed mobile phones (UNESCO, 2014:39). This point at possibility of same technologies being used in different ways by different individuals, groups as well as governments. Be it that social media is undoubtedly changing the African political landscape, the intention of the people who made it may not have been in the interest of the poor and marginalised Africans or even democracy.

Erik Herselman, a prominent African blogger argues that, mobile phones penetration into the continent has been followed by a wave of critical mass with internet usage leading in countries like Kenya, South Africa, Ghana, Nigeria and Egypt (Essoungou, 2010:2). With about 19% of Africa's population connected to internet by 2014, up from 10% in 2010, the continent registered highest growth in internet use worldwide (UNESCO, 2014:37). The continent's internet connectivity is however still below the world average of 30% (UNESCO, 2014:38). This fast connectivity facilitates internet access, allowing a growing number of Africans to take part in political dialogues within and across countries' borders. Social networks such as Facebook, Twitter and YouTube are amongst the most visited websites in Africa. Recent rankings show that Africa is the continent with the most dynamic Facebook growth rates where its user numbers have doubled in the past six months (Essoungou, 2010:3).

Papacharissi (2015:17) observes that global increased social media use in political dialogues is due to its ability to evoke emotional reactions, by permitting imagined meaning-making of situations unknown to us. Facebook and Twitter for instance, make users tune into events they are physically removed from by imagining what these events might feel like for the people directly experiencing them. Condensed description of tension filled moments on twitter or live blogged accounts of revolutions-in-the-making convey a sense of immediacy that make us feel like we are there. Papacharissi (2015) argues that, tuning in emotionally does not however

restrict people to emotional reactions, rather, it prompts people to interpret situations by feeling like those directly experiencing them.

This phenomenon is not new in media, Walter Lippmann's (1922) pseudo-environment, juxtaposes a blend of the world outside and one's mental picture. Print journalism enabled us to achieve it through the construction of biased mental images of lives of others as we read about them. Live Television coverage also amplifies our ability to emotionally tune into events physically removed from us, by enabling us to feel like we are there due to the sense of immediacy conveyed. Social media therefore amplify and remediate that very tradition of storytelling.

Papacharissi (2015:17) disputes that, whereas conventional wisdom often separates reason from emotion, the two are connected and only require some balance between them for people to function as informed citizens. This balance helps people to progress through civic life ably, in pursuit of what Aristotle called "the act of living to one's full potential". This can be nowadays referred to as happiness and well-being in every day's life. Philosophy holds that, the balance between reason and emotion helps people not to be too rational and misjudge out of over conviction or be too emotional and be swayed to distort the judgment.

Although emotions may be considered fleeting and reason more fixed, the two are a combination with co-occurring tendencies (Unwin, 2009:3). When co-present and balanced, they can be responsible for the most inspiring and most con-founding moments of human history. Papacharissi, (2015:19) observes that, more emotion and less reason in a way enhance or entrap people's aspirations when evoked through social media. He argues that, the people are activated and sustained by a feeling of belonging and solidarity in pursuit of their aspirations and however fleeting or permanent the feeling may be depending on societal factors. As such, democracy as a form of governance is at stake since it is founded upon the right and ability of the people to make own decisions about their own governance.

Review of governance in Traditional African Societies

As early as 9th Century, highly advanced and sophisticated African civilisations, cultures, societies and states such as ancient *Egypt*, *Kush*, *Axum*, *Mali* and *Ashante* existed (Yoyotte, 1981:130; Guy, 2012:11). Political systems and institutions were traditionally based on kinship and lineage or common ancestry sanctioned by a founding myth (Guy, 2012:12). African indigenous societies' political organisation began at the lineage or village level where village assemblies were regularly held,

headed by an elderly person since age was associated with wisdom. Lineage ensured unity and stability whereby each lineage head was chosen on basis of age, maturity and relations with ancestors. Each ethnic group had its own system of governance, with religion defining moral duties and informing the customary law across all the ethnic groups. Religion and politics were inseparable because the African concept of political power fused the secular and sacred. The powers of leaders were believed to derive from the founding ancestors and were hereditary. The political leader added up as a religious leader, acting as the intermediary between the people and the ancestors (Busia, 1967:9).

The rules and the procedures of governance in the indigenous African political systems were established by custom and tradition rather than a written constitution (Guy, 2012:12). The systems were based on rule of law; respect for customary way of resolving conflicts and upholding the traditional governing political behaviour (Busia, 1951:21). Customary African laws were subject to full public scrutiny and debate, and the chiefs and kings could not promulgate laws without the consent of the councils (Ayittey, 1991:73). In Pharaonic Egypt, as in other indigenous African societies, every individual was equal before the law regardless of gender and social status (Yoyotte, 1981:131). Mali Empire had an unwritten charter specifically stating that foreigners should never be harmed and that the security of the foreign envoy is inviolable. The maintenance of peace within most African communities was based on four fundamental principles: Fairness, settlement of disputes by deliberation and discussion rather than by force, correction of wrong doing by compensation except for serious offences such as murder, assessment and adjudication by elders-who were considered to be impartial (CELTHO, 2008:14; Fynn, 1971:33).

Various mechanisms and institutions created to resolve conflicts emphasised the principles of custom, tradition and fairness. For instance, the *Arusha* of Tanzania had elaborate peaceful conflict resolution procedures while *Tallensi* of Ghana abhorred killing and violent resolution of conflicts. They held a cultural festival called *golib*, during which all inter clan feuds and hostilities were prohibited and the theme of social harmony, fecundity and common interest of the people as a whole were emphasised (Skinner, 1964:127).

Indigenous African political systems were democratic in many ways in that they were based on an elaborate system of checks and balances. In exercising his functions and discharging his duties, the leader had to take advice from two bodies: The inner or privy council which represented the aristocratic clans, and constituted the leader's

close relatives, friends and prominent members of the community. This inner or privy was appointed by the leader and so could be dismissed. The other body was the council of elders which represented the non-aristocratic clans and were chosen by the clans, so the leader could not dismiss them. These acted as effective checks on the potential abuse of power by the leader, be it king, chief or emperor (Busia, 1951:22). There was also check on unnecessary power struggles in the kingdoms through careful institutionalization of political succession in such a way that family, clan and ethnic competition for power was minimised and physically or mentally unfit were automatically eliminated (Wamala, 2004: 436).

In all the indigenous African societies, wealth and property did not belong to the leader personally but to the office. In the Ghana Kingdom in 8th Century for instance, gold, the basis for the kingdom's wealth was held in trust for the people by the king, who could not appropriate it for personal use (Ake, 1976:199). Busia (1967:26) observes that, all nuggets of gold that were found in the mines of the empires belonged to the king, and he only left to his people the gold dust. Without this precaution, gold would be so plentiful that it would practically lose its value. Similarly, the *Ashante* in central Ghana had a golden stool that was the symbol of the office of the supreme chief of the *Ashante*. The stool enshrined the soul of the nation, forming a symbol of wealth as well as political and religious power of the *Ashante* confederation (Ake, 1976: 201).

Other democratic features in indigenous African political systems include emphasis on the village assembly- the basic political unit, where major decisions concerning the society were adopted. The ordinary people were able to express their opinions, have their voices heard and actively participate in a political decision-making process based on majority rule where consensus was unreachable (Busia, 1951:23). These indigenous political systems decentralised political authority and delicately balanced between central and regional powers. This allowed each lineage and or village to manage its own affairs. The chief was obliged to act with the advice of his own local council. Among the *Ashante* for instance, if the chief abused his powers, his subordinate chiefs and members of his council could remove him from power, in what Busia (1967:9) called to "destool" a leader, literally meaning removing him from the golden stool, regarded as the symbol of unity and power – political and religious.

African leaders were fully accountable for their actions all the time. In theory, the leader ruled for life but in practice he ruled only as long as the people allowed it

(Busia, 1967:10). However autocratic a chief would be permitted to appear, he only ruled by the consent of the people. The leader would be abandoned, be removed or in worst case scenario be a victim of ritual murder if he did not perform according to the customs and expectations, irrespective of how long he had been in office (CELTHO, 2008:16). The *Ashante* people had an ultimate constitutional right to “destool” a leader. The fundamental principle was that only those who elected the chief could “destool” him and a “destoolment” required the consent of the elders. At times elders initiated the “destoolment” process themselves if the leader repeatedly rejected their advice, broke a taboo or committed a sacrilegious act. A leader could also be “destooled” if he became blind, suffered from leprocy, fits, or if his body was maimed in a way that disfigured him (Busia 1967:11). Aggrieved or oppressed peasant subjects could always “vote with their feet” by deserting the village to create a new one, thus abandoning the leader. Natural disasters such as drought, famine and epidemics were generally attributed to bad leadership and the leader had to be deposed. Among the *Yoruba* of Nigeria, *Shilluk* of South Sudan and *Serer* of Senegal, ritual murders of kings deemed morally or physically unfit to rule were a common practice (Ayitte, 1991:75).

Busia (1962:69) documents that, at the village level, ordinary African people acted as the ultimate judges and final authority on contested issues. Therefore, the village assembly was convened whenever the elders could not reach unanimity on contested issues. Among the *Bantu* societies of East, Central and Southern Africa, village assemblies also ratified new laws. Meetings and procedures in the village assemblies were essentially democratic. Everybody who wished to speak or ask questions including “commoners” and women would do so. Decisions were taken by consensus and if that failed, then majority rule prevailed. The *Ashante* system provided opportunities for commoners to express criticism to government through their lineage heads. As the last resort, they could depose their rulers (Fynn 1971:35)

Women played key role in African political systems as well as institutions. In ancient Egypt, women were masters of their homes and children were named after them. Of the ancient Egyptian Pharaohs four were women, including the famed Cleopatra (Guy, 2012:30). The first female monarch in the world history was Queen Hatshepsut, the first female Pharaoh who ruled between 1105 and 1085 BCE (Diop, 1987:123). Guy (2012:27) observes that Hatshepsut’s rights of succession were superior to those of her male relatives including her husband, brothers and father, making her appear in the eyes of the people as the legitimate

heir to the ruling Egyptian dynasty. One could conclude from this that the ancient Egypt women naturally inherited political rights.

In ancient Kush- present day Sudan, the queen acted as a co-regent when she assumed power after the death of the husband. At times, the queen mother assumed political office upon the death of their husbands and became very famous and powerful figures to be buried with full royal rites (Mudimbe, 1988:51; Gyekye, 1978:277). In the Mali Empire, the *mande* charter stipulates that because women are mothers, they should be treated with respect and in addition to their duties, women should be part of the political process. The women enjoyed a high social status and high degree of freedom. For long, the first wife of the Mali Emperor was the second most senior person in the politico-administration hierarchy of the empire (CELTHO, 2008:16).

Statement of Problem

There is persistence of social media influence in African Autocratic regimes despite the underdevelopment and frequent shut down of infrastructures that support the social media. This means that the impact of social media is not determined by technological infrastructure but rather by other factors in African societies such as ancient sociocultural practices. Ingram, (2011) observes that, although social media help activate the bonds between individuals enabling self-expression and information sharing that liberate them and lead to collective actions, they are not sufficient to cause radical influence. Even with shared socioeconomic problems such as unfair distribution of resources and limitless-term rule of political elites, social media have not had similar political influence in sub-Saharan Africa as they have had in North Africa. There is possibility that ancient sociocultural factors among individual social groups are responsible for the differential impact of social media in Africa. This exploratory study identifies and analyses the ancient socio-cultural factors responsible for the vast but differential influence of social media use in democratisation process on the continent

Theoretical Framework

Marshall McLuhan's (1964) Medium theory serves as the pragmatic theoretical lens through which to examine historical sociocultural, economic and political factors responsible for the vast but differential social media influence on Africa's democratisation process. McLuhan's infamous metaphorical statement "the

medium is the message” holds that different channels differ not only in terms of content but also in regard to how they awaken and alter thoughts and senses. He popularises the idea that channels are a dominant force that must be understood to know how the media influence society and culture.

Medium theory focuses on characteristics of the medium rather than what it conveys, or how information is received. In the theory, the medium is not simply the newspaper, radio, television or internet; rather, it is the symbolic environment of any communicative act. Media, other than the content it transmits, influences individuals and society. McLuhan (1964) argues that that people adapt to their environment through a certain balance or ratio of the senses, and that a primary medium of age brings out a particular sense of ratio, thereby affecting perception. Medium theory examines physical, psychological and social variables as the senses that are required to attend to the medium. Whether the communication is bi-directional or unidirectional, how quickly the messages can be disseminated, how many people can attend to the same message at the same time among others. Medium theorists argue that such variables influence the medium’s use and its social, political and psychological influence (McLuhan 1964).

Wilbur Schramm (1973:128) criticises McLuhan’s medium theory arguing that, logically the message cannot be the medium. Schramm cites an example that, American citizens reacted with similar horror to the news of John F. Kennedy’s assassination regardless of whether they heard the message in conversations, over radio, on television or in newspaper. Later researches however absolved McLuhan, confirming that the same content about Richard Nixon’s speech was perceived differently whereby on radio, he was authoritative while on TV he looked more appealing. In attempt to criticise McLuhan’s medium theory, Jeffrey Scheuer (1999) says that, medium slants the message but the medium cannot be the message. Scholars argue that, Scheuer (1999) simply restated McLuhan’s statement after misinterpreting it.

Research Design and Methods

The researcher takes constructivist stance which attempts to interpret phenomena and how they be used to improve human life in society (Candy, 1991:9). Of interest to the researcher will be to interpret how socio-cultural issues shape the impact of social media in African societies; to help address forms of domination including social, political, cultural, economic, ethnic, racial and gender.

The ethnographic study took a qualitative approach where a purposive sample of three key informants, including traditional diviners from west, East South and North Africa respectively, whereby scheduled face-to-face interviews were conducted. The researcher settled for diviners because in Africa, diviners are sanctioned custodians of indigenous cultural information. Sets of questions drawn from indigenous communication aspects were asked to the diviners whose responses were recorded and then transcribed into meaningful information. Each of the four diviners was interviewed three times at a six months' interval but using the same sets of questions. This was used as a form of internal validation. The study zeroed on the diviners because traditional warriors no longer exist in modern Africa. The diviners interviewed did not know each other, and the information got from each was used to externally validate or invalidate the others'. While drawing up the research instrument - Face to face interview schedules, conscious effort was made to standardise the researcher's questions by ensuring that the scheduled questions are asked in the same way to all the four diviners. Effort to ensure a representative sample was made where the researcher's samples came from The East, West, south and north of Africa. The diviners' information was gotten through asking them a set of questions drawn from indigenous governance aspects, where their responses were recorded and then transcribed into meaningful information. This ensured a representative sample from which generalization can be made from the study's findings. The researcher also interviewed purposively sampled University lecturers of new media for expert opinion. Effort was being made to corroborate the diviners' information with the archival records in gazetted museums.

Discourse Analysis

The units of analysis in discourse analysis were the officially gazetted information and items from national museums on Indigenous African democracy dating back to pre-colonial and during colonial era. The information was used to corroborate data from the interviews with the diviners. Data collected was tabulated and analysis carried out manually using a code scheme constructed. Analysis for ordinary meaning vis-à-vis hidden meaning was sought for, in corroboration with the diviners' information.

To minimise on weaknesses of discourse analysis, the researcher refrained from relying on the positivism paradigm which seeks to treat existing information as truth without questioning it. Thus, the study did not treat the museum items as unquestionable truth. The researcher was also careful while using social

constructionism paradigm to avoid letting own world views and personal realities infiltrate in the data analysis process.

Analysis and Presentation of Findings

Interview:

Qn. How did Village Assemblies work before colonial disruption? Transcribed responses combined from the four respondents:

African communal tendencies included groups of family homesteads that formed village settlements. These village settlements were the smallest units of political representation. The political units had shared values, interests and at times blood relations. This compares to today's social media groups such as WhatsApp whose members share interests and aspirations. In the indigenous African contexts, there were no written rules abiding one in the village settlements. In fact, too often aggrieved members of the village unceremoniously walked away to form their own. This loosely compares to a WhatsApp group whose membership is voluntary and aggrieved members are free to "exit" or leave the group. Indigenous Africans were bound together by consensus, without which they "left" the villages. Modern authors use the phrase "voting with the legs" to refer to people leaving a village due to unresolved grievances often related to leadership. In part, the ease of exit from social media groups make African people embrace the medium in their political dialogues.

Qn. How did participation and freedom of expression in Africa disappear? Analysis of the responses:

Whereas Indigenous African Democracy allowed for expression of opinions by the people, colonial governments abolished it and over time collaborated with kings, chiefs and other traditional leaders to establish dictatorship. Mbembe (2013) argues that everyone is born and grows up somewhere and the 'somewhere' inscribes them, within a lineage which is impossible to choose. As such, Africans are inscribed by African Democracy characterised by freedom of opinion, and have no choice but to nurture it to full acceptance on the continent (Mbembe 2013:17). The autocratic regimes witnessed in Africa today are as a result of past colonial influence. As Diop (1974) documents, indigenous Africa had women political leaders as early as over 2000 years ago. Such included Cleopatra the Egyptian Pharaoh and wife to Julius Caesar. Women and low social status people were entitled to opinion on

social issues affecting the villages and their consensus was sought before decisions were made, usually under a tree in broad daylight. The colonial disruption was not however uniform. This led to the differential influence of social media across the societies on the continent since different societies recollected their disrupted socio-cultural lives variedly, depending on how intensely the respective colonial disruption was.

The above responses point at a direct comparison with social media groups in Africa where African citizens, regardless of their social statuses are known to take on their leaders demanding for accountability. For example, Kenyans On Twitter (KOT) is an online group in Kenya known to express their often “hash” opinions on a range of issues. The group is known to hold countries, institutions and powerful individuals in society accountable for their deeds. In 2013, KOT under the hash tag #someoneTellCNN forced the American powerful media house CNN to apologise following their erroneous airing of falsehood about Kenya’s preparedness for the 2013 general elections. The online group also led to a diplomatic row between Kenya and Rwanda in 2015 with a hash tag #someoneTellKagame, where they criticised Kagame’s dictatorial style of leadership in the small central African country. The opinions of the group members put pressure on individuals and institutions holding them accountable for their deeds regardless of the social status or gender of the group members. All that matters is the consensus they build around an issue from wherever they are across the globe, thereby creating a public perception on an issue.

Qn. How did members conduct village assemblies?

Herbalists, wrestlers, hunters among others dramatised their prowess with illustrations and emotions during village assemblies. There was no clear distinction on which gathering is for which debates. As long as people gathered, they discussed everything in the same sitting including politics, medication, entertainment, resolving internal conflicts, among others. In fact there was no clear distinction between a herbalist treating a patient, an aggrieved member launching a complaint to the gathering or an entertainer playing a traditional instrument, since they all appealed to audiences through the drama, emotions and illustrations they used. The herbalist used the drama and illustration to create some sort of entertainment that would help diffuse tension especially when a patient was in critical condition. Social media also has these abilities whereby it evokes emotions and create illustrate through pictures and memes. When the social media is used in political dialogues,

it conveys a sense of immediacy besides entertaining, by use of the pictures and illustrative memes. This ability has made social media adaptable in African political dialogues because indigenous Africa was largely emotive, dramatic and illustrative.

Conclusion

The study established that there are socio-cultural factors responsible for the persistence and influence of social media in Africa. These socio-cultural factors include the communal tendencies that influenced the formation village assemblies, consensus seeking tendencies on societal issues, the ease of exit from villages to form others by members aggrieved by unresolved grievances, evocation of emotions as well as entrenched freedom of expression regardless of social status and gender. The differential influence of social media across the continent is because different communities in Africa experienced varying intensity of socio-cultural disruption from the colonialists. Thus, societies whose socio-cultural values were more disrupted failed to reconstitute the values after colonial era.

Recommendations

The study recommends further research on how socio-cultural factors in individual communities in Africa influence the adaptability of social media in the communities. This will help map out the suitability of social media in the different communities in Africa, with view to address the different communities' communicative needs.

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Section Seven:
TEACHING
AND LEARNING
TECHNOLOGIES

Harnessing New Media for Teaching and Learning Communication Skills: Possibilities and Challenges at the Technical University of Kenya

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Abstract

Communication Skills is a common university course offered by the Department of Language and Communication Studies at the Technical University of Kenya. The purpose of the course is to enable students use basic language skills effectively and efficiently for communication in academic and social settings. The study sought to establish the teaching and learning methods used to deliver a skills-based course in a large-class context; to examine the challenges faced by both instructors and learners in meeting the expected learning outcomes of Communication Skills, the participants' perceptions about new media, and its usefulness for academic purposes. University records indicated an enrolment of 2416 first year diploma and degree students on the regular programme. The Department subsequently divided learners into five groups of approximately 480 students each for purposes of teaching Communication Skills. One group was selected using convenience sampling, leading to a population of 471 students representing 16 departments. 84 students responded to an online questionnaire. All six instructors were included in the study and three returned the paper-based questionnaire. The findings revealed that the lecture method was commonly used; other methods and tools included pair, group, whole class discussion and presentations; audio-visual aids and various online platforms and channels. Challenges included large classes, inadequate infrastructure, and low level of interest by learners. Learners indicated that all their language skills had improved; however, writing skills were not rated as highly as other skills. Both instructors and learners indicated that the course could be effectively delivered using both face-to-face instruction and new media. The study provides a basis for further research into innovative methods of teaching and learning of common courses, which are generally characterised by large class sizes, and further investigation into how each language skill area can be improved.

Keywords: Communication Skills, New Media, Common University Courses, Large Classes.

Introduction and background

Common university courses are carefully selected as vehicles for the impartation of valuable knowledge, skills and attitudes to all learners, irrespective of their areas of study. Among the common courses on offer at The Technical University of Kenya is UCCC 1101: Communication Skills. The course is offered by the Department of Language and Communication Studies to all first-year students in their first semester of study, except under extenuating circumstances where the course may be offered at other times.

The Technical University of Kenya has three faculties: The Faculty of Engineering Sciences and Technology, The Faculty of Social Sciences and Technology, and The Faculty of Applied Science and Technology. The faculties comprise various schools, and the schools comprise various departments. Given an annual student enrolment of about 2000-2500, the average Communication Skills class size is composed of approximately 400-500 students drawn from various departments, within these faculties. Learners are co-taught by eight full time staff in the Department, with the assistance of adjunct staff as and when necessary. Classes of this size are generally considered “large classes”, although use of the term depends on perceptions, context and expectations.

It is recognised that large classes in themselves are not necessarily ineffective; indeed, a few studies point out some interesting benefits. Nonetheless, the challenges that accompany large class situations may have a negative impact on effective teaching and learning. To counter some of these challenges some universities have begun exploring the option of delivering common courses via online platforms. In itself, however, online course delivery is not problem-free. Challenges include staff adaptability, technical issues, time management and self-motivation among learners. Another option is the use of blended or hybrid learning systems which combine traditional learning with the use of online learning in order to reap the benefits of both approaches and mitigate the weaknesses of each. Which methods and tools are currently used to teach communication skills to large classes? What challenges do instructors and learners face in teaching and learning? Which new media technologies are familiar to potential users, and can they be incorporated in teaching and learning? These questions are addressed in this paper, accompanied by insights from both instructors and learners of communication skills at The Technical university of Kenya.

The current purpose statement of the course UCCC 1101: Communication Skills

reads as follows: The purpose of this course is to enable students use the four basic language skills effectively and efficiently for communication in academic and all human settings, to become effective library users, and to use New Media ethically and effectively. The course, therefore, mainly focuses on effective use of the four language skills (listening, speaking, reading and writing). The library section is taught in collaboration with library staff and academic staff who are specialised in information and knowledge management. The aspect of ethical and effective use of new media was included in the purpose statement in 2017, but received mixed reactions from Departmental staff. On one hand, it was argued that the course UCCC 1101 ought to focus on the four language skills, for academic purposes. On the other hand, it was argued that the main function of language is to communicate; therefore, it would be important to recognise that channels of communication have morphed, particularly with the introduction of new media. It was finally agreed to include the topic, although the course would retain its intended focus on the teaching of effective listening, speaking, reading and writing skills, particularly for academic purposes.

The expected learning outcomes of the course are: that the learner should be able to communicate effectively for academic purposes; apply the requisite communication skills in other relevant contexts; use of libraries effectively, use of information technology and new media ethically and effectively for academic and non-academic purposes.

Literature review

This section is divided into three thematic areas: large classes, blended learning and innovation.

Large classes

Much of the literature on large classes emanates from experiences in developing countries, where such classes tend to be the norm; however, large class sizes are a universal phenomenon. It is recognised that perceptions of what constitutes a large class are highly subjective, and there is no universally accepted figure. According to Todd (2006), such perceptions are often based on the largest classes that the teacher teaches. Additionally, there are several other considerations that recur in the literature, including but not limited to space, subject focus, teaching methodology and availability of resources. These factors influence perceptions of what a large class is and what it is not.

Wang and Zhang (2011) cite Hayes' (1997) five categories of problems associated with large classes arising from research in Thai schools, namely, discomfort caused by physical constraints, control or discipline problems, lack of individual attention, difficulty in evaluation and problems of learning effectiveness. These and similar challenges are captured in the literature on large classes from various parts of the world (Benbow, Mizrahi, Oliver, & Said-Moshiro, 2007; Smith, 2014; Todd, 2006). Kerr (2011) cites various studies in the Canadian context, showing that large classes can have a negative impact on students, particularly first-year students enrolled in introductory courses who may experience anonymity, isolation and reduced motivation. She cites Bedard and Kuhn (2008) and Cueso (2007), who observe that instructor effectiveness decreases with increasing class size, with the lecture method being predominant.

Although large classes tend to be presented as problematic at all levels of learning, it is also recognised that there exist innovative, home-grown solutions to these challenges that potentially apply across various teaching and learning contexts. Coleman (1989) in Shamim, Negash, Chuku and Demewoz (2007) highlights two general principles for teaching large classes: being realistic and giving more responsibility to students. Shared responsibility involves use of pair and group-work, sharing of control with learners, use of self-evaluation and interactive activities. Other suggested solutions include early establishment of rules of participation, use of ice-breakers, participatory decision making, peer assessment, self-reflection and self-evaluation, among others.

Studies that have examined learners' perceptions provide some similar, but also some unique perspectives, to the challenges of large classes. Shamim et al. (2007) highlight the following challenges, noted by learners: overcrowding, inadequate attention from the teacher, lack of opportunity to participate in classroom activities and difficulty in receiving teacher feedback. Ajjan, in an interview with Kuchah (2012) comments on her study of large university classes of about 400 students in Damascus, Syria observes that student voices have not been captured much in large-class research. Her qualitative study revealed that learners were not bothered about being in a large class, but were interested in good teachers, who were further defined as being friendly and interacting with students (in the sense of keeping them mentally engaged, not necessarily verbally active). Kerr (2011) also cites studies that indicate that the skill and competence of the instructor, as well as the course design affect learning more than class size alone. These views are supported

by Obanya et al. (n.d) and Kumar (1992) in Todd (2006), who show that the quality of teaching, and activities used, are more important than class size. Indeed, Todd (2006) indicates that the view that large classes per se are problematic is mostly unsupported; however, the related problems arising from large classes cumulatively have a negative knock-on effect. Ajjan, in Kuchah (2012) points to some of these associated challenges: lack of facilities, fixed benches or sitting positions, and lack of teaching aids, such as projectors.

The challenges are exacerbated when the class in question is a language class:

‘When the teaching involves transfer of factual knowledge, such class sizes may not be problematic (Obanya et al., n.d), but for the teaching of English, which requires the learning of complex skills, these massive lecture classes are likely to cause a wide variety of problems.’ (Todd, 2006, pp.1-2).

In their study of a Thai University Jimakorn and Singhsiri (2006) observe that large classes make it challenging for learners to develop language skills, especially productive skills (speaking and writing) since such classes promote a lecture-based approach, which focuses on receptive skills (listening and reading). Their study revealed lack of individual attention and feedback to students, while group work was marred by lack of contributions. Tutorials simply added to teacher responsibilities, while continuous assessment was impractical due to the demands of marking. They advocate greater sensitivity by administrators in understanding teacher attitudes and beliefs towards language teaching and learning, as well as recognition of the need for training teachers on teaching and managing large classes. Ajjan in Kuchah (2012) advocates understanding the context of teaching and learning, and similarly emphasizes the central role that the teacher plays in adapting to their particular teaching and learning contexts in order to deliver content effectively to learners. These studies place instructors, by use of innovative methods, at the heart of effective handling of large classes. Effectiveness can be achieved with administrative support, and training.

Among the interventions that have been proposed as solutions to the challenges of large classes are technological solutions. In line with the call by other researchers to include more student voices in large class research, this paper focuses on both teacher (whose centrality has been highlighted in various studies), and learner views on the viability of incorporating of new media for teaching and learning of the Common Course, Communication Skills.

Blended learning

Blended learning is a Social Constructivist method of learning. Social Constructivism is founded on the seminal works of thinkers such as Jean Piaget, John Dewey and Lev Vygotsky in the areas of child development, social activism and discovery learning. Robyler (2006) observes that “learning occurs when one constructs both mechanisms for learning and his or her own unique version of the knowledge, coloured by background, experiences, and aptitudes.” Horn and Staker (2014) define blended learning as a mix of technology and face-to-face instruction where the brick-and-mortar classroom is combined with online learning, and students have some control over the time, pace, and place of their learning. Blended learning has been suggested as a remedy to the types of challenges associated with large classes, including classroom management, behaviour management, effective instruction, learner engagement and assessment. At the same time, adoption of technology is often viewed as a way of controlling cost, while improving quality.

Several models of blended learning are practiced, as outlined by the Clayton Christensen Institute (2018). The Rotation Model is a commonly used model in blended learning. Learners rotate between learning modalities such as small group projects, individual tutoring, full-class instruction and written assignments. This can occur at the teacher’s discretion, or it can be according to a fixed schedule. Various types of rotations exist. Station Rotation involves student rotation within a classroom or several classrooms, with students working both offline and online, during which time they engage in a variety of online based activities, allowing for independent and private work. Lab Rotation is similar to this, only that online instruction takes place in a computer laboratory. The Flipped Classroom requires learning off-site, via the computer, combined with face to face instruction that is largely activity-based. Individual Rotation is not prescribed by the teacher; rather, it is determined by learner needs. Apart from rotation models, there also exist other models. The Flex Model has online learning as its core, with the teacher providing support only as needed. Learners have a high degree of independence as they engage with the curriculum. The A-La Carte Model enables students to take one or more online courses whether on or off-site, and face-to-face sessions. The face-to-face instructor is often the same as the online instructor. Finally, the Enriched Virtual Model has required face-to-face sessions, but not daily attendance. Most of the work is done by learners, online and off-site.

It is evident that blended learning modifies, but does not diminish the role of the

teacher. In line with constructivism, teachers help students to construct knowledge rather than to reproduce a series of facts. This is because the constructivist teacher provides tools such as problem-solving and inquiry-based learning activities with which students formulate and test their ideas, draw conclusions and inferences, and pool and convey their knowledge in a collaborative learning environment. There is fluidity of teaching where, simultaneously, one can be a “sage on the stage” and “guide on the side” (King, 1993). Blended learning suggests that certain core knowledge, skills, mores and expectations will be delivered by the teacher using the lecture method, then complemented later on by technology. The advantages of guidance begin to recede only when learners have sufficiently high prior knowledge to provide ‘internal’ guidance. The teacher, like many modern learners, has to become digitally competent because of the dexterity with which the students handle technological appliances, and the availability of the Internet. The fact that 88.8% of Kenyans have Smartphones (Communications Authority of Kenya, 2015) contributes to the viability of blended learning.

Several studies focus on the use of blended learning among homogeneous groups of learners in different contexts, for instance in medicine, engineering, economics and other professions. Abbas (2015), however, reports on a heterogeneous large class of students in Pakistan university, where blended learning of English as a foreign language was introduced experimentally. The findings revealed a mixture of fear and excitement among students, who appreciated the convenience and flexibility of the programme, as well as benefits such as autonomy, independence and personal time management. They found the web-content engaging, and were satisfied with their instructors; however, students still wanted more face-to-face support. Challenges included high Internet costs, maintenance of commitment, and boredom of self-study. Additionally, blended learning was not successful among students with poor language skills.

Since each educational context is unique, there is need for more studies that examine the pros and cons of introducing new technologies to enhance language or language-based courses. This is especially true in the context of large classes, where ‘going online’ may be viewed as a quick panacea.

Innovation and change management

Innovation is defined as the introduction of something new, such as a method, or device. Institutions and individuals can be said to be innovative when they are open

to new ideas, processes and products. Rogers (2003, p. 12), however, cautions that innovation does not necessarily have to be new in and of itself. It is “an idea, practice or object that is perceived to be new by an individual or other unit of adoption.” Innovation involves change, which is often resisted. Rogers (2003, pp. 15-16) further observes that for innovations to spread, communication is necessary; however, there will be different rates of adoption depending on the relative advantage of the innovation over the idea it supersedes, its compatibility with the needs, values and experiences of users, its complexity, capacity to be experimented with on a limited basis, and its observability or visibility to others. Acceptance of innovations is not uniform because individuals exhibit different adopter characteristics: innovative/venture; early adopters/respected; early majority/deliberate; late majority/skeptical and laggards/traditional (Rogers 2003, pp. 282-285).

The innovation literature is important to any institution or organisation intending to introduce changes. As Rogers’ seminal work indicates, communication is a key factor in adoption of innovation, as are awareness of adopter characteristics and differences in adoption rates.

Methodology

The target population of the study was students learning communication skills at The Technical University of Kenya and academic staff instructing the students in the same course. At the beginning of the 2017/2018 academic year, the Department of Language and Communication Studies divided the recorded 2416 incoming full-time first-year diploma and degree students into five (5) groups of approximately 480 students each. The study population therefore had five (5) strata. Each group was assigned two course instructors, with two-hour lessons scheduled twice a week for the semester. The researchers selected one of the strata (classes) as a case study. The group comprised a heterogeneous group of degree students drawn from different schools and departments. The class had 471 students, who were invited to fill in an online questionnaire. 84 (17.8%) responses were received. Snowballing was initially used to obtain participants, beginning with class representatives from each department; subsequently, during class time, announcements were made, and learners were requested and reminded to voluntarily fill in the online form, for research purposes. From the onset, the course instructors encouraged learners to obtain e-mail addresses and make use of social media platforms and online channels to ease communication on matters pertaining to the course. The six instructors, who were not participants in the research study but were participating in teaching

the course, were invited to fill in a paper-based questionnaire. Three (50.0%) responded and returned their questionnaires. Frequencies and percentages were computed for close-ended questions. Open ended questions were thematically coded, and the responses provided qualitative information, thus enabling the voices of participants to be captured

Findings

The study sought both instructor and learner views on the teaching and learning of Communication Skills, the challenges perceived by both groups, and their views about the adoption of new media for teaching and learning purposes. The data from both groups is organised under these broad thematic headings, derived from the research questions.

Participants

The instructors had 5-7 years of experience, teaching Communication Skills at The Technical University of Kenya, and their class sizes averaged 450 learners. All classes were handled in the University's main hall. Student participants were a heterogeneous group, drawn from the Schools of Biology and Life Sciences, Computing and Information Technology, Health Sciences, Mathematics and Actuarial Science, and Physical Sciences and Technology. The students were pursuing various courses, such as applied biology, biochemistry, biotechnology, and communication and computer networks, among others.

Teaching and learning

All instructors indicated that they used the lecture method. Other methods and tools cited were question and answer, group discussion, presentations and use of audio-visual aids. All instructors were moderately satisfied that their instructional methods helped learners achieve effective communication in all the language skills. The availability of a sound system, use of groups and class presentations, and use of e-mail to receive written assignments were cited as reasons for moderate to high satisfaction.

Table 1: Learners' perception on teaching and learning methods for communication skills

	Highly effective	Moderately effective	Slightly effective	Ineffective
Lecturing	49 (61.3%)	26 (32.5%)	5 (6.3%)	0 (0.0%)
Small group discussions	24 (30.0%)	43 (52.5%)	10 (12.5%)	4 (5.0%)
Pair work	20 (25.0%)	34 (42.5%)	20 (25.0%)	6 (7.5%)
Student presentations	28 (36.4%)	25 (32.5%)	28 (23.4%)	6 (7.8%)
Whole class discussion	19 (25.8%)	18 (22.5%)	28 (35.0%)	15 (18.8%)

Table 1 above, shows that students rated lecturing as moderately to highly effective, 75 (93.8%), with only 5 (6.6%) regarding it as slightly ineffective. Group work was also rated highly, with 66 (82.5%) rating it as moderately to highly effective, and 14 (17.5%) regarding it as slightly effective or ineffective. 54 (67.5%) regarded pair-work as moderately to highly effective and 26 (32.5%), as slightly effective or ineffective. Class presentations received a similar response with 53 (69.9%) and 24 (31.2%) respectively. Whole class discussions were not equally well received, with only 37 (46.3%) regarding whole class discussion as a moderately or highly effective method, while 43 (53.8%) thought it only slightly effective or ineffective. Learners therefore preferred lectures, small group discussions, pair-work, class presentations and whole class discussions, in that order.

Table 2: Learners' views on whether communication skills course helped improve language skills

	Yes	Somewhat	No	Don't Know
Listening	77 (97.5)	2 (2.5%)	0 (0.0%)	0 (0.0%)
Speaking	68 (85.0)	11 (13.8%)	1 (1.3%)	0 (0.0%)
Reading	65 (83.3%)	11 (14.1%)	1 (1.3%)	1 (1.3%)
Writing	62 (80.5%)	8 (10.3%)	7 (9.0%)	1 (1.3%)

Table 2 indicates that learners perceived that they had improved in all language skills; comparatively, writing skills recorded the greatest challenge, with 15 (19.2%) students indicating that they had not improved, or had only somewhat improved. This was further supported by their comments, which pointed to poor writing skills on entry, and the need for more writing practice, (this would be best achieved in smaller classes). One of the students commented as follows:

'For me, writing is and has always been a struggle. Writing skills can be improved by engaging in more essay writing as part of most assignments.'

In their open-ended responses, learners suggested various ways in which Communication Skills classes could generally help them improve their language skills: they desired use of audio-visual aids and interactive videos, better guidance on essential reading materials, written handouts, more research questions, assignments and essays in order to improve writing skills, division of the class into smaller groups to enhance effectiveness and voluntary (rather than mandatory) class presentations. They also proposed the use of peer teaching, use of an e-learning platform and group presentations in course delivery.

Challenges faced by instructors and learners

Among the challenges instructors faced in teaching Communication Skills were large classes, which were considered inappropriate for teaching a skills-based course. Instructors indicated that the expected learning outcomes of the course would be better achieved with smaller classes, suggesting that students ought to be taught within their schools or departments.

Instructors further indicated that learning venues needed to be better equipped both in terms of basic furniture and readiness to use of new media and multimedia technologies. They cited infrastructural challenges such as lack of halls (classrooms/teaching space), lack of furniture and poor lighting, as well as lack of interest by students.

Table 3: Learners' perceptions on challenges in learning Communication Skills

	Not a challenge	Slightly challenging	Moderately Challenging	Very Challenging
Large classes	16 (20.7%)	32 (41.6%)	15 (19.5%)	14 (18.2%)
Little interaction with instructors	18 (23.4%)	25 (32.5%)	21 (27.3%)	13 (16.9%)
Little interaction with other students	25 (32.5%)	31 (40.3%)	12 (15.6%)	8 (10.4%)
Few opportunities to practice language skills	20 (26.7%)	23 (30.7%)	18 (23.4%)	14 (18.2%)
Lack of use of technology to enhance learning experiences	11 (14.1%)	24 (30.8%)	22 (28.2%)	21 (26.9%)

Among the students, only 29 (37.7%) indicated that large classes were moderately or very challenging for them. The majority 48 (62.3%) indicated that large classes were only slightly challenging or not challenging at all. Similarly, fewer learners found lack of interactional opportunities and lack of opportunities for language practice moderately or very challenging, compared to those that did not. Table 3 shows that 34 (44.2%) found reduced opportunities of instructor-student interaction moderately or very challenging, compared to 43 (55.9%) who did not find it challenging or only slightly challenging. 20 (26.0%) found reduced opportunities for peer interaction moderately or very challenging compared to 56 (72.8%) who did not. 32 (41.6%) did not find reduced opportunities for language practice moderately or highly challenging compared to 43 (57.4) who did not.

On use of technology to enhance learning experiences, however, more learners indicated that this was a challenge to learning. 43 (55.1%) found the lack of use of technology moderately or highly challenging, compared to 35 (44.9%) who indicated it was not a challenge or only slightly challenging. This is supported by their previously stated suggestion on the inclusion of audio-visual aids, interactive videos and use of online platforms as potentially effective methods of engagement.

Technology and new media use

Instructors indicated that they had used the following technologies to enhance classroom instruction: PowerPoint, videos, and the Internet (via e-mail and social media platforms). They further indicated, more specifically, that social media platforms such as Facebook and blogs, and integrated e-learning platforms, such as Blackboard, could be incorporated to enhance the teaching and learning of Communication Skills at The Technical University of Kenya.

Among the instructors, only one indicated that he or she, and the students, did not have the necessary knowledge, skills and attitudes to incorporate new media in instruction. The other two noted that new media could be used to enhance teaching and learning; they indicated that they had the necessary knowledge skills and attitudes, although they did not know whether the learners did, as well.

From a choice of eight new media platforms and channels, namely Facebook, LinkedIn, Twitter, YouTube, blogs/vlogs, wikis, WhatsApp and e-mail, learners rated WhatsApp (39, 46.4%) and e-mail (37, 44.0%) as the most commonly used channels used by both instructors and learners in the teaching and learning of Communication Skills. They perceived that learners commonly used WhatsApp,

Facebook and e-mail among themselves, and that instructors mainly used WhatsApp, blogs/vlogs, LinkedIn, Twitter and E-mail, as shown in Table 4.

Table 4: Use of new media platforms and channels by instructors and learners

	Used by instructors	Used by learners	Used by both instructors and learners
Facebook	7 (8.3%)	15 (17.9%)	13 (15.5%)
LinkedIn	9 (10.7%)	13 (15.5%)	12 (14.3%)
Twitter	9 (10.7%)	11 (13.1%)	5 (6.5%)
WhatsApp	11 (13.1%)	18 (21.4%)	39 (46.4%)
YouTube	8 (9.5%)	11 (13.1%)	16 (19.0%)
E-mail	9 (10.7%)	14 (16.7%)	37 (44.0%)
Blogs/vlogs	11 (13.1%)	6 (7.1%)	3 (3.6%)
Wikis	8 (9.5%)	6 (7.1%)	7 (8.3%)

Table 5 shows that WhatsApp was most highly ranked as the major choice for communication of messages about course content, delivery and sharing of course content and interaction with one other about course content (75, 89.4%), followed by E-mail (60, 71.5%).

Table 5: Usage of new media platforms and channels in teaching communication skills

	To communicate messages about the course	To deliver/share course content	To interact with each other about course content	TOTAL
Facebook	6 (7.1%)	7 (8.3%)	15 (17.9%)	28 (33.3%)
LinkedIn	3 (3.6%)	5 (6.0%)	6 (7.1%)	14 (16.7%)
Twitter	2 (2.4%)	3 (3.6%)	9 (10.7%)	14 (16.7%)
WhatsApp	25 (29.8%)	25 (29.8%)	25 (29.8%)	75 (89.4%)
YouTube	4 (4.8%)	4 (4.8%)	5 (6.0%)	13 (15.5%)
E-mail	19 (22.6%)	26 (31.0%)	15 (17.9%)	60 (71.4%)
Blogs/vlogs	2 (2.4%)	5 (6.0%)	2 (2.4%)	9 (10.7%)
Wikis	3 (3.6%)	3 (3.6%)	3 (3.6%)	9 (10.7%)

These findings are to be understood in view of the nature of the hardware available to most learners in terms of accessing various platforms. Most learners indicated that the most commonly used tool in the course was the Smartphone. This was used for communication of messages, 20 (23.8%), delivery/sharing of content,

18 (21.4%), and interaction about the course, 23 (27.4%). Comparatively fewer instances of use of other tools, a computer – desktop or laptop, or a tablet were observed, as shown in Table 6.

Table 6: Use of available hardware

	To communicate messages about the course	To deliver/ share course content	To interact with each other about course content	TOTAL
Computer (Desktop/laptop)	12 (14.3%)	11 (13.1%)	13 (15.5%)	36 (42.8)
Smartphone	20 (23.8%)	18 (21.4%)	23 (27.4%)	61 (72.6%)
Tablet	7 (8.3%)	6 (7.1%)	10 (11.9%)	23 (27.3%)

Although the institution does not have an integrated platform for purposes of e-learning, the findings indicate that the available technologies and new media platforms are being harnessed to enhance communication of messages, deliver course content and promote interaction within a large-class context. Learners perceived all these factors as very beneficial, but the greatest benefit was seen to be in the area of access to more and varied course content (45, 53.6%), as shown in Table 7.

Table 7: Learners' perceptions on benefits of using new media for teaching and learning

	Slight benefit	Moderate benefit	Great benefit
Timely course communication	6 (7.1%)	17 (20.2%)	44 (52.4%)
Increased interaction with course instructors	11 (13.1%)	15 (17.9%)	41 (48.9%)
Increased interaction with other students	6 (7.1%)	21 (25.0%)	40 (47.6%)
Access to more and varied course content	6 (7.1%)	16 (19.0%)	45 (53.6%)

Learners' rated the challenges of incorporating of technology and new media in the teaching and learning of communication skills as slightly challenging, moderately challenging or greatly challenging. Learner knowledge, internet accessibility, and challenges relating to hardware and relevant software elicited the greatest concern, having being ranked as moderately and greatly challenging by a majority of students, as shown in Table 8. Limited Internet access for students was a major concern with 41 (48.8%) students citing it as a moderate or great challenge. A further seven students commented on infrastructural and lack of Internet or Wi-Fi as a major challenge in their open-ended comments.

Table 8: Challenges of incorporating new media in teaching and learning

	Slight challenge	Moderate challenge	Great challenge
Limited instructor knowledge	31 (36.9%)	22 (26.2%)	6 (7.1%)
Limited student knowledge	24 (28.6%)	30 (35.7%)	8 (9.5%)
Limited Internet accessibility for instructors	31 (36.9%)	17 (20.2%)	12 (14.3%)
Limited Internet accessibility for students	23 (27.4%)	21 (25.0%)	20 (23.8%)
Miscommunication or poor communication	29 (34.5%)	18 (21.4%)	15 (17.9%)
Hardware challenges	22 (26.2%)	28 (33.3)	14 (16.7%)
Software challenges	19 (22.6%)	30 (35.7%)	14 (16.7%)

The study sought to elicit views from both instructors and students on the role and place of new media in teaching and learning communication skills. None of the instructors was of the view that the course content would be learnt best if wholly delivered via new media. Instructors indicated that the course content was best learnt through a combination of face-to-face instruction and use of new media, although to some, face-to-face instruction alone was also acceptable. Instructors held diverse views on the topics that would best be taught via face-to-face instruction alone, citing topics such as introduction to communication skills, speaking, reading and writing skills. Face-to-face instruction with new media was viewed as having the potential to enhance all language skills, and in particular reading, while the three other skills could be taught via new media only.

Learners overwhelmingly concurred that new media could be used in the teaching and learning of Communication Skills at the University (90.3%). Comparatively fewer respondents thought it best to teach Communication skills face-to-face only, with 34(40.4%) saying yes, and 43 (49.3%) saying no and 43 (62.3%) saying no. They concurred that content would be taught best through mixing face to face interaction and use of new media, with 62 (87.3%) saying yes, and 6 (8.5%) saying no. Only 10 (15.4%) indicated that the course would best be delivered via new media platforms and channels alone, as shown in Table 9.

Table 9: Learners' perceptions on role of new media and face-to-face interaction in teaching and learning

	Yes	No	Don't Know
Content is best learnt through face-to face interaction	34 (49.3%)	43 (62.3%)	1 (1.5%)
Content is best learnt through face to face interaction and use of new media	62 (87.3%)	6 (8.5%)	3 (4.2%)
Content is best learnt through new media only	10 (15.4%)	54 (83.1%)	1 (1.5%)

Learners went on to justify their view that new media could be successfully incorporated to teach and learn Communication skills, citing benefits such as enhanced content, diversity of methods, learning at one's pace, interaction and greater motivation. These are some of their comments:

'It lets the learner use the media when interest is high and excites the learner because it involves new age technology as well as enhancing memory since the student isn't rushed to grasp content which can't be immediately repeated by the lecturer. Some students prefer reading and rereading to get content in lieu of enduring a 2-hour lecture which doesn't come with written back up'

'In topics like public speaking, watching public speakers is better than the teacher explaining everything.'

'Most students can access it comfortably and without the pressure that comes with hard copy books'

'Because it keeps the learners in touch with each other and also helps in research activities'

Conclusion

The lecture method was the most commonly used method, supplemented by some use of audio-visual resources as well as online platforms and channels. Learners rated the lecture method highly, while also valuing pair-work and class presentations. Both instructors and learners acknowledged that a large class was challenging; however, most learners did not consider it a major challenge, and indicated that their language skills had improved. Although learners perceived that their writing skills had improved, improvement in writing was rated lower than all other language skills. The literature suggests that productive skills (both speaking and writing) are difficult to achieve in a large class, learners were more satisfied with their progress in speaking than in writing. Both instructors and learners concurred that it would be appropriate to deliver the course using a mix of face-to-face instruction and

new media. For learners, WhatsApp was a popular platform for communication of messages, delivery of course content and interaction. E-mail was also a popular channel. Most learners used Smartphones for these purposes.

Innovative practices targeting delivery of common courses such as Communication Skills to large classes are welcome, and the use of new media technology is one possibility. There is, however, need, at an early stage, to capture as fully as possible the voices of those who will be part of the innovation, or affected by it. This paper takes a step in that direction. As Smith (2014, p. 4) observes:

...all types of large-scale, top-down innovation, whether mediated by the latest technology or otherwise, are flawed to the extent that they continue to ignore context in the *contents* of training, fail to engage teacher agency, and thereby fail to 'take hold'. Instead, more localised, bottom-up innovations are called for as an alternative to decades of inappropriate top-down reform.'

Recommendations

The study showed that both instructors and learners were open to the use of new media to teach and learn UCCC 1101: Communication Skills, a common University course. As it is, both groups harness available technology in the process of teaching and learning. The following are recommendations that, if adopted, would help harness new media more systematically effectively for teaching and learning purposes:

1. *Institutional infrastructure*: At the institutional level, participants cited need for Internet access and well-furnished computer laboratories. They observed that for the use of new media to become a useful feature in academic life, there was need for strong Internet connectivity and Wi-Fi on the compound.
2. *Training*: Although many instructors and students are familiar with new media, they require training in order to utilise it systematically and effectively for academic purposes. As one participant observed, there exist e-learning platforms such as Blackboard that incorporate new media, and other features geared towards teaching and learning, all under one roof. This requires investment in information technology and training at the institutional level.
3. *Blended learning models research*: Participants advocated use of both face-to-face instruction and new media, thus indicating that while technological

interventions are welcome, teacher-student contact is valuable. This calls for closer examination of blended learning models, taking into consideration all the contextual and human factors pertaining to the delivery of the course.

4. *Methodology*: To confirm the trends suggested in this paper, broader representation among students, staff and other stakeholders is required in an enhanced study. This study narrowly focused on a single large class. The use of online forms, while advantageous in many ways, reduced the number of participants. Studies reveal that online surveys receive 20-47% response rate, while paper-based surveys receive 32-75% response rate (Nutly, 2008). Additionally, triangulation through pre and post-tests, and classroom observation would help establish more clearly whether, and how much, progress has been achieved in each of the language skills.

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The Intersection of Multiple Intelligences in Musical Performance

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Abstract

This paper examines the various musical components that make up a piece of music and the special intelligences that a performer employs simultaneously to express the composer's intended outcome. It examines the interplay between the elements of music and the intelligences required to interpret them in a musical performance. This is aimed to contribute towards the formulation of an integrated curriculum in the Kenyan education system where music plays a significant role in the education of learners. Two areas have been given attention, namely, the components of a piece of music and the multiple intelligences applied simultaneously in its performance through the medium of a human voice or an instrument. It defines what is meant by "components" of a music performance and the intelligences derived from a music context, including the intended and expressed as well as the realised and experienced intelligences. The paper also reviews the methodology used to inform, though in an introductory sense, what this inquiry found, and to suggest some basic remedies to the weaknesses that accompany the state of music in the imagination of Kenyans in the education sector, the academy, and the general society.

Keywords: Music education, skill sets, auditory intelligence, digital/vocal intelligence.

Introduction

This paper examines the importance of the simultaneous use of multiple intelligences through the evaluation of the components of musical performance. This has been prompted by the low enrolment of music students in schools, colleges and universities in Kenya. Parents, the national education system, and the Kenyan society place a low value to music, thus contributing to the problem in several ways. For example, music is discriminated in the chain of the education system. It is marginalised in the priorities of the school curriculum and in the

prerequisite university entry cluster points for placements into the university study programmes. Talented students, therefore, become less motivated to pursue advanced music studies. These issues have come to light through the methodology of long time participant observation by this author. The author's observations include early childhood experiences, encounters as a student at different levels, and his experiences as composer, performer, connoisseur and teacher. These observations reveal that the low enrolment in music in high schools and universities in Kenya stem from the low value that parents, the education system and general Kenyan society give to music. The university cluster system for placement places music in the margins. This leads to the erroneous view that music gives low esteem and value as an intellectual sphere of life and professional success. Studies have shown that all human beings have a multiple set of intelligences that are used simultaneously in making meaningful contributions in learning. What is unknown is that music contributes to the nourishment of the neurological capacities of the brain responsible for learning in all subjects, including mathematical reasoning. This means that music intelligence is a vital aspect of human existence. The practical implication is the recognition that music education at university level can stand as a good example of validation of both cerebral and manual/kinesthetic intelligences. It implies that a change in the curriculum and teaching methodology is needed to promote an interdisciplinary relationship between music, the sciences and the arts. Furthermore, an understanding of what music does in the learning environment and in the cognitive development of learners can also be developed through an integrated programme. This can contribute to human interactions and multiple professional involvements to foster the study and performance of music in Kenya. The value of this study is anchored in the understanding that music intelligence, as expressed in the ability to play an instrument, sing or compose a piece of music, or collaborate in a group to produce music, is composed of many kinds of intelligences, including auditory intelligence, haptic intelligence, kinetic intelligence, visual intelligence, among others. These musical intelligences in the intellectual formation of high school, college and university students can encourage greater institutional participation. Currently, otherwise, the education system in Kenya shows a decline in the growth of music in education, especially in public schools, colleges and universities. This has led to the wrong assumption that music is merely for entertainment and contributes little to a person's intellectual development

Components of Musical Performance

The word “components” is used in this paper to refer to the various aspects of a piece of music being performed. Similarly, “performance” may be defined as an act of performing a play, concert, or some other form of entertainment.

A piece of music is composed for a particular medium through which its inherent musical elements conceived by a composer and expressed on a written score are interpreted and realised through a performance. They include: the chosen musical key, pitch, melody, rhythm, harmony, form, tone colour, dynamics, tempo, and more. These elements, upon which the composer conceives the music, give character to the music itself in regard to its genre. In a performance, a musician trained in a specific medium is aware of all these components and is able to accurately interpret the music in the manner conceived and prescribed by the composer on the score regardless of time and space.

The Multiple Intelligences Simultaneously Applied in a Musical Performance

The term “intelligence” may be defined as the ability to learn, understand and think in a logical way about things; the ability to do this well. In relation to this discussion, the phrase “multiple intelligences” refers to a combination of a set of abilities that are selected and carefully used to accurately interpret a piece of music in a performance. These abilities are acquired through a considerable length of training in a specific medium, such as voice, violin, piano, clarinet, trumpet, drum, and so forth.

The discussion in this paper is informed by the theory of “Multiple Intelligences” which a number of renowned scholars have proposed. Due to the limitation of the scope of this paper, I will briefly highlight some valuable insights suggested by Gardner (1983) which will help to illustrate how these intelligences are linked with a wide range of musical genres, whether African or Western in origin. Dr. Howard Gardner, professor of education at Harvard University, developed the theory of multiple intelligences in 1983 out of a research he conducted entitled “Project Zero.” From his findings, Gardner challenged the traditional notion that intelligence is a single capacity possessed by every individual to a greater or lesser extent. These findings led him to conclude that there exist a number of intelligences that result in a unique cognitive profile for each individual. He suggests that the intelligence traditionally based on I.Q. testing is far too limited.

According to Gardner, human cognitive competence is better described in terms of a set of abilities, talents, or mental skills called intelligences. All normal individuals possess each of these skills to some extent; although individuals differ in the degree of skill and in the nature of their combination. Gardner proposes eight different intelligences to account for a broader range of human potential in children and adults. These intelligences include:

1. Logical-mathematical intelligence (“number/reasoning smart”): Consists of the ability to detect, reason deductively, and think logically and is associated with scientific and mathematical thinking.
2. Linguistic intelligence (“word smart”): This is the mastery of a language or ability to effectively manipulate language to express oneself rhetorically and poetically, use language to remember information, events, and dates, among others.
3. Spatial/visual intelligence (“picture smart”): The ability to manipulate and create mental images in order to solve problems. Gardner found that it is also found in blind children.
4. Musical intelligence (“music smart”): This is the ability to recognise and compose pitches, tones, and rhythms. Auditory functions are required to develop intelligence for pitch, tone and rhythm but not for knowledge of rhythm.
5. Bodily kinesthetic intelligence (“body smart”): The ability to use one’s mental abilities to coordinate his/her bodily movement.
6. Interpersonal intelligence (“people smart”): This is the emotional feelings for others and cooperating with them.
7. Intrapersonal intelligence (“self-smart”): The feelings for others and understanding their intentions.
8. Naturalist intelligence (“nature smart”) The ability to nurture and relate information to one’s surroundings including classifying and categorising forms such as plants, animals and objects including rocks and mountains.

Gardener noted that although the intelligences are many, the human body works as an organism and therefore, they work jointly in any given task. In other words, they are used concurrently and complement each other as individuals develop skills to solve problems in their immediate environment. Against this background, I have recognised that, in a music performance, a multiple number of intelligences fall

simultaneously into place to successfully articulate the interpretation of a given piece of music during a performance. Gardner's has summarised the outcomes of his research, as follows:

1. The theory of multiple intelligences drew the attention of many educators in the USA and some Asian countries and many schools are currently using its philosophy to redesign the way they educate children.
2. In a redesigned curriculum, each child has the opportunity to learn in ways harmonious with their unique minds to facilitate effective learning. The eight intelligences are converted into learning pathways through which learners benefit.
3. The theory of multiple intelligences has also been used to design curriculum for adult learning and development. Many adults find themselves in jobs that do not make optimal use of their most highly developed intelligences (for example, the highly bodily-kinesthetic individual who is stuck in a linguistic or logical desk-job when he or she would be much happier in a job where they could move around, such as a recreational leader, a forest ranger, or physical therapist). It gives adults a whole new way to look at their lives, examining potentials that they left behind in their childhood (such as a love for art or drama) but now have the opportunity to develop through courses, hobbies, or other programs of self-development.
4. The theory also implies that teachers, regardless of their level of school, have to diversify their methods of presenting their lessons. They need to apply a combination of approaches in order to meet the individual learners' abilities in regard to the eight intelligences.
5. Whatever the topic or concept for a lesson, the teacher has to critically analyse how to link words (linguistic intelligence), numbers (logical-mathematics intelligence), pictures (spatial intelligence), music (musical intelligence), self-reflection (intrapersonal intelligence), physical experience (bodily-kinesthetic intelligence) a social experience (interpersonal intelligence, and an experience in the natural world (naturalistic intelligence) to effectively deliver the intended learning outcomes.
6. The teachers are under no obligation to apply all the eight learning pathways in one lesson but to figure out the most effective methods that might work best to explain the main concept (s) prepared for the day.

Gardner's study is useful in examining Kenya's current situation regarding the environment of the music curriculum in schools and universities. This will become clear in the following sections of this presentation.

Methodology

Participant observation has informed the insights that illuminate the local Kenyan context. This has been drawn from lifetime interaction with the music subject as a child growing up in a rural community, a student of the Kenyan educational system, composer, performer, connoisseur, teacher and lecturer.

I grew up in a musical environment both in my rural home and later in school, college, national and international contexts. During my childhood, my father played the traditional *Gusii* (Kisii) eight-stringed lyre (*Obokano*) in the afternoons while relaxing or in the evenings after the rest of the family had retired to bed. The traditional *Gusii* music grammar, through the tunes he played, got ingrained in me quite unconsciously. Unlike the Western classical tradition, which relies on notation for its composition, learning and performance, I learnt to play the *Obokano* by apprenticeship.

In school, my teachers, through the singing of Western children's songs, introduced me to Western music first by rote before I learnt to read music notation as I developed through the school system. The learning of the Western notation system facilitated my understanding of the anatomy of the music and the associated skills for writing, interpreting and performing pieces of music either on an instrument or voice. I learnt various performance skills, such as auditory skills or aural culture, sight-reading, articulation, expression, and so on. In the end, these elements simultaneously come into play in the performance of a particular piece of music.

As a music teacher, I have taught groups and individual students of all ages for over three decades. Each student I have interacted with is a unique character from a unique cultural and family background. With this in mind I have employed various methods of teaching various aspects of music, including music theory, music appreciation and practical musicianship. In recognising their entry behaviour, relevant learning materials are prepared to aid the student to internalise the various intelligences required in creating and performing a piece of music. Students have always demonstrated their recognition of and response to various expressions and musical elements inherent in a piece of music. Many of the students I have taught over time have progressed to become music professionals or teachers of music; they

are playing a big role both in our school system and in the music industry in Kenya and beyond.

As a music examiner for practical examinations in Kenya and adjudicator at the Kenya Music Festival, the rating for each individual's performance is depended upon how well the performer has applied previously learnt and internalised intelligences simultaneously to interpret the music according to the composer's direction on the score. Each piece of music requires a multiple set of abilities applied with great care and sensitivity.

In composing a piece of music, the basic components of music - rhythm and melody - are organised into measures (bars), phrases and periods and then put together to make a sizeable length or a large music composition. Other music elements essential in the building up of a composition include, contrasts, tempo, harmony, dynamics, and tonality, among others. The composed piece of music, regardless of its length, is given the shape or form by which it is known or recognised. A simple piece of music may have two parts designated as "A-B" or binary form; or three parts designated as "A-B-A" or ternary form. The form of a piece defines the genre of the music and the composer plans how a number of musical elements are systematically incorporated, as the composition gets under way. Other than the compositional techniques used to assemble the musical materials to build a particular piece of music, a composer requires a mastery of the same intelligences simultaneously applied by a performer in the interpretation and performance of the music piece.

Findings

Musical performance is a complex product of multiple kinds of intelligence many of which are often taken for granted. Through observations made over time, I have known that a person who has not had formal training may not make sense out of a score of music or to manipulate an instrument to create and intelligible melody out of it. In the same way, a listener to a musical performance, either through an electronic medium or by watching a live performance, may not be aware of the underlying interplay between the elements present on the music score and the multiple intelligences used simultaneously in the performance. However, after taking music lessons, the same individual who at first could not make sense out of a piece of music begins to take small steps in interpreting the musical symbols and what they mean and how sound is produced. On the other hand, it must be pointed

out talented musicians in traditional settings with no formal musical training exhibit performance and expressive skills mastered through oral culture. The skills demonstrated by their mastery of instruments, voices and movement reveal their ability to incorporate multiple intelligences in a music performance. Such music still has the potential to be elevated further through an intelligible manipulation of more complex and advanced skills that incorporate new or additional possibilities.

In trying to understand the complexity of a musical performance, various researchers have made findings that a number of musical intelligences or skills are simultaneously employed in any given music performance context. Why, for example, would it be so difficult for one not to read a piece of music on the piano or any other instrument, even in a case where one is highly educated? Some answers to this question are found in some existing studies that enlighten us on the nature of music and its relationships with the environment in which it freely interacts. Edward Rothstein, in his book, “The Emblems of The Mind: *The Inner life of Music and Mathematics*” (1996:13, 16), notes that music and mathematics are both abstract and cannot be easily translated because they are records of thinking and hearing. He further states that they are only fully understandable to those who are highly talented and have been given intensive training in them and in their application but in their performance they are accessible to all.

Rothstein’s explanation of the abstract nature of music and mathematics recorded in the mind clearly confirms that music is more readily understood, decoded and expressed intelligibly through a performance by a trained musician. He or she can mentally understand all the elements of a piece of music and perform it as intended. Based on this understanding, a pianist manipulates the notation on the score as he/she runs fingers on the keyboard to produce beautiful melodic and harmonic sounds. The movement is a well-calculated simultaneous use of a combination of intelligences of audial, sight (spatial) reading, finger dexterity (kinesthetic), sensitivity to dynamic control (haptic), articulation, and contrasts. It follows, therefore, that a beautiful piano, violin, flute or vocal performance on the stage is a product of an intricate interface between simultaneous expressions of multiple intelligences mastered through a considerable time of training by a performer.

Practical Implications

Music education at university level can stand as an example of validation, both of “cerebral” and manual/kinetic intelligences. Kenya’s education system has not

given equal importance to music education compared to those grouped as “core” subjects in the school curriculum. Over many years, I have observed that on the admission day of new students into Form 1 in high schools in Kenya, many parents advised their children against choosing music as a subject of study. They instead advised them to choose only the subjects perceived to lead their entry into lucrative courses at the university and to prestigious professions like medicine, engineering, law, and others, except music. This is because a majority of Kenyan parents have not seen or understood the correlation between music and the sciences and how this can enhance their learning outcomes in such areas of study, or how music on its own right can lead to a successful and fulfilling career. Due to these perceptions, talented candidates are denied the opportunity to study music at high school and are disadvantaged at college or university level. Consequently, few students opt to study music as a prestigious profession at the university level.

After high school, the rules on cluster points and subjects for entry into university seem discriminative. Students who excel in practical music skills but have low grades in the other subjects are denied the chance to pursue higher music education at the university. However, studies undertaken on the effects of music in learning indicate that music nourishes an integrated system of sensory, attention, cognitive, emotional and motor capacities, which are the main drive of the forces behind all learning (Konrad, 2000: Empathy, Arts and Social Studies). On the same breath, Rauscher (1997) observed that children given piano lessons improve in their spatial temporal IQ important for types of mathematical reasoning.

The bias towards music as a “less-valued” subject in the Kenyan educational situation may be similar to what Gardner experienced during his research on the American school system. He observed that schools and society focus most of their attention on linguistic and logical-mathematical intelligence. He further noted that although people who are highly articulate or logical are regarded highly by society, equal attention should also be given to individuals who show gifts in the other intelligences, including artists, architects, musicians, naturalists, designers, dancers, therapists, entrepreneurs, and the others who enrich the world in which we live. He learnt that many children with these gifts were denied recognition and encouragement in school, while many of them may be labelled in terms like “learning disabled”, “ADD (attention deficit disorder)”, or simply “underachievers”, because their unique ways of thinking and learning are not addressed by a heavily linguistic or logical-mathematical classroom situation.

The theory of multiple intelligences proposes major shifts in the way schools are run. It suggests that teachers be trained to present their lessons in a wide variety of ways using music, and to offer opportunities for cooperative learning, art activities, role-play, and more to address their students' learning needs. In this regard, the Kenya higher education system ought to give attention and space to highly talented students in music and other creative subjects to develop their potential. In examining the multiple intelligences that go into composing a piece of music or its performance, demonstrates that they are similar to those applied in the learning of the "high-value" subjects such mathematics and the sciences. Further, studies conducted have also demonstrated that music nourishes an integrated system of sensory, attention, cognitive, emotional and motor capacities which are the main drive of the forces behind all learning (Konrad, 2000) in any subject and the playing of an instrument (Rauscher, improves students' spatial temporal IQ important for some types of mathematical reasoning.

As already argued, a strong bond and interrelationships exist among subjects in a school curriculum. It is therefore, justifiable to conclude that all subjects in a school curriculum, including music, are important and support the learning in each of them. There should thus be no discriminative criteria on any of them in terms of importance. All subjects can be studied to equip the learners with skills to enable them solve societal problems and to prepare holistic, broadminded, collaborative and confident citizens. Furthermore, Kenya is part of the global village and career opportunities in the creative industry are ever expanding with the need for highly trained and skilled musicians to play their roles as composers, performers, music engineers, innovators of music technology, music therapists, sound engineers, teachers, researchers, conductors, producers, orchestrators, event organisers, marketers, entrepreneurs, and so forth.

In reference to his theory of Multiple Intelligences, Dr. Howard Gardener has argued that not all students can learn and be tested in the same way. Education systems could be biased towards a particular way of instruction that may not favour some learners because of individual differences. Gardner is of the view that this theory has important educational implications, including curriculum development. Educators should thus recognise and teach to a broader range of materials in a style, which engages most or all intelligences. Gardener's theory of Multiple Intelligence provides a theoretical foundation for recognising the different abilities and talents of students. It also points out that while all students may not be verbally

or mathematically gifted, children may have an expertise in other areas, such as music. They may also be gifted in special relations or interpersonal knowledge.

This extraordinary conception of individual competence has changed the approaches to education in North America and in some Asian countries. Many educators and researchers have explored the practical implications of Multiple Intelligence theory the powerful notion that there are separate human capacities. Kenya can benefit from this finding and incorporating the theory of multiple intelligences in the design of its school curriculum.

Musical Intelligence

Music intelligence, as expressed in the ability to play an instrument, sing or compose a piece of music, or to collaborate in a group to produce music, is 'composed' of many kinds of intelligence, including auditory intelligence, haptic intelligence, kinetic intelligence, and visual intelligence, among others. Different pieces of music are written for particular mediums through which they are expressed in a performance. Any music performer, be it an instrumentalist or singer, applies multiple skills, including visual/spatial skills, to interpret the music score which preserves a latent piece of a music composition. In composing a piece of music, a composer conceives it in his/her mind as a three dimensional structure in sound and space, using a number of known elements that are patterned into a given shape. This is comparable to a building designed by an architect and built by engineers.

A building's structure can be discerned visually; the structure of a musical score can also be discerned visually, but it is only understood and interpreted through sensory decoding by a mind and ear that has undergone formal training. The process of creating a piece of music involves the simultaneous understanding and use of the musical elements of pitch, rhythm, tone colour, texture, form, and dynamics in a logical pattern and sequence. The various abilities and skills that come into play when learning or performing a piece of music though singing or playing an instrument include auditory, visual, or kinesthetic. Singing involves mental and visual sight to see, hear and vocalise a note and verbalise a word syllable sung to a note. All these happen at the same time.

A pianist playing a piece of music interprets related elements in the music, namely, pitch, rhythm, texture, form, and dynamics in the course of the performance. In

time and space, a rhythmic element is invariably in the form of a mathematical subdivision of the main pulse or beat as its melodic form may be built on a melodic motif that is sequentially treated, either in an ascending or descending pattern. The performer is able to learn, identify and interpret patterns of these elements to bring out the entire shape of the music as he/she performs it. Playing a flute, piano, violin, or guitar simultaneously involves the eye, ears and hands in coordination. Playing the pipe organ involves much more, including both of the feet. This is to say that the involvement of massive cognitive and motor skills is unavoidable in a music performance. Through designed movement based activities right from pre-school, learners develop fine motor skills as they cognitively interpret the music notation resulting in a beautiful performance.

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Use of E-learning Technologies for Teaching Foreign Languages at the Technical University of Kenya

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Abstract

Using computers and new technologies in Technical University of Kenya has become a very important part of learning as well as teaching. The objective of this paper is to demonstrate how E-learning has improved the quality of teaching and learning of foreign languages in the institution in the past two academic years. The participants in this research were lecturers of foreign languages who frequently use e-learning in their classrooms. Data for the study was collected through observation and interviews. Assessment was done on the attitude of learners towards the use of e-learning in their various classes. Both qualitative and quantitative data was collected and analysed. The interviews were conducted face to face with randomly selected respondents. The findings of this study show the effectiveness of technology integration in the teaching of foreign languages at The Technical University of Kenya with the possibility of application in Kenya and beyond. Other findings reveal the attitude of the lecturers and students towards learning the language; the digital devices incorporated in the teaching foreign language as well as their impact. Moreover, E-learning can play an important role in facilitating the learning of foreign languages in the institution in the near future but only under certain critical conditions that enable the technology to become a bearer of language learning improvement and innovation.

Keywords: *E-learning, Foreign languages, Teaching and learning, Kenya*

Introduction

E-learning has redefined some strategies and concepts of teaching that have enabled the teaching community to perform better. We define E-Learning as a course that is specifically delivered via the Internet to somewhere other than the classroom where the lecturer is teaching (www.elearningnc.gov). It basically unites learning

and technology, that is, the use of innovative technologies and learning models that can be used without the limitations of place or time factors. Today, E-learning has been a key factor in various industries and teaching is among them; especially the teaching of languages. Therefore, using computers and new technologies have become an important part of learning as well as teaching in Technical University of Kenya. This study reviews the ways in which e-learning has redefined the language teaching practices at the Technical university of Kenya. The study also focuses on the teaching/learning issues or problems that might possibly be solved, at least partially by the provision of conducive learning arrangements that make deliberate, effective use of technology.

Statement of the problem

This study reviewed the use of E-learning to teach foreign languages at the technical university of Kenya. This paper analyses how lecturers at The Technical University use e-learning in their classrooms to motivate the learning of foreign languages. The research also analyses how the learners respond to the use of e-learning in their language classrooms. The objective of this paper is to study the E-learning platform services offered in Technical University of Kenya. The study sets out to answer the following research questions:

1. To what extent has the Technical University developed its' E-learning services?
2. Do the foreign language instructors use the university's E-learning platform?
3. How have the Instructors and the learners embraced the E-learning facilities in the institution?
4. What are the effects of incorporating E-learning technologies in the teaching of foreign languages in Technical University of Kenya?

Literature review

According to Sankale (2006) Kenya realised the importance of ICT in education and as a result, the government set up ICT structures at all levels of education in order to build an ICT-literate community. Du (2014) writes about advantages of E-learning in French teaching. He says that "paperless educational resources" can significantly reduce energy consumptions. He gives a list of audio-visual teaching material and these include: pictures, texts, word and PDF, mp3, RMVB, MPEG, WMV and finally AVI. In a study conducted by Otieno (2017), "Incorporating

the latest digital technology into traditional language teaching systems has opened up a wealth of multimedia and interactive applications available to bring teaching methods into this century. In the last 10 years, the world has experienced a sudden increase of technology and this has had a great impact on the teaching of foreign languages. Learners are more conversant, proficient and knowledgeable about the digital world through Internet and social media and through digital devices such as smart-phones and computers”.

Significance of the study

E-learning is widely used nowadays in helping instructors train their students for enhancing language learning. This paper discusses the application and advantages of e-learning in foreign language teaching. Du (2014) states that e-learning introduces the new concept of pan-education, and analyses how to change the pedagogical strategies for instructors to improve teaching efficiency and enable learners to master the language quickly and effectively. The application of this modern method of teaching foreign languages moulds students into active learners as they learn the language better than the traditional method that makes them passive learners.

Theoretical framework

This study adopts an E-learning Framework developed by Aparicio, Baçao and Oliveira (2016). This Theoretical Framework is based upon three principal dimensions: users, technology and the services related to e-learning. The Framework shows a typology of e-learning systems’ services. This theoretical approach integrates learning strategies, technologies and stakeholders. According to Baçao and Oliveira (2016), E-learning concept was not the first term to be used in conceptualising the use of computerised systems to enable or facilitate the learning process.

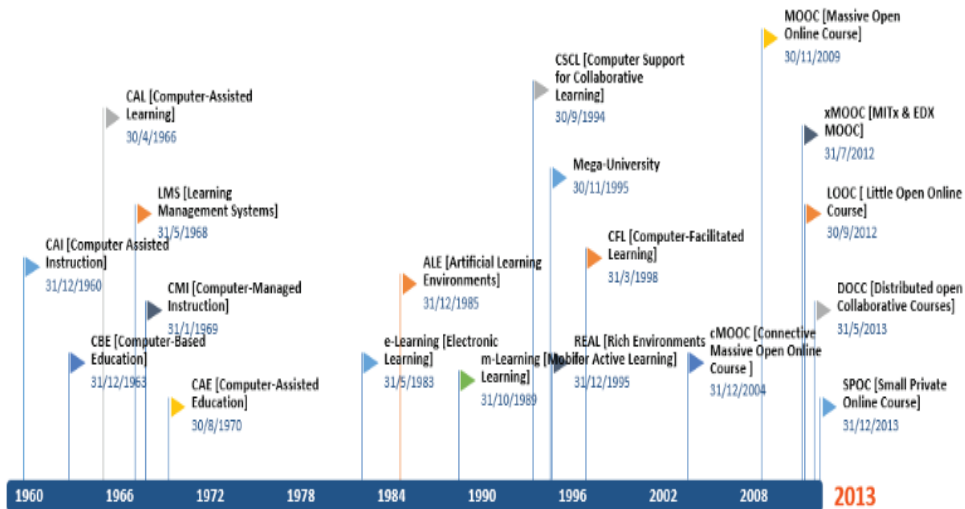


Figure 1. Timeline of E-learning related concepts (Aparicio, Baca, & Oliveira, 2014b)

In the 1960s, this concept focused on task accomplishment and thereafter focused more on the students. Mary Alice White coined the term “e-learning” in 1983, in a journal article entitled “Synthesis of Research on Electronic Learning.” E-learning was defined as “learning via electronic sources, such as television, computer, videodisk, teletext, videotext” (White, 1983, p. 13). In 1997, e-learning meant an abbreviation of electronic learning, in turn meaning “an interactive distance learning” environment (Morri, 1997). Despite the use of the e-learning term, another author referred to the capacity of technologies combined with distance learning and with universities, which was named “mega-university” (Daniel, 1996).

Online learning is another concept related to e-learning. Online learning can be defined as learning that takes place partially or entirely over the internet making information or knowledge available to users disregarding time restrictions or geographic proximity (Sun, Tsai, Finger, Chen, & Yeh, 2008). E-learning systems’ concepts include a technological and a functional focus, regarding the Internet possibilities in overcoming time and space issues. The e-learning systems’ theoretical framework below contains the three main components of information systems as indicated on the figure below. These components are people, technologies, and services. People interact with e-learning systems. E-learning technologies enable the direct or indirect interaction of the different groups of users. Technologies provide

support to integrate content, enable communication, and provide collaboration tools. E-learning services integrate all the activities corresponding to pedagogical models and to instructional strategies.

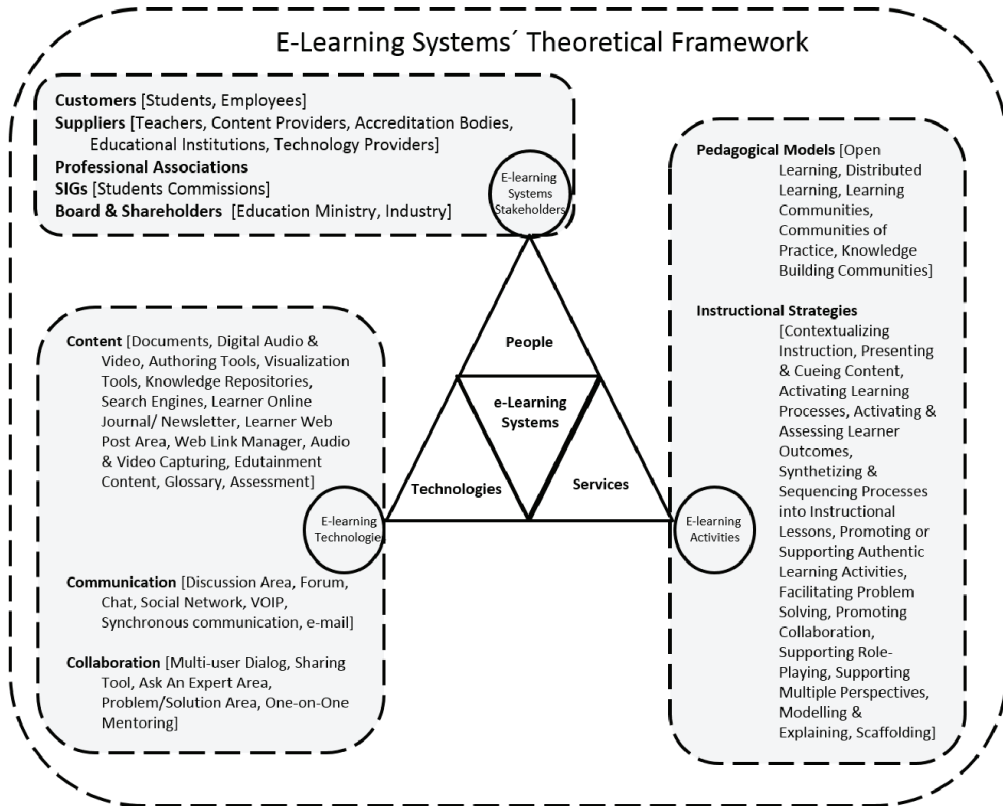


Figure 2: Holistic E-learning systems theoretical frame work

Justification of the study

The traditional way of teaching today does not attract majority of learners to a language class unless the language is mandatory in the course. The instructors therefore have to look for ways and means to attract learners into their classrooms. One way by which an instructor can attract learners to his class is by using the digital devices. The study conducted by Otieno (2017) in Technical University of Kenya shows how learners developed interest in learning foreign languages thank God to the incorporation of various digital devices into the language classroom.

Methodology

The participants in this study were 5 foreign language instructors out of 7, German and French languages, who have used e-learning in their classrooms for at least two years to support the foreign language teaching and learning in all the levels. Data was collected through observation and interviews. This observation was done on the attitude of learners towards the use of e-learning in their various classes. Both qualitative and quantitative data was collected and analysed. The interviews were conducted randomly in class during class activities. The sample population included both the foreign language lecturers and students from the departments of Information Knowledge Management (78 learners out of 134), Governance and Public Policy (58 learners out of 88), Business Administration (52 learners out of 78), Tourism, Hotel and Restaurant Management, and Leisure and Event Management (170 learners out of 250) at The Technical University of Kenya. A total of 358 learners were observed. Interviews were carried out in the various classes. The observation was done with a check list table. The table had a list of activities where the observer had to tick whether the learners are “**active**” or “**passive**”. The researcher sampled learners who were on their 2nd and 3rd levels of the language. The 1st levels were left out because they had no past history in the learning of the language in the university. Most of the departments have 3 levels except for one department, Information Knowledge management department, the fourth level was also, therefore, left out because it is only one group.

Findings and Discussion

The findings in this study have illustrated the potential of technology integration in the teaching of foreign languages in The Technical University of Kenya with the possibility of application in Kenya and beyond. All along this study we have seen that, for E-learning in a foreign language to exist, the three components have to be present, namely: Technology, Instructor and Learner as illustrated in the diagram below:

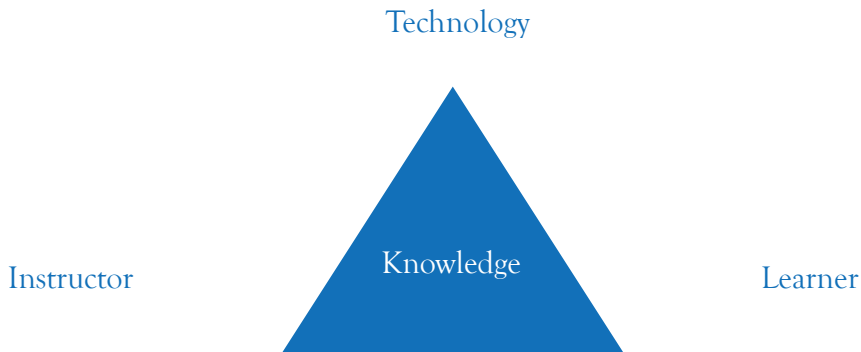


Figure 3: The components of E-learning

From the sections above, we can confirm that learning is a cognitive process that enables one to achieve Knowledge and Technology is an enabler of the learning process, in other words technology is used like any other tool in the education praxis, as is a pencil or a notebook for example. The other findings revealed the attitude of the lecturers and learners towards learning the language; the digital devices incorporated in the teaching of foreign languages language as well as their impact.

This study has expressed the expectation that availability of technology in the teaching of foreign languages in Technical University of Kenya has automatically changed teaching processes, learning processes, and learning outcomes.

The study focussed on the teaching/learning issues or problems that might possibly be solved, at least partially by the provision of conducive learning arrangements that make deliberate effective use of technology. E-learning includes a wide range of electronic learning alternatives: multimedia CDs, online courses (web-based), audio conference (video), chat, podcasting, blogs, computer simulations and tests.

In the Technical University of Kenya, the commonly used audio-visual teaching materials are pictures, texts, word and PDF, mp3 and MPEG. From the observation, the findings indicate that for online activity, majority of the learners were active, while for offline, they seemed to be passive.

Foreign language instructors and the learners use the E-learning on their personal laptops or on their smartphones.

Both instructors and learners have embraced the E-learning as it makes the lesson more interesting and most learners are very active. The incorporation of E-learning

technologies in the foreign language classroom in the institution has motivated most learners a lot in the learning of these foreign languages.

In the Technical University of Kenya's E-learning platform in all these services have been developed. The platform however has not started operating, and according to the Director of Lifelong Distant Learning, the platform will start operating in September 2019. Usually, an e-learning solution combines two or more variants, depending on the customer profile and requirements. There are clear advantages of e-learning and our learners will benefit a lot from this once platform is launched.

Some of the advantages of E-learning for both Day and Evening classes once it is installed and launched on the Technical University of Kenya's platform:

Reduced costs: Educational software and e-learning solutions are not cheap. However, their costs are lower than those implied by a classical learning session because expenses with trainers, learner's movements are eliminated. In some cases, depending on the technical solution adopted, time can be categorised as cost reduction: taking the evening class students into consideration, the employee will not miss a few days from work, but will "lose a few hours daily to learn online or offline, on the computer". (Holmes, Gardner, 2006:75)

Individualisation of the learning process: Given the different types of students in the institution, each individual has his own pace of assimilation and relies on a particular type of memory in the learning process (auditory or visual). Some learners have a better performance during the weekend, others in the early morning hours. E-learning can address these needs by creating learning solutions appropriate to individual profile of each learner.

Mobility: Last but not least, E-learning offers the opportunity to access the content of educational material from anywhere, using personal computer. For example, employees in different locations at high distances from each other, do not have to be physically present in the conference hall to hear an expert in their field. You can watch live, online, or download an audio-video file to open it later.

There are disadvantages of e-learning process, both in Technical University of Kenya and the world at large. It is claimed that the classical method (individual or in classroom) is more effective and that e-learning could even be a disadvantage because it tends to eliminate human factors of learning (interaction with the instructor), a key variable in the process of information assimilation. This is a debate that has been on for quite some time.

Some of the disadvantages include:

1. High cost of technical equipment and software (studies indicate that training online course is more expensive than the traditional one; the building team of a course being made up of persons specialised in web design and instructional design);
2. The course can only be effective when the computer provision is appropriate, when Internet connections are fast and reliable;
3. Time required to prepare and facilitate an online course is much higher than for traditional courses;
4. Changes in mentality, expanding managerial vision and decisive action to support the penetration of information and communication technologies in schools all over the country, in all subjects and at all levels of education; this is a long-term perspective, sustained by the political will and the participant's agreement;
5. Reducing the ability of verbal expression, accompanied by a loss of the capacity to argument-present-counter-argument, paradoxically even if "technique and technology have opened new ways and provided new tools and techniques for interpersonal communication".
6. Access to an appropriate computer can be a problem for learners;
7. Information can vary in terms of quality and accuracy, so guidance is needed.

As learners use the e-learning platform, of course they are only conscience of the benefits and overlook the disadvantages.

Conclusion and recommendations

Departments in the institution should write proposals to establish e-learning so as to enhance knowledge in the various disciplines. On comparison of advantages and disadvantages of e-learning adoption it is clear that while e-learning has many benefits it will not completely replace tradition teaching methods. E-learning can play an important role in facilitating the learning of foreign languages in the institution in the near future but only under certain critical conditions that enable the technology to become a bearer of language learning improvement and innovation.

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(Footnotes)

- 1 The costs of imported fuels and the indigenous extraction of fuels are different and are defined separately in the import or extraction technologies for each fuel.