FACTORS INFLUENCING THE ELECTION OF WOMEN SCIENTISTS TO LEADERSHIP POSITIONS: A CASE OF THE NETWORK OF AFRICAN SCIENCE ACADEMIES (NASAC)

BY

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2013
DECLARATION

This Research Project Report is my original work and has not been submitted for a degree in any other university.

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JACQUELINE ALICE AKINYI OLANG
L50/70994/2007

This Research Project Report has been submitted with my approval as the University Supervisor.

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DEDICATION

This work is first and foremost dedicated to my family, and especially to my two wonderful sons, EddTakka and Robert Ngurre.

Secondly, this study was inspired by my work as an employee of the Network of African Sciences (NASAC). For this reason, the study is also dedicated to NASAC with the hope that it will add value to the remarkable work it is already doing for science and scientists in Africa.
ABSTRACT

Science academies hold elections to select and appoint members to leadership positions within their governance structures. It is noteworthy these elections result in a majority of the leadership positions taken up by male scientists and rarely women scientists. This study attempts to establish the factors that influence the election of women scientists to leadership positions within the membership of the Network of African Science Academies (NASAC). The world's academies of science, engineering, and medicine must take immediate action to remedy the widespread, persistent and wasteful under representation of women in scientific and technological fields. In 2013, out of the nineteen members of NASAC, only one of the science academies – the Tanzania Academy of Sciences – had elected a woman scientist as its President. The question that begs to be asked is: What can a Network like NASAC do to meet the demands for equality and equity in the election process so as to increase the number of women scientists in leadership positions? The objectives of this study focused on science academies and sought to: examine how level of education influences the election of women scientists; establish how socio-economic background influences the election of women to leadership positions; determine how the female scientist’s level of awareness of the available leadership positions influences their election; and lastly, assess to what extent prior positions held by female scientists influence the election. For all purposes and intents, this study only covered the factors that influence the election of women scientists to leadership positions within the membership of NASAC with a using the survey research design on target population of 40 respondents with a focus on the four main objectives. The survey instrument used was an interview schedule by which face-to-face and online interviews were conducted. While several other major areas of disciplined study and knowledge exist under the general rubric of "science", such as basic science and applied science, this study focused on the leadership processes of science academies with a special reference for women scientists. The study established that women scientists can serve as role models and become instrumental in attracting and retaining young girls into scientific fields and/or professions. The first major finding of the study was related to examining how the level of education influence the election in to leadership positions of the women scientists who participated as respondents. The second major finding was related to establishing how the socio-economic background of the respondents influenced their election into leadership positions within the academies. The third major finding was related to determining the level of awareness of the respondents to the available leadership positions that women scientists can vie for within the academies. The fourth major finding of the study was related to assessing to what extent prior positions held by the women scientists influenced their election to the leadership positions within the academies. The main recommendation of the study is that science academies in general and NASAC in particular, should take cognizance of the factors that influence the election of women scientists to leadership positions so as to guarantee, at the very least, the availability of female scientists as role models. Further research is however still necessary in finding the link between socio-economic background and retention of women in scientific professions especially in Africa where the data on women scientists is not readily available.
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<tr>
<td>IAC</td>
<td>Inter Academy Council</td>
</tr>
<tr>
<td>IAP</td>
<td>Inter Academy Panel – the global network of science academies</td>
</tr>
<tr>
<td>MA</td>
<td>Master of Arts</td>
</tr>
<tr>
<td>MDGs</td>
<td>Millennium Development Goals</td>
</tr>
<tr>
<td>MSc</td>
<td>Master of Science</td>
</tr>
<tr>
<td>NASAC</td>
<td>Network of African Science Academies</td>
</tr>
<tr>
<td>NSF</td>
<td>National Science Foundation (United States)</td>
</tr>
<tr>
<td>OWSD</td>
<td>Organization for Women in Science for the Developing World</td>
</tr>
<tr>
<td>PhD</td>
<td>Doctor of Philosophy</td>
</tr>
<tr>
<td>SciDevNet</td>
<td>Science Development Network</td>
</tr>
<tr>
<td>STEM</td>
<td>Science, Technology, Engineering and Mathematics</td>
</tr>
<tr>
<td>TWOWS</td>
<td>Third World Organization for Women in Science</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
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<tr>
<td>US$</td>
<td>United States Dollar(s)</td>
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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The Network of African Science Academies (NASAC) was established on 13th December 2001 in Nairobi, Kenya, and eventually secured its legal registration as an international non-governmental organization on 18 April 2012. The Network is a consortium of merit-based science academies in Africa (NASAC, 2013) and aspires to make the “voice of science” heard by policy and decision makers within Africa and worldwide. The Network’s main objective is to enhance the capacity of existing science academies and encourage African scientists to create new academies in countries where none exist (NASAC, 2011). By 2013, the Network had membership comprising of nineteen members, namely; one regional academy, the African Academy of Sciences and eighteen national academies from Benin, Cameroon, Ethiopia, Ghana, Kenya, Madagascar, Mauritius, Morocco, Mozambique, Nigeria, Senegal, South Africa, Sudan, Uganda, Tanzania, Togo, Zambia and Zimbabwe.

From a Women-for-Science-Workshop held in December 2011 by NASAC, it was noted that gender parity in the sciences grows out of investments made in earlier phases of the education cycle, that is, from high school or secondary school to universities. At that workshop, science academies were urged to reach-out to girls in secondary schools so as to stir-up their interest in science careers. It was advocated that academies should enact strategies to motivate young peoplesuch as awarding of prizes and holding of science clinics, so as to increase the up-take of careers in science, technology, engineering and mathematics. Additionally, effort was also necessary to ease the discriminatory-barriers for entry of qualified and promising female scientists to academic membership or fellowship. With this in mind, several academies, like South Africa, Zambia, Senegal, and Nigeria, took deliberate steps to facilitate the growth of female membership. Several approaches have been propagated by different academies, such as the reiteration of affirmative action in the strategic plan (by the Senegalese academy), the holding of science conferences with a special target for women and youth (by the South African academy), and the diversification of membership classes like associate members, young fellows (by the Zambian academy). Another strategy that has been employed
ismentorship schemes whereby, senior female scientists prepare younger colleagues to succeed them in their respective fields of expertise. The Organization for Women in Science for the Developing World (OWSD) has entrenched this approach in its activities (NASAC Women for Science Working Group, 2011).

There are other factors stymieing the work of female scientists in academia, besides the structural and administrative drawbacks. Female scientists, like their male counterparts, have difficulty in obtaining grants and awards due to limited skills in writing grant proposals that would ensure upward mobility in scientific careers (NASAC-TWOWS, 2009). Therefore, there is need for academies to be proactive and innovative in encouraging women to vie for leadership positions. To do this, the women scientists themselves will need to secure streams of funding, firm-up their resolve to lead in academic circles, and better coordinate their efforts on outreach to bring more women into science.

While the foregoing holds true, and it is noble indeed to increase the number of women scientists in the scientific professions, an additional push is necessary to ensure that they actually garner requisite support to hold leadership positions as well. Science academies hold elections to make appointments for these positions. This study attempted to establish what factors influence the election of women scientists to leadership positions within the membership of the Network of African Science Academies (NASAC).

1.2 Statement of the Problem

Women are not elected in significant numbers to sit on the scientific advisory boards or councils of science academies in Africa. The Inter-Academy Council report on Women for Science (2006) says world's academies of science, engineering, and medicine must take immediate action to help remedy the widespread, persistent and wasteful under representation of women in scientific and technical fields. As at 2013, out of the nineteen members of the NASAC, only one of the science academies, the Tanzania Academy of Sciences, had elected a woman scientist as its President. Furthermore, even in taking a look at the composition of science academy boards, governing/executive councils or executive committees, male scientists are the majority. The NASAC Board of six members in 2013, and since its inception, has constituted of one hundred per cent male scientists.
Science, technology, engineering and mathematics (STEM) fields are often referred to as “elite”. Not only because they attract the best and the brightest, but also because those involved are responsible for the scientific and technological advancements that shape our world. Unfortunately, retention of female scientists in the STEM fields seems negligible and does not translate visibly into the STEM workforce, the STEM industry boardroom or into STEM academic leadership positions (Fraser & Fimbres, 2012). Development of a critical mass of scientists in Africa is one of the pillars for the promotion of science and technology for development.

It is important that the inequity between women and men representation in developmental roles is addressed because human resource capacity building cannot be completely successful if half of the population is excluded. This is irrespective of the constraints in access to higher education in science and technology. The promotion of women in science requires actions at all levels using different modalities including advocacy, enactment of appropriate policies and capacity building. There are also issues of strategy such as acquisition of skills for prospective market demands, capacity in teaching and research in new and emerging areas of science, advocacy, policy planning and management, mentoring and the use of role models in the promotion of women in science. What can a Networklike NASAC do to meet the demands for equity and equality in science and increase the number of women in leadership positions? These issues need to be discussed and strategies and actions developed to accelerate women’s access and participation in science especially through election into leadership positions in scientific organizations. For this reasons, the study aims to identify the factors that influence the election of women scientists to leadership positions within NASAC members as a first step to initiate remedial change in the organizational processes if necessary.

1.3 Purpose of the Study

The study seeks to determine the factors that influence the election of Women Scientists to Leadership positions among members of the Network of African Science Academies.
1.4 **Objectives of the Study**

The study objectives are:

a) To examine how level of education influences the election of women scientists to leadership positions in science academies within the Network.

b) To establish how socio-economic background influences the election of women scientists to leadership positions in science academies.

c) To determine how the level of awareness on the available leadership positions influences the election of women scientists in science academies.

d) To assess to what extent prior positions held influences the election of women scientists into leadership positions within the academies.

1.5 **Research Questions**

The research questions that will guide this study are:

a) How does the level of education of women scientists influence the election into leadership positions within the science academies?

b) How does the socio-economic background of women scientists influence the election into leadership positions?

c) How does the level of awareness on available leadership positions by the female scientists influence their election in science academies?

d) To what extent do the prior positions held influence the election of women scientists into leadership positions within the academies?

1.6 **Justification of the Study**

It is generally understood that childcare is one major factor that blocks the career of many women (Nature, 2013). Unfortunately, even the most improved childcare policies will not fix overt or unconscious gender bias. The fate of women in science can be influenced by organizational politics especially when women and men have a disproportionate recruitment in scientific research training institutions. This sets the stage for gender imbalance in the future and robs science academies of role models that will inspire an increase in the number of women in leadership positions. Gender bias, as in most professions, is locked in place by male dominance at all the levels of decision-making that affect academic careers — from
editorial boards, to grant-reviewing boards, to academic selection committees, to academy governing organs. Women are barely visible at these levels, fixing the subconscious idea that science belongs to men. There are many ways to chip away at this invisibility and they should all be tried, with the results published so that other organizations can learn from them.

One way of overcoming gender bias is the imposition of quotas, yet none of the science academies under reference has explored that option in their governance structures. In certain contexts, such as academic promotions, adoption of a quota system would ensure that young female scientists have senior female role models. It is also argued that setting a quota for women in leading academic positions such as professorships results in mediocre female candidates being promoted. But there is a gap in reasoning here. Women and men are equally talented, so if men occupy a large majority of high-level posts, that would imply some level of mediocrity among the male numbers is admissible. Is mediocrity more acceptable in men than in women? Quotas on decision-making committees, however, do come with the inbuilt problem of overburdening the few women who already hold top positions, since they are already few in the science profession.

For NASAC as an organization that became a legal entity in April 2012, the factors influencing the election of women scientists in leadership positions are a critical component for its own organizational development. It is therefore anticipated that this study will identify those factors and document them for future remedial action(s) by the Network.

1.7 Significance of the Study

Women constitute half of humanity, yet even in countries where there is access to higher education, the number of women taking up professional sciences as career choices remains drastically below parity with that of men. As a result, the overall participation of women scientists in the workforce continues to be very limited, and these professional women seldom reach the pinnacle of the hierarchy – within academic and scientific institutions or organizations (InterAcademy Council, 2006). The report by an Advisory Panel on Women for Science constituted by the InterAcademy Council (IAC) in 2006, in discussing the topic “an urgent need for academies’ actions”, it cited that:

“A critical omission has been the wholehearted commitment to inclusiveness on the part of the existing science and technology leadership. Without support from the
establishment, women can only progress so far. This is where academies can play a major role, as they represent the scientific and engineering elite and are thus held in high esteem. Moreover, their members are leaders at universities and other research institutions; and in many countries they are trusted advisers to government.”

Africa’s capacity to compete on the global market depends on its ability to innovate using science and technology to transform its vast natural and latent human resource capability into value added goods, processes and service. This requires harnessing the potential of its population through education and training to create a critical mass of experts in STI and providing equal access for both men and women (UNESCO, 2012). The numbers of women who pursue science and engineering programmes in higher education institutions are fewer than men. Furthermore, the ability to retain the few women who embark on training in science disciplines is hindered by discrimination and suppressed motivation. The few African women in science and engineering also face unique challenges that are likely to derail their careers at a much higher rate than their male counterparts (InterAcademy Council, 2006). And the result is that all over the continent, there are still very few women scientists with even fewer in leadership positions to articulate the inclusion of women in the management of science and technology institutions, such as science academies.

It is hoped that this study will help academies globally in general, and the Network in particular, to promote and encourage participation of women scientists in the leadership of scientific organizations and hence provision of enabling and conducive structures. Failure to examine factors influencing the election of women scientists in leadership positions will mean maintaining the status quo and hence not fully realizing the potential and aspiration for gender equality of the Network. The study will also contribute to knowledge and forms a basis for further research.

1.8 Delimitation of the Study

This study covers the roles of women scientists within the membership of the Network of African Science Academies and targeted to interview 50 women scientists in Africa who have interacted with NASAC. Members of the Network are drawn from eighteen countries in Africa.
1.9 Limitations

This study may be limited by the time and costs required to contact and get feedback from each and every member of the Network of African Science Academies.

1.10 Assumptions

It is assumed that representatives of the target population will have an in-depth understanding of factors influencing the elections of women scientists into leadership positions and that respondents will be honest and available.

1.11 Definitions of Significant Terms

**Academic Training:** Higher education specific to acquisition of professional skills

**Awareness:** Awareness in this study means being fully informed and ready to exploit the knowledge and opportunities to one's advantage without fear.

**Gender mainstreaming:** A process of identifying, taking full account of, and integrating the needs of women and men into policies, strategies, programs, administrative and financial activities.

**Gender:** Refers to the set of rules and identities that prescribe and proscribe behavior, roles, expectations and responsibilities for persons, in their social and cultural constructs as men and women. These rules and identities may be deliberate or unintended, explicit or implicit, conscious or unconscious.

**Network:** A consortium of member organizations pursuing common goals and aspirations.

**Science Academy:** An honorific society, association or organization promoting the use of merit-based science advice to inform developmental policy and propagate scientific values in society and the public in general.

**Scientist:** A person who is studying or has expert knowledge of one or more of the social, natural or physical sciences.
1.12 Organization of the Study

This research project report is organized into five chapters. Chapter One looks at the introduction by defining the background of the study highlighting the role of the Network of African Science Academies since its inception. Chapter One also identifies the problem statement and discusses the purpose of the study and provides the objectives. Under significance of the study, Chapter One discusses the Inter-Academy Council Report of 2006 which observed that a critical omission to inclusiveness has been encountered in the science and technology leadership. Chapter One then concludes by stating the delimitation, limitation and assumptions of the study before ending up with the definition of significant terms.

Under Chapter Two, literature review is undertaken for the study. The definition and history of science and scientist is reviewed under this chapter, the role and statistics available for women scientists is also discussed, and the definition and history of science academies is highlighted. Chapter Two also discusses the roles and types of science academies, the social-cultural factors that influence the election of women scientists to leadership positions and the need for gender mainstreaming in science and technology. This Chapter then concludes by looking at the theoretical framework highlighting the application of constructionism theory as the basis for the study. The conceptual framework is also discussed under Chapter Two.

Chapter Three addresses the research methodology under which the research design is discussed. The study employed both survey and descriptive research design and identified the target population through purposive and snow-ball sampling. A sample size of 40 women scientists was used in the study. Chapter Three concludes by providing the independent and dependent variables as well as indicators for the study under figure 3.1 showing the operationalization of variables.

Under Chapter Four, data analysis, interpretation and presentation is discussed. The findings of the study are presented through use of frequency tables and percentage scores. A correlation is also made between each independent variable and the dependent variable under this chapter. In Chapter Four, correlational and descriptive statistics is used to analyze and interpret the study findings for each of the research questions.
Chapter Five then tackles the summary of findings, provides an in-depth discussion of those findings, and then the major conclusions and recommendations from the study are made. A reflection of the research questions is made as well as the research design used from which the major findings of the study are drawn and discussed. Under Chapter Five, the findings for each study objective are compared and contrasted with the literature review presented in Chapter 2.

Under each chapter, an introduction and summary is provided. References for this work as well as the appendices follow immediately after Chapter Five. Within the appendices, a transmittal letter is provided, the interview guide for women scientists and the timeframe and budget for the study is provided.
CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature on election of women scientists to positions of leadership both globally and locally through history to contemporary times. The theory upon which the study is premised is explained. A conceptual framework has also been included.

2.2 Definition and History of Science and Scientist

*Scientia* is the Latin root-word for science meaning "knowledge". Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe (Wilson, 1998). Modern science however is a discovery as well as an invention. It was a discovery that nature generally acts regularly enough to be described by laws and even by mathematics; and required invention to devise the techniques, abstractions, apparatus, and organization for exhibiting the regularities and securing their law-like descriptions. (Heilbron, 2003). According to Merriam-Webster Online Dictionary “science is a body of knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through scientific method. Such knowledge or such a system of knowledge is concerned with the physical world and its phenomena (Merriam-Webster Online Dictionary, 2013).

There is general agreement among scholars in definition that "science" also refers to a body of knowledge itself, of the type that can be rationally explained and reliably applied. Since classical antiquity, science has been seen as a type of knowledge closely linked to philosophy and in varied literature even sometimes used interchangeably (Lindberg, 2007). By the seventeenth century, natural philosophy/science was considered a separate branch of philosophy. In modern use, "science" more often refers to a way of pursuing knowledge, not only the knowledge itself. It is viewed as synonymous with *natural and physical science*, and thus restricted to those branches of study that relate to the phenomena of the material universe and their laws, sometimes with implied exclusion of pure mathematics or social sciences.
In the course of the 19th century, the word "science" became increasingly associated with the scientific method, a disciplined way to study the natural world, including physics, chemistry, geology and biology. It is also from this period that that the term scientist was created by the naturalist-theologian William Whewell to distinguish those who sought knowledge on nature from those who sought knowledge on other disciplines (Heilbron, 2003). The Oxford English Dictionary dates the origin of the word "scientist" to 1834. The term “scientist” by definition however omits the study of human thought and society, an area of knowledge that has since then been classified as social science. Similarly, several other major areas of disciplined study and knowledge exist today under the general rubric of "science", such as pure science and applied science (Lindberg, 2007).

2.3 Definition and History of Science Academies

In the modern sense of the term, science academy refers to an assembly of intellectuals or fellowship of scientists dedicated to the advancement of scientific knowledge within their societies and on a global scale (NASAC, 2010). This definition has to be contextually applied to science academies around the world since each academy has its own peculiar features in organizational structure, budget, membership and the range of disciplines. A common feature of all the world’s science academies is their overall goal to seek nationwide economic and social advancements through merit-based applications of science and technology (Inter-Academy Panel, 2013).

The origins of the oldest science academies of the western world lie in old academic centers that provided a forum for a society of scientists and/or thinkers curious about nature and natural phenomena (NASAC, 2010). The Arab word majma, meaning assembly or an academy dates back to the 7th century. For example, Al-Ghazali’s Nizamiyah Academy in Baghdad, with all fields of knowledge, including science, was one of the world’s most renowned seats of learning at the turn of the first millennium, almost 400 years before the creation of the first science academy. Academia Nazionale dei Lincei of Italy, founded in 1603, is the oldest science academy to be followed by the Royal Society of London of England which was founded in 1660. Shortly after the French counterpart l’ Académie Royale des Sciences was established in 1666 in Paris, France.
At the turn of the 17th century and later in the first half of the 18th century two more science academies materialized in Berlin and Stockholm. Die Königliche Preussische Akademie der Wissenschaften of Germany was founded in 1700 and the Royal Swedish Academy of Sciences in 1739. Science academies in Asia and Africa are relatively younger. The oldest academy in Asia, Academia Sinica of Chinese Taipei/Taiwan, was founded in 1928. Its counterpart in Africa is Madagascar’s National Academy of Arts, Letters and Science (originally the National Malagasy Academy) which was created in 1902 when the country was under French colonial rule. The 20th and the beginning of the 21st centuries saw the birth of many national science academies particularly in Africa and Asia. The advances in science and technology and the recognition that science and technology play a pivotal role in improving the social and economic life of nations, led to the establishment of many of the national science academies worldwide (NASAC, 2010).

2.4 Women Scientists in Contemporary Science

The roles and the statistics for women scientists in contemporary science is reviewed in this section.

2.4.1 The Role of Women Scientists

Women were historically excluded from science which was mainly male-dominated, yet women scientists’ contribution date as far back as Ancient Greece, and perhaps even further. In historical times, women were forced into the ‘shadows’ mainly due to patriarchal social set-ups. For example, Hypatia of Alexandria (AD 350 and 370-415), a Greek scholar from Alexandria, Egypt, has been considered the first notable woman in mathematics. Around 400 AD, she became head of the Platonist School of Alexandria. During her life, she discouraged mysticism and encouraged logical and mathematical studies. She was killed by a Coptic Christian mob who blamed her for causing religious turmoil. She has been hailed as a "valiant defender of science against religion" (Dzielska, 1995). In more recent years, the contribution of women to the scientific community has been appreciated as essential.

Fifty percent (50%) of the human resource is female, and vital for the progress of both society and science. To empower women in general and in science in particular, requires that their involvement in decision-making processes be increased. Such decisions affect their lives both within and outside the household (National Academy of Sciences, India, 2012).
Dogmas of gender and science developed over time resulted in the exclusion of women from science for a long time all over the world, and moreover, women were also barred from their fundamental right to education. Even today, their participation is restricted and limited in many areas because of lack of proper means of communication and awareness or even education. It is important to educate women in science so as to enhance their awareness on the available scientific careers and provide them with scientific skills necessary to deal with societal challenges and facilitate socio-economic development. Women scientists can also serve as role models and become instrumental in attracting young girls into science.

The highest honour for scientists worldwide has been the recognition through the Nobel Prize award for scientific contribution. This Prize is awarded in honour of Alfred Nobel, who on 27 November 1895, signed his last will and testament, giving the largest share of his fortune to a series of prizes in Physics, Chemistry, Physiology or Medicine, Literature and Peace - the Nobel Prizes. The Nobel Peace Prize in 2004 was awarded to the late Prof. Wangari Maathai (Kenya) "for her contribution to sustainable development, democracy and peace". (Nobel Foundation, 2004). In 2011, the Nobel Peace Prize was also awarded to three other outstanding women, Ellen Johnson Sirleaf (Liberia – then President), Leymah Gbowee (Liberia) and Tawakkul Karman (Yemen) for “their non-violent struggle for the safety of women and for women’s rights to full participation in peace-building work”. In their press release, the Prize Committee noted that democracy and lasting peace cannot be achieved in the world unless women obtain the same opportunities as men to influence developments at all levels of society (Nobel Foundation, 2011). What is noteworthy though, is that since 1901-2011, the Nobel Prize has been awarded five hundred and fifty-five (555) times out of which only forty-nine (49) awards have been given to women. Only two Nobel Prizes have been awarded to African women, both for Peace and not Science.

2.4.2 Statistics about Women in Science

The UNESCO Institute for Statistics (UIS) has estimated that of the world's total science researchers, only twenty-seven percent (27%) are women (UNESCO Institute for Statistics, 2006). Most statistics recorded are used to indicate disadvantages faced by women in science, and also to track positive changes of employment opportunities and incomes for women in science (Schiebinger, 2001). In addition to this, statistics about women in science is not
readily available for those in Africa as it is for those in the United States of America- USA. Many scholars seem to agree that in the USA, women earn more bachelor’s and master’s degrees than men (see Table 2.1).

Table 2.1: Percentage of Degrees Received by Women in 2004 by Major Discipline and Group in USA

<table>
<thead>
<tr>
<th>Degrees</th>
<th>All Fields</th>
<th>All Science and Engineering</th>
<th>Psychology</th>
<th>Social Sciences</th>
<th>Biology</th>
<th>Physical Sciences</th>
<th>Geosciences</th>
<th>Math and Statistics</th>
<th>Engineering</th>
<th>Computer Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor’s</td>
<td>57.6</td>
<td>50.4</td>
<td>77.8</td>
<td>54.2</td>
<td>62.5</td>
<td>42.1</td>
<td>42.2</td>
<td>45.9</td>
<td>20.5</td>
<td>25.1</td>
</tr>
<tr>
<td>Master’s</td>
<td>59.1</td>
<td>43.6</td>
<td>78.1</td>
<td>55.9</td>
<td>58.6</td>
<td>37.5</td>
<td>44.6</td>
<td>45.4</td>
<td>21.1</td>
<td>31.2</td>
</tr>
<tr>
<td>Doctoral</td>
<td>45.3</td>
<td>44</td>
<td>67.3</td>
<td>44</td>
<td>46.3</td>
<td>25.9</td>
<td>33.9</td>
<td>28.4</td>
<td>17.6</td>
<td>20.5</td>
</tr>
</tbody>
</table>


The National Science Foundation (NSF) reported in 2007 in *Women, Minorities, and Persons with Disabilities in Science in Engineering* that in 2004, women earned 57.6 percent of the bachelor’s degrees in all fields and 59.1 percent of all master’s degrees. Beginning in 2000, women also earned more of the bachelor’s degrees in science and engineering, although they earned only 43.6 percent of the master’s degrees in those fields. In 2004, women earned 60 percent of the PhDs in fields other than science and engineering, but only 44 percent of the PhDs in science and engineering received by American citizens and permanent residents.

In many of the social and the life sciences, women have reached parity in the percentages of degrees received. In other areas, such as the geosciences, mathematics, and physical sciences, the percentages of women continue to increase but have not approached parity. In engineering and computer science, the percentages of women have reached a plateau or dropped over the past decade (National Science Foundation, 2004). The aggregated data however, does not openly disclose the attrition of women at every phase of the educational and career in science. Despite grades and other academic attainments equal to or surpassing those of the men who remain in Science, Technology, Engineering and Mathematics
(STEM) fields, more women than men leave science and engineering. As a result, few women are in senior or leadership positions in the STEM workforce (see Table 2.2).

Table 2.2: Percentage of Women Doctoral Scientists and Engineers in Academic Institutions by Field and Rank in 2003

<table>
<thead>
<tr>
<th>Field of Study</th>
<th>Assistant Professor</th>
<th>Associate Professor</th>
<th>Full Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Science and Engineering</td>
<td>41</td>
<td>31.1</td>
<td>17.6</td>
</tr>
<tr>
<td>Psychology</td>
<td>63.1</td>
<td>52.5</td>
<td>30.8</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>48.4</td>
<td>35.5</td>
<td>21.4</td>
</tr>
<tr>
<td>Biology and Life Sciences</td>
<td>38.4</td>
<td>29.4</td>
<td>19.4</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>24.5</td>
<td>19.2</td>
<td>6.8</td>
</tr>
<tr>
<td>Engineering</td>
<td>16</td>
<td>11.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Math and Statistics</td>
<td>29.2</td>
<td>15.9</td>
<td>9.2</td>
</tr>
<tr>
<td>Computer Science</td>
<td>23.3</td>
<td>19.9</td>
<td>12.3</td>
</tr>
</tbody>
</table>

Note: The percentages in the “total” category include instructors and lecturers.

In “Women Faculty Gain Little Ground,” published in 2006 in Chemical and Engineering News, senior journal editor Corinne A. Marasco reports that women made up 41.0 percent of assistant professors of science and engineering at four-year colleges and universities in 2004, 31.1 percent of associate professors, and 17.6 percent of full professors. At the top fifty PhD-granting institutions, women accounted for 21 percent of assistant professors, 22 percent of associate professors, and only 10 percent of full professors in chemistry.

In spite of the statistics above being specific to the situation in the United States of America, the data provided is one that African Countries can closely make inference to.

2.5 The Role of Science Academies

Today’s science academies have a critical role to play as a strong public voice for the promotion of both scientific excellence and science-based development. Science academies, in fact, shoulder primary responsibility in demonstrating that a strong scientific community strengthens communities throughout nations by enabling citizens to address critical economic, environmental and social issues in systematic and effective
Thus, the prime mission of an Academy of Sciences is to empower curiosity, discovery and innovation by stimulating interest in the sciences and technology, promoting and supporting research, improving science education, disseminating scientific knowledge and recognizing and publicizing high achievement in attaining these objectives.

Academies of Science can be constituted in different structures to pursue different objectives. Nonetheless, all academies share the same set of goals, which include; honouring and rewarding scientific excellence, promoting the advancement of science, increasing public awareness of the value of science, and providing advice to governments on science-related issues (SciDev Net, 2012). Despite these common goals specific objectives of individual national science academies could differ owing to the academy’s capacity, focus area and budget in the respective country.

2.6 Types of Science Academies

Each and every academy of the over a hundred academies worldwide is unique. However, analysis of their role and functions shows that essentially there exist three types of science academies as highlighted in the following section.

2.6.1 Learned Society

For a science academy that serves as Learned Society, it is essentially an association of scientists for science, for a limited set of disciplines. It’s most important function is to act as honorific association extending recognition to eminent scientists by inducting them into the Academy’s membership. It also acts in support of science and scientists and it often is engaged in the publication of scientific publications (NASAC, 2010). Overall, the interest-horizon of the Learned Society is essentially limited to science. Therefore, the leadership of a Learned Society is in the hands of scientists. To facilitate this function a small administrative staff and limited financial resources are employed.

2.6.2 Advisor to Society

Like the Learned Society, an academy that serves as an Advisor to Society is a honorific association of scientists for science, but with broader ambition. This type of science academy does not just serve science, but also serves the society at large. Accordingly, the Advisor to
Society has an advisory role through the government and the general public. Usually, this role has two sides: policies for science and science for policies (NASAC, 2010). Accordingly, the interest-horizon of an Advisor to Society is not limited to science, but it also extends to societal issues. Leadership is in the hands of scientists, but there is a larger number of staff as well as financial resources.

2.6.3 Manager of Research

An Academy that serves as a Manager of Research is an honorific association as well, but also acts as Advisor to the Government. The additional element is that a Manager of Research actually manages and operates a number of research institutes, usually on behalf of the government (NASAC, 2010). As a result, the Manager of Research is a bigger organization than the other two types, sometimes employing many thousands of scientists and other staff. Leadership is therefore a much more complex arrangement, often involving several layers of authority. The Manager of Research usually has a large number of staff and extensive financial resources.

It follows from these brief descriptions that the three types of science academies are not mutually exclusive. Rather, the Manager of Research builds on the Advisor to Society, just like the Advisor to Society builds on the Learned Society.

2.7 The Socio-cultural Factors that Influence the Election of Women Scientists to Leadership Positions

Interviews, case studies, and statistical research consistently suggest that two primary factors stand out among the multiple forces pushing women to leave the scientific careers, and by extension become unavailable to vie for leadership positions. These factors are (i) the need to balance career and family and, (ii) a lack of professional networks (Schiebinger, 2001).

For both male and female scientists, marriage and family create demands that can cut short a thriving STEM career. In his 2001 book, From Scarcity to Visibility: Gender Differences in the Careers of Doctoral Scientists and Engineers, sociologist and statistician J. Scott Long reported that single men and single women participate about equally in the STEM workforce. In contrast, a married female PhD is 13 percent less likely to be employed than a married
male PhD. If the woman is married with young children, she is 30 percent less likely than a single man to be employed. Dozens of studies document the struggle to balance career and family.

Another major source of attrition by women from scientific careers results from lack of networking and mentoring. Studies by Fiona Murray and Leigh Graham of the Massachusetts Institute of Technology have found that women scientists may have fewer graduate and postdoctoral students to support their work than men and less diverse networks. In addition, women faculty report fewer referrals from collegial networks to participate in the commercial marketplace by being asked to consult, serve on science advisory boards, and interact with industry (Murray & Graham, 2012).

2.8 Gender Mainstreaming in Science and Technology

To achieve the targets under the Millennium Development Goal3 (MDG-3) focusing on promoting gender equality and empowerment of women, a multi-pronged approach needs to be adopted in science and technology (National Council for Science and Technology, 2010). Firstly, it must be recognized and acknowledged that gender is a cross-cutting issue and must be mainstreamed in all the other MDGs if real progress is to be made. Secondly, there is need to generate gender disaggregated data of activities in science and technology so as to target interventions effectively. Thirdly, there is need for an integrated approach to development in science and technology since there are very close connections between diverse actors and processes. Fourthly, a concerted effort must be made to involve local women and men in the design of science and technology management projects. Fifthly, the role of law in the achievement of MDGs needs to be interrogated through the legal instruments used by institutions at different levels to allocate resources to ensure that the negative impacts on women are minimized while also providing an enabling framework for women’s empowerment (Kameri-Mbote, 2008).

It is also critical that women’s participation in decision-making at higher levels is assured so as to tackle the need for change in gender issues. Finally, local institutions in science and technology, such as science academies, need to be strengthened and equipped to work for the benefit of all members of the communities including women. In this regard, there is need for institutional supply and resources to the local institutions to enable them accept and apply...
principles of fairness and equity even when these are not required by the local cultural norms and processes.

Like in all sectors of development, in order to attain gender mainstreaming in science and technology, key actors and practitioners must continually be involved with undertakings that include gender analysis and evaluation, generation of a gender responsive plan and determination of gender sensitive action.

2.9 Theoretical Framework

This section discusses the theory that is relevant to the study and its application.

2.9.1 Constructionism Theory

This study is based on societal empowering theories with particular reference to social constructionism theory. Constructionism became prominent in the USA with Peter L. Berger and Thomas Luckmann's 1966 book, *The Social Construction of Reality*. Berger and Luckmann argue that all knowledge, including the most basic, taken-for-granted common sense knowledge of everyday reality, is derived from and maintained by social interactions (Otieno-Omutoko & Wambugu, 2012). When people interact, they do so with the understanding that their respective perceptions of reality are related, and as they act upon this understanding their common knowledge of reality becomes reinforced. Since this common sense knowledge is negotiated by people, human typifications, significations and institutions come to be presented as part of an objective reality, particularly for future generations who were not involved in the original process of negotiation.

Social constructionism is a sociological theory of knowledge that considers how social phenomena or objects of consciousness develop in social contexts. A social construction (also called a social construct) is a concept or practice that is the construct (or artifact) of a particular group (Otieno-Omutoko & Wambugu, 2012). Anything that is socially constructed focuses on its dependence on contingent variables of the social self rather than any inherent quality that it possesses in itself. The underlying assumptions on which social constructionism is typically seen to be based are reality, knowledge, and learning (Kim, 2006). Social constructs are therefore by-products of countless human choices, rather than laws resulting from human judgment.
A major focus of social constructionism is to uncover the ways in which individuals and groups participate in the construction of their perceived social reality. It involves looking at the ways social phenomena are created, institutionalized, known, and made into tradition by humans. The social construction of reality is an ongoing, dynamic process that is reproduced by people acting on their interpretations and their knowledge of it. Because social constructs as facets of reality and objects of knowledge do not naturally exist, they must be constantly maintained and re-affirmed in order to persist. This process also introduces the possibility of change and hence, what "gender" is and what it means shifts from one generation to the next (Otieno-Omutoko & Wambugu, 2012).

Therefore a claim that gender is socially constructed probably means that gender, as currently understood, is not an inevitable result of biology, but highly contingent on social and historical processes. In addition, depending on who is making the claim, it may mean that our current understanding of gender is harmful, and should be modified or eliminated, to the extent possible. According to Ian Hacking, 1999, in his book, “The social construct of what?”, he postulates that "social construction" claims are not always clear about exactly what isn't "inevitable", or exactly what "should be done away with." Take for example a hypothetical claim that gender biases are "socially constructed". This claim either means that gender bias in itself is not "inevitable" or "determined by the nature of things." Or, it could also mean that the idea (or conceptualization, or understanding) of gender biases is not "inevitable" or "determined by the nature of things". The distinction between "gender biases themselves" and "the idea (or conceptualization, or understanding) of gender biases" will undoubtedly bring about philosophical disagreements. Hacking's distinction is based on an intuitive metaphysics, with a split between things out in the world, on one hand, and ideas in our minds, on the other. Hacking advocates a useful way to analyze claims about "social construction" (Hacking, 1999).

2.9.2 Application of Constructionism Theory to this Study

In this study, the social constructionism theory helped to make women scientists aware of the factors that influence their election to the available leadership positions within academies to enable them work towards changing or transforming the constructed reality. Change occurs
when active effort is placed to alter existing reality or the status quo. By working to change these factors, a permanent solution is achieved not only for the scientists but also for other women aspiring to become scientists in future.

Constructionism will help to empower the men and women already undertaking scientific professions by offering an alternative perspective that will impart practical skills and change inattitudes. The realization of the existing construct, especially if emerges to be unfavourable to women scientists will form a basis for further research as well as instill a level of consciousness that can make requisite changes to occur. These changes will most likely be geared towards informing the choices women make to vie or not to vie for leadership positions within the framework of scientific institutions.

The study will investigate how four independent variables namely: education; awareness of available leadership positions; socio-economic backgrounds; and prior positions held influence the elections of women scientists in leadership positions. The female scientists’ social status will be treated as an intervening variable. The science academies’ organizational structure will be considered as an extraneous variable in the study. These variables are summarized in the conceptual framework in Figure 1.
2.10 Summary

This chapter has reviewed the literature on women in science, technology, engineering and mathematics (STEM) fields, and examined the definition and role of science academies. Although the scientific community is faced with several challenges, the literature shows that women scientists are generally marginalized and this translates to a lack of participation in leadership positions. Whereas recommendations from various studies with respect to academic background and awareness of available leadership positions have been taken up by some organizations, it is not clear whether these have helped to mitigate the factors that influence the election of women scientists into existing leadership positions. The chapter has also presented a conceptual framework to enable a study and assessment of factors that influence the election of women scientists to leadership positions.
CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section explains the research designs chosen for the study, the sampling techniques and the data collection methods to be employed. How the variables will be operationalized is described in Figure 3.1.

3.2 Research Design

This study is based on quantitative method as it is concerned with the observable behavior of election of women scientists to leadership positions in terms of measurable variables. The quantitative method has been selected because it will allow for testing of hypothesis to establish relationships between the independent and dependent variable of this study. In this study, a combination of survey and descriptive research methodologies will be used.

This study’s purpose is to describe existing phenomena of the election of women scientists to leadership positions by use of survey research design. Women scientists will be asked to explain how they perceive their situation, their attitudes toward their roles within science academies and situations which facilitate or deter their election into leadership positions. The study explores how variables such as education and level of awareness influence the election of women scientists into leadership positions. Since the women scientists are spread over a wide area in Africa, making direct observation would have been very difficult, interviewing a representative sample was therefore done to get the information being researched upon.

The study seeks to report the existing situation of women scientists with respect to being elected into leadership positions within science academies, which constitute the Network. Descriptive research was used, and is defined as “a process of collecting data in order to test hypothesis or to answer questions concerning the current status of the subject in the study” (Yin, 2009). Descriptive research design facilitated the statistical computation of percentages, means and correlations, used when reporting the findings of the study.
3.3 Target Population

The study targeted about 50 women scientists, most of who have interacted with science academies within NASAC since its inception in 2001 to date. Some of the women scientists would have participated in the NASAC Women for Science Working Group meetings (NASAC Women for Science Working Group, 2011), or already served in various capacities within the academies in the Network, and/or are members of the Organization for Women in Science for the Developing World – OWSD.

3.4 Purposive and Snow Ball Sampling

Purposive sampling allows for handpicking of cases because they are informed or possess the required characteristics. Those identified name others with similar characteristics (Mugenda & Mugenda, 2003). These sampling methods are used in this study because the study focuses on acquisition of in-depth information about women scientists who have interacted with science academies so as to investigate the degree to which the knowledge acquired has influenced – negatively or positively – their election to leadership positions. From list of women scientists kept by NASAC and OWSD, contacts were made by electronic mail and those contacted initially were requested to identify others.

NASAC and OWSD were chosen to provide samples for this study due to several reasons. The two organizations organized workshops in 2009 and 2011 to discuss the plight of women scientists in science academies with consideration to science education for girls (NASAC Women for Science Working Group, 2011). While NASAC is the only regional network of Academies in Africa, OWSD is the only women-scientists’ organization worldwide. However, for OWSD, the target group will be African women scientists only. The headquarters of NASAC is based in Nairobi, Kenya, while the headquarters of OWSD is based in Trieste, Italy. The validity of this research will be enhanced by sampling from these two organizations.
3.5 Sample Size

For correlational research, a minimum of 30 cases is required (Kennesaw State University, 2010). Given time and cost limitations and the yield of the snowballing method, the first 25 women scientists were taken as the sample. Through the initial 25 women scientists, an additional 15 were contacted making the study sample size as 40 respondents. The initial expected target group of 50 respondents was not achieved.

3.6 Methods of Data Collection

The data collection method that was used in the study and the validity and reliability aspects of that method are discussed under this section.

3.6.1 Data Collection

Data was collected using interview guides administered by the interviewer and an assistant. Clusters of structured questions targeting each variable have been prepared as shown in Appendix 1. The interviewer and the assistant delivered and guided the filling of the interview guides to the respondents via electronic mail, video conferencing and where possible through face-to-face interviews. In order to minimize situational measurement errors, where respondents coach each other, interviews were carried out in such a way as to ensure that respondents do not consult and duplicate responses.

3.6.2 Validity of the Research Instrument

Validity is the degree to which evidence supports inferences based on the data collected using a particular instrument. It is concerned with whether the information is relevant to the purpose of the study or not. It is enhanced by preparing easy to understand instruments, free from ambiguity as well as pre-testing the instruments before full application. The prepared interview guides were pre-tested with some of the target population before full administration to the selected sample.
3.6.3 Reliability of the Research Instrument

Reliability is a measure of the consistence of results or scores obtained. It is improved by standardizing the conditions under which the measurement takes place. Rehearsals were done with the assistant to ensure that she fully understood the instruments and was motivated enough to carry out the study without introducing any auxiliary questions which may distort the responses. Interviewer and interviewee biases were considered and whenever it was possible, actions were taken to overcome them.

3.6.4 Ethical Considerations of the Study

This study will protect the privacy of the respondents especially since the survey instrument is based on anonymity. Only respondents who voluntarily agreed to participate in the study were contacted and the information they provided was solely used for the research project. For this reason, no information collected from respondents was used for financial or material gain by the researcher. The information was expressly collected for purposes of the research project and based on the study objectives. The study is undertaken on the premise of full disclosure to the respondents.
## Table 3.1: Operationalization Table of Variables

<table>
<thead>
<tr>
<th>Objective</th>
<th>Variable</th>
<th>Indicator(s)</th>
<th>Measurement</th>
<th>Scale</th>
<th>Data Collection Method</th>
<th>Data Analysis</th>
</tr>
</thead>
</table>
| To examine how level of education influences the election of women in the science academies within the academies. | **Independent Variable** Education | • Basic Degree  
• Masters in Science (MSc)  
• Doctorate (PhD)  
• Professorship | Years of securing the certification  
a) Up to 4 years  
b) 5 to 12 years  
c) Over 12 years | Ratio and nominal | Interview guides | Correlational and descriptive statistics |
| To establish how social-economic background influences the election of women to leadership positions in science academies. | **Independent Variable** Socio-economic background | • Family status  
• Support systems | a) Earnings  
b) Scientific Community or Government | Ratio and nominal | Interview guides | Correlational and descriptive statistics |
| To determine how the female scientist's level of awareness of the available leadership positions influences their election in science academies. | **Independent Variable** Level of awareness of:  
• Academies Statutes and/or Constitution  
• Special Group Entitlements  
• Where and how to get support  
• Votes garnered  
• Academy Membership  
• Knowledge of other support systems  
• a) Election process  
b) Proof of Membership  
c) Knowledge of where to report election flaws  
d) Behavior e.g. quitting, silence or reporting | | Ordinal | Interview guides | Correlational and descriptive statistics |
| To assess to what extent prior positions held by female scientists influence the election within the academies. | **Independent Variable** Prior positions held | • Duration | Years served on the position  
a) 0-1 year  
b) 1-2 years  
c) 3 years and above | Ratio | Interview guides | Correlational and descriptive statistics |

**Note:**
- Interview guides comprising all the above indicators were administered by the author and her assistant.
- Methods of data collection and analysis are the same for independent and dependent variables.
CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents the data analysis, interpretation and presentation there-to on the study to investigate the factors that influence the election of women scientists to leadership positions among member of the Network of African Science Academies (NASAC). The study had targeted 50 respondents out of which 40 respondents filled and returned their interview schedules constituting 80% response rate. Data analysis was done through spreadsheets in Microsoft Excel 2010. Frequencies, percentages and mean were used to display the results which were presented in tables and graphs.

4.2 Analysis of women scientists respondents

This study was undertaken using an interview schedule divided into five main sections namely: general information; education; socio-economic status; level of awareness; and prior positions held. The data analysis done by the researcher and the findings of the study based on the information provided by respondents are discussed under this topic based on the sections of the interview schedule.

4.2.1 General information

The study sought to establish respondent’s age; the results are presented in Table 4.1 below.

<table>
<thead>
<tr>
<th>Table 4.1: Distribution of respondents by Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>Above 50 years</td>
</tr>
<tr>
<td>Between 40 to 50 years</td>
</tr>
<tr>
<td>Below 40 years</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
The researcher sought to know the respondents age, from the findings in figure 4.1, 12 (30%) of the respondents were aged below 40 years, 16 (40%) were aged between 40 to 50 years, 12 (30%) were aged above 50 years. This information shows that most of the women scientists contacted for this study were aged between 40 and 50 years.

On distribution of respondents by whether or not they had an academy in their countries, the results are presented in the Table 4.2 below.

<table>
<thead>
<tr>
<th>Table 4.2: Distribution of respondents with and without Academies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>With Academies</td>
</tr>
<tr>
<td>Without Academies</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

On the distribution of respondents based on whether or not they had an academy the study found that 38 (95%) of the respondents had science academies in their home countries, while only 2 (5%) did not have academies. The main reason cited by the two respondents for not having an academy in their country was that the scientists had not thought of it. This information indicates that most of the women scientists who participated in the study had science academies in their countries.

Out of the 40 respondents, 34 (85%) indicated that they were members of an academy, while 6 (15%) were not members at all. The distribution by category of membership of the 34 respondents who are members of an academy is presented in Table 4.3 below.

<table>
<thead>
<tr>
<th>Table 4.3: Distribution of respondents by membership categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membership Category</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Ordinary Member</td>
</tr>
<tr>
<td>Associate Member</td>
</tr>
<tr>
<td>Fellow</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
As shown on Table 4.3, the study found that out of 34 respondents who were members of an academy, 22 (65%) belonged to the ordinary member category, 4 (12%) were associate members, 4 (12%) were Fellows, while 4 (12%) belonged to other categories. This shows that a majority of the respondents were ordinary members of their country’s academy.

On how the respondents become associated with science academies, a majority of them cited their own efforts. The findings are shown on Table 4.4.

Table 4.4: Respondents association with a science academy

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referred by a colleague</td>
<td>14</td>
</tr>
<tr>
<td>Referred by a friend</td>
<td>0</td>
</tr>
<tr>
<td>Through the university</td>
<td>8</td>
</tr>
<tr>
<td>Through the government</td>
<td>0</td>
</tr>
<tr>
<td>Through own efforts</td>
<td>16</td>
</tr>
<tr>
<td>No association</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
</tr>
</tbody>
</table>

From the findings on Table 4.4, the researcher found that 16 (40%) became associated with a science academy through their own efforts, 14 (35%) were referred by a colleague and 8 (20%) through the university. 2 (5%) respondent however had no association with their science academies while none of them became associated with a science academy through a friend or the government.

4.2.2 Level of Education

The study sought to examine how the level of education influenced the election of women scientists into leadership positions in the science academies. First, the study established the level of education of respondents by asking them to indicate whether they had attained a Basic Degree, Master of Science (MSc), Doctor of Philosophy (PhD) or a Professorship (Prof). Additionally, the respondents were to indicate how long it took them to acquire that level of education. The results are presented in Table 4.5.
Table 4.5: Level of education and duration of acquisition

<table>
<thead>
<tr>
<th>Duration</th>
<th>MSc</th>
<th>PhD</th>
<th>Prof</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 4 years</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>5 to 12 years</td>
<td>12</td>
<td>4</td>
<td>0</td>
<td>16</td>
<td>40%</td>
</tr>
<tr>
<td>Over 12 years</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>14</td>
<td>35%</td>
</tr>
<tr>
<td>Totals</td>
<td>16</td>
<td>14</td>
<td>10</td>
<td>40</td>
<td>100%</td>
</tr>
</tbody>
</table>

On the respondents level of education, the study found that for those who had acquired a Master of Science (MSc) level of education, 4 (10%) of the respondents took a duration of up to 4 years, 12 (30%) of the respondents took a duration of 5 to 12 years. For those who had acquired Doctor of Philosophy (PhD) level of education, 6 (15%) of the respondents took a duration of up to 4 year. There were however 4 (10%) who took a duration of 5 to 12 years, and another 4 (10%) who took over 12 years to acquire their PhDs. All the respondents 10 (25%) who had acquired a Professorship level of education took a duration of over 12 years. None of the respondents had only attained a basic degree.

In total, 16 (40%), 14 (35%) and 10 (25%) had acquired a Master of Science, Doctor of Philosophy and Professorship level of education respectively. From these findings it can be concluded that acquisition of a level of education of up to a professorship level would take women scientists more than 12 years to attain. It is also further concluded from the findings that a majority of the respondents were Masters of Science degree holders and to attain this, it took less than 12 years duration.

The study also sought to establish what benefits the respondents’ had received upon attaining the various levels of education. The results are presented in table 4.6.

Table 4.6: Benefits of attaining various level of education

<table>
<thead>
<tr>
<th>BENEFITS</th>
<th>MSc</th>
<th>PhD</th>
<th>Prof</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promotion to a higher position</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>24 (60%)</td>
</tr>
<tr>
<td>Salary raised while serving in the same position</td>
<td>4</td>
<td></td>
<td></td>
<td>4 (10%)</td>
</tr>
<tr>
<td>Supervised other women scientists</td>
<td>4</td>
<td>6</td>
<td></td>
<td>6 (15%)</td>
</tr>
<tr>
<td>No significant benefit</td>
<td>4</td>
<td>2</td>
<td></td>
<td>6 (15%)</td>
</tr>
<tr>
<td>Academy member</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academy committee/board/council member</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>16</td>
<td>14</td>
<td>10</td>
<td>40(100%)</td>
</tr>
</tbody>
</table>
From the findings on the Table 4.6 the study found that 24 (60%) of the respondents indicated that on attaining the various levels of education, they attained promotions to higher positions. It was further noted, is that it is only the PhD holders who took time to supervise other women scientists. None of the respondents benefited from their level of education by either becoming members of the science academies or serving on the academies’ committee, board or council. This information shows that for most of the women scientists, their level education only influenced their professional/career roles but not involvement with science academies. Additionally, the number of women scientists supervising other women scientists is low at only 15% of the respondents.

From the findings the independent variable of education only has a direct correlation with the election of female scientists into the leadership positions at the point of becoming a member of an academy. It can also be deduced from the study that the over 12 years necessary for the respondents attain the highest level of education at Professorship may affect their election into leadership positions due to lost opportunities.

4.2.3 Socio-Economic Background

The study sought to establish how the socio-economic background of the women scientists who participated in the study influenced their election into leadership positions in the science academies. This was done by finding out the respondents’ size of families, the level of monthly salary-income and the social-status stratification. The results are presented in Table 4.7.

<table>
<thead>
<tr>
<th>Family Size</th>
<th>Less than 4 siblings</th>
<th>More than 4 siblings</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than KES50,000</td>
<td>2</td>
<td>0</td>
<td>2 (5%)</td>
</tr>
<tr>
<td>Between KES50,001-100,000</td>
<td>8</td>
<td>8</td>
<td>16 (40%)</td>
</tr>
<tr>
<td>More than KES100,000</td>
<td>6</td>
<td>14</td>
<td>20 (50%)</td>
</tr>
<tr>
<td>Don't Know</td>
<td>0</td>
<td>2</td>
<td>2 (5%)</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>16 (40%)</td>
<td>24 (60%)</td>
<td>40 (100%)</td>
</tr>
</tbody>
</table>
From Table 4.7, the findings of the study show that a majority, 24 (60%), of the respondents had a family size of more than four siblings, out of which 14 (35%) earned a monthly salary income of more than KES100,000. 20 (50%) of the respondents had a monthly salary income of more than KES100,000. 16 (40%) earned a monthly salary income of between KES50,001 to KES100,000, half of whom had more than four siblings while the other half had less than four siblings. 2 (5%) of the respondents less than four siblings and earned less than KES50,000, while another 2 (5%) did not know their monthly income level but had more than four siblings. All the respondents described their social status as middle-class, and hence were neither poor nor rich/wealthy.

From the study, it can therefore be concluded that a majority of the women scientists who participated, came from large families of more than four siblings, but also earned a high monthly income of more than KES100,000 per month. Using socio-economic background as the independent variable, the study discovered there was no direct correlation with the election of the respondents into leadership positions. Therefore, the socio-economic background of the women scientists had no influence in their election into leadership positions within the science academies.

4.2.4 Level of Awareness of Available Leadership Positions

On the level of awareness of available leadership positions, the study sought to determine how this would influence the election of the women scientists into leadership positions. The study therefore first sought to find out how the respondents became scientists. From the study, all the respondents indicated that they liked science, technology, engineering and mathematics (STEM) in school. In addition to liking STEM subjects, 5 (13%) indicated that they were also encouraged by their families to become scientists. As to whether or not the respondents knew what a science academy is or does, 12 (30%) responded in the negative, while 28 (70%) responded in the affirmative. Out of the 28 respondents who knew what a science academy is and does, 8 (20%) were however not able to name at least three academies that were members of NASAC – the Network of African Science Academies.
The study also sought to find out how leadership positions get filled in any academy that the respondents knew. Only the 28 (70%) of the respondents who knew science academies responded saying it was through an election process as shown on Table 4.8.

**Table 4.8 Election process for leadership positions in academies**

<table>
<thead>
<tr>
<th>Process</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Election through secret ballot</td>
<td>14</td>
<td>50%</td>
</tr>
<tr>
<td>Election through consensus</td>
<td>8</td>
<td>29%</td>
</tr>
<tr>
<td>Do not know</td>
<td>6</td>
<td>21%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

From Table 4.8, 50% of the respondents indicated that the elections for leadership positions were done through secret ballot, 29% indicated through consensus, while 21% did not know the process undertaken. The study also found that in the event that the election process was flawed, all 79% (22 out of the 28) of the respondents would confront and discuss matters with the academy officials.

The study also sought to establish if the academies that the respondents knew had a constitution or statute that supports affirmative action for women scientists and if the respondents knew the leadership positions that existed for women scientists. The findings are shown in Table 4.9.

**Table 4.9: Awareness of constitutions with affirmative action for women scientists and positions**

<table>
<thead>
<tr>
<th>Awareness</th>
<th>Constitution/Statutes</th>
<th>Positions for women scientists</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>Yes</td>
<td>20</td>
<td>71%</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>7%</td>
</tr>
<tr>
<td>Don’t know</td>
<td>6</td>
<td>22%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>28</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

From the findings on Table 4.9, 20 (71%) of the respondents knew constitutions of academies that supported affirmative action for women while 2 (7%) did not know. Unfortunately, only
8 (29%) of the respondents knew the leadership positions that existed for women scientists to vie for, leaving 14 (50%) of the respondents without this information. 6 (22%) did not know whether the academies had a constitution/statute or any position for women scientists. This shows that even when the majority of the respondents knew academies with constitutions/statutes that supported affirmative actions for women scientists, half of them did not know the leadership positions that women scientists could vie for.

For the 14 (50%) respondents who did not know the leadership positions that women scientists could vie for, the reasons provided are shown on Table 4.10.

**Table 4.10: Reasons for not knowing available leadership positions**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is no value in knowing what positions exist because male scientists always get elected to them</td>
<td>6</td>
<td>43%</td>
</tr>
<tr>
<td>The academy does not publish the existing leadership positions openly</td>
<td>4</td>
<td>29%</td>
</tr>
<tr>
<td>I am simply not interested in those leadership positions</td>
<td>4</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

From Table 4.10, a majority, 43% (6 out of 14) of the respondents believe that there is no value in knowing what positions exist because the male scientists always get elected to them. 29% were not interested, while the same number of respondents blames the academies for not publishing the existing leadership positions.

The study also sought to determine the composition of members serving in the academy board or council in terms of women versus males scientists. 14 out of the 28 (50%) of the respondents said that the majority were males scientists, 12 out of the 28 (43%) did not know, while 2 out of the 28 (7%) thought there were equal male as there are female scientists in the academy board or council. The reasons given for this included the fact that a majority of scientists were male, and that women were not willing to make the sacrifice required to hold those positions. Others mentioned that this was due to historical factors whereby science was viewed a male discipline, but more women were only just beginning to get involved in it.

From the findings, the independent variable of level of awareness on academies constitution/statutes, special group entitlements and where and how to get support directly
influenced the election of women scientists into leadership positions. Given that 50% of the respondents were not aware of the available leadership positions indicates that even if the opportunity presented itself, they are unlikely to vie for the positions.

### 4.2.5 Prior Positions Held

The study sought to assess to what extent the prior positions held by the women scientists influenced their election into leadership positions. The findings revealed that the prior positions held by women scientists play a role in influencing their election into leadership positions within the science academies. The study sought to establish the length of time respondents have been associated with or served in an academy, and the extent to which the positions they held previously affected their interaction with the academy. Table 4.11 shows the findings.

<table>
<thead>
<tr>
<th>Duration associated with an academy</th>
<th>No change</th>
<th>Better Recognition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 year</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>1-2 years</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2-3 years</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>over 3 years</td>
<td>6</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>18</strong></td>
<td><strong>32</strong></td>
</tr>
</tbody>
</table>

Out of the 40 respondents, 8 (20%) abstained from responding to this question indicating that they were not members of any science academy yet. This left a total of 32 (80%) respondents amongst whom a majority 18 (56%) cited better recognition with more responsibilities for academy work, while 14 (44%) cited no change as their interaction with the academy remained the same. None of the respondents indicated that their prior positions held resulted to worse association with the academy or that it was considered of little regard. The respondents who served as academy members or were associated with an academy for more than 3 years (6 or 19%) or less than 1 year (8 or 25%) also cited the fact that the prior positions they held had no influence.
From these findings, the study deduced that the longer the respondents were associated with an academy, the better the recognition and additional responsibilities they acquired. With recognition based on their prior positions held, it is possible to be elected into the leadership positions.

The study also sought to establish how the prior positions held by the respondents influenced their interaction with the science academies. The findings are shown on Table 4.12.

Table 4.12: Mode of interaction in the academy when better recognized

<table>
<thead>
<tr>
<th>Mode of interaction</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Got nominated to serve in a committee</td>
<td>10</td>
<td>56%</td>
</tr>
<tr>
<td>Got accepted as a member of the academy</td>
<td>4</td>
<td>22%</td>
</tr>
<tr>
<td>Kept updated on academy projects</td>
<td>4</td>
<td>22%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

From Table 4.12, for respondents who got better recognition, a majority, 10 out of the 18 (56%) got nominated to serve in an academy’s committee. The remaining 8 (44%) either got accepted a members of the academy or were kept updated on academy projects. The study found that none of the respondents felt that the academy called on their expertise to undertake any activity. Prior positions held by the women scientists therefore had a direct correlation with their election into leadership positions within the academies.
CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

From the analysis of data collected, the following discussions, conclusions and recommendations were made. The responses were based on the objectives of the study which were to examine how level of education, socio-economic background, level of awareness of the available leadership positions and the extent to which prior positions held by female scientists influence their election into leadership position within the academies. The Network of African Science Academies (NASAC) was the case used for this study.

5.2 Summary of findings

The purpose of this study was to investigate the factors influencing the election of women scientists into leadership positions, the case of the Network of African Science Academies. The study was guided by the following objectives to:

a) To examine how level of education influences the election of women scientists in the science academies within the Network.

b) To establish how socio-economic background influences the election of women to leadership positions in science academies.

c) To determine how the female scientist’s level of awareness of the available leadership positions influences their election in science academies.

d) To assess to what extent prior positions held by female scientists influence the election within the academies.

The research design used for this study was descriptive design. The study population consisted of 40 women who were actively involved and/or aware of the work of science academies that are members of the Network, NASAC, in Africa. An interview schedule presented in the form of a questionnaire was used to collect primary data from the respondents. The data collected was then analyzed using descriptive statistics such as
frequency and percentage scores. The results of the analysis were presented in form of tables and figures. The survey recorded a response rate of 80% with a total of 40 out of 50 respondents targeted.

The following is a highlight of the major findings of this study based on the specific objectives. The first major finding of the study was related to examining how the level of education influence the election into leadership positions of the women scientists who participated as respondents. 40% of the respondents indicated that they had a Master of Science (MSc) level of education, out of which 30% had acquired the MSc within 5 to 12 years’ duration. The study also discovered that only the respondents with a Doctor of Philosophy (PhD) indicated supervision of other women scientists as a benefit of attaining that level of education.

The second major finding was related to establishing how the socio-economic background of the respondents influenced their election into leadership positions within the academies. A majority as represented by 60% of the respondents came from families with more than 4 siblings and earned a monthly salary income of more than KES100,000. Respondents earning more KES100,000 were represented by 50%. All the respondents indicated that they belonged to the middle-class social stratification.

The third major finding was related to determining the level of awareness of the respondents to the available leadership positions that women scientists can vie for within the academies. From the study, 70% of the respondents were aware of functions and the existence of science academies out of which 50% knew that leadership positions could only be secured through a secret ballot election process. The level of awareness on the available leadership positions that women scientists could vie for remained low at 29% of the respondents, in spite a majority of them, 71%, knowing that the constitutions of science academies supported affirmative action for women scientists. The low level of awareness on available leadership positions was attributed to the reason that there was no value in knowing since the male scientists always get elected. This was represented by 43% out of the 50% of the respondents who did not know the available leadership positions within the academies.

The fourth major finding of the study was related to assessing to what extent prior positions held by the women scientists influenced their election to the leadership positions within the
academies. The study found that a majority as represented by 80% of the respondents had been associated with science academies directly. 56% of them cited better recognition with more responsibilities for academy work as a notable influence for over 3 years of association with the academies. The remaining 44% saw no change in their interaction with the academies based on the prior positions they had held. A majority of those who were better recognized as represented by 56% of the respondents indicated that they were subsequently nominated to serve in a committee within the academy. The study however found that none of the respondents felt that the academy called on their expertise to undertake any activity.

5.3 Discussion of the findings

From the study, it was found that for all the women scientists who participated as respondents, all had post graduate level of education. None of the respondents was recorded as only having a basic degree. A majority of the respondents were Master of Science (MSc) degree holders at 40%, Doctor of Philosophy (PhD) holders followed in number at 35% and subsequently those with Professorship qualification at 25%. The other finding from the study was that it was only the PhD holders who cited supervision of other women scientists as a benefit of attaining that level of education, but even this was at a low rate of 15%. This finding implies that scope of finding role models for female scientists is very limited. In a report titled “Gender in Science Education” (2011), the Inter-American Network of Academy of Science (IANAS) cited that although some science courses at the tertiary level see 50% female participation or more, this trend is generally restricted to the biological and life sciences. Participation rates for females in other science and engineering courses remain substantially and consistently less than males throughout the hemisphere (IANAS, 2011).

The study also looked at the duration the respondents took to acquire the various levels of education. The findings indicate that most, up to 30%, of the respondents holding a MSc degree took between 5 to 12 years’ duration to attain it. The apex of education level for the study was set at professorship level and all the respondents, constituting 25% of the total, took more than 12 years duration to attain it. From the study, this can be interpreted to mean that if the highest level of education, that is professorship, influences the election of women scientists in to leadership positions within academies, then only a few would qualify due to
the investment of time required. This can therefore influence the female scientists’ level of participation as they balance their time with career, family and education.

A majority of respondents depicted by 60% cited the main benefit of attaining the various levels of education, whether MSc, PhD or professorship, as promotion to a higher position within their respective careers. None of them recorded academy membership or serving in an academy committee, council or board as a direct benefit of their level of education. This is line with the observation that academies are first and foremost learned societies. An academy’s most important function is to act as honorific association extending recognition to eminent scientists by inducting them into the Academy’s membership. It also acts in support of science and scientists and it often is engaged in the publication of scientific publications (NASAC, 2010). Overall, the interest-horizon of the Learned Society is essentially limited to science. Therefore, in spite the high level of post graduate education being a prerequisite for membership; it has no influence or bearing when it comes to election in to the leadership positions that are available within the science academies or the network by extension.

The findings of this study therefore confirms what the National Science Foundation, 2004 report mentioned, that in engineering and computer sciences the percentages of women have reached a plateau or dropped over the past decade. The available data does not openly disclose the attrition of women at every phase of the education and career in science. The study further confirms that more women than men leave science and engineering and as a result, few women are in leadership positions in the STEM workforce (National Science Foundation, 2004).

The study sought to establish the socio-economic background of the respondents by considering their family sizes, the level of monthly salary income, and their social status. While the foregoing was used as indicators for socio-economic status, the study found that none of the respondents had the same definition of the term, or even a conclusive list of items for research that can accurately define it. This is because the construct entails political ideologies about existing and desired social structures, none of which can be quantified or defined objectively.

In simple terms scholars agree that socio-economic status is a component of factors that allow an individual’s access to collectively desired resources so as to thrive in the social
world (Oakes & Rossi, 2003). These collectively desired resources may include material goods, money, power, friendship networks, healthcare, leisure time, or education opportunities. The study only focused on three aspects and hence a limited interpretation of what influence the respondents socio-economic status or background can be made.

Many scholars agree that marriage and family create demands that can cut short a thriving scientific career. In his 2001 book, From Scarcity to Visibility: Gender Differences in the Careers of Doctoral Scientists and Engineers, J. Scott Long reported that single men and single women participate about equally in the STEM workforce. However, a married female PhD is 13 percent less likely to be employed than a married male PhD and if the woman is married with young children, she is 30 percent less likely than a single man to be employed. As earlier noted, dozens of studies document the struggle to balance career and family, but the struggle is more significant for women scientists than it is for their male counterparts. From this observation, it is therefore not possible to determine the reasons for disparity in levels of incomes among the respondents, or the impact of having a large or small family size on their socio-economic backgrounds. For this reason, the study concludes that the socio-economic background of the respondent does not have a direct influence on whether or not they are elected into leadership positions with the science academies.

The study found that all the respondents perceived themselves as possessing a socio-economic status of the middle-class in spite of having a varied size of family and level of monthly salary income. The majority of respondents depicted by 60% came from families with more than four siblings and out of which 35% earned an income of more than KES100,000. The choice of socio-economic status of the respondents was subjectively determined by them and other issues of perceptions and personal aspirations come into play. The result of which makes that particular survey question less practical to use as a basis of establishing how socio-economic background influences the election of the women scientists in to the leadership positions within science academies.

From the findings, the study revealed that the main reason the respondents became scientists was because they like science, technology, engineering and mathematics in school, and that several of them were also encouraged by their families. None of them cited inspiration by a role model scientist or being unsure of how they ended up in the scientific field. Having a personal choice in their field of expertise indicates that the level of attrition will be reduced.
On whether the respondents knew what a science academy is or does, 70% of the women scientists responded in the affirmative. This level of awareness is critical to establish an interest in association or participation in academy activities and presents an opportunity for vying for election to the leadership positions within the Academy. The study further requested the respondents to name at least three science academies that are members of NASAC. Out of the respondents aware of what an academy is and does, 20% were unable to provide correct names of the academies. Awareness creation is therefore necessary by the academies in Africa to gain publicity of their existence and activities among the scientists that are associated with them.

The study also revealed that the women scientists were aware of the how leadership positions were filled within academies citing either election by secret ballot or consensus. This level of awareness is essential in order to ensure that women scientist vie and campaign in the process of electing their academy officials into the leadership positions. Given that a majority of the respondents were aware of this fact indicates a good likelihood of women scientist aspiring to lead the organizations within the network of science academies in Africa. The study also revealed that in the event of a flawed election process most of the respondents would confront and discuss the matter with academy officials. This depicts a high level of social justice and responsibility as well as a desire to adhere to set out rules of engagement by the members of the academies.

The study further revealed that the women scientists were aware of academies having constitutions or statutes that supported affirmative action for them. It was however a challenge to ascertain the correlation of an affirmative action constitution to their awareness of the available leadership positions for women scientists. Up to half of the respondents were not aware of the available leadership positions that they could vie for. This finding indicates that even if the positions were available for the uptake of women scientists, they may not readily vie due to lack of awareness.

A few of them shown by 21% were completely oblivious of the existence of either the academy constitution with affirmative action elements or the existence of leadership positions within the academies that they could vie for. On further investigating the reasons for this lack of awareness, the study revealed that most respondents felt that there was no value in
knowing what positions existed within the academies because male scientists always get elected to them. Others felt that it was the responsibility of the academies to publish existing leadership positions openly and this had not been done, which resulted to their lack of awareness. Worse still, some respondents indicated that they were simply not interested those leadership positions and hence felt the lack of awareness of those positions justified.

Given that the highest governing organ of academy is either its board or council, the study revealed that according to most women scientists, these organs had a composition that was majority male scientists. This was for 43% of the respondents. The reasons provided for the low representation of women scientists in the leadership organs of the academies were cited as fewer women in the academy membership to start with, and the perception that science is mostly a male-dominated field enabling them to take up existing opportunities more easily. This perception was deduced as being predominant due to historical reasons of living in a patriarchal society. Only two, constituting 7% of the respondents felt that the academy in their country had a board or council of equal male and female scientists’ representation. The fact that more women scientists are now getting involved in science and science academy work was also acknowledged.

The awareness, or lack thereof, of available leadership positions that women scientists can vie for, confirms that a major focus of social constructionism is to uncover the ways in which individuals and groups participate in the construction of their perceived social reality (Otieno-Omutoko & Wambugu, 2012). From the study, the social order of having male scientists dominate the leadership positions is reaffirmed and maintained because the social constructs as facets of reality and objects of knowledge do not naturally exist. From this deduction, it can therefore be concluded that the level of awareness or lack of awareness of available positions directly influences the election of women scientists into leadership.

In assessing the extent to which the prior positions held by women scientists influenced their election into leadership positions within the academies, the study revealed that women scientists who associated with the academies longer gained better recognition and were accorded more responsibilities. The recognition facilitates merit required to vie for the leadership position during an election and this usually proved to be a critical factor. The science academies are membership organizations and it is assumed that members would vote
during an election for leaders that they know or are familiar with their track record within the ranks of the academies.

Of the 80% of respondents who addressed this issue, a majority at 56% indicated they were better recognized due to association with the academies. The remaining 44% cited that in spite of their association with the academy the positions they held previously had no significant influence on their interaction with the academies. They recorded no change as the interactions remained the same. The study also revealed that none of the women scientists felt that the prior positions they had held resulted to a worse-off relationship or association with their academy or that little regard was given to their previous roles.

The study also found that the most common mode of recognition for women scientists that have associated with academies was to be nominated to serve in a committee. A few of the scientists recognized acceptance into academy membership also as mode of interaction showing recognition while others cited being updated on academy projects and activities as another way. The various modes of recognition can serve as a stepping stone to pursuing other roles within the academy echelons including positions of leadership and hence influence the elections.

The findings on prior positions held in influencing the election of women scientists into leadership positions contradicts the findings of studies carried out by Fiona Murray and Leigh Graham of the Massachusetts Institute of Technology showing that a major source of attrition by women from scientific careers results from lack of networking and mentoring. Networking and mentoring are two aspects that become evident when the respondents are associated with the academies for a longer duration of time and hence the recognition and additional responsibilities cited as an added advantage. The Murray and Graham study, which found that the women had fewer referrals from collegial network to participate in the commercial marketplace when being asked to consult, serve on science advisory boards, and interact with industry (Murray & Graham, 2012), may be true for faculty staff members but not for women scientists within academies.
5.4 Conclusions

From the findings, the study concludes that the three major factors that influence the election of women scientists into leadership positions within the science academies that are members of the Network of African Science Academies are: level of education, level of awareness of the available leadership positions and the prior positions held. The study further concludes that there is no evidence to show that the socio-economic background of women scientists influences their election into the leadership positions within the academies. Academic elections focus more scientific track record of the aspirants within the academies, rather than their socio-economic status, perceived family background or wealth.

The researcher concludes that the involvement and participation of women scientists is important for the work of science academies. The women scientists have the capability and awareness to serve in committees, boards and councils of science academies within NASAC. The researcher also concludes that the level of education is only critical at the point of entry for membership within academies but has limited role in the nomination into any leadership positions done through elections. The researcher also concludes that very few women scientists serve as role-models making it difficult for more women scientists to pursue scientific careers, and hence limiting their chances to vie for elected leadership positions when these become available in the academies.

5.5 Recommendations

From the above discussion and conclusion the study recommends that the content of the academy constitutions or statutes should promote affirmative actions for women scientists. This information should further be publicized to increase the level of awareness among women scientists of the leadership positions that are available. At any rate, no special academic qualification should be championed, but instead a basic quota of positions should be reserved for qualified women scientists.

The study also recommends that the role-model aspect for women scientists should be supported and a mechanism devised for implementation. Women scientists are few and
women role-models for young scientists are even fewer. The status quo needs to be reversed and science academies can provide an avenue to address this.

5.6 Suggestions for further study

The study further recommends that women scientists should place a high premium on information, especially as relates to the available leadership positions that they can vie for. Ways of how this can be done should be investigated further. It is not enough to resign to fate and cite patriarchal societal norms as the basis for lack of awareness. Women scientists should be keen to review and revise the societal constructs that perpetuate gender disparities.

Another suggestion for further study is the factors influencing the retention of women in scientific careers or professions. Additionally, further research is also necessary in finding the link between socio-economic background and retention of women in scientific professions especially in Africa where the data on women scientists is not readily available.
REFERENCES


Fraser, E., & Fimbres, L. S. (2012). *Prospectives on Women on STEM*. Panama City: Boyd Brothers Inc.


APPENDICES

APPENDIX I: TRANSMITAL LETTER

Jacqueline A. A. Olang  
Network of African Science Academies  
P.O. Box 201 Karen 00502 Nairobi  
Tel: +254 720 566 605  
Email: jackie.olang@gmail.com

Dear Sir/Madam,

RE: RESEARCH PROJECT ON THE TOPIC “FACTORS INFLUENCING THE ELECTION OF WOMEN SCIENTISTS TO LEADERSHIP POSITIONS: A CASE OF THE NETWORK OF AFRICAN SCIENCE ACADEMIES (NASAC)”

I am a final year Master of Arts student carrying out an academic research for the purpose of examination leading to the award of a degree of Master of Arts in Project Planning and Management.

The purpose of this letter is to request you to provide the required information as per the questionnaires and interview guides provided. Kindly be as honest and as thorough as possible. The information you provide will be considered as confidential and will only be used for the purpose of my examination only.

Thanking you in advance for your cooperation.

Yours faithfully

JACQUELINE A. A. OLANG  
L50/70994/2007

Form serial number……………..
APPENDIX II: INTERVIEW GUIDE FOR WOMEN SCIENTISTS

INSTRUCTIONS

Please place X where appropriate.

SCHEDULE A - General Information

1. How old are you?
   a) Below 40 □ b) 40-50 □ c) Above 50 □

2. Do you have a science Academy in your country?
   a) Yes □ b) No □

3. If no, why?
   a) The scientists I know have not thought of it □
   b) The value of establishing an academy is not yet clear □

4. Are you a member of any scientific organization?
   a) Yes □ b) No □

5. If yes, what is the membership category?
   a) Ordinary Member □ b) Associate Member □ c) Fellow □ d) Other □

6. How did you become associated with a science academy? Choose one.
   a) Referred to by a colleague □
   b) Referred to by a friend □
   c) Through the University □
   d) Through Government □
   e) Through my own efforts □
**SCHEDULE B-Education**

1. What is your level of education?
   a) Basic Degree
   b) Masters in Science (MSc)
   c) Doctorate (PhD)
   d) Professorship (PostDoc)

2. How long did it take you to acquire that level of education?
   a) Up to 4 years
   b) 5-12 years
   c) Over 12 years

3. What benefit would you say you received from attaining that level of education?
   a) I got a salary raise while serving in the same position.
   b) I got a promotion to a higher position
   c) I became a member of a science academy
   d) I supervised other women scientists
   e) I serve as a committee/board/council member in an academy
   f) No significant benefit

**SCHEDULE C-Socio-Economic Status**

1. What is the size of your family?
   a) Less than 4 siblings
   b) More than 4 siblings

2. What is the level of your salaried income per month?
   a) Don’t know
   b) Not more than Ksh.50,000 (or US$602)
   c) Between Ksh.50,001-100,000 (or US$603-1,204)
   d) More than Ksh.100,000 (or US$1,204)
4. How would you describe your social status?
   a) Poor ☐
   b) Middle-class ☐
   c) Rich/wealthy ☐

**SCHEDULE D- Level of Awareness**

1. How did you become a scientist?
   a) Not sure, it just happened ☐
   b) I liked science, technology, engineering, and mathematics in school. ☐
   c) I was inspired by a role-model scientist ☐
   d) My family encouraged me. ☐

2. Do you know what a science academy is or does?
   Yes ☐ No ☐

3. If yes, please name at least three academies in Africa that are members of NASAC-the Network of African Science Academies.
   a) 
   b) 
   c) 

4. How do leadership positions get filled in any academy you know?
   a) By an election through secret ballot ☐
   b) By an election through consensus ☐
   c) By an election through acclamation ☐
   d) By direct appointment by academy officials ☐
   e) I do not know ☐

5. If the process of filling leadership positions in the academy is flawed, what do you do?
   a) Nothing. I, leave matters to God ☐
   b) I confront and discuss with the academy officials. ☐
c) I report the matter to:
   i. Government Official
   ii. Police
   iii. Academy Board/Council/Election Committee

d) I relinquish my association with that academy

5. Does the science academy that you know have a constitution/statute that supports affirmative action for women scientists? Yes [ ] No [ ]

6. Do you know the various leadership positions that exist for women scientists within science academies? Yes [ ] No [ ]

7. If Yes, state at least three leadership positions:
   a) 
   b) 
   c) 

8. If No, why do you not know?
   a) There is no value in knowing what positions exist because male scientists always get elected to them. [ ]
   b) The academy does not publish the existing leadership positions openly. [ ]
   c) I am simply not interested in those leadership positions [ ]

9. What is the composition of members serving in the academy Board/Council
   a) There are equal males as there are females [ ]
   b) Majority are male scientists [ ]
   c) Majority are female scientists [ ]
   d) I do not know [ ]

10. Give one reason why you think this is the case in 9 above?

________________________________________
**SCHEDULE E - Prior Positions Held**

Responses to these questions will help to assess the influence of prior positions held in the election of women scientists to leadership positions in the academy.

1. How long have you been associated with or served as a member in the academy?
   a) 0-1 year
   b) 1-2 years
   c) 2-3 years
   d) Over 3 years

2. How do you think the prior positions that you have held affected your interaction with your academy?
   a) No change, the interaction has remained the same
   b) Got better recognition and more responsibilities
   c) Got worse with little regard for the positions I have held

3. If it got better, please say how by choosing any or several of the choices below.
   a) Got nominated to serve in a committee
   b) The academy called on my expertise to undertake an activity
   c) Got accepted as member of the academy
   d) The academy keeps me updated on their projects.

4. If it got worse, please say how by choosing any or several of the choices below.
   a) I got invited to academy activities more irregularly/infrequently
   b) The academy looks down at my profession because it not scientific.
   c) I got intimidated by the other scientists.
   c) The academy declined my application into an award/membership category