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Journal Background and Scope

PROGRESS Multidisciplinary Research Journal is an academic and peer-reviewed journal published bi-annually by the Polytechnic of Namibia. The journal seeks to give visibility and worldwide access to applied research. It publishes research articles written by professional academics as well as doctoral students from original completed and ongoing research, special issues, short communications, and reviews. The journal serves as platform for discussion and dissemination of research findings, new research areas and techniques, conceptual developments, and articles with practical application to any field.

Its scope is multidisciplinary, covering studies in the arts, human and social sciences, economic and education sciences, natural sciences, engineering and technology. All articles are evaluated by the editorial board and two or more international reviewers with scholarly expertise in the subject.

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ISSN 2026-7096
Editorial

Basic Education and Skills Acquisition in Namibia

Nnenesi Kgabi, Polytechnic of Namibia

Background
As much as the Namibian Government had been committed to improve access to and quality of basic education, and despite all previous efforts and above mentioned successes, the education system is still showing serious weaknesses regarding coverage and provision, and in particular with respect to the quality of education. The quality of teaching and the performance of learners is still unsatisfactory, especially in urban and rural poverty areas [1]. The importance of laying a solid foundation in education so as to ensure acquisition of relevant knowledge and skills, progression, and completion; is confirmed by the fact that 20% of employees in Namibia have no relevant education for the profession they are working in [2]. Whilst trying hard to achieve the Millennium Development Goal of more than 99% enrollment for primary school and a literacy rate of almost 100% among the population between the age of 15 and 25; the question posed by Fischer (n.d) [2], i.e. why has the independent Namibia not managed to overcome weaknesses of the low educational standard and the lack of skilled workers, which is of course a legacy of colonial times, remains unanswered. Figure 1 shows the gross and net primary and secondary school enrollment percentages (based on World Bank data) in Namibia [3].

Figure 1: Gross and net enrollment percentages for primary/secondary schools
The low secondary enrolment shown in Figure 1 and the number of children getting out of primary school (Figure 2) confirms poor progression at the most basic/foundation level. This creates problems with secondary school progression and also affects the completion rates. According to IDASA [4], school dropout and repetition rates are high, and they are another cause for concern in Namibia.

![Graph showing number of children out of primary school](image1)

**Figure 2:** Number of children out of primary school

Figure 3 shows that the primary school completion rate has always been lower than the progression to secondary school. The reasons for failure to complete schooling as reported by Republic of Namibia [5] are mainly pregnancy, demands from parents, distance to school, poverty and hunger. Apart from this, as a result of HIV/AIDS, approximately 121 000 orphans are enrolled in school, accounting for 21.2% of the total number of learners [5].

![Graph showing progression rate to secondary school](image2)

**Figure 3:** Primary School Completion Rate (%) and Progression Rate to Secondary School (%) from 2003 to 2010
Figure 3: Completion of primary school and progression to secondary school

In an attempt to answer the questions raised, the attention of researchers and policy makers needs to be directed to possible factors affecting the quantity (access) and quality of education, namely location and distribution of schools resources (and facilities), the main focus (competencies and skills) of primary and secondary education, funding, sustainability of improvement initiatives, and quality control.

Access to Learning Resources/Facilities

Constitution of the Republic of Namibia states in Article 20 (1) that all persons shall have the right to education. The Government Policy on Education strives to provide primary, secondary and tertiary education; and adult literacy and self-development skills [6]. It is however worth noting that Namibian schools facilities differ widely from region to region, with rural schools in general being less equipped. This may be due to the fact that there are more employment opportunities in urban areas, with schools being more likely to raise the deficit required to buy school books through the school development fund [4]. Rural learners are also faced with the lack of proximity to schools and the resultant higher transport costs.

While about 78% of schools have toilet facilities, 81% have access to water and 56% to electricity, the availability of equipment and basic goods and services, or lack thereof, affects the quality of education [4]. The fact that majority of well educated and ambitious teachers want to work in urban areas, makes the quality problem even more concerning in rural areas [2]. Speaker of the Children’s Parliament stated during the 2011 National Education Conference that: “Namibian children are confronted with various challenges in almost every sphere of our existence” (The Namibian) [7]. He also pointed out the challenges Namibian children face, ranging from unqualified teachers, lack of textbooks, school’s proximity to shebeens and low standards in the education system [4].

Funding

Namibia ranks among the top ten countries in the world in terms of the percentage of funds spent on education, but among rank 120 in terms of the average outcome of well educated students [2]. Funding for education has always been priority for the Republic as shown in Figure 4.
Even though the constitution forbids fees for primary schooling, school is not without cost in Namibia. Learners have to pay for school uniforms, school feeding, learning materials and other incidentals. The amount of these indirect school fees differ between the schools, but the poor usually struggle to even afford the cheapest ones [2].

The primary and secondary school funding issue seem to create a “crack on the wall” into which most Namibian children disappear while trying to scale up. This prevents them from completing some primary and most secondary schooling, thus adding to either the unemployment statistics or to the unskilled labor.

**Initiatives to Improve**

Initiatives to improve the education standard in Namibia have always been evident. The government of Namibia has the National Education Act, the Vocational Training Amendment Act and Higher Education Policy titled ‘Investing in People” which are responsible for the establishment of training and educational awareness campaigns and projects [6].

Several projects like the National Literacy Programme aiming to educate the previously educationally disadvantaged adults in Namibia; and the Adult Skills Development or Self-Development Programme identifying small business entrepreneurs and providing support training in basic management skills; have been implemented.
The Mathematics and Science Teachers Education Programme (MASTEP) improves the capacity of mathematics and science teachers. The Namibian College of Open Learning (NAMCOL) was established as a separate entity in terms of its own Act in 1998, with the aim of addressing the development of adult learning in Namibia [6].

One of the current/ongoing initiatives is the Education and Training Sector Improvement Programme (ETSIP), a reform program to the educational sector established in 2006 to eradicate the weaknesses of the sector until 2020. Some of the main measures, which all aim at better quality and efficiency, are taken for enforcement of early childhood development and pre-primary education; quality improvement of general school education; massive expansion of vocational education and training; quantity and quality improvement of tertiary education and training; introduction of post-school adult and lifelong learning; increasing pro-poor access to education; and for increasing general knowledge and innovation. In all of these fields, human resources management (including teacher education), standardization measures (clear definitions of competences learners should acquire), monitoring of results and usage of modern technologies are central points of ETSIP [2].

**Quality Control/Assurance**

Namibia is a member of the Southern African Consortium on Monitoring of Educational Quality (SACMEQ). The country is signatory to the Convention on the World Declaration on Education for All and the Salamanaca Framework for Action-Special Needs Education. Namibia is party to the Universal Declaration of Human Rights and the Convention on the Rights of the Child [6]. With this profile, discussions should be way beyond poor quality education in the country.

According to Basic Education Namibia Programme [1], at the end of grade 6 only 25% of the Namibian learners have acquired sufficient competencies in the learning areas of English and Mathematics. Only 40% of all learners pass grade 7 without repeating a year. On average 13 school years are needed to pass the final examinations for grade 10. Almost 40% of the teachers do not have senior secondary school leaving examinations, and 28% of those teach without formal pedagogical qualifications [1]. This suggests the need to assess exit level-to-skills/competencies matching within the system.

With just over 1500 schools in the country, of which about 100 are private, and mainly farm schools (Figure 5); coordination, monitoring and addressing
the possible hiccups in the system should not be a complicated matter.

Figure 5: Percentage of private to public primary and secondary schools

Language remains a very crucial issue in Namibian schools. On the one hand, learners often struggle to switch to English after the 4th grade and their overall performance suffer from these difficulties. On the other hand, many teachers don’t even enforce the turn to English due to their own challenges of poor language skills [2]. Irrespective of the situation, final assessments have to be taken in English and learners not accustomed to the language fail or perform below the average. Ideally, the language problems for learners should be reduced by better teaching.

The teachers’ skills and knowledge play an important role in schools and universities, not just in terms of language, but in acquisition of other critical skills and competencies like mathematics, science and technology. It has been reported that the whole system suffers from lack of qualified teachers [2].

The EMIS Division, Ministry of Basic Education and Culture, Namibia and the World Bank however, seem to point out improvement on primary school teachers’ qualifications from the 1990s (12 – 25%) to the 2000s (90 – 96.4%) [3]. The learner-teacher ratios in Figure 6 also rule out the ‘pressure of work overloads’ on the part of primary and secondary school teachers.
It seems that the problem is not with acquisition of qualifications, but the skills appropriate to the qualification level. There is also a possibility that in an attempt to improve teacher qualifications, the gaps created by the legacy of the past system (poor quality education) are not ‘closed’. While capacity building for teacher’s training is done through National Institute for Educational Development (NIED) and teachers are trained at Teachers Education Colleges; and training is offered to university students on teaching methods in order to improve the quality of education in Namibia [6]; it may be necessary to re-visit teacher training and capacity building for the whole country.

Concluding Remarks

Some of the major gaps in the Namibian education system, and that affect the quality of basic education have been identified. These include quality control, distribution of resources, language barriers, teacher capacity building and training, acquisition of skills and competencies, and sustainability of improvement initiatives. The following recommendations seem essential in an attempt to improve the quality of education in Namibia: (1) Assess the efficiency and effectiveness of the current quality control measures; (2) Review the focus of Namibian education system in order to transfer relevant skills at the right time to the Namibian child; (3) Conduct skills mapping of the school curriculum, particularly at the primary and secondary school exit points; (4) Teacher training and in-service capacity building systems need to be reviewed and aligned with the country’s skills and competencies.
gap; (5) The timing and approach for introduction of English as a medium of instruction should be revisited; (6) Implement ETSIP recommendations/suggestions for improvement to the system; (7) Address the distribution of resources from region to region (and urban-rural); and (8) Improve the Research-Policy interface by taking well informed decisions, and not just importation of models that may not necessarily work in the Namibian context.

References


Situational analysis and promotion of the cultivation and utilisation of the *Moringa oleifera* tree in selected sub-Saharan Africa countries

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**Abstract**

Malnutrition, poverty and lack of safe drinking water and sanitation are serious problems in developing countries, especially sub-Saharan Africa. The *Moringa oleifera* (MO) tree could be the solution to these problems due to its medicinal, nutritional and water purification. The aim of the study was to assess and promote the cultivation and utilisation of the MO in 5 SADC countries namely Botswana, Namibia, South Africa, Swaziland and Zambia. The study was done between September 2010 and March 2011. It was found that the tree is generally used for nutritional and medicinal purposes except in Namibia where another species is found. The prices of the products vary from country-to-country. The information about the benefits of the MO was well received although a lot still needs to be done in order to benefit from this sustainable resource.

**Keywords:** HIV/AIDS, Malnutrition, Leaf powder, Moringa ovalifolia, Moringa oleifera, Nutrition, Poverty
Introduction

Malnutrition is a major factor in the often high rates of infant mortality in the tropics and sub-tropics. In the poorest countries, as many as one child in five dies during infancy. Worldwide it is estimated that seven million people die each year from hunger-related causes, and the vast majority of these deaths are caused by chronic under nourishment. According to the SADC international conference on poverty and development held in Pailles, Mauritius, in 2008 [1], the region should not experience the ills of poverty and/or lack behind in development because it is endowed in natural resources. Approximately 45% of the total population lives on 1 US$ per day. Malnutrition ranges from 44% to 72% across the region with an average of 36.1%. Life expectancy has been declining over the years from about 60 years to slightly below 40 years as of 2008. Infant mortality rates remain for most countries in the SADC region above 50 per 100 births. The above figures reflect the gravity of the poverty situation in the region.

Poverty is complex and takes a variety of forms, it is characterised by lack of income, lack of access to means of production and livelihood systems and general deprivation and exclusion arising from socio-political and socio-cultural circumstances. Overall poverty is due to a lack of opportunities to make choices and utilize one’s potential to its maximum. Considerable investments have been made by governments and aid agencies in programs designed to prevent malnutrition, poverty and lack of safe drinking water and sanitation (World Bank [2], 2007). For instance, approaches to prevent malnutrition have included school lunch programs, nutrition education, introducing exotic vegetables, and even campaigns to periodically give children massive doses of vitamin A. A major drawback to these approaches is the dependence on imported solutions and outside personnel, and progress can quickly dissipate once the program funding dries up.

While successfully treating malnutrition is good, preventing it is much better. Malnutrition is brought on by a multitude of causes: lack of education, poverty, famine, parasites and impure drinking water are but some of them. A program which focuses on correcting micro-nutrient deficiencies alone
will not fully eradicate malnutrition until these other causes are addressed. With poverty and recurrent food shortages a fact of life in the SADC region, we therefore believe that we must explore alternative cost effective, accessible and affordable therapies that can improve health and well being and prolong lives of people infected with HIV and AIDS. To lead a healthier life, all people, whether HIV-infected or not, need to meet their daily energy, protein and micronutrient requirements by eating a variety of foods. Maintaining good nutritional status helps to build and support the immune system, allowing the body to fight infection.

Furthermore, there is an undeniable link between water quality and HIV and AIDS. HIV infection has reached epidemic proportions. The HIV and AIDS epidemic poses an inescapable challenge to the world at large and to Africa in particular. According to the Joint United Nations Programme on HIV and AIDS (UNAIDS), AIDS has killed more than 25 million people since it was first recognised on 1 December 1981, making it one of the most destructive pandemics in recorded history [3]. According to estimates from the UNAIDS 2010 AIDS Epidemic Update, around 30.8 million adults and 2.5 million children were living with HIV at the end of 2009 [4]. According the report, some 2.6 million people became infected with HIV, including an estimated 370,000 children during 2009. Most of these children are babies born to women with HIV, who acquire the virus during pregnancy, labour, or through breast milk. Drugs are available to minimise the dangers of mother-to-child HIV transmission (MTCT), but these are still often not reaching the places where they are most needed. Women are particularly affected by HIV in sub-Saharan Africa. Southern Africa accounts for around 40% of the global total of women living with HIV. While the epidemic seems to have stabilised in many parts of the region, a significant proportion of people are living with the disease. HIV strikes across lines of race, gender and social standing, however, informal settlements have been shown to have the highest incidence of HIV. AIDS may not be a water-related disease, and HIV is not spread via contaminated water or poor hygiene. Yet there is a more important link between HIV and AIDS and water than people realise. Easy access to safe and sufficient water and sanitation is indispensable for people living with HIV and AIDS (PLWHA). Diarrhoea
and skin diseases are among the most common opportunistic infections in people living with the disease. For some patients, diarrhoea can become chronic, weakening them even more. In order for HIV-infected people to remain healthy as long as possible and for people with AIDS to reduce their chances of getting diarrhoea and skin diseases, clean and adequate water supply and sanitation facilities are of the utmost importance, especially if people do not have access to antiretroviral (ARVs) treatment. Clean water is also needed to take medicines. Good-quality water is also crucial for HIV-positive mothers who cannot breast feed their babies for fear of infecting them. Unsafe water used in infants feed increases the risk of diarrhoeal diseases and infant mortality. Clean water is needed to bath patients and for washing soiled clothing and linen. Finally, water is needed to keep the house environment and toilet clean in order to reduce the risk of opportunistic infections.

Persons living with AIDS are susceptible to many types of illness from food-borne pathogens. A massive effort is needed to cushion the impact of the epidemic, and nutritional care and support should be integral elements of any action taken. An evidence-based response is required to alleviate the overall burden of malnutrition and to reduce the severity and complexity of the impact that HIV and AIDS and malnutrition have on each other. Good nutrition is important in tackling HIV and AIDS.

The *Moringa oleifera* (MO) tree, or “miracle tree” as it is sometimes called, could be the solution to the developing world problems of nutrition, water quality and poverty discussed above. The MO is a tropical plant belonging to the genus Moringaceae. It grows rapidly even in marginal soils, demands little or no horticultural attention and possess a hardness that enables it to survive prolonged periods of drought. The tree is native of northern India, but is now widely cultivated throughout the tropics and is found in many countries of Africa including some SADC countries. It is a multipurpose tree with most of its parts being useful for medicinal and commercial applications in addition to its nutritional value and water treatment (see Table 1) (Ramachandran [5], Morton [6], Markar [7], Fuglie [8,9], Rickter
[10], Fahey [11]. Table 2 shows the nutritional content of fresh and dry leaves whereas Table 3 shows a gram-for-gram comparison in some nutrients composition of fresh and dried leaves to other foodstuffs. Clearly the MO is more potent than most foods.

The MO project approach has shown, for instance in many regions e.g. in south-western Senegal, very impressive results in reducing the incidence of malnutrition. A major advantage of MO is the fact that it is a local resource. This contrasts with many of the ongoing programs designed to fight malnutrition which depend on imported products and outside donor support.

Treatment of water to render it fit for human consumption is an immense challenge in all countries. In developing countries, the quality of drinking water is often hazardous to human health. Studies have identified that a protein extract from MO seeds is an effective flocculent/coagulant to aid purification and, as mentioned above, can replace aluminum and iron salts, and synthetic polymers that are commonly used but can be hazardous to health. For example, Alzheimer’s disease and similar-health related problems have been associated with residual aluminum in treated water. The protein, apart from being non-toxic, has further great advantages because it is entirely biodegradable, it has significantly reduced volume of sludge and has no effect on the pH and conductivity of the water. Furthermore, there are useful products extracted from its seeds. The residual solids can be used as animal feed and fertiliser and the shell of the seed can be activated and used as an adsorbent. Ultimately, the coagulant protein for water treatment is obtained at extremely low or zero cost.

In this paper we report on the situational analysis and promotion of the cultivation and utilization of the MO tree as a sustainable intervention to address malnutrition, poverty, and safe drinking water and sanitation problems in five sub-Saharan Africa countries carried out from September 2010 to March 2011. The aim of the overall study was to assess how the nutritional, medicinal and water purification properties of the MO tree are used and can be used/promoted to mitigate the problems of HIV and AIDS,
and poverty in selected SADC countries. The study was to be used to further assess the status of the prevailing conditions in the target areas, capture and establish some current qualitative and quantitative data for specific indicators against which data collected in the future will be compared to so as to measure progress and impact of MO tree utilisation in solving the above-mentioned problems.

Table 1: MO plant parts and their benefits

<table>
<thead>
<tr>
<th>Tree part</th>
<th>Uses or benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves</td>
<td>Nutritional, medicinal, biomass, plant growth hormone, forage</td>
</tr>
<tr>
<td>Flowers</td>
<td>Nutritional, medicinal, honey</td>
</tr>
<tr>
<td>Pods</td>
<td>Nutritional, medicinal</td>
</tr>
<tr>
<td>Bark</td>
<td>Medicinal, rope making, gum for turning hides</td>
</tr>
<tr>
<td>Roots</td>
<td>Medicinal</td>
</tr>
<tr>
<td>Gum</td>
<td>Medicinal</td>
</tr>
<tr>
<td>Wood</td>
<td>Paper, animal feed, medicinal, alcohol production</td>
</tr>
<tr>
<td>Seeds</td>
<td>Water treatment, food, cosmetics, cooking oil, lubricant</td>
</tr>
</tbody>
</table>

Table 2: Mean nutritional values of 100 g of MO fresh leaves and leaf powder

<table>
<thead>
<tr>
<th>Tree part</th>
<th>Amount in Fresh leaves</th>
<th>Amount in Leaf powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>20-25%</td>
<td>90-95%</td>
</tr>
<tr>
<td>Proteins</td>
<td>2-3 g</td>
<td>20-26 g</td>
</tr>
<tr>
<td>Total ash (= total minerals)</td>
<td></td>
<td>8-11 g</td>
</tr>
</tbody>
</table>
### Minerals

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Fresh Leaves</th>
<th>Dried leaf powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (Ca)</td>
<td>350-550 mg</td>
<td>1600-2200 mg</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>200-500 mg</td>
<td>800-1800 mg</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>80-120 mg</td>
<td>350-500 mg</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>50-120 mg</td>
<td>200-600 mg</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>5-8 mg</td>
<td>18-28 mg</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>1.2-1.5 mg</td>
<td>5-9 mg</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.4-0.6 mg</td>
<td>1.5-3 mg</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.2-0.3 mg</td>
<td>0.7-1.1 mg</td>
</tr>
</tbody>
</table>

### Vitamins

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Fresh Leaves</th>
<th>Dried leaf powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin C</td>
<td>120-200 mg</td>
<td>15-100 mg</td>
</tr>
<tr>
<td>Vitamin A (as b-carotene)</td>
<td>1500-4000 mg eq. retinol</td>
<td>4000-8000 mg eq. retinol</td>
</tr>
<tr>
<td>Vitamin E (as a-tocopherol)</td>
<td>150-200 mg</td>
<td>80-150 mg</td>
</tr>
</tbody>
</table>

Table 3: Comparison of some nutrients composition of the fresh and dried leaves of MO with other foodstuff

<table>
<thead>
<tr>
<th>Nutrient in foodstuff</th>
<th>Fresh Leaves</th>
<th>Dried leaf powder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gram for gram, fresh leaves contain about:</td>
<td>Gram for gram, fresh leaves contain about:</td>
</tr>
<tr>
<td>Vitamin A of carrots</td>
<td>4 times</td>
<td>10 times</td>
</tr>
<tr>
<td>Vitamin C of oranges</td>
<td>7 times</td>
<td>$\frac{1}{2}$ times</td>
</tr>
<tr>
<td>Calcium of milk</td>
<td>4 times</td>
<td>17 times</td>
</tr>
<tr>
<td>Potassium of bananas</td>
<td>3 times</td>
<td>15 times</td>
</tr>
<tr>
<td>Iron of spinach</td>
<td>$\frac{3}{4}$ times</td>
<td>25 times</td>
</tr>
<tr>
<td>Protein of yogurt</td>
<td>2 times</td>
<td>9 times</td>
</tr>
</tbody>
</table>
Methodology

Study Design/Approach

The first step of the study involved a literature review of the available information about the benefits of MO and how it is or has been used in alleviating problems of malnutrition for PLWHA and children, poverty, water treatment problems and treatment of certain ailments/diseases. The situational analysis included determining the present cultivation methods, the uses of the plant in the region by indigenous folk (either as food, medicinal uses or as fodder), the distribution and cultivars of the each in each country, the non-governmental organisations and government agencies involved in promoting or which are able to promote the cultivation and utilisation of MO to mitigate malnutrition. Other uses would be to address issues of poverty, safe drinking water, sanitation, and the marketing of the MO products in the region. Questionnaires, interviews, field surveys, pamphlet and workshops on MO cultivation and utilisation were used as research and teaching tools. Questionnaires were designed in order to obtain qualitative and quantitative data.

The language barrier was identified to be a possible constraint in the communities where the study was carried out. Most of the respondents in the traditional community could not communicate in English and for this reason translators or research consultants were engaged. In some cases, the questionnaire and brochure were translated into local languages to make sure the participants understood the content on their own.

Selected Countries

The selected SADC countries were Botswana, Namibia, South Africa, Swaziland and Zambia. Only five countries were chosen due to the short timeframe available to carry out the study. It was assumed that this was a representative enough sample of SADC countries that could provide sufficient information of how the problems of malnutrition, poverty, safe drinking water and sanitation in the whole of SADC region can be mitigated by the MO tree.
Sampling
The sampling varied from country to country for a number of reasons. For instance, workshops were held only in Botswana, Swaziland and Zambia. The study areas varied considerably in terms of population such that it was not possible to have uniform sample sizes. The details of the sampling procedures done in each participating country are described in section 4.4 below.

Data collection/Teaching
Questionnaires, interviews, field surveys, pamphlet and workshops on MO cultivation and utilisation were used as data collection and teaching tools in all five countries with slight variations. For instance, in South Africa and Namibia workshops were not done as much as in other countries. In these two countries the emphasis was to be on situational analysis of the cultivation and utilisation of Moringa. South Africa is quite vast such that identification and organisation of workshops would have been highly complicated due to the way rural communities are organised; whereas the 3 countries where workshops were held have similar community settings thereby making comparisons possible. In South Africa, a workshop and questionnaire survey were conducted at the community of Atteridgeville informal settlement situated west of Pretoria. Two visits were made also to a Moringa farmer in Tooseng village in Limpopo province who is a major supplier of Moringa products (i.e. seeds, seedlings, leaf powder and oil). The first visit was to gather information about the cultivation method used, products sold and names of other MO farmers known countrywide. The second trip was with community leaders from the Atteridgeville informal settlement for them to learn the cultivation and processing of MO products. Namibia has another type of species of the Moringa family called *Moringa ovalifolia* and the study areas visited has only this type of species. This type is unique to this country and not much is known about its cultivation. The tree is readily available in the north-west of Namibia. A forest of Moringa known as Sprokiewoud, or the Phantom Wood, near Okaukuejo in the Etosha Game Reserve, is the tree’s best-known setting in Namibia. It is on this basis that the study
in Namibia was slightly different from the other 4 countries which have the MO. So, in addition to the above, the study in Namibia which was mainly a survey on the biodiversity of the *Moringa ovalifolia* in the country focused on the determination of the cultivation methods, if any, and on the assessment the possibilities of domestication and gather information on indigenous knowledge (planting, use, marketing, selling) about the *Moringa ovalifolia*. The study is important in that comparisons with the MO can be done in future studies in terms of the potential of the two species in nutritional benefits and water purification properties.

Questionnaires were designed in order to obtain qualitative and quantitative data. Some of the questions were used to obtain information on what participants know about MO and what strategies are used by communities to tackle health and nutritional challenges. From the questionnaires, an analysis of Moringa cultivation and distribution was done. The brochure on Moringa
gave information about some of the nutritional benefits, the cultivation from seeds, the water treatment and the processing of leaves for leaf powder for consumption. The workshops were used to explain the content of the brochure and distribute seeds and seedlings. The seeds for distribution were purchased from individuals with Moringa trees in Botswana, South Africa and Zambia. The seedlings for distribution were either cultivated from seeds purchased or purchased from local growers. In Botswana, the workshops were mostly held at both high schools and communities whereas in Swaziland and Zambia workshops were held in communities in rural areas. In Botswana and Swaziland the brochure was translated into a local language. Questionnaires were either collected after the workshop or participants were allowed to take them home to complete and were then collected by the project research assistants. The areas_regions_schools where the workshops were held are given in Table 4. Figure 1 shows the maps of Botswana and Swaziland indicating the locations of the study areas.

Table 4: Workshop centres and areas of study in different countries (SSS: Senior Secondary School; CJSS: Community-aided Junior Secondary School)

<table>
<thead>
<tr>
<th>Botswana</th>
<th>Namibia</th>
<th>South Africa</th>
<th>Swaziland</th>
<th>Zambia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghanzi SSS, Shakawe CJSS, Gaborone SSS,</td>
<td>Tsiseb Conservancy, Doro</td>
<td>Atteridgeville</td>
<td>Hhohho, Lubombo, Manzini</td>
<td>Mbabala (20 km from Choma town),</td>
</tr>
<tr>
<td>St Joseph’s College (Gaborone),</td>
<td>!Nawas Conservancy,</td>
<td></td>
<td>and Shiselweni</td>
<td>Sipatunyana (40 km from Kalomo</td>
</tr>
<tr>
<td>Motswakhumo CJSS(Lentsweleta), Lentsweletaun Kgotla, Ipelegeng CJSS, Kopong Kgotla, Motswana CJSS(Molepolole), Mogoditshane CJSS(Gaborone), Motswedi CJSS(Gaborone)</td>
<td>Kamanjab, Okaukuejo (Etosha National Park), Halali (Etosha N. Park)</td>
<td></td>
<td>town)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Maps of Botswana (9 schools and 2 local communities) and
Swaziland (22 local communities) showing the locations of the study areas.

**Ethical Considerations**

Contact was made through, and permission was granted via local and tribal authorities. In Botswana, for instance, the contact persons in schools were the headmasters or deputy headmasters and in villages it was the chiefs. A letter of introduction was written and signed by the supervisor of this study for the research assistants distributing questionnaires. Included in the letter was an explanation of the kind of research that was being conducted and why it was necessary to conduct this research. A similar caption was included in the questionnaire. Furthermore participants were assured of the confidentiality of their taking part in the study. The participants in the questionnaire were assured that the interview was voluntary and the information provided would strictly be confidential and anonymity would be respected by the study team. All participants therefore participated willingly.

**Results and Discussion**

**Knowledge and knowledge gaps about Moringa**

The results obtained about the knowledge of Moringa in the SADC region reveal
that the plant is generally known although the percentages are quite low. However, because of no coordinated efforts taking place to increase knowledge gaps in each country studied, the study found that the actual usage is quite low. In Swaziland, for instance, from a total of 565 interviewees in 22 communities from the four regions, 95 (16%) have seen a Moringa tree and out of these only 50 people (10.4%) use it as a food, fodder or for water treatment. Another group of 36 people (6.4%) have heard about it but do not use it. The use in water purification, however, is not very well known as only 2 respondents out of 565 use it to clean their drinking water. Moringa farmers were also interviewed about the different cultivation methods employed in Swaziland. Moringa is mainly cultivated from seeds which are imported from India and Mozambique. Very few plants are grown from branch cuttings. Two cultivars of tree/plant were identified viz: MO (which is the common cultivar) and M. stenopetala (identified from two farmers).

The part of the study conducted in Botswana found that out of the 349 questionnaires distributed in 12 communities and schools, 62% (218) of the respondents indicated knowledge of Moringa (Figure 2). From the responses, people are generally aware of the tree through a television program that was shown just before the study period, hearing from neighbours and from government Forestry departments.
People are also aware of the nutritional and medicinal benefits of the tree although there are serious misconceptions as to what it can do. Most of the claims such as cure for HIV and AIDS are misleading because they have not been scientifically proven. However, no respondents use the tree for water treatment although only one respondent had heard of its water treatment properties.

Figure 2: The percentage of respondents out of 310 in Botswana indicating where they had seen or heard about MO tree (A = Saw it in the wild; B = Grown within our community; C = Saw it at a community training; D = Have it at home in our yard or farm; E = Never heard or seen it before; F = Other).

The results of the interviewees at the three settlements in Namibia revealed that all participants had seen *M. ovalifolia* tree before in the wild. None of the respondents reported growing the tree. With regards to water treatment, all three communities make use of tap water for drinking, and therefore do not treat water on their own. The roots of the tree are used to relieve chest pain. They dig out the roots, crush them, boil them and drink the water. The pulp of the tree is used to treat women after giving birth. 90% of respondents from Okaukuejo reported that the tree was useful during rainy season, whereby people drink the water trapped at the junction of the tree trunk. Although all respondents at Halali indicated to have seen the tree, none of them knew or had heard of the uses of the tree.
Although the sample size in the Zambian study was small, most participants (79%) knew about the Moringa plant while 75% had seen the plant within their communities, and 75% had heard about its uses. All participants from Sipatunyana had a vernacular name for it as Zakalanda. Only one participant had a tree at home and it was grown from a branch cutting. Participants also indicated that their previous experience of growing Moringa was by Care International, World Vision and DAPP from which they had only received verbal instructions on the plant.

No detailed study through questionnaires was conducted in South Africa. Only one study was done to a total of 30 people in Atteridgeville community, west of Pretoria. Prior to this study, none of the interviewees from this group had heard, used or seen the Moringa tree. Most of the knowledge dissemination about Moringa in the country, especially in Limpopo Province, had been through the Lammangata Moringa project. Lammangata Moringa was officially launched in March 2009 in the rural area of GaMphahlele, Limpopo, with the aim of harnessing the nutritional and healing power of the Moringa tree to stem malnutrition and alleviate food insecurity in economically disadvantaged communities in South Africa. Thus far, over 500 families and child-care projects have received their own Moringa seedling. Despite these efforts, knowledge on Moringa is still low/scanty as seen from the study carried with Atteridgeville community. More information on dissemination is needed especially using community radio stations and workshops as these directly reach those less advantaged. The obtained results cannot represent a national picture as more detailed survey is needed. However, the findings/results could correctly reflect in other parts of the country where most of the communities are uneducated and have no access to media such as TV and newspapers.

**Moringa distribution**

The study carried out revealed that Moringa is being grown in various parts of these countries. In South Africa, it is only recently that Moringa growing started whereas in other countries it has been going on for much longer. Hence, in Botswana, Swaziland and Zambia much bigger MO plants are found countrywide. Namibia has been endowed with another species called
*M. ovalifolia* which has existed for decades in selected areas. The distribution of Moringa in each individual country differs with Swaziland perhaps having the highest distribution numbers per square km.

The Swaziland study found that from the twenty two areas surveyed, Moringa plantations were found in 13 areas (59%). Out of these, areas of success in cultivation for seed production are located in the dry Lowveld (eastern part of the country) and the midlevel. The Highveld (the western part of Swaziland) is characterised by wet summer conditions and very cold winters) is not suitable for Moringa growth, only one plantation was identified in this region. These trees are also planted in shaded houses due to the cold and very wet conditions.

A study of the distribution of Moringa tree among small scale farmers in South Africa identified 18 farmers with more than 100 plants. Limpopo province is leading the way with 58% farmers followed by Gauteng at 21% (Figure 8). Other provinces such as Northern Cape, Western Cape and Eastern Cape are not listed as no data was available. The results in Figure 3 are not surprising because Moringa cultivation in the country is relatively new. MO has been identified as the only variety being grown. The major player in the cultivation and distribution is the Lammangata Moringa project which has sold over 3700 seedlings countrywide. This explains why Limpopo has the highest distribution. The spreading of Moringa cultivation to other provinces has happened within the past one year. It will be therefore interesting to see how Moringa trees will perform in the long run because of variations mostly in weather. However, the current distribution is encouraging and hopefully Moringa will be found in every corner of the country.
Figure 3: The distribution of Moringa in South Africa.

In Botswana the Moringa seems to be found sparsely all over the country. It is interesting that not all the people interviewed who have the tree(s) at their homes know about its nutritional and medicinal benefits. There is quite a sizeable number of farmers and individuals who know about its benefits. Another interesting observation, especially in Gaborone is that most the homes where the tree was found are either occupied by residents of Indian origin or that home had previously been occupied by residents of Indian origin. This is because they are aware of and knowledgeable of the tree’s benefits from their country of origin where the Moringa is known to have originated. The government Forestry departments across the country have been distributing and selling the MO and other (mainly fruit) plants

(e.g. Pommer granate, Paw Paw, Palm tree, Hen & Chicken, Kurra jong, Mango, Thuja, Duranta, Peach, Ficus Benjamin, Guava, Fig, Honey suckle, Jacaranda, Purple heart, Hibiscus, Bauhania, Bouganvelllia, Apple, Naarjies, etc.). At the moment, there is no NGO which is solely involved
in promoting the utilisation of the Moringa products as the case in other countries such as South Africa, Zambia and Swaziland. The exception is the National Agency for the Control of AIDS (NACA) which in 2011 also started to distribute medicinal and nutritional plants including MO to communities in Botswana.

The Botswana College of Agriculture (BCA) was in the past to conduct research into the growing of Moringa plant species from different countries but this project stalled when the expatriate lead researcher left the country 4 years ago. One farmer in Mahalapye who is a medical doctor has a plantation of over 200 trees and has been selling leaf powder and seed oil until a year or so ago when his interest shifted to growing the Jatropha tree. All these institutions have in one way or another contributed to the distribution of Moringa trees countrywide.

*M. ovalifolia* (also known as Phantom or Ghost tree), which is the main Moringa species in Namibia, is restricted in its distribution in the wild in the north-western half of the country where it mainly grows on rocky hills (see Figure 4). This tree is widely spread in Namibia e.g.

- singly scattered on dry rocky slopes along the edge of the Namib from southern Angola to the vicinity of the Helmeringhausen and reaching as far east as Grootfontein.
- a few young Moringa trees very near to and east of the B1 just south of Tsumeb.
- along the extension of B1 where it leads into Tsumeb (where they have been successfully planted).
- on the two dolomite hills near Halali in Etosha.
- well-known “Sprokieswoud” or ‘enchanted forest to the west of Okaukuejo.
- growing naturally on two hills on the Moringa Safari Farm about 60 km from Okahandja to Karibib on a D2156 route. The farm claims to have about 630 Moringa trees.
The tree is reported to grow easily from a seed, and can be transplanted easily. The data about the distribution of this species was obtained through the senior curator (a taxonomist) of the National Herbarium and by contacting relevant officials and researchers working in different regions. The areas where specimens of *M. ovalifolia* were collected have been identified. As mentioned earlier, the distribution of Moringa trees along the western half of the country means that most of these areas are in the desert where there are no people living there. The sites presented in Table 4 above were selected based on availability of nearby local communities, records of collections from these areas (National Herbarium), and information obtained from key people contacted.

The MO is found and/or grown in many parts of Zambia. Commercial farmers are growing the tree on the Copperbelt, and in/around Mkushi and Lusaka. In nearly all provinces, the villagers are encouraged by NGOs (DAPP and HOPE) to have these trees in their backyards. Christian organizations that care for the sick also grow it. The distribution in Zambia, hence, is as follows: Central Province in the Kapiri Mposhi area; Copperbelt – introduced by an organization called National Institute for Scientific and Industrial Research (NISIR); Luapula Province – introduced by Sisters of Mercy in 1998; Lusaka – Grown by NISIR and local farmers; North Western Province in the Kabompo area; and Eastern province in the Chipata.
Figure 4: A. *Moringa avolifolia* trees (A) on one of the two dolomite hills near Halali in Etosha Game Reserve. B. *Moringa avolifolia* pods from a forest of *Moringa* known as Sprokiewoud, or the Phantom Wood, near Okaukuejo in the Etosha Game Reserve.

**Medicinal uses and combating of symptoms of HIV and AIDS**

Moringa leaves are predominantly used as food in many SADC countries. The use as cure for HIV and AIDS is also a common misconception found in countries such as South Africa, Botswana and Swaziland. Some people within the region are promoting it as a cure for HIV and AIDS.

In Swaziland, of the 565 people who participated in the survey, only 10.4% use Moringa for purposes other than as food and medicine. It is being used to treat different ailments such as ulcers, headaches, influenza and general body malaise. HIV patients also use it to improve their health conditions. One HIV positive woman interviewed who is currently using the Moringa claimed that her health condition has greatly improved since she started using the leaf powder in her diet. At some point she was bed-ridden but
when she started using it she felt better and was able to move around. Some members of the community attested to this. The only disappointing factor in the testimony was her withdrawal from using antiretroviral drugs as soon as she started using the leaf powder. This demands an urgent need for more training and information to communities on the role of Moringa in health.

Besides being used as a food supplement in Botswana, there are claims of how the tree cures a number of ailments. The medicinal uses mentioned by the respondents include curing a number of ailments such as ankle and knee diseases, pain killer, high blood pressure, flu, diabetes, asthma, arthritis, skin diseases and wounds, HIV and AIDS, stomach cramps, cancer, weakened immune system, leg wounds, cleanse the body and reduce fatigue or tiredness, etc. Some respondents also mentioned that the leaf powder improves appetite and digestion, cleanses the body and reduce fatigue or tiredness. Oil can also be extracted from the seeds.

From the responses above, it can be said that people are generally aware of the benefits of the tree although there are serious misconceptions as to what it can do as medicine. Most of the claims such as cure of HIV and AIDS are misleading because they have not been scientifically proven. This is the issue that needs further investigation because people on ARVs may stop taking them. There is a big knowledge gap that needs to be addressed by future research with regard to the benefits of the MO tree.

In Namibia, the medicinal uses of *M. ovalifolia* mentioned during the survey included using roots for chest pain relief and pulp to treat women after giving birth.

Zambian study found that Moringa is mainly used for nutrition purposes as a vegetable and food supplement particularly leaf powder. The centres that care for the sick also use it for nutritional purposes. There were no cases reported of its use as medicine, water treatment and cosmetics.

In South Africa, Moringa is used as a food supplement. During an interview
with the owner of Lammangata Moringa she gave an account of how Moringa usage in village has completely eliminated malnutrition. Each village home has a Moringa tree donated by the Lammangata Moringa project. The owner also gave a testimony of people infected with HIV and AIDS taking Moringa leaf powder supplements who were eventually able to lead a normal life after being bed ridden. The fresh leaves are cooked like any other vegetable and eaten by the community. Dry leaves are added as supplements in various dishes just like spices are added and also added in tea as supplements. Figure 5 shows Moringa dried leaf powder used as nutrient supplement sold in South Africa. However, a survey carried among the Atteridgeville informal community settlement in Pretoria West found out that no one was using Moringa as medicine or for combating the symptoms of HIV and AIDS.

Figure 5: Moringa dried leaf powder used as nutrient supplement sold in South Africa.

**Moringa promotional strategies**

Demonstration workshops were held in Zambia, Botswana, and Swaziland and partly in South Africa. Workshops involved a brief presentation on:
• the uses with emphasis on its nutritional benefits and water treatment
• cultivation of the MO from seeds
• processing of leaves for leaf powder

The presentation was based on the MO brochure and pamphlets were distributed at each study/workshop centre. The presentation was followed by distribution of seedlings and seeds. The workshops were well received as the participants were happy to learn about the benefits of Moringa and how it can be grown. Seeds were given to the participants to go and plant. Most of these have germinated and many new people in the region now own Moringa. In South Africa, seedlings were grown as no supplier of seeds was found. In Botswana, Swaziland and Zambia seedlings were also given out to participants when available.

In Swaziland, a demonstration workshop was held in the Mamisa area. This area is part of the dry lowveld region where the tree grows very well. Even though it grows in this area, only one of the 55 workshop participants had a tree at home. This is because most of the residents of this area did not know about Moringa. From the people interviewed in the area, 95% had not seen a tree nor heard about it at all. The seeds and seedlings were distributed to workshop participants and community leaders.

In Botswana, it was discovered that the television broadcast prior to this investigation played a major role in making a lot of people interviewed aware of Moringa and its benefits. Demonstration workshops were held in Ghanzi, Shakawe, Maun, Lentsweletau and Kopong. Figures 7 below shows some Shakawe CJSS staff and Kopong villagers lining up to receive seedlings, seeds and brochures of MO. Furthermore, the brochure was distributed to students in Ghanzi, Shakawe, Maun and a number of schools in and around Gaborone.

In South Africa, workshops were held at the Atteridgeville informal settlements. The first one was held near the site where Moringa plants have now been planted. The second meeting was held at the Municipality offices
in Atteridgeville. This is also where questionnaires were distributed. More than 30 people attended, mostly elderly women. The benefits of the tree were explained and the brochure was handed out. The community was excited to hear about the Moringa and what it can do to alleviate poverty. Figure 9 shows the site where the tree has been grown. This is on land of , about 10 hectares, that belongs to Tshwane Municipality but has been given to the community for the Moringa project. So far more than 100 plants have been planted on the site. The first harvest of the Moringa leaves has been performed already because the trees seem to grow very fast. About 380 grams of Moringa dry leaf powder was obtained which was distributed to the most needy members of the Atteridgeville informal settlement community. These were identified by community leaders who were research assistants on the project.

In Zambia, workshops were held in order to promote Moringa cultivation and utilisation in 2 selected communities. An inventory was prepared for the participants and how many seedlings had germinated. The cultivation promotion carried out introduced 34 participants in Mbabala with a sum total of 746 plants and 22 growers in Sipatunyana with about 306 plants. As control experiment so as to get first hand experiences the growers may face in cultivating the tree, the lead researcher planted 100 trees on piece of land in Kalomo.

The Namibia study was not mandated to hold workshops but it was discovered that Moringa needs to be promoted aggressively in Namibia for the following reasons:

- There is no MO cultivar documented with the National Herbarium of the National Botanical Research Institute (NBRI) and many people are unaware of the two species.
- The distribution of *M. ovalifolia* in Namibia along the western half of the country means that most of these areas are in the desert where there are no communities of people living there.

One of the most encouraging promotional strategies of the study was the idea of forming national Moringa Associations and a Southern African
Moringa Association. This was the resolution of the workshop held in South Africa involving the study team members and South African stakeholders (government and private). The associations were to coordinate Moringa activities in each country in SADC and also at SADC level. These national associations will lobby government on policies related to Moringa use and growing. The SADC association can further encourage unified messages and standards on Moringa products. However, participants felt that more research was needed on the requirements, especially the legal ones before an association can be formed. It was also agreed that a SADC Moringa association should be formed first while individual country representatives should go and investigate the possibilities of forming national associations. The SADC association when formed should represent countries within SADC that were represented at the workshop and these are South Africa, Botswana, Swaziland, Namibia and Zambia. Other countries in SADC should be encouraged to join later on. The national associations could have provincial associations which should be under national associations and these in turn will be under the SADC association. It was agreed that members of the JEAPP project from various countries should be part of the interim structure to investigate the possible formation of the SADC association. An interim committee was set up with at least 2 representatives from the 5 represented SADC countries. The terms of reference for the interim structure chosen are:

- Review structure of the SADC Moringa association and corresponding national associations.

- Review other associations at SADC and national levels so as to understand how Moringa association can be formed.

- Come up with a draft constitution for SADC Moringa association.

- Review and collect legal requirements for such an association in each country and at SADC level.

- Recommend functional structure of both SADC and national associations.
• Collect data base of Moringa growers on each country and in SADC region.

• Convene a meeting for the formation of SADC and/or national associations on Moringa.

• Seek funding for a meeting for the formation of SADC and/or national Moringa associations.

The meeting further resolved that the interim committee should convene a meeting in May 2011 in South Africa for the formation of SADC and/or national Moringa associations. The association’s main function would be to promote the processing and marketing of Moringa products so that they meet the following criteria:

• Good quality and attractive to consumers.

• Processed well and procedure should be emphasized.

• Contain scientific data such as nutrient composition.

• Contain directions for usage.

• Approved by a national or international standard depending on the customer.

• Should be bar-coded for traceability.

• Reasonable pricing structure

The other important aspect discussed that could enhance marketing is branding. Branding labels such as “proudly SADC label”, grown and processed in the SADC, fair trade or organic labelling, global GAP accreditations, etc., could be used as promotional marketing strategies to assist the growers. The following items were agreed that a product should have name, contact details of seller, processing procedure, nutritional content, weight/composition, car code, date packaged and expiry date.
As an additional strategy the Moringa market needs to be studied and promoted. Events such as Moringa day should be encouraged where product range can be displayed and/or the communities can taste and try the different products. Food competition, creativity, value-addition or research into other Moringa products should be promoted. Brochures on Moringa should also be given out to the public. Advertisements through various media channels should be encouraged including community radio stations.

**Promotion of Moringa by NGOs and Government Agencies**

Non-government organisations (NGOs) and some government agencies have played and continue to play important roles in the region in promoting the cultivation and utilisation of Moringa. The actual number and role differ from country to country in the region. Swaziland and Zambia seems to be leading with many NGOs involved.

Botswana is the only country where there is no known NGO actively involved in the promotion of the tree. This scenario may soon change with the recent involvement of the government agency called NACA and TV broadcast. The government Forestry departments have also played a key role in Botswana in the supply of seeds and trees to individuals throughout the country. However, it was observed that no information was provided as to the tree’s benefits and cultivation. Key players in Botswana are therefore government Forestry departments spread across the countries and local farmers.

In Swaziland non-governmental organisations were identified to facilitate the dissemination of information among community members and to train individuals on Moringa cultivation. Some community social workers are already involved in informal one-on-one information dissemination and teaching about the Moringa. These workers are eager to be part of the team that will provide training to their respective communities. Some NGOs are also fully involved in cultivation and utilisation of MO among some community members. The NGOs, government ministries, associations and farmers which are key partners in Swaziland in facilitating the dissemination of information
among community members are New Life Homes (KaMfishane), Vusumnotfo (Ngonini), Impala Development Services, Pasture Valley (Nhlangano), Maphiveni Carepoint (Maphiveni), Herefords Carepoint (Herefords), Christian Family Church International (Tabankulu), Guba (Malkerns), Somtongo Carepoint (Lavumisa), Sizanani Bomake Farmers Association (Lavumisa), Mamisa Community Committee (Mamisa), University of Swaziland, Swazi Secrets and governmental ministries (i.e. Ministry of Health & Ministry of Agriculture).

In South Africa, not many key partners have been identified and their role has mostly been to provide funding and involvement on the ground helping grow the plants with communities. The study reviewed that no NGOs were identified to facilitate the dissemination of information among community members and to train individuals on cultivation. However, a number have provided funding especially to Lammangata Moringa project for the above to be realised. Some of these that have been involved in funding are Star Fish Great Heart Foundation and Southern African Trust.

A number of NGOs were identified in the Zambian component of the study just like in Swaziland. These play similar roles as mentioned in the Swaziland study above. Some of these NGOs involved in the promotion of the MO tree are Mututa Memorial Day Care centre, World Vision, Care and Hope, Sipatunyana Rural Centre, Mbabala, Mututa Day Care Center and Christian organizations and Zambia Development Agency (ZDA).

The Namibian component of the study also identified organisations as key players in the promotion of Moringa. These include National Herbarium of Namibia, NBRI, Ministry of Agriculture, Water and Forestry, Etosha Ecological Research Institute, Etosha National Park, Ornamental Nurseries Development Project in North West Conservancies, Welwitschia Development Trust, Conservancies, i.e. Doro!nawas, Huab, and Sorri Sorris.
Assessment of Moringa Marketing

The study found that the leaf powder, seeds, seeds powder, seedlings and oil are being sold in countries of study except Namibia. The main product on the market as a food supplement and for medicinal purposes is the leaf powder. Generally, the prices varied from country-to-country as shown in Table 8 and even area-to-area in the same country.

The market assessment in Swaziland found only two retail shops located in Manzini and Mbabane that sell Moringa powder to the general public. The rest of the powder sellers identified are the farmers. The marketing strategy in this country could in future be designed such that the products are first accepted by the high income earning group of the Swazi market so as to establish a sense of acceptability to the low earning groups. It is believed that once the product is accepted by elites of the country, the product will be better positioned and easy to market to the rest of the country. The different prices in local markets are listed in Table 8.

Table 8: Local market Moringa prices

<table>
<thead>
<tr>
<th>Country</th>
<th>Price of leaf powder</th>
<th>Price per seedlings/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana (Pula)</td>
<td>40 – 60 for 100 g</td>
<td>10 -75</td>
</tr>
<tr>
<td>South Africa (ZAR)</td>
<td>40 – 120 for 40 g</td>
<td>40 – 60</td>
</tr>
<tr>
<td>Swaziland (ZAR)</td>
<td>20 – 70 for 50 g</td>
<td>10 – 20</td>
</tr>
<tr>
<td>Zambia (ZAR)</td>
<td>40 – 60 for 100 g</td>
<td>20 - 50</td>
</tr>
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</table>

In South Africa, most of the Moringa growers have just recently planted the seeds and seedlings. Not many suppliers of Moringa related products are available in the country. Lammangata Moringa project is the main supplier and sells seeds, seedlings, dry leaf powder and a dry leaves. There are people who buy in bulk to resell in other areas at a profit. The price for 40 g of leaf powder varies from ZAR 40 to ZAR 120 depending on the region. The marketing component of the study in Botswana found that MO products are
sold by individuals especially in markets, work places and shopping malls. The seed powder was found to be sold for P40 - P50 in markets for medicinal purposes. The sellers were unwilling to disclose what ailments the powder was used to treat. Prices for trees for planting also vary from as low as P10 to as high as P75 each. In most cases, the size of the tree matters although for some sellers this factor does not matter at all. The price of seeds also varies from about P300 – P450 per kg. In Zambia MO leaf powder and seeds are sold on the streets of Lusaka on nearly every stand that sells traditional medicine. NGOs as well as individuals also sell both products. The prices are variable and generally about ZAR 20 for a seedling from a government agriculture centre and ZAR 40 for 100 g of leaf powder.

The prices were, generally, found to be too high for the people who need the products the most and that is, the poor. The need to grow more Moringa trees in the region is thus imperative so that there can be an abundance of the products and this will ultimately bring down the prices. In countries like South Africa, there is one major supplier and demand cannot be met. The other problem is that in most cases, the products are not properly labelled as per market requirements. This raises health concerns as some unscrupulous people may take advantage of this knowledge and sell wrong or sub-standard products or products that are not really of Moringa origin. Many of the mentioned problems can be minimised with the formation of national Moringa associations and even SADC association to be mandated in setting product standards, processing protocols, marketing and also provide other vital information about the tree’s benefits.

Conclusion

The project aimed at conducting a survey on the cultivation and the use of MO in selected SADC countries, its distribution, identifying NGOs and government agencies involved in the promotion of Moringa as well as assessing the marketing of products. The above objectives were met with minimal constraints. Interviews were conducted in selected areas in the study countries to gather information on the cultivation and use of Moringa in
these countries. NGOs and government agencies were contacted about their possible roles (if any) in Moringa promotion. Some of the NGOs are already involved in the promotion and supply of seedlings. The government agencies contacted have not yet begun promotions except the forestry department in Botswana which is involved in the distribution and selling of seedlings to communities and individuals. Moringa farmers were also identified in different regions in the country and an analysis of marketing in the selected SADC countries was done. The different suppliers of Moringa were identified and the respective prices in local markets. The study also identified serious knowledge gaps about the medicinal and nutritional benefits and the water treatment properties of MO. There is also need to correct, through education, the misconceptions about the tree’s medicinal benefits especially the fact that some people feel that MO can cure HIV/AIDS. These issues need to be addressed for the benefit of the communities to mitigate the effects of poverty, malnutrition and HIV and AIDS.

Moringa cultivation and utilisation in the region has great potential. This is evident from the general acceptance of this plant by people both in rural and urban areas. Most of the people interviewed are eager to plant the tree for personal and commercial purposes. The wide distribution of Moringa in different rural areas is also a positive aspect towards its cultivation to full potential. Promotion of Moringa in rural communities can be augmented by NGOs and social workers who have shown willingness to teach masses about its benefits. However, more training of communities is needed to realise the full potential of the tree especially cultivation from both seeds and branch cuttings, processing of the products such as leaf powder, packaging and marketing. In all the communities surveyed, nearly all trees were grown from seeds only. Since there is no evidence of its usage in cosmetics and very little knowledge about its use for water purification, there is an opportunity in teaching communities about these aspects for income generation and sanitation, respectively. The cultivation of Moringa can also provide job opportunities to local entrepreneurs because of the vast uses which include, among others, water purification, cosmetics, food supplement, medicine and fodder.
Although *Moringa* is a plant that has received attention in many countries, due to the high nutritional value of its leaves, it is still underutilised. It is, therefore, recommended that acceptability studies in communities be initiated and that *Moringa* could be considered as a source of supplementation in households’ diets where the need requires micronutrient supplementation. Intervention programmes have to be designed and investigated and health workers in rural clinics and disadvantaged communities could be educated on the attributes of *Moringa* so that could in turn educate the mothers of malnourished children. This is an inexpensive and natural method of alleviating malnutrition. Apart from being used as food, *Moringa* has other uses like its medicinal applications, water purification, seed oil and use of the green leaves as green manure which could be beneficial to disadvantages communities.

**Acknowledgement**

The research team is very grateful for funding from the Australian Government’s Aid Program through the Joint Economics AIDS and Poverty Programme (JEAPP).
References


A non-monotonic convergence analysis of population clusters of random numbers

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Abstract

The standard deviation of a population (of size $N$) is a measure of the spread of the population observations about the mean. A population may be clustered and the standard deviation of each cluster calculated. This paper looked at how the mean of the standard deviations of the clusters of a population of random numbers relate to the standard deviation of the population as the size of the clusters increased. We assumed that all clusters have the same size. As the size $n$ of each cluster increased, the number of clusters $N/n$ decreased, making the population a single cluster when $n = N$. The sequence $\{s_n\}$ of the means of the standard deviations of the clusters converged to the standard deviation $s_N$ of the population. However, this convergence was not monotonic.

Keywords: standard deviation of a population, population clusters, sequence of means of standard deviations, short-cut estimates, proximity, cluster size, estimation of standard deviation, randomly generated numbers, non-monotonic convergence, convergence simulation.

Introduction and literature review

Discussions have been on-going about the determination and usage of the standard deviation of a population. Many authors have expressed themselves on the relationship between the standard deviation of a single sample of a population and the standard deviation of the population as the sample size increased. This paper aimed at determining how the size of each cluster affected the proximity between the mean of the standard deviations of the clusters of a population of 5040 randomly generated numbers and the standard deviation of the population.

Short-cut estimates of the standard deviation of a population have their advantages and shortcomings. Sabers and Klausmeier [1] investigated the
accuracy of some short-cut estimates of standard deviation. They found that the loss in accuracy due to short-cut methods versus the conventional method ranged from 0% to 7.8%.

On the other hand, Hargreaves and Samani [2] had the following to say: A weather simulation procedure utilizing a monthly climatic data base can be substituted for the daily climatic data to produce very comparable results. The weather simulation procedure requires the standard deviation of potential evapotranspiration (ETP). A series of monthly mean values of maximum and minimum temperatures provides the required data for estimating mean ETP and the standard deviation. If only long term mean maximum and minimum temperatures and the mean temperature of a series of years are available, the standard deviation of the mean temperature provides a means for making an estimate of the standard deviation in ETP.

The size of the sample plays a part in the proximity of the standard deviation of a sample to the standard deviation of the population.

Altman and Bland (date unknown), in their response to Nagele [3], wrote that the standard error (SE) of the sample mean depends on both the standard deviation (SD) and the sample size, by the simple relation

\[
SE = \frac{SD}{\sqrt{\text{sample size}}} \quad (1)
\]

They further stated that the standard error fell as the sample size increased, as the extent of chance variation was reduced. This idea underlined the sample size calculation for a controlled trial, for example. By contrast the standard deviation would not tend to change as they increased the size of their sample.

Also on the question of sample size, Ziliaka and McCloskey [4] wrote the following: We find here that in the next decade, the 1990s, of the 137 papers using a test of statistical significance in the AER fully 82% mistook a merely statistically significant finding for an economically significant finding. A super majority (81%) believed that looking at the sign of a coefficient sufficed for science, ignoring size.

In a response to a question on the relationship between standard deviation and sample size, Professor Mean had this to say: The estimate of the
standard deviation becomes more stable as the sample size increases. But after about 30 – 50 observations, the instability of the standard deviation becomes negligible.[5]

According to Cochran [6], there are four ways of estimating variances for sample size determinations:

(1) by taking the sample in two steps
(2) by the results of a pilot survey
(3) by previous sampling of the same or a similar population, and
(4) by guesswork about the structure of the population, assisted by some mathematical results.

Here again, there is that link between standard deviation and the sample size. However, (4) indicates that the structure of the population plays a role if guesswork is applied.

**Methodology and analysis**

We generated 5040 random numbers using Excel and calculated the standard deviations $s_n$, where $n$ is the cluster size and $n_i$ denotes the cluster number for $i = 1, 2, ..., \frac{5040}{n}$. The mean of the standard deviations of the clusters was calculated using

$$\overline{s_n} = \frac{1}{\frac{5040}{n}} \sum_{i=1}^{\frac{5040}{n}} s_{n_i}$$

For instance, when the cluster size is 504, then

$$\overline{s_{504}} = \frac{1}{10} (s_{n_1} + s_{n_2} + \ldots + s_{n_{10}})$$

This procedure was repeated for different sets of 5040 randomly generated numbers. Table 1 shows the non-monotonic convergence of the means of standard deviations of the clusters to the standard deviation of the population for one of the sets. For this set, the standard deviation was 28.6164:
Table 1: Non-Monotonic Convergence Simulation

| Serial number | Cluster size $n$ | Mean SD of Clusters $\overline{s}_n$ | Difference $|\overline{s}_n - s_N|$ |
|---------------|-----------------|-------------------------------------|---------------------------------|
| 1             | 10              | 26.73438                            | 1.88202                         |
| 2             | 15              | 27.29214                            | 1.32426                         |
| 3             | 20              | 27.64601                            | 0.97039                         |
| 4             | 30              | 27.95824                            | 0.65816                         |
| 5             | 35              | 28.05827                            | 0.55813                         |
| 6             | 40              | 28.11891                            | 0.48749                         |
| 7             | 45              | 28.15516                            | 0.46124                         |
| 8             | 60              | 28.28728                            | 0.32912                         |
| 9             | 70              | 28.31353                            | 0.30287                         |
| 10            | 80              | 28.3693                             | 0.2471                          |
| 11            | 90              | 28.3641                             | 0.2523                          |
| 12            | 105             | 28.45474                            | 0.16166                         |
| 13            | 120             | 28.45288                            | 0.16352                         |
| 14            | 140             | 28.44798                            | 0.16842                         |
| 15            | 180             | 28.51759                            | 0.09881                         |
| 16            | 210             | 28.51448                            | 0.10192                         |
| 17            | 240             | 28.54756                            | 0.06884                         |
For each set of 5040 randomly generated numbers, the sequence \( \{s_n\} \) converged to \( s_N \). However, the convergence was non-monotonic for each set.

**Results and discussion**

We found that as the sample size of each cluster increased, the mean of the standard deviations of the clusters tended to the standard deviation of the population. However, for each \( n \), the difference between the means of the standard deviations and the standard deviation of the population does not necessarily decrease as \( n \) increased.

The following charts illustrate the relationship between the means of the standard deviations of the clusters and the standard deviation of the population:
In Figure 1, as the serial numbers (and consequently the cluster sizes) increased, the mean of the standard deviations of the clusters also increased generally. However, when serial number is 14, $\bar{s}_{140}$ is 28.44798. When serial number increased to 15, $\bar{s}_{180}$ increased to 28.51759 whereas when serial number further increased to 16, $\bar{s}_{210}$ decreased to 28.51448. The same trend could be noticed for the serial numbers 21, 22 and 23. These indicated that the convergence was not monotonic.
Conclusion

The results indicate that the mean of the standard deviations of clusters of a population may be used to estimate the standard deviation of the population by making the size of the clusters large enough.
References


[3] Nagele, P: http://www.bmj.com/content/331/7521/903


Trends in biomedical research in Namibia: 1995-2009

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Abstract

Research publications are often used as proxies for the scientific progress and development of a particular country. Country-specific bibliometric studies reflect national strategies to build capacity in tertiary education, research, and health services. In Namibia, no study to date has analyzed trends at the country level. The aim of this study was to evaluate the biomedical publication patterns in Namibia between 1995 and 2009. Using the keyword ‘Namibia’ in PubMed and ISI Web of Knowledge, resulting papers were hand searched for information on subject areas, types of studies undertaken, first authorship patterns, and institutions involved in biomedically-focused publications. This study identified 450 publications between 1995 and 2009. Only 129 (28.6%) involved Namibian authors. Just over half (58%) of the studies were carried out in Namibia but varied dramatically by subject area. 52% of Namibian-authored papers were Namibian first-authored with a decreasing trend since 2004. Only 7.5% (34) of the publications involved authors from Namibian universities. Namibia has a strong potential to develop in biomedical research but there is a need for tertiary institutions to modify current policies, continue to diversify sub-areas and become equipped to build capacity with local and international collaborators.

Keywords: Bibliometrics, biomedical science, publication productivity, Namibia,

Introduction

Research publications are valuable indicators of scientific progress and development, especially when evaluating the status of a particular country (Dandona [1], Benamer [2,3], Bissar-Tadmouri [4], Noden [5]). As publications are the result of individual scientists or ‘webs’ of both foreign
and local collaborators (Newman [6]), ‘bibliometrics’ (the scientific analysis of research productivity) is a popular means of assessing a country’s research strategy (Bakoush [7]). By studying the patterns of publication, it is possible to identify individuals and research entities within a country which can assist in identifying local issues and design studies to answer specific questions (Pouris [8]).

There are many forms of bibliometric studies with those particularly focused on regions or individual countries the most popular for a variety of reasons. Regional studies compare between countries and highlight which country is publishing the most and attempt to identify the reasons (Bissar-Tadmouri [4], Rosselli [9], Neves [10], Uthman [11], Hofman [12], Uthman [13]). Country-specific bibliometric studies focus on particular research topics ([Dandona [14], Aaron [15]), the output of various medical schools (Benamer [3]), university faculties (Gulluoglu [16], Dakik [17]), the author and the identity of publishing units (Noden [5]) or biomedical publication patterns (Benamer [2], Bakoush [7], Neves [10]). Studies which focus on the research output from a specific country reveal trends in national strategies which encourage and build capacity in the institutions and the personnel involved in tertiary education, in research, and in the health services to do nationally important research [Benamer [2], Rosselli [9], Neves [10], Gulluoglu [16], Thompson [18], Nwagwu [19], Abramo [20]]. Namibia has been a fertile ground for a wide variety of biomedical research (Noden [5]).

While most Namibian authors since Independence in 1990 have published once, there is great potential in the variety of publishing institutions if research could become more part of the biomedical culture (Noden [5]). The purpose of this publication, then, is to analyze the biomedical research production in Namibia, identifying subject areas, types of studies undertaken, and authorship patterns involved in biomedically-focused publications between 1995 and 2009. The overall goal was to provide a baseline from which future studies can be compared.

**Methods and materials**

On July 3, 2010, during a one hour period, data was collected for all publications between 1995 and 2009 using ‘Namibia’ as a key word in PubMed and ISI Web of Knowledge (Thompson Reuters) search engines.
PubMed is a MEDLINE-linked search engine which provides access to 20 million biomedical citations and considered the ‘most optimal’ tool in biomedical electronic research (Falagas [21]). ISI Web of Knowledge is a citation database provided by Thomson Reuters with multidisciplinary coverage of over 10,000 high-impact journals in the sciences, social sciences, and arts and humanities. While PubMed is an open search engine, the author had access to the ISI Web of Knowledge through an adjunct position at Illinois State University. It is notable that PubMed and ISI Web of Knowledge do not index all journals which may publish Namibian-related studies. However, they index the most cited journals which would have the highest opportunity to be read by an international audience (Pouris [8]). The reasons for evaluating only publications during the 15 year time period, the inclusion and exclusion criteria, and a detailed description of how the papers were manually checked to ensure quality s has already been described by Noden [5].

**Study details**

Four main study types apparent during data collection were: a) ‘travel studies’ – studies which focused on travelers to Namibia who returned home with a medical issue; b) ‘Namibian studies’ – studies which were carried out in Namibia including both those entirely completed in Namibia and those in which the experimental work was done in Namibia but the analysis and writing were done elsewhere, c) ‘sample studies’ - studies which collected samples in Namibia but examined, analyzed and wrote the study up elsewhere, and d) ‘data sets’ – studies taken from published Namibian data sets (usually available online) and analyzed individually or part of a larger regional or global study.

‘Study focus’ describes how the data/materials gathered from Namibia were used: a) ‘Namibian” focused on those studies entirely completed in Namibia and those in which the experimental work was done in Namibia and samples taken abroad for testing, analysis and writing; b) ‘Regional’ included studies using data collected either in Namibia or from Namibian data sets and were compared with other regional samples in the Southern Africa region (geographically this included Zimbabwe, Zambia, Angola, Botswana, Mozambique, Swaziland, Lesotho, and South Africa); c) ‘Sub-Saharan Africa’ (SSA) were those comparing Namibian data to other SSA countries; d) ‘global’ were those comparing Namibian data or samples to other samples taken from different countries around the world.
First authorship was assigned to general region: Asia, Europe, Middle East, North America, Southern Africa, and Namibia based on the address provided. Authorship identification methods were described earlier.

Subject areas described relied on the PubMed categorizing system. Where discrepancies occurred between the two search engines, keywords used were evaluated separately and subject area was determined. Articles were grouped into 7 main categories to aid in analysis: 1) biomedical, medical, and pharmacological; 2) ecology, evolution, or systematics; 3) public, occupational, or environmental health; 4) veterinary or animal science or zoology; 5) social science (biomedical in focus); 6) marine science; and 7) environmental science (soils, radioactivity).

Results

Search Engine Comparisons

A total of 513 papers involving ‘Namibia’ were identified by PubMed and/or ISI Web of Knowledge search engines between 1995 and 2009 (Table 1). Of those, 63 studies were identified using ‘Namibia’ but were not used. 41 (65.1%) were studies which did not directly involve Namibia. These included studies of animals long-time removed from Namibia in European zoos, Namibians moved years earlier to South Africa, authors based in Namibia but writing on studies done in other countries, Namibian reference samples taken years before with no other reference to Namibia in the paper, or Namibia only mentioned in passing in the Discussion. 16 (25.4%) were mislabelled, studies from neighbouring countries or completely carried out in other countries but incorrectly labelled as Namibian studies in the keywords. The remaining 6 (9.5%) papers consisted really of 2 papers found only in PubMed which were double and triple referenced. It is noted that the double reference has since been corrected since this data was collected.
Table 1: Differences between Pubmed and ISI Web of Knowledge in regards to biomedical subject areas being searched for between 1995 and 2009.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Both (%)</th>
<th>Pubmed (%)</th>
<th>ISI Web (%)</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedical, Medicine, Pharmacology</td>
<td>38 (79)</td>
<td>8 (17)</td>
<td>2 (4)</td>
<td>48</td>
</tr>
<tr>
<td>Ecology/Evolution/ Systematics</td>
<td>47 (40)</td>
<td>9 (8)</td>
<td>61 (52)</td>
<td>117</td>
</tr>
<tr>
<td>Environmental science</td>
<td>26 (96)</td>
<td>1 (4)</td>
<td>0 (0)</td>
<td>27</td>
</tr>
<tr>
<td>Marine science</td>
<td>4 (40)</td>
<td>2 (20)</td>
<td>4 (40)</td>
<td>10</td>
</tr>
<tr>
<td>Public, Occupational, Environmental health</td>
<td>89 (67)</td>
<td>40 (30)</td>
<td>4 (3)</td>
<td>133</td>
</tr>
<tr>
<td>Social science (biomedical)</td>
<td>8 (89)</td>
<td>1 (11)</td>
<td>0 (0)</td>
<td>9</td>
</tr>
<tr>
<td>Veterinary/Zoology/Animal science</td>
<td>76 (72)</td>
<td>7 (7)</td>
<td>23 (22)</td>
<td>106</td>
</tr>
<tr>
<td>TOTAL</td>
<td>288 (64)</td>
<td>68 (15)</td>
<td>94 (21)</td>
<td>450</td>
</tr>
</tbody>
</table>

For the subject areas evaluated, the majority of papers were found in both search engines (Table 1). The majority of ecology, evolution, and systematics papers were found only in ISI Web of Knowledge as well as a significant number of marine science papers. Notably, 74.2% of the 62 papers not found in ISI Web of Science used completely different identifying keywords than PubMed. The remaining 25.8% (16) used the keyword ‘Multidisciplinary’ to identify the subject of the publication as opposed to specific keywords used in PubMed.
Subject areas

Figure 1. Total percentages of articles in the four major subject areas by year.¹

¹The areas of marine science, environmental science, and social science were not included in the figure due to having such small contribution.

Figure 1 details the annual total proportions of articles in the four principle subject areas by year. Other subject areas monitored in this analysis provided too few publications to meaningfully include in the figure – environmental science (27 publications – 6% total), marine science (10 publications – 2.2% total), and social science/anthropology (9 publications – 2% total). General patterns observed with studies involving animals decreased over the 15 year period (44% of all publications in 1997 to 12% in 2008) and ecology/evolution related studies increased (11% of all publications in 1997 to 42% in 2007). While public, occupational, and environmental health publications were cyclical (averaging 29% of all publications with peak of 44% and 41.9% in 1994 and 2009, respectively, and low of 17% in 2004), Biomedical articles averaged 10% reaching a high of only 23% in 2005 and a low of no publications in 2000.

Study type

Figure 2 details the proportions of publications in subject areas by study type during 1995-2009.
The slightly over half of the studies (58%) were carried out in Namibia, varying by subject area: 100% of social science/anthropology, 70% of environmental science, 68% of veterinary/animal studies, 65% of Biomedical/medicine/pharmacology, and 62% of public, occupational and environmental health. 33.1% of all studies involved removing samples from Namibia. Removed samples accounted for a high percentage of publications for marine science (80%), ecology/evolution (62%) and veterinary/animal science (31%). ‘Data set’ studies accounted for 8.4% of all publications with the majority (89.5%) focused on public, occupational, or environmental health. Biomedical, medicine and pharmacological articles had the highest proportion of ‘travel studies’ (1% of the total publications).
Authorship comparisons

Of the 450 papers analyzed between 1995 and 2009, 129 (28.7%) involved Namibian authors. Of publications first authored by Namibians, 94% were Namibian-focused studies with the rest regional or SSA-focused (Fig 3a). Comparing first authorship trends, the slightly over half (51.9%) of Namibian-authored papers were first-authored by Namibians (Fig 3a) whereas the papers with no Namibian authors were first-authored by Europeans (45.5%) followed by South Africans (28%) or North Americans (21.8%) (Fig 3b). Interestingly, only one (a regional study) of 19 studies by Asian authors involved a Namibian author (Fig 3a). 5 (26.3%) of 19 Asian-authored papers were completed in Namibia with the remaining 13 involving genetic comparative studies with samples removed from Namibia (Fig 3b). 54.4% (49) of the 90 papers first-authored by South Africans with no Namibian involvement were regional, using data sets secured from Namibia (Fig 3b).

Figure 3. Comparison of study focus by articles involving Namibian authors and those where no Namibian authors were involved between 1995 and 2009.

a) First authorship of 129 articles involving Namibian authors.
b) First authorship of 321 articles involving no Namibian authors

Regarding authorship, the majority of Namibians involved in publications were part of studies carried out in Namibia (95.3%) while 6 involved data sets or samples removed from Namibia for further analysis (Fig 3a). All but one Namibian first authored study was carried out in Namibia compared with Namibian studies organized by authors based in Europe (55.8%), South Africa (43.8%) and North America (57.6%) (Fig 3b). A large proportion of studies involving samples removed from Namibia were first authored by South Africans (48.6%), Europeans (32.6%) or North Americans (28.2%) (Fig 3b).

Figure 4 details the annual percentage of publications involving Namibian authors with special emphasis on Namibian first-authored papers.
Figure 4. Percentages of papers by authorship between 1995 and 2009. The figure demonstrates total % of annual publications involving Namibians. Between 1995 and 2009, the average annual percentage of papers including Namibian authors was 28.5% with lows of 16% (1995) and 17% (2005) and highs of 44% (1998), 42% (2003) and 41% (2004). Interestingly, the trend did not change in the last 4 years (2006-2009).

The 129 papers authored by Namibians involved 280 different authors (Table 2). When comparing the publishing institutions, almost an equal number were from Centers of Higher Learning, Government related Ministries, and Private organizations/NGOs. Most authorship by Namibians was as co-authors (68%) followed by first-authored papers (25%). Only 7% of Namibian authored papers were by single authors.

Table 2. Authorship by general category of institutions

<table>
<thead>
<tr>
<th>Research Institutions</th>
<th>1st Author (n)</th>
<th>Single author (n)</th>
<th>Co-author (n)</th>
<th>TOTAL (n)</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centres of Higher Learning</td>
<td>28</td>
<td>13</td>
<td>45</td>
<td>86</td>
<td>31%</td>
</tr>
<tr>
<td>Government Related</td>
<td>19</td>
<td>1</td>
<td>85</td>
<td>105</td>
<td>37%</td>
</tr>
<tr>
<td>Private/NGOs</td>
<td>22</td>
<td>5</td>
<td>62</td>
<td>89</td>
<td>32%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>69</td>
<td>19</td>
<td>192</td>
<td>280</td>
<td>100%</td>
</tr>
<tr>
<td>% of total</td>
<td>25%</td>
<td>7%</td>
<td>68%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Discussion

The results of this study were encouraging as they demonstrate that Namibian institutions and authors are involved in biomedically-related research with strong potential for growth and development. First, this study demonstrates that there is a high diversity of subject areas which already have baseline studies on which Namibian research can develop. In the past 15 years,
44 institutions involving 190 Namibian-based authors have contributed to research which has resulted in at least one paper (Noden [5]). The publication rate of Namibia is on par with the rest of the continent (Hofman [12]) as well as the world ([Perez-Iratzeta [22]), contributing 0.01% of the total number of biomedical publications in Sub Saharan Africa (SSA) (Hofman [12]). This publication rate is also in line with the Gross National Product (GNP) and total population of the country (Uthman [11]), one of the main predictors of biomedical research productivity in developing countries ([Perez-Iratzeta [22]).

Secondly, the majority of Namibian-focused biomedically-related publications were found using PubMed. This is a great advantage as ISI Web of Knowledge or other search engines need subscriptions for access. Pubmed provides access to 20 million biomedical citations and is considered the ‘most optimal’ tool in biomedical electronic research (Falagas [21]). While the searching component is encouraging, the lack of access to journals continues to be a challenge for Namibian scientists as it is for other developing countries ([Goehl [23], Koehlmoos [24]). At the time of writing, Namibia has received Band 1 [free] HINARI coverage. However, because of arrangements made before 2012 with private institutions, Namibia’s HINARI does not provide access to Elsevier and Springer journals. Namibia is considered an ‘upper-middle income country’ by the World Bank [25]. While Namibia’s GDP might be high when divided by a low population (GNI per capita, Atlas method - US$ 4,270) (The World Bank [25]), Namibia is also known to have the highest Gini coefficient in the world (CIA [26]). The Gini coefficient is commonly used as a measure of inequality of income or wealth. Around the world, Gini coefficients range from 0.23 (Sweden) to 0.70 (Namibia) (CIA [26]). This means that most of the wealth remains with a very small proportion of the population. This works out in reality to approximately half of the Namibian population living below the international poverty line of US$1.25 a day (49.1% - 2009 figures). With 52% unemployment, 90% of persons have no access to health insurance (2008 figures) (CIA [26]). This ‘upper-middle income country’ label in Namibia considerably undercuts the potential for biomedical research to develop as it affects funding formulas for grant proposals as well as access to information.

Another encouraging factor is that a majority of Namibian authors were part of studies completed in Namibia. The majority of these publications were
multi-authored papers with Namibians as first-authors. This encourages the research process in Namibia to go a step further and complete the whole study, including the analysis and writing, in Namibia. This is much in line with developing global trends in co-authorship patterns in the sciences [Bissar-Tadmouri [4], Bartneck [27]). This trend comes with an encouraging reduction in single authored publications and an increase in collaborative efforts by Namibians and foreign-based scientists in the past 4-5 years (Noden [5]).

Along with these encouraging factors, there were a number of concerns. Most notably is the observation that 3 out of every 4 papers published involving Namibia did not involve Namibian authors. It isn’t clear why this happened although lack of infrastructure, limited priority by various institutions involved, a significant focus on ‘systemic research’ in the Ministry of Health and Social Services (MOHSS) (Tugwell [28]), and a lack of capacity to finish studies carried out in Namibia may all play a role. There is a need to study where the research process is struggling and take steps to ensure the whole research process, including the analysis and writing, is able to take place in Namibia. It is difficult to address this matter as funding often comes with a quick endpoint. Often, with foreign funding, the priority is to get the study completed and written up in as short a time as possible, leaving Namibian authors out of the final stages. The commitment for this should come from those funding the study as well as all researchers involved. While building capacity can be tedious, this is one of the main underpinnings which have created strong independent biomedical research communities in other African countries (Killeen [29], Laabes [30]).

Related to this issue of authorship, a disturbing trend indicates that first-authorship in Namibia has been decreasing since 2004 while Namibian co-authorship is increasing (Figure 4 and Noden [5]). The first author usually is the person who envisions, carries out, analyzes and writes up a study. It involves persons who have experience in the whole research cycle. The fact that Namibian first-authorship is decreasing indicates that either non-Namibians have stepped in to do most of the work or there is a lack of capacity among Namibian authors to finish a study to the publication stage.

Together with authorship trends is the trend to remove samples from Namibia for testing, analysis and publication, particularly in marine science, ecology/evolution and veterinary/animal science. This is most likely due to a lack of
infrastructure and trained personnel to complete the work in the country. Again, the solution comes from an agreement by both funding agencies and Namibian institutions to not only get the information disseminated but see research as a whole process which needs capacity building.

**Tertiary education involvement**

The results revealed the essential need for Namibian tertiary institutions to grow into their roles as centers of biomedical research excellence. In the past 15 years, only 7.5% (n=34) of the 450 biomedically-focused publications involved authors from Namibian tertiary institutions (University of Namibia (n=33) and Polytechnic of Namibia (n=1)). Biomedical, medical, and pharmaceutical articles averaged 10% of all publications annually. While, admittedly, this study did not identify all possible search engines where authors may have published, both engines provide access to the most important biomedical journals which are accessed by the international community.

While appearing troubling, there is a logical explanation for this skewed statistic. Since independence in 1990, most of the tertiary level biomedical training for Namibians has taken place in South Africa. In 2008, training programs for medicine, pharmacology, and veterinary science were initiated at UNAM and biomedical laboratory science and environmental health at the Polytechnic of Namibia. At the time of writing, these programs have a strong dimension of research built into their curriculums. It is hoped that with this training and focus on research, there will be more contribution to biomedical research by Namibian tertiary institutions in the future.

As Namibian institutions build their biomedical capacities, there is also need to evaluate how that research will be empowered. As of 2011, there is a lot of excited talk about research in these newly developing programs in Namibian universities. However, without a dramatic change of existing policies, it is unlikely the universities will be able to attain significant levels of influence. For example, multiple authorship on biomedical studies needs to be highly encouraged at both universities, even to the level of incentives. Also, there is a dramatic need to address the teaching and service overload experienced by competent and talented researchers in Namibian universities (Noden [5]). As long as the multi-disciplinary approach to research, freeing researchers to develop, is not rewarded in the promotional schemes of both
Namibian universities, it is highly unlikely that the cross-pollination of ideas will produce the fruits which come from dynamic local and international collaborations (Noden [5]).

While all attempts have been made to reduce various limitations, some are unavoidable. First of all, it is difficult to identify the country where authors of various studies resided during the study. Some studies, particularly those originating in South Africa, may have Namibian authors but because the study was done in South Africa, the addresses provided are South African. Even though all attempts were made to identify the addresses of each author, it is not possible to know how many were missed. Secondly, because of the small sample size used, this study only evaluated quantity of papers and did not use impact factors to evaluate quality (Benamer [3], Gulluoglu [16]). Finally, potential authorship and institutional information contained in the ‘grey literature’ in the archives of government offices and NGOs was not available on the internet and hence, lost to the parameters of the study.

In conclusion, the study identified that Namibia clearly has a strong potential to develop in biomedical research. An encouraging diversity of studies carried out by Namibians in the past 15 years has been published in journals accessed by using PubMed. The concern, however, is that the researchers are not being fully equipped as a result most studies are being lead and written by foreign-based collaborators. There is an exciting mandate for Namibian tertiary institutions with developing Biomedical training programs to modify current policies, diversify sub-areas, strengthen their IRB capacity and become equipped on all levels to build capacity together with local and international collaborators. These modifications will do much for both tertiary education institutions to realize their potential as the catalysts for change in the Namibian research environment. Until those changes occur, however, Namibia’s researchers and centers of research excellence will never reach their potential.

Acknowledgements

Grateful thanks to Mr. Chris Hikuam of PoN Department of Biomedical Science for illuminating discussions and reviewing of the manuscript. Special thanks to the anonymous reviewers whose insights greatly enhanced the quality of this manuscript.
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STUDENT SUCCESS AND DROPOUT RATES AT THE POLYTECHNIC OF NAMIBIA

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Abstract

In developing the Education and Training Sector Improvement Programme (ETSIP), the government of Namibia had indicated that one of its key goals was to strengthen and improve quality, effectiveness and efficiency in higher education. This descriptive, non-intervental study was undertaken in response to the changing policy environment, mainly to determine the teaching and learning performance of the Polytechnic of Namibia in terms of student enrolment, success and dropout rates for a fifteen year (1996 – 2010) period. The key findings of the study are that between 2006 and 2010 student success rates declined (68 to 59%), and over the same period student dropout rates also decreased (23 to19%). Whilst reasons for the decrease in dropout rates were not easily identifiable, reasons for decrease in success rates could be linked to changes in the ratios of student, programme and course to academic staff.

Keywords: higher education; teaching and learning; success rates; dropout rates; performance.

Introduction

There are many challenges facing higher education globally, and while most of the challenges are common, there are those that seem to be characteristic of the African region. Taferra [1] reporting on the Norwegian development aid agency (NORAD)’s new policy of engaging African higher education observes that challenges in African institutions include, “overcrowded classrooms, poorly paid and poorly prepared faculty, shortage of qualified faculty, low research capacity, dilapidated infrastructure, and lack of resources and brain drain.” According to Reisberg [2], a more serious issue is that in many African countries higher education decisions are politically driven and taken without sober considerations of rationale policies that provide for autonomy and resourcing of the institutions. This, in turn, paralyses university leadership.
The Education and Training Sector Improvement Programme (ETSIP) [3] was a key strategic initiative of government, which recognised the need to improve and strengthen the quality, effectiveness and efficiency of education and training. With specific reference to higher education institutions the lack of capacity to manage and deliver education programmes and postgraduate training and research; and need to strengthen quality assurance systems were amongst the issues ETSIP highlighted for attention.

It is an established trend internationally that government funding of higher education is declining significantly and the situation is exacerbated by the unprecedented and unpredictable economic downturn [4]. For example, in 2010 through the report on “Comprehensive Spending Review” the United Kingdom government indicated that public funding to universities for teaching would be cut by 40% within 4 years [5]. The US austerity measures and budget cuts have resulted in government subsidy to higher education decreasing rapidly from about 36% to 26% between 2001 and 2010 [6]. During the same period there was a shift in the burden to students, whose contribution to the cost of education increased rapidly from about 32% to 45%. The subsequent reaction of raising student tuition fees has been one of the responses of institutions to mounting funding pressures on higher education. Given the risks associated with burdening students with high tuition fees, institutions have had to consider other positive approaches that include inter alia streamlining operations and adopting cost containment measures.

In the American system, the overall impact of these socioeconomic dynamics called for unprecedented changes in higher education in order to deliver high quality postsecondary education [7]. One of the key focal points was to create a campus culture that was friendly and conducive for students to be successful.

In this era of scarce financial resources, where governments have to distribute these resources amongst many competing societal needs, governments in relation to funding higher education are increasingly demanding greater accountability for utilisation of these resources by institutions. As a result the funding of institutions becomes linked to their performance. It is clear that the Namibian government is moving in a similar direction by developing an appropriate regulatory framework; and prioritising quality, effectiveness and efficiency in developing strategies for improvement in the higher education
sector [3]. This study was therefore aimed at determination of the student success and dropout rates in order to establish effectiveness and efficiency of teaching and learning, which is a core function of the Polytechnic of Namibia.

Methodology

Over the years the Polytechnic of Namibia has been collecting data on various operational units of the institution for the purpose of planning, monitoring, evaluation and decision making. With the introduction of the Integrated Technology System (ITS) with advanced software packages, copious data relating to personnel, students, financial resources and facilities is managed by the Management Information System Unit. In this study quality-checked data on academic staff and students was provided by the above Unit. The analysis of data as well as the regression analysis thereof was carried out using Microsoft Office Excel. The figures presented in the Results section were also produced on Microsoft Excel 2007.

Results

The Polytechnic of Namibia was established from a predecessor institution, the Centre for Out of School Training in 1996 and this development was one of the post-independence government initiatives to transform the higher education sector in the country.
Figure 1: Growth of the Polytechnic in student enrolment and full-time academics over the years.

Figure 1 looks at the growth of the institution over the years from 1998 to 2010. At the commencement of the institution student enrolment was at 2554 and the number had doubled by 2005. Thereafter student enrolment grew rapidly to reach 11531 by 2010.

With respect to academic staff which was at 63 at inception, doubled by 2001 and thereafter increased steadily to reach 197 by 2009. This was followed by a sharp increase in academic staff number to reach 279 by 2010.

Critical to the growth of the institution was the introduction of new academic programmes (Figure 2). While the Polytechnic inherited 36 programmes from the Centre for Out of School Training, during the first three years of transition it phased out several programmes that were not appropriate for delivery at higher education level and hence programmes reduced to 20 by 1998.
Subsequently, this phase was followed by the Polytechnic developing its new programmes which grew steadily to 65 by 2008. Thereafter the pace of programme development increased rapidly to reach 89 programmes in 2010. Interestingly, as more programmes were introduced, it followed that shifts would be seen in students enrolling in different qualifications. These shifts are depicted in Figure 3. Three qualifications were inherited from the Centre for Out of School Training and these were the N level, certificate and diploma qualifications.

By 1998 all the National level and certificate qualifications were phased out. However, the certificate qualification was reinstated in 2000. Nonetheless, enrolment in this qualification consistently remained below 0.8% of total student enrolment throughout the years. During the same period, enrolment in higher certificate was negligible. In the meantime the enrolment in diploma, which sat at 100% in 1998, began decreasing slowly. This happened at the expense of the bachelor of technology qualification that had been introduced in 1999 as well as certificates.
Figure 3: Percentage student enrolment in different qualifications from 1996-2010.

However, diploma enrolments dropped from 85.4% in 2003 to 32.0% in 2004, while at the same time the enrolment in bachelor of technology rose sharply from 7.1% to 60.0%. This was a result of a decision to encourage many of the diploma students to convert their registration from diploma to bachelor of technology.

In 2007, 14.7% of the total student enrolment was in the bachelor degree qualification which was newly introduced then. This led to a decrease in registrations for bachelor of technology which fell to 44.0% by 2010, whereas the bachelor degree enrolment shot up to 48.2% correspondingly. In comparison, even though honours degree started in 2009 the growth in enrolment has been slow (1.2% by 2010). An important observation is that whereas the institution started by offering N level, certificate and diploma qualifications, by 2010 it was offering a total of six qualifications. This does not include a masters qualification (not shown) that was introduced recently.
Figure 4 shows changes in the number of enrolled, returnee and dropout students from 1996 to 2010. The pattern of increase in returnee students followed more or less that of growth of student enrolment. The student dropout level was considerably lower and it followed the same pattern as that of returnee students, albeit the increase in numbers with years was smaller. It should be noted that as part of the development of the institution, the Polytechnic regularly reorganised its schools such that the clustering of programmes made both academic and management sense and by 2005 the institution had structured itself into five academic schools, namely the Schools of Business Management; Engineering; Information Technology; Communication and Criminal Justice; and Natural Resources and Tourism. The School of Health and Applied Sciences was started in 2009.
Figure 5: Success and dropout rates at the Polytechnic during the period 2006-2010.

Student success and dropout rates at the Polytechnic are given in Figure 5. In 2006, a student success rate of 68% was achieved, which thereafter decreased linearly to reach a level of 59% by 2010. In a similar fashion student dropout rates decreased from 23% in 2006 and it got to 19% by 2010.

In this study, it was important to determine what factors were responsible for the decline of both success and dropout rates as well as to establish whether there was any direct link between success and dropout rates. To explore these questions the relationship between success and dropout rates was examined and the result is shown in Figure 6. The linear regression analysis gave a correlation value ($R^2$) of 0.613. This seems to suggest that there might not be a close relationship between the two parameters.
Figure 6: The relationship between success and dropout rates during the period 2006-2010.

It is well established that the calibre and workload of academic staff account for a major contribution to low success rates of students [8]. Figure 7 examines changes in parameters that might impact on the workload of academic staff in the period 1998-2010. In all three parameters evaluated, namely the number of students per academic, the number of academics per programme and the number of courses offered per academic, there were no dramatic changes prior to 2004, but post that period changes created a ‘bubble’ in the graph (Figure 7).

From 2005 the number of students per academic rose from about 34 to 57 in 2009 and thereafter decreased to 44 by 2010. As a result of programme re-curriculation activities that the Polytechnic undertook, after 2005 a similar rise in the number of courses per academic as in students per academic, was observed. In 2005 courses per academic stood at about 4.3 and increased to 7.4 by 2009 and thereafter decreased to 6.0 in 2010.
In the case of number of academics per programme there was a decrease from about 4 in 2004 to 3.0 by 2006 and remained more or less at the same level throughout. The combination of the three factors in the ‘bubble’, that is the increase in students and courses per academic and the decrease in the number of academics per programme seem to point to huge increases in the complexity of the work and the workload of the academic.

**Discussion**

In line with other institutions elsewhere, the Polytechnic in response to post-colonial education transformation and demands for increased access to higher education has experienced a phenomenal student growth (seen in Figure 1) that has almost outstripped expansion and improvement of facilities as well as sourcing of qualified academic staff. Hence, it was imperative that as an institution going through such a developmental transition we look at our performance on core functions. This was also prompted by a recent report [9] that investigated and identified process issues that needed improvement in the value chain of the institution. One of the main findings of that study was the fact that whilst a number of process changes were needed in various operational areas, the teaching and learning area functioned very well.
Rao [10] claims that many poor and developing countries experience high dropout rates in higher education institutions and this ensues from their use of outdated academic practices. Taferra [1] asserts that quality issues become a major concern in those institutions that have had rapid growth in student enrolment. This taken together with the fact that one of the key strategic goals of ETSIP [2] is to improve and strengthen effectiveness and efficiency of higher education, it was decided to examine success and dropout rates at the Polytechnic. Focusing on the period 2006-2010, a major finding was that institutional success rates dropped by nine points from about 68% in 2006 to 59% in 2010.

It is important to note that in the South African higher education system 80% is used as a benchmark for institutions [11] and therefore success rates that are moving away from this benchmark should cause deep concern. In the American higher education system, when it was realised that many students were leaving college or university without getting the education they had set out to achieve, a number of initiatives were introduced. These included a national initiative termed “Achieving the Dream; Community Colleges Count”, (reported in [12]), which was about creating data on student success/failure so that based on evidence, it would be possible to develop targeted interventions. Interestingly, the Polytechnic has developed a comprehensive data base, but it has not yet established a culture of evidence based on analysis of data in order to develop strategic interventions.

It was instructive to try and find answers to what were the reasons for the observed drop in the success rates of students. It is clear that as the student enrolment increased, the student/academic ratio increased (Figure 7). Equally, as new programmes were introduced the number of academics per programme decreased. The curriculation process that led to the introduction of bachelor degree qualification brought about increased courses per programme and thereby increased considerably the number of courses per academic. These three parameters constitute the ‘bubble’ that is found in Figure 7. Adding further complexity to the situation has been the development of qualifications in the institution. At the start of the Polytechnic, only three qualifications and were at N levels, certificates and diplomas (Figure 3), and over the years the qualification profile has changed considerably with respect to the number of qualifications (reaching 8 by 2010) and the levels thereof (masters degrees were also offered). The combination of these factors together with the fact that the qualification profile of academics has
not changed significantly (academics with doctoral degrees have remained at about 12% over the past six years (data not shown) has resulted in increased workloads for academics. It is intriguing that the recently published Green Paper on “Post school education and training” [8] indicates that the calibre and workload of academic staff are a major contributing factor to low success rates of students.

A surprising finding was the fact that the dropout rate was at 23% in 2006, but it declined gradually to 19% by 2010. The occurrence of reduction in dropout rates, while the student enrolment was growing rapidly, seems to contradict the assertions of Rao [10] and Tafera [1]. It was also noted from the plot of relationship between success and dropout rates, that it appeared the relationship was not tightly linked (R^2 value of 0.64). This seems to suggest that factors other than success rates have an impact on dropout rates. To gain an understanding of factors driving the reduction in dropout rates is important as this would help us ensure that nominal dropout rates are achieved at the earliest. This is an area that needs further investigations.

Recommendations and Conclusion

A pertinent question to ask is what is needed to turn around the decline in student success rates at the Polytechnic? The answer might lie in the statement of Richard Ruch (quoted in [13]), which says “In the for-profit environment the success of a student is the top priority for faculty, administrator and support staff. They know that customer is king. In these institutions student success is interpreted to mean both academic success, as measured by successful progression through and completion of a programme of study, and career launching upon graduation, as measured by placement in a job related to the program of study at a good salary, preferably one that offers opportunity for career advancement.” However, Keeling and Hersh [14] seem to advocate for a radical systemic rethinking in an institution that would unflinchingly accept the challenges of improving student success rates by collectively putting learning first. There is no doubt that through the adoption of these two approaches could lead to institutionalising a learning culture. Several reports seem to confirm that student engagement in a strong indicator of student success [15, 16]. Zepka and Leach [17]’s analysis identifies four key elements to student engagement, namely motivation of the student, nature of interaction between student and academics, institutional support and development of citizenship in students. Therefore the thrust of activities
to engage students should be in these areas. However, the Report on ‘What Works? Student Retention and Success Programme’ [18] succinctly captures what needs to happen in student engagement by stating that all activities and interventions should aim to nurture a culture of belonging. It is some of these ideas that the Polytechnic would need to explore in order to find its formula to improve student success and dropout rates.

In conclusion, the findings in this study are that, on the negative side student success rates showed a decline, whilst on the positive side student dropout rates decreased. It will benefit the institution and students, in particular, if interventions targeting to further decrease dropout rates and also boost significantly success rates are developed.

Acknowledgements

The author is grateful to Mr Reino Ihemba of the Management Information System of the Polytechnic of Namibia for providing the data used in this study. Also words of appreciation go Drs Sarala Krishnamurthy and Anna Matros-Goreses for their insightful input to the manuscript.
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