SOUTHERN AFRICA MATHEMATICAL SCIENCES ASSOCIATION ANNUAL CONFERENCE
SAMSA 2018 (PALAPYE, BOTSWANA)

BUAN
BOTSWANA UNIVERSITY OF AGRICULTURE AND NATURAL RESOURCES

UNIVERSITY of BOTSWANA

BIUST
BOTSWANA INTERNATIONAL UNIVERSITY OF SCIENCE & TECHNOLOGY

Conference dates: November 19-23, 2018

SAMSA 2018 Conference summary report

The 37th SAMSA conference was held at the Botswana International University of Science and Technology (BIUST) Campus in Palapye, Botswana during the period 19 - 22 November 2018, under the theme "Mathematical Sciences: A Catalyst in Driving a Knowledge - Based Economy".

The conference was jointly organized by the Botswana International University of Science and Technology (BIUST), University of Botswana (UB), and Botswana University of Agriculture and Natural Sciences (BUAN). The conference was honoured by the highest office in the Botswana government, the President who became the first SADC president to open the SAMSA conference.

His Excellency, the President of The Republic of Botswana, Dr Mokgweetsi Eric Keabetswe Masisi, officially opened the conference and invited SAMSA to promote the use of Mathematics in industry and business and to demystify the subject among students in primary and secondary schools. The conference was graced by many high government officials, including the Minister of Tertiary Education, Research Science and Technology, Assistant Minister of Tertiary Education, Research Science and Technology, Assistant Minister of Investment Trade and Industry, Serowe and Palapye chiefs, Members of the University

Councils, Vice Chancellors of local universities, Chief Executive Officers, Deans and Directors from the co-hosting institutions and representatives from the private sector, to mention just a few. SAMSA is grateful for the generous support from the sponsors, without which the event would not have been possible. Financial support was received from Auburn University, Liberty Life, African Mathematics Millennium Science Initiative, International Mathematics Union and London Mathematical Society and Research and Graduate Studies in Mathematics and its applications (RGSMA) based at BIUST. We also acknowledge and appreciate the contribution by the attendees, presenters, volunteers, scientific committee, keynote speaker: Prof. Abba Gumel (Arizona State University, USA), and the plenary speakers: Prof. F.J. Vermolen (Delft Technical University, The Netherlands), Prof. T. Dube (University of South Africa, South Africa), Prof. C. Chidume (African University of Science and Technology ,Nigeria), Prof. T. Goetz (University of Koblenz, Germany), Mrs. T. Beardon (AIMSSEC, South Africa, and University of Cambridge, UK), Dr. J. White (University of Bath, UK), Prof. K. Aase (The Norwegian School of Economics, Bergen-Norway), Prof. S. Manda (South African Medical Research Council) and Prof. A.J. Menezes (University of Waterloo, Canada). As part of the conference, two public lectures were presented by Prof. A.F. Beardon (Probability and the law) and Prof. A.J. Menezes (Public-Key Cryptography).

Alongside the SAMSA conference, BIUST also hosted: the 2018 Masamu Advanced Study Institute (MASI) and workshop; a two-day workshop for secondary school teachers from within Botswana which was held in conjunction with the Ministry of Basic Education and Mathematics Association of Botswana; a workshop for Women in Mathematics organized by the African Mathematics Union Commission for African Women in Mathematics; a two-day workshop for post graduate students funded by the Simons Foundation Facilitators Fund through the Research and Graduate studies in Mathematics and Applications (RGSMA).

The 2018 edition of the SAMSA annual conferences attracted over **205** delegates including over **80** students representing at least 25 different **countries from the African** continent, Europe and North America.

Summary information of invited talks and speakers

	Speaker	University	Area	Speaker category
1	Prof. Abba Gumel agumel@asu.edu	Arizona State University	Applied Mathematics, Mathematical Modeling	Keynote Speaker
2	Prof. Themba Dube dubeta@unisa.ac.za	University of South Africa (UNISA), South Africa	Algebra	Plenary speaker
3	Prof Samuel O. Manda zewotir@ukzn.ac.za	University of KwaZulu-Natal, South Africa	Statistics	Plenary speaker

4	Dr. Jane White k.a.j.white@bath.ac.uk	Department of Mathematical Sciences, University of Bath, UK	Mathematical Biology	Plenary speaker
5	Prof. Knut Aase Knut.Aase@nhh.no	The Norwagean School of Economics, Bergen- Norway	Financial Mathematics	Plenary speaker
6	Prof. F. Vermolen F.J.Vermolen@tudelft.nl	Delft Technical University, The Netherlands	Industrial Mathematics	Plenary speaker
7	Prof. T. Götz goetz@uni-koblenz.de	University of Koblenz, Germany	Industrial Mathematics	Plenary speaker
8	Toni Beardon lab11@cam.ac.uk toni@aimssec.ac.za	AIMS-AIMSSEC	Mathematics Education	Plenary speaker
9	Prof. Charles Chidume	African University of TScience and echnology.	Analysis	Plenary speaker
10	Prof. Alfred Menezes	University of Waterloo, Canada	Graph Theory	Plenary speaker

Plenary speaker abstracts

Category: Algebra

Speaker: Prof. Themba Dube

Title: The power of pointfree topology

Abstract: Pointfree topology is a study of abstract lattices that generalise topologies. Such lattices are called locales, and, by definition, they are complete lattices L such that the distributive law

$a \wedge S = \{a \wedge S \vee s \in S\}$

holds for every $a \in L$ L and every $S \subseteq L$. In the talk I will give a survey of some results in pointfree topology that may surprise classical topologists who are not familiar with pointfree topology. One such is that the subcategory of the category of locales consisting of the Lindelöf ones (the definition of Lindelöf locales is lifted wholesale from classical topology) is reflective. This then tells us that products of Lindelöf locales are Lindelöf, in marked contrast the situation in the category of topological spaces.

On the algebraic side, I will highlight a symbiosis that exists between Ring Theory

and Pointfree Topology. The emphasis will be on how the latter makes some results in the former more streamlined and lucid.

Category: Statistics

Speaker: Professor Samuel Manda

Title: Spatial Smoothing Models for Subnational Level Estimation Using Health Surveys

Abstract: Spatial small area smoothing models play an important role in facilitating a geospatial distribution of disease burden and informing public health policy intervention and response. Often data obtained from complex surveys are employed in the application of spatial smoothing models. However, the complex sample design empl0yed in the surveys is infrequently considered in the analyses, which may potentially subject the small area estimation results to bias. Furthermore, problems remain concerning potential bias to small area estimates due to non-response, missing data and self-reporting. An even greater statistical challenge in using these data for spatial smoothing is the unrepresentativeness of data at lower subnational levels. Most of these surveys are designed to collect representative data at national and regional levels. In this paper, we investigate the impact of disregarding the survey design and the effect of nonresponse and self-report on the resulting small area estimation. We further compare predictive accuracy between several spatial analysis methods for generating maps at finer administrative levels based on survey data. Both simulation studies and motivating examples from health surveys are used.

Category: Mathematical Biology

Speaker: Dr K.A. Jane White

Title: The Challenging Landscape for Infection Control

Abstract: Using mathematical models to understand infectious disease dynamics has transcended the disciplines to a point where the model parameter R0, which provides a measure of infectiousness, is commonly used in the public health arena to estimate the potential scale of any infection outbreak. The notion of herd immunity which has been used to inform vaccination strategy, is also derived from this model parameter. And so, it may appear that public health strategy benefits hugely from a mathematical contribution. However, if you delve a little deeper, it becomes clear that much more work is needed before mathematics has fully done its job particularly in infectious disease control. In this talk, I will highlight the importance of using Occam's Razor to build simple mathematical models which nonetheless represent complex systems.

My interest is to understand infection control in heterogeneous populations, whether that heterogeneity arises from the population ecology or from the infection dynamics. I will describe several projects that I have worked on, including the role of badgers in driving and maintaining bovine tuberculosis outbreaks and the importance of host variability when trying to control macroparasitic infections of farmed animals. My summary will describe several challenges that I think the mathematical epidemiology community might wish to explore in

order that mathematics might continue to make important contributions within the public health arena.

Category: Mathematical Finance

Speaker: Prof. Knut K. Aase

Title: Economics of uncertainty and time

Abstract: A key feature of the economic theory presented is concerned with dynamic equilibrium
in a multiperiod world where uncertainty and time play major roles. Another key variant, also mentioned in the talk, is the life cycle model. In the latter the agent takes a dynamic market as given in some sort of equilibrium (e.g., absence of arbitrage possibilities), and then determines optimal consumption and investment strategies. These two types theories have many applications in a variety of fields within economics and is central in for example dynamic micro-based macro, in pension and life insurance, as well as in mathematical finance. The standard model assumes that agents have preferences represented by expected, additive and separable utility. This assumption has been questioned for quite some time. The standard utility representation leads, for example, to the celebrated Equity Premium Puzzle, discovered in the beginning of the 1980's, one of the most stubborn problems that economics has ever encountered. There are also several other anomalies, regarding, for example, optimal consumption and portfolio choice. In the talk it will be demonstrated how recursive utility can be used to tackle some of these inconsistencies and puzzles.

Category: Industrial Mathematics

Speaker: Prof. Fred J. Vermolen

Title: Mathematical modelling of the evolution of skin after a deep tissue injury

Abstract: Deep tissue injuries, like severe burn injuries, are often accompanied with hypertrophic
scars and/or contraction of skin. Hypertrophic scars have a bad impact on the appearance of the patient, which can lead to social-emotional problems. If the contraction of skin is so intensive that the joint of the patient loses mobility, then one speaks of a contracture. In this talk, we will primarily focus on contractures. Contractures arise because of pulling forces that are exerted by skin cells ((myo) fibroblasts) on their direct environment. We mathematically model the evolution of skin by approximating the solution to a set of (nonlinear) partial differential equations using the finite element method. Another approach that we use is based on treating cells as individual entities. This agent-based modelling approach is applicable to small scales and models cellular processes as stochastic processes. These stochastic processes involve cell division, cell death, differentiation and the random walk as one of the migratory modes. The partial differential equations that we consider are to model reaction-transport of various agents, as well as mechanical equilibrium, which is modelled by a morphoelastic approach to simulate permanent contractions. Since many of the parameters

are not known, and since the cell-based (agent-based) modelling approaches contain stochastic processes, uncertainty is an important issue to deal with. Therefore, we use techniques to quantify the uncertainty, which can lead to the estimation of the likelihood that severe contractures occur. In this talk, we will see some of the mathematical models, as well as the implications from uncertainty quantification.

Category: Industrial Mathematics

Speaker: Prof. Thomas Götz

Title: Optimal Control and Applications

Abstract: Mathematical models and simulations are of increasing relevance for applications in
engineering and the life sciences. With modern numerical methods and the ever-increasing computing power not just, simulations of industrial or biological systems are within reach, but also questions of optimizing the systems can be addressed. The goal of this optimization can be manifold, ranging from parameter identification calibrating the model to the design of optimal control strategies driving the system to a desired output or even the computation of optimal domains and geometries. In this talk we will present concepts and tools from optimal control, that can be applied to industrial and biomathematical models. The concepts and tools are illustrated in several examples like mathematical epidemiology, biomechanics and industrial processes like film blowing form polymers.

Category: Mathematics Education

Speaker: Mrs Toni Beardon

Title: Mathematics Education for the 21st Century

Abstract: There is a widely held belief amongst teachers, educational researchers, policy makers,
politicians and employers that teaching methods need to change to equip young people with 21st Century skills and competences and there is research evidence for this belief (Ananiadou and Claro, 2009). However, there is limited experience of teaching and assessment methods, and few resources, particularly in developing countries, to support such a change. Some governments have incorporated into national educational standards sets of skills, competences and values that every student should attain by the end of compulsory schooling to function effectively in the workplace, as citizens and in their leisure time (e.g. Rwanda Competence Based Curriculum for Sustainable Development 2015). In her talk Toni will explore the nature of this change, how it might be brought about and explain her work in this context. Bearing in mind the conditions that prevail across Africa of large classes, lack of resources and both teaching and learning in an additional language, Toni designs and develops training programmes, research, and free online open source learning resources for teaching and learning mathematics to support independent, active, inquiry-

based learning and to provide learning experiences that require deep thinking, develop 21st century skills and focus on what young people understand and can do rather than just memorize. Toni founded two projects, NRICH http://nrich.maths.org in 1996 and AIMSSEC https://aiminghigh.aimssec.ac.za/ in 2003. AIMSSEC is a not for profit organization run by a team of African educators supported by a large international team of academics who work as unpaid volunteers. AIMSSECs objectives are to advance educational opportunities for disadvantaged communities, to introduce new skills to teaching and learning mathematics, and to raise the standards of mathematics teaching in Africa, making these opportunities accessible to teachers in rural areas. AIMSSEC workshop guides enable teachers to
share what they have learned through AIMSSEC and to run self-help professional development
for other teachers without the need of an expert to lead the group.

Category: Analysis

Speaker: Prof: Charles Chidume

Title: Fixed Point Theory

Abstract: The intimate connection between convex optimization and fixed-point theory in real
Banach Spaces more general than Hilbert spaces that motivated the recent introduction of the new concept of J-fixed points will be presented. Furthermore, existence theorems for J-fixed points of some important nonlinear maps will be discussed. Following this, iterative algorithms for approximating J-fixed points, minimizers of some nonlinear convex functionals, solutions of Hammerstein integral equations, zeros of nonlinear monotone operators will be presented and discussed. Finally, some research problems of interest will be exposed.

Category: Cryptography (Public Lecture)

Speaker: Prof: Alfred J. Menezes

Title: Public-Key Cryptography

Abstract: Cryptography provides the foundation for information security in many applications. Although cryptography has been used for thousands of years to protect the confidentiality of communications, its deployment has greatly increased over the past twenty years with the development of modern communications systems and networks such as the internet. This lecture will highlight the applications of public-key cryptography on the internet and will mention some of the challenges that the future will bring.

Category: Statistics and the law (Public Lecture)

Speaker: Prof: Alan Beardon

Title: Probability and the Law

Abstract: A description of some real-life legal cases in which probability was misused and misunderstood by the prosecution, or by the defence, or (in one case) by the judge. No Prior knowledge of probability is or the low will be assumed.

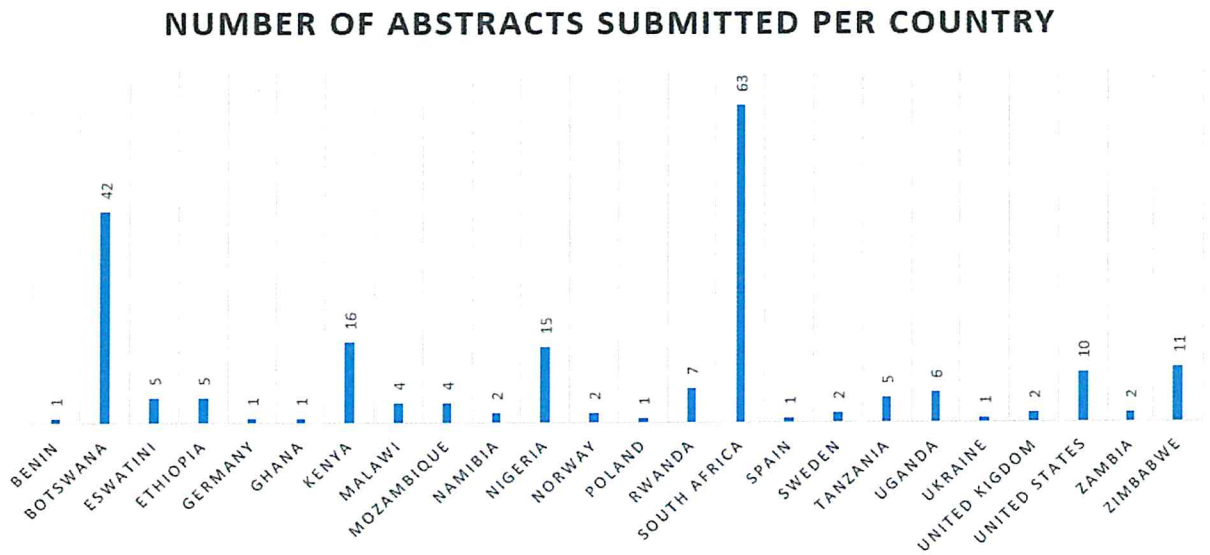
Conference abstract submissions:

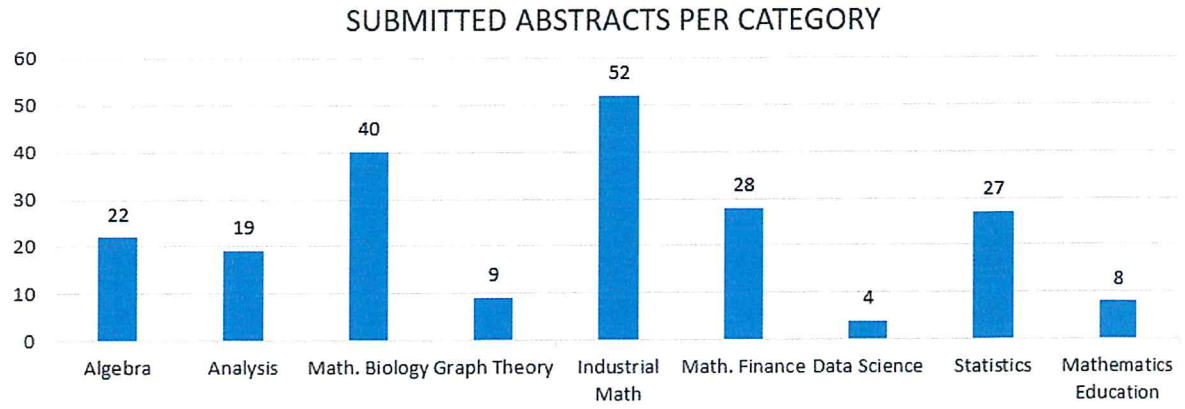
A total of 209 abstracts for conference paper presentations were submitted and were categorised under the areas of Algebra, Analysis, Mathematical Biology, Graph theory and combinatorics, industrial Mathematics, Data Science, Mathematics education and Statistics. The abstract submissions were from researchers based in 24 countries around the world. The Majority submitting countries were South Africa (63) and Botswana (43) .The summary of the abstract submissions per country and subject category are indicated below.

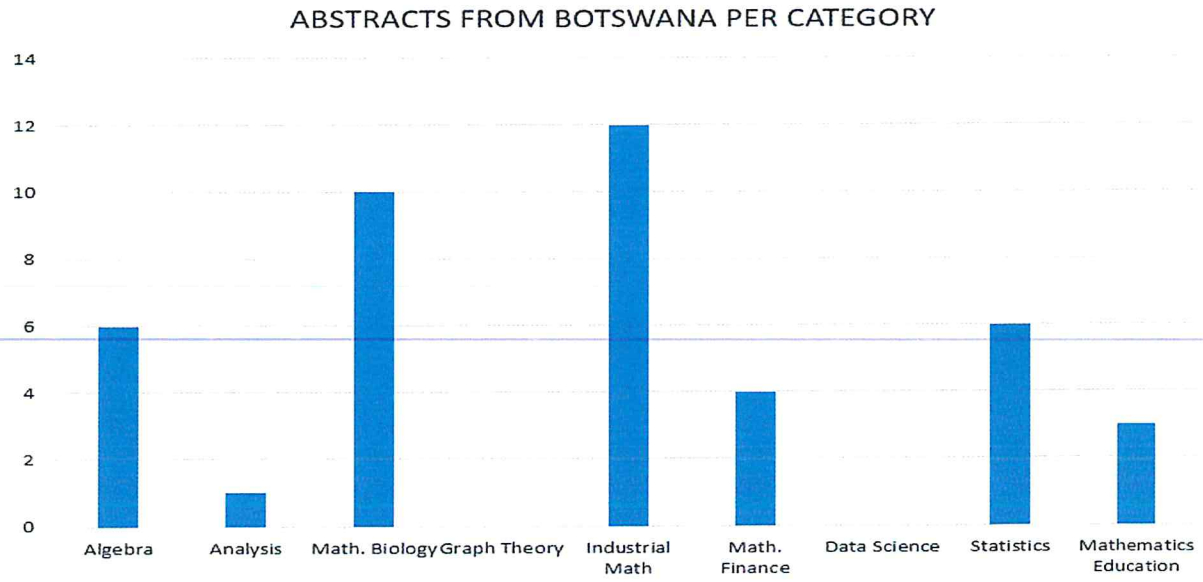
Country	Algebra	Analysis	Math. Biology	Graph Theory	Industrial Math	Math. Finance	Data Science	Statistics	Mathematics Education	Number of Abstracts
Benin					1					1
Botswana	6	1	10		12	4		6	3	42
Eswatini			1		3	1				5
Ethiopia	2	1	1		1					5
Germany						1				1
Ghana						1				1
Kenya		3	7		1	1		2	2	16
Malawi	1				1			2		4
Mozambique	1		1		1	1				4
Namibia					1			1		2
Nigeria	3	4			4	3			1	15
Norway						2				2
Poland						1				1
Rwanda		1	2		4					7
South Africa	5	8	7	4	20	5	4	8	2	63
Spain						1				1
Sweden						2				2
Tanzania		1	3			1				5
Uganda	2		3		1					6
Ukraine	1									1
United Kigdom			1			1				2
United States			3	5				2		10
Zambia	1					1				2

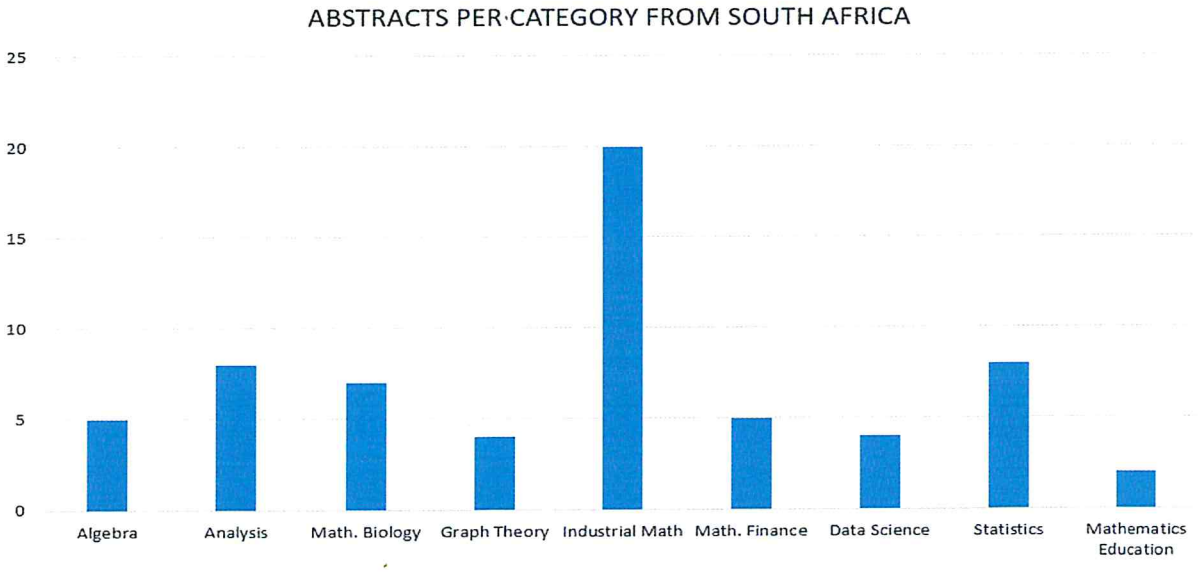
Zimbabwe			1		2	2		6		11
Number of Abstracts	22	19	40	9	52	28	4	27	8	

Graphical summaries of submissions for countries that submitted the most are indicated below.









Logistics

The Logistics subcommittee was tasked to work out aspects of the conference that were related to transport and accommodation of delegates, meals and venues and well as organising excursions and entertainment on the opening day of the conference.

Transport

The conference organisers provided transport from and to Sir Seretse Khama airport and the process went on smoothly with all delegates who needed transport covered. The Botswana University of Agriculture and Natural Resources (BUAN) assisted with providing buses,

welcoming and guiding delegates upon their arrival at the airport. The transportation of guests was jointly managed by BIUST and BUAN transport departments.

Meals and Functions

Meals of good standard were served for lunch throughout the conference (comprised of mostly local Botswana dishes). Break/evening tea/coffee/juice+ snacks were served as per SAMSA tradition. A conference dinner was held on 21st November 2019 for all delegates.

Accommodation

All delegates found accommodation in Palapye. We note that more lodges were able to market themselves through the Internet and so delegates had a relatively wide choice in the middle and lower prices accommodation facilities. The invited speakers were provided accommodation at Majestic Five Hotel Palapye covered by the conference sponsorships.

Excursion

There was an excursion at Khama Rhino sanctuary, a community-based wildlife conservation project at approximately 82 Km East of BIUST. The sanctuary assists in protecting rhinoceros, which are among endangered species. Delegates were happy to spot rhinoceros at a short distance, but also viewed various antelopes, springboks, giraffes and a leopard. The sanctuary is also a home to more than 230 species of birds.

Entertainment

A traditional dancing group from one of the neighbouring villages was facilitated to perform during the opening ceremony. The facilitation included accommodation and meals.

Publicity, Finance and Fundraising:

The Income and expenditure files are attached

Conference sponsors

No.	Sponsor	Sponsor Logo
1	**Botswana International University of Science and Technology (BIUST)**	BIUST BOTSWANA INTERNATIONAL UNIVERSITY OF SCIENCE & TECHNOLOGY

2	**Botswana University of Agriculture and Natural Resources (BUAN)**	BUAN BOTSWANA UNIVERSITY OF AGRICULTURE AND NATURAL RESOURCES
3	**University of Botswana (UB)**	THUTO KE THEBE UNIVERSITY of BOTSWANA
4	**Auburn University, USA**	AUBURN UNIVERSITY
5	**Liberty Life Botswana (PTY) LTD**	LIBERTY
6	**International Mathematics Union (IMU)-Commission for Developing Countries (CDC)**	INTERNATIONAL MATHEMATICAL UNION CDC

7	**African Institute for Mathematical Sciences (AIMS) South Africa** **Alexander von Humboldt Stiftung/Foundation**	AIMS African Institute for Mathematical Sciences SOUTH AFRICA Bundesministerium für Bildung und Forschung Unterstützt von / Supported by Alexander von Humboldt Stiftung/Foundation
8	***The*** **African Mathematics Millennium Science Initiative (AMMSI)** **London Mathematical Society**	AMMSI LONDON MATHEMATICAL SOCIETY 150 YEARS
9	**Simons Foundation Facilitators Fund through the Research and Graduate studies in Mathematics and Applications (RGSMA) based at BIUST.**	SIMONS FOUNDATION Advancing Research in Basic Science and Mathematics

Chairman SAMSA 2018 LOC

16/8/2019

Prof. E. Lungu

Secretary SAMSA 2018 LOC

, 16/08/2019

Dr J.B.H Njagarah