

# Mathematics in the Countries of Southern Africa, Realities and Aspirations

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Currently there is a dearth of qualified mathematics teachers both at high school and university levels in the entire southern African region. In a continuing effort to remedy this basic structural problem in our countries, each university in the region aims to train its staff through staff development programs. These are programs where the best students are encouraged to go for M.Sc. degrees in the hope that upon completion they will become members of the university staff. Even these programs are currently hampered by the lack of financial resources. As an example, the University of Zimbabwe used to send its graduates overseas for M.Sc./Ph.D. studies, but cannot afford to do so now because there is no longer any money to fund these students. Locally the facilities for their advanced training are either inadequate or simply nonexistent.

Funding for mathematics education and mathematics programs by the various governments of the region is simply inadequate. Most universities have neither the resources nor the expertise to offer mathematics courses with sufficient specialization at bachelor's-degree level or above. For example, in the region the Univer-

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sity of Zimbabwe and the National University of Science and Technology (also in Zimbabwe) are the only two which offer honours degrees in mathematics. As a result, the application of mathematics in modeling industrial, environmental, or other real-life problems is fairly unknown in this part of the world, since there is a dire shortage of qualified personnel.

The governments of our various countries tried hard to train manpower when our economies were "strong". As the economies have declined, less money is being spent on manpower training. For this reason, the universities in the region are pooling their resources by establishing regional programs. Recently, for example, through partnerships with the University of Oslo and with the Austrian government small combined regional masters programs in mathematical modeling and in graph theory have been established at the University of Zimbabwe. To widen the pool of graduates entering these local programs as well as programs abroad, the region requires a "pre-M.Sc." program, through which many people will be raised to the required level.

A 12-month intensive "B.Sc. Honours" program at the University of Botswana is currently being contemplated to bridge the gap between the university preparation in mathematics available in many surrounding countries and advanced programs such as those in Zimbabwe. It can also be used as preparation for various staff development fellows from Southern Africa Development Corporation countries. There are also good students who pursue combined majors in mathematics with another science subject. Upon completion of their studies, these students will not have done enough advanced courses in mathematics. The 12-month program can be used to raise the standard of these students to "pre-M.Sc." level. This program at the University of

Botswana can and will go a long way towards addressing the problems of advanced undergraduate mathematics education in the region.

With colleagues from Europe who have worked in the region, we are currently attempting to formalize these efforts, incorporate them into a several-year cooperative plan, and, with the help of the international mathematical community, find the financial and human resources that will help us to a full and fruitful implementation. We are calling the project MUSA (Mathematics and its Uses in Southern Africa).

The goal of MUSA is to foster dialogue and cooperative activities involving mathematicians and students of mathematics from a geographically connected region of sub-Saharan Africa, hopefully including Botswana, Malawi, Mozambique, Namibia, Zambia, and Zimbabwe, as well as Lesotho and Swaziland. Ties with the South African mathematical community would also be sought. MUSA will focus on regional development of a vigorous community of mathematicians, students of mathematics, and users of mathematics in government and business. MUSA contemplates three components:

1) A 12-month full-time program called a "B.Sc. with Honours in Mathematics" at the University of Botswana in Gaborone consisting of four year-long courses:

Abstract Algebra/Linear Algebra

Real/Complex Analysis

Topology/Geometry

Functional Analysis/Applied Mathematics

With the help of the international mathematical community, MUSA hopes to generate a scholarship fund to enable qualified students from participating countries to complete this program.

2) The 18-month M.Sc. in Mathematical Modeling program at the University of Zimbabwe, which has been established in recent years under a cooperative agreement with the Norwegian Universities' Committee for Development, Research and Education (NUFU). Again with the help of the international mathematical community, MUSA hopes to generate a scholarship fund for this program. The support of countries in the region will also be sought in the form of continuing the salaries of mathematics teachers and others employed as mathematicians during a leave of absence to complete this program. In addition, visiting students from government, industry, and other countries would be encouraged.

3) The gradual formation and strengthening of a community of researchers/teachers connected with a small number of mathematical research centers in Europe, the Americas, and Asia. We envision the establishment of an annual teaching/research meeting in consultation and

cooperation with existing activities of the Southern African Mathematical Sciences Association. The site of this meeting would rotate among the countries having students/teachers/researchers participating in the program at any level. In addition, the content of this meeting would include minicourses, mini-research projects, and research talks, as well as a pedagogical component. The emphasis of each component would change from year to year depending on the mathematical situation of the country in which it is held.

In addition, and again with the help of the international mathematical community, MUSA hopes to establish a series of small pilot programs:

i) A visiting program for research mathematicians from established centers outside the region to participating southern African centers. These visiting mathematicians would teach undergraduate and postgraduate courses and participate in research activities. (Preference would be given to those involved in longer-term joint research or learning projects.)

ii) A program of visits to established centers for the African mathematicians, again with preference for those involved in longer-term joint research or learning projects.

iii) A program of 1-2 year "visiting lectureships" for young mathematicians with degrees from established centers outside the region to work on-site, teaching and collaborating in the above activities. We would design such positions so as to allow the young mathematicians ample time to continue their own research programs during their lectureships.

iv) A program of research and teaching visits for mathematicians from one participating Southern African country to teach advanced undergraduate and postgraduate courses and to do research in other participating countries.

These annual teaching/research meetings and the visiting programs, although long-term projects, would greatly benefit a lot of young mathematicians in the region who after their Ph.D. find themselves overburdened by teaching demands and with no prospects of promotion by authorities requiring "a good research record".

Alone our countries do not yet have the human and financial resources to realize these aspirations for our mathematical community. Indeed, a good part of the program outlined above will require funding from abroad, either in the form of foundation grants or cooperative agreements. In the hope that we can gradually find friends for our efforts in America and other countries, we wish to draw the attention of the American mathematical community to our current work and future aspirations here in southern Africa.

