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Mapping Research and Innovation in the Republic of Malawi

GO→SPIN Country Profiles in Science, Technology and Innovation Policy
Volume 3

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Technology and Innovation Policy

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In co-operation with the
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Republic of Malawi



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Acronyms and Abbreviations

AECID	Spanish Agency of International Co-operation for Development (Agencia Española de Cooperación Internacional para el Desarrollo)
ARIPO	African Regional Intellectual Property Organisation
ASTI	Agriculture Science and Technology Indicators
ASTII	African STI Indicators Initiative (NEPAD)
AOSTI	African STI Observatory (African Union)
COMESA	Common Market for Eastern and Southern Africa
GDP	Gross domestic product
GO→SPIN	Global Observatory of Science, Technology and Innovation Policy Instruments (UNESCO)
EPO	European Patent Office
FDI	Foreign direct investment
FTE	Full-time equivalent
HDI	Human Development Index (UNDP)
ICTs	Information and communication technologies
IDRC	International Development Research Centre (Canada)
IPR	Intellectual property rights
ISCED	International Standard Classification of Education
MDG	Millennium Development Goals
NCST	National Commission for Science and Technology (Malawi)
NEPAD	New Partnership for Africa's Development (African Union)
NRCM	National Research Council of Malawi
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing power parity
R&D	Research and development
SADC	Southern African Development Community
S&T	Science and technology
SETI	Science, engineering, technology and innovation
STI	Science, technology and innovation
STPI	Science and Technology Policy Instruments (IDRC)
UNCT	United Nations Country Team
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UIS	UNESCO Institute for Statistics
USPTO	United States Patents and Trademark Office
WIPO	World Intellectual Property Organization



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Foreword by Irina Bokova



Science, engineering, technology and innovation hold key answers to the new, complex challenges facing governments. These cannot be stand-alone processes but rather should be integrated into societies through partnerships, through strong links between science, policy and society, through effective national policies and robust systems of governance and through science education. Innovation is not a decision but an ecosystem that is a foundation for knowledge societies and sustainable development.

Governments need tools to map the landscape of science, technology and innovation (STI) in their countries, in order to strengthen national frameworks and take sharper decisions. This is the importance of UNESCO's Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN), which allows governments to review their country's performance against established indicators while exploring best practices from other countries. GO→SPIN provides key information on a range of levels, from STI policies, operational instruments and legal frameworks to STI national systems and data – all in order to improve policy-making, implementation and evaluation.

GO→SPIN is a core part of UNESCO's strategy to support the development of science policy initiatives, working with governments and other partners. Reliable information is vital for integrating research and innovation as cross-cutting policies into national development strategies and for catalysing greater investment by governments in the sciences for sustainable development.

I am confident that this new online series of country profiles by UNESCO will provide Member States and the global scientific community with a useful tool as we seek to build more inclusive knowledge societies.

A handwritten signature in black ink that reads "Irina Bokova".

Irina Bokova



Introduction

The growing complexity of science and innovation systems and the interface with society have been accompanied by a more complex policy environment. This results in a need for better co-ordination and coherence at national level. One of the most crucial factors is the increasingly global nature of the issues with which national policy-makers are confronted. In a whole series of areas, such as the environment, telecommunications, health, energy, education and intellectual property, it no longer makes much sense to construe problems in purely sectoral and national terms. In a world that is becoming daily more interdependent, policy-making is inevitably assuming an increasingly transversal and global dimension. In this context, science, technology and innovation (STI) policy systems have emerged as interconnections between knowledge, values, national and international socio-economic, environmental, technological and organizational components.

UNESCO has a long tradition of supporting Member States in policy development. With the convergence of S&T fields, the need to harness science, engineering, technology and innovation (SETI) for human and economic development and the transnational nature of today's challenges, STI policy processes have become a much more complex undertaking.

It is our vision that STI policies are transversal, cross-cutting policies that support and build the structural pillars for sustainable development. Therefore, UNESCO is conscious that monitoring and evaluating the impact of explicit and implicit policies and instruments is part of our work in supporting the design and implementation of STI frameworks in our Member States.

Mapping Research and Innovation in the Republic of Malawi is the third in a series of a series of country profiles prepared by the Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN), a new UNESCO initiative.

The GO→SPIN programme is helping Member States to reform and upgrade national science systems and governance, and to build capacity to monitor and evaluate performance through SETI and social indicators. In this way, the scope of standard SETI assessment can be widened, to take into account country-specific contexts, as well as emerging knowledge of technological advances that contribute to sustainable development. Complementing efforts to promote evidence-based SETI policy-making, GO→SPIN offers a good basis for the promotion of scientific and technological foresight studies.

Through the GO→SPIN programme, UNESCO's Division of Science Policy and Capacity Building is working as a standard-setter, assisting in the elaboration of guidelines for SETI policy formulation, review and reforms, including monitoring and evaluation of policies and programmes. In this context, scientific advisory systems for governments and parliaments are necessary, as well as the availability of a wide range of scientific assessments to inform policy- and decision-makers and to bridge the gap between science and policy.

The Division of Science Policy and Capacity building has been collaborating with African Member States with the support of the Agencia Española de Cooperación Internacional para el Desarrollo (AECID) and its Spanish Fiduciary Fund allocated to the project, entitled Capacity Building in STI Policy in Africa.



After African countries expressed a common need to enhance capacities in the design and evaluation of SETI policies, policy instruments and governing bodies, three sub-regional workshops were organized by UNESCO between November 2012 and June 2013, in Harare (Zimbabwe), Dakar (Senegal) and Maputo (Mozambique). We applied the methodological approach developed by GO→SPIN to train higher national officials in designing, implementing and monitoring different types of operational policy instrument. This training involved officials from Angola, Botswana, Burkina Faso, Burundi, Cape Verde, Cote D'Ivoire, Gabon, Malawi, Mozambique, Niger, Senegal, Zambia and Zimbabwe. There are plans to extend this training to other sub-Saharan countries and Arab States.

In November 2012, during the African Ministerial Conference on Science and Technology (AMCOST V), it was recommended that the African Observatory on STI (AOSTI), the African STI Indicators Initiative (ASTII) and UNESCO's GO→SPIN programme improve co-ordination among their different surveys. Following this recommendation, an agreement between UNESCO and AOSTI was established in February 2013. The terms of this agreement place AOSTI in charge of following up each GO→SPIN survey for a group of West African countries. There are plans to extend this agreement to the entire continent.

The participating countries are currently completing a national GO→SPIN survey on SETI policies and policy instruments that will be part of both this new series of country profiles and the GO→SPIN online platform.

The present profile is based on the GO→SPIN survey conducted as follow-up to the Harare sub-regional training workshop by the officers of the Ministry of Education, Science and Technology of the Republic of Malawi. The profile was further developed by a local consultant working in tandem with his international counterpart. The latter travelled thrice to Lilongwe, twice on fact-finding missions and a third time to participate in the validation workshop for the profile in June 2014.



Acknowledgments

Mapping Research and Innovation in the Republic of Malawi is the outcome of a GO→SPIN training workshop organized by the Division of Science Policy and Capacity Building in Harare in 2012. Our sincere thanks go to the Government of Spain and the Spanish Agency for International Co-operation and Development (AECID) for their financial support and presence at this workshop. We would also like to express our gratitude to the senior officers of the Ministry of Education, Science and Technology of the Republic of Malawi who made this study possible: the Hon. Emmanuel Fabiano (Minister), Hon. Vincent Winstone Ghambi (Deputy Minister), Macphil Magwira (Secretary for Education, Science and Technology) and to the GO→SPIN survey team within the ministry's Department of Science and Technology: Patrick Mphadzula (Director) and William Ngwira. We also wish to acknowledge with thanks the contribution from Victor Gondwe (National Commission for Science and Technology), Chikosa Banda (Chancellor College, University of Malawi), John Saka (Chairperson of the Taskforce Team for review of STI policy) and all the STI stakeholders who participated in the GO→SPIN country profile consultation workshop (Lilongwe, 25–26 June 2014).


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Last but not least, my grateful thanks to the editors of the present volume, UNESCO consultant Guillermo A. Lemarchand and UNESCO science editor Susan Schneegans, who transformed the survey into an informative and readable study.

Maciej Nalecz,
Director
Division of Science Policy and Capacity Building
UNESCO

The methodological framework for this series





GO→SPIN Country Profiles in Science, Technology and Innovation Policy is a series of reports published by UNESCO within its Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN). The GO→SPIN programme is run by UNESCO's Division of Science Policy and Capacity-Building.

The aim of this new series is to generate reliable, relevant information about the different landscapes of science, engineering, technology and innovation (SETI) policies around the world. The published information is based on replies to the GO→SPIN surveys, combined with government reports and statistical data from the UNESCO Institute for Statistics and other international sources.

Each country profile represents a comprehensive study of all the SETI policies, which include:

1. a long-term description of the political, economic, social, cultural and educational contextual factors;
2. a standard content analysis of the explicit SETI policies, including those research and innovation policies implemented in other sectors, such as the agricultural, energy, health, industrial and mining sectors;
3. a study of R&D and innovation indicators;
4. a long-term scientometric analysis of scientific publications, patents, trademarks and utility models;
5. a description of the SETI policy cycle;
6. a complete analysis of the SETI organizational chart at five different levels (policy-making level; promotion level; research and innovation execution level; scientific and technological services level and evaluation level);
7. an inventory of all the SETI government bodies and organizations related both to research and innovation and to science and technology services;
8. an inventory of the SETI legal framework, including acts, bills, regulations and international agreements on SETI issues;
9. a standard inventory with 18 different analytic dimensions of all the SETI operational policy instruments in place;
10. a SWOT analysis of the country's research and innovation landscape.

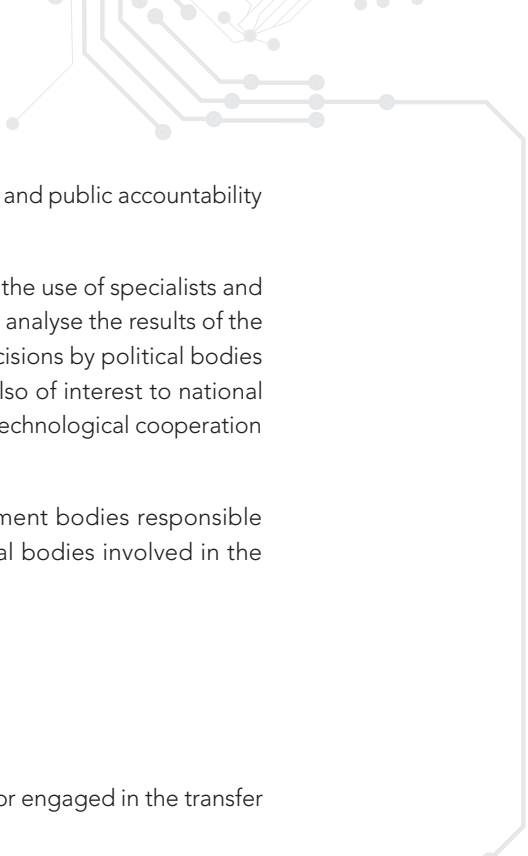
THE GO→SPIN APPROACH

The strategy of the GO→SPIN programme is four-fold:

- ▶ **Capacity-building:** training high-ranking national officials in the design, implementation and evaluation of a variety of SETI policy instruments at national and regional levels;
- ▶ **Standard-setter:** providing a standard practice for surveys on SETI policies and operational policy instruments through the *Paris Manual*¹
- ▶ **Data collection:** worldwide distribution of the GO→SPIN surveys, prioritizing Africa, Arab States, Asia–Pacific and Latin American and the Caribbean.
- ▶ **GO→SPIN platform:** creation of an online, open access platform for decision-makers, knowledge-brokers, specialists and general public, with a complete set of various information on SETI policies.

The online platform will provide an innovative cluster of databases equipped with powerful graphic and analytical tools. The platform has been devised for political leaders, planners, directors and administrators of S&T in government, parliament, universities, research institutions, productive enterprises concerned with innovation, international organizations working for development; research personnel and specialists whose field of study embraces S&T policies.

¹ The *Paris Manual* is being drafted by an international committee of experts put together by UNESCO in 2011. Once completed, the manual will define the ontological and epistemological bases of a common paradigm for evaluating STI policies and policy instruments worldwide.



The platform will also be a useful tool for the democratization of decision-making and public accountability of SETI policies.

The GO→SPIN survey and the information generated are primarily intended for the use of specialists and governmental bodies responsible for national SETI policies. It is their function to analyse the results of the survey and draw appropriate conclusions when they are required to prepare decisions by political bodies in the field of science, engineering, technology and innovation. The survey is also of interest to national bureaux of statistics and international organizations for promoting scientific and technological cooperation among their member states. Collectively, these users are:


- ▶ the national developing planning agencies, more particularly the government bodies responsible for formulating and co-ordinating national SETI policies and other national bodies involved in the application of science and technology (S&T) to sustainable development;
- ▶ parliamentary groups especially concerned with STI policies;
- ▶ SETI information brokers, consulting groups and advisory bodies;
- ▶ teaching and research departments engaged in SETI policy studies;
- ▶ The governing bodies of R&D institutes and S&T services;
- ▶ The boards of management of productive enterprises heavily reliant on R&D or engaged in the transfer of technology and innovation;
- ▶ International governmental and non-governmental organizations concerned with SETI and their application to sustainable development;
- ▶ Other more peripheral users, such as university departments of political science, economics and social sciences and national and international documentation and information services;
- ▶ The mass media.

At individual level, the main groupings are:

- ▶ **Decision-makers:** i.e. those responsible for national SETI policies and the management of R&D (ministries of R&D or S&T, directors of bodies responsible for formulating national S&T policies, directors of R&D institutes, heads of productive enterprises heavily reliant on R&D, etc.)
- ▶ **Intermediate users:** i.e. those who serve as the link between decision makers referred to above and researchers in S&T policy; their function is to prepare decisions by the former using theories and methods put forward by the latter, this category is made up of experts, consultants, advisers, liaison officers, the staff of ministerial offices and of parliamentary committees, etc., and they usually require rapid access to factual data.
- ▶ **Researchers in SETI policies:** i.e. those who develop the theories and methods on which S&T policy is based (researchers in the philosophy, history, sociology and economics of science, engineering and innovation, in the transfer of technology and in the management of R&D.
- ▶ **The general public:** by making SETI information more accessible, the GO→SPIN approach introduces a new dimension to the democratization of SETI.

THE METHODOLOGICAL FRAMEWORK

Science, engineering, technology and innovation (SETI) are becoming increasingly important for socio-economic and sustainable development. During the past 60 years, both developed and developing countries have recognized this fact by increasing the number of SETI government bodies, establishing new SETI legal frameworks and implementing a diverse set of new SETI policy instruments. This has driven investment in scientific research, technological development and innovation (STI), led to an increase in the number of scientists and engineers and fostered exponential growth in the number of new scientific articles and patents worldwide (UNESCO, 2010a).



The information economy is one of the key concepts invented to explain structural changes to the modern economy (Godin, 2008). The infrastructure to manage SETI information has been largely considered the core resource of national competitiveness in research and innovation (Neelameghan and Tocatlian, 1985). With the globalization of SETI information infrastructure has come a need to implement comprehensive strategies to connect, share and trade both domestic and foreign information at the national level (Lee and Kim, 2009).

The formulation of adequate SETI policies is critical to tackling contemporary challenges that include mitigating the consequences of global climate change; exploring new energy sources; generating innovation to foster social inclusion; promoting the sustainable management and conservation of freshwater, terrestrial resources and biodiversity; disaster resilience; and fostering the eradication of extreme poverty and hunger. These policies also need to be designed to achieve the UN Millennium Development Goals.

Over the past five decades, operational definitions have been elaborated within the framework of multilateral organizations to measure R&D and the broader concept of S&T. Statistical techniques have been developed to estimate private and public resources invested in these areas. For the former the OECD has laid down a methodological framework in the *Frascati Manual*, the sixth edition of which was published in 2002 (OECD, 2002). For the latter, the Member States of UNESCO have adopted the *Recommendations concerning the International Standardisation of Statistics on Science and Technology* (UNESCO, 1978; 1982; 1984a; 1984b). Methodologies for generating data about R&D investment and human resources have been constantly upgraded and extended.

During the first African Ministerial Conference on Science and Technology² (AMCOST I), in 2003, countries committed themselves to developing and adopting a common sets of STI indicators. The New Partnership for African Development (NEPAD) established the African Science, Technology and Innovation Indicators Initiative (ASTII) with the objective of building Africa's capacity to develop and use STI indicators. More specifically, NEPAD aims to: (a) develop and promote the adoption of internationally compatible STI indicators; (b) build human and institutional capacities for STI indicators and related surveys; (c) enable African countries to participate in international programmes on STI indicators; and (d) Inform African countries on the state of STI in Africa. The first *African Innovation Outlook* was published in 2011, while the second volume is being published in 2013. The methodology employed – that suggested by ASTII officials – follows the recommendations of the *Frascati Manual* for R&D indicators and the *Oslo Manual* (OECD, 2005) for innovation indicators.

In 2009, the UNESCO Institute for Statistics organized an Expert Meeting on Measuring R&D in Developing Countries, in Windhoek (Namibia). During the meeting, the experts identified the difficulties and challenges faced by the majority of developing countries, which were not explicitly addressed in the *Frascati Manual* (UNESCO Institute for Statistics, 2010; see Box A). The UNESCO Institute for Statistics is working towards a global standardization of STI statistics, including those items which are not taken into account in the *Frascati Manual*.

The availability of input and output R&D indicators alone does not suffice to evaluate SETI policies. Much more important than the particular value of one specific indicator at a given time is the long-term rate of change that long temporal series of indicators show (Lemarchand, 2010: 27–28). For that reason, long-term temporal series of indicators are necessary to analyse the impact of specific public policies. Improving the reliability of this analysis requires new ways of standardizing information about public policies and the policy instruments designed to implement them. Owing to the complexity of these issues, the 'science of science policy' has emerged in recent years as a new discipline where new analytic paradigms can be tested.

2 The final declaration of the AMCOST meeting in 2012 recommended coordination between the African Observatory on STI (AOSTI), ASTII and UNESCO's GOSPIN. An agreement between UNESCO and AOSTI in February 2013 assigned AOSTI with responsibility for following up GO→SPIN surveys with a group of West African countries.



BOX A – MEASURING R&D: CHALLENGES FACED BY DEVELOPING COUNTRIES

The methodology for measuring R&D is detailed in the *Frascati Manual* (OECD, 2002), which has been in use for more than 50 years. A revised edition is due out in 2015. Despite the manual's longevity, developing countries still face problems when trying to apply its standards to measuring the situation in their particular country.

The UNESCO Institute for Statistics conducts a biennial data collection of R&D statistics and produces a methodology tailored to the needs of developing countries; it also holds training workshops and builds capacity through other means in developing countries.

In 2014, the UNESCO Institute for Statistics published a *Guide to Conducting an R&D Survey: for Countries starting to Measure R&D*. This guide presents the relevant R&D indicators, discusses the main issues facing each of the major sectors of performance, provides a simple project management template and proposes generic model questionnaires for the government, higher education, business and private non-profit sectors which countries can use and adapt to suit their needs.

In 2010, the UNESCO Institute for Statistics produced a technical paper on *Measuring R&D: Challenges faced by Developing Countries*. The OECD Working Party of National Experts on Science and Technology Indicators subsequently suggested that the paper serve as the basis for an annex to the *Frascati Manual: Proposed Standard Practice for Surveys of Research and Experimental Development* (6th edition). This annex was adopted as an online adjunct to the *Frascati Manual* in March 2012 (OECD, 2012).

Measuring R&D: Challenges faced by Developing Countries provides guidance on a number of challenges that are relevant to developing countries and which may not be elaborated on clearly enough in the *Frascati Manual*. The following situations are addressed in the document, among others:

- ▶ Despite the increasing presence of developing countries in global R&D, there is still a marked lack of demand for science, technology and innovation (STI) indicators from policy-makers in developing countries. Even if the demand does exist, there are often significant problems with compiling the data due to a lack of coordination at the national level, a lack of cooperation by research institutions, universities and businesses, and a generally weak statistical system in the country.
- ▶ R&D used to be largely funded by the government but new sources of funds are emerging. Foundations, scientific associations, NGOs and particularly foreign organizations already play an important role. In addition, the contribution of private business is becoming more important and gaining more recognition in a wider range of developing countries. Many of these new sources of funding go directly to individuals and groups rather than to institutions and therefore remain unaccounted for, including for statistical purposes.
- ▶ Although the *Frascati Manual* recommends the collection of primary data through direct surveys, the use of secondary data from national budgets and budgetary records of public R&D performing units has been a widely adopted practice to obtain a rough estimate of gross expenditure on R&D (GERD). However, there is often a discrepancy between voted and allocated budgets. Furthermore, national research systems have a limited absorption capacity, which may leave funds unused in central accounts instead of being transferred to institutions performing R&D. Moreover, care needs to be taken to ensure that such transfers are not 'double counted' as expenditure of both the funding body and the institution performing R&D.
- ▶ The definitions used by finance ministries and other government institutions to establish S&T budgets may be *ad hoc* and fail to distinguish between broad S&T and narrower R&D activities. Furthermore, many institutions (universities in particular) do not compile a separate R&D budget, especially where research is a low institutional priority.
- ▶ R&D components in the national budget, especially capital expenditure, can be difficult to identify and may be aggregated under different headings. In addition, when R&D activities



stretch over more than one financial year, it may not be easy to estimate the amount of resources used each year. For example, work done to develop land and buildings used for research in a given year should be clearly earmarked and not recorded in subsequent years.

- ▶ A concentration of innovation activities by sector or in a small set of institutes may lead to volatility and inconsistencies in statistics. There is generally lower emphasis on R&D in the business sector, in part due to reduced competitive pressure in local markets.
- ▶ In the higher education sector, the increasing number of private universities makes it useful to distinguish between public and private higher education and to further break up private higher education into government-dependent and independent private institutions. Further disaggregation into private-for-profit and private-not-for-profit higher education institutions should also be considered to track where most research is carried out.
- ▶ Surveys that cover all R&D performers should in principle all report for the same period. This is difficult to achieve since, in many countries, higher education institutions and businesses do not necessarily report on the same period – the business sector’s calendar tends to be the most problematic. Also, not all countries follow the same calendar. As a solution, the recommendation that R&D performers report on the financial year closest to the survey period may have to suffice.
- ▶ Information systems in government and higher education are often not set up to enable the extraction of data on R&D personnel and expenditure. Thus, accurate information on financial expenditure only becomes available a long time after completion of an activity. Unfortunately, ad hoc IT solutions to address these issues may also lead to errors and inconsistencies.
- ▶ The collection of data in full-time equivalents (FTE) for researchers provides useful information on the true volume of human resources devoted to R&D. This information is also essential for estimating R&D labour costs. Tallying the number of researchers in a given country presents further challenges. In some developing countries, salaried researchers may not have research budgets or unpaid researchers may undertake research. In other scenarios, academic staff may hold part-time contracts at more than one university. Even if academic staff have contracts that specify the amount of time to be spent on conducting research, it is difficult to enforce especially where there is a lack of resources. Estimating the time spent on research and hence the calculation of the FTE for research staff – particularly in the higher education sector – is fraught with difficulties. This directly impacts the calculation of R&D expenditure.

A number of special types of activity warrant attention when measuring R&D, as they are rest on the border of what is considered R&D. Three examples follow from the technical paper:

- ▶ In the case of traditional knowledge, it is important to set boundaries. Activities which establish an interface between traditional knowledge and R&D are considered R&D. However, the storage and communication of traditional knowledge in traditional ways is excluded.
- ▶ Clinical trials are an area of growth in some developing countries. Identifying research personnel in the extended clinical trials value chain may be difficult, as their involvement is occasional and harbours a risk of double counting (i.e. as personnel in the trial and as academic staff).
- ▶ Reverse engineering is important in many developing countries. However, this generally falls outside the scope of R&D. Only if reverse engineering is carried out within the framework of an R&D project to develop a new (and different) product, should it be considered R&D.

STI statistical systems are often weak in developing countries. To help strengthen these systems, the paper recommends that countries institutionalize R&D statistics, establish registers of R&D performers and document survey procedures and estimations.

Countries interested in embarking on R&D measurement are encouraged to contact the UNESCO Institute for Statistics.





Better ways of measuring evidence-based policies

SETI policy debates are not yet dominated by a thoughtful, evidence-based analysis of the likely merits of different investment options and policy decisions. The latter are strongly influenced by past practice or data trends that may be out of date (Husbands Fealing *et al.*, 2011). The evolution of new policies has been accompanied by more difficult challenges related to planning and evaluating these policies (see Box B); this indicates a need to improve the theoretical frameworks for policy formulation (Steinmueller, 2010).

Unfortunately, a number of factors prevent countries from reaching most of the objectives established by their own development plans: the lack of reliable information on SETI national potentialities; difficulties in coordinating the various SETI stakeholders; an absence of mechanisms for promoting a strong interaction between the *supply* and *demand* sectors in SETI, and; the absence of any explicit industrialization policy promoting endogenous innovation.

These difficulties mostly appear in small economies. For example, Flanagan *et al.* (2011) have explored the ways in which innovation policy studies treat actors, instruments, institutions and interactions, in order to arrive at a more useful conceptualization of the policy mix for innovation. They stress the need for a genuinely dynamic view of policy formulation and policy interaction. They conclude that ‘despite the importance attached to “strategic policy intelligence” in recent innovation policy analysis, little empirical attention has been devoted to actual processes of policy learning.’ In developing and exploiting technological opportunities, institutional competencies – namely, the governance of SETI decision-making bodies – are just as important as the SETI incentive instruments they promote (Pavitt, 1996). Path dependency emerges, as the cost of institutional changes to SETI is often higher than that of accommodating new instruments and policies in existing structures (Van der Meulen, 1998). For this reason, the design, analysis and monitoring of any national SETI policy will strongly depend on the adequate mapping of: the structure of the SETI governing bodies; the SETI national legal framework and; of the implicit and explicit operational SETI policy instruments which are implemented (Herrera, 1971; 1972; Sagasti and Aráoz, 1976).

BOX B – THE POLICY-MAKING CYCLE

A stylized presentation of the policy-making cycle typically involves five stages:

- ▶ *Agenda-setting*: refers to the process by which problems related to SETI and the linkages between SETI and both society and the economy come to the government’s attention;
- ▶ *Policy formulation*: refers to the process by which SETI policy options are formulated by the government;
- ▶ *Decision-making*: refers to the process by which governments adopt a particular course of action or non-action;
- ▶ *Policy Implementation*: refers to the process by which governments put SETI policies into effect and;
- ▶ *Policy evaluation*: refers to the process by which the results of SETI policies are monitored by both the State and societal actors. The result may be a re-conceptualization of policy problems and solutions, in which the effectiveness, efficiency and continuing appropriateness of policies and policy instruments are assessed and the results fed back into another round of agenda-setting.

Responsible and accountable SETI governance entails developing capabilities at each of these five stages.

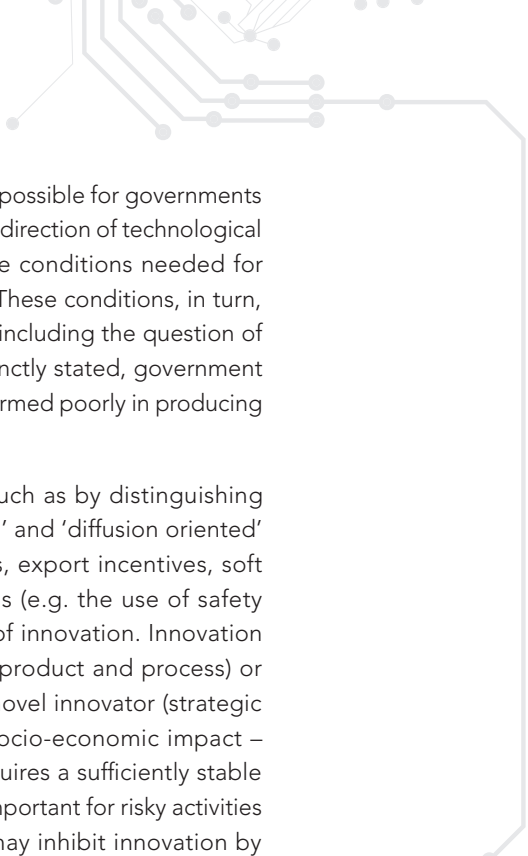


WHY TALK ABOUT SETI POLICIES?

The term 'science policy' was coined following publication in 1945 of Vannevar Bush's seminal article *Science – the Endless Frontier*, which laid the foundations for the first social contract for science. By 1950, UNESCO had initiated the first systematic studies on science policies in a dozen developed countries. Originally, this term referred to public policies related to scientific and technological research, experimental development, scientific and technological services and innovation. *Science policy* as a discipline evolved over the coming decades. Today, it is possible to distinguish specific operational policy instruments according to the different needs established by science policies, engineering policies, technology policies and innovation policies. As these four distinct types of public policy require different skills, major universities around the world have recently introduced specific postgraduate programmes targeting each of the four types of policy:

Science policy: relates to those policies needed to: promote scientific research, determine and select scientific objectives and goals consistent with national plans or strategies, exercise judgment in fixing norms to govern the ways and means by which science is developed, transferred and applied; gather, organize and deploy resources required to pursue the selective objectives and; monitor and evaluate the results obtained from applying the policy. The following are therefore among the most important questions dealt with by policy-makers in the field of science policy: (a) establishing and strengthening government structures and mechanisms for planning, budgeting, co-ordinating, managing and promoting scientific research; (b) gathering, processing and analysing basic data concerning the national scientific potential, including data on ongoing research, monitoring national scientific development and ensuring the smooth growth of the institutional infrastructure for scientific research; (c) maintaining a proper balance between the various types of research (fundamental, applied, experimental development), supporting the development of a creative national scientific community and setting standards for the status of scientific researchers in conformity with their responsibilities and rights; (d) optimizing human, financial, institutional and informational resources to achieve the objectives established by the national SETI policy; (e) assessing and promoting productivity, relevance, quality effectiveness of national research and scientific and technological services in various sectors of performance (higher education, government institutions, business enterprise, private non-profit) and removing organizational and managerial difficulties encountered in the execution of scientific research; (f) initiating appropriate legislative action in relation to the impact on the individual, society as a whole or the natural environment of the application of discoveries and inventions; evaluating the economic profitability and social utility (or harmful effects) of the said discoveries and inventions. Although the aforementioned list is not exhaustive, it indicates the key areas for which government policy-makers are primarily responsible. Each individual issue requires the design of a particular operational policy instrument.

Engineering policy: the role of engineers in public policy can be seen as a two-fold endeavour: (1) to help create public policy related to the utilization of technology to solve public problems as well as monitor and ensure compliance with such policies; and (2) to use engineering knowledge to assist in the construction of policy directives to help solve social problems. In many cases, the development and implementation of such regulations and laws requires both a technical understanding of the functioning of these artefacts and an understanding of how this technology interacts with social and natural systems and would benefit from the involvement of a technical expert. The issues addressed by engineering policies are vast and global in nature and include water conservation, energy, transportation, communication, food production, habitat protection, disaster risk reduction, technology assessment and the deterioration of infrastructure systems. These issues need to be addressed while respecting the rights and meeting the needs and desires of a growing world population [for a detailed list of issues and challenges addressed by engineering policies, see UNESCO (2010 b)].



Technology policy: the fundamental premise of technological policies is that it is possible for governments to implement public policies to improve social welfare by influencing the rate and direction of technological change. The conventional entry point for economic analysis is to identify the conditions needed for such influence to be superior to the outcome of ordinary market competition. These conditions, in turn, direct further examination of the feasibility and methods for such intervention, including the question of whether government intervention is necessary to improve social welfare. Succinctly stated, government intervention would be necessary if profit-seeking actors underperformed or performed poorly in producing or exchanging technological knowledge from the perspective of social welfare.

Innovation policy: innovation policy can be characterized in various ways, such as by distinguishing between 'supply-side' and 'demand-side' policy, or between 'mission-oriented' and 'diffusion oriented' policy. Policy instruments include financial instruments (e.g. R&D tax credits, export incentives, soft loans, etc.) and regulatory instruments such as laws and binding regulations (e.g. the use of safety equipment for children in cars). Innovation policy encompasses many types of innovation. Innovation may be characterized, *inter alia*, by: the type of innovation – technological (product and process) or non-technological (organizational and marketing); the mode of innovation – novel innovator (strategic and intermittent), technology modifier and technology adopters and; the socio-economic impact – incremental, disruptive or radical. The effectiveness of innovation policies requires a sufficiently stable framework, institutions and policies. Stability and predictability are particularly important for risky activities with a long time horizon such as R&D and innovation. Excessive instability may inhibit innovation by increasing uncertainty for innovators. It may lessen the effectiveness of policy instruments by weakening the incentives they provide. In addition, it reduces opportunities for learning and developing evidence-based policy practices. Whereas there are manifold sources of unwarranted discontinuities, political instability and fiscal problems – often related to policy cycles – are a common cause. In an increasingly complex innovation landscape, developing effective governance requires better co-ordination at, and among, the local, regional, national and international levels.

SETI projects normally occur within a larger temporal framework administered by an organization or a government policy-making body. The early stages of a new SETI policy usually appear as successive expansions of the group of agents and stakeholders whose endorsement is needed to launch the initiative, whereas the latter stages focus on programme management, with feedback as to its success or failure at the policy level (Marburger III, 2011). Consequently, in order to provide an accurate landscape of the SETI policies and policy instruments in a specific national context, it is imperative to understand the long-term evolution of the SETI organizational chart, SETI infrastructure and legal framework (i.e. explicit policies), as well as the type of funding mechanisms implemented. The latter dimensions must be contrasted with detailed analyses of the long-term behaviour of political, educational, economic, productive and social macrovariables (i.e. implicit policies).

It is impossible to describe the current status of SETI without accurate data. Moreover, these data should be presented in such a way as to allow decision-makers and experts to estimate whether the status of SETI meets societal needs or expectations. Policy-makers benefit from additional policy tools to assist them in deciding about budget allocations or in the design of new SETI policy instruments, especially if these are real-time tools or new innovative prospective methodologies. Recent empirical studies show the relevance and long-term impact of appropriate SETI information services on SETI policies designed to improve national competitiveness (Lee and Kim, 2009).

It is also important to note the availability of a large group of public and private databases. These can be most useful tools for evaluating the performance of the SETI policies and providing adequate technology intelligence studies. There are robust, accessible systems designed to make rapid analyses and apply mathematical models to identify critical points or levers triggered by policy changes that can directly affect the performance of innovation activities. For example, Zucker and Darby (2011) present a comprehensive survey of all available databases that may be used to analyse the impact of SETI policies (see Box C).



BOX C – USING MATHEMATICAL THEORY TO PROMOTE STRATEGIC NATIONAL INNOVATION

Recent developments in the mathematical theory of networks can be applied to formulating new SETI policies, in order to promote strategic innovation within national economies.

Hidalgo *et al.* (2007) found that ‘economies grow by upgrading the products they produce and export. The technology, capital, institutions and skills needed to make newer products are more easily adapted from some products than from others. The study of this network of relatedness between products, or ‘product space,’ shows that more-sophisticated products are located in a densely connected core, whereas less sophisticated products occupy a less connected periphery. Empirically, countries move through the product space by developing goods close to those they currently produce. Most countries can reach the core only by traversing empirically infrequent distances, which may help to explain why poor countries have trouble developing more competitive exports and fail to converge to the income levels of rich countries.’

This type of analysis can be applied directly to formulating customized SETI policy instruments to foster the development of specific technologies, where the country has detected a potential new technological niche. The availability of access to new electronic international databases (Zucker and Darby, 2011), combined with the appropriate analytic software, might transform this type of analysis into a standard procedure for selecting national SETI priorities.

Access to appropriate, reliable data is also a prerequisite for responsible and accountable governance, which demands informed decision-making at the planning stage of SETI policy and foresight as to the possible short and long-term impact of policy decisions. Therefore, policy-makers not only need a clear picture of the national, regional and global situation. They also need to be able to estimate the impact of current SETI policies and plan on future policies. The analysis of any national or regional SETI policy strongly depends on the adequate mapping of the structure of SETI governing bodies, SETI national legal frameworks and the implicit and explicit operational SETI policy instruments. Gaps or blind spots in information can cause a specific field to be neglected, which can result in missed opportunities for socio-economic development.


POLICY INSTRUMENTS: LEVERS FOR IMPLEMENTING DECISIONS

A policy may remain a mere rhetorical statement if no means are provided for its implementation or to realize its potential effect. To do this, a number of things may be needed, which we will incorporate under the term of policy instrument. A policy instrument constitutes the set of ways and means used when putting a given policy into practice. It can be considered as the vehicle through which those in charge of formulating and implementing policies actualize their capability to influence decisions taken by others.

The study of public policy instruments in national settings has contributed significantly to the understanding of policy, political systems and relations between State and citizen. Research on policy implementation usually focuses principally on the effects of a specific instrument, within a wider reflection on whether the correct instrument has been chosen for the purpose. As far as new governance models is concerned, the search for suitable instruments is above all governed by pragmatism (Kassim and Le Gales, 2010).



Figure A: Instruments for ensuring a policy obtains the desired effect. Adapted from Sagasti and Aráoz (1976)



SETI operational policy instruments are the levers by which the organizational structure ultimately implements the decisions on a day-to-day basis and attempts to produce the desired effect on the variables the policy has set out to influence. Throughout the analysis of an instrument's effectiveness, it is important to bear in mind the 'actors' or key decision-makers who are directly involved in the design and use of a policy instrument. An instrument does not act on its own accord. Rather, it responds to the will of the policy-makers and decision-makers using it.

A related concept can be found in the problem of *Ordnungspolitik* stressed by the German Freiburg School in the 1930s. Here, the focus was how to devise a framework or set of rules (*Ordnungsrahmen*) for an economy that would define the operating space for individual and private activities. The challenge for SETI policy instruments can be interpreted as a problem of transformation, namely the question of choosing the best policy instrument in order to reach the set target.

A policy instrument attempts to make individuals and institutions take decisions following the rationality dictated by the collective objectives established by those in power. It is the connecting link between the purpose expressed in a policy and the effect that is sought in practice. An SETI policy instrument includes, as a significant component, the manipulation of SETI variables.

One of the first and more relevant studies on SETI policy instruments was conducted in the 1970s by the International Development Research Centre. The principal objective of the study was to devise ways and means of understanding how a country's investment in S&T could be most effectively related to its objectives for industrial development. Sagasti and Aráoz (1976) developed an interesting methodological framework for making a survey and analysing the policy instruments of ten countries in Latin America, the Middle East, Southern Europe and Asia.

UNESCO's Global Observatory of Science, Technology and Innovation Policy Instruments³ (GO→SPIN) has adapted and expanded the theoretical framework of Sagasti and Aráoz (1976), in order to implement a systematic survey in Africa, Arab States, Asia and the Pacific and in Latin America and the Caribbean. The information in the present country profile has been organized according to this methodological approach. Figure A presents the basic analytical units around which the present report is organized.

All national SETI policies, be they *implicit* or *explicit* (Herrera, 1971; 1972), attempt to harness a country's creative potential to its socio-economic, environmental and cultural objectives. An *explicit* SETI policy is a statement by a high-level government official or institution, such as a ministry or the planning secretariat, that deals with activities related to STI. The policy expresses a purpose (effects according to SETI variables) and may set objectives, define desired outcomes and establish quantitative goals. Policies also contain criteria for choosing from among several alternatives to guide decision-makers as to how SETI works. SETI policies might also be formulated by representatives of the private sector. A number of factors impinge on the efficiency of SETI governance, namely, the extent to which policy processes have the greatest effect with a given use of resources. It must be acknowledged that overall efficiency is not easily defined and measured in a multi-objective, multi-actor world.

3 See www.unesco.org/new/en/natural-sciences/science-technology/sti-policy/global-observatory-on-policy-instruments

THE KEY ROLE OF THE SETI ORGANIZATIONAL STRUCTURE IN POLICY IMPLEMENTATION

The SETI organizational structure or chart usually shows the distribution of responsibility for implementing a given policy. Under the term 'organizational structure,' it is possible to distinguish at least five different levels: (1) policy planning level (policy design); (2) promotional level (i.e. funding and co-ordination of R&D, innovation and scientific and technological services); (3) implementation level (execution of R&D and innovation); (4) scientific and technological services and; (5) assessment or evaluation level.

1. *Policy planning level:* includes policy planning, budgeting, decision-making, interministerial co-ordination. The responsibility for the formulation of SETI policies generally rests with a special government department, ministry or statutory body, in some cases assisted by national councils of research and innovation. SETI policy formulation normally includes the preparation of the national development plan or strategy relating to SETI; it also includes the annual preparation of the functional state budget for SETI activities (mainly research, innovation and scientific and technological services). The decision-making function usually falls to the government, or to a committee of ministers more specifically concerned with SETI; it mainly involves the approval of the national SETI plan (or strategy), as well as the assignment of funding mechanisms. The interministerial co-ordination takes place during the formulation of policies and preparation of plans and budgets then at the various stages of the implementation of these policy documents, once approved by the government.
2. *Promotional level:* the promotion, financing and co-ordination of research, innovation and scientific and technological services in the various sectors of the economy and in society. The functions performed at this level begin with the policy decisions taken by the government and continue with the various government departments or ministries through traditional budgetary procedures along administrative budget lines or through programme budget procedures, as applied to the so-called management by objectives. Several funding mechanisms and SETI operational policy instruments of various kinds have been implemented over the years (i.e. research funds, innovation funds, sectorial funds, tax-incentives; competitive grants, scholarships, etc.). Most countries apply a combination of operational policy instruments to handle the financing of research, innovation and scientific and technological services according to well-defined programmes. The latter can be achieved either by responding to requests for the funding of specific projects submitted by external institutions, laboratories, research units, individual research scientists and high-tech enterprises, or by providing incentives for innovation, or by selectively entrusting the external bodies mentioned above with the execution of specific projects called for by certain development objectives according to the national SETI plan or strategy (normative method). At this particular level, several countries have special institutions (i.e. national research councils) which promote the advancement of scientific research and technological development with a view to improving the quantity and quality of new scientific knowledge to expand the country's potentialities, particularly through support for post-graduate education and research at universities and polytechnics.
3. *Implementation level:* this operational level concerns the actual performance of scientific research, technological development and innovation.
4. *Scientific and technological services (STS) level:* this represents a mixed group, including the institutions in charge of: (a) SETI information and documentation, (b) museums of science and technology, botanical and zoological parks and other SETI collections (anthropological, archaeological, geological, etc.), (c) general purpose data collections: all the activities comprising the routine systematic collection of data in all fields of SETI, such as topographical, geological and hydrological surveys, routine astronomical, meteorological and seismological observations, surveying of soils and plants, fish and wildlife resources, atmosphere and water testing, monitoring of radioactivity, UV and CO₂ levels, prospecting and related activities designed to locate and identify oil and mineral resources, gathering of information on human, social, economic and cultural phenomena, usually for the purpose of compiling routine statistics; testing, standardization, metrology and quality control, activities related to patents and licenses, as well as the production of scientific publications.

5. *Assessment or evaluation level*: this consists in government sectors and institutions monitoring the implementation of policy goals and measuring the societal impact of those policies. Their function also encompasses the conduct of an ongoing survey of a country's SETI potential at the level of research, innovation and scientific and technological service units, including ongoing research results and their practical application.

The GO→SPIN methodological approach introduced a normalized way of encoding the different types of organization and their functions. By representing each national SETI organizational chart and by using the same set of coding tools (Lemarchand, 2010: 310), it will be possible in future to associate these charts and tools with specific topological metrics to identify patterns in performance. The latter will be very useful for defining a new set of SETI policy indicators able to reveal the level of complexity and functionality of each STI organizational chart. Table A shows a typical example on how different countries structure SETI policy design.

Since its purpose is to guide decisions about the future that must be taken now, a SETI watch cannot seek to identify future developments in S&T independently of past and current developments, or independently of the material and human resources devoted to research and innovation. The prerequisites for any future is: knowledge of the present, knowledge of the current trends observed in a real world composed of different nations and institutions and knowledge of the strength and weaknesses of the national SETI system in which the decisions informed by the GO→SPIN survey methodological approach have to be taken.

Table A: Models of governing bodies heading SETI policy design

Argentina	Scientific and Technological Cabinet (GACTEC) Ministry of Science, Technology and Productive Innovation
Australia	Prime Minister's Science Engineering and Innovation Council Commonwealth State and Territory Advisory Council on Innovation Coordination Committee on Innovation
Chile	Inter-ministerial Committee for Innovation National Corporation for the Promotion of Production (Ministry of Economy) National Commission for Scientific and Technological Research (Ministry of Education)
Croatia	Ministry of Science, Education and Sports National Council for Science National Council for Higher Education
Czech Republic	Ministry of Industry and Trade Council for Research, Development and Innovation Ministry of Education, Youth and Sports
Finland	Research and Innovation Council Ministry of Employment and the Economy Ministry of Education and Culture
Ireland	Inter-Departmental Committee on STI Department of Jobs, Enterprise and Innovation
Malaysia	Ministry of International Trade and Industry Ministry of Science, Technology and Innovation Economic Planning Unit
Republic of Korea	National Science and Technology Council Ministry of Science and Technology
Singapore	Economic Development Board Research, Innovation and Enterprise Council National Research Foundation
South Africa	Department of Science and Technology Department of Trade and Industry Department of Higher Education and Training

Source: UNESCO

The diversity of institutions at the promotion level (funding) in a given country seems to be one of the most fundamental indicators of good practices. The GO→SPIN global database will provide empirical evidence to confirm or refute this and other hypotheses.

The so-called *legal framework* can also be considered as a legal instrument. This embodies the policy, or parts thereof, in the form of a law, decree or regulation. Formal agreements, contracts and international STI cooperation treaties may also be included in this category. A legal instrument goes one step beyond a policy by stipulating obligations, rights, rewards and penalties. The GO→SPIN systemic approach has developed a friendly platform offering direct access to the entire SETI legal framework, description and the full text of laws, acts, decrees and agreements adopted by each country. Table B shows different examples of the most important types of legal instrument.

Table B: Examples of SETI legal instruments

A law for the creation of national research labs, universities, national research councils, ministry of S&T, R&D Funds, etc., or a legal framework to regulate the organization of the national innovation system.
A law to regulate the imports/exports of high-tech products.
A law to regulate tax incentives to promote innovation within the private sector.
A law to regulate foreign direct investments promoting the establishment of new high-tech enterprises.
A law to regulate the protection of the national biodiversity and to establish norms on how foreign companies exploit the active substances available within each national territory (new rules for the protection of indigenous knowledge).
Laws to foster R&D activities within the private sector and the creation of technological funds associated with the most strategic sectors of the economy (energy, mining, agriculture, industry, communication, fishing, tourism, etc.).
National regulations and decrees to establish new national policies, creation of new funding mechanisms, import/export tariffs, etc.
Bilateral, regional and international agreements on SETI activities.
Contracts on technology transfer.

Source: UNESCO

GO→SPIN also includes a complete description of SETI operational policy instruments; these are the levers, or actual means, through which the organizational structure ultimately implements the decisions on a day to day basis and attempts to influence the behaviour of the various stakeholders targeted by the policy. Throughout the analysis of an instrument, it is important to keep in mind the actors or key decision-makers who are directly involved in the design and use of a policy instrument. An instrument does not act on its own accord. Rather, it responds to the will of the policy-makers and decision-makers using it. Table C shows different types of operational policy instrument, whereas Figure B shows various instruments that can be employed to effect at the different stages leading to market penetration of an innovation. Table D presents the taxonomic classification of SETI operational policy instruments employed by GO→SPIN according to its methodological approach, by objective and goal; the type of mechanism/mode of support and target groups/beneficiaries. By analysing the aggregated information for groups of countries employing these classification schemes, it is possible to detect development patterns.

Table C: Examples of operational SETI policy instruments

Programmes and objectives	Policy instrument	Strategic objectives	Beneficiaries	Mechanisms for allocating funding
Scientific research and technological development	Competitive grants	Promote the endogenous production of new scientific knowledge in the exact and natural sciences. Promote regional networking.	Research groups at national universities and national research centres associated with similar research groups from other countries in the region, within formal partnership agreements	Competitive grants selected on a peer review basis; national research groups must be associated with similar groups from countries in the region which provide matching funding
Promotion of science education	Public subsidies for projects establishing science laboratories at public secondary schools	Improve scientific knowledge; methodological approach and critical thinking for secondary school pupils	Public secondary schools in less developed parts of the country	Public subsidies to mount new science cabinets and laboratories and new posts for science professors
Promotion of gender equality in research and innovation	Scholarships	Promote the participation of women in high-tech research and innovation	Young women enrolled in a PhD programme in basic and engineering sciences	Scholarships of up to four years and small grants for participation in international conferences
Protection of indigenous knowledge	Intellectual property rights, public law–national legislation and public subsidies	Protection of traditional knowledge to confer exclusive ownership and rights on local communities when the object of protection is a product or domesticated animal, cultivated plant or any micro-organism, or a design or an object of a functional or aesthetic nature, including any element of handicrafts, the act prohibits third parties from making, using, stocking, offering for sale, selling, commercializing, importing, exporting or identifying the active substances for commercialization, without consent	A local traditional practitioner, a local community or its representative may apply to register traditional knowledge	Public subsidies and tax exemptions to defend the Intellectual property rights of holders of indigenous and traditional knowledge
Attraction and reinvestment of foreign direct investment	Public financing Tax incentives	Strategies vary from country to country, examples being: (a) an Industrial policy based on attracting export-oriented industries; (b) promotion of structural change; (c) capacity-building to improve competitiveness, focusing on sectors or market niches; (d) internationalization of enterprises, and promotion of innovation; (e) prioritizing the generation of higher-tech goods and services (f) attracting selective FDI oriented towards ICTs, biotechnology, nanotechnology and financial services; (g) improving the business climate by refining legislation and simplifying formalities to facilitate corporate operations.	National Infrastructure (buildings, technology corridors, technological cities) and training of labour and professionals for the industry in question SMEs with export capacity	Soft-loans, tax incentives, grants For specific periods: tax discounts, exemptions, preferential rates, rebates on machinery and equipment
	Attracting R&D firms		Endogenous entrepreneurs High-tech emerging sectors: biotechnology, nanotechnology, new materials, ICTs.	The same tax incentives plus special competitive funding
	Other services	Structural change within a large country offers more opportunities for the domestic market, small and medium-sized countries generally focus on schemes conducive to the development of exports	Strengthening exports of industries and services considered to have strong potential in the country	Creation of a “one-stop shop” with representatives from different ministries/agencies to deal with problems concerning programmes, public regulations and post-investment services

Programmes and objectives	Policy instrument	Strategic objectives	Beneficiaries	Mechanisms for allocating funding
Technological development	Non-repayable contributions	Increased competitiveness through innovation in products, services and processes	Micro-, small and medium-sized enterprises and broader enterprises certified as having attained international standards	By public competition; up to 50% of project cost
	Loans for technological development projects	Finance for middle-income technology production projects	Micro-, small and medium-sized enterprises with R&D departments or teams, collaborating groups and technical linkage units underwritten by the enterprise	Compulsorily repayable loans; up to 80% of the total cost, allocated on an open window basis, with a maximum of \$... for three years
Technological modernization (improvement of products and processes, training)	Fiscal credit programme	Assistance in executing R&D	Physical or juridical persons who own enterprises producing goods and services	Subsidies through fiscal credit certificates obtained via public competition; up to 50% of the total cost of the project
	Loans for modernization Projects	Technological adaptation and improvements to products and processes with a low level of technical and economic risk	Enterprises with R&D department or groups; collaboration groups, and technical linkage units underwritten by the enterprise	Special compulsorily repayable loans allocated on an open window basis. Up to 80% of the total cost of the project, with a maximum of \$...in three years
	Loans to enterprises	To finance projects for the development of new production processes, products and modifications thereto	Enterprises, without any restriction on size or sector; no finance provided for projects with a rate of return of less than 12%	Compulsorily repayable loans allocated on an open window basis. Up to 80% of the total cost of the project, with a maximum of \$...
Promotion of the technological services market (research institutes and business research centres)	Subsidies for projects to develop business plans	Finance for business development projects based on R&D	Micro-, small and medium-sized enterprises whose projects are executed by technical linkage units	Subsidies allocated on an open window basis. Up to 50% of the total project cost, with a maximum of \$..., for up to one year
	Loans to institutions	To promote the establishment and strengthening of structures for the provision of technological services to R&D enterprises and institutions	Public or private institutions providing services to the private productive sector; projects may be presented on an individual or associated basis	Obligatorily repayable subsidies allocated on an open window basis, up to a maximum of \$...
Training and technical assistance	Subsidies for training and retraining projects	Subsidies to support activities for training and retraining human resources in new technologies	Micro-, small and medium-sized enterprises whose projects are executed by technical linkage units	Subsidies allocated on an open window basis. Up to a maximum of 50% of the total cost of the project, or \$... for up to six months
	Subsidies for project Formulation	Support for the formulation of R&D projects, technology transfer or technical assistance	Micro-, small and medium-sized enterprises whose projects are executed by technical linkage units	Subsidies allocated on an open window basis. Up to a maximum of 50% of the total cost of the project, or \$... for up to six months
Technological advisory assistance programmes and those strengthening the performance of technical small and medium-sized enterprises	Technological advisory assistance programme	Support for the formulation of R&D projects, technology transfer or technical assistance	Micro-, small and medium-sized enterprises producing goods and services which incorporate technological added value	Subsidies allocated on an open window basis to individuals or groups, with a maximum of 50% of the total cost of the project, or \$... and a maximum of \$... per participating enterprise
Popularization and social appropriation of science	Competitive grants	Support for the organization of national exhibitions and science fairs	Science museums, educational institutions at primary, secondary and tertiary levels	Subsidies allocated on a competitive basis

Source: UNESCO, UN ECLAC, FONTAR (Argentina)

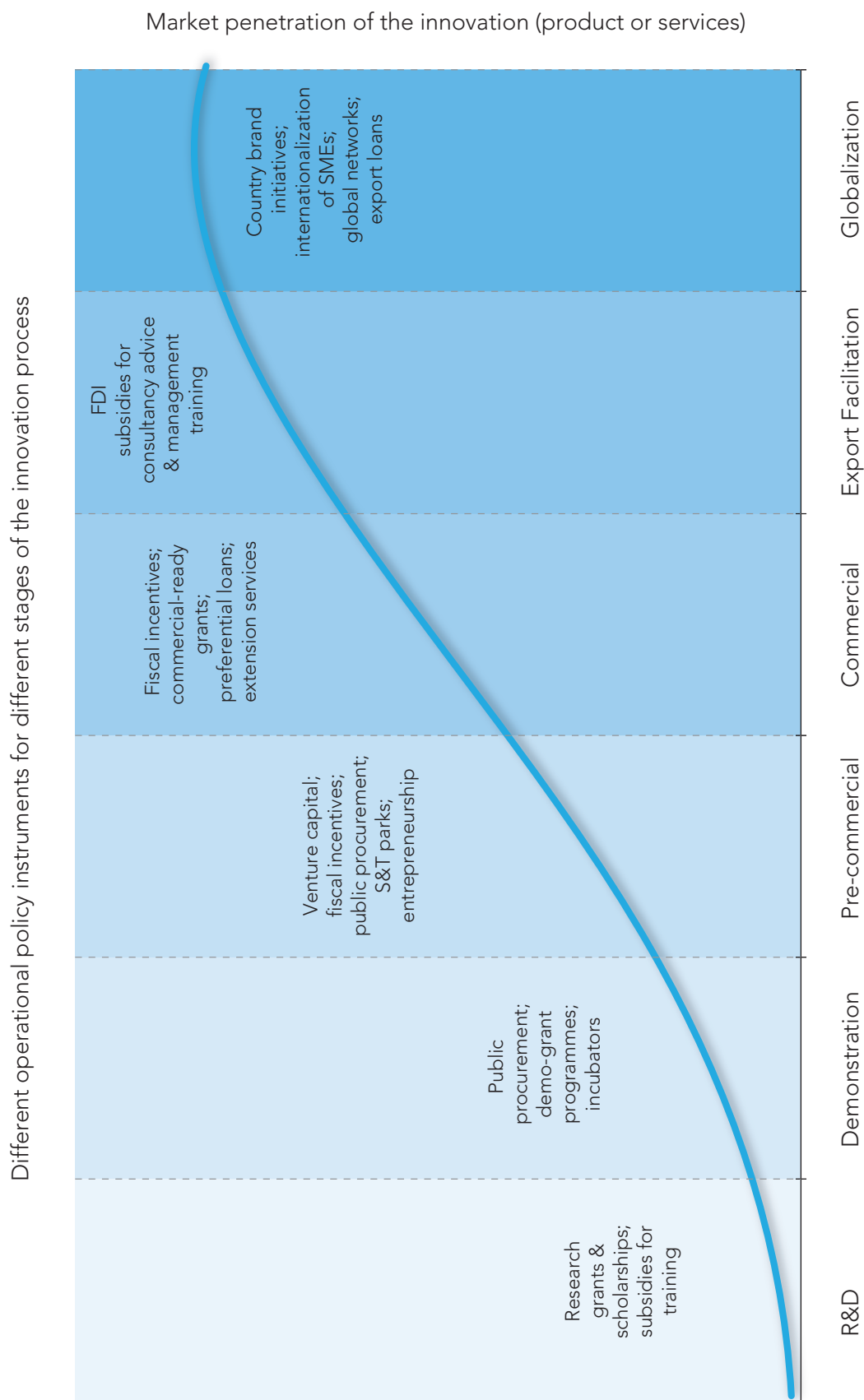


Figure B: Policy instruments for different stages of the innovation process and market penetration.
Source: UNESCO

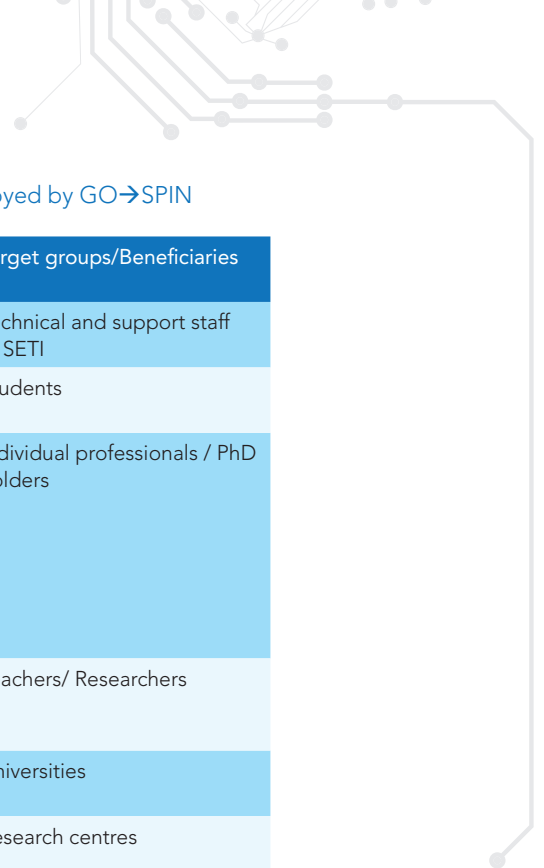


Table D: Taxonomic classification of SETI operational policy instruments employed by GO→SPIN

Objectives and goals	Type of mechanism/ Mode of support	Target groups/Beneficiaries
Strengthen the production of new endogenous scientific knowledge	Grants (grant funds)	Technical and support staff at SETI
Strengthen the infrastructure of research laboratories in the public and private sectors	Donations (individuals/ companies)	Students
Human resources for research, innovation and strategic planning; capacity building, education and training of specialized human capital for (1) the production of new scientific knowledge, (2) development of new technologies, (3) promotion of innovation within the productive and services systems and (4) management of the knowledge society	Loans	Individual professionals / PhD holders
Strengthen gender equality for research and innovation	Creation of, and support for, technological poles and centres of excellence	Teachers/ Researchers
Strengthen the social appropriation of scientific knowledge and new technologies	Tax incentives	Universities
Development of strategic technological areas and new niche products and services with high added value; promotion and development of innovation in the production of goods and services; promotion of start-ups in areas of high technology	Technical assistance	Research centres
Strengthen science education programmes at all levels (from primary school to postgraduate)	Scholarships	Technical training centres
Promotion of the development of green technologies and social-inclusion technologies	Credit incentives and venture capital	Schools/ Colleges/ Institutes
Promotion of indigenous knowledge systems	Trust funds	Corporations/ Foundations
Research and innovation eco-system: strengthening co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific, technological and productive innovation system (i.e. government, university and productive sectors)	Information services	Professional Institutes
Strengthen the quality of technology foresight studies to: assess the potential of high-value markets; develop business plans for high-tech companies; construct and analyse long-term scenarios and; provide consulting services and strategic intelligence	Others	SETI local groups (e.g. a group of independent researchers)
Strengthen regional and international co-operation, networking and promotion of SETI activities		Private companies
		Science and technology public or private non-profit organizations
		Ad hoc associations
		Individuals
		Small and medium-sized enterprises
		Public institutions
		Co-operatives
		Other

Source: UNESCO

Malawi: mapping the landscape of a small-economy innovation system





OFFICIAL NAME: Republic of Malawi

ABBREVIATION: MW

CAPITAL CITY: Lilongwe

HEAD OF STATE AND HEAD OF GOVERNMENT:

His Excellency Professor Arthur Peter Mutharika, President of the Republic of Malawi

NATURE OF GOVERNMENT: multiparty democracy

POPULATION¹: 14 844 822 (est. 2012)

SURFACE AREA: 118 484 km²

ETHNIC GROUPS: Chewa: 32.6%, Lomwe: 17.6%, Yao: 13.5%, Ngoni: 11.5%, Tumbuka: 8.8%, Nyanja: 5.8%, Sena: 3.6%, Tonga: 2.1%, Ngonde: 1%, other: 3.5%

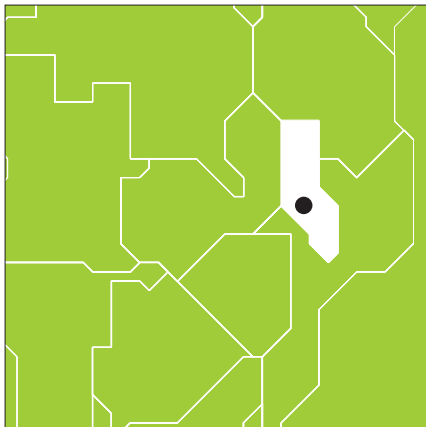
LANGUAGES: English (official), Chichewa (common), Chinyanja, Chiyao, Chitumbuka, Chilomwe, Chinkhonde, Chingoni, Chisena, Chitonga, Chinyakyusa, Chilambya

RELIGIONS: Christian 82.6%, Muslim 13.0%, other 1.9%, none 2.5% (2008 est.)

UNIT OF CURRENCY: Malawian kwacha

DATE OF INDEPENDENCE: 6 July 1964

DATE OF CONSTITUTION: 1953 (pre-independence), 1966; latest drafted January – May 1994, entered into force on 18 May 1995; amended several times since, most recently in 2013



HISTORY OF A PEOPLE

Malawi derives its name from the Maravi, a Bantu people who migrated from the southern Congo about 600 years ago. Upon reaching the area north of Lake Malawi, the Maravi separated into two branches. One branch, the ancestors of the present-day Chewas, moved south to the west bank of the lake. The other branch, the ancestors of the Nyanjas, moved down the east bank to the southern part of the country (Gall, 2004).

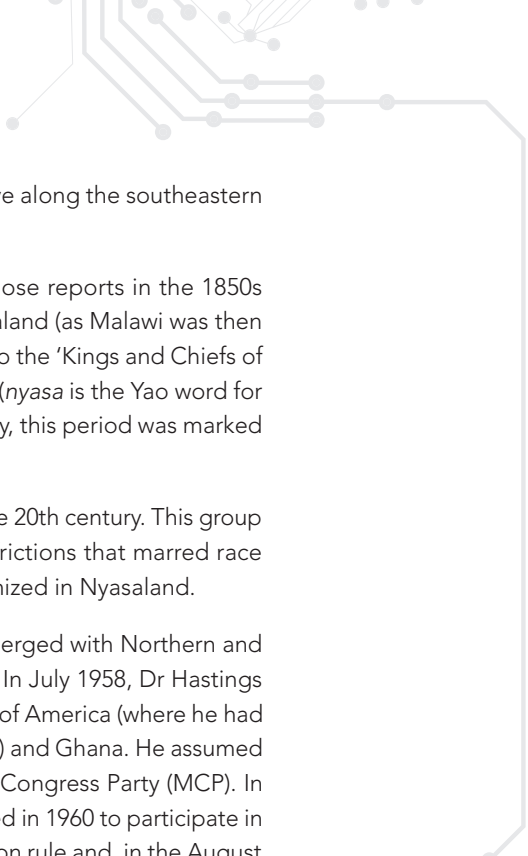
Malawi has been inhabited for at least 12 000 years; its earliest peoples were nomadic hunter-gatherers. By the 13th century, Bantu-speaking migrants had entered the region. The Chewa peoples had become dominant by the early 16th century; their clans were consolidated under the leadership of a hereditary ruler called Karonga. By AD 1500, the two divisions of this tribe had established a kingdom stretching from north of the present-day city of Nkhonkhotakota to the Zambezi River in the south and from Lake Malawi in the east to Luangwa River in Zambia in the west.

Before the advent of the Europeans in the second half of the 19th century, Malawi was an important area of operations for Arab slave traders. The incursions of the slave traders took a heavy toll on the inhabitants, although the Chewa state never came under direct Arab rule (Kurian, 2007).

Migration waves and tribal conflicts precluded the formation of a cohesive Malawian society until the turn of the 20th century. In more recent years, ethnic and tribal distinctions have diminished. Regional distinctions and rivalries persist, however. Despite tribal groups having their differences, there is no significant friction at present and the concept of a Malawian nationality has begun to take hold. Predominately a rural people, Malawians are generally conservative and traditionally non-violent.

The Chewas constitute 90% of the population of the central region; the Nyanja tribe predominates in the south and the Tumbuka in the north. In addition, significant numbers of Tongas live in the north; Ngonis, an offshoot of the Zulus who came from South Africa in the early 1800s, live in the lower northern and

¹ Estimate by UN Statistics Division



lower central regions (Gall, 2004). As for the Yao, who are mostly Muslim, they live along the southeastern border with Mozambique.

The first European to explore the area extensively was David Livingstone, whose reports in the 1850s and 1860s were instrumental in establishing a series of mission stations in Nyasaland (as Malawi was then known) in the 1870s. In 1883, a consul of the British government was accredited to the 'Kings and Chiefs of Central Africa' then, in 1891, the British established the Nyasaland Protectorate (*nyasa* is the Yao word for lake). Although the British remained in control for the first half of the 20th century, this period was marked by a number of unsuccessful Malawian attempts to obtain independence.

Nyasaland attracted a small group of European planters in the first decades of the 20th century. This group settled mainly in the Shire Highlands and was never substantial. Many of the frictions that marred race relations in South and North Rhodesia (now Zimbabwe and Zambia) were minimized in Nyasaland.

During the 1950s, pressure for independence increased when Nyasaland was merged with Northern and Southern Rhodesia in 1953 to form the Federation of Rhodesia and Nyasaland. In July 1958, Dr Hastings Kamuzu Banda returned to the country after a long absence in the United States of America (where he had obtained his medical degree), the United Kingdom (where he practiced medicine) and Ghana. He assumed leadership of the Nyasaland African Congress, which later became the Malawi Congress Party (MCP). In 1959, Dr Banda was sent to Gwelo Prison for his political activities but was released in 1960 to participate in a constitutional conference. The MCP stepped up the campaign against federation rule and, in the August 1961 elections, polled more than 90% of the vote, winning all of the 20 lower-roll seats and two out of eight upper-roll places. An era of 'responsible' government began, with the MCP obtaining five, and eventually seven, of the 10 available Executive Council positions. At a constitutional conference held in London in November 1962, it was agreed that Nyasaland should become fully self-governing early the following year.

Dr Banda became Prime Minister on 1 February 1963, although the British maintained control of Malawi's financial, security and judicial systems. A new constitution took effect in May 1963, providing for virtually complete internal self-government. The Federation of Rhodesia and Nyasaland was dissolved on 31 December 1963, paving the way for Malawi to become a fully independent nation on 6 July 1964. Two years later, Malawi adopted a new constitution and became a one-party state with Dr Banda as its first president.

The years 1957–1964 not only saw the triumph of the struggle for independence; they also correspond to the period when the pre-independence polity defined essential characteristics of Malawi as an independent nation. According to Guta (2011), from an evolutionary perspective, an independent Malawi has preserved many of the institutional features that originally characterized this pre-independence period. This includes the maintenance of a *statu quo* state, with the promotion of agricultural exports in exchange for manufactured imports. Probably, one of the most influential legacies of this pre-independence polity was its negligence of education (Moyo, 1990; Guta, 2011). This led to a shortage of the requisite skills for industrialization, research and innovation. This paradigmatic posture would influence choices about education policies in the period following independence.

On 14 June 1993, Malawians voted for the reintroduction of a multiparty democracy in a historic referendum marking the end of more than 30 years of a one-party dictatorship under Dr Banda's Malawi Congress Party (MCP). These democratic reforms were preceded by a series of economic reforms. In both transformation processes, external donor conditionality played a crucial role (Bertelsmann Stiftung, 2012). Under the 1995 constitution of Malawi's multiparty democracy, the president, who is both chief of state and head of the government, is chosen through universal direct suffrage every five years.

All the different ethnic groups in Malawi have their own language or dialect. The Chewa are the dominant group and their language, known as Chewa or Chichewa, is the national language; it is widely spoken throughout the country.

English is the official language and is widely spoken, particularly in the main towns but also in some remote rural areas. Of the other languages spoken in Malawi, Tumbuka is spoken by about 500 000 people in the north and Yao is spoken by about 600 000 people in the south.

DEMOGRAPHIC PROFILE

The United Nations Development Assistance Framework (UNDAF) 2012–2016 identified three binding constraints on development. The first among these was population growth (UNCT, 2012).

The annual average population growth rate in Malawi over the past five decades has been 3.3%, the sixth-highest in the world. There are approximately 41.8 births/1 000 population (2014 est.), the seventh-highest birth rate in the world. In comparison, Malawi counts 8.74 deaths/1 000 population (2014 est.), placing it in 72nd position for this indicator. The country's fertility rate is extremely high, with 5.66 children being born to every woman on average (2014 est.). Population density amounts to around 147 inhabitants/km².

Rapid population growth, particularly in rural areas, has exacerbated migration to urban areas. The share of the urban population increased from 5% in 1966 to 11% in 1987 and an estimated 15.7% in 2011, with an estimated annual urbanization rate of 4.2% between 2010 and 2015. By the year 2020, it is projected that 21% of the country's population will live in urban areas. Rapid urbanization is being accompanied by a range of problems, from poor access to a clean water supply and sanitation, the spread of disease, unemployment and growing crime rates to environmental degradation.

Figure 1 shows the long-term evolution in the population of Malawi (1960–2012). The percentage share of different age groups has remained more or less constant over this period.

An estimated 10.8% of adults (aged 15–49) were living with HIV/AIDS² in 2012. This represents the ninth-highest adult prevalence rate in the world.

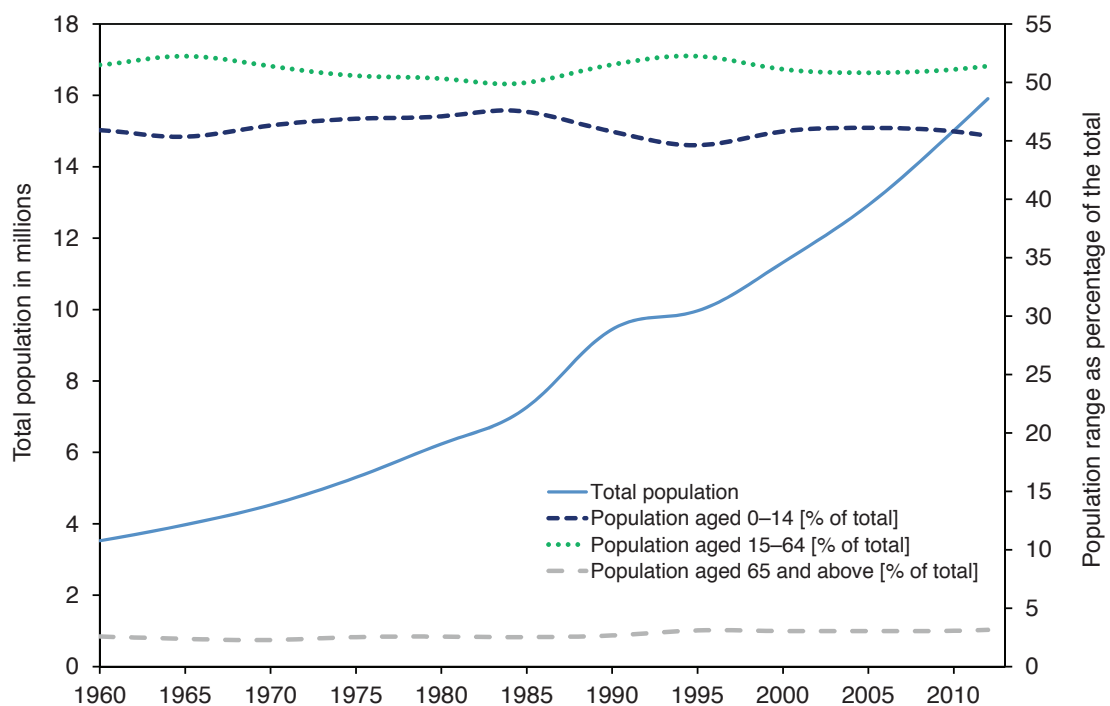
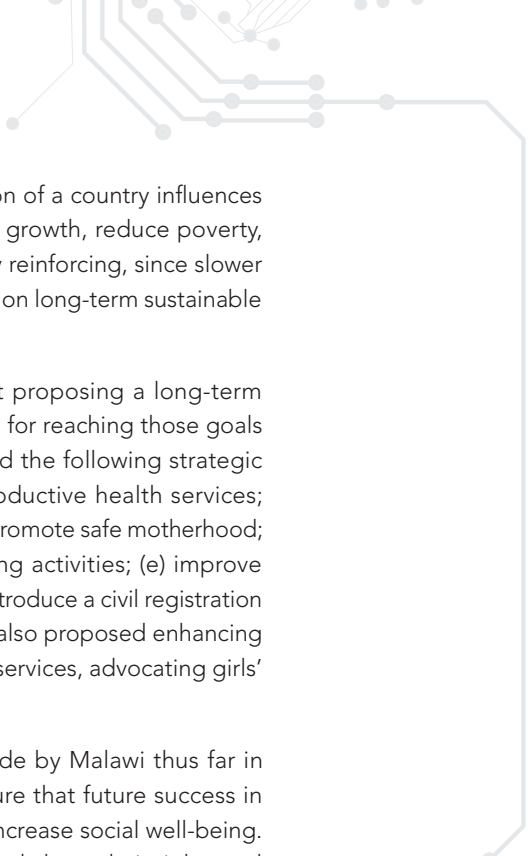


Figure 1: Evolution in the population of Malawi, 1960–2012. Source: UNESCO, based on data provided by UN Statistics Division

² The HIV/AIDS adult prevalence rate is calculated by dividing the estimated number of adults living with HIV/AIDS at year's end by the total adult population at year's end.



This long-term behaviour has compromised development gains. The population of a country influences all aspects of socio-economic development. Efforts to slow down population growth, reduce poverty, achieve economic progress and improve environmental protection are mutually reinforcing, since slower population growth and sustainable fertility levels can have a very positive impact on long-term sustainable development and quality of life.

In the late 1990s, the government elaborated a country foresight document proposing a long-term vision for the country, identifying development goals and suggesting strategies for reaching those goals (Government of Malawi, 1998). Known as *Vision 2020*, the document proposed the following strategic options to reduce population growth: (a) enhance family planning and reproductive health services; (b) improve information, education and communication on population issues; (c) promote safe motherhood; (d) improve the status of women through greater access to income-generating activities; (e) improve population planning; (f) increase awareness of critical population issues and; (g) introduce a civil registration system to act as a support mechanism for the proposed strategies. *Vision 2020* also proposed enhancing the provision, access, delivery and utilization of sexual and reproductive health services, advocating girls' education and delayed marriage and promoting the small family concept.

Family planning and population policy needs to safeguard the progress made by Malawi thus far in reaching the United Nations' Millennium Development Goals (MDG), to ensure that future success in reaching the MDGs does indeed lead to a net reduction in poverty ratios and increase social well-being. (See page 13 for details.) Young men and women, in particular, must be informed about their rights and given access to social services, such as training opportunities, health and social benefits, contraception, childcare and maternity leave (UNCT, 2012).

HUMAN DEVELOPMENT IN MALAWI

The concept of human development focuses on the result rather than the means of achieving development. This holistic approach puts people at the centre of the development process. Since 1989, the United Nations Development Programme (UNDP) has been measuring the Human Development Index (HDI). The latter measures the average achievements of a country for three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. Data availability determines the HDI country coverage. The three dimensions are normalised with the corresponding lowest and highest values obtained from a sample of 187 countries then combined into a single index. Each country will have a HDI value situated between 0 and 1. The global rank of countries is obtained by representing each individual HDI value in descending order.

Countries are classified as being of very high, high, medium or low development, according to their ranking. Africa's breakthrough came in 2013 when the Seychelles achieved very high human development with a rank of 46th place, ahead of wealthier states in Europe and the Middle East. Algeria, Libya, Mauritius and Tunisia were attributed high human development, while ten other African countries reached medium human development. The remaining 37 African countries fall in the low human development category, South Sudan being precluded from the study (UNDP, 2013a).

Malawi's HDI value for 2012 is 0.418 – in the low human development category – positioning the country in 170th place out of 187 countries and territories. Between 1975 and 2012, Malawi's HDI value increased from 0.253 to 0.418, an increase which follows quadratic growth. The rank of Malawi's HDI for 2011 based on data available in 2012 and methods used in 2012 was 171st out of 187 countries. Figure 2 shows the long-term evolution of Malawi's HDI, following the latest methodology for measuring HDI (UNDP, 2013a). The best-fitting curve over 37 years adjusts to a parabola with an excellent value for the correlation coefficient of $R^2=0.99$.

By decoupling the HDI in their three main components, it is possible to explain the coherent behaviour shown in Figure 2. For example, one of the components, life expectancy at birth, continuously increased between 1960 and 1991 when it peaked at 47.2 years. In 1992, life expectancy trailed off until 1999 when it climbed again to 46 years. Between 1999 and 2012, life expectancy began rising again (see Figure 3), reaching 54.8 years in 2012.

Income levels have remained almost constant for the past five decades. For example, GDP per capita (in 2012 constant US\$) remained steady from 1960 to 2012 at around US\$260 (see Figure 4). Another more relevant unit of measurement is 2012 constant purchasing power parity (PPP) in US\$, which fluctuated little over 1990–2012. In 1990, this value amounted to PPP US\$643, compared to PPP US\$753 in 2012. The highest peak was reached in 2008 with PPP US\$808.

The number of mean years of schooling has also increased slightly for adults over the past 30 years. Growth has followed a smooth parabolic pattern, from 1.8 years in 1980 to 4.2 years in 2012. As for children, they could expect to spend 10.4 years at school in 2012 (see Table 1).

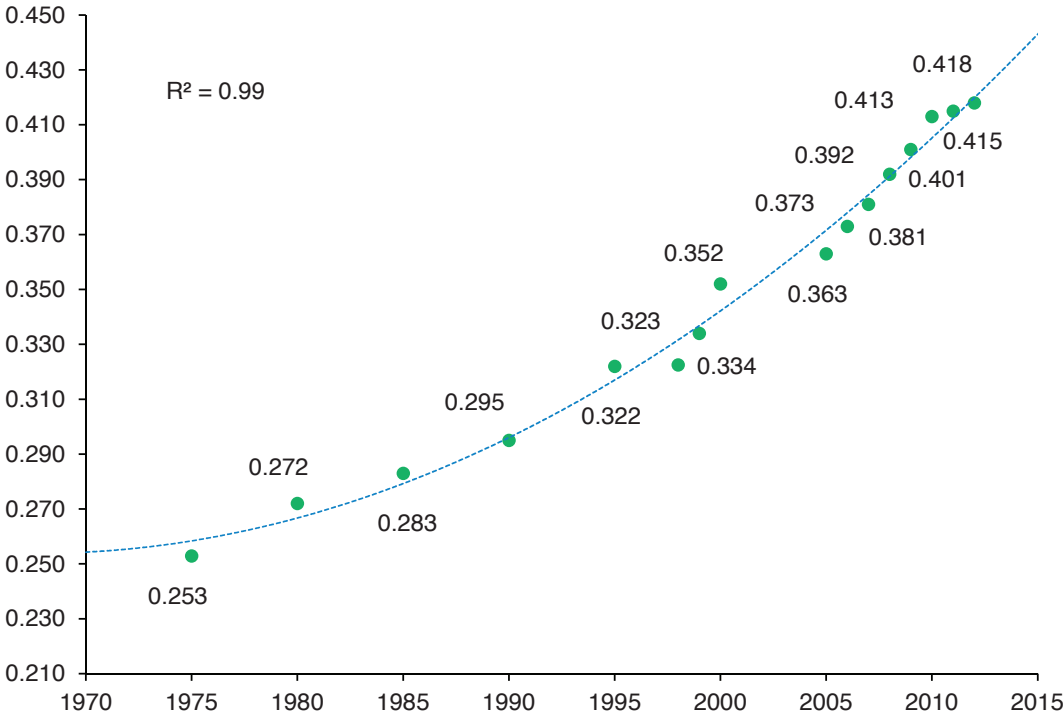


Figure 2: Evolution in Malawi’s Human Development Index, 1970–2012. Source: UNESCO estimation, adjusted according to the latest HDI methodological approach and data provided by UNDP (2013a). The fitting curve has a parabolic growth with a correlation coefficient of $R^2=0.99$

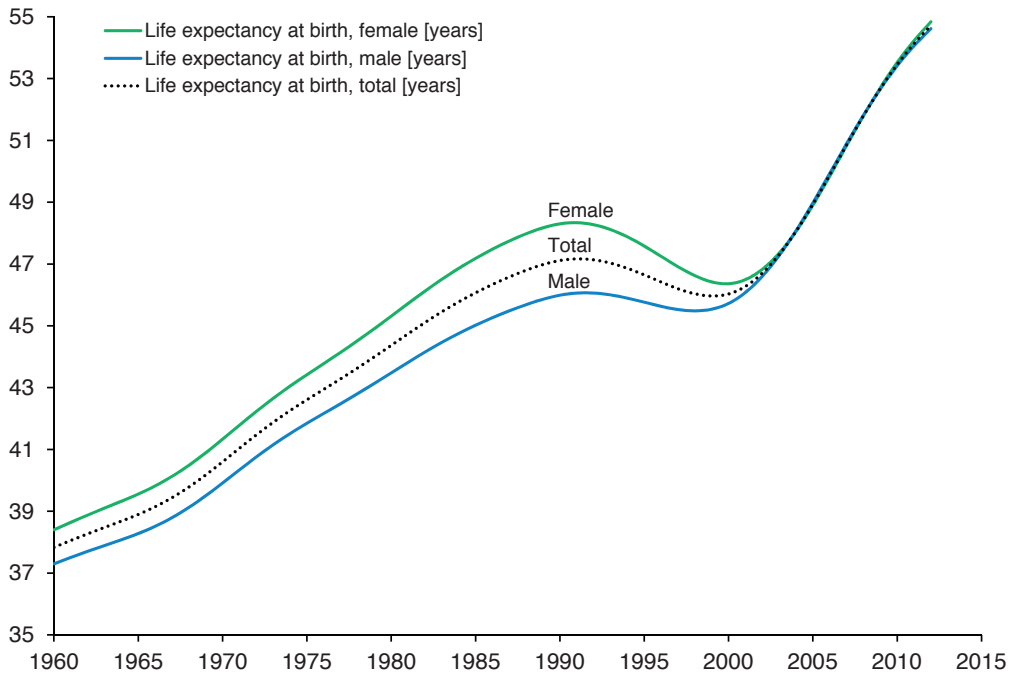


Figure 3: Evolution in life expectancy at birth in Malawi, 1960–2012. Source: UNESCO, based on raw data provided by UN Statistics Division

Recent *Human Development Reports* have launched an Inequality Adjusted Human Development Index (IHDI) and Gender Inequality Index (GII) alongside the HDI. When Malawi's HDI value is discounted for inequality, the HDI falls to 0.287, a loss of 31.4%. Zambia shows losses due to inequality of 36.7%. The average loss due to inequality for low HDI countries is 33.5%, compared to 35% for sub-Saharan Africa.

The GII reflects gender-based disadvantages in reproductive health, empowerment and the labour market. Countries with better gender equality tend to have low maternal mortality, low adolescent fertility and a high proportion of males and females with at least secondary education. With a GII of 0.573, Malawi falls in the lower gender inequality group in Africa. The HDI for Africa as a whole drops to 0.284 when gender inequality is taken into account, a loss of 28.5%. High inequality is undermining the positive impact of Africa's economic growth. Gender inequality on the continent is linked to the persistence of discriminatory laws, norms and practices, which restrict the access of women and girls to opportunities, resources and power (see Table 1).

Malawi has a GII value of 0.573, ranking it 124th out of 148 countries in the 2012 index. In Malawi, 22.3% of parliamentary seats are held by women and 10.4% of adult women have reached at least the secondary level of education, compared to 20.4% of their male counterparts. For every 100 000 live births, 460 women die from pregnancy-related causes; the adolescent fertility rate is 105.6 births per 1000 live births. Some 84.8% of women participate in the labour market, compared to 81.3% of men.

Malawi's HDI of 0.418 in 2012 is below the average of 0.466 for countries in the low human development group and below the average of 0.475 for sub-Saharan Africa. The African countries closest to Malawi in terms of HDI ranking in 2012 and population size are Zambia (0.448) and Zimbabwe (0.397).

Table 1: Quality of life in Malawi

Indicator	Value (2012)
Human Development Index (HDI)	
HDI [value]	0.418
HDI [world ranking out of 187 countries]	170
Health	
Public expenditure on health [% of GDP]	n/a
Under-five mortality [per 1 000 live births]	n/a
Life expectancy at birth [years]	54.8
Education*	
Public expenditure on education [% of GDP 2011]	5.4
Public expenditure on education [% of total government expenditure 2011]	14.9
Primary school teachers trained to teach [%]	n/a
Primary school dropout rates [% of primary school cohort]	n/a
Expected years of schooling [of children] [years]	10.4
Adult literacy rate, both sexes [% aged 15 and above, 2010]	51.3
Mean years of schooling [of adults] [years]	4.2
Combined gross enrolment in education [both sexes]	n/a
Inequality	
Loss due to inequality in life expectancy [%]	39.9
Loss due to inequality in income [%]	23.1
Gender	
Population with at least secondary education [ratio of females to males]	n/a
Adolescent fertility rate [births per 1000 women aged 15–19]	n/a
Labour force participation rate [ratio of females to males]	n/a
Gender Inequality Index, value	0.573
Women in parliament [ratio of females to males]	0.287
Maternal mortality rate [deaths of women per 100 000 live births]	n/a
Sustainability	
Carbon dioxide emissions per capita [tonnes]	n/a
Change in forest area, 1990/2010 [%]	n/a
Demography	
Population, total both sexes [thousands]	14 844.8
Population, urban [% of population]	15.8
Population, female [thousands]	7 583.3
Population, male [thousands]	7 261.5
Income	
GDP per capita [2012 US\$ PPP]	753

*The UNESCO Institute for Statistics provides the education data for UNDP's *Human Development Reports*.

Source: UNDP (2013a) *Human Development Report*



BOX 1 – CULTURAL REQUISITES FOR SCIENCE AND TECHNOLOGY

The *National Science and Technology Policy of Malawi* (Government of Malawi, 2002) recognizes that culture in Malawi, like elsewhere in Africa, is dominated by superstition, traditional ideas and beliefs and low levels of literacy. For example, in the village setting, innovative smallholder farmers who follow modern agricultural practices are often suspected and sometimes even accused of using charms in order to attain high yields.

This poor S&T culture is a serious impediment to socio-economic development. The ease with which technologies may be imported from abroad enables planners and policy-makers to import ‘comfort’ and pay lip-service to the development of a science culture among their own people. It will thus take a cultural revolution for science and technology to play their rightful role in reducing poverty in Malawi.


Strategies for achieving this include taking action to: (i) inculcate S&T awareness and appreciation at all levels of government, especially at the policy-making and planning levels, (ii) elevate S&T awareness and appreciation by including S&T in the education system through intensifying creative thinking and problem solving skills; (iii) design syllabi that achieve a balance of S&T, the arts and humanities; (iv) increase vocational and technical skills content in secondary schools and intensify efforts to increase S&T competence to acquire, absorb and disseminate S&T knowledge and skills; (v) utilize mass media to strengthen public awareness and appreciation of S&T by expanding the S&T content of both the print and electronic media and the training of journalists to improve the standard of S&T journalism; and (vi) demystify science by producing popular science materials for the young both in print and electronic media.

LONG-TERM VISION AND DEVELOPMENT PLANS FOR MALAWI

Malawi’s economy is largely dependent on agriculture, its industrial and service sectors remaining relatively small. Market competition is limited and operates within a weak institutional framework. There is a large informal sector, albeit difficult to quantify. Government intervention is relatively high, as suggested by the size of government spending (40% of GDP) and the fact that the public sector is the largest employer.

In March 1998, the Government of Malawi launched *Vision 2020*, a policy framework setting out a long-term development perspective for Malawi. *Vision 2020* emphasizes strategic thinking, a shared vision and visionary leadership, participation by the population, strategic management and national learning. *Vision 2020* states that, ‘by the year 2020, Malawi, as a God-fearing nation, will be secure, democratically mature, environmentally sustainable, self-reliant with equal opportunities for, and active participation by, all, having social services, vibrant cultural and religious values and a technologically driven middle-income economy’ (Government of Malawi, 1998).

In May 2002, the government launched the three-year *Malawi Poverty Reduction Strategy* (MPRS), which represented a first attempt to translate this long-term vision into action plans focused on the medium term. The MPRS became the government’s overarching medium-term strategy for reducing poverty. The goal of the MPRS was to achieve ‘sustainable poverty reduction through empowerment of the poor’. The MPRS was built around four strategic pillars, namely: sustainable pro-poor growth; human capital development; improving the quality of life of the most vulnerable and; good governance. In addition, it covered four key crosscutting issues, namely: HIV and AIDS, gender, environment, science and technology. The most notable achievement of the MPRS was the decline in poverty levels from 54.1% to 52.4%. Also important was the fact that ministries and government departments implemented their activities within the MPRS framework (Government of Malawi, 2011).



In 2007, the Government of Malawi launched the *Malawi Growth and Development Strategy* (MGDS). This was designed as an overarching operational medium-term strategy for Malawi to attain the nation's *Vision 2020* and the MDGs over the period 2006–2011. The main aim of the MGDS was to create wealth through sustainable economic growth and infrastructure development as a means of reducing poverty. The MGDS presented a policy framework that balanced issues related to both economic growth and social development.

In 2011, the Government of Malawi launched a second medium-term strategy, the *Malawi Growth and Development Strategy II* (MGDS II). The MGDS II identifies six broad thematic areas, namely: (I) sustainable economic growth; (II) social development; (III) social support and disaster risk management; (IV) infrastructure development; (V) governance; and (VI) gender and capacity development. Within these thematic areas, the MGDS II defines nine key priority areas, namely: (1) agriculture and food security; (2) transport infrastructure and the Nsanje World Inland Port; (3) energy, industrial development, mining and tourism; (4) education, science and technology; (5) public health, sanitation, malaria, HIV and AIDS management; (6) integrated rural development; (7) green belt irrigation and water development; (8) child development, youth development and empowerment and; (9) climate change, natural resources and environmental management. The selection of key priority areas is intended to sustain and accelerate economic growth within the confines of available resources.

The MGDS II addresses SETI activities with the purpose of enhancing the contribution of research, science and technology to national productivity and competitiveness. The medium-term expected outcomes are: (1) well-co-ordinated science and technology generation and dissemination; (2) improved operation of research and development institutions; and (3) greater adoption of appropriate technologies. The defined key strategies are the following: (a) promote the adoption, transfer and utilization of appropriate technologies; (b) promote prioritized, focused and multi-disciplinary research and development; (c) mainstream research, science and technology development across all sectors; (d) enhance linkages between research, science and technology institutions and users; (e) strengthen the institutional and regulatory framework, including protection of intellectual property rights; (f) strengthen the institutional research capacity; (g) compile information, education and communication on research, science and technology development; (h) promote public–private partnerships to generate and disseminate appropriate technology; and (i) improve scientific and technological infrastructure for research and development and innovation.

The fact that foreign aid still exerts a strong influence on Malawi's economy makes it hard for the authorities to pursue their own policy goals with a great deal of consistency. In 2012, the government proposed an *Economic Recovery Plan* (2012–2014) as a short-term strategy for addressing the economic shocks which had affected the country since 2011. The plan identified the following five priorities: mining, energy, commercial agriculture, tourism and ICTs (Government of Malawi, 2012). Of note is that this recovery plan does not explicitly address the use of research and innovation as tools to reach these objectives. Only ICTs are considered part of the plan.

Since the first economic shocks in 2011, the Malawian Reserve Bank has been implementing a tight monetary policy to ensure price stability. Although prices remained stable briefly during the crisis period, the shocks persisted, destabilizing the monetary sector in the face of inadequate foreign reserves to cushion demand for foreign exchange and fuel shortages, which increased transaction costs as well as the cost of goods and services. This tight monetary policy proved difficult to manage because of the long-lasting negative impact on a major foreign exchange earner, the country's tobacco industry, which saw production drop and tobacco prices soar. Consumer prices also soared in 2011 and, by the end of 2012, the bank rate was still high at 25% and interest rates had increased sharply, worrying some investors. The unavailability of foreign exchange also affected the repatriation of funds, procurement of raw materials and capital base. Recently, interest rates have climbed as high as 50% in some commercial banks, thereby affecting the mobilization of capital available to small and medium-sized enterprises.

Since 2012, the Malawian currency (kwacha) has depreciated considerably against major trading currencies. Since the devaluation of the local currency to 250.00 MWK from 168.00 MWK for every US dollar on 7 May 2012 and the subsequent floatation of the exchange rate, the local currency has remained unstable. The kwacha depreciated to just 298.97 MWK against the US dollar in September 2012.

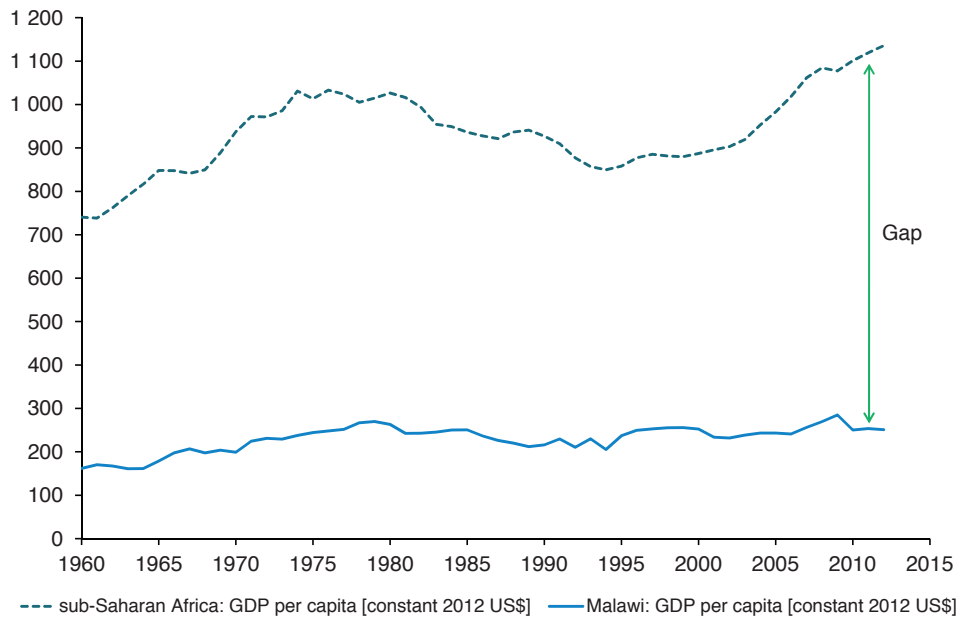


Figure 4: Evolution of GDP per capita, expressed in constant 2012 US\$, in Malawi and sub-Saharan Africa, 1960–2012. Source: UNESCO, based on data provided by the UN Statistics Division (Population), World Bank (GDP in US\$) and US Census Office (GDP deflator)

Sustainable economic growth is key to reducing poverty and improving the living standards of Malawians. Figure 4 shows that GDP per capita remained practically constant in Malawi for more than five decades (1960–2012). The gap with the average for sub-Saharan Africa has been widening since 1994. Since 1990, GDP per capita has remained relatively stable, at around PPP US\$730. The fact that these values have barely changed in half a century represents an enormous hurdle for the country’s sustainable development.

Malawi’s real GDP growth climbed from 1.8% in 2012 to an estimated 5.5% in 2013, driven by a rise in exports after a good tobacco season and strong recovery in the key sectors of agriculture, manufacturing, construction, services and wholesale and retail trade (IMF, 2013; ADB *et al.*, 2014). Tobacco output increased by 211% in response to higher auction prices following the depreciation of the Malawian kwacha. The strong recovery in tobacco output boosted overall growth in the agriculture sector to 5.7%, up from a 2.3% contraction in 2012. Similarly, manufacturing output grew by 6.2%, up from 1.3%. The IMF (2013) estimates that, in 2014, Malawi’s real GDP will grow by 6.1% before accelerating further to 6.2% in 2015 and 6.5% in 2018 (see Table 2). This positive outlook presupposes continued macro-economic stability, high tobacco prices, an adequate availability of foreign exchange, favourable weather conditions and an improvement in the business climate (ADB *et al.*, 2014).

Table 2 shows the annual percentage change in real GDP for all the member states of the Southern African Development Community (SADC) and the weighted average for sub-Saharan Africa, as well as projections for 2013, 2014 and 2018. In the past decade, Malawi’s economy has grown by 5.6% each year on average. This performance is surpassed only by Angola (10.9%), Mozambique (7.6%), Tanzania (6.9%), Zambia (6.7%) and the Democratic Republic of Congo (6.5%).

Table 2: Annual percentage change in real GDP for SADC countries and projections, 1995–2018

SADC countries	1995-2004	2005	2006	2007	2008	2009	2010	2011	2012	2013*	2014*	2018*
Angola	7.7	20.6	20.7	22.6	13.8	2.4	3.4	3.9	8.4	6.2	7.3	6.0
Botswana	7.3	1.6	5.1	4.8	3.0	-4.7	7.0	5.1	3.8	4.1	4.2	4.1
Democratic Rep of Congo	-0.6	7.8	5.6	6.3	6.2	2.8	7.2	6.9	7.1	8.3	6.4	4.6
Lesotho	3.3	2.9	4.1	4.9	5.1	4.8	6.3	5.7	4.0	3.5	3.1	4.0
Madagascar	2.8	4.6	5.0	6.2	7.1	-4.1	0.4	1.8	1.9	2.6	3.8	5.1
Malawi	4.3	2.6	2.1	9.5	8.3	9.0	6.5	4.3	1.9	5.5	6.1	6.5
Mauritius	4.4	1.5	4.5	5.9	5.5	3.0	4.1	3.8	3.3	3.7	4.4	4.5
Mozambique	8.5	8.4	8.7	7.3	6.8	6.3	7.1	7.3	7.5	8.4	8.0	7.8
Namibia	4.3	2.5	7.1	5.4	3.4	-1.1	6.6	4.8	4.0	4.2	4.0	4.3
Seychelles	2.0	9.0	9.4	10.1	-1.9	-0.2	5.6	5.0	2.8	3.2	3.9	3.5
South Africa	3.1	5.3	5.6	5.5	3.6	-1.5	3.1	3.5	2.5	2.8	3.3	3.1
Swaziland	2.8	2.2	2.9	2.8	3.1	1.2	1.9	0.3	-1.5	0.0	0.3	0.3
United Rep of Tanzania	5.2	7.4	6.7	7.1	7.4	6.0	7.0	6.4	6.9	7.0	7.2	6.6
Zambia	3.0	5.3	6.2	6.2	5.7	6.4	7.6	6.8	7.3	7.8	8.0	7.8
Zimbabwe	n/a	-5.6	-3.4	-3.7	17.8	8.9	9.6	10.6	4.4	5.0	5.7	5.5
sub-Saharan Africa	4.5	6.2	6.4	7.0	5.6	2.7	5.4	5.3	4.8	5.6	6.1	5.5

* IMF Projections

Source: IMF (2013)

The macro-economic challenges faced by Malawi have been exacerbated by the revelation in September 2013 of the looting of public funds through the Integrated Financial Management System, a scandal known as 'cash-gate' (ADB et al., 2014). Donors suspended budget support, leading to a widening of the fiscal gap. In response to the scandal, the government is implementing, with the support of donors, a comprehensive action plan to correct weaknesses in public finance management.

The MGDS II recognizes the government's commitment to several global agreements and declarations, including the MDGs, and the *Plan of Implementation* adopted by the World Summit on Sustainable Development in 2002. Through the MGDS II, the government is committed to the MDGs as internationally agreed targets for eradicating extreme poverty and hunger; achieving universal primary education; promoting gender equality and empowering women; reducing child mortality; improving maternal health; combating HIV and AIDS, malaria and other diseases; ensuring environment sustainability and; developing global partnership for development (Government of Malawi, 2011). The country has made progress on all its targets and is on track to attain five of the eight MDGs targets by the year 2015.

As concerns eradicating extreme poverty and hunger, the poverty head count has declined from 50% of the population in 2005 to 39% in 2010 while the proportion receiving less than the minimum level of dietary energy requirement has decreased from about 22% in 2005 to 15% in 2009. There has been an increase in primary school net enrolment from 73% in 2006 to 83% in 2009, while the youth literacy rate has increased from 75% in 2005 to about 84% in 2009. Progress has also been made on gender equality and empowerment of women. Malawi attained gender parity at primary school level between 2005 and 2009 when the ratio of girls to boys rose from 0.95 to 1.03. The proportion of seats held by women in Parliament has also significantly improved, from 14% in 2004 to 22% in 2009 (Government of Malawi, 2010).

According to the UN's latest monitoring report, *Assessing Progress in Africa towards the Millennium Development Goals* (UNDP, 2013b), Malawi is one of three countries in Africa that 'are making especially impressive progress' for several MDGs, along with The Gambia and Rwanda. The report observes, for instance, that Malawi recorded a 43.44% decline in underweight children between 1990 and 2012. It is also one of 11 African countries which managed to reduce their under-five mortality rate by 60% between 1990 and 2011. The report notes that, in Africa, Malawi is surpassed only by Lesotho for the progression of its gender parity index between 2006 and 2012. Malawi is also one of many African countries where 'favourable changes in risky sexual behaviour are evident' (UNDP, 2013b).

Malawi still has some way to go to achieve other MDGs, however. One in four Malawians (26.2%) has an 'unmet need for family planning', for instance (UNDP, 2013b), and, in 2011, 93% of the population still lacked access to electricity, 16% improved water and 47% improved sanitation (WWAP, 2014).


According to the Global Hunger Index³ (GHI), Africa has long been a 'hungry continent', based on the countries' scoring of moderate to extremely alarming hunger since 1990. Table 3 presents the GHI values for a group of SADC countries. Most improved their scores between 1990 and 2013. The exception is Swaziland, where vulnerability increased. Africa's overall hunger in 2013 was lower than in 1990. Over 1990–2013, Africa had the lowest average value for food production. Consequently, the continent has remained a net food importer and countries depending on imports of major food staples have been vulnerable to global food price volatility. Price volatility, especially for staple foods, has resulted in serious food insecurity for African farmers and consumers alike because such foods are the most widely planted by smallholder farmers and account for a large share of spending among poor consumers.

Table 3: Global Hunger Index for SADC countries, 1990–2013

SADC Country*	1990	Hunger level 1990	1995	2000	2005	2013	Level 2013
Angola	39.5	Extremely alarming	38.5	31.6	22.7	19.1	Serious
Botswana	16.8	Serious	17.0	17.8	16.3	13.9	Serious
Lesotho	13.2	Serious	14.6	14.6	14.9	12.9	Serious
Madagascar	25.5	Alarming	24.6	25.9	24.4	25.2	Alarming
Malawi	30.6	Extremely alarming	27.6	21.6	18.7	15.1	Serious
Mauritius	8.5	Moderate	7.6	6.5	5.9	5.2	Moderate
Mozambique	36.0	Extremely alarming	32.0	28.5	25.1	21.5	Alarming
Namibia	22.1	Alarming	21.9	17.5	17.1	18.4	Serious
South Africa	7.2	Moderate	6.5	7.4	7.7	5.4	Moderate
Swaziland	10.4	Serious	12.9	12.7	12.5	14.4	Serious
United Rep of Tanzania	23.4	Alarming	26.9	26.1	20.5	20.6	Alarming
Zambia	24.9	Alarming	24.5	26.3	25.3	24.1	Alarming
Zimbabwe	20.0	Alarming	22.0	21.7	20.5	16.5	Serious

* The scores are unavailable for the Democratic Republic of Congo and Seychelles.

3 A country's GHI is calculated by averaging the percentage of the population that is undernourished, the percentage of children younger than five years old who are underweight and the percentage of children dying before the age of five. This calculation results in a 100-point scale on which zero is the best score (no hunger) and 100 the worst. The scores are considered low if $0 < GHI < 4.9$, moderate if $5 < GHI < 9.9$, serious if $10 < GHI < 19.9$, alarming if $20 < GHI < 29.9$ and extremely alarming if $GHI > 30$ (Grebmer et al., 2013). See: www.ifpri.org/book-8018/ourwork/researcharea/global-hunger-index



Malawi constantly improved its score over the period 1990–2013, from 30.6 (extremely alarming) in 1990 to 15.1 (serious) in 2013.

Recently, the Government of Malawi has introduced the Agricultural Input Subsidy Programme to improve the productivity of small-scale farmers, increase their self-sufficiency and reduce their vulnerability to hunger (UNECA *et al.*, 2013). Malawi has allocated more than 15% of its national budget to agriculture for the last eight years.

BOX 2 – INVESTMENT IN IRRIGATION, WATER AND SANITATION

The irrigation, water and sanitation sector is one of the key priority areas for infrastructure development and effectively contributes to sustainable economic growth. The sector has direct linkages with agriculture and food security, industrial development, climate change, natural resources and environmental management, health, tourism, energy generation, fisheries and other socio-economic sectors. Water is fundamental for energy, transport, health, agriculture and biodiversity. Improved water supply services have a direct impact on the well-being of people, particularly women and children in rural areas. They also reduce the burden of water bearing (as women and children normally carry water from source to home). Time and effort saved in water collection has a huge potential for better childcare and education.

Improved school water, sanitation and hygiene significantly contribute to the quality of education by reducing the disease burden among children and staff, improving school attendance and retention (particularly among girls), making teaching more attractive and retaining teachers. Irrigation also makes a profound contribution to the economy, through its contribution to agriculture. Several technologies, such as the use of treadle and motorized pumps and gravity-fed irrigation systems, have been adopted by farmers. In 2011, 25 small and medium-sized multi-purpose dams were constructed in 24 districts across the country to make water resources readily available for multiple uses. Citizens now have greater access to a portable water supply, especially in rural areas, thanks to the construction of over 7 500 boreholes and shallow wells through both government and other stakeholder initiatives in the sector. Irrigation farming contributed approximately 15% of the gross national maize production in the 2009/2010 agricultural season.

The National Commission for Science and Technology has identified the following challenges: (i) vandalism of water supply systems, leading to water losses, in addition to high repair and replacement costs; (ii) inadequate funding for construction of new water sources to cater for the increased demand for water arising from population growth; (iii) ageing infrastructure; (iv) dwindling water resources; i.e. streams, dambos and rivers, due to siltation; (v) increased water demand, leading to water shortages; (vi) lack of equipment (plants and machinery) to undertake the construction of dams and boreholes; and (vii) land tenure problems affecting construction of permanent infrastructure for most irrigation schemes.

To overcome these challenges, the following strategies were identified by the National Commission for Science and Technology: (i) strengthen water users associations at the community level to run and manage the water facilities; (ii) create an enabling environment for the use of locally developed technologies to protect water outlets; (iii) ensure efficient use of funding; (iv) enhance catchment protection and management; and (v) develop the capacity to maintain water resources.

The provision of safe and potable water to all of Malawi's citizens is a priority. However, the water sector is experiencing challenges which require technological intervention. There is thus a need to upscale the use of more efficient and effective technologies.

Source: excerpts from NCST (2013a), State of Science and Technology in Malawi 2010–2011, pp.47–49.



ATTRACTING FOREIGN DIRECT INVESTMENT

Foreign direct investment⁴ (FDI) is also usually considered a major source of growth. FDI is an important source of finance for transition economies, as it helps to cover the current account deficit and fiscal deficit (in case of privatization-related FDI) and supplements inadequate domestic resources to finance both ownership change and capital formation.

Secondly, compared with other financing options, FDI facilitates the transfer of technology, know-how and skills and helps local enterprises expand into foreign markets. It not only increases the activity of FDI-beneficiary firms but can also have a knock-on effect on other firms and sectors through technological spillover and increased competition, thus raising productivity for the whole economy.

Countries can increase the inflow of FDI by creating a business climate that makes foreign investors feel that their capital is safe. Among the incentives that countries can offer, one could cite low tax rates or other tax incentives, protection of private property rights, access to loans and funding, and infrastructure that allows the fruits of capital investment to reach the market.

According to the latest *World Investment Report* (UNCTAD, 2013), developing countries accounted for a record 52% of global FDI inflows in 2012, exceeding flows to developed economies for the first time ever, by US\$142 billion. By contrast, FDI flows to and from developed economies declined by 32% to US\$56 billion, a level last seen a decade ago.

Technological innovation can be transferred to foreign economies through various channels, such as FDI, international trade and the international diffusion of knowledge and innovation. Technology transfer may be a major reason for the growth in total factor productivity (TFP) in many economies. Wang and Wong (2012) have demonstrated that, over the period 1986–2007, foreign R&D, transferred through inward FDI and imports, improved the technical efficiency of countries by an estimated 9.97% on average. This indicates that, for a country with an average level of technical efficiency of 0.85, its efficiency score would have dropped to about 0.72 had it not received any international R&D through FDI and imports.

For this reason, FDI is an effective conduit for technology transfer through technology spillovers to domestically owned firms in the host country. Managia and Bwalya (2010) analysed the significance of productivity externalities of FDI to local firms, in terms of both intra-industry and inter-industry spillovers, using firm-level data from Kenya, Tanzania and Malawi. The results show evidence of intra- and inter-industry productivity spillovers from FDI for Kenya and Malawi. This shows that significant knowledge spillovers occur through backward linkages from foreign firms in upstream sectors to local firms in downstream sectors. This is consistent with the vertical technology spillover hypothesis. Foreign firms have an incentive to facilitate knowledge transfer to local firms to enable them to produce intermediate inputs more efficiently, thereby making them available to foreign firms upstream at a lower cost.

Many African governments have implemented investment-friendly frameworks to attract more foreign investment. Nonetheless, most foreign investment in Africa goes to extractive industries in a relatively limited group of countries. Thus, the broader development impact of FDI-backed projects is often limited. Attracting investment into diversified and higher value-added sectors remains a challenge for Africa. However, constraints on investment such as weak infrastructure and fragmented markets also adversely affect FDI flows to Africa. FDI levels still vary widely by region, sector and country.

At the time of independence in 1980, the new Malawian government adopted a highly controlled and inward-looking economy. Foreign capital constituted about 70% of the total capital stock and FDI dominated foreign capital inflows (Clarke, 1980). Owing to the unfavourable policy environment for foreign investors, FDI inflows were very low during the first decade of independence (Gwenhamo, 2011).

4 The International Monetary Fund defines (foreign) direct investment in its *Balance of Payments Manual* as the category of international investment that reflects the objective of obtaining a lasting interest by a resident entity in one economy (direct investor) in an enterprise resident in another economy (direct investment enterprise). A direct investor is defined by its ownership of 10% or more of the ordinary shares or voting power in a direct investment enterprise.

FDI trends in Malawi since 1990

Table 4 shows the long-term evolution of FDI inflow, outflow and FDI inflow/gross fixed capital formation⁵ (GFCF) for Malawi between 1990 and 2012. The sharp surge in FDI inflow in 1998 was partly driven by the privatization and liberalization wave in the Malawian economy. This saw a substantial inflow of foreign capital, particularly from South African companies, into various sectors of the Malawian economy. The sudden reversal of FDI inflow, coupled with falling domestic investment, had a depressing effect on GFCF, which fell from a record high of 24.6% of GDP in 1995 to only 2% of GDP by 2005. Since 2008, GFCF has shown sustained growth, reaching 22.4% in 2012 (see Figure 5).

Table 4: FDI inflow and outflow for Malawi, 1990–2012

Year	FDI inflow [million current US\$]	FDI outflow [million current US\$]	FDI inflow/ GFCF*
1990	23	n/a	6.2
1991	-29	n/a	-7.7
1992	-7	n/a	-2.3
1993	8	n/a	3.0
1994	25	n/a	7.9
1995	6	n/a	2.7
1996	16	n/a	7.1
1997	15	1	6.0
1998	12	6	6.2
1999	59	3	26.1
2000	26	3	12.1
2001	19	5	8.1
2002	6	3	0.0
2003	66	1	24.3
2004	108	2	30.5
2005	27	3	25.1
2006	72	6	5.0
2007	124	14	14.2
2008	195	19	19.1
2009	49	-1	4.09
2010	97	42	7.4
2011	129	50	17.0
2012	129	50	4.4

*Gross fixed capital formation

Source: UNCTAD *World Investment Report (s)* [several years]

5 GFCF consists of investment in land improvements (fences, ditches, drains and so on); plant, machinery and equipment purchases; and the construction of roads, railways and the like, including commercial and industrial buildings, offices, schools, hospitals and private residences.

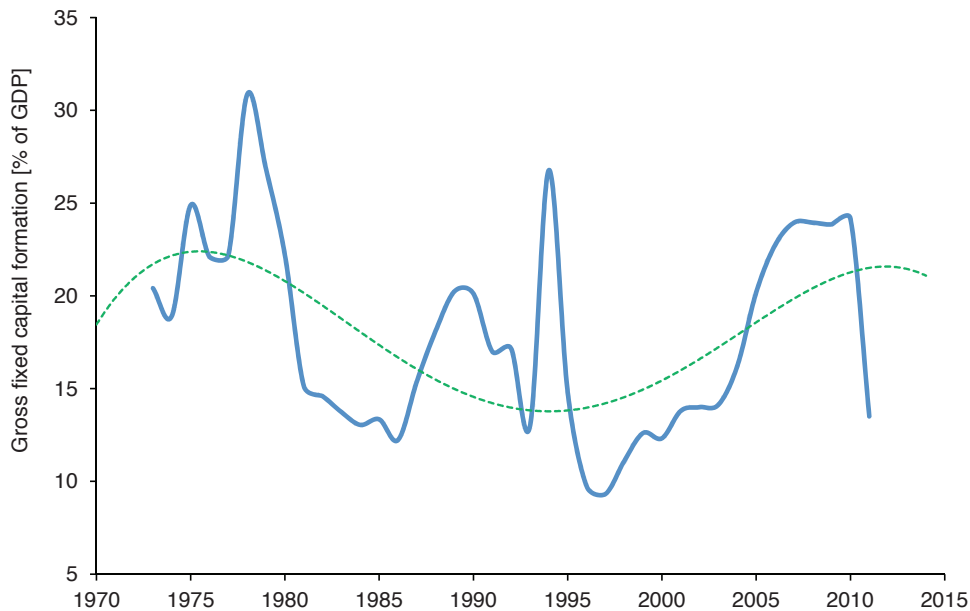


Figure 5: Evolution of gross fixed capital formation in Malawi, expressed as a percentage of GDP, 1970–2013. The dotted line indicates the best-fitting curve. Source: UNESCO, based on raw data provided by the World Bank

Prospects for FDI in 2013 and the medium term

In recent years, Malawi's improved business environment has attracted a greater number of investors from within and beyond Africa. Commencing in 2011, this upward trend has diverted attention from the collapsing investment figures between 2008 and 2010. The infrastructure and energy sectors shared 62% and 33% respectively of total investment in 2012, tourism, services and agro-processing making a minimal contribution. As for the origin of investors, 46% came from China and as many (46%) from the United Kingdom, investors from South Africa, India, Pakistan, Malawi and elsewhere making up less than 4% of the total and investors from other countries the remainder.

Foreign direct investment in 2013 is expected to show positive growth, in line with the current trend which is benefiting from the country's investment-friendly economic reforms. The current government has liberalized the exchange rate and devalued the kwacha, which should ensure availability of foreign exchange for investment. Restored good relations with the donor community are also expected to boost confidence among investors. The *Economic Recovery Plan* is expected to put Malawi's economy back on track, which subsequently should make investing in Malawi a more secure endeavour. Furthermore, the one-stop investment facilitation due to commence this year is a likely determinant for increased investment.

However, the subjective perception of the international community concerning Malawi's ability to attract FDI still ranks the country 130th out of 148 countries, according to a series of opinion polls by the World Economic Forum (2013). See also page 25.

The potential of FDI for improving technical efficiency

In their study, Wang and Wong (2012) define technical efficiency as a country's ability to obtain maximum output from a given vector of inputs, so technical efficiency improvement refers to the movements toward the production frontier. They show that the inflow of foreign R&D transferred via FDI plays an important

role in improving a country's technical efficiency. They have estimated the average technical efficiency scores for individual countries based on the value of the inflow of foreign R&D transferred via FDI. Based on their findings, Table 5 presents the evolution (1986–2007) in technical efficiency and scientific productivity for a selected group of sub-Saharan countries, including Malawi. On average, technical efficiency has increased over time for the majority of these countries, with the exception of Zambia and Zimbabwe, where it decreased.

Table 5: Average technical efficiency and scientific productivity in Malawi, 1986–2007

Other countries are given for comparison

Country	Country technical efficiency								Scientific productivity		
	1986–1989	1990–1994	1995–1999	2000–2004	2005–2007	1986–2007	σ	τ	α	$b = \sum_{1986}^{2007} \frac{Pop}{\Delta t}$	$SCIP = \frac{A}{(B \times \Delta t)}$
Botswana	0.755	0.763	0.802	0.895	0.934	0.824	0.077	22	2,066	1.61	58.33
Cameroon	0.449	0.403	0.471	0.598	0.670	0.508	0.100	22	4,680	14.65	14.52
Congo, Dem. Rep.			0.391	0.385	0.459	0.404	0.037	13	1,462	43.33	1.53
Gambia, The	0.391	0.413	0.411	0.477	0.542	0.441	0.054	22	1,156	1.13	46.50
Ghana	0.383	0.418	0.413	0.435	0.468	0.421	0.029	22	3,762	17.49	9.78
Kenya	0.701	0.704	0.698	0.681	0.732	0.701	0.025	22	13,441	28.70	21.29
Malawi	0.265	0.289	0.393	0.443	0.450	0.365	0.079	22	2,287	10.63	9.78
Mali	0.418	0.437	0.519	0.618	0.653	0.523	0.095	22	1,215	9.60	5.75
Mozambique	0.610	0.624	0.664	0.758	0.863	0.694	0.098	22	802	16.89	2.16
Senegal	0.562	0.556	0.587	0.635	0.656	0.596	0.041	22	3,010	9.11	15.02
South Africa	0.934	0.935	0.896	0.928	0.944	0.926	0.018	22	107,511	40.55	120.51
Togo	0.273	0.268	0.361	0.413	0.456	0.349	0.076	22	773	4.51	7.79
Uganda	0.510	0.478	0.578	0.651	0.712	0.584	0.089	20	3,656	22.17	7.50
Zambia	0.882	0.883	0.695	0.660	0.678	0.762	0.105	22	2,125	9.35	10.33
Zimbabwe	0.639	0.545	0.568	0.493	0.412	0.550	0.068	20	5,380	11.59	21.10

Note: In this table, s represents the standard deviation of the technical efficiency measurements; t indicates the total number of annual observations; a represents the total number of scientific publications listed by Web of Science between 1986 and 2007; b is the total average population between 1986 and 2007; Dt is the number of years between 1987 and 2007 and $SCIP$ is the scientific productivity or the average number of scientific publications per million population between 1986 and 2007.

Source: UNESCO, based on data provided by Wang and Wong (2012), Web of Science and UN Statistics Division

As least developed countries may not have adequate domestic resources to promote the accumulation of R&D stock, the study conducted by Wang and Wong (2012) suggests that adopting preferential policies to promote trade and capital flows which increase access to the results of foreign R&D can be extremely important for improving technical efficiency and, consequently, industrial competitiveness.

However, technical efficiency, innovation and competitiveness also depend on other variables, such as infrastructure and political stability. Arnold (2004) identified other factors, such as managerial deficits, a lack of technological understanding, learning ability or absorptive capacity to make use of externally generated technology, or a failure to (re)configure public institutions, such as universities or research institutes, so that they work effectively within the innovation system, or deficiencies in regulatory frameworks (e.g. health and safety rules), as well as other indirect factors, such as the sophistication of demand or cultural and social values, all of which can have a negative effect on innovation and economic performance. Improvements in infrastructure and political stability, combined with adequate human capital policies, can help to improve a country's technical efficiency and its attractiveness for FDI.



Malawi has continued borrowing some funds to finance investments in SETI, with a positive impact. Most of the SETI activities in the government sector have either been funded through grants like that provided for the construction of the Malawi University of Science and Technology (see page 44). This has implicitly influenced implementation of SETI in other sectors. The implementation of development programmes through donor-aided projects has a positive impact on any country; the country strives to implement these programmes in a timely fashion using the allocated resources, in order to attain the output and targets that were agreed upon during the project planning phase.

THE CORRELATION BETWEEN GOOD GOVERNANCE AND SCIENTIFIC PRODUCTIVITY

In an increasingly complex innovation landscape, developing effective governance requires better co-ordination at, and among, the local, regional, national and international levels. With the broadening of innovative processes, players and locations, the systems of governance that provide for their proper functioning become even more important. As no single actor has the knowledge and resources to tackle the innovation challenge unilaterally, all countries – in one way or another – face the task of better co-ordinating the various actors involved in formulating and implementing policy.

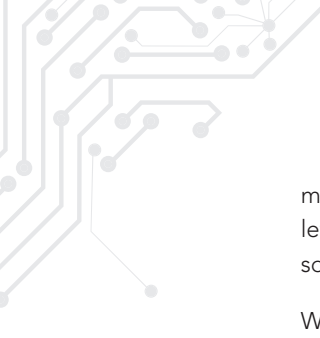
It is understood that institutions, politics and economics are central to any system of governance. Where controversy has sometimes arisen, it has concerned what constitutes good and bad governance and linking governance to democracy. The first multi-party elections in Malawi were held in 1994 and the country has since been struggling to consolidate its young democracy. Malawi's *Vision 2020* identifies democratic governance characterized by transparency and accountability as a core challenge for Malawi. *Vision 2020: the National Long-term Development Perspective* was formulated in 1998, as a national long-term strategic document to guide Malawi's development over a 20-year period. Notwithstanding this, it appears not to have inspired a number of the country's medium-term strategies, such as the *Malawi Poverty Reduction Strategy (2002–2005)*, *Malawi Economic Growth Strategy (2004–2005)* and the first *Malawi Growth and Development Strategy (2006–2011)*, all of which were largely influenced by short-term adjustment needs and changing priorities as perceived by the country's leadership.

The government works closely with bilateral and multilateral donors in support of democratic institutions and free market economic principles. It seeks to make use of international development assistance for its domestic reform agenda.

The Government of Malawi, through the Ministry of Economic Planning and Development and with the support of the United Nations Country Team (UNCT), undertook and co-ordinated the Stakeholders' Post-2015 Development Agenda Consultation Process (see Box 5, page 38). The primary aim of these country-level consultations was to stimulate an inclusive bottom-up, participatory debate on a post-2015 development agenda for *The Future We Want*, a reference to the document adopted in Rio de Janeiro (Brazil) in 2012 by the United Nations Conference on Environment for Development (also known as the Third Earth Summit). These consultations in Malawi were conducted with a wide range of stakeholders through face-to-face interviews, focus groups, roundtable discussions, e-consultations and via the media (UNCT and Government of Malawi, 2013).

The survey identified a series of key governance issues, including: the lack of transparency and accountability; the lack of transformative leadership; the politicization of the development agenda; weak inter- and intraparty democracy; weak local governance; the need for fiscal decentralization; the need for better co-ordination of development efforts and stronger representation by Members of Parliament and; a desire to expand the role of traditional leaders.

Since 1996, the World Bank has published a set of standardized governance indicators each year for every country in the world. The World Bank's team defines governance as the traditions and institutions by which authority in a country is exercised. This includes: the process by which governments are selected,



monitored and replaced; the government's capacity to formulate and implement sound policies and; the level of respect on the part of both citizens and the state for the institutions that govern economic and social interactions (Kaufman *et al.*, 1999).

Within UNESCO's GO→SPIN programme, some correlation among these governance indicators and SETI productivity was found (Lemarchand, 2013). For example, in Figure 6, countries are represented in a Cartesian graph (four quadrants), according to their positive or negative values for government effectiveness and political stability/absence of violence. The size of the bubble reflects the number of scientific publications – listed by the Web of Science – per million population. Few nations fall in the first quadrant. Those countries with the largest GDP per capita and number of scientific publications per million population are located in this first quadrant⁶ (Lemarchand, 2013). The only African countries included in the first quadrant are Botswana, Cape Verde, Ghana, Mauritius, Namibia, Seychelles and South Africa (at the limit for positive values for political stability/absence of violence).

No African country features in the second quadrant (negative values for political stability/absence of violence but positive values for government effectiveness). The third quadrant (negative values for both indicators) concentrates the great majority of African countries. Figure 6 also shows the smallest bubble size and, consequently, features the least productive countries in terms of scientific publications per capita. Lastly, 10 African countries fall in the fourth quadrant (positive values for political stability/absence of violence but negative values for government effectiveness).

Figure 7 shows the evolution in these two governance indicators for Malawi between 1996 and 2012. Both political stability/absence of violence and government effectiveness had negative values for the entire period.

During this period, governance evolved across the third quadrant, the relative distance of the bubbles to the origin of co-ordinates indicating how much governance evolved (a shorter distance implies better governance). Consequently, governance in Malawi deteriorated between 1996 and 2009 when it reached its lowest ebb. Since then, the governance indicators have begun improving, in spite of the fact that the country still has negative values for these two indicators. Figure 8 shows the evolution of these two combined governance indicators over time.

The Government of Malawi (2012) has recognized that good governance minimizes distortionary incentives and ensures equitable allocation and distribution of public resources. It enhances public security and safety, and guarantees property and personal rights, which in turn creates an environment conducive to private sector investment.

Corruption is another important variable – associated with the quality of governance – which has increasingly been incorporated in most of the regional and international reports published by international organizations, including the *African Economic Outlook* (ADB *et al.*, 2013, 2014). Since 1998, Transparency International has published the Corruption Perceptions Index (CPI). The CPI ranks countries and territories on the basis of how corrupt their public sector is perceived to be, on a scale from 0 (highly corrupt) to 100 (very clean). A country's rank indicates its position relative to the other countries and territories listed in the index. The total number of countries included in the survey varies each year, ranging from 85 (1998) to 183 (2011). The CPI is calculated using data from 10 independent institutions. All 13 sources measure the overall extent of corruption (frequency and/or size of bribes) in the public and political spheres and all sources provide a ranking of countries⁷.

⁶ The exception to the rule is Israel, which falls in the second quadrant.

⁷ To determine the mean value for a country, the data are standardized using the technique of matching percentiles. This method uses the country ranking reported by each individual source. It is useful for combining sources that have a different distribution. Whereas there is some information loss with this technique, it allows all reported scores to remain within the bounds of the CPI, i.e. between 0 and 100. A beta-transformation is then performed on scores. This increases the standard deviation among all countries included in the CPI and avoids a smaller standard deviation from year to year, one of the drawbacks of the matching percentiles technique. All of the standardized values for a country are then averaged, to determine a country's score. The CPI score and ranking are accompanied by the number of sources, high-low range, standard deviation and confidence range for each country. The confidence range is determined by a bootstrap (non-parametric) methodology, which allows inferences to be drawn from the underlying precision of the results. A 90% confidence range is then established, whereby there is a 5% probability that the value is either below or above this confidence range. Source: Transparency International (2013)

Within the Stakeholders' Post-2015 Development Agenda Consultation Process, the national survey in Malawi revealed that society considered corruption a very serious issue. Corruption was perceived to be not only draining resources for national development but also raising the cost of doing business in Malawi and creating a disincentive for development. These sentiments were echoed at all three validation workshops, where corruption was recognized as being one of the major obstacles to development. Similarly, the entrenchment of nepotism in Malawian society was highlighted as being one of the evils leading to suboptimal resource allocation in terms of human resource deployment (UNCT and Government of Malawi, 2013).

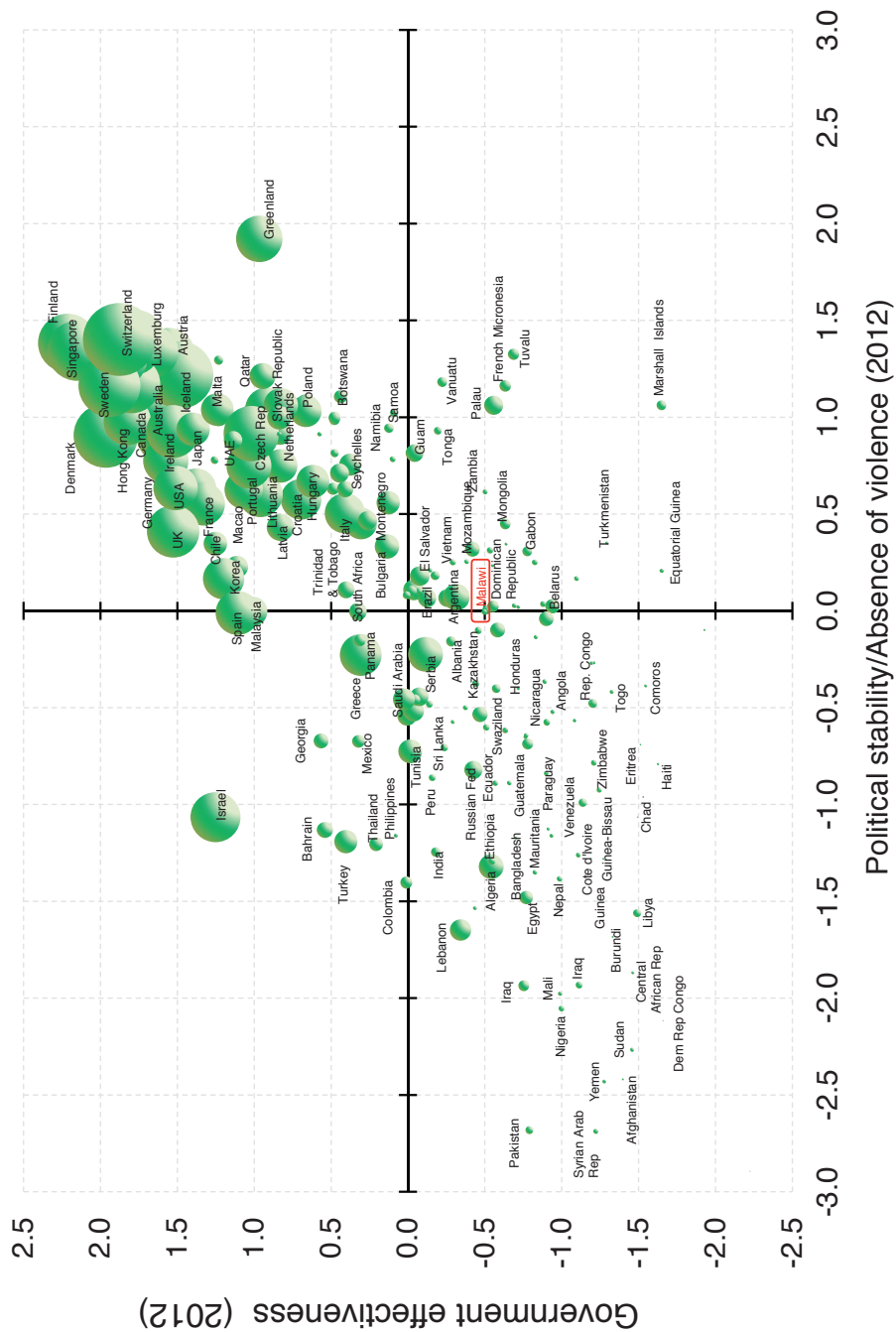


Figure 6: Evolution in government effectiveness worldwide, as measured against political stability/absence of violence, 1996–2012. The size of the bubbles reflects the number of scientific publications per million population for the same years. Malawi appears in the third quadrant (in red). The majority of countries with high scientific productivity appear in the first quadrant (positive values for political stability/absence of violence and government effectiveness). Source: UNESCO, based on raw data provided by World Bank, UN Statistics Division and Web of Science

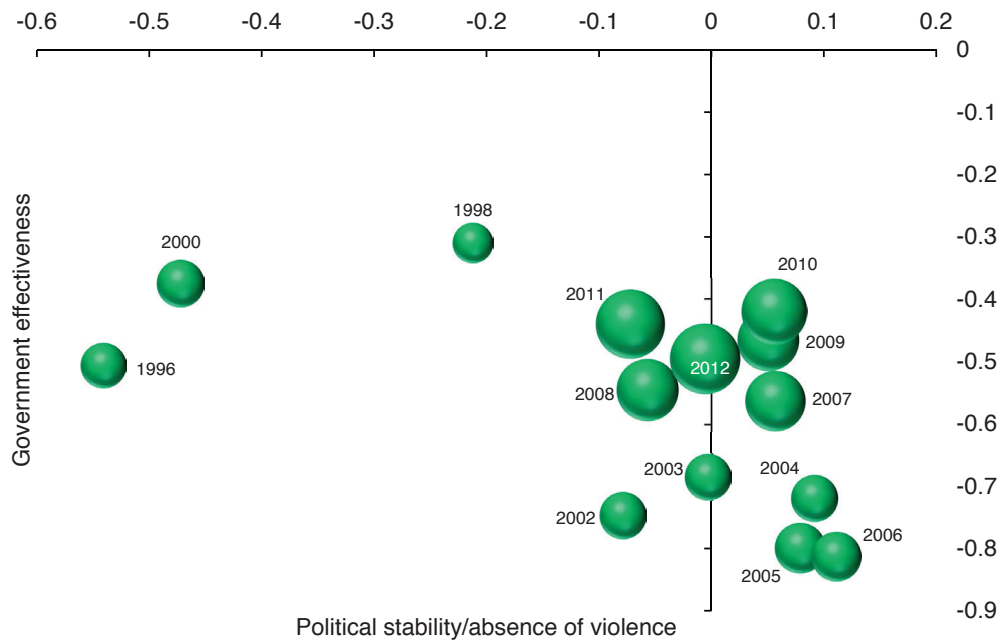


Figure 7: Evolution in government effectiveness in Malawi, as measured against political stability/absence of violence, 1996–2012. The size of the bubbles reflects the number of scientific publications per million population for the same years. Source: UNESCO, based on raw data provided by the World Bank, UN Statistics Division and Web of Science

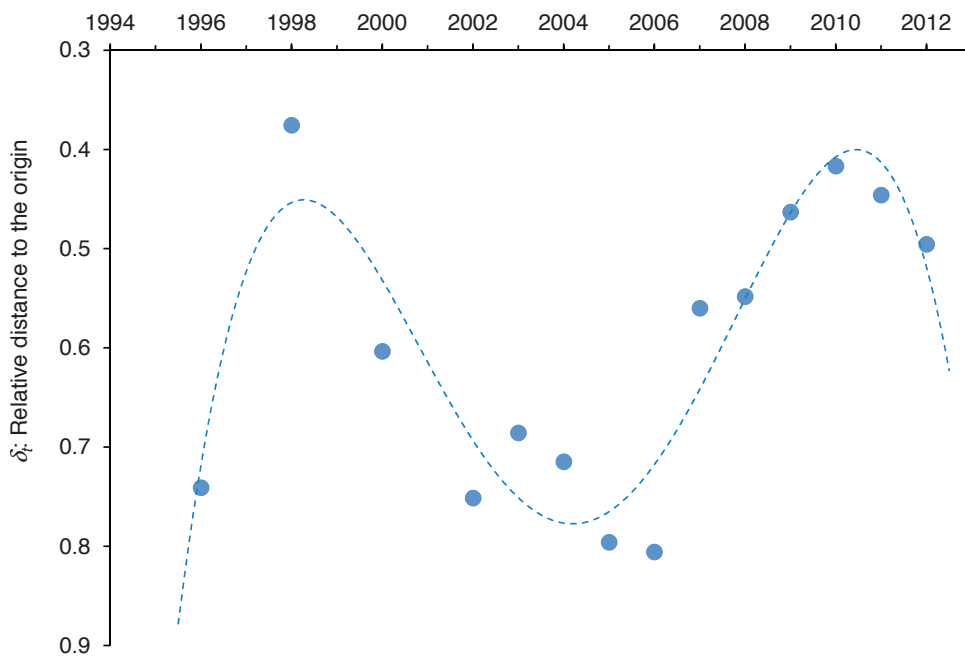


Figure 8: Evolution (1996–2012) in the two combined governance indicators represented in Figure 7. Here, the relative distance to the centre of the origin of co-ordinates is plotted over time. Since all the circles in Figure 7 fall in the third quadrant, these shorter distances mean a better level of governance. The dotted line is the best-fitting curve. It shows that Malawi’s combined governance indicators deteriorated until 2009 when the negative slope reversed. The relative distance d_t at time t (year or measurement) is estimated as $d_t = \sqrt{G_t^2 + P_t^2}$ where G_t is the value for *government effectiveness* at year t and P_t is the value of *political stability/absence of violence* at year t . Source: UNESCO

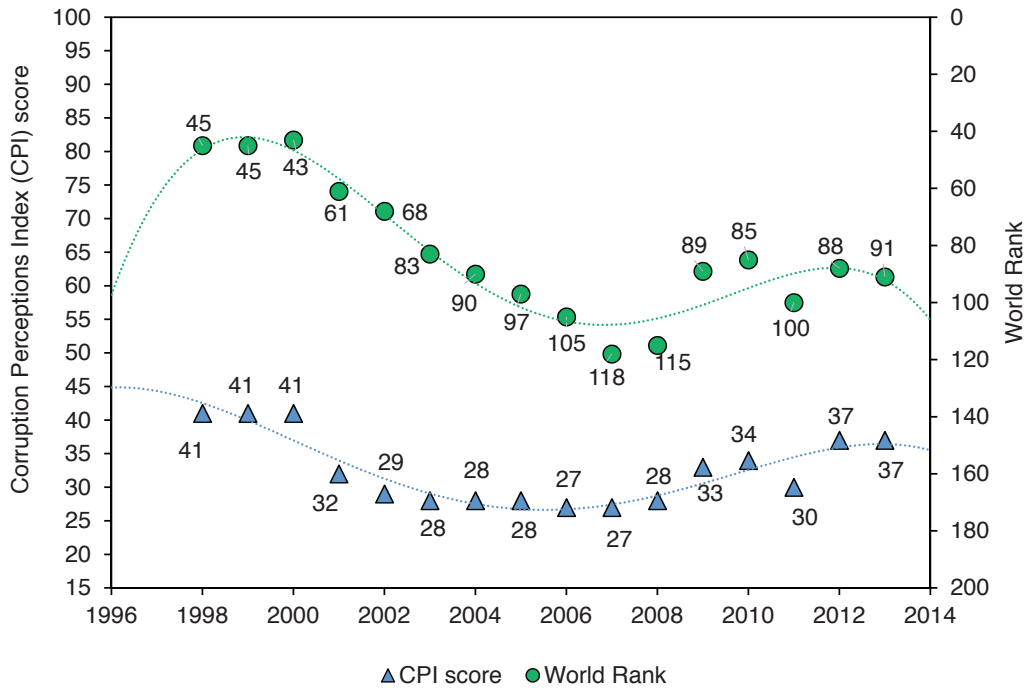



Figure 9: Evolution in the Corruption Perceptions Index (CPI) in Malawi (triangles associated with the left-axis) and world ranking (circles associated with the right-axis), 1998–2013. The dotted lines represent the best-fitting curves. Source: UNESCO, based on raw data generated by Transparency International

Figure 9 shows the CPI scores of Malawi and its corresponding world ranking between 1998 and 2013. The shape of these curves follows a similar pattern to that for the governance indicators (Figure 8). In 1998, Malawi ranked 45th (out of 85 countries), in 2007, it ranked 118th and in 2013 97th.

Weak governance is often a source of persistent failure in applying public policies to development. Whereas efforts have been made to develop policies which are good for managing the economy and social sectors, the enforcement mechanisms for such policies and associated legislation have been considered very weak and, according to the Stakeholders’ Post 2015 Development Agenda Consultation Process, continue to weaken as time goes by (UNCT and Government of Malawi, 2013).

The United Nations system and its specialized agencies, as part of their programme for ‘delivering as one’ have been supporting a functional Democratic Governance Sector Working Group (DGSWG). The DGSWG now serves as a critical instrument for facilitating a co-ordinated approach to interventions in the democratic governance sector by bringing together 19 institutions with different mandates to achieve the MDGs’ target for democratic governance. The democratic governance sector is one of 16 sectoral working groups and includes all institutions responsible for the administration of justice and democratic accountability. This embodies the principle that accountability and justice contribute mutually to democratic governance and should be addressed in a coherent, integrated and consolidated manner.

Malawi’s National Commission for Science and Technology (NCST, 2013b) recognized that politicizing opportunity removes control from the individual, thus attenuating entrepreneurial effort and risk-taking behaviour and the innovation that this engenders. The NCST (2013b) considered that lack of good governance helped to sustain firms that were failing while limiting the creation of new ones. The process of market entry and exit by firms is a sign of a healthy economy.



Political stability and good governance sustained over decades are prerequisites for developing sound public policies. Stability and predictability are particularly important for research and innovation, since both endeavours involve risk-taking with long time horizons. They thus require a stable framework, institutions and policies. Political instability may inhibit innovation by increasing uncertainty for innovators and venture capitalists; it may lessen the effectiveness of SETI policy instruments by weakening the incentives they provide. Moreover, research and innovation are crosscutting activities that involve the ministries of science and technology, higher education, health, agriculture, energy, mining, environment, water and planning, etc. To be effective, research and innovation require co-ordination and coherence among government departments, programmes and policies; empirical studies over the past two decades show that governments find this difficult, since their traditionally departmentalised structures are generally ill suited to deal with crosscutting policy issues such as research and innovation. The way in which STI are managed in Malawi by different ministries, universities and research centres which interact little is an example of this. Adopting a coherent approach entails not only co-ordinating a multitude of policy moves dictated by the core set of research and innovation policies, such as those for higher education and entrepreneurship, but also evaluating their possible interaction with policies pursuing other primary objectives, such as the fiscal policy, competition laws and regulations which provide the framework for innovation (OECD, 2010).

CONSTRUCTING AN INNOVATION PROFILE: INDUSTRIAL POLICIES AND DEMAND FOR SETI

The national innovation systems paradigm usually characterizes the relationship among institutions that support and foster knowledge creation and the firms which exploit this knowledge. This stream of work suggests that institutions within a country need to complement each other and work in tandem to maximize innovation. It is argued that technology policy, which creates efficient institutional mechanisms for integrating the functions of knowledge production and knowledge commercialization, is likely to enhance a country's ability to sustain an innovative technology system over time (Stern *et al.*, 2002).

Innovation policy is usually defined as a set of policy instruments and appropriate institutions that assist in the local generation of technology and the introduction new products and services to the market. This may include adapting imported technologies to local conditions. Appropriate technology policies can be derived only from an understanding of how technical change takes place at the level of the enterprise. Whereas companies everywhere have to make an effort to master or adapt existing technologies, a high level of basic knowledge and capabilities exists in most firms in mature industrial countries, or can be easily acquired from other firms, labour markets, support institutions or consultants. This makes it relatively easy and routine to master existing technologies. In developing countries, by contrast, not only is the internal knowledge base for mastering technologies relatively weak; the support network provided by other enterprises, institutions and human capital also tends to be underdeveloped (Lall and Teubal, 1998).

The promotion of innovation at firm level includes the participation of representatives from the public and private sectors (e.g. entrepreneurs, researchers, public servants, financiers); some ventures may also include actors from civil society. The successful launch and running of initiatives involving innovation require aligning the interests of all stakeholders. This, in turn, implies a difficult co-ordination process. Among all stakeholders, the state appears best placed for the role of initiating, guiding or facilitating co-ordination, owing to its stronger convening and co-ordinating power. Its major role is to set up appropriate policy instruments and incentives to change the behaviour of the different social actors involved in the innovation process. The public sector plays the fundamental role of aligning different incentives with different stakeholders, establishing risk-sharing mechanisms for multi-stakeholder ventures and promoting knowledge sharing and dissemination. In developing countries, the lack of adequate public policies to promote co-ordination among different stakeholders is the major source of failure in promoting new innovative firms.

The productive units in a country constitute the SETI demand side. The characteristics and behaviour of demand for SETI over time determine whether or not it is possible to use the results of research obtained by universities and research centres (SETI supply side) to generate innovation and introduce new products and

services to the market. To handle new knowledge and its incorporation into production, the productive unit has to make a number of technological decisions. Some are clearly concerned with the choice of alternatives regarding the source of new knowledge, the source of equipment and the use of such inputs. Others have to do with the building-up of the firm's capacity (technical and design groups, administrative organisation, information) to make such choices, adapt foreign technology and incorporate new knowledge effectively into production. The adaptation of foreign technology is particularly important, since it contributes to the optimal use of foreign technology and can link foreign technology to domestic S&T.

The lack of adequate information about the characteristics and potentialities of the SETI supply and demand sides in a given country is a source of failure for research and innovation policies, policy instruments and incentives.

In recent years, a growing number of surveys have studied the behaviour of entrepreneurship and innovation in different countries. Some of these provide valuable information on Malawi (World Economic Forum, 2014; INSEAD *et al.*, 2013). See Table 6 for a series of subjective and objective indicators showing the perception of research and innovation in Malawi.

Table 6: Selected subjective and objective measurements for Malawi

Subjective index: World Economic Forum Executive Opinion Survey 2013 (Max. value = 7)			Objective Measurements		
Indicator	Value 1–7	Rank out of 148	Indicator	Value	Rank out of 148
Quality of the education system	3.4	92	Secondary enrolment, gross percentage (2011)	34.2	137
Quality of Math and Science Education	3.2	113	Tertiary education enrolment, gross percentage (2011)	0.8	146
Quality of management schools	3.3	124	School life expectancy, in years (2011)	10.8	106
Internet access in schools	2.8	123	Individuals using internet, % (2012)	4.4	135
Availability of research and training services	3.7	104	Broadband internet subscriptions per 100 population (2012)	0.0	143
Extent of staff training	3.9	84	Int'l internet bandwidth, kb/s per user (2012)	2.8	129
Availability of latest technology	3.9	127	Mobile broadband subscriptions/100 population (2012)	3.5	106
Firm level technology absorption	3.8	133	Mobile telephone subscriptions/100 population (2012)	27.8	145
FDI and technology transfer	3.6	130	Fixed telephone lines/100 pop (2012)	1.4	125
Capacity for innovation	3.0	116	Number of applications filed under the Patent Co-operation Treaty per million population (2010)	0.1	98
Quality of scientific research institutions	3.2	104	Scientific articles listed at SCOPUS (2012)	382	103
Company spending on R&D	2.3	113	Citable scientific articles-H index (2012)	80	83
University-industry collaboration in R&D	3.1	111	Life expectancy at birth, in years (2011)	54.1	132
Government procurement of advanced tech products	3.4	83	Women in labour force, ratio to men (2010)	1.06	1
Availability of scientists and engineers	3.6	101	Imports as a percentage of GDP (2012)	46.8	70

Note: The subjective indicators (from a low of 1 to a high of 7) are based on a series of executive opinion surveys prepared by the World Economic Forum, whereas the objective indicators (related to research and innovation) were originally produced by other agencies and have been compiled by the World Economic Forum. Both columns show Malawi's ranking out of 148 nations for each individual indicator. Similar surveys and data have also been produced by INSEAD *et al.* (2013).

Source: World Economic Forum (2013) *Global Competitiveness Report (2013–2014)*

In 2012, 54.8% of Malawi's merchandise exports went to high-income economies⁸ and 25% to other economies in sub-Saharan Africa.

In terms of the research and innovation components of merchandise exports, Figure 10 shows the evolution in the percentage of manufactured exports/merchandise exports versus high-tech exports/manufactured exports between 1994 and 2011. Over the past two decades, the share of manufactured exports has remained stable at between 7% and 16% of all merchandise exports. Likewise, the high-tech component of manufactured exports has remained steady at between 0.4% and 3.2% of the total.

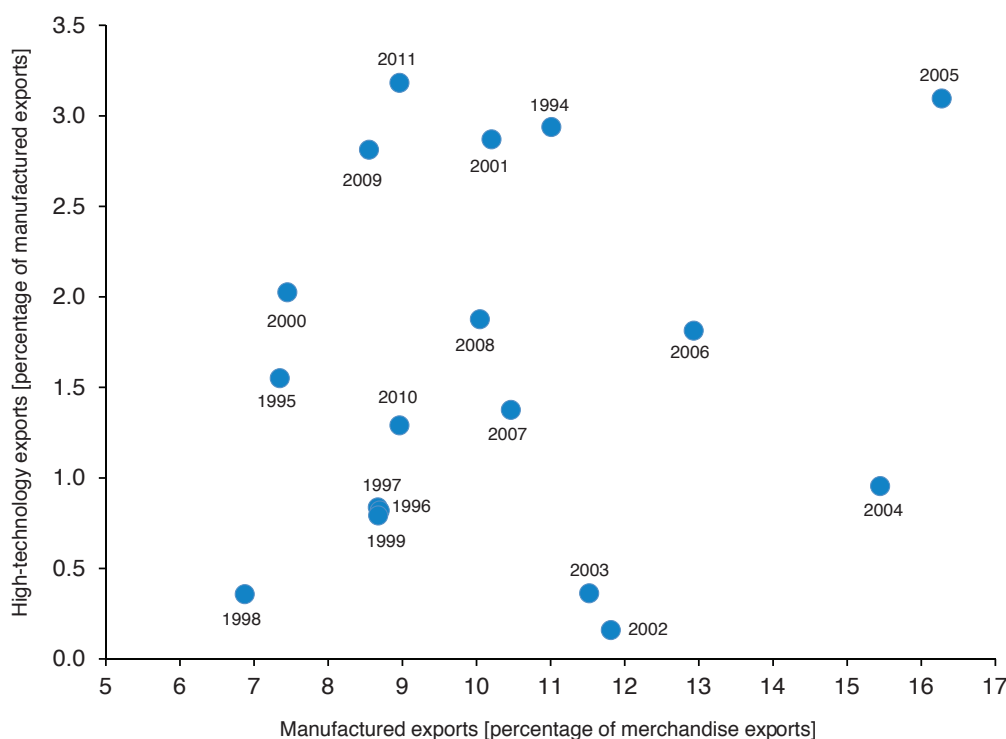


Figure 10: High-tech exports as a percentage of manufactured exports versus manufactured exports as a percentage of merchandise exports in Malawi, 1998-2012. Source: UNESCO, based on raw data provided by World Bank

In recent years, several executive polls have been conducted by different international organizations to measure the dynamism of innovation and the competitiveness of different countries (i.e. World Economic Forum, 2014; INSEAD *et al.*, 2013).

Figure 11 shows the results of an executive poll designed to determine the major difficulties faced by the productive sector in promoting innovation and improving competitiveness. The poll reveals that foreign currency regulations, the lack of access to financing and inadequate infrastructure are deemed to be the major hurdles.

INSEAD *et al.* (2013) made a systematic analysis of the major components of innovation in 142 countries. Their study analyses seven pillars: business sophistication; creative output; human capital and research; infrastructure; institutions; knowledge and technology output and; market sophistication. Figure 12 shows the cartographic results obtained by Malawi for each individual pillar. In 2013, Malawi came 132nd out of 142 countries, with an integrate value of 24 out of 100 maximum points.

⁸ Merchandise exports to high-income economies are the sum of merchandise exports from the reporting economy (in this case, Malawi) to high-income economies, according to the World Bank classification of economies; these data are computed only if at least half of the economies in the partner country group had data.

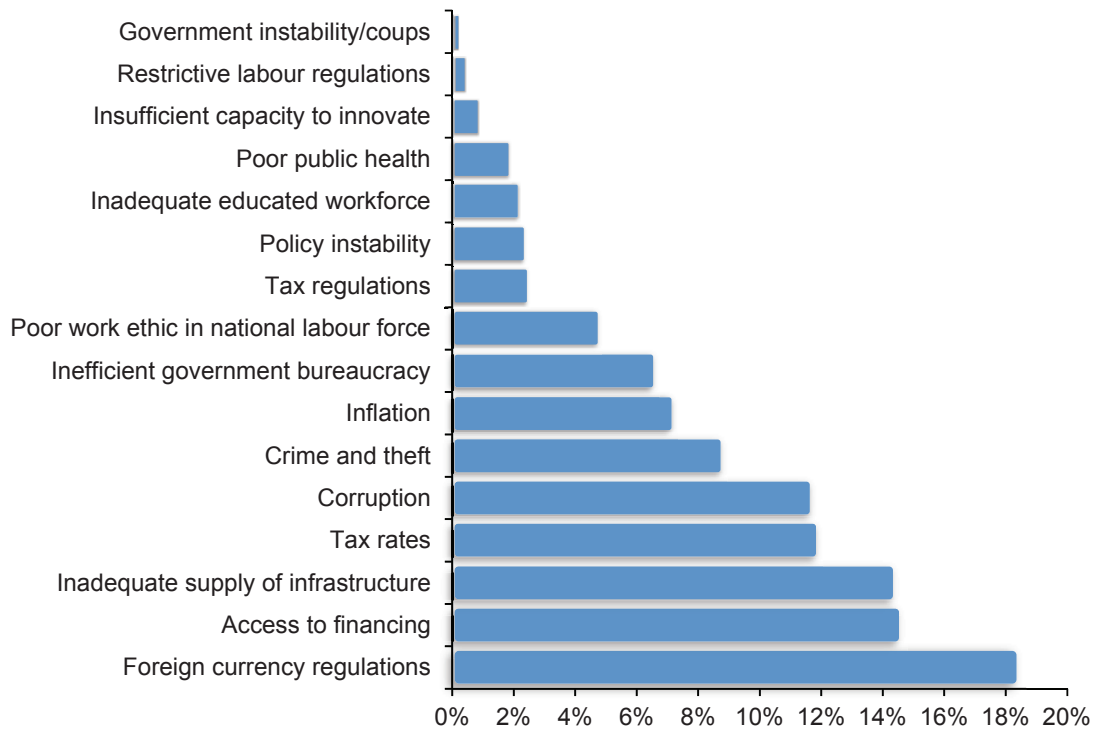


Figure 11: Major difficulties in promoting innovation and competitiveness in Malawi, 2013. Source: World Economic Forum (2014)

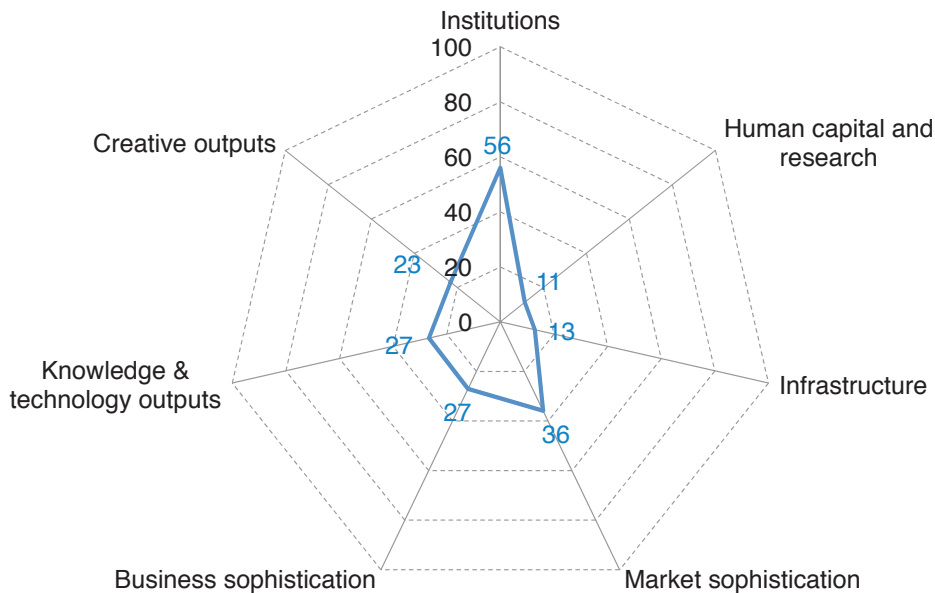


Figure 12: Malawi's scores (0–100) for each individual pillar of innovation, taking into account the estimation of the Global Innovation Index. Source: INSEAD et al. (2013)



SURVEYING MALAWI'S MICRO-ENTERPRISES AND SMALL AND MEDIUM-SIZED ENTERPRISES

Manufacturing in Malawi accounts for just 12% of GDP and most of the country's products are exported in a raw or semi-processed state. The government is prioritizing manufacturing projects that can add value to Malawi's agricultural products (Government of Malawi, 2013).

Micro-enterprises and small and medium-sized enterprises (SMEs) make up the majority of firms in developing countries and thus contribute substantially to employment. They are also significant for their ability to innovate. Micro-enterprises and SMEs, in general, attract the interest not only of policy-makers but also of researchers, as the sector is seen as an important means of enhancing the long-term development and growth of countries.

In 1994, the Malawi Industrial Research and Technology Development Centre (MIRTD) conducted its first technology needs assessment of the manufacturing sector. This assessment targeted the needs of micro-enterprises and small industries, in keeping with the support of the government and development partners for this sector. The study identified technological support, both hardware and software, as being the sector's biggest need. This finding led MIRTDC to develop responsive technologies and programmes.

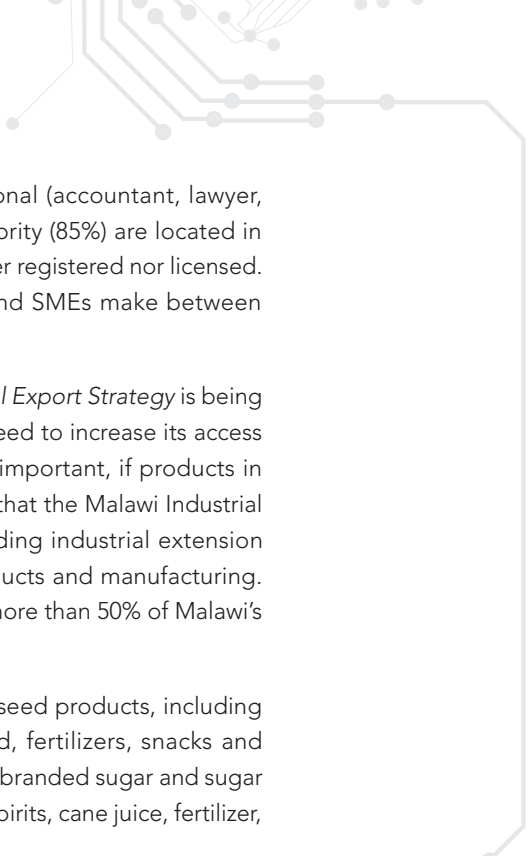
The latest *Industrial Technology Needs Survey* (MIRTD, 2010) has identified needs in all areas of technology. For example, the training budget for operations personnel is equivalent to less than 5% of the operations budget in 50% of companies, whereas the dependence of 51% of companies on on-the-job training reflects badly on their state of readiness and future competitiveness. The survey indicated a scarcity of personnel in production/operations management and quality management. It would therefore be advisable for institutions of higher learning like the University of Malawi to introduce courses that target specific industries (cotton, sugar, tobacco, tea) both at undergraduate and postgraduate levels. Institutions like the Tea Research Foundation and Agricultural Research Trust could also design tailor-made courses for their specific areas of interest. The survey identified the following training programmes as being needed by Malawi's industrial sector, in order of priority: (1) operations management, (2) quality management, (3) environment, health and safety, and (4) machine maintenance.

The MIRTD (2010) survey identified a need for proper benchmarking in industrial processes. It was observed that 71% of manufacturing companies considered themselves as being leaders in their field. Another cause for concern is the low level of International Organization for Standardization (ISO) certification (27%) and rare observance (13%) of Hazard Analysis and Critical Control Points (HACCP). The small local market makes participation in international trade crucial. The low ISO certification and HACCP observance should be addressed as a matter of priority, where applicable. The zero certification according to ISO 14 000 could either be a result of weak legislation on compliance or poor enforcing mechanisms.

The observation that 80% of companies are operating at a rated capacity is an indication that growth can only come about through greater capacity vis-à-vis new machine acquisitions or the implementation of new operational policy instruments and adequate incentives to promote innovation on all scales (from minor to major innovation systems).

Governments are interested in setting up support programmes to enable firms to increase their export sales, given the positive impact that a surge in exports has on the economic growth and competitiveness of a country. Despite the recognized importance of micro-enterprises and SMEs, these still face major challenges today associated with business creation, survival and growth.

In a recent survey, FinScope (2013) estimated that there were almost a million micro-enterprises and SMEs in Malawi. The fact that there are far fewer business owners (758 118) suggests that some people own more than one business. The survey showed that the sector employed over a million people (1 050 320) and generated an income of 326 billion Malawian kwachas (MWK) in 2011, making it a significant contributor to Malawi's economy. However, the majority of these enterprises are very small. Almost 60% consist of individual entrepreneurs who employ no other people. Even among companies with a salaried mass, the majority are micro-businesses. The majority of micro-enterprises and SMEs (87%) are retailers



who sell agricultural products primarily. The remaining 13% render professional (accountant, lawyer, consultants) or skilled (hair salon, plumber, mechanic) services. The great majority (85%) are located in rural areas and 91% of micro-enterprises and SMEs trade informally, being neither registered nor licensed. Given their size, their net profit is relatively low: 35% of micro-enterprises and SMEs make between 110 MWK and 25 000 MWK a month.

In order to diversify the economy and prioritize exports of the country, a *National Export Strategy* is being implemented (Government of Malawi 2013). The government recognizes the need to increase its access to technology and to promote endogenous research and innovation. This is important, if products in the selected clusters are to compete in target markets. The strategy proposes that the Malawi Industrial Research and Technology Development Centre play a support role by providing industrial extension services to SMEs in three priority clusters: oil seed products, sugar cane products and manufacturing. The government estimates that these clusters have the potential to represent more than 50% of Malawi's exports by 2027, thereby complementing tobacco as a major export product.

The strategy calls for establishing production facilities for a wide range of oil-seed products, including cooking oil, soaps, lubricants, paints, varnishes, flours, bio-fuel, animal feed, fertilizers, snacks and confectionery. Concerning sugar cane, the strategy promotes the production of branded sugar and sugar products with high added value, including syrups, candies, sweetener, ethanol, spirits, cane juice, fertilizer, animal feed and cosmetics.

The government proposes supporting the three clusters by promoting access to the latest practices and technology through the provision of expert advice, greater access to the outcome of international research, better information about available technologies and assistance in helping companies obtain grants to invest in such technologies from sources such as the financial sector, the Export Development Fund, the Malawi Innovation Challenge Fund (see page 33) and other available matching grant schemes. This service will be provided in collaboration with the Small and Medium Enterprise Development Institute and Malawi Bureau of Standards and will focus on the selected priority clusters.

A good business environment is a prerequisite for private sector-led economic growth, as it encourages investment. On the contrary, a poor business environment discourages private investment, generating a demand for the design and application of appropriate policy instruments and incentives to turn the situation around.

Since 2012, the Malawi Confederation of Chambers of Commerce and Industry (MCCCI, 2013) has been conducting the *Malawi Business Climate Survey*. The latter is a perception survey aimed at getting current views from the business community on the business environment in Malawi. This survey also helps to reveal some of the underlying issues that can explain the movement of some economic variables in an economy to inform policy better. The results of the survey cover the general perception of the business climate, obstacles to doing business as perceived by specific key sectors of the economy and internal constraints faced by businesses. In 2013, a survey questionnaire was sent to 215 companies, 72 of which returned the questionnaire duly completed; this represents a survey response rate of 33%.

The inadequate, erratic supply of electricity has consistently been rated the most serious obstacle to doing business in previous years. The government thus needs to prioritize the long-term generation and supply of electricity. The business community welcomed the Millennium Challenge Account Project as an opportunity to rehabilitate the existing system, the Interconnector Project to the Mozambique Power Grid and other investments in the energy sector. The survey pinpointed the responsibility of the electricity challenge in Malawi's lack of competitiveness, since it increases the cost of doing business.

MCCCI (2013) considers that investment in R&D is a fundamental basis for improving and maintaining the competitiveness of businesses at both local and international levels. According to its survey, the importance of research and its utilization by businesses have been underestimated in Malawi. Figure 13 compares responses to the 2012 and 2013 surveys concerning the ways in which businesses utilize research findings. The responses show that hardly any enterprises prioritize research and innovation.



BOX 3 – WOMEN IN SMALL BUSINESS

FinScope (2013) has conducted a survey of women's participation in small business. From January to March 2012, it conducted 1 997 face-to-face interviews with owners of micro-enterprises and SMEs (MSMEs) aged 18 years or more with fewer than 100 employees, including individual entrepreneurs with no employees at all. The following observations are taken from this study:

Women in business are mostly aged between 31 and 40 years, similar in proportion to the overall population in business. Women in the 25–30 year age group form the next largest group who own MSME businesses. Women in business are most likely to be the spouse/partner (68%) of the head of the household. Thus, gender roles might affect the division of the business. This also affects access to, and control over the allocation of, resources, benefits and decision-making.

For 52% of women, their business is in fact the only source of income. Of those who have alternative personal income (48%) in addition to their main business, 39% derive their personal income from other businesses and 35% receive money from other sources, i.e. 26% from spousal salary and 9% from other family contributions.

Accordingly, the majority of these women (90%) acquired the necessary business skills informally. Most women taught themselves (48%) or were taught by family members/spouse (36%), while 6% learnt the required skills while running the business. Only 2% attended a training programme and 0.5% received their training from a formal educational institution such as a school or technical college. Only 0.2% attended university. Circumstances have often limited women's access to a meaningful business experience (such as formal education and training, previous work experience). However, education and experience are critical in the management and development of their businesses.

Most women (97%) are individual entrepreneurs or tend to be in small sector microenterprises, mainly in the informal sector. Most women-owned businesses (91%) operate in the retail sector, mainly trading at 49% (including agricultural products at 28% and vending at 21%). In fact, buying and selling agricultural products is the main activity of women-owned MSMEs in Malawi. It needs to be considered, however, that the proportion of women who sell agricultural products is probably much higher. This survey refers to business activity, only those who sell more than they consume, i.e. mainly produce for retail purposes and only consume a proportion of fruits/vegetables/livestock produced (less than 50%).

Women face a range of constraints in terms of starting, operating and growing their businesses. The majority of them, however, do not use/have access to any professional support to overcome these challenges. The survey identifies that access to finance features as the single biggest constraint affecting the establishment as well as the expansion of women's entrepreneurial activities. Women normally rely on personal income and friends and family to provide the initial finance for their enterprises. Although inadequate education was not mentioned, it is expected to affect business, given the low levels of formal education and skills training for the majority of female entrepreneurs. This also relates to the ability to access resources in the environment, e.g. finance/capital, suppliers and customers.

Informal networks seem to be a very important source of support for women, particularly women's (17%) and church/religious groups (35%) – which are most likely to provide emotional support. However, only 9% of women belong to a business networking group/organisation or to professional bodies, indicating the limited access to professional / operational support. In fact, the majority of women (62%) are not aware of MSME support and 45% of small business women do not belong to any group. Within this survey, only 1% of the responses admitted to having obtained technical support from the Malawi Industrial Research and Technology Development Centre.

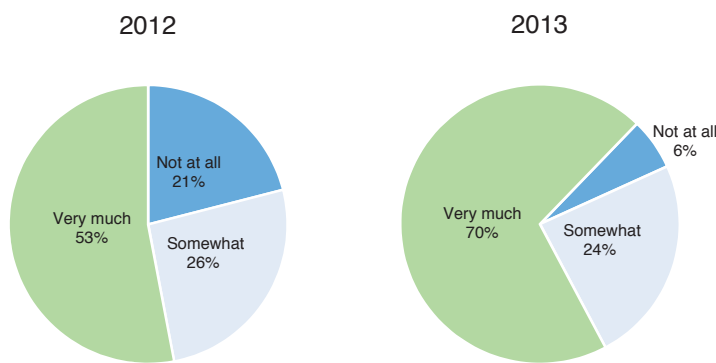
Source: FinScope (2013)

Some 71% of respondents affirm that they usually use and absorb new technologies but only 11% of these firms are export manufacturers. Nearly half of respondents (47%) collaborate extensively to promote technology flows, which is very important for business.

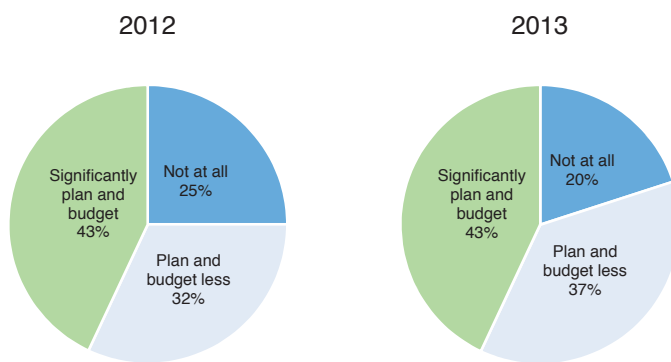
Among those respondents who employ at least 21 employees, half (50%) of staff have benefitted from tertiary education. Among businesses with fewer than 20 employees, the proportion is even higher: 67%.

According to the report (MCCCI, 2013), competitive businesses meet the needs of their local and international customers by being able to adapt technologies and innovate. This implies that businesses need to address firm-level constraints by investing in human resources, technology and R&D. The Malawi Confederation of Chambers of Commerce and Industry considers that the government needs to promote public-private partnerships, in order to help businesses develop the necessary infrastructure to become more competitive.

Extent to which new research findings are important for growth of businesses



Extent to which companies plan and budget to benefit from new research



Extent to which companies spend on research and development

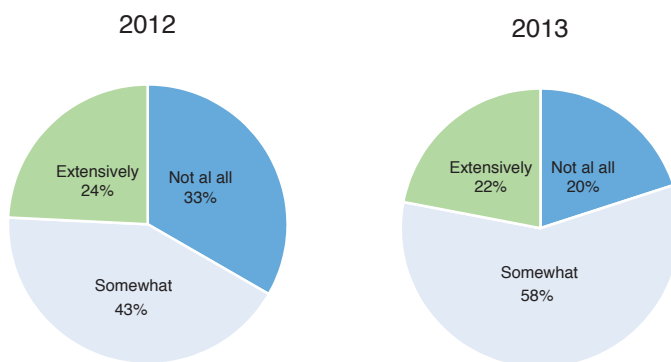


Figure 13: Respondents' opinions concerning the importance of R&D in Malawi's manufacturing sector. Source: MCCCI (2013)



Investment opportunities as drivers of innovation

The government's policy reforms aim to diversify the economy, which is largely agriculture-based. To this effect, a number of key priority sectors and export clusters have been identified for investment, as outlined in the country's strategic development plans (Government of Malawi, 2011, 2012).

Recently, the Malawi Investment Trade Centre (MITC, 2013) identified a portfolio of key economic sectors for foreign investment. It assumes that Malawi may represent a new market for some investors and that a diversified investment portfolio could spread investors' exposure to risk across several projects. Consequently, a Malawi-based financial institution is currently considering establishing a Malawi-focused investment fund which would offer a co-ordinated approach to managing investment funds on behalf of investors in the priority sectors of Malawi's economy.

The following key sectors have been identified:

Agriculture: the primary economic activity for around 85–90% of Malawi's population, contributing 30% of GDP and comprising the main input for much of the manufacturing sector's foodstuffs and agro-processing production. Malawi is now exploring the idea of diversifying into crops other than tobacco (traditionally its main export) which have significant potential.

Manufacturing: the manufacturing sector provides scope for significant growth and there are several well-documented opportunities, particularly in agro-processing, some of which are profiled in the current study. Other manufacturing sectors with potential are textiles, plastics, packaging, soaps, steel production, pottery and ceramics.

Energy: the critical driver for industry in Malawi, if it is to boast manufacturing effectively. Energy projects will therefore have a significant impact on development. The Scottish Academic and Industry consortium, Energy Technology Partnership, European Union and UK Department for International Development are currently investigating opportunities for value addition and investment. Large energy infrastructure projects are being planned, including to increase the supply of hydroelectric power. As many Malawians are off the grid, there are numerous opportunities for microhydro, solar energy and biofuels.

Mining: an important sector for foreign exchange-based income generation, which is critical for funding imported inputs such as fuel and machinery, for example for agro-processing and other high-growth industries. In addition to the high-profile uranium mining operations run by Paladin Energy in the north of Malawi (Karonga region), there are a number of mining opportunities currently being explored (e.g. precious and semi-precious stones – these are often mined in the informal sector operated by associations of small producers). There are further opportunities in the wider extractive industries, which may be explored through the Ministry of Mines and with the Malawi Investment Trade Centre.

Tourism: an important cluster in Malawi and one that has significant potential because a) there is scope for further investment in tourism to meet growing demand, and b) a growing appreciation of Malawi as a 'hidden gem' tourist destination, particularly Lake Malawi, known as the 'Lake of Stars'. Malawi has one main chain of hotels (Sunbird), which provides good quality hotel accommodation in key cities (Mzuzu, Lilongwe, Blantyre) and holiday destinations (Lake Malawi, Zomba Plateau). However, there is scope for other hoteliers to enter the market. Niche and more informal accommodation is also available at various tourist locations across the country. There is further potential to offer unparalleled and unique holiday experiences. Secondary services to the tourism sector such as car hire and internal transport options provide further opportunities for investment.

Infrastructure: large infrastructure projects (including those above related to energy), along with projects to develop clean water and sanitation, national and regional grain storage silos, warehouse systems, road and rail are all under way, with scope for additional investment. Further innovative financing models to fund silos, schools, hospitals and other infrastructure would be welcomed.

Table 7 presents the investment portfolio prepared by the Malawi Investment and Trade Centre. Spanning the major growth sectors of Malawi's economy and ranging in size from US\$0.1 million to US\$70 million, with a combined value of US\$177 million, these proposals offer promise for innovation.

Table 7: Summary of the investment portfolio in Malawi, 2013

No.	Prospect	Sector	Investment	Approx Value US\$ million
1	Open	Agro-processing	Sugarcane	70.0
2	Open	Agriculture	Pigeon peas	33.0
3	Afriseed Ltd	Agriculture	Seeds	22.0
4	Sunbird Hotels	Tourism	Eco-lodges	8.0
5	Mpatsa Holdings Ltd	Agriculture	Irrigation	7.0
6	Universal	Agro-processing	Soy bean processing	7.0
7	RAB Processors	Agro-processing	Soy beans	6.0
8	Mpatsa Holdings Ltd	Financial services	Commercial bank	5.0
9	NASCOMEX Ltd	Agro-processing	Input/output marketing	5.0
10	Pride Malawi	Financial services	Micro-finance	3.2
11	Skyband	Infrastructure / ICT	Fibre optic cables	3.0
12	Company X	Agro-processing	Groundnuts	2.2
13	BERL	Energy	Bio-energy	1.3
14	Paragon Ceramics Ltd	Tourism/Manufacturing	Lodge & pottery	1.0
15	Mpatsa Holdings Ltd	Agriculture	Fish cages	1.0
16	Beta Television	ICT	Commercial TV station	0.9
17	Eqnon Electricity Kiosks	Energy	Mobile electricity	0.4
18	Tafika Milling	Agro-processing	Baobab juice	0.3
19	Ink It Design & Print Press	Services	Printing press	0.3
20	Naturals	Agro-processing	Baobab juice	0.3
21	Waster Water Environment	Infrastructure / ICT	Water/waste services	0.3
22	Namiashi Lodge	Tourism	Lodge & pottery	0.1

Source: MITC (2013)

The government recently created the Malawi Innovation Challenge Fund (MICF). This is a source of US\$8 million in funding supported by the United Nations Development Programme and the UK Department for International Development. MICF is a competitive facility through which businesses in Malawi's agricultural and manufacturing sectors can apply for grant funding for innovative projects with potential for making a strong social impact and helping the country diversify its narrow range of exports. The MICF provides a matching grant of up to 50% to innovative business projects to help absorb some of the commercial risk in triggering innovation. This support should speed up the implementation of new business models and/or the adoption of technologies. The first round of competitive bidding opened in April 2014 (see page 193).



BOX 4 – TAX INCENTIVES IN MALAWI

Raw Materials under Industrial Rebate Scheme

An industrial rebate scheme exempts companies from paying import duty, value-added tax (VAT) and excise tax on goods used for certain purposes, mainly manufacturing. Various types of industry are approved for rebate and specified materials used by those industries may be imported or delivered from an excise factory, at reduced (i.e. rebated) rates of duty. In the 2012/2013 financial year, this scheme was expanded. It now grants zero import duty, no VAT and no excise tax on all approved raw materials.

Tourism Sector

Car hire and safari companies, hotels, lodges and inns enjoy duty-, excise- and VAT-free direct importation of equipment, as long as they are licensed under the Tourism and Hotels Act.

Agriculture Sector and Fishing Industry Incentives

Dairy farms enjoy a waiver from customs duty, excise and VAT on specialized machinery, equipment and other related goods, as well as from excise duties on the purchase of raw materials and packaging materials made in Malawi. Those investing in specialized goods for use in the fishing industry enjoy customs duty-, excise- and VAT-free status.

Mining Industry

Firms that invest in machinery, plant and equipment enjoy waivers on customs duty, excise and VAT. However, this incentive has not been applicable lately, leaving room for discretionary incentives often arising out of negotiations between government and the investor.

Water Supply, Electricity Generation, Transmission and Distribution and Telecommunication Sectors


Customs duty, excise and VAT do not apply to the purchase of goods for direct use by the telecommunications industry, upon the approval of the Commissioner General of the Malawi Revenue Authority. The same is true for goods imported by the boards responsible for investing in the water supply and electricity generation and transmission.

Export Incentives

There are export incentives for companies establishing operations in an Export Processing Zone, as stipulated in the Export Processing Zones Act (1995). A company applies to the Minister of Finance for a certificate upon fulfilment of conditions through the Export Processing Zones Appraisal Committee. If issued, the certificate is valid for a period of five years and may thereafter be renewed for successive periods of two years.

In making recommendations to the Minister of Finance regarding an application, the committee is instructed to consider the following; contribution to employment, use of advanced technology, utilization of local raw materials, export-oriented activities other than the production for export of tobacco, tea, coffee and sugar, among others.

The Minister of Finance may, by notice published in the *Gazette*, declare any area of land on which a factory has been built, is under construction or is likely to be built to be an export-processing zone (EPZ). Where an export enterprise imports or purchases any dutiable goods for use in a bonded factory or EPZ, no duty shall be paid on the goods if the goods are transported



directly to a bonded factory or EPZ and placed there under such conditions as the Commissioner General of the Malawi Revenue Authority may impose.

However, since the announcement by the Minister of Finance in the 2010/2011 budget session, investors in EPZs no longer enjoy a zero corporate tax rate and the number of factories designated as EPZs has since declined from 30 to 10.

Further, the Export Processing Zone Amendment Bill (2013) specifies the entitlements of exporting firms as those stated in the Taxation Act, Customs and Excise Act, Value Added Tax Act and the Exchange Control Act. It stipulates that the following goods shall not be imported free of import duty and value-added tax by an export enterprise: (a) a vehicle not used solely within an EPZ and, in any case, a passenger car or mini bus; fuel for use in generators and boilers, in quantities and subject to such conditions as the Commissioner General may, from time to time, determine and; (c) spare parts for motor vehicles, including vehicle tyres.

Those manufacturing under bond are given an export tax allowance of 12% of export revenues for non-traditional exports (such as nuts, soya beans, rice etc., tobacco, tea, coffee or sugar being considered traditional exports), a transport tax allowance equal to 25% of international transport costs (excluding traditional exports), no duties on imports of capital equipment used in the manufacture of exports, no VAT and excise tax or duty on the purchase of raw materials and packaging materials and a refund of all duties (duty drawback) paid on imports.

Exporters are also entitled to the following privileges: training allowance of an additional 50% of the costs incurred by a tax-compliant company during the year of assessment in the training of an employee who is a Malawian, intended to enable him/her to attain a qualification at the degree, diploma or certificate level.


Source: Nsiku (2013)

Fiscal incentives

The main thrust of the *Malawi Growth and Development Strategy II* (MGDS II) is to create an enabling environment for domestic and foreign investment through pro-business legal and regulatory reforms. A range of reforms are in the process of being developed, some of which will soon be tabled in Parliament, including the: (1) Export Processing Zones (amendment) Bill; (2) Business Licensing Bill; (3) Insolvency Bill; (4) Companies (amendment) Bill; (5) Business Registration Bill and; (6) Personal Property Security Bill. A key objective is to ease the transaction costs of doing business in Malawi. Another medium-term outcome sought under MGDS II is the development of local micro-enterprises and SMEs, as well as greater private sector investment in rural areas.

The general tax incentives granted in Malawi are the:

- a. 100% investment allowance, which allows capital costs to be deducted from taxable income, on qualifying expenditures for new buildings and machinery;
- b. investment allowance of up to 40% for used buildings and machinery;
- c. 50% investment allowance for qualifying training costs;
- d. 100% investment allowance for manufacturing companies, allowing a deduction of all operating expenses, during the initial 25 months of operations;
- e. loss carry forward of up to seven years, enabling companies to take advantage of allowances;
- f. additional 15% investment allowance for investments in designated parts of the country, such as industrial sites.



To place these incentives in context, tariff rates range from 5% to 25% (WTO, 2012) and the value-added tax is currently 16.5% (Nsiku, 2013).

The Government of Malawi uses a mix of fiscal, financial and regulatory instruments to administer its investment policy. Management and responsibility are thus spread across multiple ministries and agencies (Nsiku, 2013).

The Malawi Investment Promotion Agency, now called the Malawi Investment and Trade Centre (MITC), is normally the first point of inquiry for new investors. Responsible for promoting investment, MITC falls under the Ministry of Industry and Trade. Taxation policy is the jurisdiction of the Treasury Department in the Ministry of Finance. The Malawi Revenue Authority is the main implementing agency for tax policy; it administers the Taxation Act and other relevant legislation. Some regulatory incentives fall within the jurisdiction of their respective ministries and, therefore, so does their implementation. The Reserve Bank of Malawi administers the market-based exchange rate of the Malawi kwacha, as well as liberal exchange controls, to allow free flow of capital and earnings: repatriation of dividends, profits and royalties. The Ministry of Internal Affairs' immigration department administers the Employment of Expatriates Policy, Temporary Employment Permits and Business Residence Permits. The Department of Lands and Physical Planning is responsible for land policy administration.

MALAWI'S INFORMATION AND COMMUNICATION POLICY

In 2012, the telecommunications sector contributed about 4.5% of Malawi's GDP and created employment for 10% of highly skilled personnel (MACRA, 2012). In 2012, Malawi counted only 4.4 internet subscriptions per 100 inhabitants (ranking it 135th worldwide). Average internet bandwidth was 2.8 kb/second (129th worldwide), there were only 3.5 mobile broadband subscriptions per 100 inhabitants (106th) and a tiny percentage of the population had internet broadband access (see Table 6, page 25). By international standards, the country has a low level of connectivity among the general population, although, relatively speaking, there has been exponential growth in subscriptions to internet services over the past 15 years (see Figure 14).

The Malawi Communications Regulatory Authority (MACRA) was established pursuant to Section 3 of the Communications Act of 1998 to assume the regulatory functions of the communications sector, which had previously been performed by the Malawi Telecommunications Corporation Limited. Key objectives of the Communications Act are universal access, rural connectivity, liberalization and private sector involvement.

Malawi's *Vision 2020* sets the conceptual parameters for subsequent policy, including the future national information and communication technologies (ICTs) policy, which was launched in 2013. The mission of this policy is to facilitate the creation of an enabling environment for efficient, effective and sustainable utilization, exploitation, and development of ICTs in all sectors of the economy, in order to attain an information-rich and knowledge-based society and economy.

The *ICT Policy for Malawi* (Republic of Malawi, 2013a) was launched in December 2013, together with the *Malawi Digital Broadcasting Policy*. The *ICT Policy for Malawi* aims to mainstream ICTs in all economic sectors to drive implementation of the *Malawi Growth and Development Strategy* (MGDS) II. It also sets out to put an appropriate institutional, regulatory and legal framework in place, in order to support the successful deployment of these technologies in all economic and productive sectors.

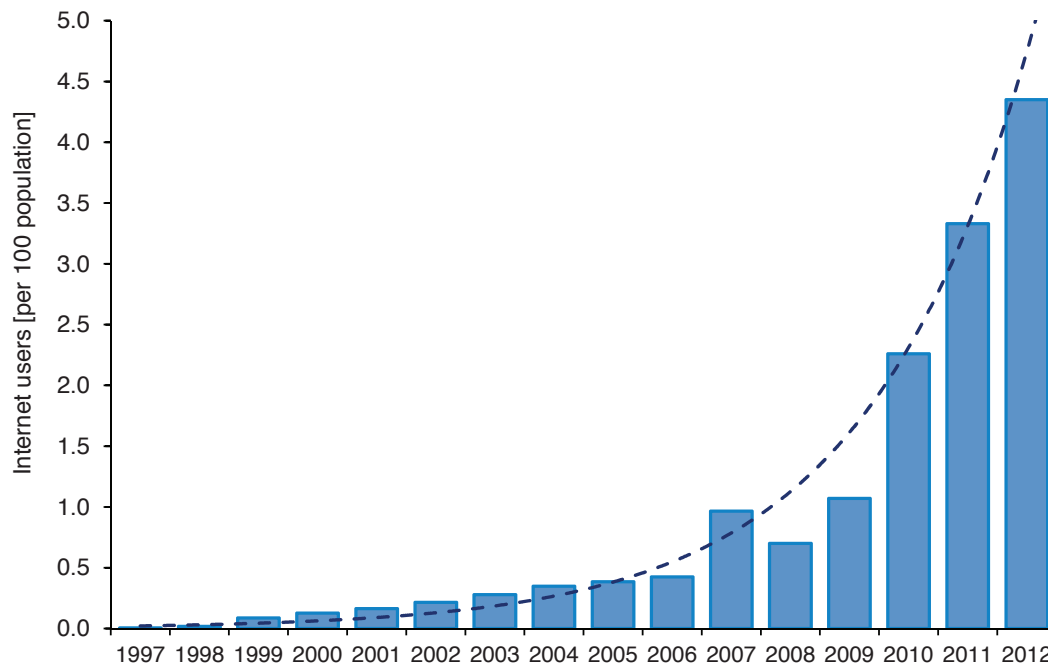



Figure 14: Evolution in internet users per 100 population, 1997–2012. Source: UNESCO, based on raw data provided by the International Telecommunications Union

Although the government recognizes that ICTs are a priority sector with the potential for turning around the economy, implementation of the *ICT Policy for Malawi* may be affected by the following challenges:

- a. *Inadequate ICT infrastructure, especially in rural areas.* As of 2012, there was a total of only 2 112 km of optical fibre cabling in the country, concentrated in urban areas. This poses a challenge for Malawi in providing electronic services to the general public, especially to rural residents.
- b. *Underdeveloped research and development (R&D) capacity in ICTs.* No patented ICT-based innovation has been recorded in the country. The country imports almost all of its ICT products and services.
- c. *An inadequate number of specialized ICT professionals and little institutional capacity.* There are very few certified professionals in specialist ICT areas. Malawi continues to depend on international experts, as well as institutions, for capacity development and for implementing and managing complex ICT initiatives.
- d. *A high investment cost for ICT infrastructure.* ICT infrastructure is heavily dependent on imported material. Linked to the foregoing challenge is the fact that experts also have to be ‘imported’ to construct infrastructure. Return on investment is low, especially in rural areas, owing to the low telephone and computer use in those areas and the fact that investors themselves shun rural areas.
- e. *Lack of local and relevant internet content and e-services of use to rural communities.* This makes it difficult to implement ICT programmes.
- f. *Lack of legal instruments protecting individuals and societies from abuse arising from the use of ICTs and participation in the information society.* Users do not trust online and electronic services in the absence of a relevant law.

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- g. *Lack of awareness of ICTs and e-services and their potential.* Awareness-building programmes on ICT and ICT-based services have not been implemented on a large scale in Malawi, owing to a lack of coordination.
- h. *Low levels of online public services and low levels of engagement with citizens using ICTs.* There has never been a deliberate policy facilitating the provision of electronic platforms for citizen engagement in the development process. Public entities, therefore, have not been encouraged to ensure that these services are made available.

BOX 5 – FINDINGS OF STAKEHOLDERS’ POST-2015 DEVELOPMENT AGENDA CONSULTATION ON SCIENCE, TECHNOLOGY AND COMMUNICATION

The Stakeholders’ Post 2015 Development Agenda Consultation Process prepared a set of questions on the role of science, technology and communication in Malawi.

The importance of science and technology was recognized by the Government of Malawi as early as the 1970s when it established the National Research Council of Malawi in 1974. However, it was only in 1990 that Malawi developed a *National Science and Technology Policy*, adopted the following year. A number of respondents to the survey indicated that, although this policy is widely accepted, it has not been implemented fully. Some contributing factors are:

- ▶ the country’s pluralistic approach to managing science and technology;
- ▶ lack of integration of the policy in the government’s overall development plans
- ▶ a lack of human, financial and material resources; and
- ▶ a lack of necessary supporting legislation.

Although the *National Science and Technology Policy* (1991) is supposed to ‘promote and coordinate the development and application of research’, it has been unable to fulfil this function effectively, largely because it does not have the power to influence budgetary considerations. At the same time, the policy is said to have been plagued by instability and uncertainty since its establishment. Respondents blamed these problems for the stagnation of all aspects of science and technology in Malawi. For example, at the United Nations Post-2015 Town Hall meeting in 2012, the following sentiments were expressed:

Malawi is lagging behind in the area of ICTs;

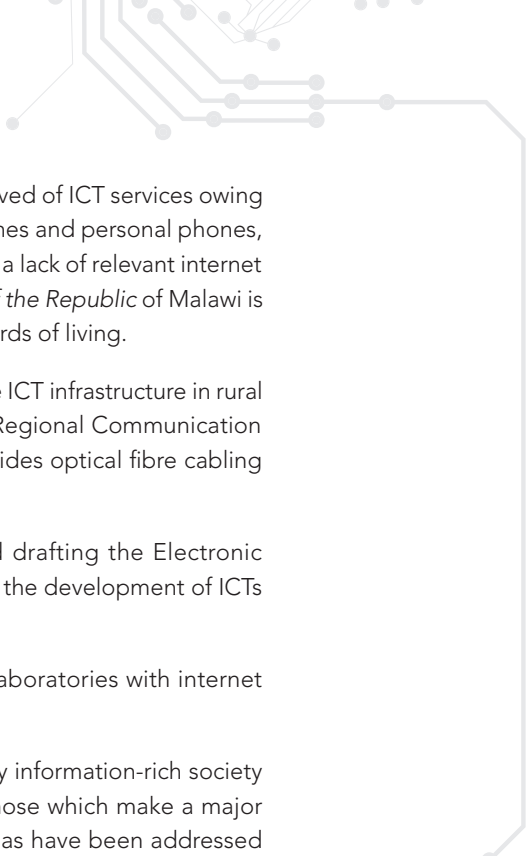
- ▶ There are too few telecentres to facilitate efficient telecommunications;
- ▶ Better ICT infrastructure will lead to better information sharing.

More importantly, there are weak linkages between the various sectors/organizations responsible for promoting and harnessing the usage of science and technology. For example, there are weaknesses in the education sector, arising mostly from lack of adequate funding; there is a lack of qualified and motivated staff, especially in science and mathematics, and a lack of equipment. These weaknesses mean that innovation that is supposed to be generated by the education sector is unable to materialize and benefit other sectors such as agriculture, manufacturing and health.

Similarly, weaknesses in ICTs, as demonstrated by the limited number of telecentres, have not improved access to information on markets and prices for farmers and traders.

Respondents also felt that science and technology were hampered by lack of supporting infrastructure such as electricity and telecommunications, and the lack of equipment like computers. Respondents also pointed out that ‘children should be introduced to computers at a tender age,’ as this would greatly facilitate the emergence of a technologically oriented future generation.

Source: Stakeholders’ Post-2015 Development Agenda Consultation Process (UNCT and Government of Malawi, 2013)



The majority of Malawians live in rural, underserved areas. These areas are deprived of ICT services owing to poor or non-existent network coverage, insufficient access to public pay phones and personal phones, a very limited availability of postal and internet services, limited TV coverage and a lack of relevant internet content of use to them. One of the fundamental principles of the *Constitution of the Republic of Malawi* is to enhance the quality of life in rural communities and to recognize rural standards of living.

The 2013 *ICT Policy for Malawi* proposes addressing the challenge of inadequate ICT infrastructure in rural areas, especially via the establishment of telecentres and by implementing a Regional Communication Infrastructure Programme Malawi Project (RCIP-MW). This project already provides optical fibre cabling connectivity to Tanzania with a very high-speed internet capacity.

The government is currently reviewing the Communications Act (1998) and drafting the Electronic Transactions and Management Bill, in order to address the challenges affecting the development of ICTs in the country.

The e-Schools Initiative is currently being implemented, whereby computer laboratories with internet access are placed in public schools.

According to the *ICT Policy for Malawi*, the transformation into a predominantly information-rich society and knowledge-based economy requires targeting priority areas, including those which make a major contribution to the economy, via a more integrated approach. Ten priority areas have been addressed by the policy; namely: (a) strategic ICT leadership, (b) human capital development, (c) e-government services, (d) ICT in industries, (e) ICT infrastructure development, (f) ICTs in the priority growth sectors, (g) a responsive ICT legal, regulatory and institutional framework, (h) national security, (i) international co-operation and, (i) universal access to ICTs and related services.

The MGDS II defines agriculture, tourism and mining as the priority growth sectors for the economy. The 2013 *ICT Policy for Malawi* addresses these sectors in the following way:

1. The government shall encourage the utilization of ICTs in the agro-business industry; agricultural extension services; research in agricultural production and processing.
2. The government shall encourage the utilization of ICTs to ensure that Malawi's presence as a unique and attractive tourist destination is recognized on the global map through the provision of up-to-date tourist information;
3. The government shall ensure that ICTs are used to strengthen sustainable natural resource and environmental management practices, provide access to geographical information on natural resources and wildlife habitats and the exact location and quantities of minerals;
4. The government shall encourage the use of ICTs to explore marketing opportunities for Malawi's products, including exportable natural resources products;
5. The government shall promote the utilization of ICTs in environmental protection.

Malawi has fully exploited the use of ICT services such as e-learning through the Republic of Malawi/Pan African e-Network Project,⁹ in collaboration with other African countries and several Indian institutions. The Ministry of Education, Science and Technology is retraining primary school teachers and increasing their number through open and distance learning. In the health sector, the country is implementing the Electronic Health Information Systems (EHIS) based on the Health Management Information Systems (HMIS) *Policy and Strategy* of 2003. The Ministry of Health has thus developed both patient-level and aggregate Electronic Medical Records Systems (EMRS); Mobile Health (mHealth) applications to support health service delivery; and District Health Information Software (DHIS 2) for collecting, analysing and reporting aggregate-level data for decision-making and planning. DHIS 2, a web-based system, has been deployed centrally at the Ministry of Health and is available for use at district level in Malawi. Each health centre aggregates its patient and other health data monthly and forwards the report to the district where the data is then captured by the electronic system (see NCST, 2013a).

9 www.cc.unima.mw



In the agricultural sector, the Ministry of Agriculture and Food Security is using GPS technology to measure garden area. In collaboration with the International Food Policy Research Institute, the ministry is piloting an electronic data transfer system for Agriculture Production Estimates Surveys (APES) and an Agriculture Marketing Information System (AMIS) within the Strengthening Evidence Based Agriculture Policy (SEBAP) project.

In the education sector, libraries have embraced ICTs to enhance the delivery of information. This is being achieved through the Malawi Library and Information Consortium (MALICO), which combines the purchasing power of its members to subscribe to vastly subsidized electronic journals, giving members access to resources on a par with European universities¹⁰. Furthermore, the Malawi Research and Education Network (MAREN) has been recognized by the Ministry of Education, Science and Technology and by the Department of e-Government as the Malawi National Research and Education Network (NREN). The network is working towards aggregating bandwidth demand for its members and providing cross-border links to enhance collaboration, improve quality and reduce costs. It is linked to the regional network supported by the UbuntuNet Alliance and co-funded by the European Union through the Africa Connect project. Both MAREN and UbuntuNet Alliance are thus enhancing the capacity of the academic ICT sector (NCST, 2013a).

EDUCATION PROFILE AND HUMAN CAPITAL FOR SCIENCE AND ENGINEERING

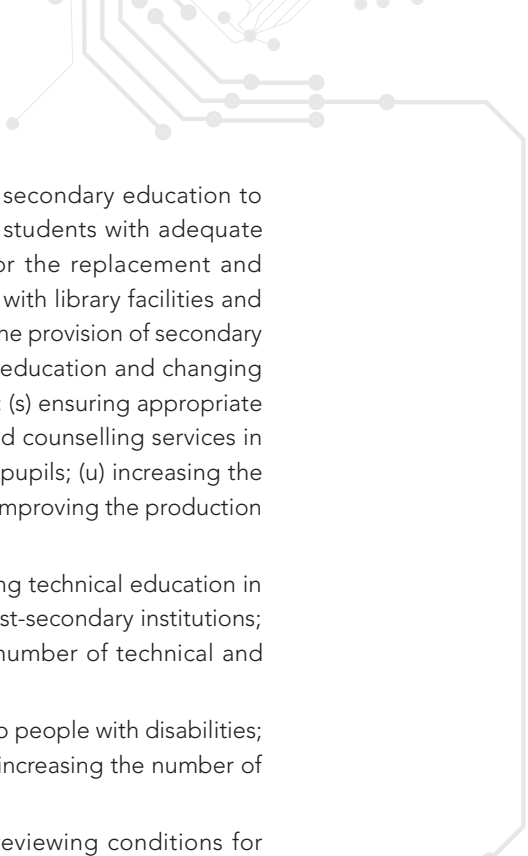
Investment in human capital via education is a major tool for sustainable development. Education is recognized the world over as a fundamental and universal human right and a prerequisite for economic growth, human development and poverty reduction. It enables the population to make informed decisions about its economic, social and political well-being. Education is important for protecting children from exploitative labour practices and is the most empowering tool for gender equality and equity. In addition to being the second United Nations Millennium Development Goal, universal access to primary education by 2015 is one of the goals of the Education for All by 2015 programme led by UNESCO and of UNICEF's agenda for A World Fit for Children by 2010. Primary education in public schools is free in Malawi, whereas secondary and tertiary education is subsidized.

Vision 2020 established that most people are unable to meet the cost of education, owing to their low income (Government of Malawi, 1998). The situation is exacerbated by the long distances children have to cover to get to school, inadequate facilities and teachers, and cultural barriers. According to *Vision 2020*, improving education will entail: improving access, quality and equity in primary, secondary and tertiary education; increasing the uptake of science and commercial subjects; increasing the number of skilled people in technical and vocational education and training; improving special education; improving the performance of support institutions in the education system and; developing effective and efficient management of the education system.

The strategic options identified by *Vision 2020* are concerned with the problem of access, quality and equity at the various levels of the education system and include:

- a. *Improving access, quality and equity in education by:* (a) continuing with the policy of free primary education; (b) making primary education compulsory; (c) the construction of additional units by both the public and private sectors; (d) introducing free and compulsory secondary education; (e) increasing the numbers of teachers and college tutors; (f) providing more and better school facilities; (g) providing adequate learning materials; (h) introducing entrepreneurial subjects in curricula; (i) increasing budgetary allocations to primary education; (j) encouraging preventive maintenance for buildings and equipment, (k) rehabilitation of buildings; (l) establishing and enforcing minimum

¹⁰ www.acu.ac.uk/focus-areas/digital-resources-for-research



standards for secondary schools; (m) reviewing the selection process for secondary education to ensure that it is fair and contributes to quality sustenance; (n) providing students with adequate appropriate instructional materials; (o) establishing a textbook fund for the replacement and maintenance of instructional materials; (p) providing all secondary schools with library facilities and increasing collaboration with communities, NGOs and the general public in the provision of secondary school education; (q) introducing compulsory free primary and secondary education and changing attitudes towards education; (r) making curricula sensitive to gender issues; (s) ensuring appropriate designs to cater for people with disabilities; (t) strengthening guidance and counselling services in order to address the academic, psychological and socio-cultural needs of pupils; (u) increasing the number of well-trained teachers and reducing teacher–pupil ratios and; (v) improving the production and distribution of learning materials.

- b. *Improving technical and vocational education and training by:* (a) introducing technical education in communities, primary schools, secondary schools, universities and other post-secondary institutions; (b) introducing science and technology subjects; (c) and increasing the number of technical and vocational training institutions;
- c. *Improving special education by:* (a) offering equal education opportunities to people with disabilities; (b) increasing the number of institutions offering special education; and (c) increasing the number of special education teachers;
- d. *Improving tertiary education by:* (a) increasing access to university by reviewing conditions for admission to allow more of those who can afford to pay to enrol and by providing scholarships to those in need; (b) encouraging individuals and organizations to establish private universities and tailor their courses to acceptable standards; (c) improving quality by diversifying university programmes to serve clearly identified areas of human resources needs; (d) introducing more postgraduate programmes; (e) improving equity by paying special attention to the enrolment of women and students with special needs; (f) decentralizing the management of universities; (g) reviewing the University Act; (h) improving the financial performance of universities; (i) increasing financing for university research and increasing the number of faculties covering pharmacology, engineering architecture; (l) increasing the number of teachers training college (TTC) tutors; (k) upgrading tutors to degree level; (1) training unqualified tutors; (m) providing to all heads of colleges with management skills; (n) increasing the number of TTCs; (o) increasing financial resources to TTCs; and (p) encouraging private sector involvement in TTCs.
- e. *Improving support institutions in the education sector by:* (a) strengthening the management of examinations and of examination bodies; (b) reviewing assessment procedures; (c) enhancing security of examinations; (d) ensuring fairness and transparency in the selection process; (e) ensuring that suitable textbooks and other materials are available in libraries; (f) promoting the local publishing industry; (g) improving management at the ministry level and;
- f. *Improving management of the education system by:* (a) improving human resource management through better remuneration packages and better housing for teachers; (b) providing more opportunities for promotion and better supervision; (c) finding a better or workable mechanism of inspecting and supervising private and public schools before issuing licenses; (d) improving intersectoral co-ordination, particularly between the Ministry of Education and other ministries involved in training matters; (e) reviewing the Education Act, especially in areas of discipline and harassment of female students; (f) selecting students on merit; (g) improving the conduct and management of examinations and; (h) training specialized teachers for students with disabilities.

The national education policy is associated with the *National Human Resources Development Policy*, which is still in draft form. This draft policy tries to identify human resource challenges in science, engineering, technology and innovation (SETI) and how these challenges could be addressed. This draft policy shows that it would be desirable to conduct a needs assessment for human resource development in sectors that could contribute positively to economic development in Malawi.

Enrolment trends in tertiary education in Malawi

Malawi has increased total enrolment at primary, secondary and tertiary levels since independence in 1964. However, the increment has not matched population growth of about 3.3% per annum over the same period. As shown in Figure 15, 359 841 children were enrolled in primary school at the time of independence in 1964 and 4 188 677 in 2012. At the secondary level, the figures were 5 951 in 1964 and 260 081 in 2012. At all educational levels (primary, secondary, university, teaching training college, technical and vocational education training and distance education) over the five decades, enrolment showed exponential growth.

Secondary schools teach mathematics, the physical sciences, biology and applied sciences like computer science. Most science teachers are men, with women representing just 17% of the total. Most men teach the physical sciences (2 250 each year¹¹), followed by biology (nearly 2 000) and mathematics (1 600). Biology appears to be the favourite science subject among girls (NCST, 2013a).

Figure 16 shows the evolution of public investment in education (all levels) as a percentage of GDP. It is possible to distinguish four periods: (1) 1970–1980: constant decrease, (2) 1980–1996: constant increase, (4) 1997–2010: constant decrease and, lastly (4) 2010–onwards: constant increase. In 2011, public investment in education amounted to 5.4% of GDP.

Figure 17 shows total enrolment in tertiary education as a percentage of gross enrolment between 1973 and 2012. This graph clearly shows that, for more than three decades, just 0.5% of the population had access to higher education and even a lower proportion of women students: 0.18%. In the past decade, the situation has improved slightly. By 2011, 0.81% of the population was enrolled in higher education.

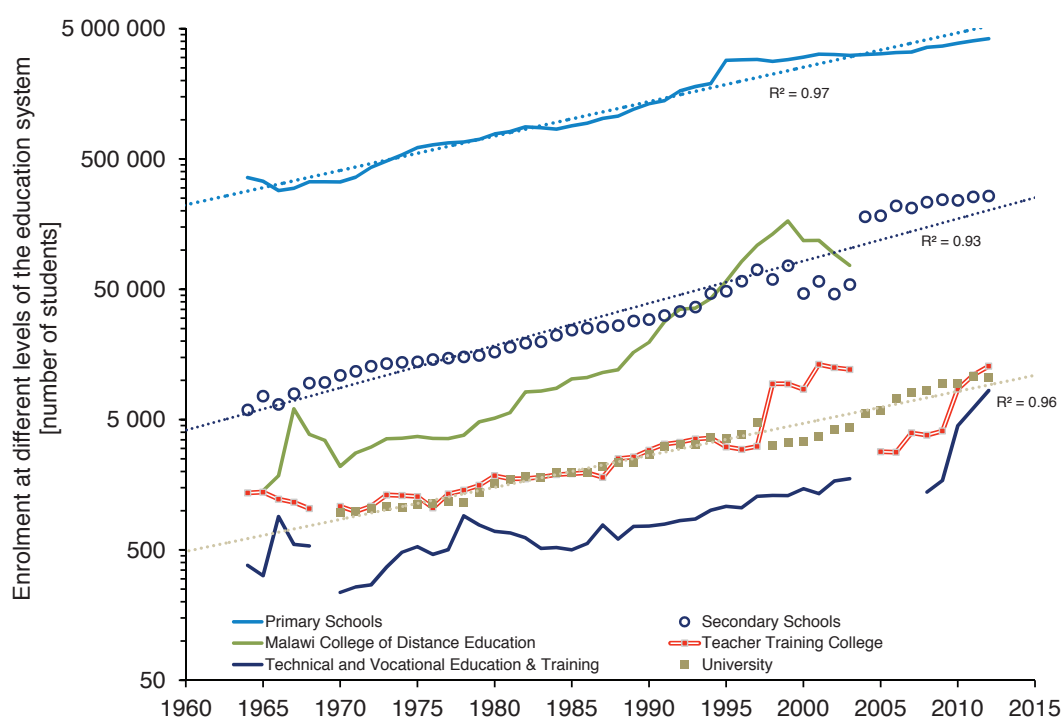


Figure 15: Evolution in enrolment at all levels of the education system since Malawi gained independence in 1964. The vertical axis is on a logarithmic scale, whereas the horizontal axis is on a linear scale. In this type of graph, the straight lines represent exponential growth. Source: UNESCO, based on raw data provided by the Ministry of Education, Science and Technology of Malawi

11 It is not clear whether teachers of the physical sciences and those teaching science and technology as a subject were double-counted; the former also teach the latter subject in most secondary schools.

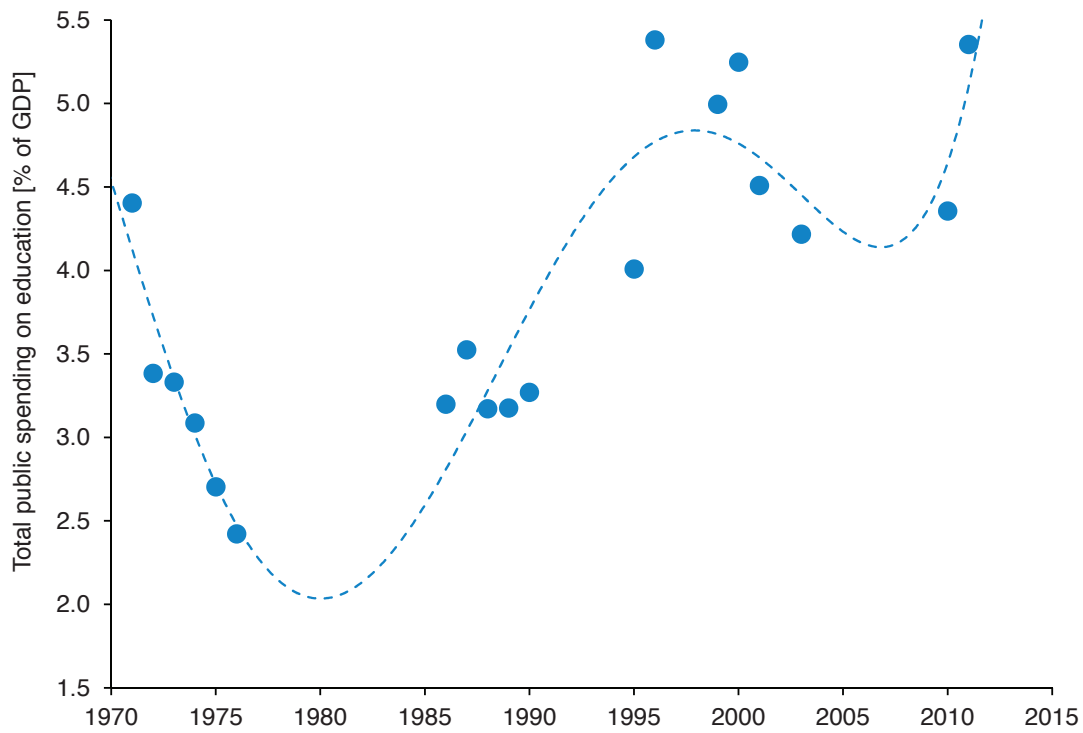


Figure 16: Evolution in total public expenditure on education in Malawi, expressed as a percentage of GDP, 1970–2012. Source: UNESCO, based on raw data provided by the Ministry of Education, Science and Technology of Malawi

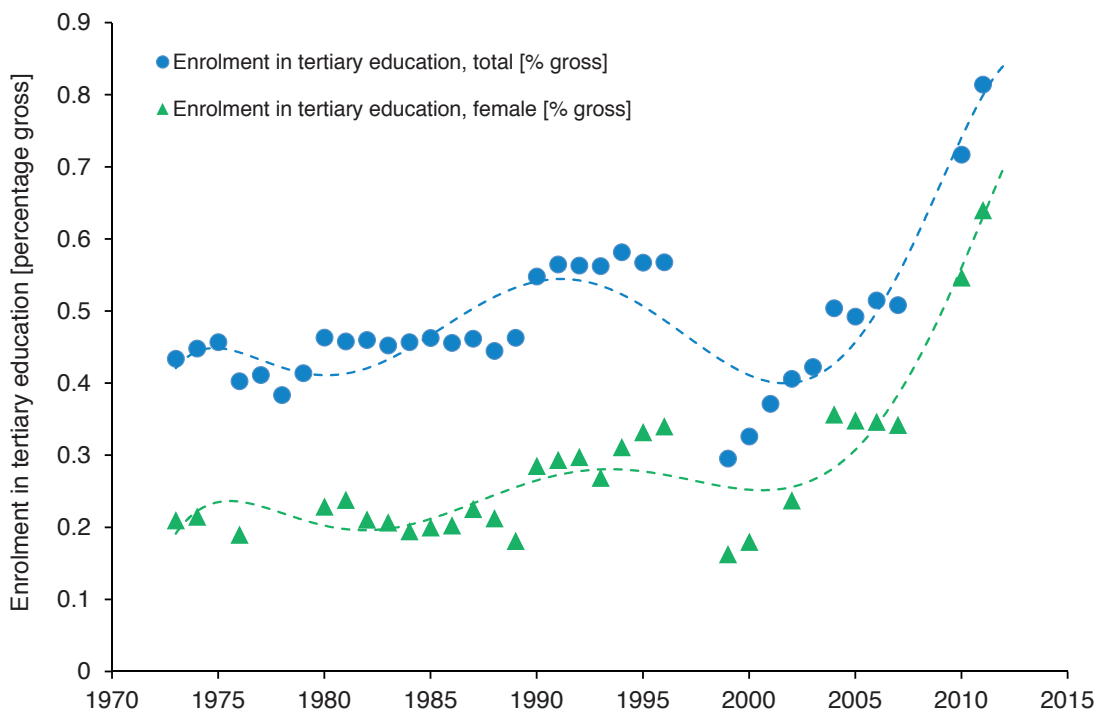


Figure 17: Enrolment in tertiary education in Malawi as a share of the total population, 1973–2012. Source: UNESCO, based on raw data provided by UNESCO Institute for Statistics

Figure 18 shows the evolution (1970–2012) in the ratio of females to males when it comes to enrolment in primary, secondary and tertiary education. The most recent measurement (2012) shows that there are 3.8% more girls than boys at primary school, 10.1% fewer girls than boys at secondary school and 35.1% fewer women than men at university.

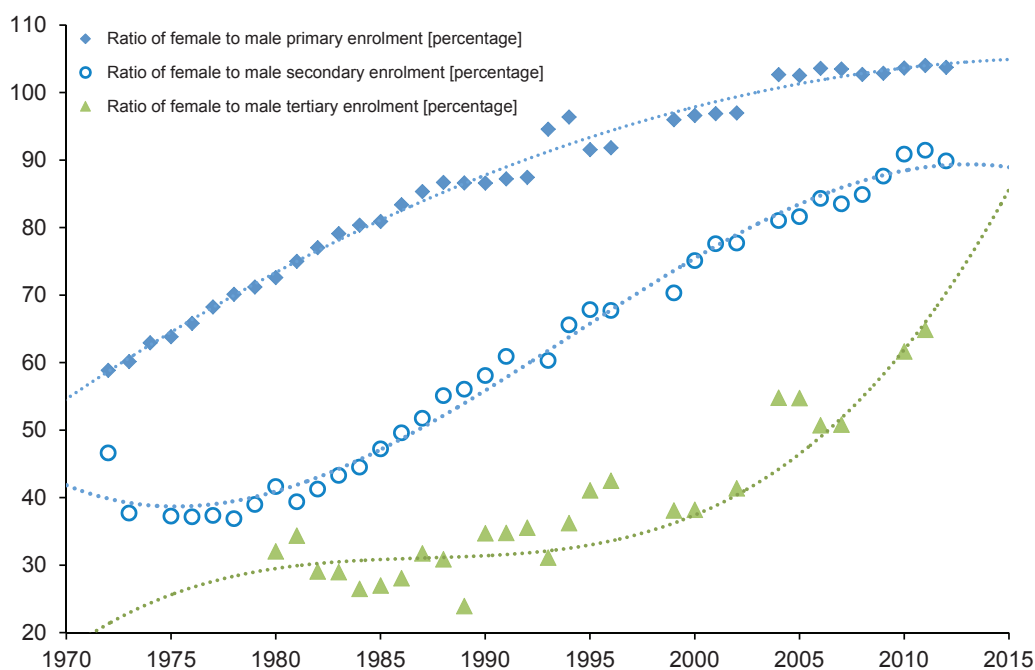


Figure 18: Ratio of female to male enrolment at primary, secondary and tertiary levels, 1973–2012.
Source: UNESCO, based on raw data provided by UNESCO Institute for Statistics

CHALLENGES FOR MALAWI'S HIGHER EDUCATION SECTOR

Malawi has two public universities, the University of Malawi and Mzuzu University. Both offer various graduate and postgraduate programmes and implement research in different disciplines, including those related to science and technology. Together, these two public universities account for 97% of graduates.

There are eight accredited private universities and colleges offering various academic programmes: the African Bible College (ABC), University of Livingstonia, Catholic University of Malawi, Blantyre International University, DMI–St John the Baptist University, Seventh Day Adventist University, Skyway University and the Share World Open University (NCST, 2013a).

The University of Malawi was founded in 1964 (see page 154). It has a federal structure, spanning four constituent colleges in three cities: Chancellor College (in Zomba), College of Medicine (in Blantyre), Kamuzu College of Nursing (in Blantyre and Lilongwe) and Malawi Polytechnic (in Blantyre). The university's central administration is located in Zomba. The *National Science and Technology Policy* (Government of Malawi, 1991) proposed that some of these colleges become separate universities and that at least one be designated the Malawi University of Science and Technology. The government has commenced building the Malawi University of Science and Technology and has detached Bunda College of Agriculture from the University of Malawi to make it part of the new Lilongwe University of Agriculture and Natural Resources (see page 138).

The University of Malawi is a strong national research entity. About 10% of the university's overall budget for its development strategy is devoted to capacity-building in research and consultancy, ensuring research quality and improving the dissemination and utilization of research findings. The university allows its staff

to spend 25% of their time on research and 75% on teaching. Staff conduct basic as well as applied research on agriculture and livestock; environmental protection and health; energy sources and utilization; engineering and construction and on; health and medical issues (Phiri, no date). Moreover, the university has a range of training equipment and purpose-built laboratories for its programmes. The qualified faculty have been trained in well-established universities in Europe and the USA (Mtegha, 2005).

Table 8: Enrolment in higher education in Malawi, 1997–2012

Year	Total	Chancellor College	Polytechnic	Bunda College of Agriculture	Kamuzu College of Nursing	College of Medicine	Mzuzu University	University of Livingstonia	Catholic University
1997	3387	1493	1064	498	239	93	-	-	-
1998	3179	1292	1041	490	263	93	-	-	-
1999	n/a	1448	1050	509	233	95	n/a	-	-
2000	n/a	1508	1101	454	248	91	n/a	-	-
2001	n/a	1555	1239	592	270	88	n/a	-	-
2002	n/a	1693	1538	590	263	149	n/a	-	-
2003	n/a	1710	1496	634	336	149	n/a	-	-
2004	n/a	2011	2343	666	331	179	n/a	-	-
2005	6252	2258	2140	814	331	179	530	-	-
2006	7320	2234	2256	737	371	308	1287	-	127
2007	8137	2407	2229	775	450	396	1435	164	281
2008	8388	2266	2532	690	469	497	1428	148	358
2009	9502	2858	2542	973	451	541	1568	197	372
2010	9446	2858	2542	973	457	541	1284	218	573
2011	10630	2773	2271	1318	518	862	1788	348	752
2012	10473	3747	2732	n/a	n/a	878	1962	250	884

Source: Ministry of Education, Science and Technology/University of Malawi/Mzuzu University/University of Livingstonia/Catholic University of Malawi

Table 8 shows enrolment in the country's major universities between 1997 and 2012. Table 9 shows the distribution of graduates by type of qualification for the period 2005–2012 and Table 10 presents the academic staff.

In order to boost tertiary enrolment and graduation, the government has implemented a series of measures, such as: (i) constructing hostels on campus on a build, operate and transfer basis, in order to increase the intake of students, in cooperation with the Malawi Housing Corporation; (ii) the construction of new lecture rooms and laboratories funded by development partners; (iii) the introduction of university open and distance learning and the establishment of the Centre for Open and Distance Learning, and (iv) the organization of talks in secondary schools on careers in science to encourage a vocation for science. In 2013, the National Commission for Science and Technology (NCST, 2013a) identified the following challenges for Malawi's higher education sector: (i) the inadequate capacity of staff to deliver, (ii) low levels of university funding for R&D, (iii) limited teaching space and student accommodation, and (iv) inadequate and outdated equipment.

In order to address these challenges, the NCST (2013a) recommended that the government and higher education institutions: (i) expand infrastructure for increased student enrolment; (ii) expand the number and scope of programmes using open and distance learning approaches; and (iii) implement programmes which encourage women to enrol in science and engineering. The NCST (2013a) concluded that greater investment was needed to increase access, quality and equity in higher education. To facilitate greater participation in R&D, tertiary institutions were urged to be proactive in expanding postgraduate programmes, which underpin knowledge generation and commercialization. The NCST (2013a) recognized the need to: (i) expand R&D physical infrastructure; (ii) provide adequate financial and human capital and (iii) undertake periodic assessments of human capital development, availability and attrition.

Table 9: Graduates in Malawi, 2005–2012

Year	Total	Chancellor College	Polytechnic	Bunda College of Agriculture	Kamuzu College of Nursing	College of Medicine	Mzuzu University	University of Livingstonia	Catholic University
Graduates [All qualifications]									
2005	1530	496	492	286	76	31	149	-	-
2006	1274	451	415	161	69	6	172	-	-
2007	1565	485	527	150	106	31	231	35	-
2008	1723	601	593	174	153	60	107	35	-
2009	1883	601	552	178	140	60	308	44	-
2010	2127	605	591	190	132	83	390	39	97
2011	2297	741	519	162	213	116	359	50	139
2012	2566	866	534	211	197	184	469	26	79
Graduates [Degree or Doctorate]									
2005	1157	377	406	161	45	6	162	-	-
2006	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	-
2007	1713	474	474	527	138	341	31	35	-
2008	1686	601	601	593	174	121	60	27	-
2009	1308	561	561	147	178	90	60	44	-
2010	1995	576	576	562	190	84	83	39	97
2011	2186	733	733	488	162	185	116	36	137
2012	2296	789	789	514	192	149	184	15	79
Graduates [Certificate or Diploma]									
2005	81	33	31	17	-	-	9	-	-
2006	148	74	10	0	-	-	40	-	-
2007	253	68	30	0	-	-	43	-	-
2008	n/a	n/a	n/a	n/a	n/a	-	n/a	-	-
2009	120	40	-	-	-	-	80	-	-
2010	132	29	29	-	48	-	26	-	-
2011	210	8	31	0	72	-	30	30	39
2012	298	77	20	19	48	-	95	39	-

Source: Ministry of Education, Science and Technology/University of Malawi/Mzuzu University/University of Livingstonia/Catholic University of Malawi

Table 10: Academic staff at academic institutions in Malawi 2005–2012

Year	Total	Chancellor College	Polytechnic	Bunda College of Agriculture	Kamuzu College of Nursing	College of Medicine	Mzuzu University	University of Livingstonia	Catholic University
2005	771	249	171	127	63	82	79	-	-
2006	781	215	187	124	55	76	124	-	-
2007	892	229	207	147	59	85	138	27	-
2008	1000	235	263	149	53	102	144	24	30
2009	1080	257	243	152	75	138	148	13	54
2010	1144	215	210	138	108	214	185	13	61
2011	1030	210	206	130	107	126	185	16	50
2012	980	221	216	136	63	119	164	15	46

Source: Ministry of Education, Science and Technology/University of Malawi/Mzuzu University/University of Livingstonia/Catholic University of Malawi

Student mobility

According to the UNESCO Institute for Statistics (2012), 'SADC students are among the most mobile in the world, with six out of every 100 tertiary students studying abroad'. In 2009, 89 000 SADC students studied outside their home country, representing 5.8% of tertiary enrolment in the region. This ratio is higher than the regional average for sub-Saharan Africa (4.9%) and three times the world average (2.0%).

One explanation for the high mobility of SADC students can be found in the SADC *Protocol on Education and Training* (1997), which sets out to facilitate mobility. Only three signatory countries, however (South Africa, Swaziland and Zimbabwe), have respected the agreement in the protocol that countries cease charging higher fees for SADC students than for national students, a practice considered a potential barrier to student mobility (UNESCO Institute for Statistics, 2012).

Students who travel abroad from Botswana, Lesotho, Madagascar, Namibia, Swaziland and Zimbabwe tend to be concentrated in one main destination: South Africa¹². South Africa hosted about 61 000 international students in 2009, two-thirds of whom came from other SADC nations. South Africa is not only the leading host country in Africa but also ranks 11th among host countries worldwide. Its higher education sector is well developed with strong infrastructure and several respected research institutions that appeal to international students. By attracting so many African students, South Africa is making an important contribution to the continent's human resource development and helping to retain skilled graduates in Africa (UNESCO Institute for Statistics, 2012).

Students from Malawi are dispersed across a wide range of host countries (along with students from Angola, Mozambique, the Seychelles, South Africa, United Republic of Tanzania and Zambia). The UNESCO Institute for Statistics (2012) observes that a wider dispersion may imply that students are returning to their home country with a richer mix of new ideas.

12 With the exception of students from Madagascar, who prefer France.

The number of Malawian students choosing to study abroad increased by 56% between 1999 and 2012 (see Figure 19). However, the share of students studying abroad as a share of the total number of students (those studying both in Malawi and abroad) showed a continual decrease, from 26% (1999) to 18% (2012).

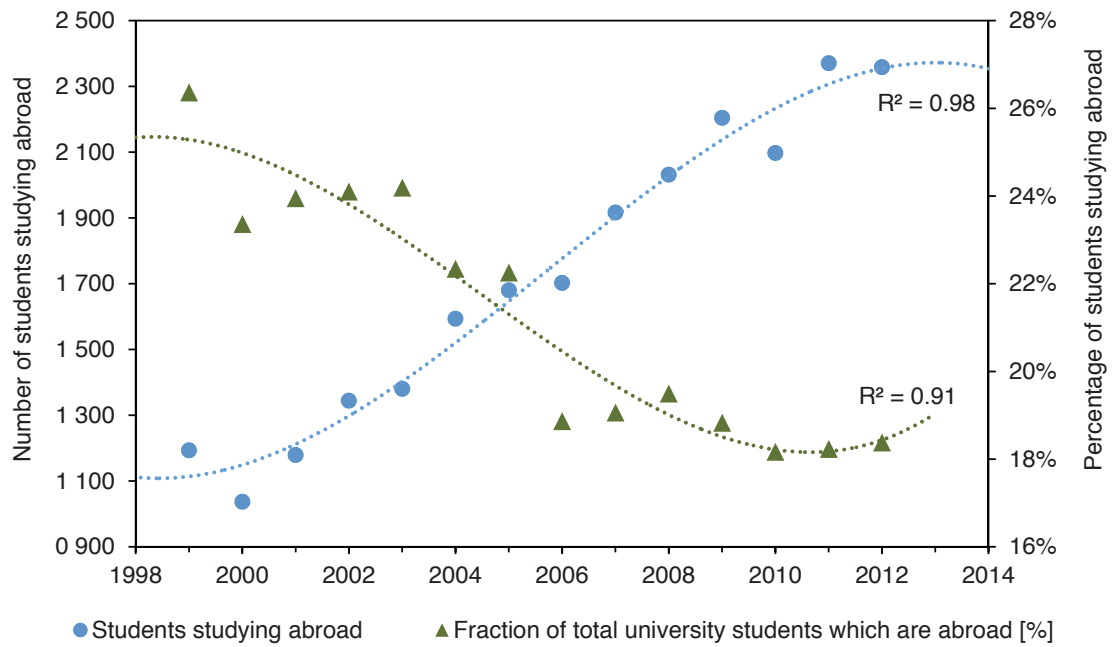


Figure 19: University students from Malawi studying abroad, 1999–2012. The scale for the blue dots can be found on the vertical axis on the left and that for the red triangles on the vertical axis on the right. The dotted lines are the best-fitting curves. Source: UNESCO, based on raw data provided by the Ministry of Education, Science and Technology of Malawi and the UNESCO Institute for Statistics



BOX 6 – MALAWI'S PARTICIPATION IN REGIONAL AND CONTINENTAL SETI COMMUNITIES

Malawi is a member of the Southern African Development Community (SADC), the Common Market for Eastern and Southern Africa (COMESA) and the African Union (AU). It participates in all programmes and activities of these groupings, including those related to science, engineering, technology and innovation.

Southern African Development Community (SADC)

While chair of SADC from 2013 to 2014, Malawi facilitated the development and finalization of critical instruments which will guide and drive the implementation of STI in the region. The following instruments were considered and approved by the meeting of SADC Ministers of Science and Technology, Education and Training, held from 16 to 20 June 2014 in Maputo, Mozambique:

- a. *SADC Science, Technology and Innovation Strategic Plan*: a guide to implementing regional STI programmes and initiatives. The plan's vision is for a region where STI are integrated into development to drive sustainable socio-economic growth, eradicate poverty and disease, and underpin the creation of employment opportunities and wealth. The plan's mission is to promote regional and international strategic co-operation with a view to accelerating socio-economic development and fostering national innovation systems, by allocating appropriate resources to ensure the mastery and transfer of STI.
- b. *Draft SADC Women in Science, Engineering and Technology (WISSET) Charter*: the main objective of which is to ensure that women participate fully in the application of scientific knowledge and technological innovation to the socio-economic development of their respective countries.
- c. *Draft SADC STI Climate Change Framework and Implementation Plan*: the aim of which is to respond to the challenges of a changing climate in the SADC region in the following targeted areas: (i) systematic observation and monitoring; (ii) impact, (iii) vulnerability and risk; (iv) mitigation and; (v) adaptation.

Common Market for Eastern and Southern Africa (COMESA)

Malawi is currently a Bureau Member of the COMESA Ministers of Science, Technology and has contributed to the establishment of the COMESA Innovation Council, the objective of which is to advise Member States on existing and new knowledge and innovation, as well as the best ways of applying them in Member States. The council is also responsible for choosing the winners of the annual COMESA Innovation Award.

African Union (AU)


Malawi is currently a Steering Committee Member of the Bureau of the African Ministerial Committee of Science and Technology (AMCOST). As a Steering Committee Member of AMCOST, Malawi has participated in a series of meetings which have seen the *Science, Technology and Innovation Strategy for Africa 2024 (STISA 2024)* developed to replace the *African Science and Technology Consolidated Plan of Action (CPA)*. Adopted by AMCOST in April 2014, STISA 2024 is the first of a series of ten-year incremental strategies designed to respond to the demand for STI from various sectors, including agriculture, health, infrastructure development, mining, security, water, energy and the environment. The strategy is anchored in six distinct priority areas that contribute to realizing the AU's vision. These priority areas are: (i) eradication of hunger and food security; (ii) prevention and control of disease; (iii) communication (physical and intellectual mobility); (iv) protection of our space; (v) living together; and (vi) wealth creation.

The strategy further defines four mutually reinforcing pillars which are prerequisites for its success. These pillars are: (i) upgrading and/or building research infrastructure, (ii) enhancing technical and professional competencies, (iii) innovation and entrepreneurship, and (iv) providing an enabling environment for SETI.

Patrick Mphadzula, Director, Department of Science and Technology, Ministry of Education, Science and Technology, Malawi

R&D indicators for Malawi





UNESCO has been conducting global surveys on R&D indicators since the early 1960s (UNESCO, 1960). For decades, this work was performed by the organization's former divisions of Science Policy and Statistics on Science and Technology. Between 1970 and 1995, information from UNESCO's global R&D surveys was published in the annual UNESCO Statistical Yearbooks and in special reports prepared by the aforementioned divisions. Between 1960 and 1990, several R&D surveys were conducted in Africa, including in Malawi in 1962, 1967, 1971 and 1977.

In the late 1990s, the Division of Statistics left UNESCO headquarters in Paris to become the UNESCO Institute for Statistics (UIS) in Montreal. Since then, the UIS has become the international repository of statistics on R&D input for the United Nations system. In 2014, it published the findings of its first global innovation survey.

In 2003, African countries endorsed the compilation of indicators for scientific research, technological development and innovation. To make this possible, the African Science, Technology and Innovation Indicators (ASTII) initiative was launched on 17 September 2007 in Mozambique as a flagship programme of Africa's Science and Technology Consolidated Plan of Action. The overall goal of ASTII is to help improve the quality of STI policies at national, regional and continental levels by strengthening Africa's capacity to develop and use STI indicators. ASTII sets out to support evidence-based policy addressing Africa's development challenges in the context of STI. So far, ASTII has brought together 28 African Union member states and published two African Innovation Outlooks (AU-NEPAD, 2011; NPCA, 2014).

Since 2010, the Government of Malawi has been conducting R&D surveys through the Department of Science and Technology under the Ministry of Education, Science and Technology and the National Statistical Office, in line with Part IV, Section 18 (2) of the Science and Technology Act of 2003 and 1967 Statistics Act. These surveys were funded jointly by NEPAD and the Government of Malawi. The first survey in 2010 covered the 2006, 2007 and 2008 financial years. A second survey was conducted in 2013 to record progress made in the country from 2008 to 2010 (Ministry of Education, Science and Technology, 2013).

TRENDS IN RESEARCHERS

Tables 11 and 12 show the distribution of R&D personnel by occupation and sector for different years (1967, 1977, 2007 and 2010) expressed in head count (HC) and full-time equivalent (FTE) respectively. The tables also show the gender breakdown whenever available. The long-term evolution in the number of researchers shows peculiar behaviour. From 1967 to 1977, the number of researchers rose by 340%. From 1977 to 2007, their number increased by 210% then by as much as 250% between 2007 and 2010. This means that the annual growth rate in the past three years was ten times higher than during the three previous decades.

In general, the number of scientific articles published in mainstream journals corresponds well to the number of scientists at national level (Lemarchand, 2014). When comparing the data in Tables 11 and 12 with long-term trends in scientific publications (see pp. 67–69), there is no match with the data on the number of researchers (1961–2010) in agriculture (see pp. 60–61). Between 2007 and 2010, R&D personnel increased by 32% by head count and 5% in terms of full-time equivalent, yet the number of researchers rose by 250% and 180% respectively. Unfortunately, the increment in R&D labour costs is not proportional to those differences (see data published by AU-NEPAD, 2011; NPCA, 2014).

Table 11: R&D personnel by occupation, head count, 1967, 1977, 2007 and 2010

R&D personnel by occupation [Head counts]	1967	1977					2007					2010				
	Total	Total	Business	Government	Higher education	Private non-profit	Total	Business	Government	Higher education	Private non-profit	Total	Business	Government	Higher education	Private non-profit
Total	1243	2073	786	928	284	76	2884	153	1751	661	319	3809	n/a	1839	1916	54
Researchers	198	353	73	116	144	21	733	27	247	349	110	1843	n/a	507	1324	12
Technicians	114	242	118	92	22	10	1022	39	830	76	77	1548	n/a	1193	324	31
Other personnel	540	1478	595	720	118	45	1129	87	674	236	132	418	n/a	139	268	11
Total females [F]	n/a	n/a	n/a	n/a	n/a	n/a	610	28	276	204	102	751	n/a	385	339	27
Researchers [F]	n/a	10	n/a	n/a	n/a	n/a	170	4	33	104	29	360	n/a	106	251	3
Technicians [F]	n/a	8	n/a	n/a	n/a	n/a	115	4	89	9	13	352	n/a	270	68	14
Other personnel [F]	n/a	n/a	n/a	n/a	n/a	n/a	325	20	154	91	60	39	n/a	9	20	10

Note: In 2010, the government survey did not include the business sector, so the totals should be bigger.

Source: UNESCO (1972, 1982); AU-NEPAD (2011); NPCA (2014)

Table 12: R&D personnel in Malawi by occupation, in full-time equivalent, 1967, 1977, 2007 and 2010

R&D personnel by occupation [Full time equivalent]	1967	1977					2007					2010				
	Total	Total	Business	Government	Higher education	Private non-profit	Total	Business	Government	Higher education	Private non-profit	Total	Business	Government	Higher education	Private non-profit
Total	548	847	318	364	131	33	1638	40	1140	247	211	1721	n/a	1422	268	31
Researchers	157	189	39	62	77	11	406	7	173	147	79	732	n/a	497	225	10
Technicians	91	170	83	65	15	7	791	20	664	42	65	873	n/a	835	26	12
Other personnel	260	488	196	238	39	15	441	13	303	59	66	116	n/a	90	17	9
Total females [F]	n/a	n/a	n/a	n/a	n/a	n/a	331	6	164	100	62	305	n/a	245	52	9
Researchers [F]	n/a	7	n/a	n/a	n/a	n/a	89	1	23	44	21	136	n/a	90	43	3
Technicians [F]	n/a	4	n/a	n/a	n/a	n/a	89	2	71	5	11	12	n/a	149	5	1
Other personnel [F]	n/a	n/a	n/a	n/a	n/a	n/a	153	3	69	51	30	15	n/a	6	4	5

Note: In 2010, the government survey did not include the business sector, so the totals should be bigger.

Source: UNESCO (1972, 1982); AU-NEPAD (2011); NPCA (2014)

The government tends to keep posts vacant until these can be financed then fill all the vacant posts at once. This may explain the steep increase observed from 2007 and 2010 in the number of researchers. Further investigation is needed to corroborate or refute this hypothesis and to confirm the reliability of the data on personnel obtained by the recent R&D surveys.

Table 13 transforms the head count (HC) of researchers and technicians done by the 2010 R&D survey into full-time equivalents.

Table 13: Full-time equivalent researchers and technicians in Malawi, 2010

	Total	Government	Higher Education	Private non-profit
Total				
Researchers	0.67	0.98	0.17	0.85
Technicians	0.38	0.70	0.08	0.37
Female				
Researchers	0.67	0.85	0.17	1.00
Technicians	0.23	0.55	0.08	0.05

Note: In 2010, the government survey did not include the business sector, so the totals should be bigger.

Source: Ministry of Education, Science and Technology (2013)

The distribution of R&D personnel (HC) and researchers (HC) by level of qualification (using the International Standard Classification of Education) is presented in Table 14. According to the data provided for 2010, only 14% of R&D personnel hold a PhD or equivalent degree, 68% a master's or bachelor's degree, 7% a tertiary diploma and 11% a post-secondary, non-tertiary diploma. Among full-time equivalent researchers specifically, 10% hold a PhD or equivalent degree, 78% a master's or bachelor's, 8% a tertiary diploma and 4% a post-secondary, non-tertiary diploma (see Table 15).

Table 14: R&D personnel by occupation and level of education, head count, 2007 and 2010

R&D personnel by level of education [Head count]	2007					2010				
	Total	Business	Government	Higher education	Private non- profit	Total	Business	Government	Higher education	Private non- profit
Total	2884	153	1751	661	319	3809	n/a	1839	1916	54
ISCED 6	208	9	76	89	34	551	n/a	239	310	2
ISCED 5A	436	13	128	221	74	2588	n/a	1085	1494	9
ISCED 5B	350	26	193	81	50	250	n/a	147	96	7
Other	1890	105	1354	270	161	420	n/a	368	16	36
Female	610	28	276	204	102	751	n/a	385	339	27
ISCED 6	35	0	6	22	7	128	n/a	49	77	2
ISCED 5A	107	3	14	66	24	350	n/a	104	240	6
ISCED 5B	77	5	21	27	24	53	n/a	34	17	2
Other	391	20	235	89	47	220	n/a	198	5	17

Note 1: In 2010, the government survey did not include the business sector, so the totals should be bigger.

Note 2: See the glossary on page 217 for a definition of the ISCED categories

Source: AU-NEPAD (2011); NPCA (2014)

Table 15: Full-time equivalent researchers in Malawi by occupation and level of education, 2010

R&D personnel by level of education and field of science [Full time equivalent]	Total	Business	Government	Higher education	Private non-profit
Total	732	n/a	497	225	10
ISCED 6	72	n/a	39	32	2
ISCED 5A	572	n/a	388	178	6
ISCED 5B	59	n/a	45	11	3
Other	29	n/a	25	5	0

Note: In 2010, the government survey did not include the business sector, so the totals should be bigger.

Source: NPCA (2014)

Table 16 shows the distribution of researchers (HC) by field of science and sector for different years (1977, 2007, 2010). Table 17 shows the distribution of full-time equivalent researchers by field of science and sector for 2010 only. Both tables break the information down by gender whenever the data are available.

Table 16: Researchers in Malawi by field of science, head count, 1967, 1977, 2007 and 2010

Researchers per field of science [Head count]	1967		1977		2007		2010					
	Total	Percentage	Total	Percentage	Total	Percentage	Total	Percentage	Business	Government	Higher education	Privatenon-profit
Total researchers by field of science	198	100	263	100	831	100	1843	100	n/a	507	1324	12
Natural sciences	54	27	77	29	306	37	288	16	n/a	71	217	0
Engineering and technology	0	0	39	15	19	2	372	20	n/a	105	267	0
Medical sciences	0	0	4	2	157	19	343	19	n/a	93	242	8
Agricultural sciences	92	46	79	30	238	29	312	17	n/a	92	216	4
Social sciences	42	22	64	24	101	12	340	18	n/a	94	246	0
Humanities	0	0	0	0	10	1	188	10	n/a	52	136	0
Total female [F]	n/a	n/a	n/a	n/a	n/a	n/a	360	100	n/a	106	251	3
Natural sciences [F]	n/a	n/a	n/a	n/a	n/a	n/a	64	18	n/a	15	49	0
Engineering and technology [F]	n/a	n/a	n/a	n/a	n/a	n/a	24	7	n/a	12	12	0
Medical sciences [F]	n/a	n/a	n/a	n/a	n/a	n/a	60	17	n/a	17	43	0
Agricultural sciences [F]	n/a	n/a	n/a	n/a	n/a	n/a	39	11	n/a	19	17	3
Social sciences [F]	n/a	n/a	n/a	n/a	n/a	n/a	94	26	n/a	27	67	0
Humanities [F]	n/a	n/a	n/a	n/a	n/a	n/a	79	22	n/a	16	63	0

Note: In 2010, the government survey did not include the business sector, so the totals should be bigger.

Source: UNESCO (1972, 1982); AU-NEPAD (2011); NPCA (2014)

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BOX 7 – UNESCO’S ROLE IN PROMOTING SETI POLICIES AND GOVERNANCE FOR AFRICA’S SUSTAINABLE DEVELOPMENT

Sub-Saharan African economies are growing rapidly, with GDP expected to increase by 5.2% on average in the coming years, according to the World Bank (2014), despite setbacks in the global economy. Discoveries of new oil, gas and mineral deposits in the past decade offer newly resource-rich countries the prospect of considerable revenue. At the same time, climate change will threaten Africa’s economic resilience if appropriate measures are not taken to curb its adverse effects on health and nutrition, food security, energy access and efficiency, water availability and environmental sustainability, youth unemployment, sprawling urban development and the fragile global economy. Similarly, a fast-growing population and rapid urbanization offer opportunities for Africa, if managed astutely. Universities, research institutions, the private sector, decision-makers and local communities will have an enormous responsibility in using science, engineering, technology and innovation (SETI) to drive the continent’s sustainable development and ensure its competitiveness and inclusive growth.

In the past decade, UNESCO has brought university leaders, policy-makers and academics together on numerous occasions to discuss strategic issues related to training, research and innovation, to share ideas and best practices and to make recommendations on how to use research, technology and innovation to drive Africa’s socio-economic renaissance (COVIDSET, 2011). These fora have taken the form of biennial conferences of university leaders; capacity-building workshops for parliamentarians, decision-makers and the private sector, and; regional conferences bringing together ministers of education, science and technology and finance, development partners and bilateral donors.

African SETI experts are tireless advocates of quality science, technology, engineering and mathematics (STEM) education, greater support for scientific research and of equipping higher education systems to meet the demand for STEM education. Over the years, they have shared best practices of how to nurture innovation and entrepreneurship, tap into existing STI knowledge and cultivate a dynamic innovation ecosystem. Their message has been reiterated in several meetings of ministers of science and technology. Notable among them are the: *Nairobi Ministerial Declaration* (2012), which called for STI policies and related funding mechanisms and investments to be integrated in national and regional development agendas; the *African Union’s Science, Technology and Innovation Strategy for Africa 2024* (Africa Union Commission, 2014) and; SADC’s *STI Strategic Plan 2015–2020*, which articulates the use of STI as a driver of regional integration and economic growth.

In light of these continental aspirations and the prevailing climate of opportunity, UNESCO is providing African Member States with technical assistance in adopting a systematic, integrated approach to STI. Through the Spanish Fiduciary Fund allotted to the project for Capacity Building in STI Policy in Africa, UNESCO has been assisting the Government of Malawi in reviewing its *Revised National Science and Technology Policy* of 2002, using the GO→SPIN methodological approach that forms the basis of the present country profile.

The findings and recommendations contained in *Mapping Research and Innovation in the Republic of Malawi* will be most instructive for other developing countries keen to review their own STI policy landscape and governance.

Peggy Oti-Boateng, Regional Science Advisor in Science Policy and Capacity Building, UNESCO Nairobi

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Table 17: Full-time equivalent researchers in Malawi by occupation and field of science, 2010

R&D personnel by level of education and field of science [Full time equivalent]	Total	Business	Government	Higher education	Private non-profit
Total FTE researchers	732	n/a	497	225	10
Natural sciences	107	n/a	70	37	0
Engineering and technology	148	n/a	103	45	0
Medical sciences	139	n/a	91	41	7
Agricultural sciences	130	n/a	90	37	3
Social sciences	134	n/a	92	42	0
Humanities	74	n/a	51	23	0
Female researchers FTE	136	n/a	90	43	3
Natural sciences	21	n/a	13	8	0
Engineering and technology	12	n/a	10	2	0
Medical sciences	22	n/a	15	7	0
Agricultural sciences	22	n/a	16	3	3
Social sciences	34	n/a	23	11	0
Humanities	24	n/a	14	11	0

Note: In 2010, the government survey did not include the business sector, so the totals should be bigger.

Source: NPCA (2014)

R&D expenditure in Malawi

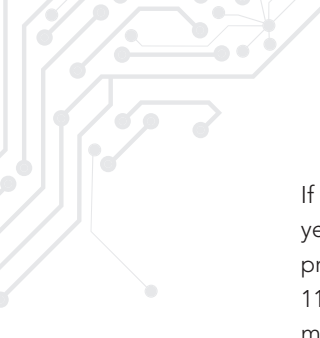
Malawi's most recent surveys estimate gross expenditure on R&D (GERD) at 7164.5 million MWK in 2007 and 8596.5 million MWK in 2010 (expressed in current Malawi Kwacha). This corresponds to a GERD/GDP ratio of 1.40% in 2007 and 1.06% in 2010.

Taken at face value, this may give the impression that Malawi is one of Africa's biggest investors in R&D, as it is one of the few countries on the continent to devote more than 1% of GDP to GERD. However, Malawi's GDP is the smallest of any country with a comparable population (15–17 million). For example, the GDP of Niger is 1.5 times higher, that of Burkina Faso 2.3 times higher, Guatemala 10 times higher, Ecuador 16 times higher, Kazakhstan 25 times higher, Chile 47 times higher and the Netherlands 195 times higher. On average, a country with a population the size of Malawi will have 37 times its GDP.

The amount invested in R&D in Malawi is thus very low in real terms. This becomes apparent when you convert Malawi's GERD into current PPP US\$: PPP US\$137.2 million (2007) and PPP US\$ 115 million (2010). Consequently, GERD as a percentage of GDP is not a good indicator for comparing Malawi's level of investment in R&D with levels elsewhere.

It is interesting to note that, despite low levels of R&D spending, scientists from Malawi are more productive than their counterparts in some countries with much higher GDP: Malawi published 317 scientific articles in 2010, on a par Burkina Faso (309) and considerably more than Niger (135) and Guatemala (130), which has ten times the GDP of Malawi. Ecuador and Kazakhstan only produced 431 and 436 articles each, despite having GDP that is respectively 16 and 25 times that of Malawi.

In other words, Guatemala produced only 0.41 times as many scientific articles as Malawi in 2010, Niger 0.43 times as many, Burkina Faso 0.97 times as many; Ecuador 1.36 times, Kazakhstan 1.38 times, Chile 21.19 times and the Netherlands 131.9 times as many.



If we examine the ratio of each country's GDP to the volume of its scientific publications for the same year, we find that Malawi was 1.5 times more productive than the Netherlands in 2010, 2.2 times more productive than Chile, 2.4 times more productive than Burkina Faso, 3.5 times more productive than Niger, 11.8 times more productive than Ecuador, 18.2 times more productive than Kazakhstan and 24.4 times more productive than Guatemala.

BOX 8 – UNESCO'S FIRST SURVEYS OF R&D IN MALAWI: 1962, 1967 AND 1971

On 14 November 1958, the General Assembly of the United Nations (13th session, 780th plenary meeting) adopted Resolution 1260 requesting the Secretary-General:

... in co-operation with the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the other Specialized Agencies concerned with the peaceful application of science, as well as the International Atomic Energy Agency, to arrange for a survey to be made on the main trends of inquiry in the field of the natural sciences and the dissemination and application for peaceful ends of such scientific knowledge, and on the steps which might be taken by the United Nations, the Specialized Agencies and the International Atomic Energy Agency towards encouraging the concentration of such efforts upon the most urgent problems, having regard to the needs of the various countries...

In the same resolution, the General Assembly requested that the Secretary-General 'submit this survey to the Economic and Social Council at its thirtieth session' in July 1960.

Ultimately, this report was co-ordinated and edited by Pierre Auger, a prominent physicist and former Assistant Director-General for Science at UNESCO. The study included a description of the most influential trends in scientific research and a series of analyses of their potential long-term impact on humanity (Auger, 1961). The report introduced the need for states to establish national scientific and technological policies, as well as new schemes fostering international scientific co-operation, one example being UNESCO's proposal in the early 1950s for the creation of the European Centre for Nuclear Research (CERN).

Auger's report broke new ground. For the first time, the UN system proposed a standard classification for scientific research and experimental development and defined scientific researchers, technicians and engineers. This preceded the OECD's Frascati Manual (c. 1963) and even the OECD itself, founded in 1961.

Using the standard classification proposed by Auger, UNESCO conducted a regional survey in 1962 and 1963 of the scientific and technical potential of 42 African countries¹³. This survey provided numerical data, for the first time, on the scientific and technical personnel working in different scientific disciplines and special fields of scientific investigation, as well as an inventory of research institutions and the number of researchers and technicians, the size of laboratories and experimental stations, amount of library volumes, etc. The results were presented to an International Conference on the Organization of Research and Training in Africa in Relation to the Study, Conservation and Utilization of Natural Resources, jointly organised by UNESCO and UNECA in Lagos (Nigeria) between 28 July and 6 August 1964.

Table 18 presents the main findings of UNESCO's survey of R&D in Malawi in 1962, when the country was still known as Nyasaland.

UNESCO (1974) presented an analysis of the 1967 and 1971 surveys of Malawi. According to this study, the scientific and technical personnel recorded in 1967 was as follows: 1 253 scientists and engineers, 369 of whom were employed in medical sciences, 148 in engineering and technology and 72 in natural sciences. The same survey presented a total of 5 028 technicians, 1 461 of whom were involved in engineering and technology, 949 in medical sciences and 100 in natural sciences. GERD was calculated as representing 0.2% of GDP in 1967.

13 UNESCO/CORPSA/4.B; Paris, 6 July 1964

As a rough guide to the personnel engaged full-time in research, it may be noted that, in January 1971, there were 75 professional officers employed by all the research organizations specializing in agriculture and natural resources, excluding the university. Support services employed approximately 75 technical and executive staff and 150 laboratory or field assistants and clerks. To this may be added the part-time contribution of 19 academic staff at the Bunda College of Agriculture and their students and some 65 academic staff in biology, chemistry, physics, engineering, mathematics, geography and economics at Chancellor College, Malawi Polytechnic and Soche Hill College of Education, all part of the University of Malawi. Almost 100% of the the support staff were Malawian, compared to about one-quarter of the professional staff, encompassing both full-time researchers and university staff. Between five and ten Malawian graduates used to join the full-time research body each year.

Table 18: Main findings of UNESCO's survey of R&D in Malawi, 1962

Institution			Total personnel [HC]	Researchers [HC]	Technicians [HC]	Laboratories [m2]	Area [ha]
1	Agricultural Research Council of Central Africa (ARCCA)			3			
2	Ministry of Natural Resources. Department of Agriculture and Fisheries	Research Division: includes Chitedze Agricultural Research Station, Makanga Experimental Station, Mkawa Experimental Station at Mrimba (Northern Region), Tuchila Experimental Station at Palombe (Southern Region), Bvumbwe Agricultural Experiment Station and Mwera-Hill Experiment Station					
3		Bvumbwe Agriculture Experimental Station	13	4	2	465	121
4		Chitedze Agriculture Research Station	250	9	6	557	202
5		Mkanga Research Station	104	2	11	93	50
6		Research organization, Malawi section	3	2	1		
7		Silvicultural Research Station	9	2	3	38	
13		Tea Research Station					
14	University of Malawi						
15	Water Development Research Laboratory						

HC = head count

Note: The denominations of institutions, territories and countries correspond to their names in 1962, which were used in the original documents of the International Conference on the Organization of Research and Training in Africa in Relation to the Study, Conservation and Utilization of Natural Resources, organized by UNESCO and UNECA, in Lagos (Nigeria) between 28 July and 6 August 1964.

The 1971 estimation for GERD was 0.43% GDP. The sources of this funding were the following: 54% government funds, 37% foreign funds and 8% private funds. Some 90% of GERD went to agriculture and natural resources, representing approximately 1% of the GDP of the agriculture sector. [Total public spending as a percentage of agricultural output (AgGDP) is a commonly used indicator for comparing agricultural R&D spending across countries and regions.]

Source: UNESCO

LONG-TERM RESEARCH TRENDS IN AGRICULTURAL SCIENCES

Formal agricultural research in Malawi dates back to the 20th century. Given the pivotal role that agriculture plays in Malawi's economy, agricultural research and development (R&D) have dominated research for decades. The research division of the locally administered Department of Agriculture established its first agricultural research station back in 1940 at Bvumbwe. At the time of independence in 1964, the research division of the Department of Agriculture, which eventually evolved into the Department of Agricultural Research, was staffed with 22 researchers, 21 of whom were expatriates.

In a seminal study, Roseboom and Pardey (1993) provided the most comprehensive study ever of the evolution of the various agricultural research institutions in Malawi, their research personnel and expenditure. Their study presents long-term trends for a series of indicators of agricultural R&D, including the number of head count (HC) researchers employed in agriculture from 1960 to 1991. Following the same methodological approach, Agriculture Science and Technology Indicators¹⁴ (ASTI) provides similar data for the period 2000–2008.

Figures 20 and 21 show the evolution in the number of HC researchers in agricultural sciences and the same per million population and per million labour force. Included are the data on HC researchers in agricultural sciences obtained by the most recent R&D surveys (see Tables 16 and 17). After considerable growth in the 1970s, the number of agricultural researchers grew by an average of 2% per year from 1960 to 1995. Thereafter, numbers began to fall from approximately 200 in 1996 to 170 in 2001 (nearly 15%), although most of this decline occurred at the Department of Agricultural Research Services (DARS) and the Forestry Research Institute of Malawi (FRIM). Losses resulted from staff departures, particularly because of the comparatively low salaries paid by the agencies of the Ministry of Agriculture, Irrigation, and Food Security; deaths from the AIDS epidemic and other causes and; the retirement of senior staff (Beintema et al., 2004). At the time, the International Monetary Fund induced a freeze on overall government recruitment, thereby exacerbating the situation. There were also limited opportunities for promotion at DARS during this period: in early 2003, only 65 of the 115 professional positions at DARS were filled. According to recent surveys, the governmental research institutes employed around 160 researchers in agriculture, forestry and fisheries between 2008 and 2010.

Figure 21 shows the number of HC researchers in agriculture per million population and per million labour force. It is clear that the number of researchers per million population has remained almost constant since the early 1970s but that the number of researchers per million labour force has decreased, after peaking in 1984. These figures are consistent with the behaviour shown by other macro-economic and educational data (see Figure 4 and Table 9). In particular, the steady state behaviour in the number of agricultural researchers over more than four decades should be considered a serious bottleneck for the development of the Malawian economy. This trend is consistent with the fact that, after a period of growth, total spending on agricultural research in Malawi was cut by half between the mid-1980s and 2001 (Beintema et al., 2004).

14 ASTI started off in 1984 as the Indicator Series Project, a series of extensive surveys of agricultural R&D in all developing countries covering the period 1961–1985. The project was initiated by the International Food Policy Research Institute (IFPRI) and the former International Service for National Agricultural Research (ISNAR). In 2000, the project was renamed ASTI and work continued with funding from the Consultative Group on International Agricultural Research. ASTI is has been facilitated solely by IFPRI since 2004, which is based in Washington DC, USA.

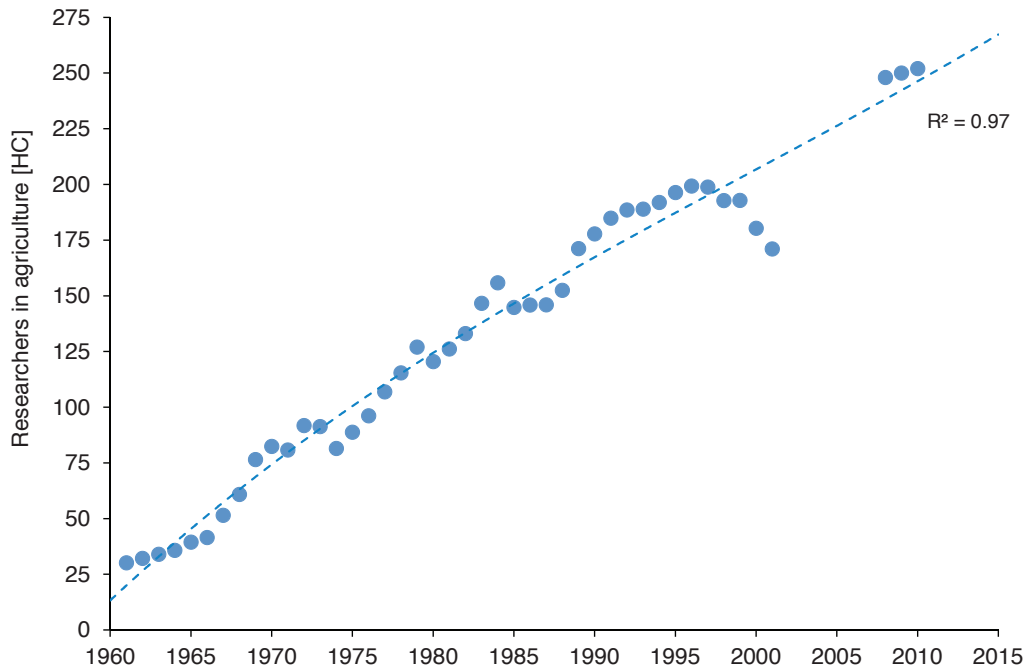


Figure 20: Agricultural researchers in Malawi, by head count, 1960–2010. Source: UNESCO based on raw data provided by Roseboom and Pardey (1993), Beintema *et al.* (2004), Maluwa and Msosa (2010) and Ministry of Education, Science and Technology (2013)

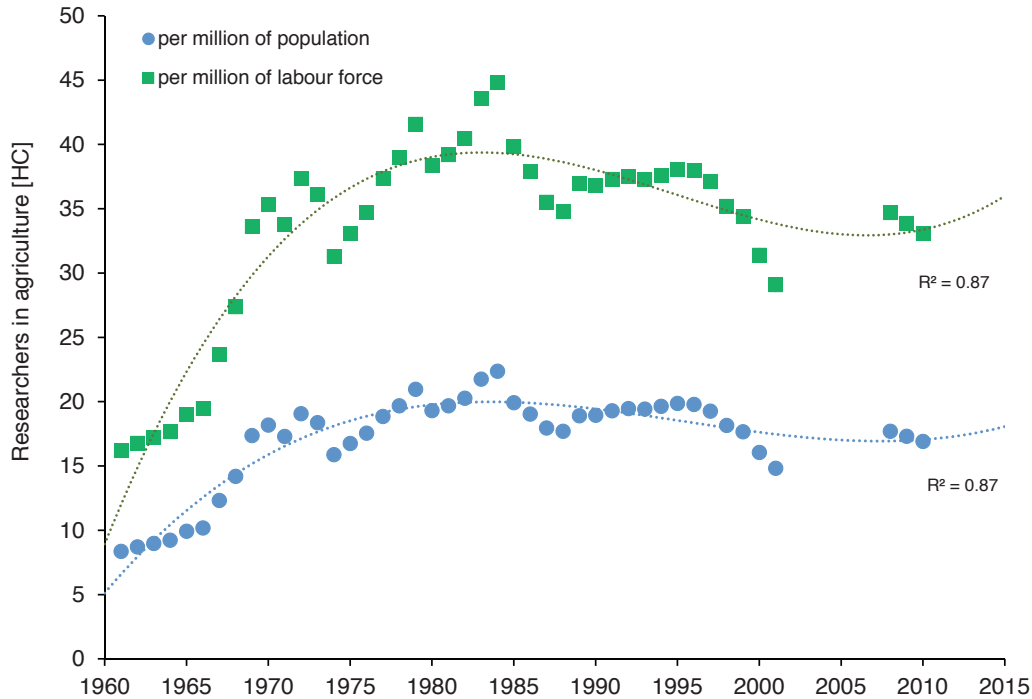



Figure 21: Agricultural researchers in Malawi per million population and per million labour force, by head count, 1960–2010. Source: UNESCO based on raw data provided by Roseboom and Pardey (1993), Beintema *et al.* (2004), Maluwa and Msosa (2010), Ministry of Education, Science and Technology (2013) and UN Statistics Division

A scientometric analysis of Malawi





Basic research is usually carried out in universities or other academic institutions. The traditional method used to measure or assess the results of academic research uses bibliometric indicators. Bibliometrics is a general term for the inventory and statistical analysis of articles, publications and citations and other more complex indicators of scientific production derived from such statistics. Bibliometric indicators are important tools for assessing R&D, performance and the specialization of countries, institutions, laboratories, universities, thematic areas and individual scientists. As with any indicator, they are not faultless and should, therefore, be interpreted with caution.

The procedure for assessing the impact of industrial R&D is essentially based on an analysis of patent statistics and, when it comes to the impact of industrial R&D on trade, on an analysis of high-tech products, as well as through studies of the technological trade balance for each country.

Both bibliometric analyses and patent statistics are included in a discipline known as scientometrics. At present, thanks to exponential growth in our data-processing capacity, it is possible to prepare sophisticated multidimensional indicators on the production of scientific articles in all disciplines, from exact sciences to humanities. Moreover, very precise analyses can be made of the impact of publications, the state-of-the-art of knowledge in various subject areas in each country, the level of co-operation in terms of co-authorship of publications, co-citations, the creation and evolution of scientist networks ('invisible colleges'), etc. By analysing cross-references used in patent applications or by cross-referencing information published in scientific literature, we can use bibliometrics to examine the links between STI and patents (Lemarchand, 2010).

One of the most relevant sources of information about the productivity of scientific knowledge is accessible through international databases (Lemarchand, 2013). This type of information is not usually open access. In particular, a very well established class of indicators about scientific production can be estimated by counting the number of articles and citations published in mainstream journals. One of the most complete databases is the Web of Science, which includes the Science Citation Index (SCI), Social Science Citation Index (SSCI) and Arts and Humanities Citation Index (A&HCI). The latter is now maintained by Thomson–Reuters, a private company, and covers 12 000 peer-reviewed journals. The other major database is SCOPUS, which is maintained by Elsevier Science and covers 18 000 peer-reviewed journals.

An analysis of the aggregated temporal evolution in the data available at the Web of Science shows a homogeneous trend that is independent of any academic discipline and avoids any substantial change in national trends, owing to the continual incorporation of new journals in the databases. In this way, it is also possible to study the evolution in co-operation patterns among countries and institutions, search for the most developed disciplines and analyse the impact of scientific research based on how other scientists have made use of this material.

Not all Malawian scientists submit their research results to mainstream journals listed by the Web of Science. Therefore, the existence of local and regional journals in several countries may reflect some peculiar domestic circumstances or a specific national scientific agenda that are not considered by the mainstream journals. For this reason, publication in mainstream journals represents only a fraction of the total scientific productivity of any particular country. The main advantage of using these databases is that they have been systematically collected and organized over several decades using similar methodologies, allowing us to perform a long-term analysis with a relatively high level of confidence (Lemarchand, 2012).

In spite of the drawback of underrepresented local and regional journals, it can be argued that there is a good correspondence among SCI, SSCI, A&HCI and other international databases on scientific knowledge production. De Moya-Anegón and Herrero-Solana (1999) and Lemarchand (2012) have shown a strong correlation in the distribution of citable articles between the Science Citation Index Extended and other databases like PASCAL, INSPEC, COMPENDEX, CHEMICAL ABSTRACTS, BIOSIS, MEDLINE and CAB. They have obtained the following values for the correlation coefficient (R) among the different databases: $0.957 \leq R \leq 0.997$. This finding supports the hypothesis that the combination of SCI, SSCI and A&HCI, listed by the Web of Science database, is a good indicator for any study of mainstream scientific knowledge production and trends in co-authorship networks among different countries.

At this point, it is important to take into account the fact that, during the period analysed here (1966–2013), the number of journals has expanded substantially and, consequently, so has the total number of published articles included in the Web of Science database. Mabe (2003) showed that journal growth rates have been remarkably consistent over time, with average rates of 0.034 since 1800 to the present day. This study presents evidence that, during the entire 20th century, these growth phenomena appear to show a system that is self-organizing and in equilibrium, with a 0.032 growth constant. Considering that the Web of Science database includes only a fraction of all the new journals that are published, the growth rate for databases should be even smaller than that estimated by Mabe (2003).

Lemarchand (2012, 2014) has developed a mathematical model showing the proportionality between the size of the national scientific network (e.g. number of FTE researchers in a country) and the corresponding scientific productivity (in terms of the aggregate number of publications per year and the number of co-authored scientific articles between pairs of countries). In this way, the productivity of scientific articles over time is a good proxy for estimating the extent of growth in the number of full-time-equivalent researchers.

The number of Malawi’s scientific publications listed by international databases (i.e. Web of Science, SCOPUS, etc.) has evolved in recent decades. Malawi occupies the 107th rank in the world and the 16th rank in Africa. Table 19 shows the distribution of mainstream scientific publications, number of citations, citations per article, H index¹⁵, world ranking and ranking among 52 African countries.

Between 1996 and 2012, Malawi’s scientific publications listed by SCOPUS received 42 360 citations, 6 042 of which were self-citations. The average number of citations per article was 16.51, which is relatively high for a sub-Saharan country. Malawi’s H index for this period was 80, placing it 82nd in the world.

Table 19: Distribution of mainstream scientific publications, citations, H index and regional and global rankings for all African countries, 2012

Country	Articles	Citable articles	Citations	Self-Citations	Citations per article	H* index	African ranking	World ranking
South Africa	13 627	12 766	7 608	2 346	0.56	231	1	34
Tunisia	5 170	4 820	1 152	390	0.22	85	2	52
Nigeria	4 748	4 552	782	230	0.16	89	3	53
Algeria	3 800	3 667	652	196	0.17	78	4	54
Morocco	3 282	3 037	1 753	359	0.53	99	5	56
Kenya	1 725	1 625	1 105	239	0.64	131	6	66
Ethiopia	1 164	1 110	314	107	0.27	73	7	76
Uganda	1 000	947	632	129	0.63	99	8	82
Ghana	981	929	404	96	0.41	73	9	83
Tanzania	902	846	540	177	0.60	93	10	86
Cameroon	850	796	267	63	0.31	72	11	87
Senegal	574	553	216	41	0.38	75	12	96
Sudan	534	509	196	56	0.37	52	13	98
Burkina Faso	449	427	187	61	0.42	62	14	101
Malawi	407	382	276	45	0.68	80	15	103
Zimbabwe	373	358	171	39	0.46	72	16	107
Côte d’Ivoire	365	353	112	22	0.31	68	17	108
Benin	343	324	101	42	0.29	49	18	109

15 The H index is an indicator of the impact of an individual’s scientific output and also, in an aggregate manner, that of institutions and countries (Hirsch, 2005).

Country	Articles	Citable articles	Citations	Self-Citations	Citations per article	H [*] index	African ranking	World ranking
Libya	336	323	75	25	0.22	35	19	110
Zambia	315	291	157	31	0.50	68	20	112
Botswana	290	278	89	8	0.31	57	21	115
Rep. Congo	287	267	136	19	0.47	49	22	116
Madagascar	246	236	115	19	0.47	56	23	121
Mali	225	217	172	29	0.76	55	24	123
Mozambique	191	187	155	28	0.81	53	25	127
Mauritius	184	175	42	11	0.23	41	26	129
Rwanda	177	163	53	11	0.30	36	27	130
Namibia	160	157	79	8	0.49	55	28	131
Gabon	134	124	85	10	0.63	61	29	135
Gambia	126	117	157	19	1.25	80	30	137
Niger	103	98	36	5	0.35	47	31	145
Togo	96	89	17	3	0.18	31	32	149
Swaziland	75	74	35	1	0.47	28	33	155
Angola	63	60	27	9	0.43	25	34	158
Democratic Rep. Congo	57	49	35	1	0.61	28	35	159
Sierra Leone	49	44	15	6	0.31	21	36	162
Guinea	42	38	17	2	0.40	34	37	166
Lesotho	38	37	14	2	0.37	22	38	170
Mauritania	37	36	17	1	0.46	25	39	171
Seychelles	37	34	25	3	0.68	33	40	172
Guinea-Bissau	37	35	38	14	1.03	40	41	173
Central African Rep.	36	36	32	4	0.89	32	42	174
Burundi	33	31	9	0	0.27	24	43	175
Chad	25	20	3	1	0.12	27	44	182
Liberia	22	21	5	1	0.23	14	45	185
Djibouti	20	16	1	0	0.05	13	46	187
Cape Verde	14	14	8	0	0.57	12	47	192
Eritrea	14	13	0	0	0.00	25	48	193
Equatorial Guinea	11	11	11	4	1.00	15	49	196
Somalia	7	6	1	0	0.14	11	50	204
Comoros	6	6	2	0	0.33	10	51	207
Sao Tome and Principe	3	2	0	0	0.00	14	52	217

Source: SCOPUS database (April 2014)

Figure 22 presents the long-term evolution in the number of scientific articles listed at the SCI Extended, SSCI and A&HCI between 1966 and 2013. The data show that the number of publications grew following a quartic function, until 1995 when the number began showing substantial growth, a few years after the launch of the first *National Science and Technology Policy* in 1991 (see page 89).

Figure 23 shows the evolution in scientific articles listed at the SCI Extended, SSCI and A&HCI between 1966 and 2013 per million population. This indicator is a proxy for measuring the level of societal interest in promoting the creation of knowledge. The shape of this curve follows the same mathematical quartic growth shown in the previous figure. The highest peak so far was reached in 2013, with 26 publications per million population.

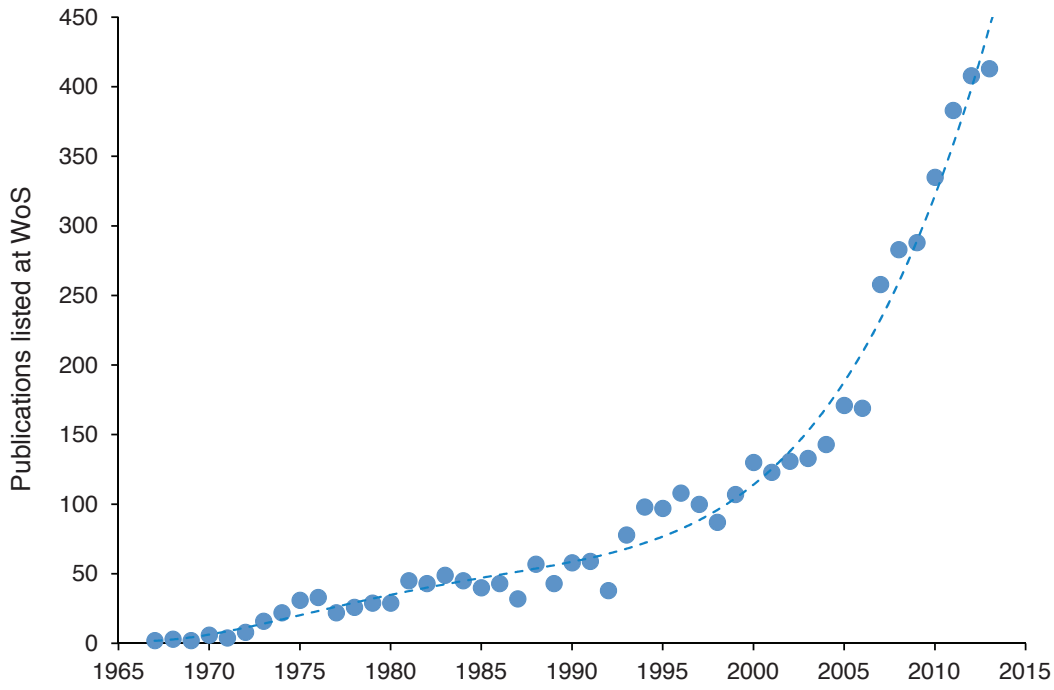


Figure 22: Evolution in number of scientific publications listed by the Web of Science for Malawi, 1966–2013. The dotted line indicates the best-fitting curve. Source: UNESCO, based on data provided by Web of Science

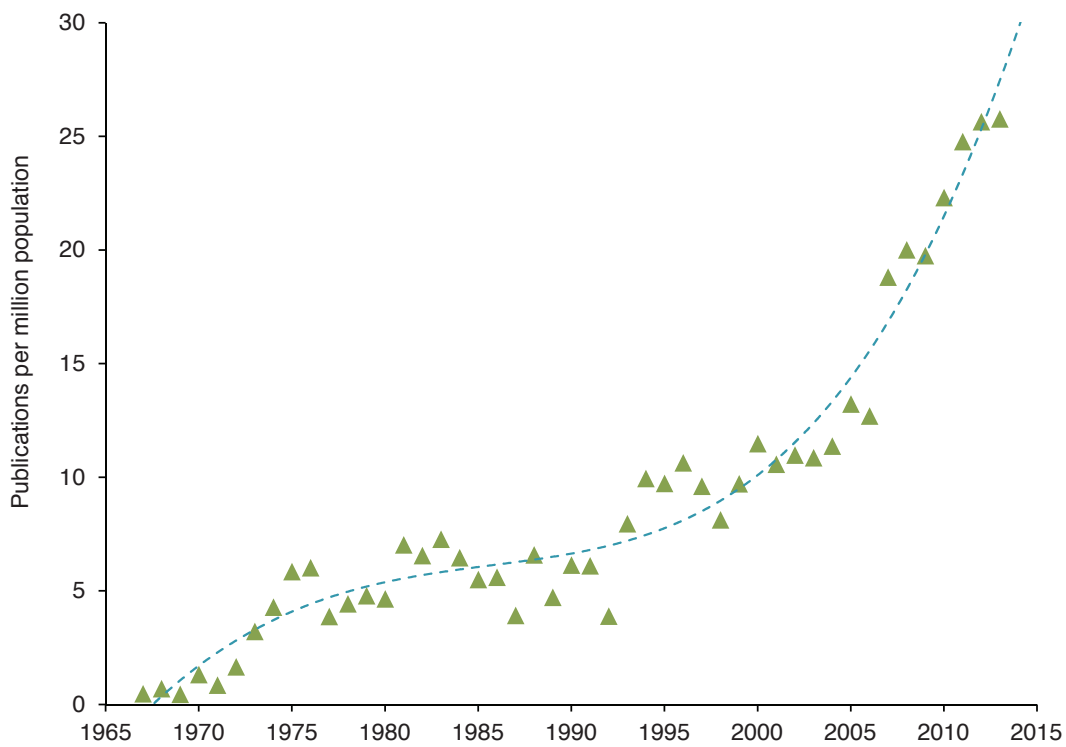
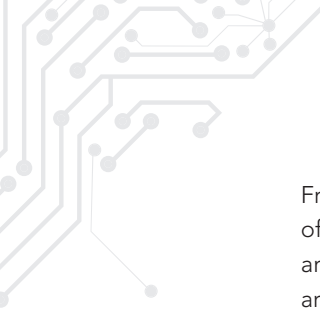


Figure 23: Evolution in the number of scientific publications per million population in Malawi, 1966–2013. The dotted line indicates the best-fitting curve. Source: UNESCO, based on data provided by Web of Science and UN Statistics Division



From the data provided by the government's *National Survey of Research and Development* (Republic of Malawi, 2013b) on the number of FTE researchers, each one published an estimated 0.26 scientific articles in mainstream journals in 2012. This is equivalent to each FTE researcher publishing just one article every four years.

From the data provided by the *African Innovation Outlook II* (NPCA, 2014), each FTE researcher in Malawi published an estimated 0.46 scientific articles in mainstream journals in 2010. This is equivalent to each FTE researcher publishing just one article every 2.2 years.

Over the years, the specialized literature has tended to assume that there is a high correlation between the number of publications per million population and GDP per capita in different countries (Konrad and Wahl, 1990; Ye, 2007). This correlation has been tested in several empirical studies by applying different mathematical models (Lemarchand, 2012), including for African countries (UNESCO, 2013). Figure 24 shows that, in the case of Malawi, this correlation is very weak ($R^2=0.41$), following a power-law mathematical relation. This means that any increment (or other type of variation) in one unit of GDP per capita would generate a change in the number of scientific publications per million population approximately equal to $3 \times 10^{-17} \times (\text{GDP per capita})^{7.28}$. Future analyses can corroborate or refute this relation, however, owing to the low value of the correlation coefficient. The weak correlation with GDP can be explained by the absence of financial incentives and adequate policy instruments to promote research and innovation in Malawi. In this way, the evolution in the number of scientific publications over time will be more strongly related to the internal dynamics of the individual scientists, who need to publish in order to advance in their career. The observed growth in the number of publications since 2002 relates to the fact that an increasing majority of these articles (over 85%) have been co-published with other countries (see Figure 25 and Table 20).

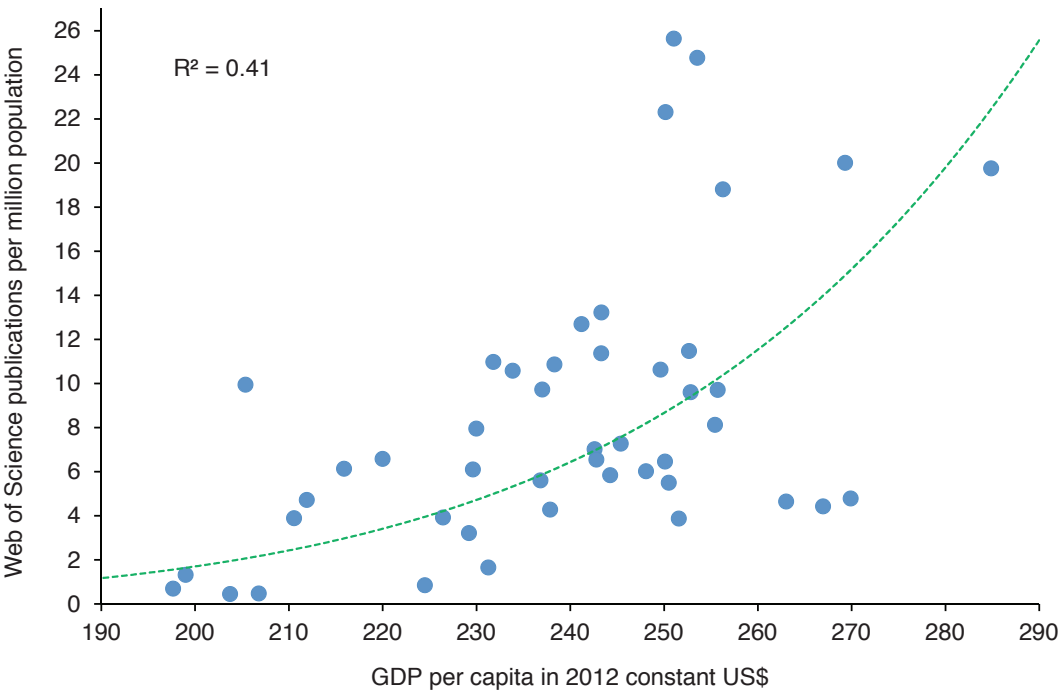


Figure 24: Weak power-law correlation between GDP per capita in constant US\$ 2012 and the number of scientific publications listed by the Web of Science per million population, 1966–2013.
Source: UNESCO

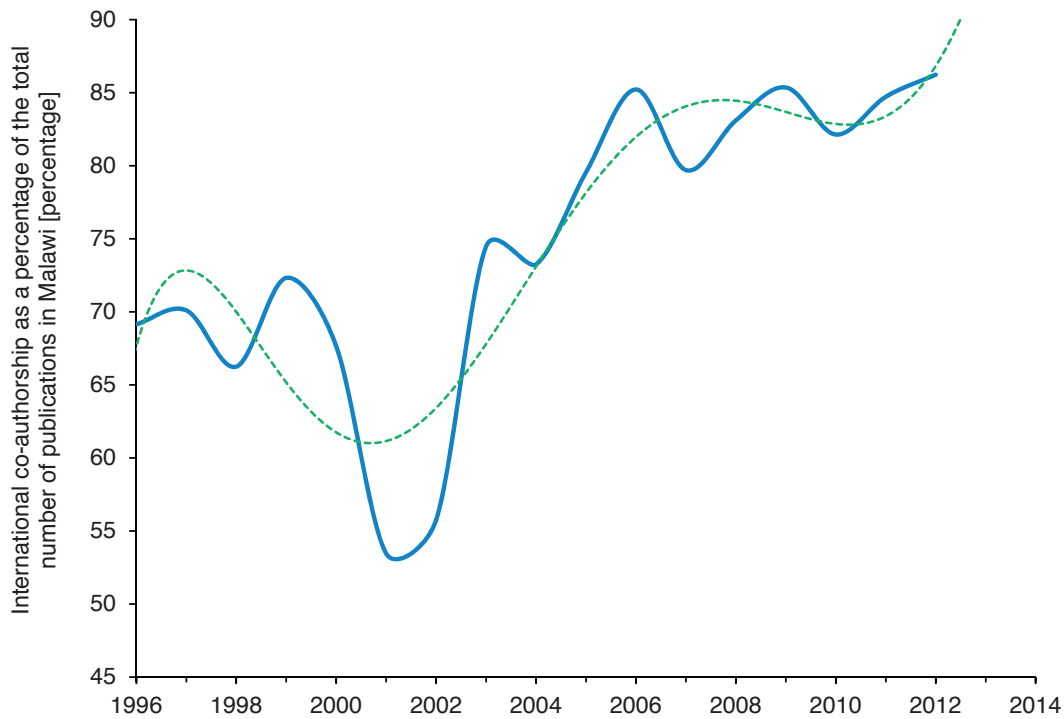


Figure 25: Evolution in international collaboration in scientific publications as a share of total annual publications in Malawi 1996–2013. The dotted line is the best-fitting curve. Source: UNESCO, based on data provided by Web of Science

Figure 25 shows the internationalization of Malawi’s publications. In the past decade, between 69% and 86% of all scientific articles with at least one author from Malawi have been co-published with authors from abroad.

Table 20 shows the distribution of co-authored articles with Malawi for the 30 most important partners over four different periods. A quick analysis shows how rapidly co-authorship has increased. In the first 14-year period between 1967 and 1981, the total amount of articles was very small (276) and the United Kingdom was the top partner, sharing 10.1% of publications, followed by the USA (2.5%), and Denmark (1.1%). In the period 1982–1996, with a total production of 888 articles, the USA had become the top partner (20%), followed by the United Kingdom (17.6%), Switzerland (4.3%), Kenya (2.3%) and Germany (2.4%). Over the third 14-year period (1997–2011), the top partner was the United Kingdom (37.6%), followed by the USA (31.4%), South Africa (9.2%), the Netherlands (7%) and Australia (4.1%). In 2012–2013, the USA came top (44.3%), followed by the United Kingdom (37.8%), South Africa (17.1%), the Netherlands (7.1%) and Switzerland (5.6%).

Table 20: Malawian co-authorship of mainstream scientific publications with other countries, 1967–2013

Rank	1967–1981			1982–1996			1997–2011			2012–2013		
	Country	Pub	Share of total [%]	Country	Pub	Share of total [%]	Country	Pub	Share of total [%]	Country	Pub	Share of total [%]
	Malawi	276	100	Malawi	888	100	Malawi	2841	100	Malawi	821	100
1	UK	28	10.1	USA	178	20.0	UK	1067	37.6	USA	364	44.3
2	USA	7	2.5	UK	156	17.6	USA	892	31.4	UK	310	37.8
3	Denmark	3	1.1	Switzerland	38	4.3	South Africa	261	9.2	South Africa	140	17.1
4	South Africa	2	0.7	Kenya	20	2.3	Netherlands	198	7.0	Netherlands	63	7.7
5	Zimbabwe	2	0.7	Germany	21	2.4	Australia	133	4.7	Switzerland	46	5.6
6	Australia	1	0.4	Netherlands	14	1.6	Tanzania	127	4.5	Kenya	45	5.5
7	Israel	1	0.4	Canada	13	1.5	Kenya	118	4.2	Australia	42	5.1
8	Kenya	1	0.4	India	11	1.2	France	113	4.0	Germany	38	4.6
9	Nigeria	1	0.4	France	9	1.0	Switzerland	113	4.0	Zimbabwe	38	4.6
10	Sri Lanka	1	0.4	Sweden	8	0.9	Zambia	101	3.6	Uganda	34	4.1
11				Denmark	7	0.8	Zimbabwe	93	3.3	France	28	3.4
12				Norway	7	0.8	Canada	82	2.9	Canada	27	3.3
13				Zimbabwe	7	0.8	Belgium	78	2.7	Tanzania	26	3.2
14				Italy	6	0.7	Uganda	67	2.4	Zambia	26	3.2
15				Niger	6	0.7	Germany	65	2.3	Ghana	25	3.0
16				South Africa	6	0.7	Finland	56	2.0	Norway	25	3.0
17				Tanzania	6	0.7	Ghana	53	1.9	India	23	2.8
18				Zambia	6	0.7	Luxembourg	46	1.6	Finland	20	2.4
19				Pakistan	5	0.6	Norway	42	1.5	Italy	20	2.4
20				Uganda	5	0.6	Gambia	38	1.3	Belgium	15	1.8
21				Belgium	4	0.5	Ireland	37	1.3	Ireland	13	1.6
22				Botswana	4	0.5	Nigeria	36	1.3	Mozambique	13	1.6
23				Australia	3	0.3	Sweden	34	1.2	Singapore	13	1.6
24				Ghana	3	0.3	India	32	1.1	Thailand	13	1.6
25				Israel	3	0.3	Thailand	32	1.1	Brazil	10	1.2
26				Thailand	3	0.3	Botswana	31	1.1	Senegal	10	1.2
27				Ethiopia	2	0.2	Denmark	31	1.1	Spain	10	1.2
28				Ireland	2	0.2	Mozambique	27	1.0	Sweden	10	1.2
29				Kuwait	2	0.2	Cameroon	25	0.9	Namibia	9	1.1
30				Senegal	2	0.2	Ethiopia	25	0.9	Botswana	8	1.0

Source: UNESCO, based on articles listed at the Science Citation Index Extended, Social Science Citation Index and Arts & Humanities Citation Index

Table 21 shows the 25 most productive institutions in Malawi in terms of scientific articles registered in the SCI Extended, SSCI and A&CI from 1967 to 2013. The University of Malawi has always been the country's leading institution for the production of scientific articles, producing 58.9% of the total between 1967 and 2013. Between 1967 and 1981, the University of Malawi (52.2%) was followed by the Tea Research Foundation (9.8%) and Agricultural Research Council of Malawi (3.6%). Little changed over the next decade or so (1982–1996), with the University of Malawi accounting for 52.5% of articles, followed by the Ministry of Health (11.4%) and the Kamuzu Central Hospital (7.3%).

During the following period (1997–2011), the University of Malawi increased its share of articles to 62%. Next came the Ministry of Health (9.4%) and the National Tuberculosis Control Programme (2.6%).

Since 2012, the University of Malawi has maintained its lead with 57.6% of all scientific articles, followed by the Ministry of Health (10.6%) and the Kamuzu Central Hospital (5.7%).

Table 21: Distribution of mainstream scientific publications in Malawi, by national institution and laboratory, 1967–2013

Rank	1967–1981			1982–1996			1997–2011			2012–2013		
	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]
	Malawi	276	100	Malawi	888	100	Malawi	2841	100	Malawi	821	100
1	University of Malawi	144	52.2	University of Malawi	466	52.5	University of Malawi	1761	62.0	University of Malawi	473	57.6
2	Tea Research Foundation	27	9.8	Ministry of Health	101	11.4	Ministry of Health	267	9.4	Ministry of Health	87	10.6
3	Ministry of Agriculture and Food Security Natural Resources	18	6.5	Kamuzu Central Hospital	65	7.3	Kamuzu Central Hospital	95	3.4	Kamuzu Central Hospital	47	5.7
4	Agriculture Research Council of Malawi	10	3.6	Lepra Evaluation Project	52	5.9	National TB Control Programme	74	2.6	Mzuzu University	13	1.6
5	Fisheries Research Centre	8	2.9	Tea Research Foundation	21	2.4	Lilongwe Central Hospital	51	1.8	Ministry of Agriculture	9	1.1
6	Bvumbwe Agriculture Research Station	7	2.5	Ministry of Agriculture and Food Security	20	2.3	Chitedze Agriculture Research Station	40	1.4	Lilongwe University Agr Natural Resources	9	1.1
7	Chitedze Agriculture Research Station	7	2.5	Central Veterinary Laboratory	19	2.1	Blantyre Malaria Project	37	1.3	Zomba Cent Hospital	7	0.9
8	Lepra Evaluation Project	7	2.5	Forestry Research Institute of Malawi	15	1.7	Institute of Tropical Medicine	26	0.9	Maimwana Project	6	0.7
9	Central Veterinary Laboratory	6	2.2	Department National Parks & Wildlife	8	0.9	Mzuzu University	25	0.9	Chitedze Agriculture Research Station	5	0.6
10	Ministry of Health	5	1.8	Mzuzu University	7	0.8	Mzuzu Cent Hospital	23	0.8	Government of the Republic of Malawi	4	0.5
11	Zomba General Hospital	4	1.4	Kasungu National Park	7	0.8	Ministry of Agriculture and Food Security	19	0.7	National AIDS Res Inst	4	0.5
12	Makanga Agriculture Exptl Stn	3	1.1	Malamulo Hospital	7	0.8	Tea Research Foundation	17	0.6	National TB Control Programme	3	0.4

Rank	1967–1981			1982–1996			1997–2011			2012–2013		
	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]
	Malawi	276	100	Malawi	888	100	Malawi	2841	100	Malawi	821	100
13	Sugar Corporation of Malawi	3	1.1	Zomba General Hospital	6	0.7	Zomba Cent Hospital	16	0.6	CDC Malawi	2	0.2
14	Tropical Prod Institute	3	1.1	Chitedze Agriculture Research Station	5	0.6	Bunda College of Agriculture	14	0.5	Lilongwe Dist Health Office	2	0.2
15	Cent Public Health lab	2	0.7	Department Antiquities	5	0.6	National AIDS Commission	14	0.5	Mzuzu Cent Hospital	2	0.2
16	Kasungu National Park	2	0.7	Geological Survey of Malawi	5	0.6	Forestry Research Institute of Malawi	13	0.5	National Malaria Control Programme	2	0.2
17	Queen Elisabeth Cent Hospital	2	0.7	Institute of Tropical Medicine	5	0.6	Malawi Country Office	10	0.4	Tea Research Foundation	2	0.2
18	Town Planning Department	2	0.7	Bvumbwe Agriculture Research Station	4	0.5	99	9	0.3	Central Veterinary Laboratory	1	0.1
19	Balaka Leprosy Hospital	1	0.4	Chikwawa Dist Hospital	4	0.5	Bvumbwe Agriculture Research Station	8	0.3			
20	Bunda College of Agriculture	1	0.4	Makoka Research Station	4	0.5	Malawi Clin Research Programme	7	0.2			
21	Department National Park Wildlife	1	0.4	Malawi AIDS Control Programme	4	0.5	Int Centre Research Agroforestry	6	0.2			
22	Forest Res Inst Malawi	1	0.4	Karonga Dist Hospital	3	0.3	National Aquaculture Centre	6	0.2			
23	Forestry Commission	1	0.4	Nyika National Park	3	0.3	National Herbarium	6	0.2			
24	Improvement Livestock Dairy Ind	1	0.4	Office President Cabinet	3	0.3	Bwaila Hospital	4	0.1			
25	Kamuzu Central Hospital	1	0.4	Sugar Corporation of Malawi	3	0.3						

Source: UNESCO, based on Web of Science articles

Table 22 presents the top ten foreign and international research organizations which co-author articles listed at the SCI Extended, SSCI and A&HCI with scientists from Malawi. As observed in the previous tables, the diversification of institutions and the amount of co-publications have increased over time. Over a period of decades, the most important collaborative ties have been established with the University of London, University of Liverpool (see Box 9), University of North Carolina, London School of Hygiene Tropical Medicine, University of California and Michigan State University, among others.

Table 22: Top ten foreign research institutions and centres co-authoring articles with Malawian scientists, 1967–2013

Rank	1967–1981			1982–1996			1997–2011			2012–2013		
	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]
	Malawi	276	100	Malawi	888	100	Malawi	2841	100	Malawi	821	100
1	University of London	11	4.0	University of London	65	7.3	University of Liverpool	464	16.3	University of North Carolina	179	21.8
2	Kings College of London	10	3.6	London School of Hygiene Tropical Medicine	57	6.4	University of London	324	11.4	University of Liverpool	122	14.9
3	UNDP	4	1.4	Center for Disease Control Prevention USA	54	6.1	University of North Carolina	277	9.8	University of London	93	11.3
4	FAO	3	1.1	University of Liverpool	37	4.2	London School of Hygiene Tropical Medicine	251	8.8	University of California	87	10.6
5	ODM Research Team	3	1.1	Int Eye Fdn	31	3.5	Michigan State University	123	4.3	London School of Hygiene Tropical Medicine	68	8.3
6	Michigan State University	2	0.7	Johns Hopkins University	28	3.2	Johns Hopkins University	120	4.2	Center for Disease Control Prevention USA	53	6.5
7	Ministry of Overseas Dev	2	0.7	University of Lausanne	26	2.9	University of California	112	3.9	Harvard University	50	6.1
8	Newcastle University	2	0.7	Int Crops Res Inst Semi Arid Trop	18	2.0	Center for Disease Control Prevention USA	111	3.9	Michigan State University	40	4.9
9	NIH USA	2	0.7	Michigan State University	15	1.7	World Health Organization	103	3.6	University of Cape Town	39	4.8
10	St Thomas Hospital	2	0.7	Rockefeller Foundation	14	1.6	Karonga Prevention Study	91	3.2	Johns Hopkins University	37	4.5

Source: UNESCO, based on articles listed at the Science Citation Index Extended, Social Science Citation Index and Arts & Humanities Citation Index



BOX 9 – MALAWI–LIVERPOOL–WELLCOME TRUST: AN EXAMPLE OF FRUITFUL SCIENTIFIC CO-OPERATION

In recent decades, there has been a significant expansion in health research in Malawi through international co-operation. The focus has been mainly on solving some of the country's pressing health problems while advancing medical science.

Most projects are funded by foreign agencies and many are led by non-Malawian investigators. However, the long-term success of these activities hinges not only on conducting research that responds to the country's quest for better health and a greater understanding of diseases that cause significant morbidity and mortality among its people but also on developing, strengthening and supporting the local capacity required to perform and sustain the work. One of the most successful cases of international co-operation is the Malawi–Liverpool–Wellcome Trust Clinical Research Programme, formally established in 1995. This partnership is visible in the co-authorship of publications by scientists from Malawi and the University of Liverpool (see Table 22).

The Malawi–Liverpool–Wellcome Trust Programme has played a substantial role in developing Malawi's capacity to conduct relevant and competitive clinical research by encouraging and promoting collaboration among clinicians, researchers and sponsors from within Malawi and abroad. Not only has this resulted in better patient care in Malawi and beyond; it has also advanced understanding of the epidemiology, pathogenesis and treatment of important communicable diseases, such as HIV/AIDS and tuberculosis, as well as parasitic diseases like malaria and bacterial infections like pneumonia.

The first director of the programme, Prof. Malcolm Molyneux, and his colleagues in Liverpool have affiliated the programme to Malawi's College of Medicine. The programme's personnel and technical and financial resources have enriched the research environment and infrastructure at Malawi's College of Medicine and at the Queen Elizabeth Central Hospital in the city of Blantyre, the largest in Malawi. Within the programme, new, well-equipped clinical research laboratories were built in the grounds of Queen Elizabeth Central Hospital in 1999. These laboratories have played an important role in clinical research as well as in the care of patients admitted to the hospital.

In a reflection of its success, the Malawi–Liverpool–Wellcome Trust Clinical Research Programme has recently been associated with the Human Heredity and Health in Africa (H3Africa) Consortium. The objective of this regional consortium of institutions is to enhance the ability of African scientists to apply genomic and epidemiological approaches to shed light on the determinants of chronic and infectious diseases in Africa. The H3Africa Consortium, now funded to the tune of US\$76 million over five years, focuses on capacity-building, as well as specific scientific goals. H3Africa research grants are awarded directly to African institutions at which principal investigators are based, allowing African scientists to develop and direct their independent research agendas. The programme encourages intracontinental collaboration and the development of specific infrastructure, namely African-based biorepositories and a pan-African bioinformatics network.

Sources: Mwandumba (2009) and H3Africa Consortium (2014)

Figure 26 shows the distribution of publications (1996–2012) for the six main research fields (UNESCO, 1978; OECD, 2002): agricultural sciences; art and humanities; engineering and technology; exact and natural sciences; medicine and health sciences and; social sciences. This figure was organized in this way, in order to allow comparisons with R&D input indicators, such as those for the number of graduates, number of researchers by field of science (see Tables 16 and 17, pages 55 and 57) and R&D expenditure by field of science.

Figure 26 shows that, over the past two decades, most research articles have related to medicine and health sciences (between 41% and 73%), whereas agricultural sciences and natural and exact sciences account for around 15% of publications. The share of publications on engineering and technology has oscillated between 4% (2004) and 0.5% (2012), whereas the share of publications in social sciences has remained around 7%.

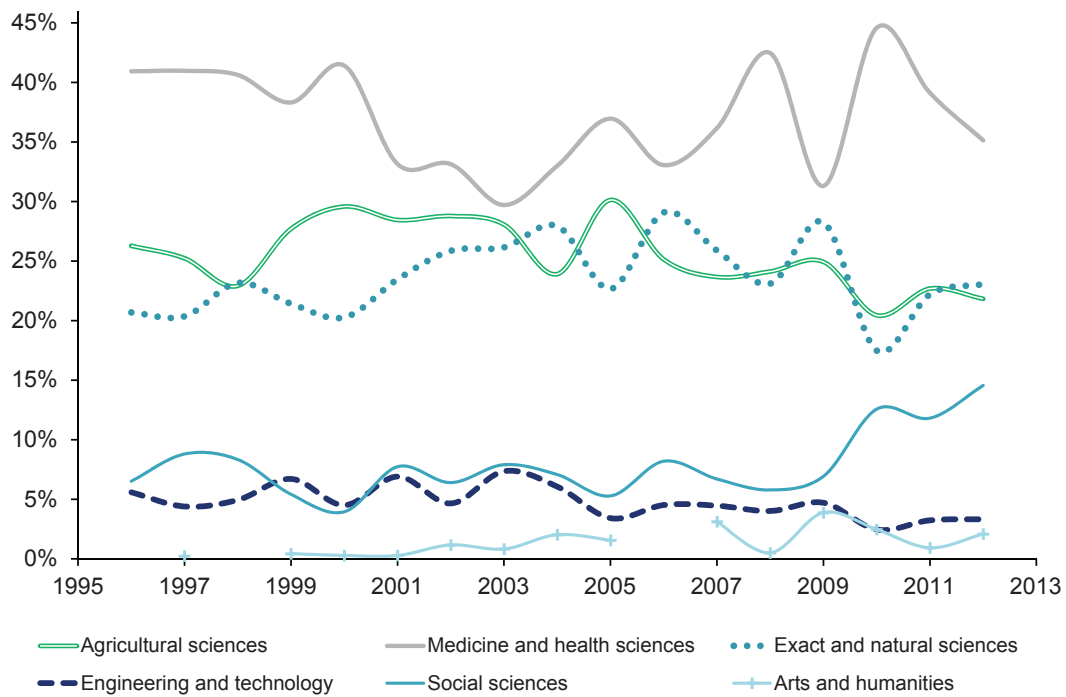


Figure 26: Distribution of publications by field of science, 1996–2012. Source: UNESCO estimation based on SCOPUS data

Table 23 analyses in detail the distribution of articles by 30 sub-fields of science over four different periods between 1967 and 2013. The data show clearly that medicine and agriculture have been the most important research fields in Malawi over this 47-year period.

Table 23: Distribution of mainstream scientific articles by sub-field, 1967–2013

Rank	1967–1981			1982–1996			1997–2011			2012–2013		
	Sub-fields	Pub	Share of total %	Sub-fields	Pub	Share of total %	Sub-fields	Pub	Share of total %	Sub-fields	Pub	Share of total %
	Malawi	276	100	Malawi	888	100	Malawi	2841	100	Malawi	821	100
1	Agriculture Multidisciplinary	32	11.6	Tropical medicine	152	17.1	Environmen- tal occupa- tional health	671	23.6	Environmen- tal occupa- tional health	153	18.6
2	Agronomy	30	10.9	Public Environmental occupational health	143	16.1	Infectious diseases	507	17.8	Infectious diseases	139	16.9
3	Medicine General Internal	21	7.6	Medicine General Internal	89	10.0	Tropical medicine	452	15.9	Immunology	113	13.8
4	Area studies	20	7.2	Infectious diseases	50	5.6	Immunology	310	10.9	Multidisci- plinary sci- ences	81	9.9
5	Entomology	16	5.8	Agronomy	47	5.3	Public Envi- ronmental occupational health	258	9.1	Tropical medicine	75	9.1
6	Veterinary sciences	14	5.1	Public Environmental occupational health	43	4.8	Medicine General Internal	222	7.8	Microbiol- ogy	55	6.7
7	Tropical medicine	13	4.7	Plant sciences	42	4.7	Respiratory	156	5.5	Medicine General Internal	46	5.6
8	History	12	4.3	Area studies	39	4.4	Microbiol- ogy	154	5.4	Paediatrics	42	5.1
9	Food science technology	11	4.0	Parasitology	37	4.2	Paediatrics	126	4.4	Nutrition dietetics	38	4.6
10	Literature	11	4.0	Pathology	30	3.4	Virology	122	4.3	Virology	34	4.1
11	Public Environmental occupational health	11	4.0	Ecology	26	2.9	Parasitology	103	3.6	Parasitology	26	3.2
12	Chemistry Applied	10	3.6	Forestry	26	2.9	Multidisci- plinary sciences	86	3.0	Surgery	22	2.7
13	Marine freshwater biology	9	3.3	Dermatology	25	2.8	Nutrition dietetics	79	2.8	water resources	21	2.6
14	Plant sciences	9	3.3	Immunology	25	2.8	Agronomy	78	2.7	Health policy services	18	2.2
15	African literature	8	2.9	Microbiology	25	2.8	Agriculture Multidisci- plinary	68	2.4	Haematol- ogy	17	2.1
16	Literary reviews	7	2.5	Agriculture Multidisci- plinary	24	2.7	water resources	52	1.8	Agronomy	16	1.9

Rank	1967–1981			1982–1996			1997–2011			2012–2013		
	Sub-fields	Pub	Share of total %	Sub-fields	Pub	Share of total %	Sub-fields	Pub	Share of total %	Sub-fields	Pub	Share of total %
	Malawi	276	100	Malawi	888	100	Malawi	2841	100	Malawi	821	100
17	Planning development	7	2.5	Planning development	22	2.5	Environmental sciences	50	1.8	Environmental sciences	16	1.9
18	Fisheries	6	2.2	History	21	2.4	Health policy services	50	1.8	Endocrinology metabolism	15	1.8
19	Infectious diseases	6	2.2	Marine freshwater biology	21	2.4	Plant sciences	45	1.6	Oncology	15	1.8
20	Ophthalmology	6	2.2	Veterinary sciences	21	2.4	Social sciences biomedical	45	1.6	Ophthalmology	15	1.8
21	Pathology	6	2.2	Biochemistry molecular Biology	19	2.1	Meteorology atmospheric sciences	44	1.5	Planning development	15	1.8
22	Agriculture dairy animal science	5	1.8	Economics	19	2.1	Geosciences multidisciplinary	42	1.5	Respiratory	15	1.8
23	Anthropology	5	1.8	Nutrition dietetics	19	2.1	Obstetrics gynaecology	42	1.5	Health care sciences services	14	1.7
24	Dermatology	5	1.8	Political sciences	18	2.0	Biotechnology applied microbiology	41	1.4	Public Environmental occupational health	14	1.7
25	Ecology	5	1.8	Ophthalmology	15	1.7	Food science technology	37	1.3	Geosciences multidisciplinary	13	1.6
26	Education, educational research	5	1.8	Pharmacology pharmacy	15	1.7	Economics	36	1.3	Nursing	13	1.6
27	Political sciences	5	1.8	Anthropology	14	1.6	Haematology	35	1.2	Social sciences biomedical	13	1.6
28	Zoology	5	1.8	Virology	14	1.6	Planning development	34	1.2	Food science technology	11	1.3
29	Chemistry multidisciplinary	4	1.4	Agricultural economics policy	13	1.5	Surgery	34	1.2	Biochemistry molecular Biology	10	1.2
30	Horticulture	4	1.4	Agriculture dairy animal science	13	1.5	Ecology	33	1.2	Obstetrics gynaecology	10	1.2

Source: UNESCO, based on articles listed at the Science Citation Index Extended, Social Science Citation Index and Arts & Humanities Citation Index



What patents tell us about research and innovation

A patent is a document issued by an authorized government agency granting the right to exclude anyone else from the production or use of a specific new device, apparatus, or process for a stated number of years (see glossary on page 220). The grant is issued to the inventor of this device or process after an examination that focuses on both the novelty of the claimed item and its potential utility.

Measuring the linkage between publications and patents has been a subject of academic research in recent decades. It helps us to understand the intensity and orientation of research, as well as the sources of the relation between science and technology. At the meso-level, a measurable relation allows us to investigate knowledge transfers and potential spillovers: describing the knowledge base of particular technologies; conversely, to disclose the technological neighbourhood of scientific themes or research fronts or the migration of topics in the innovation process, for example from research to technology then on to commercialisation.

A patent constitutes a milestone in the progress of a given technology. However, it is only one piece in a larger puzzle of technological innovation, which entails combining new knowledge with a suitable business strategy and other factors to achieve commercial success. Patent data have been widely used in many innovation studies (Griliches, 1990). Next to patent count data, it is obvious that patent documents, because of legal reporting requirements, provide the STI policy expert with a wealth of information, which can be used for various types of foresight study and strategic analysis. For instance, typical patent documents contain the names and the addresses of the inventors and their applicants, as well as references to other scientific and technological documents. This information can easily be used to map progress and collaboration in technological fields, as well as to assess the vitality of various organisations (firms as well as universities) in a particular field of technological development or in a particular system of innovation.

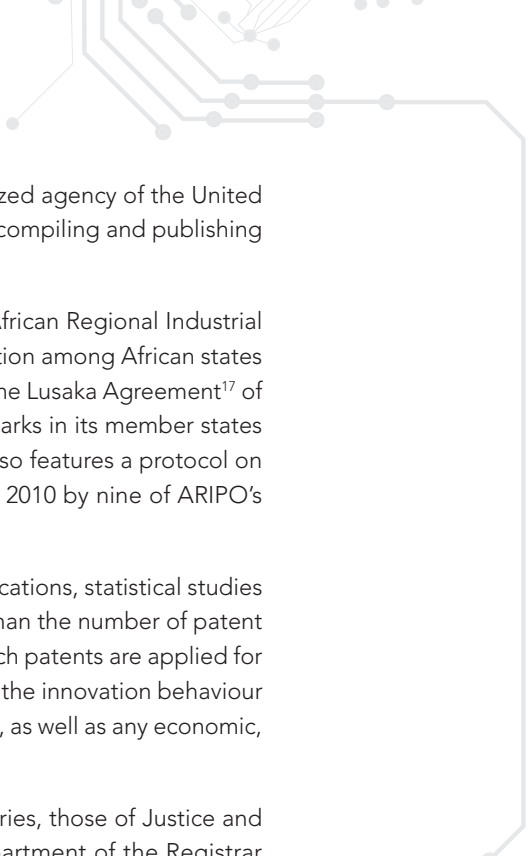
The kind of economic studies in which patent statistics have been used include the long-term changes in the amount and direction of inventive output in particular industries; the relationship between these changes and other long-term economic indicators; the relative efficiency of company-financed and government-financed industrial R&D; the contribution of individual firms to particular areas of innovative activity; the relative significance of foreign and home-generated technology and; for measuring individual inventive output.

Patent analysis takes many forms, with important distinctions between macro- and micro-analyses (Trippe, 2003). In the private sector, for instance, intellectual asset management groups probe deeply to understand the development of individual technologies through a systematic mapping of the content of patents. From the perspective of SETI policy studies, the methodological approach has recourse to the macro-analysis. This analysis focuses on studying the patenting patterns at national level, combined with bibliometric research.

Patent offices and regional bodies

Aggregate patent statistics are usually classified in a variety of ways and have been compiled since the late 19th century¹⁶. Studies of patent statistics are generally based on information produced by international databases. The most relevant databases are United States Patents and Trademark Office (USPTO), Japan Patent Office (JPO) and European Patent Office (EPO). This is so because these offices are based in highly industrialized countries, which consequently have a higher likelihood of transforming the patent claims into an innovation.

16 The year 1883 marked the birth of the Paris Convention for the Protection of Industrial Property, the first major international treaty designed to help people from one country obtain protection in other countries for their intellectual creations in the form of industrial property rights, known as: (a) inventions (patents); (b) trademarks and; (c) industrial designs.



In 1974, the World Intellectual Property Organisation (WIPO) became a specialized agency of the United Nations system with a mandate for administering intellectual property matters, compiling and publishing global statistics on patents, trademarks and industrial designs.

The African Regional Intellectual Property Organisation (ARIPO), formerly the African Regional Industrial Property Organisation, is an intergovernmental organization fostering co-operation among African states in patenting and other intellectual property matters. ARIPO was established by the Lusaka Agreement¹⁷ of 1976. It has the capacity to hear applications for patents and registered trademarks in its member states which are parties to the Harare (patents) and Banjul (marks) protocols. ARIPO also features a protocol on the protection of traditional knowledge, the Swakopmund Protocol, signed in 2010 by nine of ARIPO's member states. Malawi was not one of the signatories.

Even though patent grants can be thought of as a moving average of past applications, statistical studies reveal that the figures for granted patents tend to fluctuate as much, or more, than the number of patent applications. It is also clear that economic conditions impinge on the rate at which patents are applied for (Griliches, 1990). Any analysis of long-term temporal series of patents will reflect the innovation behaviour of a particular country and the stage of national development at different epochs, as well as any economic, political and societal crisis along the way.

In Malawi, all issues related to intellectual property are handled by three ministries, those of Justice and Constitutional Affairs, Tourism and Culture, and Industry and Trade. The Department of the Registrar General, which falls under the Ministry of Justice and Constitutional Affairs, is responsible for administering industrial property (patents, trademarks and registered designs). The Copyright Society of Malawi (COSOMA), which falls under the Ministry of Tourism and Culture, administers copyright and related rights, whereas the Ministry of Industry and Trade is concerned with trade-related aspects of intellectual property. This ministry also handles the World Trade Organization's Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS). However, the Ministry of Industry and Trade is the policy-holder for industrial property laws.

Analysing patent trends in Malawi

Figure 27 shows the evolution between 1960 and 2002 in patent applications and grants for residents and non-residents of Malawi (see glossary of related terms on page 220). The vertical axes in Figure 27 and 28 use a logarithmic scale. Consequently, in this type of graph, a straight line represents an exponential curve. Figures 27 and 28 show that the number of patent applications has decreased exponentially over time, whereas the number of patent applications by residents has shown erratic behaviour, with one or two patent applications per year in most cases and a peak of seven applications in 1981. The observed decrease in the number of granted patents has been even more abrupt than that for the number of patent applications.

These curves are consistent with trends in the local productive sector, the lack of endogenous industrial innovation and the absence of incentives for entrepreneurship and commercialization of research results.

¹⁷ The members of ARIPO are those which have ratified the Lusaka Agreement: Botswana, The Gambia, Ghana, Kenya, Lesotho, Liberia, Malawi, Mozambique, Namibia, Rwanda, Sao Tome & Principe, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

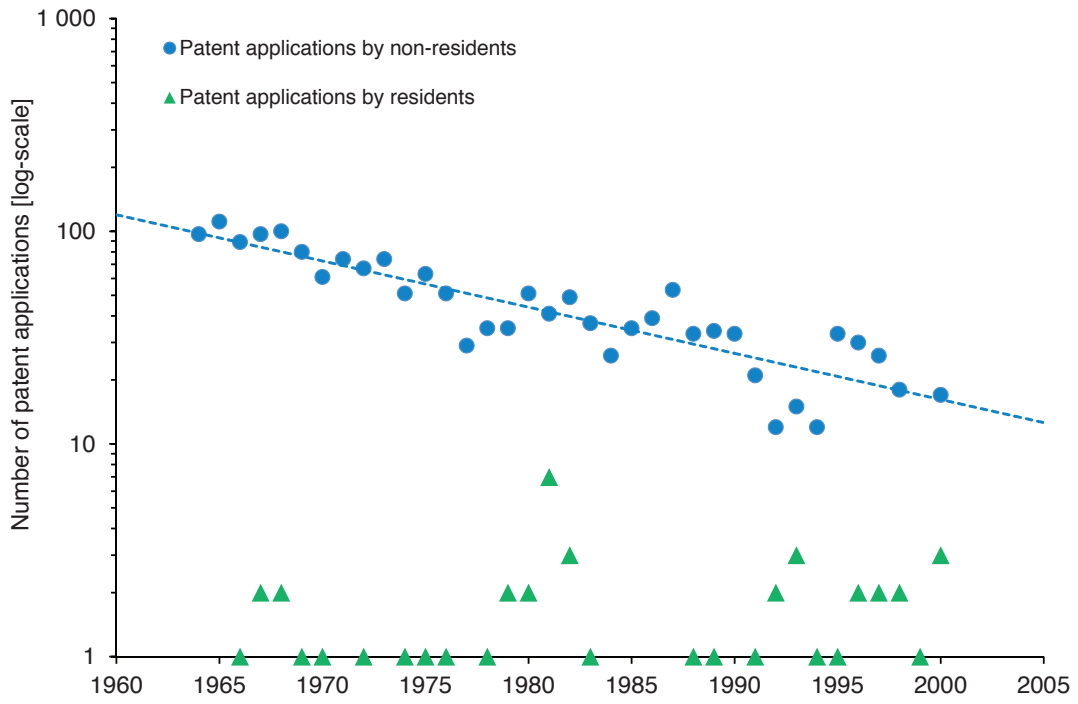


Figure 27: Evolution in patent applications in Malawi by residents (triangles) and non-residents (circles), 1960–2000. The dotted lines are the best-fitting curves. The vertical axes are expressed on a logarithmic scale. Source: UNESCO, based on data provided by WIPO

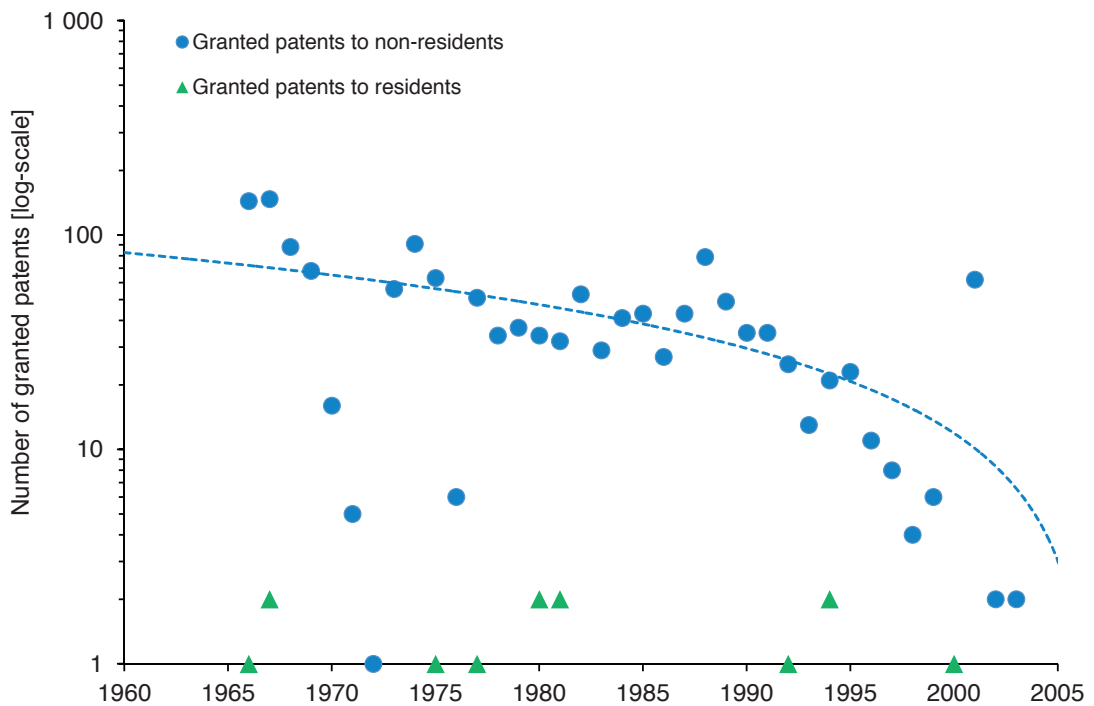


Figure 28: Evolution in patents granted in Malawi to residents (triangles) and non-residents (circles), 1960–2003. The dotted lines are the best-fitting curves. The vertical axes are expressed on logarithmic scales. Source: UNESCO, based on data provided by WIPO

Table 24 shows the number of patent applications filed and patents granted abroad by Malawian residents (1994–2012) with the Africa Regional Intellectual Property Organisation (ARIPO). In recent years, most patents have been registered through ARIPO, with very few applications being presented to the Department of the Registrar General in Malawi. According to NCST (2013a), these low levels of patenting can be attributed to a lack of awareness of intellectual property rights and the absence of a strong culture of invention and innovation in Malawi, a situation compounded by low public and private sector investment in R&D, innovation and commercialization.

Between 1991 and 2010, Malawi did not register any of the applications presented by African Union countries to the United States Patents and Trademark Office (1 757 applications) and European Patent Office (954) [AOSTI, 2013].

Table 24: Number of patent applications filed and patents obtained at ARIPO by Malawian residents, 2005–2012

Year	Patent applications filed at ARIPO by residents	Patents granted at ARIPO to residents
2005	248	106
2006	312	125
2007	343	78
2008	277	62
2009	213	14
2010	217	1
2011	n/a	1
2012	n/a	1

Source: WIPO and NCST (2013a)

What trademark data reveal about innovation

Recently, trademark data have also been used to convey information on two key aspects of innovation which are not usually covered by traditional indicators: marketing innovation and innovation in the services sector (Millot, 2009). Different empirical studies have shown the link between trademark counts and other indicators of innovation performance, when available. For instance, trademark numbers at the firm level have been found to correlate positively with innovation, as reflected in responses to innovation surveys, with R&D (for certain industries), with patents, and with the number of new product launches. This correlation is particularly high for knowledge-intensive services and in high-tech sectors like the pharmaceutical industry. A further advantage of trademarks as a source of data is their broad availability and relatively easy accessibility.

A trademark is a sign capable of distinguishing the goods or services of one enterprise from those of other enterprises. Trademarks are protected by intellectual property rights. In principle, a trademark registration will confer an exclusive right on the use of the registered trademark. This implies that the trademark can be used exclusively by its owner, or licensed to another party for use in return for payment. Registration provides legal certainty and reinforces the position of the right holder, for example, in case of litigation. The term of registration can vary but is usually ten years. It can be renewed indefinitely on payment of additional fees. Trademark rights are private rights and protection is enforced through court orders.

The link between trademark deposits and product innovation is relatively straightforward: the commercialisation of new products is sometimes associated with the creation of a new trademark in order to communicate about the innovation and, later, possibly become the reference on the market for the product, which in turn enables firms to appropriate the benefits of their innovation. When it comes to marketing innovation, the link with trademark deposits is more complex.

Data on trademarks are available for Malawi from 1960 onwards. Figure 29 shows the evolution in trademark applications by residents and non-residents between 1960 and 2002. The vertical axis has a logarithmic scale. The behaviour of both types of application follows an oscillatory shape for non-residents applications and a parabolic shape for resident applications. For non-resident applications, the parabola has its vertex at a minimum value of 193 and the maximum values at the left- and right-hand extremes with approximately 740 applications. For the resident applications curve, the parabola has its vertex at a minimum value of three and maximum values at the left- and right-hand extremes with around 180 applications.

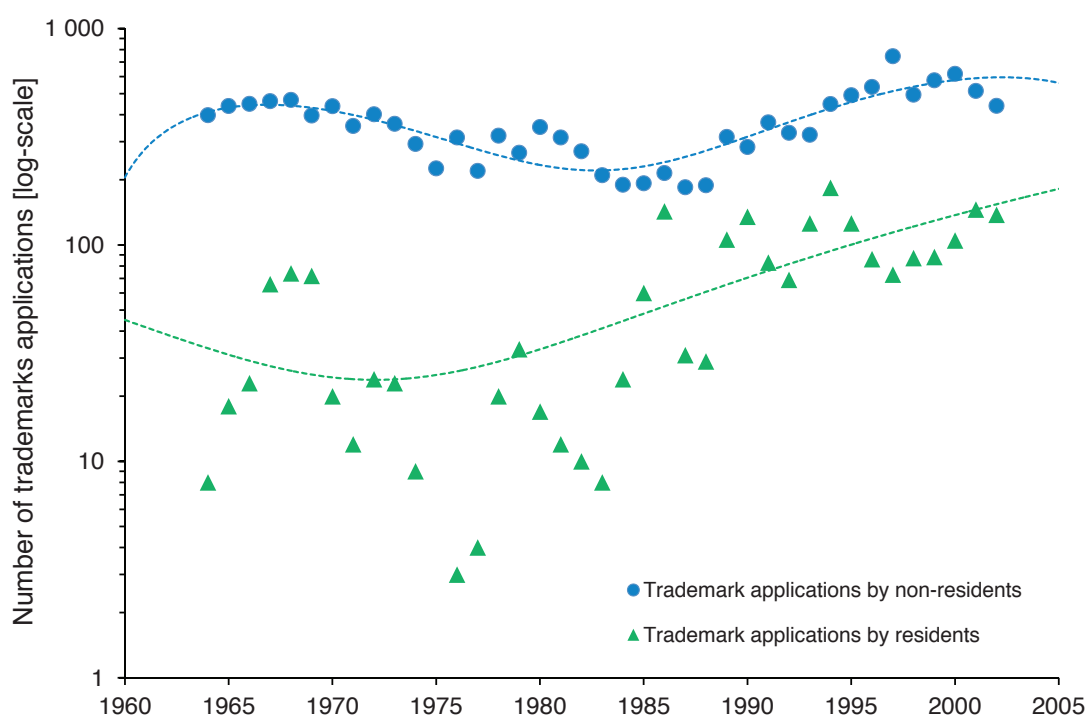


Figure 29: Evolution in the number of trademark applications in Malawi, 1960–2002. The dotted lines are the best-fitting curves. The vertical axis is expressed on a logarithmic scale. Source: UNESCO, based on data provided by WIPO

Lastly, Table 25 shows the trademark applications and registrations involving residents and non-residents in Malawi and filed/obtained abroad (1998–2012) and Table 26 shows the recent evolution in the number of applications and registrations concerning industrial designs in Malawi.

Table 25: Trademark applications and registrations involving residents and non-residents in Malawi and filed/obtained abroad, 1998–2012

Year	Trademark Applications			Trademark Registrations		
	Residents	Non-residents	Filed abroad by residents	Residents	Non-residents	Obtained abroad by residents
1998	87	495	0	45	275	0
1999	88	577	0	42	254	0
2000	105	618	0	24	208	0
2001	146	515	0	51	588	0
2002	138	440	0	81	367	0
2003	0	0	1	0	0	1
2004	0	0	1	0	0	0
2005	0	0	4	0	0	0
2006	222	582	0	96	274	0
2007	0	0	0	0	0	0
2008	0	0	1	0	0	0
2009	0	0	0	0	0	0
2010	0	0	4	0	0	1
2011	0	0	11	0	0	2
2012	0	0	12	0	0	2

Source: WIPO

Table 26: Industrial design applications and registrations involving residents and non-residents in Malawi and filed/obtained abroad, 1998–2012

Year	Industrial Design Applications			Industrial Design Registrations		
	Residents	Non-residents	Filed abroad by residents	Residents	Non-residents	Obtained abroad by residents
1998	12	21	0	0	2	0
1999	5	9	0	0	5	0
2000	14	4	0	11	14	0
2001	7	17	0	2	3	0
2002	10	12	0	3	9	0
2003	5	5	1	7	6	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0	0
2006	0	0	0	0	0	0
2007	0	0	0	0	0	0
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	0	0	0	0	0	0
2012	0	0	0	0	0	0

Source: WIPO



A national intellectual property office for Malawi?

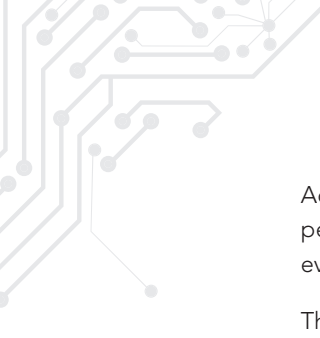
A study by the National Commission for Science and Technology (NCST, 2013a) supports the draft national intellectual property policy currently under preparation.

The NCST (2013a) considers that the proposed establishment of an autonomous national intellectual property office would solve resource and capacity challenges while, at the same time, boosting the profile of intellectual property in Malawi. Such an office would require a centralized monitoring system, in order to implement the various intellectual property laws existing today (see page 169), as well as guide government policy formulation and implementation in various sectors. The NCST (2013a) suggests that stakeholders lobby for the creation of the national intellectual property office, in order for relevant matters to be given due priority and so as to stimulate a culture of creativity, inventiveness, innovation and commercialization.

The NCST (2013a) also suggests introducing courses in intellectual property into most institutions of learning and increasing social awareness of related issues.

Historical background to SETI policies in Malawi





According to Guta (2011), Malawi's economic development trajectory can be broken down into three periods defined by five phases. This theoretical framework is very useful for tracing the institutional evolution of SETI in Malawi over the past century.

The first period and phase is termed by Guta (2011) as Pre-Independence Colonialism. It runs from the time when the natives of the territory (later named Nyasaland) first made contact with Scottish missionaries to 1964 when Malawi obtained independence. Agricultural research dominated S&T at this time (i.e. Pardey *et al.* 1992; Roseboom and Pardey, 1993 and Beintema *et al.*, 2004).

The second period was defined as the Post-Independence Dictatorship. It runs from 1964 to 1994 and consists of two phases, a 'boom' phase (Mhone, 1990) which ended in 1979–1983 and a 'bust' phase which ended in 1994.

The third period, which Guta (2011) defined as the Post-Independence Multiparty System because it saw the country emerge 'from dictatorship to democracy' (Harrigan, 2001), runs from 1994–1995 to the present. The Post-Independence Multiparty System comprises two phases characterized by 'the performance of the two democratically elected polities'.

Each of the three periods is associated with the evolution of institutions and, thus, the norms and conventions which have influenced Malawi's learning and innovation systems.

The following historical analysis will focus on the evolution of SETI policies and governing bodies after independence.

FROM INDEPENDENCE TO CONSOLIDATION OF THE FIRST GOVERNING BODIES FOR R&D

Back in 1962, Malawi participated in UNESCO's first regional survey of R&D in Africa. Just weeks after independence, Malawi participated in UNESCO's first International Conference on the Organization of Research and Training in Africa in Relation to the Study, Conservation and Utilisation of Natural Resources, which took place in Lagos (Nigeria) between 28 July and 6 August 1964 (UNESCO and UNECA, 1966). In 1967 and 1971, Malawi conducted two R&D surveys with UNESCO's help (see page 58). UNESCO has thus been supporting SETI policies in Malawi for half a century.

The first report on SETI policy in Malawi (UNESCO, 1974) revealed the absence of any document on national science and technology policy in the early 1970s. However, the report did detect very close ties between the national organizations conducting research (Ministry of Agriculture, Agricultural Research Council of Malawi, University of Malawi, etc.) and the bodies responsible for the national development policies and plans (President's Office, Treasury and the planning units of those government departments).

In the 1970s, there were very limited research facilities, with nearly all investment going to the fields of agriculture and natural resources. Most ministries had an officer or a unit responsible for part of the overall development plan but only the Ministry of Agriculture and Natural Resources had research departments in fields such as agriculture, veterinary sciences, fisheries, forestry and game. In those days, the University of Malawi also contributed to the research effort on a wide range of subjects. Figure 30 shows the organizational chart of research and innovation in Malawi *in circa* 1972.

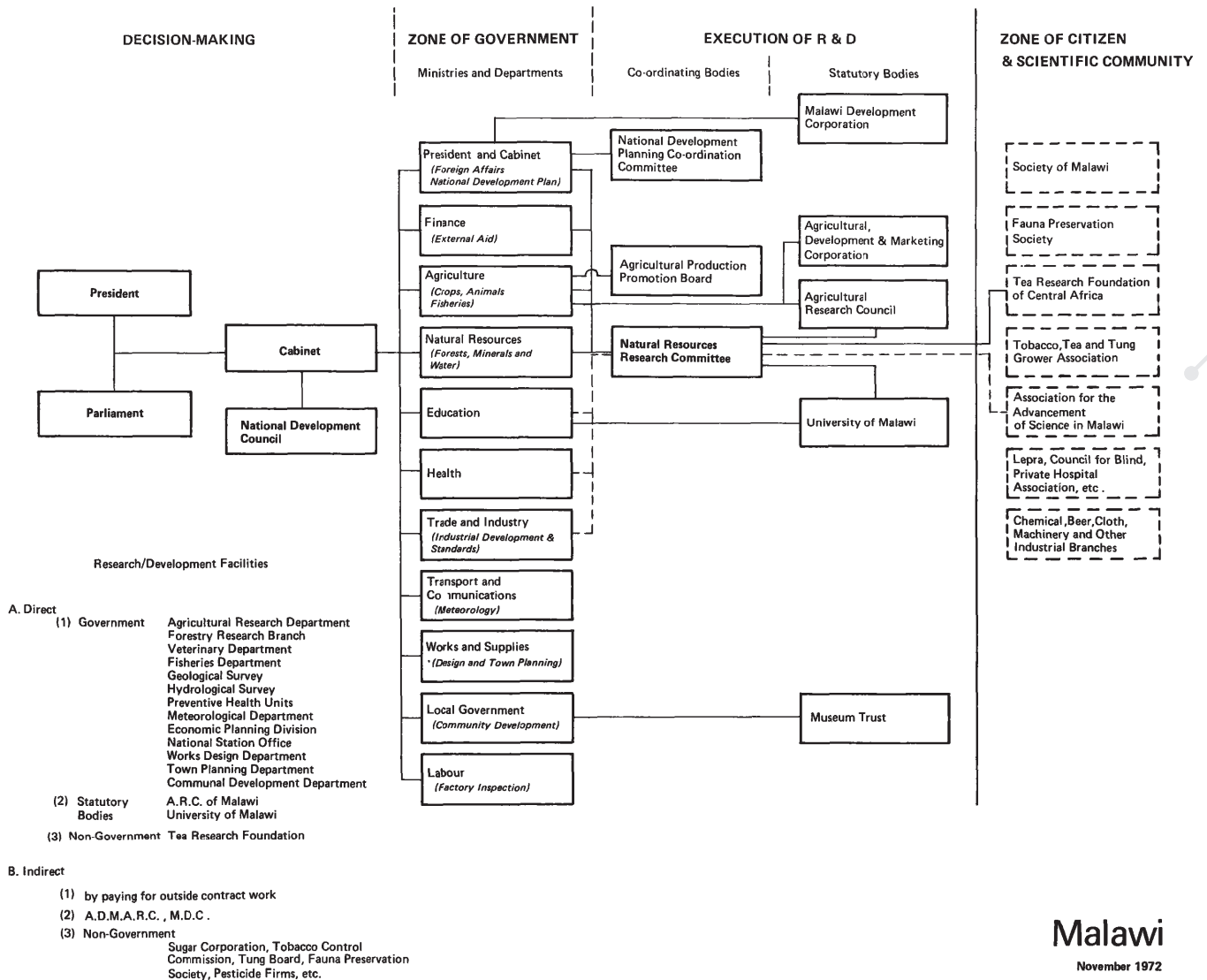


Figure 30: Organizational chart showing Malawi's research and innovation system in 1972.
Source: UNESCO (1974)



In the 1970s, the University of Malawi, Agricultural Research Council and Tea Research Foundation did discuss the idea of formulating science and technology policies. The main co-ordinating body for research at the time was the Natural Resources Research Committee. Organizations engaged in agricultural research and innovation liaised closely with the Government Research Department and the Agricultural Research Council, with help from tea- and tobacco-growers' associations.

The Conference of Ministers of African States responsible for the Application of Science and Technology to Development (CASTAFRICA) was organized by UNESCO in co-operation with the United Nations Economic Commission for Africa and the Organization of African Unity. The conference was held in Dakar, Senegal, from 21 to 30 January 1974. During the conference, the Government of Malawi presented the following general science policy statement (UNESCO, 1974):

- a. Research shall be clearly related to the development needs of Malawi and shall be so organized that useful ideas and technologies are developed to the stage where they can be adopted by the producing public.
- b. Investigations will normally be into the adaptation of existing advanced theory and technology to the present state of organization and development in Malawi, developing new ideas and technologies where existing ones are patently unsuitable.
- c. Research and development work will be organized on a project basis, i. e. the objectives and current limiting factors will be clearly defined before personnel and resources are committed to the solution of the problem. There will be written terms of reference for each project and these will be reviewed at short intervals (yearly on average) and brought up to date as necessary.
- d. Projects will be entrusted to the scientists best able (in terms of ability and personal qualifications, laboratory or field space and other duties) to carry them forward at the time, irrespective of the institution by which they are employed. Where no suitable worker exists, the responsibility for recruitment will be given to the institution, which has support facilities available.
- e. Malawian research workers are to be recruited and trained alongside experienced scientists, so that there is a permanently resident corps of Malawian scientists to sustain the research effort in the country and to which expatriate workers can be attached for special duties on a contract or technical assistance basis

At CASTAFRICA, it was observed that R&D and scientific and technological services were a source of momentum for development and that each country consequently ought to possess its own scientific and technological base capable of generating and accelerating this momentum. It was further noted at CASTAFRICA that any nation, however underdeveloped or small in population, could not do without a national science and technology policy.

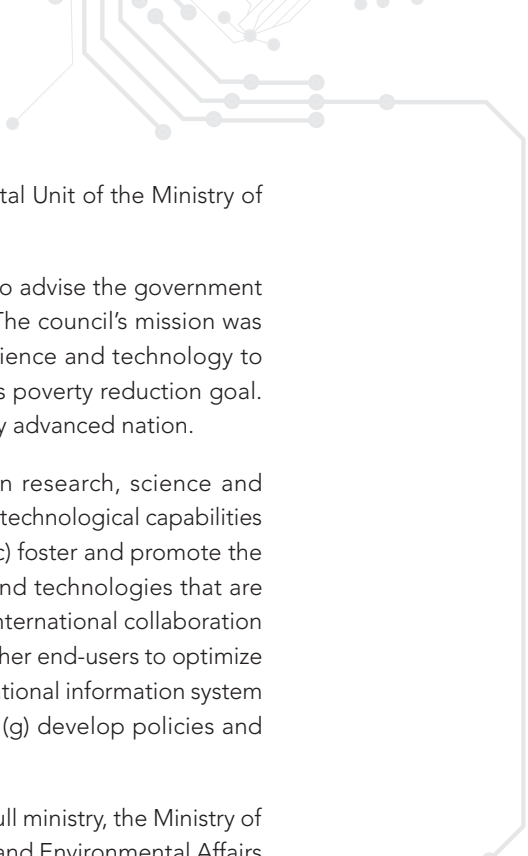
In the wake of this seminal conference, the authorities of Malawi set up the National Research Council of Malawi by presidential decree in 1974 (Malawi Government Gazette, 1976).

The National Research Council of Malawi

The National Research Council of Malawi (NRCM) rapidly become one of the government's central agencies, operating within the purview of the Office of the President and Cabinet (OPC), the country's highest office with control over all other ministries and departments.

The NRCM's Governing Council was chaired by the Secretary to the President and Cabinet. The Governing Council was comprised of members of academia, parastatals and the private sector.

By reporting directly to the OPC, it was easy for the NRCM to co-ordinate the S&T activities of various ministries and departments (Mphadzula, 2012). As a professional arm of the OPC on matters relating to research, science and technology, the NRCM played a crucial role in promoting and co-ordinating research, science and technology.



In 1988, the activities of the NRCM were merged with those of the Environmental Unit of the Ministry of Forestry and Natural Resources.

The constitution adopted in 1990 defined the NRCM's main purpose as being to advise the government on all matters relating to scientific research and technological development. The council's mission was to promote and co-ordinate the development and application of research, science and technology to realize sustainable socio-economic development, in line with the government's poverty reduction goal. The NRCM's vision was for Malawi to become a scientifically and technologically advanced nation.

The NRCM's main functions were to: (a) provide national policy direction in research, science and technology; (b) develop and implement programmes to strengthen scientific and technological capabilities through human resource development, infrastructure and institution-building; (c) foster and promote the development and application of demand-driven, focused scientific research and technologies that are adaptable and relevant to the needs of Malawians; (d) strengthen national and international collaboration and liaison among science and technology institutions, scientists, industry and other end-users to optimize the application of research results for development; (f) develop and maintain a national information system to meet identified social, scientific and technological information needs and; (g) develop policies and guidelines on indigenous knowledge and access to genetic resources.

In 1991, the NRCM Secretariat was elevated to a full department then later to a full ministry, the Ministry of Research and Environmental Affairs (MOREA). In 1997, the Ministry of Research and Environmental Affairs was abolished, causing the NRCM to be reinstated.

The first science and technology policy


With the acceptance of technology as being the most important strategic variable in development, the need emerged, in early 1989, for a national science and technology policy to provide a blueprint for orienting the country's SETI system towards driving development. The country's first national science and technology policy was approved by the Government on 11 June 1990 (Government of Malawi, 1991). The *National Science and Technology Policy* recognized the fact that it was only by applying scientific creativity, enterprise and innovation to problem-solving and technological development that most of Malawi's important development problems could be addressed.

In 1991, the Ministry of Research and Environmental Affairs designed a five-year master plan for the first *National Science and Technology Policy* (Government of Malawi, 1991).

The 1991 *National Science and Technology Policy* outlined a number of broad strategies. It is widely accepted, however, that the policy has not been fully implemented. Some contributing factors are: (a) the country's pluralistic approach in the management of science and technology; (b) lack of integration of the policy in the government's overall development plans; (c) a lack of human, financial and material resources; and (d) a lack of the necessary supporting legislation.

Each individual sector had to decide what level of research capacity to establish, the issues to address, the degree of consultation to adopt and the levels of R&D funding without the benefit of a co-ordinating mechanism, despite the cross-cutting nature of SETI activities. Following the abolition, in 1997, of the Ministry of Research and Environmental Affairs and the reinstatement of the NRCM, the latter was once more able to play its co-ordinating and developmental role.

As some of the objectives of the Department of Science and Technology were similar to those of the NRCM, a conflict emerged between the two institutions. In May 1997, the Malawian president merged education, science and technology under a single ministry, of which he personally took charge. However, the merger did not solve the conflict between the Department of Science and Technology and the NRCM. The National Research Council of Malawi had a dual reporting system whereby ministerial



guidance was provided by the minister, whereas all administrative and financial provisions came from the OPC. This dual allegiance of the NRCM has occasioned some misunderstandings, sometimes at the expense of progress.

In performing this role, the NCRM has encountered two main obstacles that are present in the early stages of development of all scientific systems. The first and probably most important obstacle is the inability to co-ordinate and direct research without the power to influence budgetary considerations. The second obstacle concerns the instability and uncertainty surrounding the institutional status of NRCM. This weakness necessitated the Government to review the policy and to propose a second science and technology policy.

In 1998, the government endorsed *Vision 2020: the National Long-term Development Perspective* (Government of Malawi, 1998), which recognizes the need to adopt a science- and technology-led development strategy. In addition, the *Malawi Poverty Reduction Strategy (2002–2005)* recognizes science and technology as a cross-cutting issue for the four pillars of socio-economic development planning (see page 9).

The 1991 *National science and Technology Policy* did not explicitly integrate SETI issues into national development planning. For this reason, the government decided to review the policy and, ultimately, to adopt a new science and technology policy in 2002 (Gausi and Kalanda, 2005).

The second national science and technology policy

With the support of the United Nations Development Programme, the NRCM established a task force whose mandate was to define the terms of reference for a consultancy to develop the new National Science and Technology Policy. The task force drafted these terms of reference at a week-long meeting from 10 to 14 November 1997.

UNESCO, as focal point for scientific and technological issues within the United Nations System, lent its technical support to the process of developing this policy document, including by identifying and contracting consultants to develop the framework of the National Science and Technology Policy. The consultants undertook their work during the period 1 May to 31 July 1998 and issued a draft national science and technology policy in December 1998.

The NRCM established a special task force to review the draft policy document. It made general and specific comments which guided the preparation of the final draft policy, which was presented to a stakeholders' workshop for review and discussion on 2–4 June 1999. The final document took into account the views expressed at both the stakeholders' workshop and a subsequent high-level consultative meeting on 31 May 2001 at the Malawi Institute of Management which involved principal secretaries and chief executives of S&T-related institutions held.

The 2002 *Revised National Science and Technology Policy* (Government of Malawi, 2002) set out guiding principles, strategies, institutional and legal framework for effective interface with sectoral policies and the development and application of science and technology for poverty reduction.

The policy also contained a set of research and innovation development objectives and strategies for all priority sectors of the Malawi economy. The policy articulated the government's commitment to increasing funding for SETI and strengthening the institutional and legal framework for science and technology. In terms of institutional capacity, the policy provided for the establishment of the National Commission for Science and Technology (NCST) as a way of resolving the problems related to policy implementation in the SETI sector (Government of Malawi, 2002).

In late 2003, a Science and Technology Act was introduced to back up the 2002 *Revised National Science and Technology Policy* (Government of Malawi, 2003).



The National Commission for Science and Technology

The National Commission for Science and Technology (NCST) was created by the merger of the National Research Council of Malawi with the Department of Science and Technology of the Ministry of Science and Technology (MIST), as provided for by the Science and Technology Act of 2003.

The Commission's function is to advise the government and other stakeholders on all SETI matters, in order to achieve science- and technology-led development (Government of Malawi, 2003).

According to the 2002 *Revised National Science and Technology Policy*, the general and specific functions of the Commission are as outlined below.

General function: the Commission is the principal body providing S&T advice to the government and other stakeholders on all S&T matters, in order to achieve a science- and technology-led development strategy.

The *specific functions*, according to the 2003 act are:

- a. create awareness of science and technology at the political and other levels of society and thereby obtain their commitment to the value of science and technology as integral parts of national development strategies;
- b. establish mechanisms to solicit support from the executive and legislative branches of government, policy-makers and the private sector, in order to promote the formulation and revision of policies, strategies, laws and regulations for science and technology and the monitoring of the implementation of science and technology development activities;
- c. source funding from within and outside Malawi to finance the national research and development effort and allocate funds to research institutions based on set priorities;
- d. chart the national direction and establish national priorities in science and technology development in relation to socio-economic development needs;
- e. appraise, review, monitor and evaluate priority research and development programmes, plans and projects of research and development institutions and undertake independently, or in collaboration with any appropriate person, body or institution, surveys and research investigations considered necessary;
- f. promote and advocate the development of science and technology human resources by building capacity in science and technology education and training programmes and providing assistance in the development of appropriate science and technology curricula for the various levels of the education system;
- g. create a conducive working environment for science and technology personnel, in order to retain them and attract those outside Malawi to return through, inter alia, providing appropriate science and technology infrastructures and facilities,
- h. encourage the use of local expertise in science and technology matters through the use of professional standards, ethics and guidelines and support professional science and technology associations;
- i. encourage the establishment of research institutions that undertake research and development activities, which promote national socio-economic development and other specialized research, and development activities in a manner that enhances co-operation and collaboration among national and international science and technology personnel and institutions;
- j. organize national science and technology fairs and open days so as to promote science and technology awareness and culture; document, consolidate and disseminate relevant science and technology information and promote the role of information and communication technologies;
- k. promote the transfer of technology through various methods and training, purchase and license agreements and joint venture agreements with foreign partners, establish and maintain national capacity for negotiating, monitoring and regulating technology transfer agreements;
- l. promote and encourage the patenting and commercialization of research results to enhance economic diversification, competitiveness and employment generation;
- m. promote sustainable socio-economic development through the generation and application of environmentally friendly technologies in order to protect and conserve natural resources;

- 
- n. develop and synthesize science and technology indicators covering such aspects as research and development statistics, bibliometrics, technology balance of payments statistics, patent data, human resources and innovation data using internationally accepted procedures and standards;
 - o. conduct an inquiry into any matter being investigated by the Commission;
 - p. sponsor such national and international scientific conferences as it may consider appropriate;
 - q. promote and maintain co-operation in science and technology with similar bodies in other countries and with international bodies connected with science and technology;
 - r. prepare, every two years, a State of Science and Technology Report for presentation to the National Assembly; and
 - s. perform any other function or activity related to science and technology.

The Commission has various important committee structures (Government of Malawi, 2002), such as:

- ▶ A Parliamentary Committee responsible for Science and Technology, which will provide a voice on S&T matters in the National Assembly. The Committee will ensure that S&T are integrated into the national budget by the time it is approved by Parliament and that S&T are integrated into the country's socio-economic development processes.
- ▶ A Cabinet Committee responsible for Science and Technology, which will monitor the development and application of science and technology in national development processes.
- ▶ Sectoral committees, which will be composed of S&T directors from the relevant sectoral ministries, as a link between the sectoral ministry and the commission. The overall responsibility of the S&T directors will be to co-ordinate S&T issues in their relevant ministries.

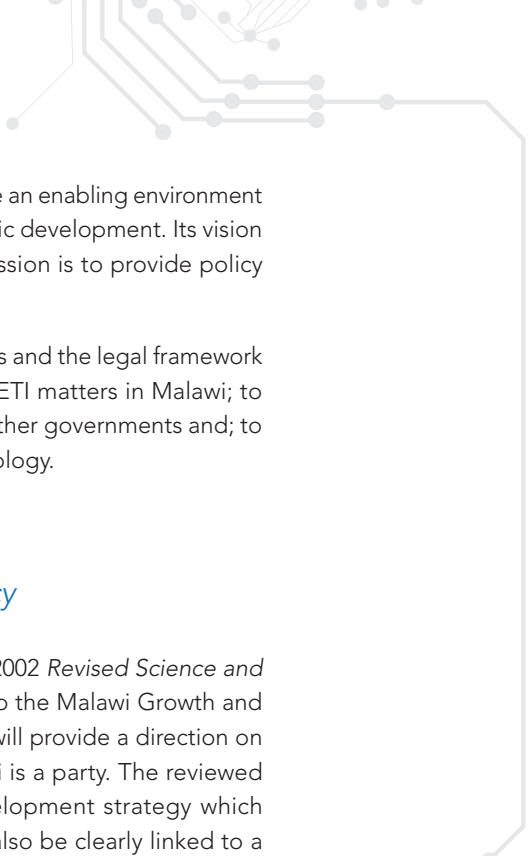
A Department of Science and Technology within the Ministry of Education, Science and Technology

In mid-2004, the Government of Malawi created a Ministry of Industry, Science and Technology (MIST) to work alongside the NRCM (Government of Malawi, 2002). MIST was created shortly after the May 2004 general elections. The articulated vision of MIST was to transform Malawi into an industrialized nation with scientifically- and technologically-led sustainable growth and development. Its mandate was to promote industrial development through the application of science and technology.

The ministry consisted of two technical departments, one for science and technology and the second for industry. However, MIST was in turn dissolved in 2006; the Department of Industry migrated to the new Ministry of Industry, Trade and Private Sector Development, whereas control over the Department of Science and Technology moved back to the OPC. This effectively meant that both the Department of Science and Technology and the NRCM henceforth reported directly to the president (Mphadzula, 2012).

The mandate of the Department of Science and Technology was to regulate, support, promote and co-ordinate the development and application of science and technology in order to create wealth and improve the quality of life. The department had four corporate objectives: (a) to promote and maintain the regulatory framework for S&T to ensure wealth creation; (b) to establish an effective capacity-building framework for the efficient development, application and transfer of science and technology; (c) to develop and commercialize technology and; (d) to enhance, promote and popularize science and technology.

As we have seen above, the National Research Council of Malawi merged with the Department of Science and Technology in 2008 to form the National Commission for Science and Technology (NCST). As the NCST had been established as a statutory corporation rather than as a full government department, the authorities decided to retain a small, lean Department of Science and Technology under the Ministry of Education, Science and Technology to handle policy issues and international co-operation in science and technology, as these issues could not be properly handled by a statutory body like the NCST.



The mandate of the new, lean Department of Science and Technology is to provide an enabling environment conducive to the application and utilization of STI for sustainable socio-economic development. Its vision is for a developed nation through the application and utilization of STI. Its mission is to provide policy direction in the field of SETI.

The department has the following core functions: to formulate and review policies and the legal framework in the field of SETI; to provide national policy guidance and direction on all SETI matters in Malawi; to develop and maintain international co-operation in SETI between Malawi and other governments and; to link national SETI institutions and the Ministry of Education, Science and Technology.

A review of the 2002 Revised Science and Technology Policy

The Department of Science and Technology is in the process of reviewing the 2002 *Revised Science and Technology Policy*, in order to include an implementation plan and to align it to the Malawi Growth and Development Strategy II (Mphadzula, 2012). Furthermore, the reviewed policy will provide a direction on international science, technology and innovation instruments to which Malawi is a party. The reviewed policy will be linked to *Vision 2020* (see page 9), a long-term national development strategy which envisages Malawi as a technologically driven middle-income economy. It will also be clearly linked to a number of sector-specific policies such as the *National Environmental Policy* (2004), *Food Security Policy* (2008), *National Youth Policy* (1999), *National Biotechnology and Biosafety Policy* (2008), *National Irrigation Policy* (2000), *National Sanitation Policy* (2006) and the *National Nutrition Policy* (2008). The department is also drafting the Intellectual Property Policy and has so far submitted it to Cabinet for approval.

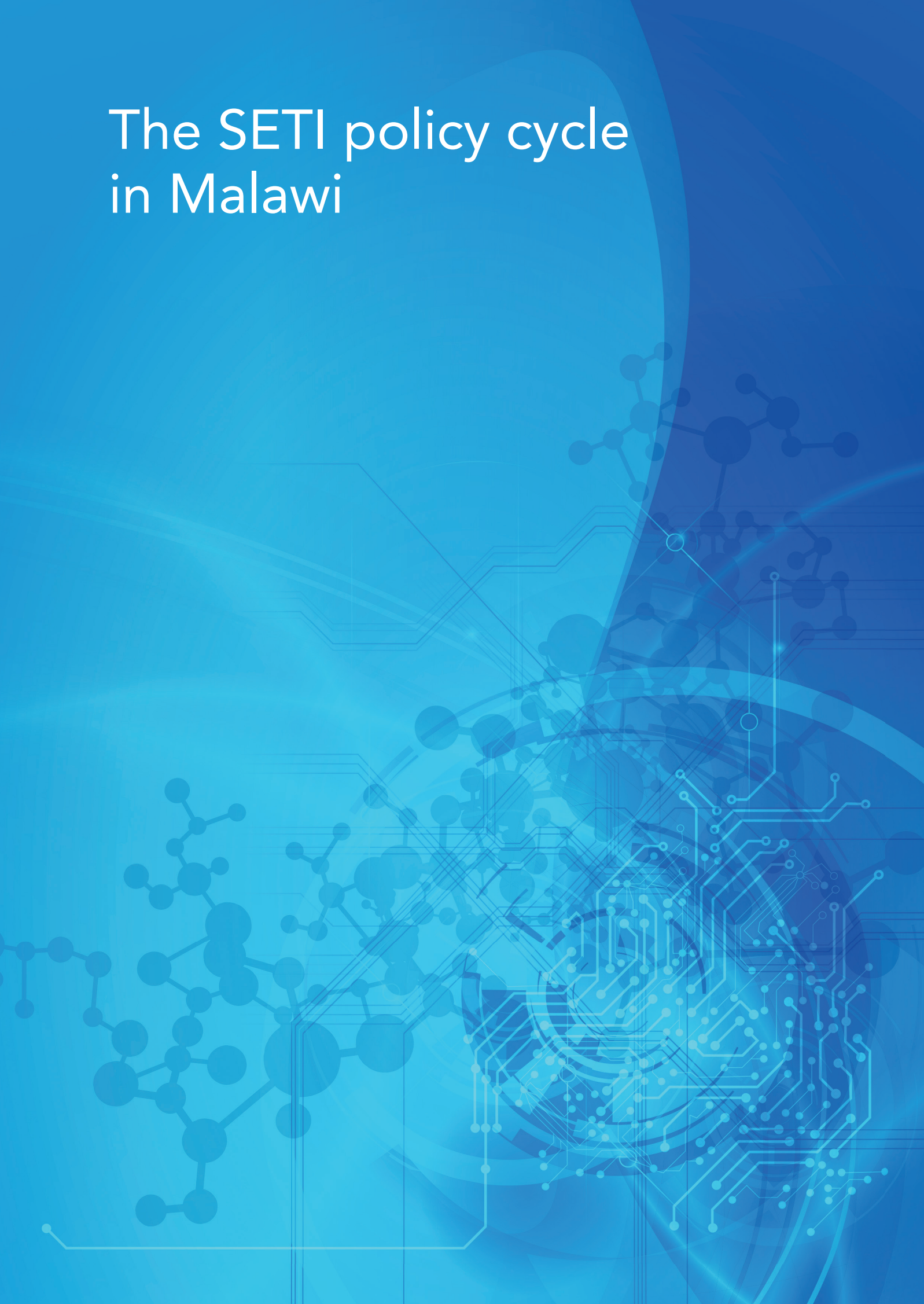
The Government of Malawi is fully responsible for appropriating resources to public sector organizations responsible for governing and implementing science, engineering, technology and innovation (SETI) activities. There is recognition of various development partners funding research initiatives in agriculture, health, education, energy, engineering and environment among other sectors.


Achievements thus far in science and technology

Malawi has made significant achievements in science and technology, as attested by the recent Millennium Development Goals report (2010) [see page 13]. It has been observed that five out of eight Millennium Development Goals are likely to be met by 2015 due to various interventions, including the application of science and technology. These goals are to: Eradicate Extreme Poverty and Hunger; Combat HIV and AIDS, Malaria and Other Diseases; Reduce Child Mortality; Ensure Environmental Sustainability and; Develop Global Partnerships for Development. Undoubtedly, development partners are playing a major role in contributing towards the attainment of these MDGs. Through the implementation of SETI policies, other notable achievements in Malawi include the following:

- ▶ establishment of the National Commission for Science and Technology with a mission to co-ordinate the work of different SETI stakeholders in the country;
- ▶ establishment of the Malawi University of Science and Technology (MUST) and Lilongwe University of Agriculture and Natural Resources (LUANAR) to build capacity in SETI;
- ▶ building health research capacity through the Health Research Capacity Strengthening Initiative (HRCSI) by awarding research grants and competitive scholarships at PhD, Master's and first degree levels;
- ▶ strides made in conducting cotton confined field trials, with support from the US Program for Biosafety Systems, Monsanto and LUANAR;
- ▶ introduction of ethanol fuel as an alternative fuel to petrol and the adoption of ethanol technology, which is expected to be launched soon at national level; and
- ▶ a review of secondary school curricula to put more emphasis on SETI subjects.

The SETI policy cycle in Malawi





The term policy cycle refers to the recurrent pattern shown by procedures that ultimately lead to the creation of a public policy. The greatest advantage of the analytical model of the SETI policy cycle is that it facilitates an understanding of public policy-making by breaking down the complexity of the process into a limited number of stages and sub-stages, each of which can be investigated alone, or in terms of its relationship to any or all of the other stages of the cycle. This also allows for an examination of the role played by all actors and institutions dealing with SETI policies, rather than solely those governmental agencies formally charged with the task. The GO→SPIN methodological approach divides the SETI policy cycle into five different stages. Here are the working definitions provided for the survey:

- I. **Agenda-setting:** refers to the process by which problems involving SETI and its relation to society and the economy come to the attention of the government. Agenda setting is also a socially constructed process, in which actors and institutions, influenced by their respective ideologies, play a fundamental role in determining which problems or issues require government action (Howlett and Ramesh, 2003).
- II. **Policy formulation:** refers to the process by which SETI policy options are formulated by the government. Policy formulation involves identifying and assessing possible solutions to policy problems, weighing the pros and cons, and deciding which should be accepted and which rejected. The relationship between the government and social actors thus exerts a significant influence on the formulation of public policies.
- III. **Decision-making:** refers to the process by which governments adopt a particular course of action or non-action.
- IV. **Policy implementation:** refers to the process by which governments put SETI policies into effect. This is when a decision is carried out through the application of government directives and is confronted with reality.
- V. **Policy evaluation:** refers to the process by which the impact of SETI policies are monitored by both state and societal actors, the result of which may be a re-conceptualisation of policy problems and solutions.

THE SETI POLICY CYCLE IN MALAWI

Agenda setting: the National Development Agenda, which embraces SETI, is set by the government, usually under leadership of the Ministry of Economic Planning and Development.

Policy formulation: in Malawi, SETI policy formulation is usually a consultative process led by the Department of Science and Technology within the Ministry of Education, Science and Technology. Owing to the cross-cutting nature of research, innovation and scientific and technological services, other line ministries contribute to the formulation of the national SETI policy, such as the: Ministry of Agriculture, Irrigation and Water Development; Ministry of Health; Ministry of Trade and Industry; Ministry of Finance and Economic Development; Ministry of Natural Resources, Energy and Mining and; Ministry of Information, Tourism and Civic Education. The National Commission for Science and Technology is responsible for formulating the SETI strategic plan.

Decision-making: it is normal practice for a policy to be reviewed at different levels before adoption. Responsibility falls to the government to ensure that a policy addresses the challenges faced by the population. The Ministry of Education, Science and Technology, which is responsible for SETI, ensures that independent reviewers of the policy have contributed to the development process, after which time policy-makers may adopt the policy. The Cabinet is responsible for the overall decision-making process.

Policy implementation: implementation covers research and innovation and the provision of scientific and technological services by the appropriate units. Owing to the cross-cutting nature of SETI activities, the implementation plans are the responsibility of the line ministries, such as the: Ministry of Education Science and Technology; Ministry of Agriculture, Irrigation and Water Development; Ministry of Health; Ministry of Trade and Industry, Ministry of Finance and Economic Development; Ministry of Natural Resources, Energy and Mining and; Ministry of Information, Tourism and Civic Education.

Policy evaluation: monitoring and evaluation of policy implementation is done by the policy unit of the Office of the President and Cabinet (OPC). It is proposed that, for greater efficiency, an ad hoc committee be established by the OPC which would report to the policy unit on implementation of the SETI policy and its instruments. Such an ad hoc committee should be set up by the Ministry of Education, Science and Technology.

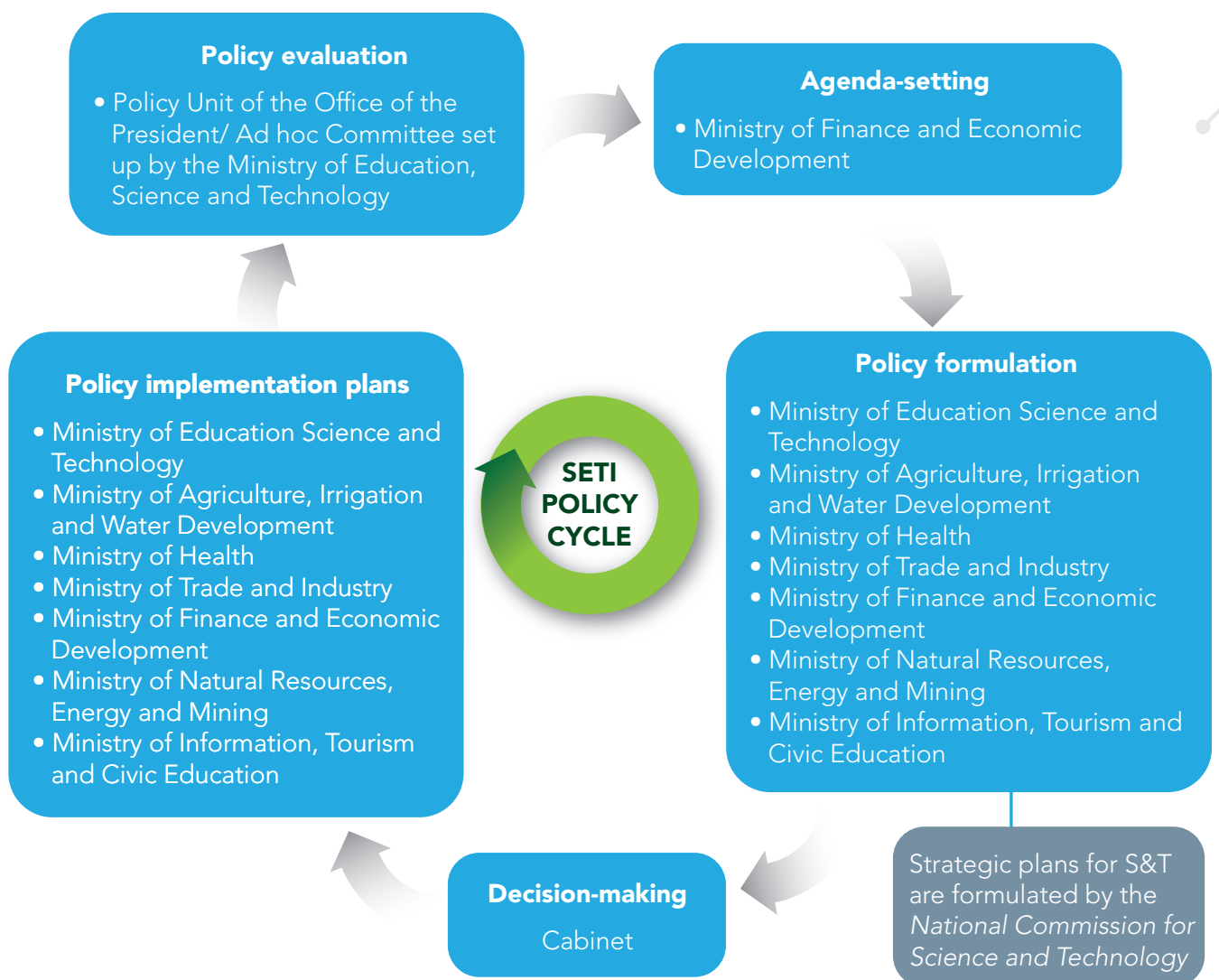



Figure 31: SETI policy cycle in Malawi, 2014. Source: UNESCO

The analytical content of Malawi's SETI policy



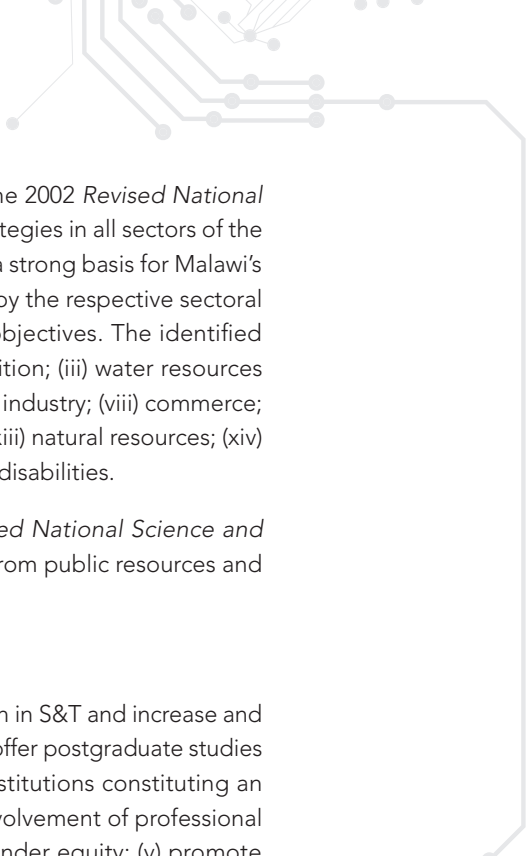


This section analyses the formal content of the *2002 Revised National Science, Technology and Innovation Policy*, in accordance with the methodological approach of the GO→SPIN survey, which has been designed to allow for international comparisons of the SETI policies adopted by different countries.

All the statements in the pages that follow have been reproduced from the official policy document (Government of Malawi, 2002) but are organized hereafter according to the 14 standard fields proposed in the GO→SPIN survey. Some of these fields may be left vacant, owing to the fact that the explicit policy does not take particular items into account.

ANALYTICAL CONTENT OF THE 2002 REVISED NATIONAL SCIENCE AND TECHNOLOGY POLICY

- I. **Policy vision:** n/a
- II. **Policy mission:** the overall goal of the *National Science and Technology Policy* is to attain sustainable socio-economic development through the development and application of S&T in order to improve the standard of living and quality of life of Malawians.
- III. **Policy goals:** to (a) establish and strengthen national capacity to research, evaluate, select, acquire, adapt, develop, generate apply, and disseminate technologies; (b) develop and raise the national productive capacity and improve competitiveness through the efficient application of technologies; (c) promote and develop traditional, endogenous, new and innovative technologies and; (d) create knowledge and S&T awareness to improve and develop the scientific and technological culture of Malawians.
- IV. **Policy objectives:** to (a) build national capacity to integrate S&T into national development programme planning and implementation; (b) improve the allocation and availability of financial, human and physical resources to S&T institutions; (c) enhance multidisciplinary R&D programmes through the establishment and strengthening of multidisciplinary research-oriented R&D institutions and programmes; (d) strengthen S&T education at all levels; (e) promote sustainable human development through the sound management of the environment; (f) promote an S&T culture; (g) promote the role of information and communication technologies in the development of an information-based society; (h) promote the development and application of S&T for economic growth and diversification, competitiveness and employment creation and; (i) promote the participation of all Malawians in the development and application of S&T, with special emphasis on women, youth and other special interest groups.
- V. **Priorities at the strategic level of the SETI policy:**
 - ▶ *Biotechnology and biosafety:* (i) establish and strengthen centres of excellence in specific areas of biotechnology; (ii) increase awareness of biotechnology and its potential impact on socio-economic development through demonstration and training centres; (iii) intensify the development of the human resource capability in biotechnology; (iv) establish a national programme of action for the promotion and adoption of biotechnology; (iv) establish capacity to monitor and evaluate biosafety issues in the economy and; (v) establish a programme for international co-operation in biotechnology.
 - ▶ *Information and communication technologies (ICTs):* (i) encourage and promote the establishment of electronics industries; (ii) enhance the use of such technologies in the social sector through the use of satellite-based information exchange systems and remote sensing; (iii) strengthen national focal points for issues related to ICTs and; (iv) promote the development and regular review of an ICT policy that would guide developments in the sub-sector.

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- ▶ *Sectoral priorities*: in order to take effect, the specific objectives of the 2002 *Revised National Science and Technology Policy* related to the policy objectives and strategies in all sectors of the economy. The implementation of specific sectoral strategies provides a strong basis for Malawi's overall S&T strategy. Sectoral priorities would have to be determined by the respective sectoral agencies, provided they are consistent with the overall S&T policy objectives. The identified sectors¹⁸ are: (i) education and training; (ii) agriculture, food and nutrition; (iii) water resources and sanitation; (iv) irrigation; (v) health and population; (vi) energy; (vii) industry; (viii) commerce; (ix) environment; (x) construction; (xi) communications; (xii) transport; (xiii) natural resources; (xiv) urban and rural planning; (xv) defense; (xvi) internal security and; (xvii) disabilities.

VI. **Normative planning strategies of the policy**: (a) under the 2002 *Revised National Science and Technology Policy*, Malawi will allocate not less than 1.0% of GDP to R&D from public resources and provide adequate funding for S&T by 2005.

VII. **Policies related to the supply of SETI**:

- a. *Human resources development in S&T*: (i) strengthen university education in S&T and increase and diversify postgraduate training programmes; (ii) ensure that universities offer postgraduate studies leading to MSc degrees and PhDs on an ongoing basis; (iii) create institutions constituting an interdisciplinary bridge between different faculties; (iv) promote the involvement of professional institutions in the training of S&T human resources while ensuring gender equity; (v) promote an integrated, demand-driven, competency-based modular technical, entrepreneurial and vocational education and training system; (vi) monitor gaps between the supply of, and demand for, technically skilled human resources; (vii) ensure the retention of S&T human resources in Malawi and; (viii) undertake national surveys of S&T human resources at regular intervals in order to establish a national inventory as a basis for developing human resources in all S&T fields.
- b. *Incentives, motivation and use of local expertise*: (i) revive the Malawi Award for Scientific and Technological Achievement, diversify the range of awards in order to open it up to more recipients and ensure that the recompense is awarded annually; (ii) introduce new awards to complement the Malawi Award for Science and Technological Achievement, such as an Outstanding Invention Award, Outstanding Entrepreneur Award and a Presidential Award, in order to promote innovation; (iii) provide an administrative system that enables local scientists who develop specific technological applications to benefit directly from the fruits of their invention through the payment of royalties; (iv) encourage and fund the participation of S&T personnel in local and international S&T fora; (v) continue and entrench the use of local personnel in consultancy services; (vi) encourage young people in the education system to be innovative by increasing their exposure to national development problems and making the science syllabi more relevant to Malawi; (vii) establish inventors' societies, based on interest groups, in educational and R&D institutions and; (viii) re-introduce The Most Innovative Stand at the Malawi International Trade Fair.
- c. *Basic and applied research*: (i) enhance stakeholder participation in identifying areas for technological research and development and in planning the implementation of specific R&D programmes; (ii) develop innovative methods for ensuring adequate funding for R&D, with a primary focus on technological research without neglecting scientific research; (iii) promote private sector funding of R&D through the provision of specific incentives; (iv) develop scientific disciplines in the university system that would lead to the establishment of journals specific to those disciplines, such as a Malawi Journal of Chemistry and; (v) establish and strengthen professional associations and societies to enhance discipline-oriented R&D.
- d. *Science and Technology Fund*: in order to raise and allocate sufficient funds for S&T, the Government of Malawi will establish a Science and Technology Fund via an act of Parliament (see page 168). The sources of income for the fund will include: (i) such sums as may be appropriated by Parliament, aiming at these representing not less than 1% of GDP for the previous government fiscal year; (ii) levies and an appropriate cess on the sale of S&T products and services;

18 The 2002 *Revised National Science and Technology Policy* proposes a detailed set of strategies and priorities for each sector of the economy (see Government of Malawi, 2002).

- (iii) any sums or properties as may, in any manner, become payable to, or vested in, the fund by virtue of the operation of any law or as a result of its administration and; (iv) any sums of money donated to the fund by any person, body or institution.
- e. *Foreign funding of research, science and technology:* foreign funds represent an essential source of financing of R&D and S&T in Malawi. The higher than normal international collaboration in R&D also means a high level of foreign funds for R&D. While this will continue to be encouraged, the government should provide adequate funding for the execution of critical programmes. In order to ensure that this policy objective is attained, a matching grant mechanism will be established and allocated from the Science and Technology Fund (see page 188).
- f. *Endowment and trust funds:* in order to expand the sources of funds for S&T, the government will establish endowment and trust funds. The Trustees Incorporation Act (Cap 5:03) already provides the legal framework for the establishment of endowment and trust funds which sector-specific S&T institutions may use for this purpose.
- g. *University funding:* Universities carry out most of the R&D in a wide range of socio-economic disciplines. Presently, there is no separate funding mechanism for R&D work done in Malawi's universities. The universities themselves allocate some of their subvention to R&D, besides that reserved for teaching services and running costs. This means that there can never be adequate funds for R&D, since the bulk of what is given has to support the entire administration of the institution. In order to promote university R&D, the government will provide separate funds through the National Commission for Science and Technology, under a dual support system for R&D done by universities and other institutions.

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BOX 10 – PROMOTING WOMEN’S PARTICIPATION IN THE DEVELOPMENT AND UTILIZATION OF SCIENCE AND TECHNOLOGY IN MALAWI

The 2002 *Revised National Science and Technology Policy* of Malawi established specific mechanisms for promoting the participation of women and indigenous minorities in the development and utilization of science and technology. The latest population statistics (see Table 1) indicate that 51% of Malawi’s population is female, yet the participation in, and utilization of, S&T by women has not received the attention it deserves: women still make up approximately 20% of S&T personnel. Few women are motivated to study S&T subjects at the secondary and tertiary levels of the education system. Nor does the development and transfer of technology often focus on the needs of women.

Notwithstanding this, the *Revised National Science and Technology Policy* noted that, according to the World Summit for Social Development (1995), the participation of women in the labour market and their equal access to employment required, among other actions, improving women’s access to technologies that facilitate their occupational and domestic work, encourage self-support, generate income, transform gender-prescribed roles within the productive process and enable them to move out of stereo-typed, low-paying jobs.

The *Revised National Science and Technology Policy* of Malawi proposed adopting strategies that foster the participation of women in the development and utilization of S&T by taking action to: (i) encourage research into all forms of gender differentiation in S&T education and employment; (ii) promote women’s access to S&T education at all levels; (iii) foster gender equity in S&T in education and the workplace; (iv) facilitate the entry of women into employment in S&T fields and their career advancement and; (v) foster socially responsible, gender-inclusive S&T.

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VIII. Policies related to demand for SETI:

- a. *Extension, diffusion and commercialization of technologies:* (i) promote government subcontracting of technology extension, diffusion and commercialization services to local S&T institutions; (ii) encourage tripartite research designed to bring together the research efforts of R&D institutions, industry and the government; (iii) provide assistance for project feasibility studies, engineering consultancy and design services and; (iv) establish venture capital funds to promote the commercialization of technology.
- b. *Role of the private sector:* (i) establish legislation that makes private sector investment in local S&T development tax deductible; (ii) encourage the private sector to support skills training under the Technical, Entrepreneurial and Vocational Education and Training Authority (see page 168); (iii) encourage the private sector to subcontract to local S&T institutions and researchers their technology and research development programmes and; (iv) invite the private sector to contribute to the development of S&T policies and strategies so that it influences the application of S&T in national socio-economic development.
- c. *Intellectual property rights:* (i) set up sound and user-friendly patent information services that would readily exploit patents as a source of technological information for the benefit of the economy; (ii) encourage and follow up the review of intellectual property legislation in Malawi to make it consistent with international practice; (iii) encourage the establishment of a Malawi Association of Inventors to enhance interaction between Malawian inventors and inventors in other countries; (iv) train staff from selected R&D institutions in the use of the international patent classification, in general, and the use of patents as sources of technological information, in particular and; (v) enhance collaboration with regional and international patent offices.
- d. *Competitiveness and productivity:* (i) create fora for interaction between the productive system, on the one hand, and the scientific, technological, educational and training systems, on the other; to promote productivity and innovation through diffusion and training programmes; (ii) create fora for interaction between the productive system, on the one hand, and the financial and administrative systems, on the other, to provide financial support and regulatory incentives for innovative ventures; (iii) develop human resources and establish and strengthen institutional structures that promote productivity and innovation and; (iv) establish institutional capability for technology monitoring and forecasting at the enterprise level in order to support technology management activities like diagnosis, evaluation and development of enterprise-specific strategies and projects.
- e. *Private sector funding:* private sector funding for S&T, especially funding for technological research and development, will be encouraged. Linkages between the private sector and R&D institutions, through contract research programmes for example, will complement public funding of R&D programmes and, thereby, improve Malawi's R&D capacity.

IX. Policies to foster networking between the SETI supply and demand sides:

- a. *Technology development and transfer:* (i) assess Malawi's needs and capabilities based on its S&T state-of-the-art and national resource endowment (human, material and institutional) and integrate specific S&T components into socio-economic development planning; (ii) monitor imported technology by establishing national capability to screen technology agreements, search and select imported technology, negotiate, bargain and acquire the technology; adapt the technology and; assimilate and diffuse the technology; (iii) foster selective development of endogenous S&T capacity in order to undertake or promote the assessment of S&T needs and their prioritization; (iv) promote innovation at the firm level, including development of indigenous S&T and the introduction of new products and processes, and encourage the conduct of R&D and commercialization of the R&D results at the enterprise level; (v) promote S&T activities in such areas as design and manufacturing, engineering services and; diffusion of indigenous technologies and; (vi) provide adequate S&T services such as information, standardization and certification, quality management and venture capital financing.

- b. *Popularization and utilization of science and technology*: (i) promote increased coverage by the popular media of R&D and S&T activities in Malawi; (ii) encourage local scientists and technologists to publish results of their research work in local journals whose publication would be supported by Government; (iii) establish within the context of the Malawi Business Council or other appropriate mechanisms, a national S&T colloquium which will be presided over by the State President or Vice-President; and (iv) strengthen S&T programmes in the education system.
 - c. *Co-operation, collaboration and networking*: (i) promote the establishment of professional associations like the Malawi Academy of Sciences; (ii) establish a research funding mechanism that fosters and encourages collaboration and networking among local researchers; (iii) evaluate and maximize benefits from Malawi's membership to regional and international groupings that promote co-ordination and integration in science and technology and; (iv) encourage the establishment of, and strengthen, mechanisms that promote collaboration and networking in R&D.
- X. **Regional and international dimensions of SETI policies**: (a) *international conventions, protocols and agreements*: (i) establish a national consensus on all international conventions, protocols, and agreements before ratification by consulting expert opinion; (ii) create national awareness of the international conventions, protocols and agreements in the fields of science and technology to which Malawi has already acceded and those that to which it will accede in the future and; (iii) establish practical mechanisms to ensure that Malawi benefits from the international conventions, protocols and agreements already in force.
- XI. **Monitoring, assessment, technological forecasting and prospective scenarios**:
- XII. **SETI policy start date**: 2002
- XIII. **Timespan for SETI policy planning**: 2002 onwards
- XIV. **Link**: www.sdn.org.mw/nstp/index.htm

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BOX 11 – FURTHER ANCHORING INDIGENOUS KNOWLEDGE SYSTEMS IN MALAWI'S RESEARCH AND INNOVATION POLICIES

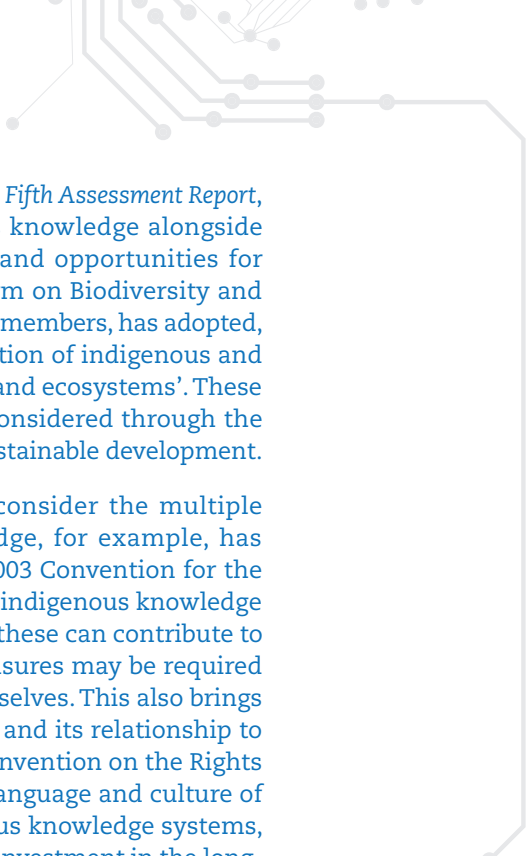
Local communities in Malawi have always maintained traditional systems and indigenous knowledge for the benefit of local people. Malawi is therefore encouraging the utilization of traditional knowledge and preservation of culture and heritage sites, while promoting cultural industries such as the music industry and expression of folklore as ways of fostering economic growth.

International recognition of the importance of indigenous and local knowledge was triggered by the 1992 Convention on Biological Diversity and its well-known article 8(j):

'respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices.'

Over the past few decades, governments have addressed the issues of knowledge access and benefit sharing, including through the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (2010). Negotiations relating specifically to intellectual property continue through WIPO's Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore.

Growing attention is also being paid to the wider application of indigenous knowledge systems, as well as to its multiple dimensions. Beyond its contribution to identifying valuable genetic resources with applications in health, agriculture or industry, indigenous knowledge has gained growing recognition in such diverse fields as renewable resources, wildlife or fisheries management, natural disaster preparedness and response, environmental impact assessment and climate change assessment and adaptation. Recently, for example, the Intergovernmental



Panel of Experts on Climate Change (IPCC) has encouraged authors of the *Fifth Assessment Report*, published in three volumes in 2013 and 2014, to consider indigenous knowledge alongside scientific knowledge when assessing the impact of climate change and opportunities for adaptation. Similarly, the newly established Intergovernmental Platform on Biodiversity and Ecosystems Services (IPBES)¹⁹, which counts Malawi among its current 118 members, has adopted, as one of its founding principles, to ‘recognize and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems’. These emerging fields of relevance to indigenous knowledge might also be considered through the development of an indigenous knowledge systems policy for Malawi’s sustainable development.

Such a policy might also provide Malawi with the opportunity to consider the multiple dimensions of indigenous knowledge systems. Indigenous knowledge, for example, has gained specific recognition for its heritage values through UNESCO’s 2003 Convention for the Safeguarding of Intangible Cultural Heritage. Recognition of the value of indigenous knowledge systems should be accompanied by a long-term vision not only of what these can contribute to Malawi’s sustainable development but also by a reflection on what measures may be required to ensure the long-term vitality of indigenous knowledge systems themselves. This also brings to the fore the issue of the continuing transmission of such knowledge and its relationship to education systems, both non-formal and formal. The United Nations Convention on the Rights of the Child underlines the importance of education that respects the language and culture of indigenous children. Ensuring the longevity and dynamism of indigenous knowledge systems, including through intercultural and mother tongue education, is also an investment in the long-term opportunities that these systems can bring Malawian society.

The importance of traditional knowledge is recognized by the *United Nations Declaration on the Rights of Indigenous Peoples* (2007), adapted to the African context through the deliberations of the African Court of Human Rights, which provides a holistic framework for an enlarged and multidimensional vision of indigenous knowledge systems that can bring long-term benefits to Malawi. It is also recognized by the *Swakopmund Protocol on the Protection of Traditional Knowledge and Expressions of Folklore* (see page 79).

The 2002 *Revised National Science and Technology Policy* recognizes that, although there are conflicts between cultural beliefs and scientific challenges, a lot can be gained from the indigenous knowledge systems and technologies embedded in Malawi’s culture. The indigenous knowledge base in traditional medicine, for example, needs to be understood, preserved, further developed and protected for the benefit of the country.

Intellectual property rights legislation systems, which cover the body of knowledge that may generally be classified as ‘Western’, are weak at protecting indigenous knowledge because it is owned collectively by extended families, clans and communities and because substantial parts of indigenous knowledge are transmitted orally. This tacit and embedded knowledge needs specialized nurturing and protection. Developments in the fields of broadcasting, cinematography, television and others can easily lead to improper exploitation of the cultural heritage of a nation without due respect to the economic interests of the communities from which it originates.

Consequently, Malawi’s *National Science and Technology Policy* will provide for the identification, development and protection of the indigenous knowledge system. The strategies for achieving this will include taking action to: (i) commission studies into indigenous knowledge systems, in order to identify, isolate and document this knowledge; (ii) promote training in indigenous knowledge systems; (iii) promote indigenous knowledge which is known and proven through its dissemination and commercialization; (iv) establish appropriate incentives that promote the generation and utilization of indigenous knowledge and; (v) develop appropriate legislation that protects the rights of origin of indigenous knowledge systems and national genetic resources.

Source: Government of Malawi (2002) and UNESCO’s Local and Indigenous Knowledge Systems (LINKS) programme

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19 Based in Bonn, Germany, IPBES was formally established in 2012 and is co-sponsored by UNEP, UNDP, UNESCO and FAO. See <http://ipbes.net>



BOX 12 – UNESCO’S REVIEW OF STI POLICY IN MALAWI, 2008–2014

UNESCO’s Division of Science Policy and Capacity-Building has been collaborating with the Government of Malawi since 2008 through the Spanish Fiduciary Fund allocated to the project for Capacity-Building in STI Policy in Africa.

In May 2008, the Malawi National Commission for UNESCO made an official request to UNESCO for technical assistance in reviewing its 2002 *Revised National Science and Technology Policy* and its *Strategic Plan*, in order to align them with the *Malawi Growth and Development Strategy 2006–2011*.

In September 2008, UNESCO ran a first sub-regional workshop for all SADC countries on STI policies and indicators, in collaboration with the African Union Commission. The workshop was hosted by the Botswana Ministry of Communication, Science and Technology and moderated by UNESCO staff, including specialists from the UNESCO Institute for Statistics. Malawi’s presentation to the workshop on the status of its review of the national STI system served as the basis for defining a roadmap for co-operation during a bilateral meeting with UNESCO.

In keeping with this roadmap, in November 2008, the Director of the UNESCO cluster office in Harare established a contract with the Malawi National Commission for UNESCO and the Department of Science and Technology of the Ministry of Education, Science and Technology for partial funding of the review of the national STI policy. The first stage in this review was the preparation of a status report on the national STI system, in co-operation with national experts and the Centre for Environmental Policy and Advocacy. The report served to define the main issues to be addressed in the revised policy.

After being revised by UNESCO staff, the STI status report and draft policy were presented to a national consultative workshop in March 2009. Research institutions, academia, users associations, parliamentary staff and line ministries were all present. Staff from UNESCO participated, providing technical input that was ultimately incorporated, along with the workshop’s recommendations, in a final draft produced in November 2009.

That same year, Malawi’s National Commission for Science and Technology was established. The Commission Secretariat grew out of a merger between the Department of Science and Technology (DST) and the National Research Council of Malawi (NRCM), thereby taking over the functions of both. Based on the previous work accomplished by the DST and UNESCO, the new Secretariat of the National Commission for Science and Technology began reviewing the national *Strategic Plan for STI (2011–2015)* in 2010. The *Strategic Plan* is currently being implemented but the revised policy, submitted to the Cabinet in 2011, is yet to be approved.

The *Strategic Plan* constitutes the roadmap for implementation of science and technology programmes in Malawi over a five-year period. The *Strategic Plan* identifies eight key issues, namely:

- ▶ Research and Development;
- ▶ Information and Knowledge Management;
- ▶ Innovation, Technology Transfer and Commercialization;
- ▶ Networking, Partnerships and Collaboration;
- ▶ Science, Technology and Innovation Regulatory Framework;
- ▶ Human Resource Development and Retention;
- ▶ Infrastructure and Resource Mobilization;
- ▶ Planning, Monitoring and Evaluation.

In Harare From 7 to 8 November 2012, UNESCO organized a first subregional workshop on surveys of STI policy, policy instruments, governing bodies and indicators, in co-operation with the African Observatory of STI (AOSTI), UNESCO Institute for Statistics, AU-NEPAD and the Ministry of Science, Technology and Development of Zimbabwe. The workshop contributed to the SADC objective of strengthening national capacities in the subregion in the design, planning, monitoring and evaluation of STI policies. All five participating countries – Botswana, Malawi, Mozambique, Zambia and Zimbabwe – expressed interest in mapping research and innovation in their respective countries, as a contribution to UNESCO’s Global Observatory of STI Policy Instruments (GO→SPIN).

During bilateral discussions with UNESCO in Harare at the time of the workshop, the delegation from Malawi raised the issue of revising the 2002 *Revised National Science and Technology Policy* and 2003 Science and Technology Act, describing this review as a top priority. It was considered that the preparation of a GO→SPIN country profile would provide a timely diagnosis of the situation in Malawi, informing the review process.

Subsequently, UNESCO worked with the national team in Malawi to prepare the present GO→SPIN profile, which was completed in 2014. UNESCO expert Guillermo Lemarchand completed two missions to Malawi in 2014 to finalize the government input to the GO→SPIN survey and gather complementary information and data. *Mapping Research and Innovation in the Republic of Malawi* was subsequently drafted at UNESCO headquarters in Paris, in liaison with the national team in Malawi, and published in September 2014.

Source: Juliana Chaves-Chaparro, Associate Project Officer in UNESCO’s Division of Science Policy and Capacity-Building



Participants in the workshop which finalized the input to the present GO→SPIN country profile of Malawi, in Lilongwe, Malawi, on 25–26 June 2014

UNESCO wishes to thank the Spanish Agency of International Co-operation for Development (AECID), as well as all national stakeholders, for their commitment to UNESCO’s activities in Malawi.



Analysis of the SETI organizational chart and flows in Malawi





The SETI organizational chart shows the distribution of responsibility for implementing a given policy. Under the term 'organisational chart', we may distinguish at least four different levels: (1) policy-planning level (policy design); (2) promotional level (funding); (3) performance level (scientific research, technological development and productive innovation); (4) science and technology services and (5) assessment or evaluation level.

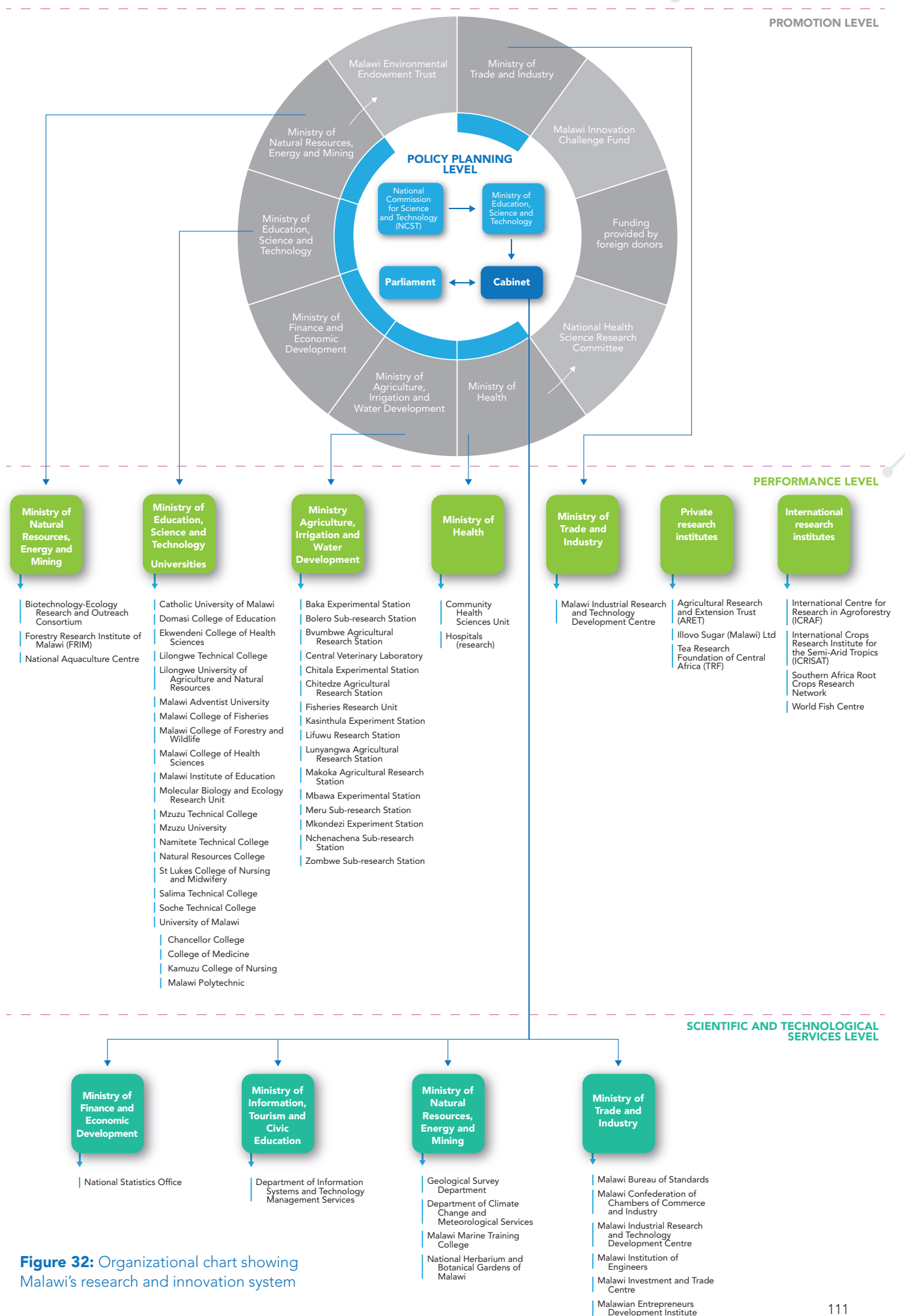
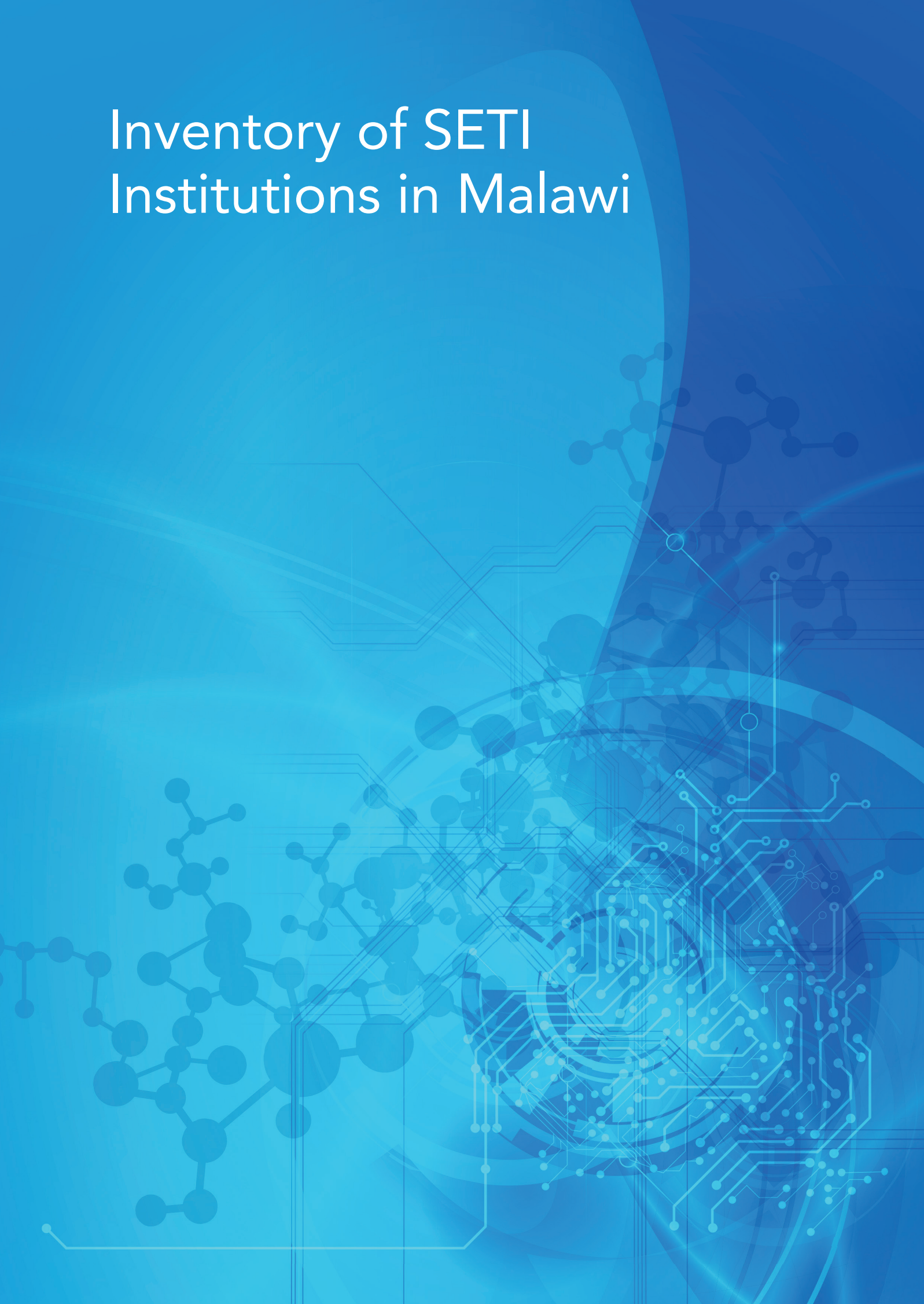


Figure 32: Organizational chart showing Malawi's research and innovation system

Inventory of SETI Institutions in Malawi



SETI GOVERNING BODIES IN MALAWI

NATIONAL COMMISSION FOR SCIENCE AND TECHNOLOGY

Address: Lingadzi Building, P/Bag B 303, Lilongwe 3, Malawi.

Telephone: +265 1771 550/+265 1774 869

Fax: +265 1772 431

E-mail Address: directorgeneral@ncst.mw

Website: www.ncst.mw

Executive Head: Mr Anthony Muyepa- Phiri

Established: 2009 by Science and Technology Act (2003) and the government **Gazette** of 2009.

Aims and responsibilities: the NCST is responsible for co-ordination, promotion, support and regulation in the implementation of SETI policies in order to achieve science- and technology-led development. The Commission reports to the Minister of Education, Science and Technology.

Priority level of the following functions

1. Planning / programming / budgeting of SETI activities: *high priority*
2. Promoting / financing co-ordination of SETI activities: *high priority*
3. Application / transfer / assessment of SETI activities: *high priority*
4. Advocacy of SETI activities: *high priority*
5. General policy advice: *high priority*

Network of relationship in the country: upstream linkage

Administrative entity specifically in charge of exchange of information with foreign organizations:
Director General

Preferred language: *English*

Frequency of professional contacts with the following organizations

1. Organizations of the UN system: regular professional contacts
2. Other intergovernmental organizations: regular professional contacts
3. International non- governmental organizations: regular contacts
4. National SETI policy bodies in foreign countries: irregular contacts
5. Other institutions in foreign countries dealing with SETI policy studies: regular contacts

SETI policy-related publications of the organization

- i. Directory of Research institutions in Malawi
- ii. National Health Research agenda
- iii. NCST Strategic Plan 2011–2015
- iv. National Technology Inventory
- v. State of S&T in Malawi 2010 / 2011 report

Number of professional staff and gender distribution: 37, eight of whom are female

DEPARTMENT OF SCIENCE AND TECHNOLOGY

Address: Ministry of Education, Science and Technology, P/Bag 328, Lilongwe 3, Malawi.

Telephone: (265) 01770 060

Website: www.dst.mw

Executive Head (Director): Mr Patrick Mphadzula

Established: 2004 by Presidential Directive to Create a Department / Ministry

Aims and responsibilities: After establishing the NCST in 2009, the Government of Malawi maintained the Department of Science and Technology (DST) in the Ministry of Education, Science and Technology in 2010 to perform core government functions of which include the formulation and review of STI policies and legal frameworks. The DST is also a focal point for establishing and fostering international co-operation agreements in relation to STI.

Priority level of the following functions

1. Planning / programming / budgeting of SETI activities: high priority
2. Promoting / financing co-ordination of SETI activities: high priority
3. Application / transfer / assessment of SETI activities: high priority
4. Advocacy of SETI activities: high priority
5. General policy advice: high priority

Network of relationship in the country: upstream linkage

Administrative entity specifically in charge of exchange of information with foreign organizations:
Director

Preferred language: English

Frequency of professional contacts with the following organizations

1. Organizations of the UN system: regular professional contacts
2. Other intergovernmental organizations: regular professional contacts
3. International non- governmental organizations: regular contacts
4. National SETI policy bodies in foreign countries: regular contacts
5. Other institutions in foreign countries dealing with SETI policy studies: regular contacts

SETI policy-related publications of the organization

African Science Technology and Innovation Indicators Report for Malawi 2010

Number of professional staff and gender distribution: ten, three of whom are female



Ministry of Agriculture, Irrigation and Water Development

BAKA EXPERIMENTAL STATION

Address: P.O. Box 97, Karonga

Telephone: +265 1362 300/+265 1362 235

Fax: +265 1362 235

Type: research Institution

Title of Head: Officer-In-Charge

Name of Head: Kanyika, W.A.

Mandate: to conduct research and develop technologies on groundnuts, horticulture, cereals and other grain legumes

Senior Administrative Staff: one Master's degree

Scientists: one Master's degree

Publications: Station guides produced during field days

BOLERO SUB-RESEARCH STATION

Address: P.O. Box 46, Rumphu

Telephone: +265 999126777

Type: research Institution

Title of Head: Officer-In-Charge

Name of Head: Kaonga, M.S.

Mandate: to conduct demand-driven research on cereals, root and tuber crops

BVUMBWE AGRICULTURAL RESEARCH STATION

Address: P.O. Box 5748, Limbe

Telephone: +265 1471 334/+265 1471207

Fax: +265 1471 323

E-mail Address: d.dars@bvumbweresearch.com

Type: research Institution

Title of Head: Deputy Director of Agricultural Research Services

Name of Head: Chilanga, T.

Mandate: to conduct basic and applied agricultural research in order to improve agricultural productivity

Senior Administrative Staff: one PhD, five Master's degrees, one diploma and one Cambridge certificate

Scientists: one PhD, seven Master's degrees and five Bachelor's degrees

Publications: annual reports; quarterly reports; research circulars/ extension circulars; training manuals; station guides

CENTRAL VETERINARY LABORATORY

Address: P.O. Box 527, Lilongwe

Telephone: +2651766341/+2651766351/+2651766352/+265 1766188/+2651766349

Fax: +265 1766357/+ 265 1766311

E-mail Address: centralvetlab@malawi.net

Type: research and diagnostics

Title of Head: Deputy Director (Research and Investigation)

Name of Head: Chikungwa, P. (PhD)

Mandate: To provide animal disease diagnostic investigation and research services

Senior Administrative Staff: one PhD, four Masters degrees and two Bachelor's degrees

Scientists: one PhD, five Master's degrees, two Bachelor's degrees and five diplomas

CHITALA EXPERIMENTAL STATION

Address: P.O. Box 315, Salima

Telephone: +265 1902343

Fax: +265 1902343

E-mail Address: chitalaresearch@globemw.net

Type: research Institution

Title of Head: The Station Manager

Name of Head: Chafika, K.M.

Mandate: to conduct research work mainly on annual crops and livestock (cattle and goats)

Senior Administrative Staff: one Master's degree and two diplomas

Scientists: one Master's degree and ten diplomas

Publications: station guides; annual reports; quarterly reports

CHITEDZE AGRICULTURAL RESEARCH STATION

Address: P.O. Box 158, Lilongwe

Telephone: +265 1707222

Fax: +265 1707041


E-mail Address: agric-research@sdpn.org.mw

Website: www.dars.gov.mw

Type: research Institution

Title of Head: Deputy Director of Agricultural Research Services

Name of Head: Maideni, F. (PhD)



Mandate: to conduct applied and production-oriented research on crops, livestock, soil and farm machinery, provide professional advisory technical services to farmers in different agricultural and related fields. Develop improved and sustainable farming systems and to assist in the dissemination of agricultural technologies through workshops, meetings, newsletters, extension circulars and field days

Senior Administrative Staff: four PhDs and one Master's degree

Scientists: five PhDs, 16 Master's degrees and 12 Bachelor's degrees

Publications: quarterly reports and annual reports; station guide produced during field days

FISHERIES RESEARCH UNIT

Address: PO Box 27, Monkey Bay

Telephone: +265 1587596

Fax: +265 1587249

E-mail Address: fru@sdpn.org.mw

Type: research, training, and service institution

Title of Head: Chief Fisheries Research Officer

Name of Head: Kanyerere, G.Z.

Mandate: to carry out research activities in all natural waters of Malawi for sustainable utilization and biodiversity conservation of endemic aquatic resources

Senior Administrative Staff: one Master's degree and one Bachelor's degree

Scientists: four Master's degrees, one Bachelor's degree and one diploma

Publications: *Fisheries Bulletin*; annual report

KASINTHULA EXPERIMENT STATION

Address: P.O. Box 28, Chikwawa

Telephone: +265 1 605 763/605757

E-mail Address: kasresearch@globemw.net

Website: www.agricresearch.sdpn.mw.org

Type: research Institution

Title of Head: Station Manager

Name of Head: Chipojola, F.

Mandate: to conduct applied technology development research in irrigation and drainage and agro-ecology trials in LEFOG, cereals and horticulture

Senior Administrative Staff: three Master's degrees

Scientists: four Master's degrees and three Bachelor's degrees

Publications: annual station guide produced during field days; annual scientific reports in irrigation and drainage research

LIFUWU RESEARCH STATION

Address: P.O. Box 102, Salima

Telephone: +265 1902295/+2651902189

Fax: +265 1263334

E-mail Address: lifuwu@malawi.net

Website: www.agricresearch.org.mw

Type: research Institution

Title of Head: Assistant Director of Agricultural Services

Name of Head: Mzengeza, T. (PhD)

Mandate: to conduct applied and demand-driven research in partnership with farmers in the areas of variety improvement, cultural practices and crop protection; to make available high quality seed to growers; to provide advisory and professional service to farmers and field days, extension contacts and publications; to provide support to other research institutions

Senior Administrative Staff: one PhD and one Master's degree

Scientists: one PhD, one Master's degree and two Bachelor's degrees

Publications: station guide produced annually; annual rice commodity team reports

LUNYANGWA AGRICULTURAL RESEARCH STATION

Address: PO Box 59, Mzuzu

Telephone: +265 1312962/+265 1310016

Fax: +265 1310687/+265 1310016

E-mail Address: lunyangwa@sdpn.org.mw

Type: research Institution

Title of Head: Deputy Director of Agricultural Research Services

Name of Head: Chikagwa-Malunga, S.K. (PhD)

Mandate: Conduct demand driven research on: Livestock and Pastures, Coffee, Root and Tuber Crops

Senior Administrative Staff: one PhD, two Master's degrees

Scientists: one PhD, two Master's degrees and four Bachelor's degrees

Publications: station guide produced during field days

MAKOKA AGRICULTURAL RESEARCH STATION

Address: P/Bag 3, Thondwe

Telephone: +265 1953060

E-mail Address: makoka.research@Yahoo.com

Type: research Institution

Title of Head: Assistant Director of Agricultural Research Services

Name of Head: Salipira, K.L.

Mandate: to carry out research/development of crop production technologies on cotton, legumes and (pigeon peas, cowpeas, soybeans and chickpeas), oil seeds (sunflower and sesame), root and tuber crops, (cassava and sweet potatoes) and agro-forestry

Senior Administrative Staff: one PhD, two Master's degrees, four Bachelor's degrees and one diploma

Scientists: one PhD, two Master's degrees, four Bachelor's degrees and one diploma

Publications: station guide produced during field days, extension circulars, cotton handbook and annual reports

MBAWA EXPERIMENTAL STATION

Address: P.O. Box 8, Embangweni

Telephone: +265 1348705

Fax: +265 1348705

Type: research Institution

Title of Head: Station Manager

Name of Head: Chanika, C.S.M.

Mandate: to conduct demand-driven research on livestock and pastures

Publications: station guide produced during field days and annual research progress reports

MERU SUB-RESEARCH STATION

Address: P.A. Misuku, PO Chitipa

Telephone: +265 99520793

Type: research Institution

Title of Head: Officer-In-Charge

Name of Head: Kabaghe, B.B.

Mandate: to conduct demand driven research on Horticulture and cereals

Senior Administrative Staff: one Master's degree

Scientists: one Master's degree

Publications: station guides

MKONDEZI EXPERIMENT STATION

Address: PO Box 133, Nkhata Bay

Telephone: +265 1352334/+265 1352317/+265 8781275

Fax: +265 1352334

Type: research Institution

Title of Head: Station Manager

Name of Head: Mwamlima, L.H.

Mandate: to carry out agro-ecological trials in Horticulture and Cereals

Senior Administrative Staff: one Bachelor's degree

Scientists: one Bachelor's degree

Publications: station guides

NCHENACHENA SUB-RESEARCH STATION

Address: P.A Nchenachena, PO Rumpi

Telephone: +265 995278135

Type: research Institution

Title of Head: Officer-In-Charge

Name of Head: Mwakikunga K.R.E.

Mandate: to conduct demand driven research on legumes, root and tuber crops

Senior Administrative Staff: one diploma

Scientists: one diploma

Publications: *Integrated Pest Management*

ZOMBWE SUB-RESEARCH STATION

Address: PO Box 59, Mzuzu

Telephone: +265 1935060/+265 1310633

Fax: +265 1312962

Type: research Institution

Title of Head: Officer-In-Charge

Name of Head: Nyirenda, J.R.

Mandate: to conduct demand-driven research on cereals, root and tuber crops



Ministry of Finance and Economic Development

NATIONAL STATISTICS OFFICE

Address: PO Box 333, Zomba

Telephone: +265 1524 377

Fax: +265 1525 130

E-mail Address: enquiries@statistics.gov.mw

Website: www.nso.malawi.net

Type: research Institution

Title of Head: Commissioner of Statistics

Name of Head: Machinjili, C.

Mandate: to provide timely, high quality and independent statistical information and promote its use in policy formulation, decision-making, research, transparency and general public awareness

Senior Administrative Staff: three Master's degrees

Scientists: 10 Master's degrees and 20 Bachelor's degrees

Publications: *Monthly Statistical Bulletin, Statistical Yearbook, Malawi in Figures, Statsflash and Quarterly Statistical Bulletin*

Ministry of Health

COMMUNITY HEALTH SCIENCES UNIT

Address: P/Bag 65, Lilongwe

Telephone: +265 1 757883

Type: service Institution

Title of Head: Officer-In-charge

Name of Head: Chilima, B. (PhD)

Mandate: to co-ordinate disease control programmes; to co-ordinate epidemiology and disease surveillance; to provide laboratory services to disease control, epidemiology and research institutions, NGOs, etc. and; to provide districts with training and supervision

Senior Administrative Staff: one PhD

Scientists: one PhD

Publications: annual report

NATIONAL HEALTH SCIENCE RESEARCH COMMITTEE

In 1988, the Ministry of Health established the Research Unit, the mandate of which is to promote and co-ordinate health research in Malawi. At the time, all health-related research proposals were reviewed and cleared by the National Health Sciences Research Committee (NHSRC), the secretariat of which was originally located at the former National Research Council of Malawi (NRCM).

The NHSRC, being subject to the rules and regulations that shall be set by government from time to time (Government of Malawi, 2007), shall have the following functions:

- a. advise government, including the Ministry of Health, on all scientific and ethical aspects of research pertaining to the health sciences;
- b. foster the rights and welfare of human subjects and review for clearance all research proposals with a health science content from prospective researchers, whatever their discipline. However, research involving members of the College of Medicine and Kamuzu College of Nursing and their collaborators shall be reviewed and authorized by the College of Medicine Research and Ethics Committee and shall be referred to the NHSRC only if national interests are at stake. Each committee shall keep the other informed by means of cross representation;
- c. offer guidance in relation to each research proposal, on the balance between the use of laboratories and expertise outside the country, and the import of techniques and equipment (including personnel) into the country;
- d. review and clear for publication all materials originating from studies approved by NHSRC;
- e. encourage and make recommendations to government on contacts among research scientists of varying capabilities and/or attachments to advanced research centres, within and outside Malawi, for the purpose of upgrading the available research pool and skills;
- f. enhance capacity-building and promote health research, especially among local professionals;
- g. ensure the proper collection, acquisition, dissemination, use, storage and management of research information;
- h. perform any function related to the protection of health.

Ministry of Information, Tourism and Civic Education

DEPARTMENT OF INFORMATION SYSTEMS AND TECHNOLOGY MANAGEMENT SERVICES

Address: P/Bag 338, Lilongwe 3

Telephone: +265 1759033

Fax: +265 1758 993

E-mail Address: distms@malawi.gov.mw

Website: www.malawi.gov.mw

Type: service and training institution

Title of Head: Principal Secretary

Name of Head: Ndilowe, H.O.

Mandate: To enhance information management in the public service

Senior Administrative Staff: five Master's degrees, eight Bachelor's degrees and three diplomas

Scientists: 11 Master's degrees and 50 Bachelor's degrees



Ministry of Natural Resources, Energy and Mining

BIOTECHNOLOGY–ECOLOGY RESEARCH AND OUTREACH CONSORTIUM

Address: P.O. Box 403, Zomba

Telephone: +265 1 582 682/+265 999877858

Fax: +265 1 582 682

Type: research and outreach institution

Title of Head: Executive Director

Name of Head: Changadeya, W. (PhD)

Mandate: to promote sustainable development through building capacity and risk mitigation of natural resources and modern biotechnology for the benefit of the Malawian citizen and to provide research and development services in the field of molecular biology, aquatic ecology and terrestrial

Senior Administrative Staff: one PhD

Scientists: one PhD and one diploma

Publications: biotechnology update published monthly

FORESTRY RESEARCH INSTITUTE OF MALAWI

Address: PO Box 270, Zomba

Telephone: +265 1524866

Fax: +265 1524548

Website: www.frim.org.mw

Type: research Institution

Title of Head: Deputy Director of Forestry (Research)

Name of Head: Chilima, C. (PhD)

Mandate: to conduct operational forestry research, generate usable technologies, and provide information for sustainable management, conservation and utilization of forest/trees and allied natural resources in order to contribute to improving the welfare of the people of Malawi

Senior Administrative Staff: one PhD and two Master's degrees

Scientists: one PhD, six Master's degrees and four Bachelor's degrees

Publications: FRIM newsletter produced three times a year; FRIM report; annual consolidated report; refereed journal articles; technical orders; research records; leaflets

GEOLOGICAL SURVEY DEPARTMENT

Address: P.O. Box 27, Zomba

Telephone: +265 1524166

Fax: +265 1524716

E-mail Address: gsdmalawi@gmail.com

Type: research Institution

Title of Head: Director

Name of Head: Kalindekafe, L.S.N. (PhD)

Mandate: to acquire, update, archive and disseminate all information on the geology and mineral resources of Malawi in order to foster mineral resources development

Senior Administrative Staff: one PhD and four Bachelor's degrees

Scientists: one PhD and 15 Bachelor's degrees

Publications: annual report of the Geological Survey Department; technical reports; geological bulletins (geochemical, geophysical); memoirs; geological maps (geochemical maps, geophysical maps); seismological bulletin

DEPARTMENT OF CLIMATE CHANGE AND METEOROLOGICAL SERVICES

Address: P.O. Box 1808, Blantyre

Telephone: +265 1822014

Fax: +265 1822215

E-mail Address: metdept@metmalawi.com

Website: www.metmalawi.com

Type: climate change and meteorological service

Title of Head: Director

Name of Head: Kamdonyo, D.R. (PhD)

Mandate: to provide reliable, responsive and high quality weather and climate services to meet national, regional and international obligations through timely dissemination of accurate and up to date data and information for socio-economic development of Malawi

Senior Administrative Staff: one PhD and one Master's degree

Scientists: one PhD, eight Master's degrees, one Bachelor's degree and 4 diplomas

Publications: 10-day rainfall and agromet bulletins; seasonal rainfall forecasts; rainfall normals; rainfall summaries; wind speed summaries; relative humidity summaries; evaporation summaries

MALAWI ENVIRONMENTAL ENDOWMENT TRUST

Address: 3 Joachim Chissano Road, Adindo House, PO Box 3053, Blantyre

Telephone: +265 1820303/+265 1822829/+265 1822930

Fax: +265 1820378

E-mail Address: meet@naturetrust.mw

Website: www.meet.org.mw

Type: service Institution

Title of Head: Chief Executive Officer

Name of Head: Nanthambwe, S.

Mandate: to enable all people to address the environmental challenge in Malawi

Senior Administrative Staff: one Master's degree and one Bachelor's degree

Scientists: three Master's degrees and one Bachelor's degree

Publications: *Grants Disbursement Policy, Grant Application Procedures, Grantee Manual and MEET 2010 – 2014 Strategic Plan*

MALAWI MARINE TRAINING COLLEGE

Address: Private Bag 1, Monkey Bay

Telephone: +265 587 500/+265 587 563

Fax: +265 587 206

E-mail Address: kamswanjo@ymail.com

Type: training institution

Title of Head: College Principal

Name of Head: Mhango, J.K.

Mandate: to train present and future marine and port operations officers to the highest level so that they may staff ships and operate ports safely, effectively and economically and to bring awareness to all those using and living around the waters of Malawi in the prevention of marine pollution and the preservation of the marine environment

Senior Administrative Staff: two Masters degrees, one Bachelor's degree and one advanced diploma

Scientists: three Master's degrees, two Bachelor's degrees, two diplomas and one Class Certificate of Competency in Marine Engineering

Publications: *Academic Handbook* produced annually

Departments:

▶ **Marine Engineering Department**

Mandate: to train marine engineering officers and crew who work on merchant, fishing and naval vessels in accordance with the requirements of the International Maritime Organization

Scientists: two Master's degrees, two Bachelor's degrees, one advanced diploma and one Class Certificate of Competency in Marine Engineering

► **Nautical Studies Department**

Mandate: to train nautical officers and crew who work on merchant, fishing and naval vessels in accordance with the requirements of the International Maritime Organization

Scientists: two Master's degrees, one advanced diploma and one Class Certificate of Competency in Marine Engineering

NATIONAL AQUACULTURE CENTRE

Address: PO Box 44, Domasi

Telephone: +265 1536 203/+265 999695203

Fax: +265 1536 203/+265 1536 460

E-mail Address: nac@sdpn.org.mw

Type: research Institution

Title of Head: Principal Fisheries Research Officer

Name of Head: Chirwa, B.B.

Mandate: co-ordinate and conduct highly-quality aquacultural research

Senior Administrative Staff: two Master's degree

Scientists: one PhD, three Master's degrees, one Bachelor's degree, one diploma and five certificates in fisheries

Publications: *Analysis of Feeds and Fertilizers for Sustainable Aquaculture Development in Malawi*; *National Aquaculture Sector Overview-Malawi* (FAO Online); *National Aquaculture Centre News*

NATIONAL HERBARIUM AND BOTANICAL GARDENS OF MALAWI

Address: P.O. Box 528, Zomba

Telephone: +265 1525 388/+265 1525 145/+265 1525 118

Fax: +265 1524 108

Type: training and research institution

Title of Head: Director General

Name of Head: Seyani, J.H. Prof. (PhD)

Mandate: to develop and maintain herbaria, botanic gardens and arboreta in Malawi; to study the flora and vegetation of Malawi and offer academic training and research in plant sciences

Senior Administrative Staff: two PhDs, one Master's degree and one Bachelor's degree

Scientists: four PhDs and three Master's degrees

Publications: vegetation surveys, reports, newsletters and annual reports

The National Herbarium and Botanic Gardens of Malawi (NHBG) is a para-statal botanical institution and the principal authority on botanical and related matters in the country. Its roots date back to 1891 when the first botanic garden was established in the city of Zomba and to 1930 when the first herbarium was established in the same city. The research activities of NHBG include taxonomic research, ethno-botanical surveys and vegetation surveys.



Ministry of Trade and Industry

MALAWI BUREAU OF STANDARDS

Address: P.O. Box 946, Blantyre

Telephone: +265 1870488

Fax: +265 1870756

E-mail Address: mbs@mbsmw.org

Website: www.mbsmw.org

Type: research and service institution

Title of Head: Director-General

Name of Head: Chokazinga, D.M.C.

Mandate: to provide standardization and certification services to industry, government and the public

Senior Administrative Staff: five Master's degree

Scientists: three Master's degrees and 17 Bachelor's degrees

Publications: quality newsletter and Malawi standards

MALAWI CONFEDERATION OF CHAMBERS OF COMMERCE AND INDUSTRY

Address: P.O. Box 258, Blantyre

Telephone: +265 1871988

Fax: +265 1871147

E-mail Address: mccci@mccci.org

Website: www.mccci.org

Type: service institution

Title of Head: Chief Executive

Name of Head: Kaferapanjira, C.L.

Mandate: Lobby for improved business environment and to provide premium services to the business community

Senior Administrative Staff: three Master's degrees and three Bachelor's degrees

Scientists: three Master's degrees and one Bachelor's degree

Publications: *Business Voice Magazine*; *Malawi Business Climate Survey Report*; monthly e-bulletins and trade and economic updates

MALAWI INDUSTRIAL RESEARCH AND TECHNOLOGY DEVELOPMENT CENTRE

Address: PO Box 357, Blantyre

Telephone: +265 1847845/+265 1847912

Fax: +265 1847844

E-mail Address: mirtdc@malawi.net

Type: industrial and scientific research institution

Title of Head: Director General

Name of Head: Chigwe, C.S.

Mandate: Conduct industrial and scientific research.

Senior Administrative Staff: four Masters degrees and one Bachelor's degree

Scientists: five Master's degrees and four Bachelor's degrees

Publications: technology update produced quarterly

The Malawi Industrial Research and Technology Development Centre (MIRTDC) is the only industrial research institute in the country. It was set up as a trust with a mandate to conduct industrial research and develop technologies for sustainable utilisation of natural resources by industry. Its programmes include, among others, the development of agricultural implements and machinery for cottage and light industries. As part of its activities, MIRTDC has developed a number of technologies to support the small-scale poultry industry, including a low cost electric egg incubator, feed mixing technologies, cages and brooders. It has also developed and disseminated improved beehive technology. At micro and rural enterprise level, MIRTDC is promoting solar driers that can be used for production of dried vegetables and fruit products. The major constraints of MIRTDC include the lack of appropriate office premises and workshop facilities, inadequate incentives to staff and limited financial base due to its over dependence on government and donor funding and a weak revenue generation capacity. The Centre has a staff level of about 10 professionals in different fields of expertise. There is a central facility as well as four technology dissemination satellite centres.

MALAWI INSTITUTION OF ENGINEERS

Address: P.O. Box 1193, Blantyre

Telephone: +265 1871615/+265 888873877

Fax: +265 1871615

E-mail Address: mw.engineers@gmail.com

Website: www.mie.mw

Type: service institution

Title of Head: Executive Secretary

Name of Head: Kalua, S.



Mandate: to serve as a platform and information centre on technological knowledge sharing for engineers and technicians practicing in Malawi

Senior Administrative Staff: two Bachelor's degrees and one certificate

Scientists: one PhD, two Master's degrees, one Bachelor's degree

Publications: newsletter issued quarterly

MALAWI INVESTMENT AND TRADE CENTRE

Address: Aquarius house, P/B 302, Lilongwe

Telephone: +265 1770 800/+265 1771 315

Fax: +265 1771 781

Email Address: mipa@mipamw.org

Website: www.malawi-invest.org

Type: service Institution

Title of Head: Chief Executive

Name of Head: Kumbemba, C.

Mandate: to promote and facilitate investments and trade in Malawi

Senior Administrative Staff: one Bachelor's degree

Scientists: one Bachelor's degree

Publications: *Trade Investors Magazine; MIPA Magazine*

MALAWIAN ENTREPRENEURS DEVELOPMENT INSTITUTE

Address: P/Bag 2, Mponela

Telephone: +265 286 244/+265 286 252/+265 286 263/+265 286 391

Fax: +265 286 412

E-mail Address medimw@yahoo.org

Website: www.medi.com

Type: training institution

Title of Head: Executive Director

Name of Head: Kazembe, C.C.

Mandate: to be the centre of excellence in the designing, developing and delivery of entrepreneurship and specific technical skill programmes and business consulting in Malawi

Senior Administrative Staff: two Master's degrees, one Bachelor's degree and one certificate

Scientists: four Master's degrees and two diplomas

Publications: newsletter

Departments: Entrepreneurship Department

Scientists: four Master's degrees and three diplomas

PRIVATE RESEARCH INSTITUTES

These include research institutes that have been set up by associations, or stakeholder groups, to perform research in specific areas or commodities (non-profit private research institutes). Funding is obtained from a levy imposed on sales of produce by farmers, with no direct government funding.

AGRICULTURAL RESEARCH AND EXTENSION TRUST

The Agricultural Research and Extension Trust (ARET) is a non-profit organization established in 1995 through a merger of the Tobacco Research Institute of Malawi with the Estate Extension Service Trust. ARET is funded and controlled by the Tobacco Association of Malawi (TAMA). Research is demand-driven, with the aim of developing improved technologies, such as varieties and production techniques that increase the production of high-quality tobacco (Beintema *et al.*, 2004). One of ARET's main roles is to produce and distribute high-quality tobacco seed, of which it is the only producer in the country. It also provides agronomic advice to smallholder farmers. ARET is funded by a 1% levy on gross proceeds at auction.

TEA RESEARCH FOUNDATION OF CENTRAL AFRICA

The Tea Research Foundation of Central Africa (TRF) is located in Malawi but conducts tea research for Malawi, Zimbabwe, South Africa and Zambia. The TRF is a non-profit organization, mainly funded by the Tea Associations of Malawi and Zimbabwe (Beintema *et al.*, 2004). Apart from conducting tea research, TRF also has coffee and other plantation crops in its portfolio. It was established in 1966 (Rooseboom and Pardey, 1993).

ILLOVO SUGAR (MALAWI) LTD

Illovo Sugar (Malawi) Ltd is part of the Illovo Sugar Group, a leading, global sugar producer and significant manufacturer of downstream products, with agricultural, manufacturing and other interests extending over six southern African countries. Until 2005, the organization was known as the Sugar Corporation of Malawi Limited (SUCOMA), a state-owned corporation. During its SUCOMA years, the organization had three researchers, who focused on sugar-related agronomic research and herbicide use (Beintema *et al.*, 2004).



INTERNATIONAL RESEARCH INSTITUTES

These are international research organizations that have established centres in Malawi. Key organizations are the World Fish Centre, the International Centre for Research in Agroforestry, the International Crops Research Institute for the Semi-Arid Tropics and the Southern Africa Root Crops Research Network.

WORLD FISH CENTRE

The World Fish Centre is an autonomous non-profit international scientific organization, with its headquarters in Penang, Malaysia. In 1987, the centre established an aquaculture project office at the National Aquaculture Centre in Domasi, Malawi. The project office was established with funding from the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), which also provided funds for vital research and training. The World Fish Centre's office in Malawi services the Southern African Development Community. It undertakes research in partnership with the Malawi Department of Fisheries, the University of Malawi and the Zambian Department of Fisheries. The focus is on fisheries research in the broad context of watershed management.

Address: P.O. Box 229, Zomba

Telephone: +265 1527344

Fax: +265 1527344

E-mail Address: worldfish-malawi@cgiar.org

Website: www.worldfishcenter.org

Type: research Institution

Title of Head: Officer in Charge

Name of Head: Jamu, D. (PhD)

Mandate: to reduce poverty and hunger by improving fisheries and aquaculture

Senior Administrative Staff: one PhD, one Master's degree and one Bachelor's degree

Scientists: one PhD, two Master's degrees and two Bachelor's degrees

Publications: *Newsletter of the Malawi National Aquaculture Centre; Policy Benefits: Malawi Fights Poverty: Impacts from collaborative Research in Southern Africa; Cage Aquaculture in Malawi*

INTERNATIONAL CENTRE FOR RESEARCH IN AGROFORESTRY

The International Centre for Research in Agroforestry (ICRAF) has a programme in Malawi which is based at the Makoka Agricultural Research Station. ICRAF-Malawi has particular strength and expertise in soil fertility improvement technologies, fruit tree domestication, sustainable tree seed systems, fodder for livestock production, strengthening grassroots capacity, empowerment through training and upscaling proven technologies.

INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that conducts innovative agricultural research and capacity-building for sustainable development with a wide array of partners across the globe. Its research unit in Malawi is based at the Chitedze Research Station of the Department of Agricultural Research Services, in Lilongwe.

SOUTHERN AFRICA ROOT CROPS RESEARCH NETWORK

The Southern Africa Root Crops Research Network (SARRNET) has facilities in Lilongwe. SARRNET is co-ordinated by the International Institute for Tropical Agriculture, in collaboration with national research programmes in SADC countries. The network focuses on breeding, agronomy, value addition, commercialization and capacity-building. In Malawi, the network is promoting R&D and the commercialization of cassava and sweet potato, in order to foster food security. This includes the implementation of projects funded by the UN Food and Agricultural Organization and PLAN Malawi to disseminate new improved technologies developed by SARRNET.

INSTITUTIONS OF HIGHER EDUCATION

CATHOLIC UNIVERSITY OF MALAWI

Address: P.O. Box 5452, Montfort Campus, Limbe

Telephone: +265 1916009

E-mail Address: information@cunima.ac.mw

Website: www.cunima.ac.mw

Type: training and research institution

Title of Head: Vice-Chancellor

Name of Head: Phiri, A.G Prof. (PhD)

Mandate: to provide holistic education through training and research to meet the technological, socio-economic needs of individuals, communities and industrials in Malawi and beyond

Senior Administrative Staff: two PhDs and one Master's degree

Scientists: two PhDs, 35 Master's degrees

The Catholic University of Malawi is a fast-growing institution of higher learning accredited by the Government of Malawi to offer degrees, diplomas and certificates. It was established by the Episcopal Conference of Malawi on 16 October 2004 and officially opened its doors in 2006. The vision of the Catholic University of Malawi is to be a centre of excellence for quality holistic education in every field of knowledge for the good of the people of Malawi and beyond. Its mission is to contribute to the integral development of the nation through vocation training, academic courses and research activities that are tailored to meeting the most critical needs of the nation and the Catholic Church.



Faculty of Social Sciences

- ▶ **Department of Anthropology**
Scientists: one Master's degree and two Bachelor's degrees
- ▶ **Department of Economics**
Scientists: three Master's degrees
- ▶ **Department of Political Leadership**
Scientists: one PhD and four Master's degrees
- ▶ **Department of Social Work**
Scientists: four Master's degrees and one Bachelor's degree

Faculty of Education

- ▶ **Department of Biblical and Religious Studies**
- ▶ **Department of Geography**
Scientists: five Master's degrees
- ▶ **Department of Mathematics**
Scientists: three Master's degrees
- ▶ **Department of Philosophy**
- ▶ **Department of History**
Scientists: two Master's degrees
- ▶ **Department of Education**
Scientists: three Master's degrees
- ▶ **Department of English and Communication Studies**
Scientists: three Master's degrees and one Bachelor's degree
- ▶ **Department of Special Needs Education**
Scientists: two Master's degrees and one Bachelor's degree

Faculty of Commerce

- ▶ **Department of Banking and Financial Services**
Scientists: one Master's degree
- ▶ **Department of Marketing**
Scientists: two Master's degrees
- ▶ **Department of Accountancy**
Scientists: one PhD and two Master's degrees
- ▶ **Department of Business Administration**

DOMASI COLLEGE OF EDUCATION

Address: P.O. Box 49, Domasi

Telephone: +265 1536 255

Fax: +265 1536 240

E-mail Address: dce@sdpn.org.mw

Website: www.dce.mw

Type: teacher training and research institution

Title of Head: Principal

Name of Head: Mwanza, A.L.D.

Mandate: to train secondary education teachers and primary teacher trainers to diploma and Bachelor degree levels

Senior Administrative Staff: one PhD, four Master's degrees and one Bachelor's degree

Scientists: seven PhDs, 26 Master's degrees and 18 Bachelor's degrees

Publications: *DCE Bulletin*; newsletter; open and distance learning modules

Domasi College of Education has three faculties, namely:

Faculty of Science

▶ Department of Biological Science

Mandate: to train teachers of biology, home economics and agriculture so that they can teach competently in secondary schools and teacher training colleges

Scientists: six Master's degrees and two Bachelor's degrees

▶ Department of Mathematics and Computer Studies

Mandate: to train teachers in mathematics and computer skills for secondary schools and teacher training colleges

Scientists: two Master's degrees

▶ Department of Physical Science

Mandate: to train competent physical science teachers for secondary schools and teacher training colleges

Scientists: one PhD, two Master's degrees and two Bachelor's degrees

Faculty of Education

▶ Department of Teaching Studies

Mandate: to give student teachers the knowledge, skills and attitudes to teach various subjects taught in secondary schools and teacher training colleges

Scientists: one PhD



▶ **Department of Education Foundation**

Mandate: to develop necessary teaching skills and professionalism in the student teachers for effective teaching in Secondary Schools and teacher training colleges

Scientists: seven Master's degrees and one Bachelor's degree

Faculty of Humanities

▶ **Department of Geography and Developmental Studies**

Mandate: to produce quality geography and social studies teachers for secondary schools and teacher training colleges

Scientists: one PhD, two Master's degrees and four Bachelor's degrees

▶ **Department of History, Theology and Religious Studies**

Mandate: to train competent teachers in History, bible knowledge and moral education for secondary schools and teacher training colleges

Scientists: four Master's degrees and two Bachelor's degrees

▶ **Department of Languages**

Mandate: to train competent English, Chichewa and French teachers for secondary schools and teacher training colleges

Scientists: two PhDs, four Master's degrees and six Bachelor's degrees

▶ **Department of Physical Education**

Mandate: to train competent teachers in physical education and expressive and performing arts for secondary schools and teacher training colleges

Scientists: two PhDs and one Master's degree

EKWENDENI COLLEGE OF HEALTH SCIENCES

Address: PO Box 49, Ekwendeni

Telephone: +265 1339339

Fax: +265 1339339

E-mail Address: ekwendenihealthcol@gmail.com

Type: training and research institution

Title of Head: Principal

Name of Head: Nkhandwe, F.

Mandate: to provide excellent training to health professionals within Christian principles by creating an environment conducive to teaching and learning

Senior Administrative Staff: two Master's degrees and two Bachelor's degrees

Scientists: three Master's degrees, nine Bachelor's degrees and two diplomas

LILONGWE TECHNICAL COLLEGE

Address: PO Box 190, Lilongwe

Telephone: +265 1725 947

Fax: +265 1725 943

E-mail Address: litecol@ltc.edu.mw

Website: www.ltc.edu.mw

Type: training institution

Title of Head: Principal

Name of Head: Kalilani, F.

Senior Administrative Staff: one Master's degree and one Bachelor's degree

Scientists: one Master's degree and 12 Bachelor's degrees

Lilongwe Technical College was established in 1963 with the overall goal of training and supplying craftsmen and -women to meet industrial demands. Three courses were offered in the early days, which included carpentry and joinery, bricklaying and plumbing. However, the college experienced expansion between 1968 and 1983, during which time the following were introduced: (1) motor vehicle mechanics, (2) general fitting; (3) electrical installation, (4) welding and fabrication, (5) vehicle body repair and (6) refinishing, machine woodwork, (7) secretarial studies and (8) accounting. Over the same period, carpentry and Joinery, and bricklaying moved to Namitete Technical College.

Lilongwe Technical College is the biggest of all the public technical colleges in Malawi, with a boarding capacity of 360 students. It trains young men and women via 18 different courses.

Vision: to be a leading institution in providing high quality technical and vocational training in Malawi

Mission statement: to provide excellent technical and vocational training for Malawians to prepare them for salaried or self-employment, thereby contributing to socio-economic development in Malawi

Departments:

▶ **Automobile Engineering Department**

Mandate: to train Malawian youth in motor vehicle mechanics, auto-electrics and vehicle body repair and refinishing

Staff: two Bachelor's degrees

▶ **Commercial Studies Department**

Mandate: to train Malawian youth in office duties like secretarial, bookkeeping and computing

Staff: three Bachelor's degrees

▶ **Construction Department**

Mandate: to train youth so that they can then be deployed in the construction industry e.g. plumbing and wood machinery

▶ **Engineering Department**

Mandate: to train Malawian youth in skills that could enhance development in industry, e.g. electrical, mechanical and welding and fabrication

Staff: six Bachelor's degrees

LILONGWE UNIVERSITY OF AGRICULTURE AND NATURAL RESOURCES (FORMERLY BUNDA COLLEGE OF AGRICULTURE)

Address: P.O. Box 219, Lilongwe

Telephone: +265 1277 222

Fax: +265 1 277 364

E-mail Address: bcapincipal@sdpn.org.mw

Website: www.bunda.unima.mw

Type: training and research institution

Title of Head: Principal

Name of Head: Kwapata, M.B. Prof. (PhD)

Mandate: to provide teaching, training, research and outreach services

Senior Administrative Staff: seven PhDs and two Master's degrees

Scientists: 54 PhDs, 84 Master's degrees and 14 Bachelor's degrees

Publications: student handbook

Faculty of Agriculture

▶ Department of Agricultural Engineering

Mandate: to provide teaching and research services in agricultural engineering

Scientists: three PhDs and eight Master's degrees

▶ Department of Animal Science

Mandate: to provide teaching and research services in animal science

Scientists: five PhDs, four Master's degrees and one Bachelor's degree

▶ Department of Basic Science

Scientists: three PhDs, five Master's degrees and one Bachelor's degree

▶ Department of Crop Science

Mandate: to provide teaching and research services in crop science

Scientists: ten PhDs, four Master's degree and two Bachelor's degrees

▶ Department of Home Economics/Human Nutrition

Mandate: to provide teaching and research services in home economics/human nutrition

Scientists: four PhDs, nine Master's degrees and two Bachelor's degrees

Faculty of Natural Resources Management

▶ Department of Aquaculture and Fisheries Science

Mandate: to provide teaching and research services in aquaculture and fisheries

Scientists: five PhDs and nine Master's degrees

▶ Department of Forestry and Horticulture

Scientists: six PhDs, four Master's degrees and two Bachelor's degrees

▶ **Department of Natural Resources and Management**

Scientists: three PhDs, eight Master's degrees and three Bachelor's degrees

Faculty of Development Studies

▶ **Department of Agribusiness Management**

Scientists: six Master's degrees and one Bachelor's degree

▶ **Extension Department**

Scientists: three PhDs, two Master's degrees and one Bachelor's degree

▶ **Department of Agricultural and Applied Economics**

Scientists: ten PhDs and one Master's degree

▶ **Department of Agricultural Education and Development Communication**

Scientist: two PhDs and eight Master's degrees

Faculty of Food and Human Sciences

▶ **Department of Human Nutrition and Health**

▶ **Department of Food Science and Technology**

Faculty of Postgraduate Studies

For over 20 years, Bunda College of Agriculture has offered postgraduate training in various disciplines which boast regional excellence. These programmes have attracted students sponsored by many reputable institutions, including GTZ/SACCAR, DANIDA, Department of Animal Health and Livestock Development (Malawi), IDRC, ARDEP, ALO, the Scottish government, NOMA, SADC/SCARDA, the Ministry of Agriculture (Malawi), NORAD, and RUFORUM.

The university has trained and currently host students from many countries, such as Ethiopia, Uganda, Tanzania, Swaziland, Lesotho, Zimbabwe, Botswana, Zambia, Kenya, Mozambique and Malawi. The cultural diversity of postgraduate students, coupled with their immense and heterogeneous experiences, enriches the learning environment. Hundreds of our graduates are contributing to national, regional and global socio-economic development through their active involvement in the private sector, research institutions, UN agencies, government and regional bodies, as well as universities.

Lilongwe University of Agriculture and Natural Resources offers the following postgraduate training programmes, in response to national, regional and international needs: Masters programmes; doctoral programmes: (1) PhD in Agricultural and Resource Economics, (2) PhD in Agriculture and Applied Economics, (3) PhD in Animal Science, (4) PhD in Aquaculture and Fisheries, (5) PhD in Biotechnology, (6) PhD in Rural Development (Agricultural Economics or Agricultural Extension Option). It also offers postgraduate diploma programmes: (a) Postgraduate Diploma in Horticulture and (b) Postgraduate Diploma in Seed Technology.

Centre for Agricultural Research and Development

Address: P.O. Box 219, Lilongwe

Telephone: +265 1277 433/+265 1277438

Fax: +265 1277 286

E-mail Address: card@bunda.unima.mw



Website: www.bunda.unima.mw

Type: research, training and outreach consultancy

Title of head: Director

Name of head: Wiyo. K.A. (PhD)

Mandate: to conduct agricultural and natural resource management policy research and training activities

Senior Administrative Staff: one PhD and one Master's degree

Scientists: five PhDs and three Master's degrees

Publications: annual reports; research reports

The Centre for Agricultural Research and Development is a research arm of Bunda College of Agriculture, the main campus of Lilongwe University of Agriculture and Natural Resources.

It is an umbrella research centre composed of four units, namely: Agricultural Policy Research Unit (APRU), Training and Consultancy Unit (TCU), Programmes Co-ordination Unit (PCU) and Agricultural Policy Analysis and Training Unit (APATU). CARD was an offshoot from the establishment of the Agricultural Policy Research Unit (APRU) in 1994. The United States Agency for International Development (USAID) provided the initial funding through the Agricultural Sector Assistance Program (ASAP).

The vision of CARD is to become a dynamic centre of excellence in agricultural, environmental and development policy research and training for sustainable and equitable development of national and international communities.

CARD's mission is to generate, adapt, apply and transfer agricultural, environmental and developmental knowledge, skills and attitudes that enhance individual, organizational and systemic capacity for sustainable and equitable development of national and international communities.

Its objectives are to provide an institutional infrastructure and capacity for research, training and consultancy in agriculture, natural resources and the environment for poverty reduction at household and national levels; encourage and conduct commissioned research in the areas of agriculture, natural resources and environmental management; co-ordinate research activities and provide researchers with information on priority areas for rural development in agriculture, natural resources and environmental management; conduct and strengthen training in demand driven policy analysis in agricultural, natural resources and environmental management using up-to-date techniques; undertake consultancies in natural resources, sustainable livelihoods, food security and environment, and; disseminate scientific research findings to appropriate target groups through publications, seminars, workshops, courses and conferences.

MALAWI ADVENTIST UNIVERSITY

Address: P.O. Box 148, Ntcheu

E-mail Address: registrar@mau.ac.mw

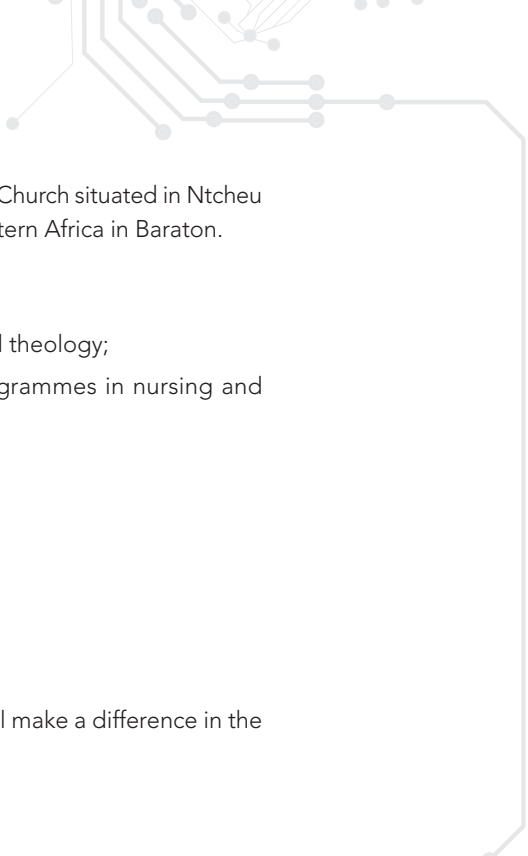
Website: www.mau.ac.mw

Type: training and research institution

Title of Head: Vice-Chancellor

Name of Head: Kadyakapita, M. J. S. (PhD)

Mandate: highest priority is given to the religious, intellectual, social and physical development of students



Malawi Adventist University is an affiliated university of the Seventh-day Adventist Church situated in Ntcheu District in Malawi. It offers four-year degree programmes of the University of Eastern Africa in Baraton.

It has two campuses:

- ▶ Lake View Campus offers degrees in education, business administration and theology;
- ▶ Malamulo College of Health Sciences offers certificate and diploma programmes in nursing and midwifery, lab technology and clinical medicine (see below).

Malawi Adventist University currently has four departments:

▶ **Department of Agriculture**

Mandate: to promote sustainable agriculture

Scientists: six Master's degrees

▶ **Department of Business**

Mandate: to train competent and committed business professionals who will make a difference in the way business is conducted in today's world

Scientists: five Master's degrees, two Bachelor's degrees

▶ **Department of Education**

Mandate: to train and prepare undergraduate students for the teaching profession at secondary school level in agriculture, business studies, English language and literature, and religion

Scientists: two PhDs, four Bachelor's degrees

▶ **Department of Theology**

Mandate: to provide quality preparation for pastors, teachers, evangelists, administrators and other related professional careers for service in the Seventh-Day Adventist Church and society at large.

Scientists: one PhD and two Master's degrees

MALAMULO COLLEGE OF MEDICAL SCIENCES

Address: P/Bag 2, Makwasa

Telephone: +265 1470 117

Fax: +265 1 470 139

E-mail Address: malamulo.college@yahoo.com

Website: www.mchsmu.ac.mw

Type: training and research institution

Title of Head: Principal


Name of Head: Kachiwala, A.Y.

Mandate: to provide high-quality training for health service providers through a holistic approach using the Seventh-Day Adventist Christian values, in order to improve health service delivery

Senior Administrative Staff: three Master's degrees and one Bachelor's degree

Scientists: nine Master's degrees, 19 Bachelor's degrees and nine diplomas

Publications: school magazine produced annually



Malamulo College of Health Sciences has been a constituent college of Malawi Adventist University since 2007 and is a member of the worldwide family of Adventist Educational Institutions.

It was initially a mission station in 1902 before becoming a small dispensary in 1908 with the objective of preaching the word of God through the ministry of healing. From 1938 to 2001, it served as an educational component of Malamulo Hospital. The hospital began training medical assistants in 1938, enrolled nurses and midwives in 1953, laboratory assistants in 1968, laboratory technicians in 1978 and clinical officers in 1998. It became an independent college with its own board of management in 2001.

Malamulo College of Health Sciences is situated in Thyolo District, 22 km from Thyolo Boma, the southern region of Malawi, approximately 70 km from Blantyre off Makwasa Road.

Currently, the college offers a diploma in Nursing and Midwifery Technician, a diploma and degree in Biomedical Sciences in Clinical Laboratory Technology and Clinical Medicine, a certificate and diploma in Clinical Medicine and a degree in Public Health.

Departments:

▶ **Basic Sciences Department**

Scientists: one Master's degree and one Bachelor's degree

▶ **Biomedical Sciences Department**

Scientists: two Master's degrees, three Bachelor's degrees and one diploma

▶ **Clinical Medicine Department**

Mandate: to train competent and compassionate clinical officers

Scientists: two Master's degrees, seven Bachelor's degrees and six diplomas

▶ **Medical Laboratory Department**

Mandate: to train competent laboratory technicians

Scientists: two Master's degrees and one Bachelor's degree

▶ **School of Nursing and Midwifery**

Mandate: to train competent and compassionate nurses and midwives

Scientists: four Master's degrees, eight Bachelor's degrees and two diplomas

MALAWI COLLEGE OF FISHERIES

Address: P/Bag 7, Mangochi

Telephone: +265 1580066

Fax: +265 1580066

E-mail Address: MCF@africaonline.net

Type: training institution

Title of Head: Principal

Name of Head: Nyasa, C.

Mandate: to impart knowledge and build capacity in the sustainable utilization of fisheries, aquaculture development and environmental management through the provision of a modern learning environment and training facilities

Senior Administrative Staff: three Master's degrees

Scientists: three Master's degrees and two Bachelor's degrees

Publications: *Usodziwa Lero Newsletter*; public awareness materials (brochures, leaflets, MCE profile); Malawi College of Fisheries publication series, produced annually

Departments:

▶ **Fisheries Resource Management Department**

Mandate: to offer biological related fisheries training such as stock assessment, fish biology, etc.

Scientists: one Master's degree and two Bachelor's degrees

▶ **Fisheries Technology Development Department**

Mandate: to offer skills and knowledge pertaining to fish exploitation and utilization

Scientists: one diploma

▶ **Rural Development Department**

Mandate: to offer rural development training aimed at improving living standards of rural communities

Scientists: one Masters degree and one Bachelor's degree

MALAWI COLLEGE OF FORESTRY AND WILDLIFE

Address: P/Bag 6, Dedza

Telephone: +265 1900264

E-mail Address: macofo@malawi.net

Type: training institution

Title of Head: Principal

Name of Head: Senganimalunje, T.

Mandate: to provide training in forestry and wildlife management in order to achieve sustainable natural resources management

Senior Administrative Staff: two Master's degrees and one Bachelor's degree

Scientists: two Master's degrees and five Bachelor's degrees

Publications: annual reports; quarterly newsletter

Malawi College of Forestry and Wildlife is an institution accredited to the University of Malawi (former Bunda College of Agriculture) that provides training, at subprofessional level, in forestry and wildlife management. In the past, it has been primarily responsible for training government staff, both new recruits and those already in service. However, there is now a recognition that the college needs to expand its service horizons to meet the needs of clients from the whole natural resources management sector, including NGOs, private sector, communities and both national and international individuals.

MALAWI COLLEGE OF HEALTH SCIENCES

Address: P.O. Box 30368, Lilongwe 3

Telephone: +265 1756906/+265 1752208

Fax: +265 1754425

E-mail Address: mchs@malawi.net

Website: www.mchs.edu.mw

Type: training and research institution

Title of Head: Executive Director

Name of Head: Masache, T.G.

Mandate: MCCHS is a health institution. It aims to be a centre of excellence in training middle-level and high-level practitioners from Malawi and beyond.

Senior Administrative Staff: six Master's degrees and five Bachelor's degrees

Scientists: six Master's degrees and one Bachelor's degree

Publications: UK/MCHS project report produced bi-annually

MCCHS was formed by the merger of Lilongwe School of Health Sciences in Lilongwe, the Medical Assistants Training School in Blantyre and the Zomba School of Nursing in Zomba. The merger of these three campuses was ordained by a government order dated 21 June 1996.

Lilongwe School of Health Sciences, formerly known as the Medical Auxiliary Training School, was built in 1976. The school opened its doors on 12 July 1976. The initial classroom infrastructure was built with funding from the French government. Later, the Howard University Project constructed the administration block and some hostels. Additional students' hostels were erected by the World Bank under the Population, Health and Nutrition (PHN) project. The World Health Organization, under 'the essential drug programme', donated equipment and rehabilitated a laboratory to facilitate teaching and learning.

The Medical Assistants Training School in Blantyre became operational in the 1960s. However, the present structure was built in 1996 with funding from the African Development Bank.

Zomba School of Nursing, which opened in 1930, is the oldest institution. The current structure was built in 1990 with support from the World Bank under the PHN project. Until 1996, all three institutions operated separately under the Ministry of Health. The current Malawi College of Sciences is a parastatal organization under the Board of Governors.

Departments on Lilongwe Campus:

▶ **Basic Sciences Department**

▶ **Mandate:** to augment the learning of professional subjects by teaching students of all programmes basic sciences subjects

▶ **Biomedical Sciences Programme**

Mandate: to train high-quality Laboratory technicians; the field of research is parasitology, especially bilharzia and malaria

▶ **Clinical Medicine Department**

Mandate: to train clinical officers

▶ **Dental Therapy Programme**

Mandate: to train high-quality dental therapists; the field of research is community dentistry

Scientists: one Master's degree Environmental Health.

Mandate: to train Assistant Environmental Health Officers

Scientists: two Master's degrees

▶ **Pharmacy Programme**

Mandate: to train pharmacy personnel; the field of research is drug use and abuse

Scientists: one Bachelor's degree

▶ **Radiography Programme**

Mandate: to train high-quality radiographers; the field of research is health systems, radiation and ultrasound

Scientists: two Bachelor's degrees

Departments on Blantyre Campus:

▶ **Clinical Medicine Programme**

Mandate: to train medical assistants and clinical officers; fields of research include medicine, surgery, paediatrics and reproductive health

Scientists: three Bachelor's degrees

▶ **Nursing and Midwifery Programme**

Mandate: to train nursing and midwifery technicians; fields of research include medical-surgical nursing, paediatrics, reproductive and community health nursing

Scientists: three Master's degree and 12 Bachelor's degrees

Departments on Zomba Campus:

▶ **Nursing and Midwifery Technician Programme**

Mandate: to train nurses and midwives

Scientists: six Bachelor's degrees

▶ **Mental Health Programme**

Mandate: to train psychiatric nurses

Scientists: two Bachelor's degrees

MALAWI INSTITUTE OF EDUCATION

Address: P.O. Box 50, Domasi

Telephone: +265 1536304/265/266


Fax: +265 1536235/221

E-mail Address: miedirector@sdpn.org.mw

Type: research and service institution

Title of Head: Director

Name of Head: Susuwele-Banda, W. (PhD)



Mandate: to contribute to improving the quality of education in Malawi by undertaking, encouraging and co-ordinating curriculum development, evaluation and research; assisting with the training of teachers; providing continuing professional development for teachers and other education personnel and; arranging for the production and publication of teaching and learning materials.

Senior Administrative Staff: one PhD, one Master's degree, two Bachelor's degrees and one Advanced Diploma in Human Resource Development

Scientists: two PhDs, 18 Master's degrees, three Bachelor's degrees

Publications: textbooks for primary school learners; teachers' guides for primary school teachers, syllabuses for primary and secondary schools and primary teacher education; handbooks for college tutors and student teachers; school leadership training manuals; human rights and democracy training manuals; training manuals for primary school teachers; training manuals for school advisors; source books for primary and secondary school teachers

The Malawi Institute of Education is a government-subsidized institution established in 1979 through Government Notice No. 60 of 1979 under the Education Act (CAP 30:01). It became operational in April 1982. The institute is located in Domasi, about 18 km from Zomba City. The Institute's vision is to be a leader in curriculum development in Malawi and beyond. Its core values include professionalism, creativity and dynamism, stakeholder involvement, equity and equality, and respect for staff. Its mission is to design, develop, monitor and evaluate the national school and primary teacher training education curricula and provide continuing professional development for education personnel, in order to ensure that education responds to the current and future needs of society.

As such, the institute's mandate is meant to contribute to the improvement of the quality of education standards in Malawi by: (1) undertaking, encouraging and co-ordinating curriculum development, (2) carrying out research, evaluation and policy studies in education, (3) assisting with the training of teachers, (4) providing continuing professional development for teachers and other education personnel, producing and publishing teaching and learning resources.

The institute delivers educational and related services through the following departments:

▶ **Department of Curriculum Development**

Mandate: to ensure that the school curriculum is responsive to the needs and challenges of the Malawian society; the department co-ordinates the design, development and implementation of curricula for the public and private educational institutions, especially primary, secondary and primary teacher training levels

Scientists: two PhDs, six Master's degrees and four Bachelor's degrees

▶ **Education Materials Development and Resource Centre**

Mandate: to facilitate the development and production of print and audio-visual resources for the primary, secondary and teacher training levels

Scientists: one Master's degree, one Honours degree and one Bachelor's degree

▶ **Department of Research, Evaluation and Policy Studies**

Mandate: to conduct research on issues affecting teaching and learning in schools and teacher training colleges with the view to providing the basis for formulating policies that could improve the quality of education in Malawi; the department also evaluates educational programmes and instructional materials, in order to ensure that they are appropriate for the needs of the target group and the nation

Scientists: three Master's degrees

▶ **Department of School and Teacher Development**

Mandate: to provide continuing professional development support to teachers at all levels and other education personnel, including education methods advisors and school inspectors

Scientists: four Master's degrees

► Administration and Finance Department

Mandate: to provide the academic departments with support, in order to ensure that the goals and objectives of the Institute are achieved; management does this with guidance from the Board of Governors

Scientists: two Bachelor's degrees and one Advanced Diploma in Human Resource Development

MZUZU UNIVERSITY

Address: P/Bag 201, Luwinga, Mzuzu 2

Telephone: +265 1320575/+265 1320722

Fax: +265 1320568/+265 1320505

E-mail Address: registrar@mzuni.ac.mw

Website: www.mzuni.ac.mw

Type: training and research institution

Title of Head: Vice Chancellor

Name of Head: Msiska, O.V. (PhD) (Acting)

Mandate: to provide high quality education, training, research and complementary services to meet technological, social, and economic needs of individuals and communities in Malawi.

Senior Administrative Staff: one PhDs, two Master's degrees and 112 Bachelor's degrees

Scientists: 26 PhDs, 96 Master's degrees and 26 Bachelor's degrees

Publications: *University Handbook*, *University Prospectus*, university newsletters, proceedings and research outputs.

Faculties are headed by deans who are elected by members of their faculty. The faculty deans represent their faculties in other bodies such as the Senate. The deans have responsibility for leading their faculty and co-ordinate the work of the faculty in terms of staffing, academic work, and student progress. Faculties work through their faculty boards and a variety of committees established by the Senate. Proposals from the departments are brought to the attention of faculty boards for deliberation before submission to the Senate for ratification.

Mzuzu University has held a UNESCO Chair in Open and Distance Learning since 2006.

At present, Mzuzu University has five faculties:

Faculty of Education

► Department of Biological Sciences

Mandate: to provide teaching and research services in biology

Scientists: three PhDs and two Master's degrees

► Department of Chemistry

Mandate: to provide teaching and research services in chemistry

Scientists: four Master's degree and two Bachelor's degrees



▶ **Department of Education and Teaching Studies**

Mandate: to provide teaching and research services in education and teaching studies

Scientists: two PhDs and seven Master's degrees

▶ **Department of Languages and Literature**

Mandate: to provide teaching and research services in language and literature

Scientists: one PhD, 11 Master's degrees and six Bachelor's degrees

▶ **Department of Mathematics**

Mandate: to provide teaching and research services in mathematics

Scientists: three PhDs and seven Master's degrees

▶ **Department of Physics**

Mandate: to provide teaching and research services in physics

Scientists: two PhDs, three Master's degrees and two Bachelor's degrees

▶ **Department of Theology and Religious Studies, Geography and History**

Mandate: to provide teaching and research services in humanities

Scientists: six PhDs, 11 Master's degrees and one Bachelor's degree

Faculty of Environmental Sciences

▶ **Department of Energy Studies**

Mandate: to provide teaching and research services in renewable energy

Scientists: three Master's degrees and two Bachelor's degrees

▶ **Department of Fisheries**

Scientists: three Master's degrees and one Bachelor's degree

▶ **Department of Forestry**

Mandate: to provide teaching and research services in Forestry

Scientists: two PhDs and six Master's degrees

▶ **Department of Land Management**

Scientists: eight Master's degrees and one Bachelor's degree

▶ **Department of Water Resources Management and Development**

Scientists: three Master's degrees

Faculty of Information Science and Communications

▶ **Department of Information and Communication Technology**

Scientists: six Master's degrees

▶ **Department of Library and Information Science**

Mandate: to provide teaching and research services in library and information science

Scientists: three Master's degrees and two Bachelor's degrees

Faculty of Health Sciences

▶ Department of Biomedical Sciences

Scientists: one PhD and three Master's degrees

▶ Department of Nursing and Midwifery

Mandate: to provide teaching and research services in nursing and midwifery

Scientists: eight Master's degrees and five Bachelor's degrees

▶ Department of Optometry

Scientists: four Master's degrees

Faculty of Hospitality Management and Tourism

▶ Department of Hospitality Management

Mandate: to provide teaching and research services in hospitality management

Scientists: one PhD, four Master's degrees and four Bachelor's degrees

▶ Department of Tourism

Mandate: to provide teaching and research services in tourism

Scientists: staff are shared with the Department of Hospitality Management (above)

▶ Department of Management

Mandate: to provide teaching and research services in management

Associated centres

▶ Centre for Continuing Education

Address: P/Bag 201, Luwinga, Mzuzu 2

Telephone: +265 1320575/722

Fax: +265 1320568/+265 1320505

Type: training and research institution

Title of Head: Co-ordinator

Name of Head: Zozie, P.

Mandate: to increase and broaden access to quality tertiary education, in order to create an open, inclusive and informed society necessary for engaging with Malawi's numerous development challenges

Senior Administrative Staff: one Bachelor's degree

Scientists: one PhD, one Master's degree and one Bachelor's degree

The Centre of Continuing Education is a centre of excellence at Malawi Polytechnic which offers continuing education programmes at the certificate and diploma levels. The centre was established in the late 1960s with the aim of providing professional development courses to working people through evening classes. Over the years, the centre has experienced a significant increase in student numbers, forcing it to introduce weekday and weekend classes.

The centre is situated on Malawi Polytechnic's main campus in Blantyre and recently opened another campus at the Kamuzu College of Nursing in Lilongwe.



▶ **Centre for Environmental Education, Training and Research**

Address: P/Bag 201, Luwinga, Mzuzu 2

Telephone: +265 1320575/722

Fax: +265 1320568/+265 1320505

Type: training and research institution

Title of Head: Co-ordinator

Name of Head: Mataya, B.

Senior Administrative Staff: one PhD and one Bachelor's degree

Scientists: one PhD, three Master's degrees and two Bachelor's degrees

▶ **Centre for Open and Distance Learning**

Address: P/Bag 201, Luwinga, Mzuzu 2

Telephone: +265 111 930 794

Fax: +265 1320568/+265 1320505

Type: training and research institution

Title of Head: Director

Name of Head: Msiska, F. (PhD)

Mandate: to increase and broaden access to quality tertiary education, in order to create an open, inclusive and informed society necessary for engaging with Malawi's numerous development challenges

Senior Administrative Staff: one PhD, one Master's degree and one Bachelor's degree

Scientists: one PhD, one Master's degree and one Bachelor's degree

▶ **Centre for Security Studies**

Address: P/Bag 201, Luwinga, Mzuzu 2

Telephone: +265 111 930 317

Fax: +265 1320568/+265 1320505

Type: training and research institution

Title of Head: Co-ordinator

Name of Head: Chirwa, M. (Brigadier)

Mandate: to address knowledge and skills gaps in the defence and security sector in Malawi, the Southern African Development Community and beyond

Senior Administrative Staff: one PhD and one Bachelor's degree

Scientists: three Master's degrees and two Bachelor's degrees

▶ **Test and Training Centre in Renewable Energy Technologies**

Address: P/Bag 201, Luwinga, Mzuzu 2

Telephone: +265 11130049

Fax: +265 1320 568/+265 1320 505

E-mail Address: energy@mzuni.ac.mw

Type: training and research institution

Title of Head: Co-ordinator

Name of Head: Gondwe, K.

Senior Administrative Staff: one Master's degree

Scientists: three Master's degrees

MZUZU TECHNICAL COLLEGE

Address: P.O. Box 316, Mzuzu

Telephone: +265 1310217/+265 1310754/+265 8185053

Fax: +265 1311754

Type: Training Service Institution

Title of Head: Principal

Name of Head: Siyasiya, T.

Mandate: to provide technical entrepreneurial, vocational education and training

Senior Administrative Staff: two Bachelor's degrees

Scientists: six Bachelor's degrees

Publications: college magazine; handbook of Mzuzu Technical College

Departments:

▶ **Administration Department**

Mandate: to plan, co-ordinate and control all activities at Mzuzu Technical College

Scientists: two Bachelor's degrees, one Master's degree and six certificates

▶ **Automobile Department**

Mandate: to provide teaching in automobile skills for wage and self-employment

Scientists: three Bachelor's degrees and five diplomas

▶ **Commercial Department**

Mandate: to provide vocational skills and knowledge in accounting, business administration, secretarial studies, HIV/AIDS management, rural and community development, ICTs and marketing; all these are taught to certificate and diploma levels

Scientists: four Bachelor's degrees and eight diplomas

▶ **Construction Department**

Mandate: to provide skills in carpentry and joinery, upholstery, brickwork, electrical installation for self and wage employment

Scientists: four Bachelor's degrees and four diplomas

NAMITETE TECHNICAL COLLEGE

Address: P/B 5, Namitete

Telephone: +265 999918133

E-mail Address: namitetecollege@gmail.com

Type: training institution

Title of Head: Principal

Name of Head: Kondowe, J.G.

Mandate: to provide Malawians with sustainable moral, technical, vocational and entrepreneurial education through a quality and demand-driven training for salaried and self-employment



Senior Administrative Staff: four Bachelor's degrees and one Master's degree

Scientists: nine Bachelor's degrees

Publications: *NATECO Focus, Namitete Technical College brochure*

Departments:

▶ **Commercial Department**

Scientists: three Bachelor's degrees

▶ **Construction Department**

Scientists: four Bachelor's degrees

NATURAL RESOURCES COLLEGE

Address: PO Box 143, Lilongwe

Telephone: +265 1766644

Fax: +265 1766652

E-mail Address: admin@nrc.mw

Website: www.nrc.mw

Type: training institution

Title of Head: Principal

Name of Head: Kaupa, F.

Mandate: to contribute to government efforts to realize sustainable socio-economic development by enhancing the integration of environmental and natural resources management in programme development, leading to national and household food security and poverty reduction

Senior Administrative Staff: eight Master's degrees and 14 Bachelor's degrees

Scientists: eight Master's degrees and 14 Bachelor's degrees

Publications: annual reports; student handbook

ST LUKES COLLEGE OF NURSING AND MIDWIFERY

Address: P.O Box 21, Chilema

Telephone: +265 1539215

Fax: +265 1539433

E-mail Address: stlukescollegeofnursing@sdpn.org.mw

Website: www.stlukescollegeofnursingmw.com

Type: training institution

Title of Head: Principal

Name of Head: Pangani, M.

Mandate: to train nurses/midwives who contribute to improving the health of Malawians through the provision of quality hospital community-based nursing and midwifery health care services

Senior Administrative Staff: one Master's degree and two Bachelor's degrees

Scientists: four Master's degrees, 12 Bachelor's degrees and three diplomas

Publications: annual report and college magazine

Departments:

▶ **Department of Community Health**

Scientists: one Master's degree and four Bachelor's degrees

▶ **Department of Maternal and Child Health**

Scientists: one Master's degree and four Bachelor's degrees

▶ **Department of Medical/Surgical**

Scientists: two Master's degrees and four Bachelor's degrees

▶ **Clinical Department**

Scientists: two Bachelor's degrees, three diplomas and one Nursing Midwifery Technician

SALIMA TECHNICAL COLLEGE

Address: P.O. Box 175, Salima

Telephone: +265 1263302

Fax: +265 1263302

E-mail Address: salimatechnical@yahoo.com

Type: training Institution

Title of Head: Principal

Name of Head: Mkandawire, C.

Mandate: To impart skills and related knowledge

Senior Administrative Staff: two Master's degrees, five Bachelor's degrees and one diploma

Scientists: two Master's degrees and six Bachelor's degrees

Departments:

▶ **Department of Automobile Mechanics**

Mandate: to train Malawian youths in motor vehicle Mechanics and Auto-electrics

Scientists: three Bachelor's degrees and one diploma

▶ **Department of Commercial Studies**

Mandate: to train Malawian youths in office duties like secretarial skills, accounting and business management

Scientists: two Bachelor's degrees and two diplomas



▶ **Department of Construction**

Mandate: to train youths in Bricklaying, Carpentry, and joinery

Scientists: one Master's degree

▶ **Department of Mechanical Engineering**

Mandate: to train Malawian youth in industrial development skills like welding, fabrication and general fitting

Scientists: one Master's degree, two Bachelor's degrees, one diploma and one certificate

SOCHE TECHNICAL COLLEGE

Address: P/Bag 515, Limbe

Telephone: +265 1845384

Fax: +265 1845401

E-mail Address: principal@sochetech.org

Type: training institution

Title of Head: Principal

Name of Head: Kawanga, G. A.

Mandate: to prepare individuals for gainful employment as skilled workers or technicians in recognized occupations and in new and emerging occupations

Senior Administrative Staff: two Bachelor's degrees

Scientists: 11 Bachelor's degrees, two advanced diplomas and six diplomas

UNIVERSITY OF MALAWI

The idea that Malawi should have a university was first conceived soon after the country achieved independence in 1964. In October 1964, the University of Malawi was founded under the University of Malawi (Provisional Council) Act, which was later replaced by the University of Malawi Act of 1974. This act was further amended in 1998.

Teaching started on 29 September 1965 on the newly established campus, which used to be an Asian Secondary School in Blantyre. Only 90 students were enrolled at the time. By 1967, the then Institute of Public Administration at Mpemba, the Soche Hill College of Education and Malawi Polytechnic, all in Blantyre, together with Bunda College of Agriculture in Lilongwe, had been incorporated as constituent colleges of the University of Malawi.

The university has a federal structure spanning four constituent colleges in three cities. These constituencies are as follows: Chancellor College (in Zomba), College of Medicine (in Blantyre), Kamuzu College of Nursing (in Blantyre and Lilongwe), and Malawi Polytechnic (in Blantyre). The university's central administration is located in Zomba. Kamuzu College of Nursing became a constituent college in 1979 and the College of Medicine in 1991, at the time of its founding.

The University of Malawi is a strong national research entity. About 10% of the university's overall budget for its development strategy is devoted to capacity-building in research and consultancy, ensuring research quality and improving the dissemination and utilization of research findings. The university further allows its

staff to spend 25% of their time on research, leaving 75% for teaching. It conducts basic as well as applied research on agriculture and livestock; environmental protection and health; energy sources and utilization; engineering and construction; and health and medical issues.

The University of Malawi's vision is to be an academic institution providing relevant world-class education, research and services for sustainable development of Malawi and the world. Its mission is to advance knowledge, promote wisdom and understanding and provide services by engaging in teaching and research and by facilitating the dissemination, promotion, and preservation of learning responsive to the needs of Malawi and the world.

The University of Malawi has held a UNESCO Chair in Renewable Energy since 1999 on the campus in Zomba (Chancellor College).

CHANCELLOR COLLEGE

Address: P.O. Box 280, Zomba

Telephone: +265 1524 222

Fax: +265 1522 046

E-mail Address: Principal@chanco.unima.mw

Website: www.chanco.unima.mw

Type: training and research institution

Title of Head: Principal

Name of Head: Kamlongera, C.F. Prof. (PhD)

Mandate: to provide teaching, research and consultancy services in various disciplines

Senior Administrative Staff: two PhDs and seven Bachelor's degrees

Scientists: 70 PhDs, 120 Master's degrees, three Honours degrees, 37 Bachelor's degrees and one diploma

Publications: *Malawi Journal of Linguistics*, produced annually; *Journal of Humanities*, produced annually; *Malawi Journal of Social Sciences*, produced annually

Chancellor College is the largest of the constituent colleges of the University of Malawi. Its mission is to advance knowledge and to promote wisdom and understanding by engaging in teaching, research, consultancy and outreach and by making provisions for the dissemination, promotion and preservation of learning that is responsive to the needs of Malawi and the world.

The college has five faculties: Faculty of Education, Faculty of Humanities, Faculty of Law, Faculty of Science and the Faculty of Social Science.

Faculty of Education

▶ Curriculum and Teaching Studies Department

Mandate: to provide teaching and research services in curriculum and teaching studies

Scientists: seven PhDs, five Master's degrees and two Bachelor's degrees

▶ Educational Foundations Department

Mandate: to provide teaching and research services in educational foundations

Scientists: two PhDs, nine Master's degrees, three Honours degrees and two Bachelor's degrees



Faculty of Humanities

▶ African Languages and Linguistics Department

Mandate: to provide teaching and research services in African languages and linguistics

Scientists: three PhDs, four Master's degrees and one Bachelor's degree

▶ Classics Department

Mandate: to provide teaching and research services in the classics

Scientists: two Master's degrees and one Bachelor's degree

▶ English Department

Mandate: to provide teaching and research services in English

Scientists: four PhDs and four Master's degrees

▶ Fine and Performing Arts Department

Mandate: to provide teaching and research services in fine and performing arts

Scientists: three PhDs, four Master's degrees, three Bachelor's degrees and one diploma

▶ French Department

Mandate: to provide teaching and research services in French

Scientists: four Master's degrees

▶ Language and Communication Department

Mandate: to provide teaching and research services in language and communication skills

Scientists: six Master's degrees and one Bachelor's degree

▶ Philosophy Department

Mandate: to provide teaching and research services in philosophy

Scientists: five Master's degrees and three Bachelor's degrees

▶ Theology and Religious Studies Department

Mandate: to provide teaching and research services in theology and religious studies

Scientists: two PhDs, three Master's degrees and two Bachelor's degrees

Faculty of Law

▶ Foundation Law Department

Scientists: three PhDs, eight Master's degrees and four Bachelor's degrees

▶ Practical Legal Studies Department

Scientists: one PhD and five Bachelor's degrees

Faculty of Science

▶ Biology Department

Mandate: to provide teaching and research services in biology

Scientists: seven PhDs, six Master's degrees and one Bachelor's degree

▶ Chemistry Department

Mandate: to provide teaching and research services in chemistry

Scientists: six PhDs, two Master's degrees and two Bachelor's degrees

▶ **Geography and Earth Sciences Department**

Mandate: to provide teaching and research services in geography and Earth sciences

Scientists: nine Master's degrees

▶ **Home Economics Department**

Mandate: to provide teaching and research services in home economics

Scientists: two PhDs, three Master's degrees and three Bachelor's degrees

▶ **Mathematical Sciences Department**

Mandate: to provide teaching and research services in mathematics, computer sciences and statistics

Scientists: four PhDs, 12 Master's degrees and three Bachelor's degrees

▶ **Physics Department**

Mandate: to provide teaching and research services in physics

Scientists: five Master's degrees and two Bachelor's degrees

Faculty of Social Science

▶ **Economics Department**

Mandate: to provide teaching and research services in economics

Scientists: 11 PhDs and two Master's degrees

▶ **History Department**

Mandate: to provide teaching and research services in history

Scientists: three PhDs and one Master's degree

▶ **Political and Administrative Studies Department**

Mandate: to provide teaching and research services in political and administrative studies

Scientists: five PhDs and six Master's degrees

▶ **Population Studies Department**

Scientists: six Master's degrees and one Bachelor's degree

▶ **Psychology Department**

Mandate: to provide teaching and research services in psychology

Scientists: three Master's degrees and three Bachelor's degrees

▶ **Sociology Department**

Mandate: to provide teaching and research services in sociology

Scientists: four PhDs and two Master's degrees

Associated research units and centres

Molecular Biology and Ecology Research Unit

Address: P.O. Box 280, Zomba

Telephone: +265 1525682

Fax: +265 1525682

E-mail Address: wchanga@cc.ac.mw



Website: www.chanco.unima.mw

Type: research institution

Name of Head: Mawaya, C. (PhD)

Title of Head: Head of Department

Mandate: to be the centre of excellence in the delivery of relevant research, training and management services in natural resources in Malawi and the SADC region; the unit is part of Chancellor College's Biology Department

Senior Administrative Staff: one PhD

Scientists: three PhDs and one Master's degree

Centre for Education, Research and Training

Address: P.O. Box 280, Zomba

Telephone: +265 1524 490

Fax: +265 1545 061

E-mail Address: dnampota@cc.ac.mw

Website: www.chanco.unima.mw/researchcentres

Type: training and research institution

Title of Head: Director

Name of Head: Nampota, D. (PhD)

Senior Administrative Staff: one PhD and one Master's degree

Scientists: three PhDs and five Master's degrees

Publications: *Malawi journal of Education Development*

Centre for Language Studies

Address: P.O. Box 108, Zomba

Telephone: +265 1527460

Fax: +265 1525587

E-mail Address: cls@sdpn.org.mw

Website: www.unima-cls.org

Type: research institution

Title of Head: Director

Name of Head: Kishindo, Pascal Prof. (PhD)

Mandate: to promote and develop both Malawian and non-Malawian languages which are of socio-economic and political relevance/importance to Malawi

Senior Administrative Staff: two PhDs, four Master's degrees

Scientists: two PhDs, four Master's degrees and one Bachelor's degree

Publications: *Centre for Language Studies Newsletter*, produced annually; *Malilime: Malawian Journal of Linguistics*

Centre for Social Research

Address: P.O. Box 278, Zomba

Telephone: +265 1524 800/+265 1525194

Fax: +265 1524 578/+265 1524 760

E-mail Address: csr@sdpn.org.mw

Website: www.chancol.mw

Type: research institution

Title of Head: Director

Name of Head: Kishindo, P.A.K. Prof. (PhD)

Mandate: to appraise, monitor and evaluate development activities in Malawi; to undertake applied research on priority problems of the country to inform policy; to promote and facilitate social science research within the University of Malawi; to promote the efficient exchange of information and experiences within the fields of social science by organizing local and regional conferences and seminars; to collect and document information on social science research and general development in Malawi, and to make these accessible to researchers inside and outside Malawi and; to compile, publish and disseminate research and evaluation results

Senior Administrative Staff: one PhD

Scientists: three PhDs and four Master's degrees

Publications: *Malawi Journal of Social Science*, produced annually; *Bwalo*: a forum for social development; working papers; research reports; annual reports

COLLEGE OF MEDICINE

Address: P/Bag 360, Chichiri, Blantyre 3

Telephone: +265 1871911/+265 1875286/+265 1876498

Fax: +265 1874700

E-mail Address: registrar@medcol.mw

Website: www.medcol.mw


Type: training and research institution

Title of Head: Principal

Name of Head: Maleta, K.M. Prof. (PhD)

Mandate: to serve as an academic centre of excellence responsible for teaching, research and services

Senior Administrative Staff: one PhD, seven Masters degrees and seven Bachelor's degrees



Scientists: 25 PhDs, 42 Specialist degrees, 20 Master's degrees and 28 Bachelor's degrees

Publications: *Malawi Medical Journal* (quarterly); annual report; *College of Medicine Prospectus* (annual); *RSC Newsletter* (quarterly)

The College of Medicine is a student-centred institution. This means that students' needs come first.

The standard of teaching and learning is one of the highest in the African region. External examiners evaluate examinations.

The College of Medicine has two faculties, namely the Faculty of Medicine and the Faculty of Biomedical Science and the Health Profession.

Faculty of Medicine

▶ Anaesthesia Department

Mandate: to provide teaching and research in anaesthesia

Scientists: one Master's degree and one Bachelor's degree

▶ Community Health Department

Mandate: to provide teaching and research in community health and psychiatry

Scientists: seven PhDs, four Specialist degrees, two Masters degrees and two Bachelor's degrees

▶ Medicine Department

Mandate: to provide teaching and research in medicine

Scientists: two PhDs, 10 Specialist degrees and three Bachelor's degrees

▶ Mental Health Department

Mandate: to provide training and research in mental health

Scientists:

▶ Obstetrics and Gynaecology Department

Mandate: to provide teaching and research in obstetrics and gynaecology

Scientists: one PhD, five Specialist degrees and three Bachelor's degrees

▶ Paediatrics and Child Health Department

Mandate: to provide teaching and research in paediatrics

Scientists: one PhD, six Specialist degrees and three Bachelor's degrees

▶ Surgery Department

Mandate: to provide teaching and research services in Surgery. Research is directed towards surgery-related areas

Scientists: nine Specialist degrees and three Bachelor's degrees

Faculty of Biomedical Science and the Health Profession

▶ Basic Medical Sciences Department

Mandate: to provide teaching and research in anatomy, biochemistry, physiology and premedical services

Scientists: six PhDs, two Specialist degrees, six Master's degrees and eight Bachelor's degrees

▶ **Pathology and Laboratory Science Department**

Mandate: to provide teaching and research in pathology, haematology, medical laboratory services and microbiology

Scientists: four PhDs, Six specialist degrees, seven Master's degrees and two Bachelor's degrees

▶ **Pharmacy Department**

Mandate: to provide teaching and research services in Pharmacy

Scientists: three PhDs, three Master's degrees and two Bachelor's degrees

▶ **Physiotherapy Department**

Mandate: to provide teaching in Physiotherapy

Scientists: one PhD, one Master's degree and one Bachelor's degree

KAMUZU COLLEGE OF NURSING

Address: P/Bag 1, Lilongwe

Telephone: +265 1751 662

Fax: +265 1756 424

E-mail Address: kcn11@sdpn.org.mw

Website: www.kcn.unima.mw

Type: training and research institution

Title of Head: Principal

Name of Head: Malata, A. (PhD)

Mandate: to provide teaching, research and consultancy services in various nursing and other health-related disciplines

Senior Administrative Staff: two PhDs, three Master's degrees and four Bachelor's degrees

Scientists: six PhDs, 28 Master's degrees and 14 Bachelor's degrees

Kamuzu College of Nursing was established in 1979 as a constituent college of the University of Malawi. It trains nursing and midwifery personnel.

Faculty of Nursing

▶ **Basic Studies Department**

Mandate: to provide teaching and research in basic studies

Scientists: four PhDs and nine Master's degrees

▶ **Community and Mental Health Nursing Department**

Mandate: to provide teaching, consultancy and research in community and mental health nursing

Scientists: one PhD, six Master's degrees and five Bachelor's degrees

▶ **Maternal and Child Health Nursing Department**

Mandate: to provide teaching, research and consultancy services in maternal and child health nursing

Scientists: five PhDs, six Master's degrees and four Bachelor's degrees



► **Medical/Surgical/Clinical Nursing Department**

Mandate: to provide teaching, research and consultancy services in medical/surgical nursing

Scientists: one PhD, 13 Master's degrees and four Bachelor's degrees

MALAWI POLYTECHNIC

Address: P/Bag 303, Chichiri, Blantyre 3, Malawi

Telephone: +265 1870 411

Fax: +265 1870 578

E-mail Address: registrar@poly.ac.mw

Website: www.poly.ac.mw

Type: Training and Research Institution

Title of Head: Principal

Name of Head: Kululanga, G. Prof. (PhD)

Mandate: to advance knowledge and professional competencies in science, technology commerce and communication through excellence in demand driven education, research, consultancy and outreach

Senior Administrative Staff: two PhDs, two Master's degrees and one Bachelor's degree

Scientists: 22 PhDs, 98 Master's degrees, 68 Bachelor's degrees and seven professional equivalents

Publications: annual report

Malawi Polytechnic is one of the constituent colleges of the University of Malawi, which has been in existence since 1964. Malawi Polytechnic has five faculties, four centres and fifteen departments. These faculties are: the Faculty of Commerce, Faculty of Engineering, Faculty of Applied Sciences, Faculty of Education and Media Studies, Faculty of the Built Environment.

The polytechnic has 15 departments offering undergraduate degrees in the following disciplines: accounting, business administration, management, civil, mechanical and electrical engineering, architecture and land management, environmental management, computing and information technology, journalism, language and communication, mathematics and statistics, physics and biochemical sciences, technical education and quantity surveying. The multidisciplinary nature of the college puts Malawi Polytechnic in a unique position to meet the multifaceted industrial and developmental needs of society.

Currently, Malawi Polytechnic is offering postgraduate programmes in business administration, infrastructure development and transport management, in response to the emerging needs of industry.

The polytechnic's vision is to be a centre of excellence in the provision of scientific and technological education and training for sustainable development. Its mission is to advance knowledge and professional competencies in science, technology, commerce and communication through excellence in demand-driven education, research, consultancy and outreach. The polytechnic has adopted a set of core values that it plans to share among all staff and students: excellence, professionalism, ethics, innovation, equality and learner-centred teaching. These values are expected to drive Malawi Polytechnic's culture and priorities.

Faculty of Commerce

▶ Department of Accountancy

Mandate: to provide tertiary education, research, consultancy and outreach in the fields of finance and accountancy

Scientists: five Master's degrees, four professional equivalents and three Bachelor's degrees

▶ Department of Business Administration

Mandate: to provide tertiary education, research, consultancy and outreach in business: marketing, human resources, procurement and logistics and commercial law

Scientists: two PhDs, eight Master's degrees, three professional equivalents and seven Bachelor's degrees

▶ Department of Management Studies

Mandate: to provide tertiary education, research, consultancy and outreach in the field of management

Scientists: three PhDs and two Master's degrees

Faculty of Engineering

▶ Department of Civil Engineering

Mandate: to provide tertiary education, research, consultancy and outreach in civil engineering

Scientists: two PhDs, eight Master's degrees and two Bachelor's degrees

▶ Department of Electrical Engineering

Mandate: to provide tertiary education, research, consultancy and outreach in electrical engineering

Scientists: one PhD, nine Master's degrees and three Bachelor's degrees

▶ Department of Mechanical Engineering

Mandate: to provide tertiary education, research, consultancy and outreach in mechanical engineering

Scientists: two PhDs, nine Master's degrees, and five Bachelor's degrees

Faculty of Applied Sciences

▶ Department of Mathematics and Statistics

Mandate: to provide tertiary education, research, consultancy and outreach in mathematics and statistics

Scientists: four PhDs, five Master's degrees and 11 Bachelor's degrees

▶ Department of Physics and Biochemical Sciences


Mandate: to provide tertiary education, research, consultancy and outreach in physics, food science and technology and environmental sciences

Scientists: two PhDs, 10 Master's degrees and eight Bachelor's degrees

▶ Department of Environmental Health

Mandate: to provide tertiary education, research, consultancy and outreach in environmental health: community health, pollution control, the built environment, food safety and occupational health and safety

Scientists: one PhD and six Master's degrees



▶ **Department of Computing and Information Technology**

Mandate: to provide tertiary education, research, consultancy and outreach in information technology and systems

Scientists: six Master's degrees and three Bachelor's degrees

Faculty of Education and Media Studies

▶ **Department of Technical Education**

Mandate: to provide tertiary education, research, consultancy and outreach in the fields of technical and vocational education

Scientists: two PhDs, six Master's degrees and five Bachelor's degrees

▶ **Department of Journalism**

Mandate: to provide tertiary education, research, consultancy and outreach in the field journalism

Scientists: one PhD, five Master's degrees and eight Bachelor's degrees

▶ **Department of Language and Communication Studies**

Mandate: to provide tertiary education, research, consultancy and outreach in the field of language and business communication

Scientists: nine Master's degrees and three Bachelor's degrees

Faculty of the Built Environment

▶ **Department of Architecture**

Mandate: to provide tertiary education, research, consultancy and outreach in the field of architecture

Scientists: two Master's degrees and four Bachelor's degrees

▶ **Department of Land and Quantity Surveying**

Mandate: to provide tertiary education, research, consultancy and outreach in the fields of land and quantity surveying

Scientists: one PhD degree, five Master's degrees and six Bachelor's degrees

Associated centres

▶ **Centre for Water and Sanitation**

Mandate: to provide professional training, research and consultancy in water, sanitation and applied technologies

Scientists: one PhD

▶ **Continuing Education Centre**

Mandate: to provide lifelong learning

Scientists: one Master's degree

▶ **Management Development Centre**

Mandate: to provide professional training, research, consultancy and outreach in: finance, commerce, business and management

Scientists: one Master's degree



► **Polytechnic Commercial and Technical Services**

Mandate: to provide professional commercial and technical services

Scientists: one Master's degree

Other universities

There are six more accredited private universities and colleges which offer various programmes. These are:

African Bible College: in 1988, African Bible Colleges established an institution on the outskirts of Lilongwe. The college welcomes students from Zimbabwe, Tanzania, Uganda, Zambia and Mozambique. African Bible College's four-year programme is designed to award its graduates a Bachelor of Arts degree in biblical studies, while giving students an opportunity to minor in either communications or Christian education.

University of Livingstonia (UNILIA): the university's headquarters are located in Livingstonia, along with Livingstonia Technical College and the College of Education, which opened on 27 August 2003. Ekwendeni houses three colleges: College of Commerce, Ekwendeni College of Nursing, Livingstonia Theological College. Students come from church or secular secondary schools.

Blantyre International University


John the Baptist University

Skyway University

Share World Open University

Inventory of Malawi's legal framework for SETI





A country's legal framework represents a collection of legal devices or legal instruments which embody a given policy, or parts of it, in the form of a law, decree or policy regulation. Formal agreements, contracts and international SETI co-operation treaties may also be included in this category. A legal device goes one-step beyond a policy by stipulating obligations, rights, rewards and penalties connected with its observance. The SETI legal framework of the Republic of Malawi is presented hereafter.

NATIONAL LAWS AND ACTS

Acts pertaining to research and innovation

TECHNICAL, ENTREPRENEURIAL, VOCATIONAL EDUCATION AND TRAINING ACT

Date of Enactment: 14 February 1999 (N°6/1999)

Description: this act makes provision for the promotion and co-ordination of technical, entrepreneurial and vocational education and training; the establishment of the Technical, Entrepreneurial and Vocational Education and Training Authority of Malawi; the establishment of a Technical, Entrepreneurial and Vocational Education and Training Fund; the payment into this fund of periodical contributions levied on employers and the application of the fund towards defraying various costs and expenses relating to technical education and training (see also page 103).

SCIENCE AND TECHNOLOGY ACT

Date of Enactment: 14 November 2008 (Cap 30:10 of the Laws of Malawi)

Description: this act provides for the advancement of science and technology in Malawi, the establishment of the National Commission for Science and Technology and for other matters connected and incidental to the preceding objectives. The act also establishes the functions of the NCST: to create awareness of science and technology, source funding and promote and advocate the development of science and technology. The act makes provision for the establishment of the Science and Technology Fund (see page 188). The act also provides for the granting of awards, science- and technology-related and biotechnology-related licenses and permits, as well as penalties for offences. It also establishes an appellate body for handling complaints. The act explicitly states that those who exercise powers under this act shall do so in accordance with the policy statements that may be made from time to time and that they shall consider and treat the *National Science and Technology Policy* and the statements as ranking paramount in the business of the government.

MALAWI UNIVERSITY OF SCIENCE AND TECHNOLOGY ACT

Date of Enactment: 17 December 2012

Description: this act makes provision for the establishment of the Malawi University of Science and Technology as the fourth public university of Malawi (see also page 44).

EDUCATION ACT

Date of Enactment: 6 December 2013 (No.21/2013); repeals the Education Act of 4 March 1962 (CAP 30:01)

Description: this act provides for the establishment, organization, governance, control, regulation and financing of schools and colleges; it also provides for the establishment of both the Teachers Council of Malawi and the Malawi Institute of Education (N.B. the latter was established in 1979 through Government Notice No. 60 of 1979 under the previous Education Act: CAP 30:01).

Acts pertaining to intellectual property rights

PATENTS ACT

Date of Enactment: 1 April 1958 (Cap 49:02 of the Laws of Malawi)

Description: this act specifies what would amount to a patentable invention and the requirements for patentability, the procedure for applying for and granting patents, the registration of patents in Malawi and the regulation of the use of patents. The act generally provides protection for the rights of inventors and inventions. Lastly, the act makes provisions for voluntary licensing, compulsory licensing and for the use of inventions by government.

Link: www.wipo.int/wipolex/en/details.jsp?id=9337

TRADE MARKS ACT

Date of Enactment: 1 April 1958 (Cap 49:01 of the Laws of Malawi)

Description: this act provides for the mode of registration of trademarks and the use of the trademark. Specifically, it provides for the establishment of the Trade Marks Office, registration of trademarks/certification marks and criteria for registrability and the procedure for registration and effect of registration. It also provides for trademark infringement and remedies, and circumstances under which a trademark can be struck off a register, including non-use. The act also makes provision for assignment and licensing of trademarks.

Link: www.wipo.int/wipolex/en/details.jsp?id=9213

COPYRIGHT ACT

Date of Enactment: 22 June 1981 (Cap 49: 03 of the Laws of Malawi).

Description: this act makes provision for copyright in literary, dramatic, musical and artistic works, audio-visual works, sound recordings and broadcasts; the rights of performers and the establishment of the Copyright Society of Malawi. The act also provides for specification of the copyright in different works. The act grants exclusive property rights to the holder. The act also provides for the transferability of copyright and issuance of compulsory licenses.

Link: www.wipo.int/wipolex/en/details.jsp?id=9208

REGISTERED DESIGNS ACT

Date of Enactment: 1 December 1958 (Cap: 49:05)

Description: this act provides, among other things, for the establishment of the designs office and appointment of officers, criteria for registration, the registration process and ownership of designs. It also provides for the effect of registration and infringement of registered designs. The act further provides for use of registered designs by government, especially during emergencies, and the circumstances under which designs can be assigned and cancelled.

Main intellectual property laws enacted by the Legislature (date of current version):

- ▶ Merchandise Marks Act , Chapter 49:04 (1966)
- ▶ Trade Marks Act, Chapter 49:01 (1967)
- ▶ Registered Designs Act, Chapter 49:05 (1985)
- ▶ Patents Act, Chapter 49:02 (1986)
- ▶ Trade Descriptions Act (1987)
- ▶ Copyright Act, 1989 (2001)

Intellectual property-related laws enacted by the Legislature (date of current version):

- ▶ Plant Protection Act (1969)
- ▶ Arts and Crafts Act, Chapter 49:07 (1990)
- ▶ Monuments and Relics Act, Chapter 29:01 (1991)
- ▶ Communications Act (1998)
- ▶ Employment Act, 1999 (2000)
- ▶ Competition and Fair Trading Act (2000)
- ▶ Companies Act, Chapter 46:03 (2000)
- ▶ Fertiliser Act (2003)
- ▶ Consumer Protection Act (2003)
- ▶ Consumer Protection Act (2003)
- ▶ Seeds Act (2005)

Acts pertaining to environmental management and protection

LAND ACT

Date of enactment: 7 June 1965 (Cap 57: 01 of the Laws of Malawi)

Description: this act governs the use and development of public land, private land and customary land in Malawi. The act provides that all public land is vested in perpetuity in the president and the land shall be under the control of the minister who governs the use and occupation of public land. In respect to private land, the ministers may grant a lease for the use of private land subject to certain rates being paid. The acts specifies that all customary land and mineral rights thereto are vested in the president and the minister shall administer and control customary land and mineral rights thereto. Furthermore, the customary land may be acquired for public purposes. The minister has powers to regulate, manage and control the use of the land. The acts also provides for ways of dealing with trespassers, encroachers and those who are in unlawful occupation of the land.

Link: www.malawilii.org/mw/legislation/consolidated-act/5701

MINES AND MINERALS ACT

Date of enactment: 1 June 1981 (Cap 61:01 of the Laws of Malawi)

Description: this act governs the granting of mineral rights to applicants who are citizens of Malawi or have resided in Malawi for a period of not less than four years. It also governs the granting of mineral licenses, exclusive prospecting licenses, reconnaissance licenses and mineral permits; specifies the rules governing the transfer, renewal, amendments suspension and cancellation of licenses; provides for the use of royalties obtained under mineral licenses and mining. The act also mandates license-holders to ensure that they protect the environment, thus rehabilitating damaged areas, controlling pollution and protecting natural resources. The administration of the mines is the responsibility of the commissioner who is appointed by the minister. The government has begun reviewing this act.

Link: www.eisourcebook.org/cms/Malawi%20Mines%20and%20Minerals%20Act.pdf

TOWN AND COUNTRY PLANNING ACT

Date of Enactment: 1 September 1991 (Cap 23:01 of the Laws of Malawi)

Description: this act governs town and country planning generally. It also provides for the national physical development plan that specifically makes plans for urban and rural growth centres, development services and economic use of resources and facilities. The national physical development plan also provides for a

spatial framework for the co-ordination and implementation of development programmes and projects and stipulates guidelines for the development of services and facilities to desirable standards. All proposals for development of public, private and customary land must be granted by the planning authorities. Permits for development may be revoked and an improvement, development, preservation order may be made in respect to any building. The minister may compulsorily or by agreement acquire any building and compensation will be given for any losses.

INDUSTRIAL LICENSING ACT

Date of enactment: 24 January 1992 (Act Cap 51:01 of the Laws of Malawi)

Description: this act provides for the control and regulation of the manufacture of firearms, ammunition and chemical and biological weapon, explosives, hazardous waste and products, the manufacture of which includes use of radioactive material. The Malawi Bureau of Standards holds responsibility for ensuring that there is compliance with set standards. These standards will relate to the standardization of commodities and of the manufacture, production, processing or treatment thereof.

ENVIRONMENT MANAGEMENT ACT

Date of enactment: 21 October 1996 (Cap 60:02 of the Laws of Malawi)

Description: this act makes provision for the protection and management of the environment and the conservation and sustainable utilization of natural resources. The act provides for the execution of an environmental impact assessment and audit to be carried out before a project is implemented. Environmental quality standards, which are based on scientific and environment principles, are to be developed and these shall take into account the practicability and availability of appropriate technology for ensuring compliance with such standards. The act also provides for the conservation of biodiversity, waste management and the control of pollution and the management of hazardous waste.

Link: www.farmersrights.org/pdf/Africa/Malawi/Malawi-environment96.pdf

Acts pertaining to energy

PETROLEUM (EXPLORATION AND PRODUCTION) ACT

Date of Enactment: 30 March 1983 (Cap 61:02 of the Laws of Malawi)

Description: this act makes provision for petroleum exploration and production. The act regulates the granting of licenses and the specific duties of license-holders. On discovery of petroleum, a notice is supposed to be made and commercial interest may be registered before a petroleum production license is granted and royalties are duly paid. Environmental protection must be prioritized in dealing with petroleum.

RURAL ELECTRIFICATION ACT

Date of Enactment: 19 March 2004 (N° 21/2004)

Description: this act concerns installation and maintenance of electricity generation (including generation from renewable sources) and distribution facilities in rural areas and for this purpose establishes the Rural Electrification Management Committee. The act also establishes the Malawi Rural Electrification Fund, which shall be administered by the committee. The act provides for the licensing of rural electrification activities by the Malawi Energy Regulatory Authority.

Link: www.malawilii.org

LIQUID FUELS AND GAS (PRODUCTION AND SUPPLY) ACT

Date of enactment: 28 December 2007 (Cap 50: 03 of the Laws of Malawi)

Description: the act makes provision for the production, blending, extraction, conversion, importation, transformation, transportation, storage, distribution and sale of liquid fuels and gas in a liberalized market and for matters connected therewith or incidental thereto. The act outlines general principles which ensure that the production of gasses or liquids guarantees public safety and that the manner of exploration is done equitably. The act provides for the granting of production licenses and specifies the rules concerning the suspension and revocation of licenses; it specifies the obligations of license-holders and the rules of fair competition to avoid monopolies, protect the environment and the safety of workers.

Link: www.meramalawi.mw/documents/liquid_fuels_and_gas_production_and_supply_act_2004.pdf

ATOMIC ENERGY ACT

Date of Enactment: 18 August 2011 (N° 16/2011)

Description: this act provides for the regulation of activities and practices involving all uses of ionizing radiation, to ensure adequate protection of workers, the public and the environment against the harmful effects of ionizing radiation and for the safety and security of radiation sources. It also provides for the establishment of the Atomic Energy Regulatory Authority and its governance and management. The act makes the Atomic Energy Regulatory Authority responsible *inter alia* for establishing requirements for obtaining a license to conduct the mining and processing of radioactive materials. The act recalls that the *National Energy Policy* of 2003 discourages the development of nuclear power (see page 174). See also the Atomic Energy Regulations of 2012 on page 175.

Acts pertaining to public health

ANATOMY ACT

Date of Enactment: 1 April 1991 (Cap 30:06)

Description: this act provides for the donation, examination and use of bodies, or parts of bodies, of deceased persons for educational, scientific, research, therapeutic or diagnostic purposes. Specifically, it provides for rules governing the anatomical examination of the body, inquests and post-mortem examinations, disposal of bodies examined anatomically, conduct of anatomical examinations and approved schools of anatomy. It also makes provision for the removal of tissue from the bodies of living human beings.

PHARMACY, MEDICINES AND POISONS ACT

Date of Enactment: 15 January 1991 (Cap 35:01)

Description: this act makes provision for the establishment of the Pharmacy, Medicines and Poisons Board, the registration and disciplining of pharmacists, pharmacy technologists and pharmacy assistants, the training within Malawi of pharmacists, pharmacy technologists and pharmacy assistants, the licensing of traders in medicines and poisons and generally for the control and regulation of the pharmaceutical profession in Malawi and for related matters. Specifically, the act provides for clinical trials and the licensing of medical products.

Malawi's general health legislative landscape includes the following:

- ▶ Public Health Act, 1948, last amended in 1998
- ▶ Mental Treatment Act, 1948, last amended in 1969
- ▶ Dangerous Drugs Act, 1956, last amended in 1995

- ▶ Medical Practitioners and Dentists Act, 1987, last amended in 1995
- ▶ Pharmacies, Medicines and Poisons Act, 1988, last amended in 1991
- ▶ Anatomy Act, 1991
- ▶ Nurses and Midwives Act, 1995
- ▶ Occupational Health, Safety and Welfare Act, 1997
- ▶ Local Government Act, 1998

BIOSAFETY ACT

Date of enactment: 5 December 2002

Description: this act provides for the safe management of biotechnological activities and related matters. The act governs the genetic modification of organisms, the importation, development, production, testing, release, use and application of genetically modified organisms and the use of gene therapy in animals, including human beings. The act also outlines principles for the granting and revocation of licenses and permits in respect of biotechnology use. The act also stipulates the rules on labelling of containers and packages of genetically modified organisms or products thereof. It also provides for the regulation of advertisements about genetically modified products. The act is administered by the minister in charge of environmental affairs who is responsible for formulating guidelines on biosafety and conducting inspections and issuing certificates; it provides for the establishment of a fund to ensure the safe management of biotechnological activities.

Link: www.malawilii.org/mw/legislation/consolidated-act/6003

NATIONAL REGULATIONS AND POLICIES

NATIONAL SCIENCE AND TECHNOLOGY POLICY

Date of Enactment: 1991, revised in 2002

Description: see pp. 89 and 100.

NATIONAL ENVIRONMENTAL POLICY

Date of Enactment: 1996, revised in June 2004

Description: this policy is based on the *National Environmental Action Plan*, with the Environment Management Act providing legislative support (see page 171). The policy recognizes the need to operationalize the Environmental Appeals Tribunal provided for under the act and to establish guidelines for environmental impact assessments. The policy sets out to facilitate the establishment and maintenance of Village, Area and District Environmental Committees and District Environmental Action Plans, as well as an Environment Fund. It outlines a strategy to encourage and finance both basic and applied research programmes related to the environment and to develop and regularly update an appropriate legal and institutional framework. These research programmes are to be regulated to ensure benefits for the nation and technology transfer. Training is to be provided in specialized areas of environmental management, an environmental component is to be included in the training offered at all institutions and all extension officers in line ministries and NGOs are to be trained and re-oriented, in order to facilitate community involvement in natural resource management. An environmental awareness and education programme is also to be implemented at all levels of the education system.

Link: www.chmmw.org/publications/mwnep.pdf

ICT POLICY FOR MALAWI

Date of Enactment: December 2013

Description: the *ICT Policy for Malawi* (Republic of Malawi, 2013a) was launched in December 2013, together with the *Malawi Digital Broadcasting Policy*. The *ICT Policy for Malawi* aims to mainstream ICTs in all economic sectors to drive implementation of the *Malawi Growth and Development Strategy* (MGDS) II. It also sets out to put an appropriate institutional, regulatory and legal framework in place, in order to support the successful deployment of these technologies in all economic and productive sectors (see page 36).

MINES AND MINERALS POLICY

Date of Enactment: March 2013

Description: the *Mines and Minerals Policy* expresses the government's desire to raise the share of mining in GDP from 10% at present to at least 20%, by developing the country's mining potential. The policy stresses the need for private sector involvement to attract modern technologies and investment. The policy evokes the following acts which regulate the mining sector in Malawi: the Petroleum (Exploration and Production) Act (see page 171), the Mines and Minerals Act (see page 170) and the Explosives Act (1968). The government undertakes to: facilitate the establishment of appropriate training and research institutions, in order to secure the necessary skills and modern technologies in this field; ensure that the curricula of higher learning institutions include the capacity needs of the minerals sector and; encourage training, research and development institutions to collaborate with the mining sector to ensure that research is relevant to it. The policy includes an Implementation Plan and a Monitoring and Evaluation Plan. The policy is to be reviewed every five years.

MINES AND MINERALS REGULATIONS

Description: these regulations govern disputes in respect to minerals and the procedure to be followed in the hearing of such disputes. There are also regulations in respect to mineral rights, which specify the shape of the area where a mineral right is granted, the dimensions of the mineral right and the demarcations of the mining area. There are further regulations on fees, non-exclusive prospecting licences, prescribed minerals, reserved minerals, royalties and safety in operations.

NATIONAL ENERGY POLICY

Date of Enactment: January 2003

Description: the *National Energy Policy* is Malawi's first energy policy. It expresses the government's desire to improve the efficiency and effectiveness of energy supply industries and the reliability of energy supply systems, while increasing access to modern energy services, enhancing economic development and rural transformation, improving energy sector governance and mitigating the environmental, safety and health impacts of energy production and utilization. The policy discourages the use of nuclear power and proposes reducing the reliance on biomass from 95% in 2000 to 50% in 2000, by increasing the share of renewable sources from 0.2% to 7.0% of the energy mix, that of liquid fuels from 3.5% to 7.0%, that of coal from 1.0% to 6.0% and that of electricity from 2.3% to 30.0%. The plan foresees the development of a national energy implementation plan and a legal framework that includes a liquid fuels and gas act (see page 172) and a rural electrification act (see page 171). This policy resulted in the formation of the Malawi Energy Regulatory Authority and influenced the restructuring of the Electricity Supply Corporation of Malawi.

ATOMIC ENERGY REGULATIONS

Date of Enactment: 31 August 2012

Description: these regulations specify the basic requirements for protecting people from exposure to ionizing radiation. They also specify the basic requirements for the safety of radiation sources, for safe radioactive waste management and for environmental protection. The regulations aim to prevent 'unlicensed access or damage to, and loss, theft or unlicensed transfer of radioactive sources, so as to reduce the likelihood of accidental harmful exposure to such sources' (see Regulation 3(1)(b)). See the Atomic Energy Act on page 172.

BIOSAFETY (MANAGEMENT OF GENETICALLY MODIFIED ORGANISMS) REGULATIONS

Date of Enactment: 2007 (G.N. 30/2007)

Description: these regulations made under s. 41 of the Biosafety Act (see page 173) operationalize some of the act's provisions. Among other things, the regulations establish the institutional framework for biosafety management. They also make provision for licenses and permits for the trial and contained release of biotechnology products, the general release of genetically modified organisms, for risk assessment and public access to information, as well as requirements for effective management of GMO-related waste.

ENVIRONMENT MANAGEMENT (MANAGEMENT OF OZONE DEPLETING SUBSTANCES) REGULATIONS

Date of Enactment: 1996

Description: these regulations made under s. 41 of the Environment Management Act (see page 171) make provision for the importation, exportation and distribution of ozone depleting substances. The regulations also ban engagement in investment projects using ozone depleting substances.

ENVIRONMENT MANAGEMENT (CHEMICALS AND TOXIC SUBSTANCES MANAGEMENT) REGULATIONS

Date of Enactment: 2008 (G.N. 12/2008)

Description: these regulations make provision for controlling the manufacturing and packaging of toxic substances.

NATIONAL BIOTECHNOLOGY AND BIOSAFETY POLICY

Date of Enactment: June 2008

Description: the *National Biotechnology and Biosafety Policy* expresses the government's desire to develop capacity in biotechnology, in order to increase agricultural productivity; enhance human health and nutritional well-being; conserve biodiversity, natural resources and the environment; and create wealth through commercialization and trade in products and services derived from biotechnology. The policy aims to strengthen existing institutions, in order to facilitate the safe acquisition, development and application of biotechnology. The development of the policy underscores Malawi's commitment to international instruments relating to biotechnology to which the country is a party and signatory. These instruments include the International Undertaking on Plant Genetic Resources for Food and Agriculture and the Cartagena Protocol on Biosafety to the Convention on Biological Diversity. The *National Biotechnology and Biosafety Policy* relates well to other sectoral policies. Of particular importance are the *National Science and Technology Policy*, *National Environmental Policy* and the Consumer Protection Act.

Implementing rules and regulations on intellectual property (date of current version):

- ▶ Trade Marks (Agents' Fees) Regulations (1962)
- ▶ Patents (Agents' Fees) Regulations (1963)
- ▶ Trade Marks (Tribunal) Rules (1967)
- ▶ Patents Tribunal Rules (1967)
- ▶ Trade Marks Regulations (1981)
- ▶ Patents Regulations (1992)
- ▶ Registered Designs Regulations (1997)
- ▶ Registered Designs (Tribunal) Rules (2000)
- ▶ Procedures and Guidelines for Access and Collection of Genetic Resources in Malawi (2003)
- ▶ Fertilizers Regulations (2003)
- ▶ Copyright (Production, Importation and Distribution of Sound and Audio Visual Recordings) Licensing Regulations, 2007 (2008)

INTERNATIONAL AGREEMENTS ON SETI MATTERS

ETHIOPIA

Malawi and Ethiopia signed an economic, trade, cultural and technical co-operation agreement in January 2006 in order to strengthen the two countries' long-standing bilateral relations. The agreement served to formalize trade between the two countries, which had been engaged in informal trade since 1965. Malawi's Foreign Affairs and International Co-operation Minister commented that Ethiopia was well advanced in the leather and handcraft industry, from which Malawi could benefit.

Link: www.malawi.gov.mw/story.php?id=34

NORWAY

Norway and Malawi signed a memorandum of understanding in October 2000, with the overall objective of alleviating poverty in Malawi. The agreed programmes focused on good governance, HIV/AIDS, macro-economic reform and health sector development. Although agriculture was not defined as a priority area, Norwegian assistance has always contributed to applied research in the agricultural sector.

Link: www.norway.mw/development/agreement/agreement.htm

JAPAN

The Governments of Malawi and Japan signed in 2006 a technical co-operation agreement. The agreement, among others, provided a solid base for the continuation of the Japanese Technical Co-operation. The latter initiative serves to transfer specialised technical expertise to various sectors of the Malawian economy, e.g. telecommunications, transport, civil aviation, fisheries, health and agriculture.

Link: www.nationmalawi.com/print.asp?articleID=15533

SOUTH AFRICA

The Governments of South Africa and Malawi signed an agreement on bilateral co-operation on 7 May 2007.

Link: www.info.gov.za/speeches/2007/07050714151001.htm

MOZAMBIQUE

A Memorandum of Understanding between the Governments of the Republic of Malawi and the Republic of Mozambique on co-operation in science, technology and innovation, was signed on 3 April 2013. The parties will co-operate in the following areas: agriculture, marine science, science parks and industrial clusters, biotechnology, ethno-botany, information and communication technology, scientific research and innovation, development of human resources, exchange of experts in matters of science and technology and technology transfer.

MULTILATERAL CO-OPERATION

SOUTHERN AFRICAN BIOSCIENCES HUB

Description: bioscience activities in Malawi form part of the Southern African Biosciences Hub, which is located at the CSIR in Pretoria. It is a NEPAD initiative under the NEPAD Science and Technology Programme. The initial focus is to drive regional co-operation in Southern Africa, with a long-term vision of creating synergy among all four regional hubs in Africa (i.e. Southern, West, Central and East and North Africa).

Link: www.csir.co.za/plsql/ptl0002/PTL0002_PGE013_MEDIA_REL?MEDIA_RELEASE_NO=7303835

SADC PROTOCOL ON SCIENCE, TECHNOLOGY AND INNOVATION

Description: the overall objective of this protocol is to foster co-operation and promote the development, transfer and mastery of STI in member states in order to: (a) establish institutional mechanisms to strengthen regional co-operation and co-ordination of STI; (b) institute management and co-ordination structures with clearly defined functions which will facilitate the implementation of regional STI programmes; (c) pool resources for R&D and innovation within the region; (d) optimise public and private investment in R&D within the region and leverage external contributions; (e) demystify STI by promoting public understanding and awareness and meaningful participation in these disciplines. Under the protocol, member States commit themselves to forging strong partnerships with the African diaspora with a view to advancing the region's scientific and technological development.

UNITED NATIONS CONVENTIONS

Malawi is signatory to leading international conventions that include the United Nations Convention on Biological Diversity and the Kyoto Protocol to the United Nations Framework Convention on Climate Change. These conventions are an international response to a global environmental crisis that is largely attributed to a global population explosion, unsustainable consumption patterns and humanity's over-reliance on fossil fuels.

- ▶ United Nations Convention on Biological Diversity (3 May 1994)
- ▶ Kyoto Protocol to the United Nations Framework Convention on Climate Change (16 February 2005)

REGIONAL WIPO-ADMINISTERED TREATIES

Below is a summary table of membership of the World Intellectual Property Organization (WIPO) and the treaties administered by WIPO, plus UPOV, the World Trade Organization and the United Nations. The date given in each case corresponds to the entry into force of the treaty for the Contracting Party.

- ▶ Paris Convention for the Protection of Industrial Property (6 July 1964)
- ▶ Agreement on the Importation of Educational, Scientific and Cultural Materials (17 November 1965)
- ▶ Universal Copyright Convention of 6 September 1952, with Appendix Declaration relating to Article XVII and Resolution concerning Article XI (26 October 1965)
- ▶ Convention on Transit Trade of Land-locked States (9 June 1967)
- ▶ Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (5 July 1968)
- ▶ Convention (II) for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea (5 July 1968)
- ▶ Convention (IV) relative to the Protection of Civilian Persons in Time of War (5 July 1968)
- ▶ Convention Establishing the World Intellectual Property Organization (11 June 1970)
- ▶ Patent Co-operation Treaty (24 January 1978)
- ▶ Convention concerning the Protection of the World Cultural and Natural Heritage (5 April 1982)
- ▶ Berne Convention for the Protection of Literary and Artistic Works (12 October 1991)
- ▶ Protocol (I) Additional to the Geneva Conventions of 12 August 1949 and relating to the protection of victims of international armed conflicts (7 April 1992)
- ▶ Protocol (II) Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (7 April 1992)
- ▶ United Nations Framework Convention on Climate Change (20 July 1994)
- ▶ Convention on Biological Diversity (3 May 1994)
- ▶ International Covenant on Economic, Social and Cultural Rights (22 March 1994)
- ▶ Property Rights (TRIPS Agreement) (1994) (31 May 1995)
- ▶ Locarno Agreement Establishing an International Classification for Industrial Designs (24 October 1995)
- ▶ Nice Agreement Concerning the International Classification of Goods and Services for the Purposes of the Registration of Marks (24 October 1995)
- ▶ Agreement establishing the World Trade Organization (WTO, 31 May 1995)
- ▶ World Trade Organization (WTO) Agreement on Trade-Related Aspects of Intellectual
- ▶ Strasbourg Agreement Concerning the International Patent Classification (24 July 1996)
- ▶ IP-related Multilateral Treaties (Entry into force of the Treaty for the Contracting Party)
- ▶ Convention and Statute on Freedom of Transit ...
- ▶ International Treaty on Plant Genetic Resources for Food and Agriculture (29 June 2004)
- ▶ International Plant Protection Convention (2 October 2005)
- ▶ Kyoto Protocol to the United Nations Framework Convention on Climate Change (16 February 2005)
- ▶ Convention on the Protection and Promotion of the Diversity of Cultural Expressions 2005 (16 June 2010)
- ▶ Convention on the Rights of Persons with Disabilities (26 September 2009)
- ▶ Cartagena Protocol on Biosafety to the Convention on Biological Diversity (28 May 2009)
- ▶ Stockholm Convention on Persistent Organic Pollutants (28 May 2009)
- ▶ United Nations Convention on the Law of the Sea (28 October 2010)
- ▶ Convention for the Safeguarding of the Intangible Cultural Heritage (16 June 2010)
- ▶ Convention relating to the Status of Stateless Persons (5 January 2010)

REGIONAL TREATIES ON INTELLECTUAL PROPERTY RIGHTS

LUSAKA AGREEMENT ON THE CREATION OF THE AFRICAN REGIONAL INTELLECTUAL PROPERTY ORGANISATION (ARIPO)

Adopted: 9 December 1976 in Lusaka

Description: Malawi became a State Party to this agreement establishing ARIPO on 15 February 1978. The objectives of ARIPO are, *inter alia*: to promote the harmonisation and development of intellectual property laws and matters related thereto, appropriate to the needs of its members and those of the region as a whole, and to promote – within its member states – the development of copyright and related rights, ensuring that these rights contribute to the economic, social and cultural development of members and of the region as a whole. The organisation has the following organs: Council of Ministers, Administrative Council and the Secretariat.

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=21&treaty_id=202

HARARE PROTOCOL ON PATENTS AND INDUSTRIAL DESIGNS WITHIN THE FRAMEWORK OF THE AFRICAN REGIONAL INDUSTRIAL PROPERTY ORGANISATION (ARIPO)

Adopted: 25 April 1984

Description: Malawi became a State Party to this protocol on 25 April 1984. The agreement empowers ARIPO to grant patents and register utility models and industrial designs and to administer these on behalf of the contracting states. The protocol also details the application process and requirements for applicants.

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=21&treaty_id=204

CULTURAL CHARTER FOR AFRICA

Adopted: 5 July 1976

Description: this charter was adopted by Heads of State and Government of the Organization of African Unity on 5 July 1976. Malawi became a State Party to this charter on 19 September 1990. The charter sets out to rehabilitate, restore, preserve and promote African cultural heritage and to encourage cultural co-operation among states, in order to strengthen African unity. It also sets out to promote popular knowledge of science and technology in each country.

Link: http://au.int/en/sites/default/files/CULTURAL_CHARTER_AFRICA.pdf

BANJUL PROTOCOL ON MARKS WITHIN THE FRAMEWORK OF THE AFRICAN REGIONAL INDUSTRIAL PROPERTY ORGANISATION (ARIPO)

Adopted: 6 March 1997

Description: this protocol entrusts ARIPO with the registration of marks and the administration of the same on behalf of the contracting states. It sets out the application process for the filing of marks and the requirements for applicants.

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=21&treaty_id=203



TREATIES RELATED TO REGIONAL ECONOMIC INTEGRATION

The Georgetown Agreement (formally establishing the African, Caribbean and Pacific Group of States, the “ACP Group”), since 1975 (12 February 1976)

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=24&treaty_id=220

Global System of Trade Preferences among Developing Countries (19 April 1989)

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=24&treaty_id=432

Treaty establishing the Southern African Development Community (30 September 1993)

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=24&treaty_id=299

Treaty Establishing the Common Market for Eastern and Southern Africa (8 December 1994)

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=24&treaty_id=218

Abuja Treaty Establishing the African Economic Community (12 May 1994)

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=24&treaty_id=217

Protocol on Trade in the SADC (25 January 2000)

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=24&treaty_id=312

Constitutive Act of the African Union (26 May 2001)

Link: www.wipo.int/wipolex/en/other_treaties/details.jsp?group_id=24&treaty_id=221

OTHER TREATIES

IP-relevant bilateral treaties (Entry into force of the Treaty for the Contracting Party): Agreement on encouragement and reciprocal protection of investments between the Government of the Republic of Malawi and the Government of the Kingdom of the Netherlands (1 November 2007)

Bilateral investment agreements with: Taiwan (22 April 1995), Malaysia (5 September 1996), Egypt (21 October 1997), Zimbabwe (4 July 2003), Italy (28 August 2003) and the Netherlands (11 December 2003).

Double taxation agreements (income and capital) with: Sweden (25 November 1954), United Kingdom (25 November 1955), Denmark (17 January 1959); France (5 November 1963), Norway (16 December 1963), Switzerland (3 May 1965), Netherlands (7 June 1969) and South Africa (3 May 1971).

Inventory of SETI operational policy instruments in Malawi



Malawi has 15 SETI operational policy instruments. These are presented in the tables overleaf. In general, each individual SETI operational policy instruments has either one or several specific objectives and goals which correspond to the standard categories adopted within the GO→SPIN methodological approach.

Figure 33 shows the distribution of SETI operational policy instruments in Malawi which are now in operation and those which were recently phased out (not included in the first group).

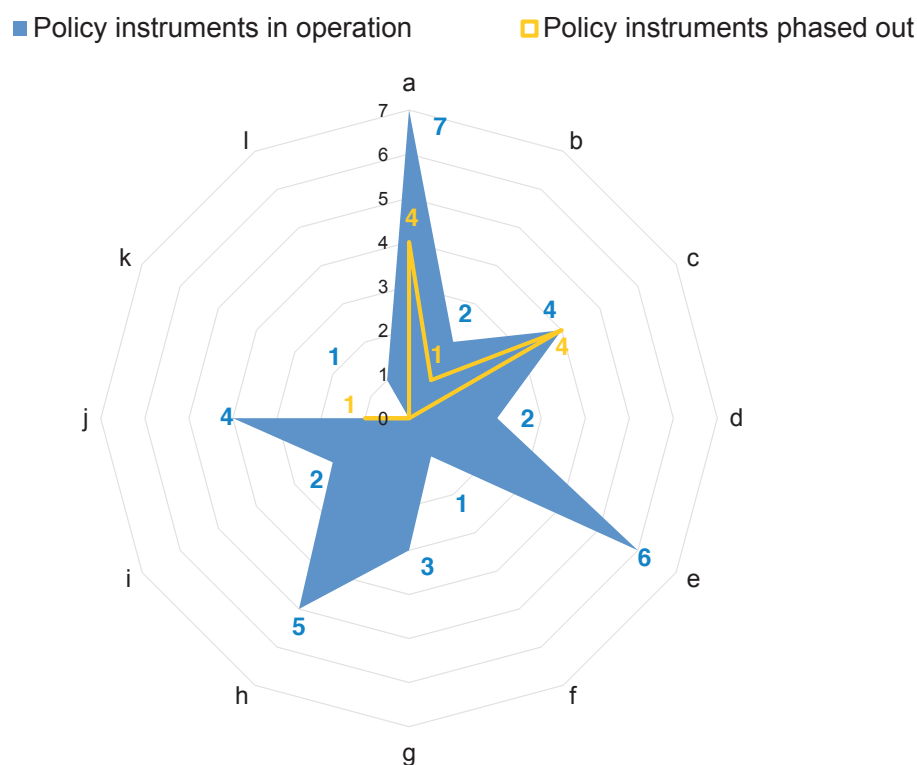


Figure 33: Distribution of SETI operational policy instruments in Malawi, according to the GO→SPIN categories of objective and goal. Source: UNESCO

Key

- a. Strengthening the production of new endogenous scientific knowledge
- b. Strengthening the infrastructure of research laboratories in the public and private sectors
- c. Human resources for research, innovation and strategic planning. Capacity building, education and training of specialized human capital for (1) the production of new scientific knowledge, (2) development of new technologies, (3) promotion of innovation within the productive and services systems and (4) management of the knowledge society
- d. Strengthening gender equality for research and innovation
- e. Strengthening the social appropriation of scientific knowledge and new technologies
- f. Development of strategic technological areas and new niche products and services with high- added value. Promotion and development of innovation in the production of goods and services. Promotion of start-ups in areas of high technology
- g. Strengthening programmes on science education at all levels (from primary school to postgraduate)
- h. Promotion of the development of green technologies and social-inclusion technologies.
- i. Promotion of indigenous knowledge systems
- j. Research and innovation eco-system: strengthening co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific technological and productive innovation system (i.e. government, university and productive sectors)
- k. Strengthening the quality of technology foresight studies to: assess the potential of high-value markets; develop business plans for high-tech companies; construct and analyse long-term scenarios and; provide consulting services and strategic intelligence
- l. Strengthening regional and international co-operation, networking and promotion of SETI activities.

SETI OPERATIONAL POLICY INSTRUMENT 1

- ▶ **Title of the SETI operational policy instrument:** Agricultural Research and Development Programme (ARDEP) Competitive Research Grant Scheme (2008–2011), currently known as Capacity-Building for Managing Climate Change (CABMACC) in Malawi (2014–2018)
- ▶ **Keywords:** research grants, socio-economic development, call for proposals
- ▶ **Overview:** to reduce poverty and vulnerability among the poorest groups and improve quality of life and social well-being of Malawians through a powerful, effective and efficient national research and outreach system for the agricultural sector of Malawi
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:**
 - (a) to increase agricultural production, utilisation of, and access to food as well as natural resources in Malawi through high-quality demand-driven agricultural research;
 - (b) to facilitate and promote widespread uptake of relevant and appropriate interventions through a pluralistic and demand-driven outreach system;
 - (c) to identify and promote the implementation of ready technologies or best practices that address poverty reduction, food and nutrition security, and efficient natural resources management, especially in women and HIV/AIDS affected households;
 - (d) to enhance the capacity of Malawians to co-ordinate, manage and implement agricultural research and outreach programmes
- ▶ **Specific objectives²⁰(*):** a. to strengthen the production of new endogenous scientific knowledge; c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialized human capital for the production of new scientific knowledge; development of new technologies; promotion of innovation within the productive and services systems and; management of the knowledge society; d. to strengthen gender equality for research and innovation; e. to strengthen the social appropriation of scientific knowledge and new technologies; h. to promote the development of green technologies and social-inclusion technologies; j. research and innovation eco-system: strengthen co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific, technological and productive innovation system (i.e. government, university and productive sectors)
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** research grants, scholarships, farmer competitions and trophies, subsidized farm inputs and livestock
- ▶ **Conditions for applying for the instrument:** (a) suitably qualified (at least an MSc degree) in the relevant field of research being proposed; (b) experience in managing research grants; (c) multi-institutional collaborative research projects with at least three institutions; (d) projects to have both research and outreach components; (e) projects to address cross cutting issues such as gender equality and HIV and AIDS; (f) short duration projects and should show potential for impact at local level.
- ▶ **Target groups/Beneficiaries:** (a) local community members and their leaders; (b) students; (c) women, the elderly, people living with HIV and AIDS and widows/ widowers; (d) teachers / researchers; (e) universities and educational organizations; (f) research centres; (g) groups of independent researchers; (h) public or private non-profit organizations: (i) individuals; (j) co-operatives.
- ▶ **Eligibility/Selection criteria:** proposed projects should be in accordance with the national research priorities, should be technically and financially sound and environmentally sustainable. Researchers and scientists had to submit a concept note in specified format. Successful concept notes after a rigorous review were recommended for full proposal development. A panel of reviewers selected the successful project proposals and the ARDEP Board awarded the grants to the successful teams.
- ▶ **Eligible costs:** each project to have a budget that specifies; Human resources, research expenses, post graduate students, travel, accommodation, Institutional costs and monitoring and evaluation.

20 (*) The respondent to the GO→SPIN questionnaire selects specific fields from among the standard categories for objectives and goals that have been defined for the GO→SPIN platform.

- ▶ **Source of funding:** ARDEP programme funds
- ▶ **Mode of disbursement of financial resources:** disbursed to financial accounting officers of research institutions
- ▶ **Annual budget:** approximately NoK 7.5 million (Norwegian Kronas)
- ▶ **Continuity of the instrument over time:** this instrument was in operation from 2008 to 2011 under the name of Agricultural Research and Development Programme Competitive Research Scheme; for the period 2014–2018, it has been replaced by the Capacity-Building for Managing Climate Change in Malawi programme succeeded by Capacity Building for Managing Climate Change in Malawi (CABMACC) covering 2014 to 2017
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** (1) number of research and outreach projects funded; (2) number of joint workshops and activities leading to development of proposals for prioritised research and outreach activities, (3) number of exchange visits with partners between Norway and Malawi; (4) out of the required MSc and PhD students from stakeholder institutions, at least 7 MSc and 4 PhD students receive their degree by the end of the Programme period through ARDEF competitive grants (funding the research component) and RUFORUM (providing the scholarship fees) producing at least 5-6 research outputs (technologies) relevant to ARDEP priorities; increased participation and consultations between ARDEP and other agricultural initiatives and structures in stakeholder institutions; (6) at least 1-2 research and outreach projects funded by the government initiated and implemented before the end of the implementation phase
- ▶ **Relevant link:** www.bunda.lunamar.mw

SETI OPERATIONAL POLICY INSTRUMENT 2

- ▶ **Title of the SETI operational policy instrument:** Malawi Award for Scientific and Technological Achievement (MASTA)
- ▶ **Keywords:** invention, discovery, social economic progress, Malawi
- ▶ **Overview:** the Malawi Award for Scientific and Technological Achievement is conferred upon any person within Malawi who makes an invention or discovery which, in the opinion of the awards committee, is likely to promote and accelerate the social and economic progress of Malawi
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** (i) achieve meaningful socio-economic development through the utilization of science, technology and innovation; (ii) develop and raise the national productive capacity and improve competitiveness through the efficient application of technologies; (iii) promote and develop traditional, endogenous, new and innovative technologies and; (iv) create knowledge and awareness to improve and develop the scientific and technological culture of Malawians.
- ▶ **Specific objectives (*):** a. to strengthen the production of new endogenous scientific knowledge. e. to strengthen the social appropriation of scientific knowledge and new technologies; h. to promote the development of green technologies and socially inclusive technologies; i. to promote indigenous knowledge systems
- ▶ **Sectoral or horizontal approach of the instrument:** horizontal
- ▶ **Mode of support/Type of mechanism:** annual award
- ▶ **Conditions for applying for the instrument:** to apply the instrument effectively, the researcher should come up with an invention or innovation
- ▶ **Target groups/Beneficiaries:** all researchers / inventors / innovators in all disciplines in Malawi

- ▶ **Eligibility/Selection criteria:** all inventors and innovators are eligible to apply if they come up with inventions and or innovations
- ▶ **Eligible costs:** n/a
- ▶ **Source of funding:** public funding
- ▶ **Mode of disbursement of financial resources:** a cheque is issued to the successful inventor / innovator
- ▶ **Annual budget:** n/a
- ▶ **Continuity of the instrument over time:** ongoing
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** four outstanding researchers in the fields of agricultural biotechnology (2) and medical research (2) have been awarded the grants
- ▶ **Relevant link:** www.ncst.mw

SETI OPERATIONAL POLICY INSTRUMENT 3

- ▶ **Title of the SETI operational policy instrument:** National Schools Science Fair
- ▶ **Keywords:** science fairs, inculcation of scientific culture, innovative ideas
- ▶ **Overview:** the former National Research Council of Malawi (now the National Commission for Science and Technology) introduced science fairs, which are held every year. At the fair, secondary school pupils display inventions, technology and innovation from their practical work. The outstanding displays are ranked first, second and third and prizes are awarded. The prizes are given both to the individual student and his/her institution.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** there is a provision for national schools science fairs in the 2002 *Revised Science, Technology and Innovation Policy* and Science and Technology Act of 2003. The main objective is to promote the development of science, technology and innovation among secondary school students while they are still very young.
- ▶ **Specific objectives (*):** e. to strengthen the social appropriation of scientific knowledge and new technologies; g.to strengthen science education programmes at all levels (from primary school to postgraduate)
- ▶ **Sectoral or horizontal approach of the instrument:** horizontal
- ▶ **Mode of support/Type of mechanism:** annual award
- ▶ **Conditions for applying for the instrument:** no conditions attached, all secondary schools that teach science are eligible to participate
- ▶ **Target groups/Beneficiaries:** secondary school science students
- ▶ **Eligibility/Selection criteria:** scientific research that is innovative and can be applied to problem-solving
- ▶ **Eligible costs:** n/a
- ▶ **Source of funding:** public funding
- ▶ **Mode of disbursement of financial resources:** a cheque is awarded
- ▶ **Annual budget:** n/a
- ▶ **Continuity of the instrument over time:** ongoing
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** so far, 25 schools have been awarded trophies and first, second and third prizes
- ▶ **Relevant link:** www.ncst.mw

SETI OPERATIONAL POLICY INSTRUMENT 4

- ▶ **Title of the SETI operational policy instrument:** Secondary Schools Girls' Award
- ▶ **Keywords:** Malawi national examinations, outstanding performance, girls, awards, scholarships
- ▶ **Overview:** the former National Research Council of Malawi used to reward students who performed extraordinarily well in the Malawi School Certificate of Education examinations. Since these awards were phased out in 2010, Zodiak, one of the private radio stations, has taken them over. Students receive prize money as individuals and are awarded scholarships to study at universities abroad in the USA, Russia, China, UK, etc. The fields of study include law, engineering and medicine.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to encourage young girls attain excellence in their final examinations at secondary school
- ▶ **Specific objectives (*):** a. to strengthen the production of new endogenous scientific knowledge; c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialised human capital for (1) the production of new scientific knowledge; (2) development of new technologies; (3) promotion of innovation within the productive and services systems and; (4) management of the knowledge society; d. Strengthening gender equality for research and innovation; e. to strengthen the social appropriation of scientific knowledge and new technologies; g. to strengthen science education programmes at all levels (from primary school to postgraduate)
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral (gender equity)
- ▶ **Mode of support/Type of mechanism:** annual cash prizes and scholarships
- ▶ **Conditions for applying for the instrument:** students who perform exceptionally well (distinctions) in all the best six subjects. Selection of the deserving students is done immediately after the Malawi School Certificate of Education Results are announced.
- ▶ **Target groups/Beneficiaries:** girls who are school-leavers
- ▶ **Eligibility/Selection criteria:** outstanding performance during the Malawi School Certificate of Education examinations
- ▶ **Eligible costs:** prize money of up to US\$1,000 per student and scholarships to world class universities in Europe and the USA
- ▶ **Source of funding:** public funding/ Zodiak Private Radio; the programme is being sustained by private sector participation.
- ▶ **Mode of disbursement of financial resources:** n/a
- ▶ **Annual budget:** variable, depending upon the number of students who qualify
- ▶ **Continuity of the instrument over time:** ongoing
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** the number of girls passing with distinction is increasing and a larger number of students are thus being offered scholarships.
- ▶ **Relevant link:** www.zodiak.mw

SETI OPERATIONAL POLICY INSTRUMENT 5

- ▶ **Title of the SETI operational policy instrument:** Norwegian High Education Development Programme
- ▶ **Keywords:** multi-centre research consortium, MSc and PhD (nursing and midwifery) scholarships; development of novel midwifery training programme, competitive research grants
- ▶ **Overview:** Malawi (through Kamuzu College of the University of Malawi), in partnership with the University of Zambia's School of Medicine and the University of Zimbabwe's College of Health Sciences, with mentorship from The Arctic University of Norway and Oslo University, has been awarded a grant by the Norwegian Agency for Development Co-operation to implement Project QZA-0484 NORHED 2013: Development of a novel nursing and midwifery graduate and postgraduate training programme in Malawi, Zambia and Zimbabwe. This is a Norwegian Programme on Higher Education Development (NORHED) project which will run for five years (2014–2018) with funding from the Norwegian Government. The project aims at addressing gaps in the training of nurses and midwives and enhance use of research to provide evidence based practice that grants quality health care in Malawi, Zambia and Zimbabwe with mentorship from Universities of Tromso and Oslo in Norway.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to develop human resources in STI, improve the quality of health care in Malawi and develop a novel, competence- and evidence-based nursing and midwifery curricula at MSc and PhD levels
- ▶ **Specific objectives (*):** a. to strengthen the production of new endogenous scientific knowledge; c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialised human capital for (1) the production of new scientific knowledge; (2) development of new technologies; (3) promotion of innovation within the productive and services systems and; (4) management of the knowledge society; g. to strengthen science education programmes at all levels (from primary school to postgraduate); l. to strengthen regional and international co-operation, networking and promotion of SETI activities
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral, the benefits go to all health and health-related research in Malawi
- ▶ **Mode of support/Type of mechanism:** research grants; MSc and PhD scholarships; project grants
- ▶ **Conditions for applying for the instrument:** all faculties in the three participating institutions
- ▶ **Target groups/Beneficiaries:** all nurses and midwives and researchers in health and health-related fields
- ▶ **Eligibility/Selection criteria:** be a member of the three participating faculties and academic performance.
- ▶ **Eligible costs:** research funds, salaries and scholarships
- ▶ **Source of funding:** Royal Norwegian Government
- ▶ **Mode of disbursement of financial resources:** project funds are disbursed annually
- ▶ **Annual budget:** NoK5.5 million per year for five years
- ▶ **Continuity of the instrument over time:** the programme will be sustained through the capacity that will be developed
- ▶ **Geographical coverage:** regional: Malawi, Zambia and Zimbabwe
- ▶ **Results, outcome and evidence of success of a given measure:** 14 faculty trained to PhD level; 20 faculty trained to MSc level; guidelines and procedures established for a Competitive Research Grant Scheme; BSc (Nursing and Midwifery) revised; MSc (Midwifery) revised; PhD programme developed; multi-centre research project conducted; individual research grants awarded to faculty
- ▶ **Relevant links:** www.unima.mw and www.norhed.no



SETI OPERATIONAL POLICY INSTRUMENT 6

- ▶ **Title of the SETI operational policy instrument:** Science and Technology Fund
- ▶ **Keywords:** grants, subventions, competitive research and development grants
- ▶ **Overview:** the national Science and Technology Fund was established by the Government of Malawi through the national Science and Technology Act of 2003. The purpose of the fund is to take a pluralistic approach to science and technology. The fund is intended to sponsor high-quality research projects and sustain donor-funded projects once the donor has been phased out the project.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to finance, by way of loans or grants, any research or study carried out on behalf of, by or for the benefit of persons or organizations engaged in research related to the development of science, technology and innovation; to finance, by way of loans or grants, the training of Malawians for the benefit of organizations engaged in research in the development of SETI; to provide support for applying the results R&D in compliance with national priorities and: to commission research projects of national importance
- ▶ **Specific objectives (*):** a. to strengthen the production of new endogenous scientific knowledge; b. to strengthen the infrastructure of research laboratories in the public and private sectors; c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialised human capital for (1) the production of new scientific knowledge; (2) development of new technologies; (3) promotion of innovation within the productive and services systems and; (4) management of the knowledge society
- ▶ **Sectoral or horizontal approach of the instrument:** horizontal
- ▶ **Mode of support/Type of mechanism:** research grants, loans
- ▶ **Conditions for applying for the instrument:** all researchers and research institutions in Malawi, according to the quality and pertinence of the project and national prioritization
- ▶ **Target groups/Beneficiaries:** all researchers and research institutions
- ▶ **Eligibility/Selection criteria:** researchers and institutional qualifications, project quality, pertinence and national prioritization
- ▶ **Eligible costs:** research costs, technological development costs
- ▶ **Source of funding:** government subvention, loans, grants, levies, licenses and permits
- ▶ **Mode of disbursement of financial resources:** n/a
- ▶ **Annual budget:** n/a
- ▶ **Continuity of the instrument over time:** it is planned for the programme to be self-sustained through the National Commission for Science and Technology
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** not in operation
- ▶ **Relevant link:** www.ncst.mw

SETI OPERATIONAL POLICY INSTRUMENT 7

- ▶ **Title of the SETI operational policy instrument:** National Agricultural Fairs
- ▶ **Keywords:** small-scale farmers; agricultural displays; agricultural production promotion; agricultural marketing; value addition.
- ▶ **Overview:** the Ministry of Agriculture and Food Security and the Confederation of Chambers of Commerce and Industry organize annual trade fairs. These fairs aim to showcase technologies, innovations, inventions and agricultural produce that have been produced in Malawi. The fairs also attract national and international buyers of agricultural produce. The fairs therefore provide a platform for interaction among producers, buyers, inventors and innovators.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to promote interaction among all actors in the production and value chain of agricultural produce; to promote the dissemination of STI activities and; to organize and conduct annual fairs to disseminate technologies.
- ▶ **Specific objectives:** e. to strengthen the social appropriation of scientific knowledge and new technologies; h. to promote the development of green technologies and socially inclusive technologies
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** display of agricultural and industrial technologies, innovations and inventions
- ▶ **Conditions for applying for the instrument:** all stakeholders in agriculture can present their products
- ▶ **Target groups/Beneficiaries:** all agricultural and industrial stakeholders in Malawi
- ▶ **Eligibility/Selection criteria:** no restrictions
- ▶ **Eligible costs:** variable depending on prevailing costs
- ▶ **Source of funding:** government subvention, industry and individual organizations/ institutions
- ▶ **Mode of disbursement of financial resources:** funds their cost of participation
- ▶ **Annual budget:** variable depending upon the prevailing costs
- ▶ **Continuity of the instrument over time:** ongoing
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** innovations from agriculture and other stakeholders in industry have been displayed; linkages have been made between producers, sellers and buyers of different products; there has been an exchange of knowledge on the production and processing of agricultural produce and value addition.
- ▶ **Relevant link:** www.mccci.mw



SETI OPERATIONAL POLICY INSTRUMENT 8

- ▶ **Title of the SETI operational policy instrument:** College of Medicine Research Dissemination Conference
- ▶ **Keywords:** health research, technology dissemination, national conference
- ▶ **Overview:** the College of Medicine of the University of Malawi organizes an annual dissemination conference where health research results are disseminated to various stakeholders.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to inform stakeholders about the research undertaken and how the results can benefit the nation; to develop and disseminate STI technologies, innovation and inventions
- ▶ **Specific objectives (*):** a. to strengthen the production of new endogenous scientific knowledge; e. to strengthen the social appropriation of scientific knowledge and new technologies
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** provision of funding for the conference
- ▶ **Conditions for applying for the instrument:** all researchers with research results in health
- ▶ **Target groups/Beneficiaries:** researchers and institutions and other health stakeholders
- ▶ **Eligibility/Selection criteria:** all health institutions in the country who may be users or developers of the research results technologies in health
- ▶ **Eligible costs:** variable depending prevailing costs
- ▶ **Source of funding:** College of Medicine and co-operating partners
- ▶ **Mode of disbursement of financial resources:** organization and support of stakeholders to participate
- ▶ **Annual budget:** variable
- ▶ **Continuity of the instrument over time:** ongoing
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** research results disseminated; technologies adopted by end-users and stakeholders; policy briefs produced on evidence-based practice
- ▶ **Relevant link:** www.com.mw

SETI OPERATIONAL POLICY INSTRUMENT 9

- ▶ **Title of the SETI operational policy instrument:** Malawi Environmental Endowment Trust (MEET) grants
- ▶ **Keywords:** environment, endowment, trust; grants disbursement, sustainable management, sustainable utilization of natural resources
- ▶ **Overview:** inadequate funding is undoubtedly a major hindrance to the implementation of environmental and natural resource management activities in Malawi. The Malawi Environmental Endowment Trust (MEET) was established as a sustainable funding mechanism to ease this funding problem.


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- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** MEET provides financial grants and technical support, in order to promote sustainable environmental management and natural resource utilization at community level. The specific objectives are to: provide financial and technical assistance to a range service providers to enable them to develop or enhance their capacity to work effectively with communities; enter into partnership with environment- and conservation-related business ventures that have a clear positive ecological and socio-economic impact; support effective and widespread environmental education and information campaigns that raise peoples' understanding of the state of their environment and the roles they can play in solving local environmental problems; support the establishment and development of networks, partnerships and associations that will improve the implementation of environmental and natural resource management and; support the adoption of efficient, appropriate and renewable energy technologies and sources through co-operation with the private sector, service providers and appropriate community-based interventions.
 - ▶ **Specific objectives** (*): e. to strengthening the social appropriation of scientific knowledge and new technologies; h. to promote the development of green technologies and socially inclusive technologies; i. to promote indigenous knowledge systems; j. research and innovation eco-system: strengthening co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific technological and productive innovation system (i.e. government, university and productive sectors)
 - ▶ **Sectoral or horizontal approach of the instrument:** sectoral
 - ▶ **Mode of support/Type of mechanism:** grants on sustainable management and utilization of the environment
 - ▶ **Conditions for applying for the instrument:** every Malawian is eligible as long as the projects relate to the management and utilization of the environment
 - ▶ **Target groups/Beneficiaries:** all Malawians, especially those in rural areas
 - ▶ **Eligibility/Selection criteria:** quality of the projects
 - ▶ **Eligible costs:** variable depending on prevailing costs
 - ▶ **Source of funding:** endowment trust
 - ▶ **Mode of disbursement of financial resources:** research/project grants
 - ▶ **Annual budget:** variable
 - ▶ **Continuity of the instrument over time:** ongoing
 - ▶ **Geographical coverage:** national
 - ▶ **Results, outcome and evidence of success of a given measure:** (1) institutional administrative and operational capacity-building at local level and environmentally friendly business ventures; (2) applied social and scientific research (conservation- and agricultural production-orientated); (3) gender activities in environmental and natural resource management and community-based natural resource management; (4) dissemination and use of scientific and social research findings at community level and beyond; (5) policy legislation, planning and strategy analysis and awareness; (6) clarification of the rights, legal support, roles and responsibilities related to community-based natural resource management; (7) environmental education, information and communication; (8) making communities more aware of appropriate lobbying procedures for legal reform; (9) generating awareness among communities and other stakeholders of methodologies concerning community-based natural resource management; (10) networking, co-ordination and sharing of experiences; and (11) production and distribution of improved/composite seeds at local level.
 - ▶ **Relevant link:** www.meet.mw

SETI OPERATIONAL POLICY INSTRUMENT 10

- ▶ **Title of the SETI operational policy instrument:** Health Research Capacity Strengthening Initiative Institutional Grants
- ▶ **Keywords:** health research, institutional grant, multidisciplinary research.
- ▶ **Overview:** the National Commission for Science and Technology was established as a parastatal organization through the Science and Technology Act of 2003 with a mandate to advise government and other stakeholders on all science and technology matters in order to achieve science- and technology-led development. In fulfilment of this mandate, the Commission implements a number of programmes, one of which is the Health Research Capacity Strengthening Initiative, which is a five-year £10 million programme supported by two funders, namely the Wellcome Trust and the UK's Department for International Development (DfID). This programme includes a component of institutional grants ranging from £60,000 to £500,000.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to support research and other related activities within the laboratory set-up and other mobile research and minor equipment upto a maximum value of £2,000 each. The specific objectives are to: enhance institutional capacity for high-quality, multi-disciplinary health-related research studies; facilitate the formulation of national health policies and programmes utilieing research findings; share scientific knowledge more effectively across international organizations and knowledge networks and; improve regulation and co-ordination of the national research environment
- ▶ **Specific objectives(*):** a. to strengthen the production of new endogenous scientific knowledge; b. to strengthen the infrastructure of research laboratories in the public and private sectors; c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialised human capital for (1) the production of new scientific knowledge; (2) development of new technologies; (3) promotion of innovation within the productive and services systems and; (4) management of the knowledge society; j. research and innovation ecosystem: strengthening co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific technological and productive innovation system (i.e. government, university and productive sectors)
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** research grants
- ▶ **Conditions for applying for the instrument:** every Malawian is eligible, as long as the projects relate to the management and utilization of the environment
- ▶ **Target groups/Beneficiaries:** institutions related to health research
- ▶ **Eligibility/Selection criteria:** quality of the projects and institutional needs
- ▶ **Eligible costs:** multi-institutional research grants to fund laboratory research equipment and ICT equipment; research, ICTs, laboratory work and minor infrastructure
- ▶ **Source of funding:** co-operating partner (DfID)
- ▶ **Mode of disbursement of financial resources:** research/project grants
- ▶ **Annual budget:** from £60,000 to £300,000
- ▶ **Continuity of the instrument over time:** ongoing
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** (1) researchers accessing funding and producing quality research that is relevant to the promotion of the Essential Health Package; (2) researchers collaborating effectively across institutions and disciplines and with research users and meeting the needs of Malawian researchers and the Malawian population and health system; (3) improved research opportunities and a working environment conducive to attracting Malawian researchers back home, as well as local and regional talent; (4) improved health indicators for Malawi.
- ▶ **Relevant link:** www.ncst/hrcsi.mw

SETI OPERATIONAL POLICY INSTRUMENT 11

- ▶ **Title of the SETI operational policy instrument:** Malawi Innovation Challenge Fund
- ▶ **Keywords:** health research, institutional grant, multidisciplinary research.
- ▶ **Overview:** The Malawi Innovation Challenge Fund (MICF) is a US\$8 million source of funding supported by the United Nations Development Programme (UNDP) and the UK Department for International Development (DfID) which aims to strengthen the private sector's ability to serve as the engine of economic growth. The goal of the project is to accelerate economic diversification and increase the opportunities for the poor to benefit from economic growth through higher incomes and better job creation, as well as through productive partnerships with the private sector, particularly between lead firms and poor producers and entrepreneurs, especially smallholders.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** The Private Sector Development Project will therefore be used as an operational tool, though a challenge funding mechanism, to support pro-poor investments in the prioritized product clusters identified by the National Export Strategy (NES). The Private Sector Development Project will establish a Malawi Innovation Challenge Fund with two funding windows aligned on the Prioritized Product Clusters of the National Export Strategy: (1) Agriculture Window and (2) Manufacturing Window. Against this background, UNDP Malawi, through the Private Sector Development Project, intends to contract the services of a firm to provide fund management services for the MICF. These services will pertain to general functions that apply to all funding windows and more specific functions peculiar to each window. The general functions include: (a) Management Systems and Process, (b) Marketing and Communication, (c) Streamlined Procedures and Effective Due Diligence, (d) Fiduciary Management and (e) Monitoring and Evaluation. The additional functions for the specific windows pertain to the Agriculture and Manufacturing Windows.
- ▶ **Specific objectives(*):** f. to develop strategic technological areas and new niche products and services with high added value; promote and develop innovation in the production of goods and services; promote start-ups in areas of high technology; h. promote the development of green technologies and socially inclusive technologies; j. research and innovation ecosystem: strengthening co-ordination, networking and integration processes, which promote synergies among the different actors of the national scientific technological and productive innovation system (i.e. government, university and productive sectors)
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** The MICF provides a matching grant of up to 50% to innovative business projects to help absorb some of the commercial risk in triggering innovation, speeding up implementation of new business models and/or technologies that have a high social impact
- ▶ **Conditions for applying for the instrument:** every Malawian is eligible, as long as the projects relate to the management and utilization of the environment
- ▶ **Target groups/Beneficiaries:** The lead organization must be an established private for-profit company. Only in exceptional cases will MICF consider new businesses (start-ups), where there is strong evidence that the new company has credible and experienced investors and a management team. The lead bidding company may collaborate with other organizations, including NGOs and community organizations. However, it is a condition that the lead applicant and implementer of the business idea must always be a commercial company/business.
- ▶ **Eligibility/Selection criteria:** The funding request must be for a specific, new and innovative business idea in either the agricultural or the manufacturing sector. The MICF views innovation in its broadest sense, including: i) a new approach, idea or service that has not been tested anywhere; ii) an approach, idea or service that is new to Malawi; or iii) an approach, idea or service that has not been applied to the sector in question in Malawi. The Malawi Innovation Challenge Fund adopts a two-stage application approach for both the Agriculture and Manufacturing Windows, which include a first step competition for 'concept notes' and a second step competition for full proposals.

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- ▶ **Eligible costs:** the MICF will primarily focus on export promotion within the manufacturing and agricultural sectors – aimed at increasing non-traditional exports. In addition, it will also support projects that promote import substitution, so long as the benefits accrued are distributed equitably between the participating firms and the poor (either as producers or as consumers).
 - ▶ **Source of funding:** DfID and UNDP
 - ▶ **Mode of disbursement of financial resources:** research /project grants
 - ▶ **Annual budget:** The total grant funds requested must be between US\$200,000 and US\$750,000, although it is recognized that larger funding requests for projects with the potential to deliver a sizeable systemic impact in a particular market or markets would be considered.
 - ▶ **Continuity of the instrument over time:** 2014 ongoing
 - ▶ **Geographical coverage:** national
 - ▶ **Results, outcome and evidence of success of a given measure:** n/a
 - ▶ **Relevant link:** <http://micf.mw/>

Inventory of SETI policy instruments phased out in recent years

SETI OPERATIONAL POLICY INSTRUMENT I

- ▶ **Title of the SETI operational policy instrument:** Health Research Capacity Strengthening Initiative (HRCSI) Internship Grant
- ▶ **Keywords:** health research, internship grant
- ▶ **Overview:** in addressing health research capacity strengthening at individual level, HRCSI has introduced an internship scheme. Interns will be hosted, for a period of up to six months, within some of the leading research and training institutions in the country that work in partnership with HRCSI. During this period and under the guidance and mentorship of senior research scientists, the interns will be exposed to techniques and methods in scientific research and gain experience and skills in performing scientific procedure. It is hoped that a number of areas will be featured such as epidemiology surveys, laboratory based work and use of computer based health research tools. The aim of the internship scheme is to nurture interest and promote desire to choose a career in health research among young and talented graduates in Malawi. It is expected that this will help to build skills among the labour force and gradually generate a pool of talented teams of health research scientists within the country. Eventually, this will translate into a resource with capacity to generate health research knowledge that can be utilized to inform policy makers and service providers and have an impact on the overall development of the country.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to seek out talented, motivated and promising recent graduates. The programme hopes to engage candidates who are willing to dedicate their time fully to pursuing work in health-related disciplines and who are interested in, and understand, the role of health research in the development of Malawi. The specific objectives are to: develop skills in scientific research; engage in research and be mentored in research by experienced professionals; provide a platform for professional and personal development and; provide a chance for self-marketing and development of contacts and networking for future job opportunities.
- ▶ **Specific objectives (*):** a. to strengthen the production of new endogenous scientific knowledge; c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialised human capital for (1) the production of new scientific knowledge; (2) development of new technologies; (3) promotion of innovation within the productive and services systems and; (4) management of the knowledge society
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** internship grants
- ▶ **Conditions for applying for the instrument:** internship is awarded in the following areas: data analysis, data collection, developing proposals, designing and organizing research, research methods, laboratory sample analysis, writing popular briefs, developing questionnaires, documentation of research information, systematic literature review and Information and knowledge management
- ▶ **Target groups/Beneficiaries:** young graduates working in health research in Malawi
- ▶ **Eligibility/Selection criteria:** qualification of the candidates
- ▶ **Eligible costs:** research and upkeep costs.
- ▶ **Source of funding:** Co-operating partner (DfiD)
- ▶ **Mode of disbursement of financial resources:** internship grants
- ▶ **Annual budget:** n/a
- ▶ **Continuity of the instrument over time:** 2010–2013

- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** enhanced institutional capacity for research; evidence-based policy and programme formulation; effective sharing of scientific knowledge and; improved regulation and co-ordination of national health research
- ▶ **Relevant link:** www.ncst/hrcsi.mw

SETI OPERATIONAL POLICY INSTRUMENT II

- ▶ **Title of the SETI operational policy instrument:** Health Research Capacity Strengthening Initiative (HRCSI) Undergraduate Programme
- ▶ **Keywords:** health research, undergraduate research programme, enhanced capacity for research.
- ▶ **Overview:** HRCSI offers undergraduate research grants to final-year students whose research is on health or a health-related topic. This grant is given to enable undergraduate students to conduct rigorous dissertation research. The primary purpose is to cultivate a research interest among students while they are still in college. The grant is administered by the college where student awardees are studying. The total amount of the grant is £270 per student. The host institution of the student makes a call for research proposals from students. The College Selection Committee reviews proposals against set criteria. A list of selected proposals is sent to HRCSI for information and record. The administering college submits final copies of the dissertation to HRCSI together with a financial report. Subsequent grants to host colleges depend on successful liquidation of previous grants.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** the long-term goal of the programme is to improve the quality of interventions affecting the delivery of health services to Malawians through the generation and use of health research evidence. Specific objectives are to: strengthen the health research capacity for the generation of scientific knowledge within Malawi; improve its use in evidence-based decision-making, policy formulation and implementation; provide training and research grant fellowships to individuals; to support the development of research infrastructure at institutional level; build capacity at individual and institutional levels through the provision of training, fellowships, research grants and the development of research infrastructure.
- ▶ **Specific objectives (*):** a. to strengthen the production of new endogenous scientific knowledge; b. to strengthen the infrastructure of research laboratories in the public and private sectors c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialized human capital for (1) the production of new scientific knowledge; (2) development of new technologies; (3) promotion of innovation within the productive and services systems and; (4) management of the knowledge society; j. research and innovation ecosystem: strengthening co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific technological and productive innovation system (i.e. government, university and productive sectors).
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** research grants
- ▶ **Conditions for applying for the instrument:** all final-year students undertaking health research to finalize their theses
- ▶ **Target groups/Beneficiaries:** university undergraduates who are finalizing their thesis work
- ▶ **Eligibility/Selection criteria:** final-year university undergraduates and candidates' qualifications
- ▶ **Eligible costs:** research and travel costs
- ▶ **Source of funding:** Co-operating partner (DfID)
- ▶ **Mode of disbursement of financial resources:** research grants

- ▶ **Annual budget:** n/a
- ▶ **Continuity of the instrument over time:** 2010–2013
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** enhanced institutional capacity for research; evidence-based policy and programme formulation; effective sharing of scientific knowledge and; improved regulation and co-ordination of national health research
- ▶ **Relevant link:** www.ncst/hrcsi.mw

SETI OPERATIONAL POLICY INSTRUMENT III


- ▶ **Title of the SETI operational policy instrument:** Health Research Capacity Strengthening Initiative (HRCSI): Small Grants Scheme
- ▶ **Keywords:** health research, small grants, professional development opportunities
- ▶ **Overview:** in its effort to address health research capacity strengthening, HRCSI is able to offer Small Grant Awards throughout its programme term in order to allow institutions and individuals in Malawi to access professional development opportunities. The small grants can also be used to facilitate a number of activities.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to facilitate attendance of conferences through travel, hotel, daily subsistence, production of proceedings, presenting research papers at local and international conferences and facilitate exchange visits.
- ▶ **Specific objectives:** a. to strengthen the production of new endogenous scientific knowledge; c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialised human capital for (1) the production of new scientific knowledge; (2) development of new technologies; (3) promotion of innovation within the productive and services systems and; (4) management of the knowledge society
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** small grants
- ▶ **Conditions for applying for the instrument:** graduates and researchers pursuing studies in the field of health
- ▶ **Target groups/Beneficiaries:** graduates and researchers within health sciences
- ▶ **Eligibility/Selection criteria:** acceptance to present a paper at a national or international workshop and candidates' qualifications
- ▶ **Eligible costs:** travel and registration costs
- ▶ **Source of funding:** Co-operating partner (DfiD)
- ▶ **Mode of disbursement of financial resources:** small grants
- ▶ **Annual budget:** n/a
- ▶ **Continuity of the instrument over time:** 2010–2013
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** enhanced institutional capacity for research; evidence-based policy and programme formulation; effective sharing of scientific knowledge and; improved regulation and co-ordination of national health research.
- ▶ **Relevant link:** www.ncst/hrcsi.mw

SETI OPERATIONAL POLICY INSTRUMENT IV

- ▶ **Title of the SETI operational policy instrument:** Health Research Capacity Strengthening Initiative (HRCSI): Fellowship Programme
- ▶ **Keywords:** health research, training, fellowship
- ▶ **Overview:** HRCSI scholarships do not target particular fields. Applicants can apply to pursue studies in all health research disciplines provided that these fall within the priority areas outlined in the Malawi National Health Research Agenda (NHRA). The NHRA is a guide to researchers, policy makers, program implementers, academic institutions, health development partners and other stakeholders on health research priorities for Malawi.
- ▶ **Objectives of the plan (or the SETI policy) to which the instrument relates:** to provide training fellowship to eligible Malawians in the health field. The specific objectives are to: facilitate the training of Malawian within and outside the country; strengthen the health research capacity for the generation of scientific knowledge within Malawi; improve its use in evidence-based decision-making, policy formulation and implementation; provide training and research grant fellowships to individuals; support the development of research infrastructure at institutional level and; build capacity at individual and institutional levels through the provision of training, fellowships, research grants and development of research infrastructure.
- ▶ **Specific objectives (*):** a. to strengthen the production of new endogenous scientific knowledge; c. human resources for research, innovation and strategic planning: capacity-building, education and training of specialised human capital for (1) the production of new scientific knowledge; (2) development of new technologies; (3) promotion of innovation within the productive and services systems and; (4) management of the knowledge society
- ▶ **Sectoral or horizontal approach of the instrument:** sectoral
- ▶ **Mode of support/Type of mechanism:** training fellowship (grant)
- ▶ **Conditions for applying for the instrument:** students pursuing studies in the field of health
- ▶ **Target groups/Beneficiaries:** graduates and researchers within health sciences
- ▶ **Eligibility/Selection criteria:** acceptance by a University in Malawi or abroad to study in the health field and candidates' qualifications
- ▶ **Eligible costs:** all training related costs
- ▶ **Source of funding:** Co-operating partner (DfID)
- ▶ **Mode of disbursement of financial resources:** fellowship grants
- ▶ **Annual budget:** n/a
- ▶ **Continuity of the instrument over time:** 2010–2013
- ▶ **Geographical coverage:** national
- ▶ **Results, outcome and evidence of success of a given measure:** enhanced institutional capacity for research; evidence-based policy and programme formulation; effective sharing of scientific knowledge and (4) improved regulation and co-ordination of national health research
- ▶ **Relevant link:** www.ncst/hrcsi.mw

SWOT analysis of Malawi's research and innovation system






This section focuses on the strengths, weaknesses, opportunities and threats (SWOT) which characterize Malawi's research and innovation system. These characteristics are summarised in Table 27 on page 207. The analysis which follows is based on the information and data in preceding sections.

Strengths

- ▶ **Stable governments and smooth transitions over the years:** since the implementation of a multiparty system in 1994, the country has maintained a certain political stability enhanced by the country's peace-loving, interdependent and hard-working communities.
- ▶ **Positive long-term trends in human development indicators:** life expectancy at birth has increased from 38 to 55 years in the past five decades (see Figure 1, page 4). The Human Development Index has progressed in a parabolic fashion for more than four decades (see Figure 2, page 6). Enrolment in primary and secondary education has risen exponentially for more than three decades (see page 42). Malawi is also one of 11 African countries which managed to reduce their under-five mortality rate by 60% between 1990 and 2011.
- ▶ **Relatively high scientific productivity:** despite low levels of R&D expenditure and a small research pool, scientists from Malawi are more productive than their counterparts in some countries with a similar population but much higher GDP (see page 57). In Africa, Malawi ranks 15th for scientific articles published in mainstream journals (see Table 19, page 65). The University of Malawi is responsible of 58.9% of all scientific articles published between 1967 and 2013 (see Table 21, page 71), which have remained constant over the years. The Ministry of Health and Kamuzu Central Hospital are also productive. These institutions have created strong co-operation links with international research centres, enhancing the impact and visibility of research results in the scientific community worldwide.
- ▶ **Fiscal incentives for foreign investment and policy instruments promoting innovation in place:** the Malawi Investment and Trade Centre has designed an investment portfolio with a combined value of US\$177 million, spanning the major growth sectors of Malawi's economy; the combination of proposals shows a selection of promising innovation projects. The country has also introduced a series of tax incentives to promote foreign direct investment (see Box 4, page 34). In 2014, the government instigated the Malawi Innovation Challenge Fund. The latter is a US\$8 million source of funding supported by the United Nations Development Programme and the UK Department for International Development; it aims to strengthen the private sector's ability to serve as the engine of economic growth. The goal of the Malawi Innovation Challenge Fund is to accelerate economic diversification and increase opportunities for the poor to benefit from economic growth through higher income and better job creation, as well as productive partnerships with the private sector, particularly between leading firms and poor producers and entrepreneurs, especially smallholders (see pp. 33 and 193).
- ▶ **Rich biodiversity and natural resources:** Malawi is endowed with abundant natural resources and very rich biodiversity, mineral deposits, arable land, abundant sunshine and water. These natural resources give Malawi a comparative advantage over other countries.
- ▶ **More SETI operational policy instruments than its neighbours:** Malawi has 11 SETI operational policy instruments (see page 182), a greater number than Botswana, Namibia, Zambia or Zimbabwe.
- ▶ **Active member of SETI regional fora:** Malawi is a member of the Southern African Development Community (SADC), the Common Market for Eastern and Southern Africa (COMESA) and the African Union and participates in all programmes and activities of these groupings, including those related to science, engineering, technology and innovation (see Box 6, page 49). Malawi is a signatory, for example, of the SADC Protocol on Science, Technology and Innovation (2008). Malawi is also involved in the Southern African Biosciences Hub, a NEPAD initiative. As Chair of SADC for 2013 and 2014, Malawi facilitated the development and finalization of critical instruments which will guide and drive the implementation of several STI programmes in SADC, COMESA and the African Ministerial Committee of Science and Technology (AMCOST).

Weaknesses

- ▶ **Small, non-diversified economy:** for a country with a population of between 15 and 17 million, Malawi has the smallest real GDP in the world. For example, the GDP of Niger is 1.5 times higher, that of Burkina Faso 2.3 times, Guatemala 10 times, Ecuador 16 times, Kazakhstan 25 times, Chile 47 times and the Netherlands 195 times higher. On average, a country with a similar population size will have a GDP 37 times bigger (see page 57). Real GDP per capita in constant 2012 US\$ has remained almost constant in the past 50 years (see Figure 4, page 11) and the gap with the rest of sub-Saharan Africa has been widening over the past decade. The economy is agriculture-dependent, imposing a limitation on the revenue base. Manufacturing in Malawi accounts for just 12% of GDP and most of the country's products are exported in a raw or semi-processed state.
- ▶ **Fragility of governance indicators:** having positive values for the indicators of political stability and government effectiveness (see Figure 6, page 21) are prerequisites for effective implementation of SETI policies, or any other public policy for that matter. On the contrary, negative values (see Figures 7 and 8, page 22) for both governance indicators promote incoherence and poor co-ordination among the various stakeholders, laxity in law enforcement, discourage foreign direct investment and private long-term investment, create lengthy procedures for investment registration and limit negotiating skills on contracts (i.e. mining, international conventions, agreements with international companies). This in turn diminishes national productivity and augments the risk of failure in attaining policy goals. Since the multiparty system was established, political stability has evolved favourably over the past decade (Figure 7) but the Government Effectiveness indicator still shows negative values for this entire period. The Corruption Perception Index places Malawi more than 100th worldwide over the same period (see Figure 9, page 23).
- ▶ **Cultural barriers and barriers tied to religious beliefs:** the lack of understanding of scientific principles and new technologies tends to produce collective behaviour that is hostile to innovation. For example, in the village setting, innovative smallholder farmers who follow modern agricultural practices are often suspected of using charms in order to attain high yields and sometimes even accused of witchcraft. The Government of Malawi (2002) has recognized that this poor S&T culture is a serious impediment to socio-economic development. The ease with which technologies may be imported from abroad enables planners and policy-makers to 'import comfort' and pay lip-service to the creation of a science culture among their own people. A cultural revolution is, therefore, a prerequisite, if science and technology are to play their rightful role in combating poverty in Malawi. Some policy interventions were suggested by the 2002 *Revised National Science and Technology Policy* (see page 90).
- ▶ **A small pool of researchers:** in 2010, Malawi had only 49 FTE researchers per million population (see page 52). In agriculture, the mainstay of the economy, the number of researchers per million of population has remained relatively constant over the past four decades but has actually decreased in the past two decades, from 22 researchers in agriculture per million of population in 1984 to 16 in 2010 (see page 60). From a global perspective, the critical mass which triggers innovation on a national scale is at least 1200 FTE researchers per million population (as in China). Developed countries have between 100 and 120 times more FTE researchers than Malawi. No formal system of government scholarships is in place for completing PhDs in science and engineering, nor any other incentive or policy instrument guaranteeing the promotion of research and innovation within a national human resources policy. Moreover, despite the fact that only 19 % of researchers are women, there is no specific gender policy for SETI. Only 0.6% of the population has access to higher education. This is 15 times smaller than in some of the neighbouring countries (i.e. Zimbabwe) and 100 times smaller than in developed countries. There are very few doctoral candidates in SETI. Owing to the poor remuneration package for SETI experts, there is considerable brain drain in all fields of science and engineering.
- ▶ **Absence of any explicit human resources policy for science and engineering:** there are no specific targets for increasing the number of scientists and engineers to achieve the *Vision 2020* goals, nor any targets concerning the staffing requirements of industry and other productive sectors in order to attain the strategic goals of diversifying the economy or those designed by the Malawi Investment Trade Centre (see page 32). Research and innovation are dependent on having the requisite stock of human capital, defined as the knowledge, skills, competencies and attributes that facilitate the creation



of personal, social and economic well-being. Policy measures can be designed to ensure a healthy supply of human resources to SETI, such as through incentives like fellowships for poor students to increase student enrolment in scientific, technological and engineering disciplines at undergraduate and postgraduate levels.

- ▶ **Low research and innovation productivity:** although Malawian researchers published 317 scientific articles in mainstream journals in 2010, this represents just one scientific article per FTE researcher every two years, or 0.48 scientific articles per FTE researcher annually. The number of articles per million population has been increasing quasi-exponentially since 1995 (after the multiparty system was established), reaching 26 in 2013, but the starting point was low. This is 170 times smaller than the productivity of Switzerland, 13 times smaller than that of Tunisia, six times smaller than that of Botswana and similar to that of Zimbabwe, to cite just a few examples. The very weak correlation between scientific publications per capita and GDP per capita (see Figure 24) in Malawi, unlike in most other countries (i.e. Lemarchand, 2012), is an indication of the absence of policy instruments for promoting scientific research. The past decade has seen a positive trend: an extraordinary increase in the number of co-publications with foreign countries, which now represent 80–85% of all Malawian scientific articles listed at the Web of Science (see Figure 25). In the past two decades, 65% of publications have been in medical sciences, 20% in natural sciences, 15% in agricultural sciences and just 3% in engineering, even though the latter is the major driver of innovation. In comparison, in the emerging economies of China and the Republic of Korea, where there are linkages between research and innovation, 80% of all publications are in natural sciences and/or engineering. As for patents, the past five decades have seen a continual decrease in the number of applications by residents (and non-residents), from a few hundred to a handful per year (see Figures 27 and 28, page 80).
- ▶ **A small SETI demand sector:** the macro-economic conditions hamper research and innovation in the business and enterprises sector (SETI demand side). In developed and emerging economies, the business sector provides between 50% and 70% of GERD. In this way, the SETI demand-side tracks the type of research done by governmental research centres and higher education institutions (SETI supply side). Businesses also need to be able to adapt technologies and innovate in order to meet needs of the customers at local and international levels and remain competitive. This implies that businesses need to address firm-level constraints by investing in human resources, technology and R&D. The Malawi Confederation of Chambers of Commerce and Industry has asked the government to promote public–private partnerships, in order to develop the necessary infrastructure (see page 31). The lack of any other policy instrument to foster networking among the business, government and university sectors is one of the country's biggest weaknesses.
- ▶ **Inadequate set of operational policy instruments to link the SETI demand and supply sides:** the GO→SPIN survey has identified only 11 operational policy instruments in Malawi (see page 181). A country the size of Malawi should have between 10 and 20 times more, of a diverse nature and adequately funded. The absence of some policy instruments impinges on research and innovation. There are no policy instruments in place promoting linkages between the SETI demand and supply sides, nor any funding mechanisms addressing the research priorities set by the *2002 Revised National Science and Technology Policy* (see page 100).
- ▶ **Indigenous knowledge remains largely disregarded:** knowledge is the key input to innovation. It can come from a formal process, such as R&D, but also in the form of indigenous knowledge developed over centuries of learning from the environment. Indigenous knowledge can play a central role in transforming and modifying technologies to suit local conditions and the local context, as well as in developing indigenous home-grown technologies. To play that role, indigenous knowledge needs to be documented, protected and efficiently managed. Malawi needs to incorporate indigenous knowledge in the formulation of R&D strategies. There is scant input from indigenous knowledge in the present SETI policies and within research programmes.

Opportunities

- ▶ **Increase awareness of the strategic importance of SETI among decision-makers, entrepreneurs and the general public:** The country should develop appropriate operational policy instruments to reach the objectives established in the *2002 Revised National Science and Technology Policy*. The policy proposes: (i) promoting greater coverage by the popular media of R&D and S&T activities in Malawi; (ii) encouraging local scientists and technologists to publish the results of their research in local journals, the publication of which would be supported by government; (iii) establishing through the Malawi Business Council, or other appropriate mechanisms, a national colloquium on science and technology which would be presided over by the State President or Vice-President and; (iv) strengthening S&T curricula and programmes in the education system (see page 104).
- ▶ **Human capital development in science and engineering:** Malawi's population is dominated by youth (45% of the population is less than 14 years old) who are eager to study and develop their potential (see Figure 1, page 4). There is an opportunity to train young people in science and engineering by putting in place adequate SETI policy instruments to provide incentives like scholarship programmes to encourage students to embark on a PhD and a system of competitive grants for young researchers in those priority fields determined by national policies. SETI research and innovation programmes designed to develop human capital should be associated with the portfolio of strategic areas identified by the Malawi Investment and Trade Centre. SETI human capital development should be tailored to the country's strategic development projects (i.e. mining, biotechnology, agribusiness, energy, infrastructure, ICTs, waste recycling, etc.). Secondary school curricula need to be revised to make them S&T-based. Schools should have well-equipped science laboratories and be resourced with science and mathematics teachers to encourage students to study science and mathematics at secondary school then SETI programmes at university. Universities should revise their academic programmes and develop ties to universities abroad in order to ensure that the skills acquired by students correspond to those needed by the private sector. New policy instruments should also be implemented to enhance the linkage between technical and vocational education, on the one hand, and the manufacturing sector, on the other.
- ▶ **Improve gender equality in science and engineering:** gender equality is one of the eight United Nations Millennium Development Goals. It will be possible to improve the participation of women in science and engineering by introducing appropriate SETI policy instruments and incentives in both the education system (from primary school to postgraduate studies) and in the terms of reference of advertised posts or calls for research and innovation proposals. The *2002 Revised National Science and Technology Policy* (see Box 10, page 102) proposed specific strategies, such as (i) encouraging research into all gender differentiation in science and technology education and employment; (ii) promoting womens' access to S&T education at all levels; (iii) fostering gender equity in science and technology both in education and in the workplace; (iv) facilitating the entry of women into employment in the fields of science and technology and their career advancement and; (v) fostering socially responsible, gender-inclusive science and technology. Specific operational policy instruments must be implemented to realize these strategies.
- ▶ **Universities with SETI programmes:** in the past 15 years, Malawi has established several new public universities with a focus on science, engineering and technology: Mzuzu University (c. 1999); Lilongwe University of Agriculture and Natural Resources (LUANAR), which includes Bunda College of Agriculture, delinked from the University of Malawi in 2012 to become part of the new university, and; the Malawi University of Science and Technology, which was established by law on 17 December 2012 (see page 168). Mzuzu University and LUANAR demonstrate great potential for research and extension activities (see Table 21, page 71). This illustrates the government's commitment to SETI; if these universities are well-equipped, in terms of both financial and human resources, as well as in terms of laboratories, they will rapidly be able to contribute to the country's socio-economic transformation.

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- ▶ **Science and Technology Fund:** created by the *2002 Revised National Science and Technology Policy* and the 2003 Science and Technology Act, this fund has not yet come into being (see pp. 101 and 188). According to the present legislation, the sources of income for the fund will be: (i) such sums as may be appropriated by Parliament, aiming at being not less than 1 % of GDP for the previous fiscal year of government, (ii) levies and an appropriate cess on the sale of S&T products and services, (iii) any sums or properties as may, in any manner, become payable to or vested in the fund by virtue of the operation of any law or as a result of its administration and; (iv) any sums of money donated to the fund by any person, body or institution. The fund still lacks an operational manual, as well as an adequate set of operational policy instruments to determine, strategically, towards which missions the fund will be oriented.
 - ▶ **Availability of special external funding mechanisms for the environment:** Malawi has access to external funding in support of environmental projects. One such source is the Global Environment Facility (GEF), which is a partnership for international co-operation whereby 183 countries work together with international institutions, civil society organizations and the private sector to address global environmental issues. Several NGOs and research groups in Malawi are promoting a series of projects on environmental management, waste recycling and value addition to waste; combined with appropriate know-how generated by the academic sector, these projects can promote the emergence of new green technologies and environmental best practices for Malawi.
 - ▶ **Networking at national, regional and international levels:** Malawi has a long tradition of successful international scientific collaboration (mainly in the health sector) which has spawned the implementation of several SETI operational policy instruments (see page 181). Based on this experience, appropriate policy instruments and special mechanisms can be designed to promote synergies and networking among national laboratories, universities and the manufacture sector. Other policy instruments should improve the participation of the diaspora in strategic research and innovation projects in Malawi, in tandem with an amelioration of national networking between public and private research institutions and enterprises. There are many Malawian PhD holders working in Malawi and beyond in leading research institutions. Collaboration and networking in research and innovation oriented to national development projects (i.e. mining, health, environment, energy, agribusiness, etc.) among those both within and without Malawi can lead to a better higher education system, greater scientific productivity and stronger linkages between the SETI supply and demand sides.
 - ▶ **Interconnectivity initiatives for educational institutions:** by creating synergies between the national ICT policy (see page 36) and recent national and regional initiatives to expand the diffusion of endogenous R&D and regional co-operation. Examples are MAREN (Malawi Research and Education Network); the Africa Connect project, which aims to establish a high-capacity Internet network for research and education in Southern and Eastern Africa, and UbuntuNet, the regional backbone network that interconnects National Research and Education Networks (NRENs).
 - ▶ **Value-addition to abundant natural resources:** besides the portfolio of strategic areas identified by the Malawi Investment and Trade Centre, value-addition across all sectors in Malawi remains low. Malawi is still a net exporter of raw materials. There is a wide margin of manoeuvre for using SETI to add value across sectors and for using innovation to add value to Malawi's abundant natural resources.
 - ▶ **Legal instrument to protect indigenous knowledge:** the *2002 Revised National Science and Technology Policy* recognizes that, although there are conflicts between cultural beliefs and scientific challenges, a lot can be gained from the indigenous knowledge systems and technologies embedded in Malawi's culture (see Box 11, page 104). The indigenous knowledge base in traditional medicine, for example, needs to be understood, preserved, further developed and protected for the country's benefit. Intellectual property rights legislation, which covers the body of knowledge that may generally be classified as 'Western', tends to be weak when it comes to protecting indigenous knowledge because the latter is owned collectively by extended families, clans and communities and because substantial parts of indigenous knowledge are transmitted orally. Malawi can follow the example of Botswana, which already has a legislative instrument to protect traditional knowledge and handicrafts. In Botswana, traditional knowledge can be owned by a group of people or by a community. This is not possible with other forms of intellectual property or intellectual property rights. The terms of protection in Botswana expire only when the traditional knowledge has lost its value as: (a) an element of cultural

identification; (b) a result of wilful and expressed abandonment by its owner or owners; or (c) as a result of non-use or use in a distorted manner by third parties of which the owner or owners are aware. This type of best practice can easily be implemented in Malawi via SADC co-operation agreements.

Threats

- ▶ **Overdependence on erratic donor support:** both multilateral and bilateral agencies have been important providers of assistance to Malawi. The principal donors are the African Development Fund, European Commission, Germany, Global Fund, International Monetary Fund, Japan, Norway, United Kingdom, USA and the World Bank. Malawi's relationship with the donor community has long been characterized by alternating periods of close collaboration and mutual distrust. Donors contribute approximately 37% of the government budget. Aid is most effective when it supports a country-owned approach to development; aid is less effective when countries feel that aid policies and approaches are driven by donors. In the context of the *Paris Declaration*²¹, ownership specifically concerns a country's ability to carry out two interlinked activities: exercise effective leadership over its development policies and strategies and; co-ordinate the efforts of various development actors working in the country. The lack of this kind of co-ordination has caused national priorities to change frequently. This has the effect of perturbing the synergy needed among different SETI stakeholders in order to make policy interventions or to operationalize international and regional SETI agreements.
- ▶ **Demographic constraints:** the annual average population growth rate in Malawi over the past five decades has been 3.3%, the sixth-highest in the world. There are approximately 41.8 births/1000 population (2014 est.), the seventh-highest birth rate in the world. In comparison, Malawi counts 8.74 deaths/1000 population (2014 est.), placing it 72nd in the world for this indicator. The country has very high rates of early marriages and teenage pregnancies. The strategic options for reducing population growth proposed by *Vision 2020* have so far failed to slow the growth rate. Unless this trend can be reversed, rapid population growth will sap Malawi's efforts to reach long-term sustainability.
- ▶ **Adverse effects of climate change:** a recent study analysed Malawi's vulnerability to climate change (Patta *et al.* 2010). This study took into account both potential changes in Malawi's exposure to climatic extreme events and trends in socio-economic development that influence a country's adaptive capacity. The results suggest that Malawi's vulnerability will increase most rapidly between now and 2050 but that socio-economic development may begin to offset the country's growing exposure to climate change in the second quarter of the century. This implies an urgent need for international assistance to finance adaptation. At present, the country has inadequate early weather warning systems. Policy interventions are needed to mitigate potential disasters by building SETI capacity and promoting the use of appropriate technologies.
- ▶ **Low participation of the business/enterprise sector in R&D:** in 1977, there were 39 FTE researchers working in the business sector (20.6% of all FTE researchers). Thirty years later, this number had shrunk to only 7 FTE researchers (see Table 12, page 53), equivalent to only 1.7% of all FTE researchers in the country. In emerging economies such as China or the Republic of Korea, the business sector employs more than 60% of national researchers. Linkages between universities, R&D centres and the business/enterprise sector in Malawi are very weak. New policy instruments are in place to promote innovation (i.e. Malawi Innovation Challenge Fund and tax incentives to promote FDI) but there is an absence of appropriate policy instruments to stimulate strong interaction between the SETI supply and demand sides. What is needed is capacity-building and a stronger human capital policy to support innovation and entrepreneurship in the business sector.

21 Recognizing that development aid could – and should – be having a greater impact, leading development practitioners came together at the Second High-level Forum on Aid Effectiveness in 2005 to adopt the *Paris Declaration*. Drawing from first-hand experience on what works and does not work with aid, the *Paris Declaration* is formulated around five central pillars: Ownership, Alignment, Harmonization, Managing for Results and Mutual Accountability. At the Third High-level Forum on Aid Effectiveness in 2008, an even greater number and wider diversity of stakeholders endorsed the *Accra Agenda for Action*, which both reaffirmed the commitment to the *Paris Declaration* and called for greater partnership between the various parties working on aid and development.


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- ▶ **Erratic energy supply and ICTs connectivity are derailing progress in SETI:** power cuts which occur in the middle of a scientific experiment or new technological development, or when a critical innovation is being implemented in a factory, can disrupt activity and erode the morale of scientists and entrepreneurs. The surveys conducted by the Malawi Confederation of Chambers of Commerce and Industry have consistently rated power cuts as the most serious obstacle to doing business (see page 29). The latter is compounded by low internet connectivity and reliability.
 - ▶ **Regional competition:** most trained scientists and engineers are migrating from Malawi to neighbouring countries which can offer better working conditions, access to well-equipped laboratories and a good remuneration. The poor performance of Malawi's economy makes it very difficult to retain new PhD degree-holders.
 - ▶ **The plethora of SETI strategic priorities dilutes policy effectiveness:** the *2002 Revised National Science and Technology Policy* proposes four primary goals and nine policy objectives. An analysis of their content (see page 100) reveals that there are, in fact, 17 different sectoral strategic priorities and two associated supporting policies (i.e. *Biotechnology and Biosafety Policy* and the *ICT Policy*). If you take into consideration the priorities set by the National Commission for Science and Technology (NCST, 2013a) and the sectoral research and innovation priorities proposed by other ministries (i.e. Ministry of Health and Ministry of Agriculture, Irrigation and Water Development, etc.), this actually inflates the number of strategic priorities. Combined with a lack of common strategies with new foreign investment policies and funding mechanisms (i.e. Malawi Innovation Challenge Fund), the absence of adequate operational policy instruments and the scarce funding allocation, the multiplication of sectoral priorities may endanger the smooth implementation and effectiveness of the proposed policy interventions. There is a need to improve co-ordination among the institutions responsible for the different tasks associated with the SETI policy cycle (see page 96).

Table 27: SWOT analysis of Malawi's research and innovation system

Strengths	Weaknesses
<ul style="list-style-type: none"> • Stable governments and smooth transitions over the years • Positive long-trends in human development indicators • Relatively high scientific productivity • Fiscal incentives for foreign investment and policy instruments promoting innovation in place • Rich biodiversity and natural resources • More SETI operational policy instruments than its neighbours • Active member of SETI regional fora 	<ul style="list-style-type: none"> • Small non-diversified economy • Fragility of governance indicators • Cultural barriers and barriers tied to religious beliefs • A small pool of researchers • Absence of any explicit human resources policy for science and engineering • Low research and innovation productivity • A small SETI demand sector • Inadequate set of operational policy instruments to link the SETI demand and supply sides • Indigenous knowledge remains largely disregarded
Opportunities	Threats
<ul style="list-style-type: none"> • Increase awareness of the strategic importance of SETI among decision makers, entrepreneurs and the general public • Human capital development in science and engineering • Improve gender equality in science and engineering • Universities with SETI programmes • Science and Technology Fund • Availability of special external funding mechanisms for the environment • Networking at national, regional and international levels • Interconnectivity initiatives for educational institutions • Value-addition to abundant natural resources • Legal instrument to protect Indigenous Knowledge 	<ul style="list-style-type: none"> • Overdependence on erratic donor support • Demographic constraints • Adverse effects of climate change • Low participation of the business/enterprise sector in R&D • Erratic energy supply and ICTs connectivity are derailing progress in SETI • Regional competition • The plethora of SETI strategic priorities dilutes policy effectiveness

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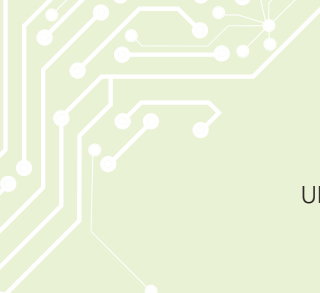
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Glossary

I. Glossary of main terms used in R&D surveys

The *National Survey of Research and Development* conducted in Malawi in 2013 used a series of definitions proposed by UNESCO (1978, 1982; 1984ab; 1988), the UNESCO Institute for Statistics (2010) and OECD (2002) which have been adopted by the African Science, Technology and Innovation Indicators (ASTII) initiative to standardise the collection of R&D statistics in Africa. In order to interpret the main findings of the Malawian survey accurately, we present a selection of the most relevant definitions here.

Sectors covered by R&D surveys

Business enterprise sector: (a) all firms, organisations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price, including both public and private enterprises; (b) the private non-profit institutions mainly serving them.

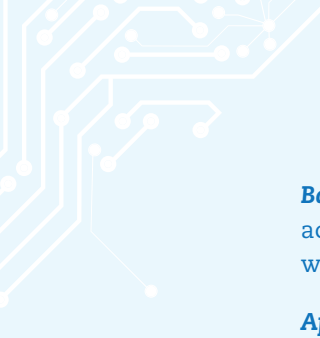
Government sector: (a) all departments, offices and other bodies which furnish, but normally do not sell to, the community, those common services, other than higher education, which cannot otherwise be conveniently and economically provided, as well as those that administer the state and the community's economic and social policy; (b) public enterprises mainly engaged in market production and the sale of goods and services are included in the business enterprise sector; (c) non-profit institutions controlled and mainly financed by government, not administered by the higher education sector.

Higher education sector: (a) all universities, colleges of technology and other institutions providing tertiary education (see below for details), whatever their source of finance or legal status; (b) all research institutes, experimental stations and clinics operating under the direct control of, or administered by, or associated with, higher education institutions.

Private non-profit sector: (a) Non-market, private non-profit institutions serving households (i.e. the general public) and (b) private individuals or households.

Definition of research and experimental development

Research and experimental development (R&D): comprises creative work undertaken on a systematic basis, in order to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock of knowledge to devise new applications. The term R&D covers three activities: basic research, applied research and experimental development.



Basic (or fundamental) research: is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Applied research: is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Experimental development: is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed towards producing new materials, products or devices, towards installing new processes, systems and services, or towards improving substantially those already produced or installed. R&D covers both formal R&D in R&D units and informal or occasional R&D in other units.

Definition of personnel

R&D personnel: all persons employed directly in R&D, as well as those providing direct services such as R&D managers, administrators and clerical staff. Persons providing an indirect service, such as canteen and security staff, should be excluded.

Head count: data reflect the total number of persons employed in R&D, independently of the focus of their work. These data allow links to be made with other data series, such as education and employment data, or the results of population censuses. They also serve as the foundation for calculating indicators which analyse the characteristics of the R&D labour force, with respect to age, gender or national origin.

Full-time equivalent (FTE): may be thought of as one person-year. Thus, a person who normally spends 30% of his/her time on R&D and the rest on other activities (such as teaching, university administration and student counselling) should be considered as 0.3 FTE. Similarly, if a full-time R&D worker is employed at an R&D unit for only six months, this results in an FTE of 0.5. However, for reporting purposes, the total sum of FTEs should be rounded to the next integer to avoid the reporting of decimals.

Researchers: are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in managing the projects concerned. Postgraduate students at the PhD level engaged in R&D should be considered as researchers.

Technicians: and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences (technicians) or social sciences and humanities (equivalent staff). They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods, normally under the supervision of researchers.


Support staff: includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects (or providing services to researchers involved therein).

International Standard Classification of Education (ISCED) levels

UNESCO developed the International Standard Classification of Education (ISCED) to facilitate comparisons of education statistics and indicators across countries on the basis of uniform and internationally agreed definitions.

The ISCED levels that were in use at the time of the Government of Malawi's 2013 *National Survey of Research and Innovation* were those from the 1997 revision of ISCED levels, namely:

ISCED 6 programmes: tertiary programmes leading to the award of an advanced research qualification. The programmes are therefore devoted to advanced study and original research and are not based on coursework only. They typically require the submission of a thesis or



dissertation of publishable quality which is the product of original research and represents a significant contribution to knowledge. They usually prepare graduates for faculty posts in institutions offering ISCED 5A programmes, as well as research posts in government, industry, etc.

ISCED 5A programmes: tertiary programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements. They must satisfy a sufficient number of the following criteria: (a) a minimum cumulative theoretical duration (at tertiary) of three years' full-time equivalent, although typically they are of four or more years; (b) faculty with advanced research credentials; (c) may involve completion of a research project or thesis; (d) provide the level of education required for entry into a highly skilled profession (theoretically based/research preparatory, such as history, philosophy, mathematics, etc., or giving access to highly skilled professions, e.g. medicine, dentistry, architecture, etc.) or an advanced research programme. This level includes all the research programmes which are not part of a doctorate, such as any type of master's degree.

ISCED 5B programmes: are tertiary programmes which are typically shorter than those in 5A and focus on giving participants occupational skills and a relevant qualification for the labour market, although some theoretical foundations may be covered. The content of ISCED level 5B programmes is mainly designed to give participants the practical skills and know-how needed for employment in a particular occupation or trade, or class of occupations or trades.


ISCED 4 programmes: are post-secondary, non-tertiary education programmes that straddle the boundary between upper-secondary and post-secondary education from an international point of view, even though they might clearly be considered as upper-secondary or post-secondary programmes in a national context. ISCED 4 programmes cannot, considering their content, be regarded as tertiary programmes. They are often not significantly more advanced than programmes at ISCED 3 level but they serve to broaden the knowledge of participants who have already completed a programme at level 3. Typical examples are programmes designed to prepare students for studies at level 5 who have completed ISCED 3 but did not follow a curriculum which would allow entry to level 5, i.e. pre-degree foundation courses or short vocational programmes. Second-cycle programmes can be included as well.

ISCED 3 programmes: are (upper) secondary education programmes typically beginning at the end of full-time compulsory education for those countries that have a system of compulsory education. The entrance age to this level is typically 15 or 16 years. The educational programmes included at this level typically require the completion of some nine years of full-time education (since the beginning of level 1) for admission, or a combination of education and vocational or technical experience, with, as minimum entrance requirements, the completion of level 2 or a demonstrable ability to handle programmes at this level.

The new International Standard Classification of Education

In 2011, UNESCO member states formally adopted a revision of ISCED. The product of extensive international and regional consultations among education and statistical experts, ISCED 2011 takes into account significant changes in education systems worldwide since the last ISCED revision of 1997.

ISCED 2011 counts four levels of tertiary education, as compared to two in the current version. The aim of the revision is to reflect the tertiary education structure found around the world better (bachelor's, master's and doctorate). This structure has been generalised across Europe since the Bologna Process got under way in 1999.



The first data collection based on the new classification began in 2014. The UNESCO Institute for Statistics is working closely with Member States and partner organisations (such as OECD and Eurostat) to map education systems using the new classification and revise statistic-gathering instruments.

The four new levels of tertiary education (effective as of 2014) are:

ISCED level 5 – Short-cycle tertiary education;

ISCED level 6 – Bachelor's degree or equivalent level;

ISCED level 7 – Master's degree or equivalent level;

ISCED level 8 – Doctoral or equivalent level.

Source: UNESCO Institute for Statistics (UIS) - UIS/RD/2012M

For details of ISCED 2011, see: www.uis.unesco.org/Education/Documents/isced-2011-en.pdf

II. Glossary on intellectual property rights

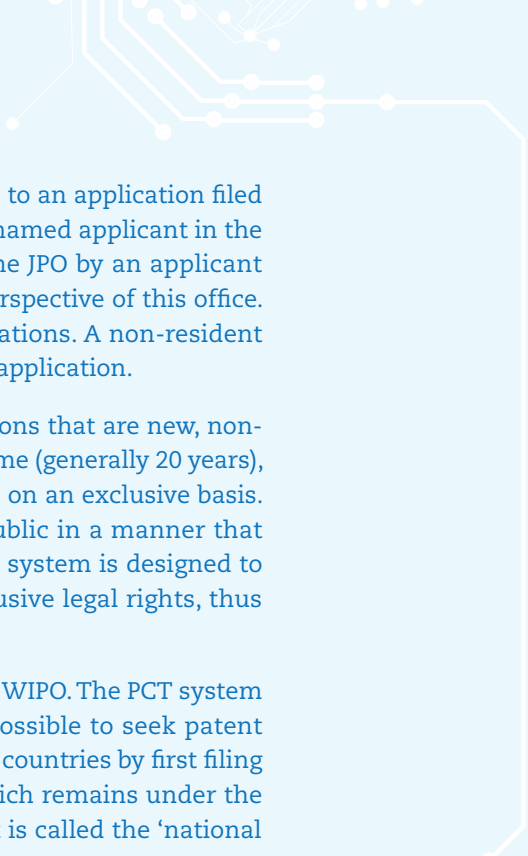
Applicant: An individual or other legal entity that files an application for a patent, utility model, trademark or industrial design. There may be more than one applicant in an application. For the statistics presented in the present publication, the name of the first-named applicant is used to determine the owner of the application.

Application abroad: For statistical purposes, an application filed by a resident of a given state/jurisdiction with an IP office of another state/jurisdiction. For example, an application filed by an applicant domiciled in France with the Japan Patent Office (JPO) is considered an 'application abroad' from France's perspective. This differs from a 'non-resident application', which describes an application filed by a resident of a foreign state/jurisdiction from the perspective of the office receiving the application.

Industrial design: applies to a wide variety of industrial products and handicrafts. It refers to the ornamental or aesthetic aspects of a useful article, including compositions of lines or colours or any three-dimensional form that gives a special appearance to a product or handicraft. The holder of a registered industrial design has exclusive rights concerning unauthorised copying or imitation of the design by third parties. Industrial design registrations are valid for a limited period. The term of protection is usually 15 years for most jurisdictions. However, differences in legislation do exist, notably in China (which provides for a 10-year term from the application date) and the USA (which provides for a 14-year term from the date of registration).

Intellectual property (IP): refers to creations of the mind: inventions, literary and artistic works, symbols, names, images and designs used in commerce. IP is divided into two categories: industrial property, which includes patents, utility models, trademarks, industrial designs and geographical indications of source; and copyright, which includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as drawings, paintings, photographs, sculptures and architectural designs. Rights related to copyright include those of performing artists in their performances, producers of phonograms in their recordings and those of broadcasters in their radio and television programmes.

Invention: a new solution to a technical problem. To obtain patent rights, the invention must be novel, involve an inventive step and be industrially applicable, as judged by a person skilled in the art.



Non-resident: for statistical purposes, a ‘non-resident’ application refers to an application filed with the IP office of, or acting for, a state/jurisdiction in which the first-named applicant in the application is not domiciled. For example, an application filed with the JPO by an applicant residing in France is considered a non-resident application from the perspective of this office. Non-resident applications are sometimes referred to as foreign applications. A non-resident grant or registration is an IP right issued on the basis of a non-resident application.

Patent: a set of exclusive rights granted by law to applicants for inventions that are new, non-obvious and commercially applicable. It is valid for a limited period of time (generally 20 years), during which patent holders can commercially exploit their inventions on an exclusive basis. In return, applicants are obliged to disclose their inventions to the public in a manner that enables others, skilled in the art, to replicate the invention. The patent system is designed to encourage innovation by providing innovators with time-limited exclusive legal rights, thus enabling innovators to appropriate a return on their innovative activity.

Patent Co-operation Treaty (PCT): an international treaty administered by WIPO. The PCT system facilitates the filing of patent applications worldwide and makes it possible to seek patent protection for an invention simultaneously in each of a large number of countries by first filing a single ‘international’ patent application. The granting of patents, which remains under the control of the national or regional patent offices, is carried out in what is called the ‘national phase’ or ‘regional phase’.

Registration: a set of exclusive rights legally accorded to the applicant when an industrial design or trademark is ‘registered’ or ‘issued’. (See also Industrial design or Trademark.) Registrations are issued to applicants so that they can make use of, and exploit, their industrial design or trademark for a limited period of time; in some cases, registration can be renewed indefinitely, particularly in the case of trademarks.

Resident: for statistical purposes, a ‘resident’ application refers to an application filed with the IP office of, or acting for, the state/jurisdiction in which the first-named applicant in the application has residence. For example, an application filed with the JPO by a resident of Japan is considered a resident application from the perspective of the JPO. Resident applications are sometimes referred to as domestic applications. A resident grant/registration is an IP right issued on the basis of a resident application.

Trademark: a distinctive sign that identifies certain goods or services as those produced or provided by a specific person or enterprise. The holder of a registered trademark has the legal right to exclusive use of the mark in relation to the products or services for which it is registered. The owner can prevent unauthorised use of the trademark, or a confusingly similar mark, so as to prevent consumers in particular and the public in general from being misled. Unlike patents, trademarks can be maintained indefinitely by paying renewal fees. The procedures for registering trademarks are governed by the rules and regulations of national and regional IP offices. Trademark rights are limited to the jurisdiction of the authority that registers the trademark. Trademarks can be registered by filing an application at the relevant national or regional office(s), or by filing an international application through the Madrid system.

Utility model: a special form of patent right granted by a state/jurisdiction to an inventor or the inventor’s assignee for a fixed period of time. The terms and conditions for granting a utility model differ slightly from those for normal patents (including a shorter term of protection and less stringent patentability requirements). The term ‘utility model’ can also describe what are known in some countries as ‘petty patents’, ‘short-term patents’ or ‘innovation patents’.


Source: WIPO (2013)

Annex

Directory of scientific and technological institutions in Malawi

NAME OF INSTITUTION	ADDRESS	TELEPHONE	FAX
Agriculture Policy Analysis and Training Unit	P.O Box 219, Lilongwe Bunda	277419/277222	01277364
Agriculture Policy Research Unit	P.O Box 219, Lilongwe	277433	277286/277364/277243
Agriculture Research and Extension Trust	P/Bag 9, Lilongwe	761157/761148/761212	761615
Baka Experimental Station	P.O Box 97, Karonga	362300/362235	
Bunda College of Agriculture	P.O Box 219, Lilongwe	277222	277364
Bvumbwe Agricultural Research Station	P.O Box 5748, Limbe	471334/471503/471527	471323
Centre for Education and Training	P.O Box 280, Zomba	424490	525061
Centre for Language Studies	P.O Box 108, Zomba	525709/522836	524297
Centre for Social Research	P.O Box 278, zomba	526622/524800/524916	524578/524760
Central Veterinary Laboratory	P.O Box 527, Lilongwe	733011/766380	766341/766570
Chancellor College	P.O Box 280, Zomba	524222	524046
Chitala Experimental Station	P.O box 315, Salilma		
Chitedze Agricultural Research Station	P.O Box 158, Lilongwe	707222	
College of Medicine	P/bag 360, Chichiri , Blantyre 3	764744	674700
Community Health Sciences Unit	P/Bag 65, Lilongwe	757205/756856/757883	756828
Domasi College of Education	P.O Box 49, Domasi	536255/536256/536306	536240

NAME OF INSTITUTION	ADDRESS	TELEPHONE	FAX
Fisheries Research Unit	P.O Box 27, Monkey Bay	587440/587432/587754	587249/587754
Forestry Research Institute of Malawi	P.O Box 270, Zomba	524866	524548,524782
Geological Survey Department	P.O Box 27, Zomba	524166	524716
International Crops Research Institute for the Semi-Arid Tropics		01707071	
Kamuzu Central Hospital	P/bag 149 Lilongwe	01756900	01756380
Kamuzu College of Nursing	P/Bag 1, Lilongwe	751662	756424
Kasinthula Experiment Station	P.O Box 28, Chikwawa	432255/423207	
Lifuwu Experimental Station	P.O Box 102, Salima	261401/829661	788801
Lilongwe Technical College	P.O Box 190, Lilongwe	725947/725943	727959
Lunyangwa Agricultural Research Station	P.O Box 59, Mzuzu	332633/332961/332017	332687
Makoka Agricultural Research Station	P/Bag 3, Thondwe	534254/534211/534364	534208
Malamulo College of Medical Sciences	P/Bag 2, Makwasa	47422/474228/474255	
Malawi Bureau of Standards	P.O Box 946, Blantyre	670488	670756
Malawi Chamber of Commerce and Industry	P.O Box 258, Blantyre	671688	671147
Malawi College of Fisheries	P/Bag 7, Mangochi	584422	584264
Malawi College of Forestry and Wildlife	P/Bag 6, Dedza	223053	223077
Malawi College of Health Sciences	P.O Box 30368, Lilongwe 3	756908	754425
Malawi Entrepreneurs Development Institute	P/Bag 2, Mponela	286244/286263/286391	286412
Malawi Export Promotion Council	P.O Box 1299, Blantyre	620499	635429
Malawi Industrial Research and Technology Development Centre	P.O Box 357, Blantyre	623805	623912
Malawi Institute of Education	P.O Box 50, Domasi	536300/536266	536235
Malawi Marine Training College	P/Bag 1, Monkey Bay	587500/587663	587206
Malawi Polytechnic	P/Bag 303, Chichiri BT 3	01670411	670578
Mbawa Experimental Station	P.O Box 8, Embangweni	342362	
Meteorological Department	P.O Box 2, Chileka	692333/692312	692329



NAME OF INSTITUTION	ADDRESS	TELEPHONE	FAX
Mkondezi Experimental Station	P.O Box 133, Nkhata Bay	352300/352321/352317	332687/352317
Molecular Biology and Ecology Research Unit	P.O Box 403, Zomba	524545	525829/524545
Mzuzu Central Hospital	P/bag1 Mzuzu	01320099/01320116	01310516
Mzuzu Technical College	P.O Box 316, Mzuzu	1031174	
Mzuzu University	P/Bag 201, Luwingu, Mzuzu 2	333575/333579	334505
National Aquaculture Centre	P.O Box 44, Domasi	53621/536321/536216	
National Commission for Science and Technology	P/bag B304, Lilongwe 3	771550/774869	772431/771 487
National Herbarium and Botanical Gardens of Malawi	P.O Box 528, Zomba	525388/525145/525118	524108
National Statistics Office	P.O Box 333,Zomba	525377	525130
Natural Resource College	P.O Box 143, Lilongwe	766644	766652
Queen Elizabeth Hospital	P/bag 95 Blantyre	01871823/01874333	
Research Trust			
Salima Technical College	P/Bag 175 salima	01263199	
Soche Technical College of Education	P/Bag 515, Limbe	01652295	
Southern Africa Root Crops Research network	P.O. Box 30288, Lilongwe 3	01707031	01707028
Tea Research Foundation (Central Africa)	P.O Box 51, Mulanje	462277/462293	462209
World Fish Centre	P.O Box 229, Zomba	536274	
Zomba Central Hospital	P/Bag 21 Zomba	01525231/01525266	

One of the poorest countries in the world, Malawi nevertheless spends 1% of its gross domestic product (GDP) on research and development (R&D), one of the highest ratios in Africa. Although R&D spending remains low in real terms, Malawian scientists publish more in mainstream journals – relative to GDP – than researchers in any other country with a similar population size.

Malawi thus has the potential to harness science, technology and innovation to reducing poverty and diversifying its agriculture-dependent economy: manufacturing accounts for just 12% of GDP and most products are exported in a raw or semi-processed state. The challenge will be to attract sufficient foreign direct investment (FDI) to foster technology transfer and empower the private sector to serve as an engine of economic growth. With stable government for the past two decades, ever since the introduction of a multiparty system, the country is a potentially reassuring destination for foreign investors.

The Government of Malawi has recently begun reforming its financial management system and has put a series of fiscal incentives in place to attract foreign investors. The Malawi Investment and Trade Centre has designed a multimillion investment portfolio spanning the major growth sectors of Malawi's economy, including a number of innovation projects. The country has also introduced a series of policy instruments to promote FDI, including tax incentives and the Malawi Innovation Challenge Fund for private businesses, which nurtures productive partnerships between leading firms and poor producers and entrepreneurs. The need for research and services is enormous, in a country where 93% of the population still lacks access to electricity, 47% improved sanitation and one in four adults any form of family planning.

In 2013, the Government of Malawi appealed for UNESCO's assistance in preparing an evidence-based policy analysis of its unique situation. *Mapping Research and Innovation in the Republic of Malawi* is the result. The present profile has been produced within the Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN), a UNESCO initiative which stresses the importance of having a wide range of policy instruments to ensure effective policy implementation. GO→SPIN is applying a new methodology to mapping research and innovation at country level, in order to inform the reform process and improve monitoring of national innovation systems.



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