

Executive Summary

Science and technology are often viewed as the powerful engines driving the new knowledge-based global economy. Yet in many nations, it is the innovations and sustainable practices of traditional and indigenous knowledge systems that underpin community food security and provide a parallel source of understanding. Taken together, the challenge for countries is to facilitate the opportunities of all citizens to contribute, by fostering an innovation system that is inclusive and a science that serves rather than threatens society. Gender-based analysis is a powerful public policy tool that can assist in achieving these goals.

This Manual provides a roadmap for mainstreaming gender into science and technology departments. It sets out the definition of gender and the dynamic of the Commonwealth's Gender Management System (GMS). It calls on governments to tap into the wealth of international conferences and mandates, already officially endorsed, as a rich resource of recommendations specific to the science and technology sector.

The Manual suggests three themes as a proposed framework for approaching issues of gender in science and technology.

1. *Science by whom?*
2. *Science for whom?*
3. *Science in the service of global stewardship*

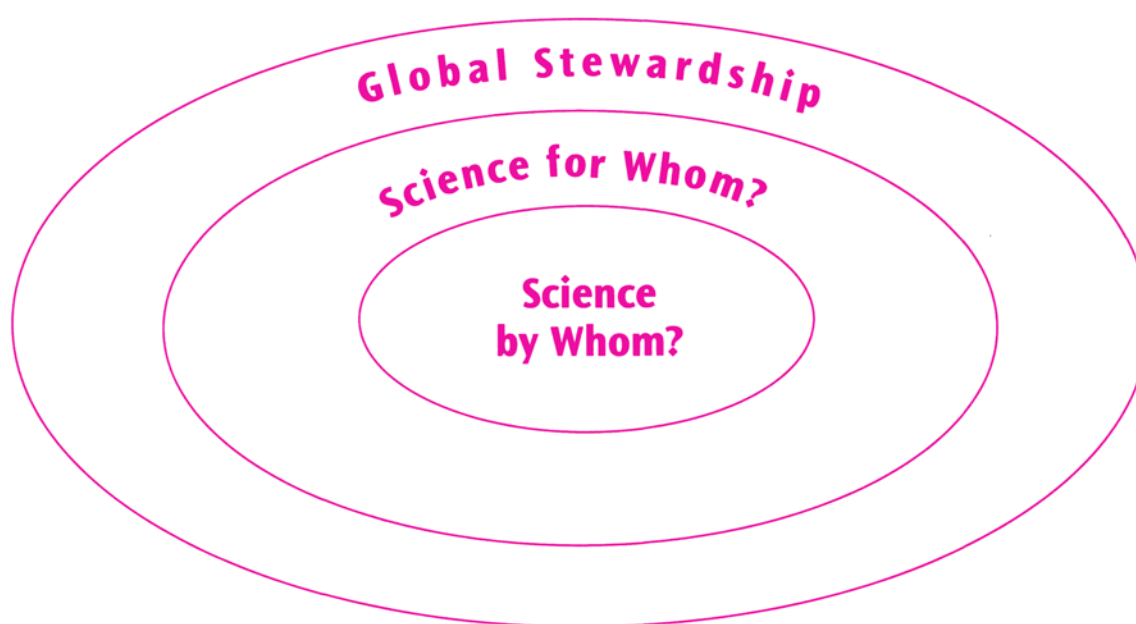
It presumes that local and indigenous knowledge systems form an integral and important part of innovation systems in many nations and that this knowledge can offer much value and understanding to modern science. In particular, it calls for recognition of the gender dimension of these systems and their protection. It also illuminates the gender dimension of a selected number of issues in science and technology including information technology, biodiversity, habitat development, the environment and disaster management.

Science by Whom?

"The single most underutilized resource in the nation's science and technology system is women."
Prime Minister's National Advisory Board
on S&T: 'Winning with Women', Canada

Posing the first question, 'Science by whom?', addresses issues of 'The Leaky Pipeline' in science and technology. A disproportionate number of girls compared to boys are excluded from the opportunity to enter school. Of those that do, fewer girls than boys select and stay with science streams of study. This attrition rate becomes increasingly apparent at successively higher levels of education. Revealing these numbers through the systematic collection of sex-disaggregated data is an essential first step in identifying the gender gap in the pipeline and informing decision-makers. Who is studying science? Who are entering the technical trades? Why do women make up two thirds of the world's illiterate? Why do more men than women enter and stay in science? Of those women who stay, why do most side-stream into the biological and social sciences? When women enter careers in science and technology, how many reach the top decision-making positions? Answering these questions leads institutions to study overt and covert barriers and systemic obstacles to women in science. Resulting recommendations formulate strategies to 'fill the pipeline'.

Figure 1

Beyond the Numbers

Yet a 'supply-side strategy', while necessary, is insufficient. Many women, once inside the pipeline, opt out. Looking at science and technology through a gendered lens means more than 'adding women in' to the existing science and technology system. It means examining perceptions, practice and policy inside structures. This Manual not only examines the series of systemic barriers causing the side-streaming of girls away from science but also tackles the equally important issue of 'The Chilly Climate' inside institutions. Governments are given an array of options and ideas to assist in attracting, promoting and retaining women in science and technology and an action agenda for the creation of enabling environments. Strategies to attract top female talent to the field are considered essential to maximise human capital and gain competitive advantage.

Increasingly, governments are commissioning studies, from Prime Ministerial inquiries to APEC Regional Policy Papers, to quantify the gender gap in science education and science careers, seeking solutions. Academic institutions are also involved in scholarship on issues of gender in science and technology. UN agencies and their gender focal points provide another focus on science, and international umbrella non-governmental organisations (NGOs) like the Once and Future Action Network (OFAN) are spearheading global considerations of gender in science and technology. There is a rich resource of networks and international with websites and active programmes for mentoring and role modelling. Chapter 6 of this Manual is devoted to providing on-line links to these valuable reports, stakeholders and partners.

Science for Whom?

"To ensure science and technology benefits all members of society, attention must be paid to the respective needs and interests of men and women equitably."

1995 UNCSTD Gender Report to ECOSOC

One of the two key findings of the United Nations Gender Working Group (1993–1995) was the gender-specific nature of technical change. Science and technology may not be gender-neutral in their impact. The 'rising tide' of new research does not lift all boats alike. Gender-based analysis (GBA) is a policy tool that permits the systematic

consideration of gender impact at every stage of the policy process. In a manner not dissimilar to the introduction in the 1990s of environmental impact assessments, GBA enables policy-makers to discern the differential impacts of their proposals on the lives of women and men. Where either group is disadvantaged, GBA allows an early alert and permits policy-makers to put into place appropriate compensatory measures.

Science in Service of Global Stewardship

“From research on human embryos to the commercialisation of life, from genetic testing to genetically engineered foods, from organ transplants to assisted suicide and euthanasia, medical technology now touches us intimately at every stage of our lives. It gives us unprecedented powers – to create, manipulate, and alter human life in the laboratory; to keep people alive in a state of living death; to use one person’s organs and tissues so that another can live; to create clones of ourselves ... Our very definitions of who we are and what it means to be human are challenged.”

Maureen A. McTeer, *Tough Choices: Living and Dying in the 21st Century*

Even if women and men have equal opportunity to enter and excel in science institutions (Science by whom?), and even if the impact of technologies on society is moderated to ensure that neither women nor men are disproportionately disadvantaged or adversely affected by technical change (Science for whom?), there remains another level of inquiry. This involves issues of ethics. We can do a lot of things with science and technology; *should* we? And is there a gender dimension to this question?

The UNCSTD Gender Report, tabled in the UN Social and Economic Committee in 1995, contends that ethical issues associated with both the conduct of scientific research and the application of the results of research frequently have a gender dimension that has not been sufficiently recognised or addressed. The Report called on national governments to develop codes of ethics to provide clear boundaries of acceptable practice both in research and in the application of technology. The Report further urged that legislation make provision for enforcement of these codes. The example used in the report pertained to the identification of foetal sex for the purpose of aborting the girl-child. Other examples highlighted were the exploitation of vulnerable groups, particularly women, for the testing of drugs and the exploitation of indigenous knowledge systems by outside groups for commercial gain without appropriate acknowledgement or compensation.

The 1996 report of the Royal Commission on New Reproductive and Genetic Technologies (NRGT) titled ‘Setting Boundaries, Enhancing Health’ in Canada made specific reference to the issue of equality in public policy pertaining to reproduction and genetic engineering.

“Equality should be promoted among women and men; however, reproductive policy development should not proceed as though reproduction affects women and men in the same way. The physical and social burdens and risks of reproduction are borne primarily by women. These realities should be acknowledged and reflected in reproductive policy. The rights of children born as a result of NRGTs must also be considered when equality issues are examined.”

Science cannot be unleashed in society with the assumption that the traditional system employed by government regulatory departments – a science-based risk assessment – is a sufficient tool. The blurring of species lines with the creation of transgenic animals and plants, genetic engineering of children, and cloning and other frontier sciences need to be placed into a social context. Regulatory departments need to reach out to stakeholders and society in general to seek guidance on issues of

profound social change. Citizen engagement and deliberation – sometimes globally – is required to reach consensus on the stewardship of science. An example of international collaboration to reach such a consensus is the 1998 UNESCO Universal Declaration on the Human Genome and Human Rights.

In defining these rules, purposeful attention to issues of ethics in science and technology must include the gender dimension if we ever hope to charter an equitable and sustainable course of global stewardship.

Agenda for Action

Recognising, valuing and protecting indigenous knowledge systems

- ◆ Ensure the preservation of local knowledge systems with attention to their gender-specific nature.
- ◆ Acknowledge the contributions of indigenous knowledge systems to other science and technology systems, noting their gender-specific characteristics.
- ◆ Promote mutually beneficial exchanges between modern and traditional knowledge systems and technologies for the benefit of both women and men in rural areas.
- ◆ Address the ability of present regulatory and legislative systems to protect the intellectual property of local knowledge owned by communities, paying special attention to its gender-specific nature.
- ◆ Where external agencies have exploited local knowledge systems for commercial gain, find mechanisms for requiring compensation to the men and/or women in the communities who generated this knowledge.

Source: 'Transformative Actions' endorsed by the UN Commission on Science and Technology for Development, 1995

Women, the environment and sustainable development

- ◆ Take women's environmental health as an important reference point for ensuring the appropriateness of all science and technology interventions.
- ◆ Use science and technology in a gender-sensitive manner to alleviate women's poverty through research, policy and programmes to meet women's expressed environmental perceptions, needs and interests.
- ◆ Support women's microenterprise activities through environmentally sound and relevant science and technology interventions.
- ◆ Ensure women's environmental literacy through increased access to formal and informal environmental education and women's access to relevant science and technology information and expertise in order that women realise a level of increased participation in community-based environmental decision-making.
- ◆ Support women's participation in national, regional and local environmental decision-making.

Source: UNCSTD-Gender Working Group, 1995

Agriculture, biotechnology and food security

- ◆ Negotiate for trade-related and environmental agreements that protect local and indigenous peoples' knowledge and ensure agricultural biodiversity through the active participation of women, small-holder farmers and indigenous peoples as partners, decision-makers and beneficiaries.
- ◆ Recognise and value women and men's local knowledge, skills and practices and promote policies and projects that create enabling environments for indigenous science and technology systems through gender-responsive participatory planning, implementation and evaluation processes.
- ◆ Redirect agricultural policy towards women-centred systems, which promote biodiversity based on small farm agriculture.

Science and Technology Education and Careers

Education

- ◆ Provide the same opportunities for access to formal education for girls as well as boys.
- ◆ Ensure literacy and basic instruction in science and technology for both boys and girls.
- ◆ Ensure that infrastructure, laboratories and equipment in schools are equally available to girls and boys.
- ◆ Ensure that teaching materials in science and technology are gender-inclusive in terms of language and illustrations.
- ◆ Ensure a strong link between science and society.
- ◆ Broaden the teaching of science to include elements addressing the economic, social and ethical implications of science and technology.
- ◆ Recognise the importance of women science teachers as mentors and role models and provide rewards to those who devote substantial time to mentoring.
- ◆ Provide multiple opportunities for re-entering school, especially for young mothers.
- ◆ Introduce education programmes with flexible locations and times to enable more students, especially girls, to acquire scientific literacy.
- ◆ Introduce new approaches to science and technology education such as distance learning, making optimal use of both old (radio) and new (multimedia) technologies.
- ◆ Support the establishment of Chairs for Women in Science and Engineering special scholarships for women entering science research and careers (see Box 2, page 18).

Careers

Institutional barriers to an inclusive and enabling environment for women pursuing science careers in science and technology should be systematically removed through a series of steps by stakeholders including the following.

Employers should:

- ◆ Provide alternative work arrangements such as flexible hours, flexible locations, and job-sharing opportunities;
- ◆ Ensure on-site childcare facilities;
- ◆ Have maternity and paternity leave policies;
- ◆ Put into place hiring and promotion criteria to allow for family responsibilities so that maternity, paternity and parental leaves do not jeopardise career progression;
- ◆ Promote women's careers in science while adhering to the merit principle;
- ◆ Introduce policies against discrimination and harassment in the workplace.

Governments should:

- ◆ Provide tax relief for payment of child-minders;
- ◆ Pass pay equity legislation;
- ◆ Enact legislation against discrimination;
- ◆ Collect sex-disaggregated statistics;
- ◆ Establish focal points for advice on gender in science and technology;
- ◆ Increase the number of women appointed to policy advisory and decision-making bodies;
- ◆ Seek input and advice from women's professional science and technology NGOs and include representatives from these groups on government delegations to meetings;
- ◆ Establish databases of professional women in science and technology to be considered for appointment to policy and advisory bodies;
- ◆ Assist non-governmental networks of women in science and technology with the design, mounting and maintenance of their web sites.

Academic Institutions should:

- ◆ Establish and support networks of female professionals in science and engineering;
- ◆ Set up and support mentoring, role-model and career advisory programmes;
- ◆ Provide flexible tenure criteria to accommodate family roles and responsibilities;
- ◆ Provide refresher courses and re-entry scholarships for women returning to careers in science;
- ◆ Establish Chairs on Women in Science and Technology at universities to act as focal points for facilitating and mentoring women. Support these Chairs with appropriate resources (see Box 2, page 18).

Addressing the differential impacts of science and technology on society

The Commonwealth Secretariat should:

- ◆ Liaise with the Gender Advisory Board (GAB) established by the UNCSTD and liaise with the GAB regional focal points globally that are implementing the Declaration of Intent and seven Transformative Actions on gender in science and technology;
- ◆ Convene an international meeting of statisticians, along with science, technology, and gender specialists from national and international bodies to identify the critical statistics necessary for policy purposes; to designate responsibility centres; and to establish mechanisms for co-ordination and collaboration;
- ◆ Decide on methods and common approaches to permit cross-cultural comparisons over time and to ensure the best use of resources.

Governments should:

- ◆ Ensure the systematic application of gender-based analysis to all science and technology policy and programme activity of the department and affiliated research agencies;
- ◆ Promote the implementation of the seven UNCSTD Transformative Actions through the establishment of national programmes for women in science and technology;
- ◆ Revise statistics data-collection methods to ensure sex-disaggregated statistics are systematically and regularly collected both on participation rates and on differential impacts;
- ◆ Ensure the collection of complementary sets of data, using common methods across countries and make the data collected available to both local and international bodies to ensure their maximum use in policy and programme formulation and to ensure their aggregation at the regional and international levels.

Biotechnology and ethical issues

Governments should:

- ◆ Support and develop conventions, declarations and codes of ethics to provide clear boundaries of acceptable practice in research and in application of science and technology giving specific attention to their differential impacts on the lives of women and men and vulnerable populations;
- ◆ Provide regulatory departments, which traditionally have approved products based on a science-based risk assessment, additional tools to incorporate an analysis of the ethical dimension of technologies and the resources to undertake citizen engagement;
- ◆ Ensure that science and technology departments hire professionals trained in ethics, including feminist ethics and fields emphasising science in society, in order to provide additional needed input into the science-based risk assessment process;
- ◆ Ensure that government-supported research agencies dedicate a portion of their funding to the consideration of the ethical, legal and social issues (ELSI) including systematic gender-based analysis and that all research is guided by research ethics boards (REBs);

- ◆ Provide departmental decision-makers with expertise on gender in science and technology to ensure that feminist bioethics and feminist ethics are articulated;
- ◆ Promote the systematic introduction of ethics into the teaching of science in schools at all levels of education including technical colleges and universities.

NGO Networks and Associations of Women in Science should:

- ◆ Play a role in articulating the views of women concerning issues of ethics and science;
- ◆ Enlarge their networks and act as fora that highlight the special concern of women and women's perspectives, as well as the role that women have and can play in the development of science and its social and ethical implications.

Information and communications technologies (ICTs)

- ◆ Establish a gender audit team at the Commonwealth level to study the impact of ICTs and globalisation on women and men's lives differentially.
- ◆ Undertake regular technology assessments to evaluate the social, economic and health implications for both women and men.
- ◆ Network with other like-minded organisations to ensure that the present phase of globalisation and ICT innovations benefit the majority of the people and not just the elite.
- ◆ Ensure that ICT-poor countries have access to these technologies; for example debt-laden countries to utilise payments for the development of ICT infrastructure with universal access as its first principle/condition.
- ◆ Establish genuine attempts at technology transfer and/or the creation of technology flows from developed Commonwealth countries to their developing counterparts.
- ◆ Set up a regulatory framework(s) to govern ICT flows and applications, which would benefit all countries in the Commonwealth.
- ◆ Establish schools and/or telecentres which serve the community, especially the marginalised, as well as provide multi-function activities, e.g. ICT training, income generating activities.
- ◆ Establish special programmes for those made redundant as a result of technological change/restructuring, especially re-skilling and re-entry for women hit disproportionately.
- ◆ Produce software that is user-friendly to meet the information requirements of women in nutrition, health care and education.
- ◆ Form websites in local languages and with local content that will benefit non-elite women.
- ◆ Find alternative ways of achieving cost-effective connectivity, especially for women in poor and rural communities.
- ◆ Encourage and facilitate the participation of civil society, including women, in the formulation and implementation of ICT policies and development programmes.
- ◆ Recognise and reward new inter-active and communication skills that have emerged as a result of the introduction of ICTs.
- ◆ Provide information and formulate internationally recognised standards on health and safety hazards relating to ICTs.
- ◆ Set up technology agreements between workers' representatives/unions and management as well as company codes of conduct/best practices related to technological change.

Habitat development

- ◆ Meet government's commitment under Article 46 of the Habitat Agreement to the goal of gender equality in human settlements development. This commitment includes: collecting, analysing and disseminating sex-disaggregated data, including statistically making visible the unremunerated work of women; designing and

implementing environmentally sound and sustainable resource management and development; integrating gender perspectives in related legislation, policies and programmes; and promoting the full and equal participation of women in human settlements planning and decision making.

- ◆ Activate and institutionalise a process of popular participation at local government level to get feedback from women on family and community needs with regard to housing design, neighbourhood planning, elderly and child care, health care, public safety, transport and urban environment.
- ◆ Introduce an affirmative action policy to increase women's representation at local government level and in ministries of housing and local government.
- ◆ Promote a network of women environmental managers, social scientists, urban planners, architects, engineers, industrial designers, health care professionals, IT professionals, women entrepreneurs and women in urban governance to forge people-friendly approaches to modern development.
- ◆ Provide incentives for pilot projects, which design consciously for women, children and sustainable communities with consideration for the extended family.

Disaster management

- ◆ Ensure representation of at least one-third women on all national security bodies and all international security bodies including NATO and the Warsaw Pact.
- ◆ Include women's units in the UN Expeditionary Forces and National Disaster Management Teams.
- ◆ Set up special UN women's peace brigades for dealing with civil violence and disasters
- ◆ Enable women's encampments at all international borders where violent combat is threatened, consisting of women trained in non-violence.
- ◆ Train and utilise travelling teams of women mediators.
- ◆ Offer special recruitment and support for women to study international affairs and conflict resolution/mediation with scholarship support.