GENDER MANAGEMENT SYSTEM SERIES

Gender Mainstreaming in Science and Technology

A Reference Manual for Governments and Other Stakeholders

Elizabeth McGregor and
Fabiola Bazo

Commonwealth Secretariat

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Gender Management System Series:

Gender Management System Handbook
Using Gender-Sensitive Indicators: A Reference Manual for Governments and Other Stakeholders
Gender Mainstreaming in Finance: A Reference Manual for Governments and Other Stakeholders
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Preface

In 1996, the Commonwealth Ministers Responsible for Women's Affairs mandated the Commonwealth Secretariat to develop the concept of the Gender Management System (GMS), a comprehensive network of structures, mechanisms and processes for bringing a gender perspective to bear in the mainstream of all government policies, programmes and projects. The success of the GMS depends on a broad-based partnership in society in which government consults and acts co-operatively with the other key stakeholders, who include civil society and the private sector. The task of gender mainstreaming has both technical and managerial dimensions, as well as the political and socio-cultural aspects of creating equality and equity between women and men as partners in the quest for social justice. The establishment and strengthening of gender management systems and of national women's machineries was identified in the 1995 Commonwealth Plan of Action.

This reference manual has been produced to assist member governments in meeting their commitment to implementing the Plan of Action. It is hoped that it will be used by development policy-makers, planners, field staff and others, in conjunction with other publications relating to the particular national context. It is intended to serve as an accessible reference manual to aid users in setting up a GMS and managing problems encountered in advancing the goal of gender equality and equity in science and technology. As part of the Gender Management System series, it can be used alone or in conjunction with other titles, particularly the *Gender Management System Handbook*, which presents the conceptual and methodological framework of the GMS.

The development of the GMS series has been a collective effort between the Commonwealth Secretariat's Gender and Youth Affairs Division and many individuals and groups. Their contributions are gratefully acknowledged. In particular, I would like to thank the following: all those member governments who supported the development of the GMS and encouraged us to move the project forward; participants at the first GMS meeting in Britain in February 1997 and at the GMS Workshop in Malta in April 1998, who provided valuable input and feedback; and the Steering Committee on the Plan of Action (SCOPA). I would like to thank especially the Canadian International Development Agency's (CIDA) Gender Equality Division, Policy Branch, for co-funding this manual. I am also most grateful to Dr Elizabeth McGregor and Ms Fabiola Bazo, who prepared the text of this manual, incorporating the work of many leading gender in science and technology researchers (listed as key collaborators and contributors); Ms Tina Johnson, Editor; members of the Guest Editorial Committee; and the staff of the Gender Affairs Department, Gender and Youth Affairs Division, particularly Dr Rawwida Baksh-Soodeen, GMS Series Co-ordinator, who conceptualised and guided the series of reference manuals through to publication.

We hope that this resource series will be of genuine use to you in your efforts to mainstream gender.

Nancy Spence
Director
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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.

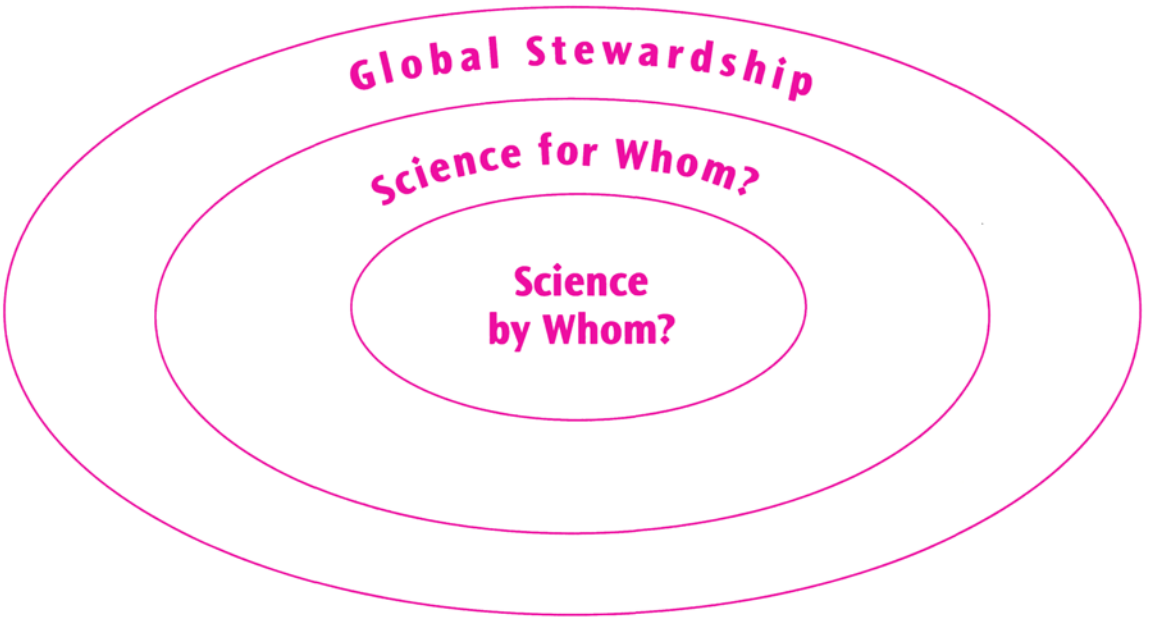
Science by Whom?

"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 then '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.

1 Introduction

Scope and Objectives of this Manual

This reference Manual provides guidelines for advancing gender equality and equity in the field of science and technology. In so doing, it applies a gender perspective to a broad range of science and technology-related issues, examining conditions as they relate to both women and men and how policies, plans, programmes and projects impact on the lives of women and men differently. This means acknowledging the need to take into account the differing needs and conditions of women and men.

The Manual's main objective is to assist governments in advancing gender equality in their countries, especially through the establishment and operation of a Gender Management System (GMS). Where governmental structures include a Ministry of Science and Technology, it will play a pivotal role in gender mainstreaming. However, it needs to be stressed that both gender and science and technology are cross-cutting issues throughout almost all areas of government, and it would be ineffective to mainstream only in such a ministry even where it exists. Other ministries, for example Finance, Water, and Agriculture, also play a critical role since they make many of the decisions which affect how science and technology impact on women and men. In addition, Ministries of Science and Technology are often under-funded, with the amount they have for research and development being extremely small in comparison to the private sector, even in developed countries.

Since the Manual's main objective is to assist governments in advancing gender equality in their countries, it is tailored to governmental structures. However, it may also be of use to non-governmental stakeholders that are involved in determining and formulating policy, applying it and ensuring its enforcement. These include NGOs, women's groups, professional associations, the academic community and others committed to promoting gender equality.

This Manual provides an overview of some of the major gender issues in the area of science and technology, including global and Commonwealth mandates for promoting gender equality. It also provides an extensive list of recommendations to ensure that governments can create an enabling environment to maximise the human capital of both women and men in science and technology in each country.

The Manual is part of the Gender Management System (GMS) Series, which consists of a number of publications presenting the concept and methodology of the GMS, with sector-specific guidelines for mainstreaming gender in key areas. The GMS is explained most fully in the *Gender Management System Handbook*.

Gender and Development in Science and Technology

Relative to other issues of women in development which have stimulated a bank of scholarship and theoretical frameworks, issues of gender in science and technology are newcomers to the international stage. In 1979, at the first International Conference on Science and Technology, only one article referred explicitly to women in science and technology. A fuller agenda was elaborated in time for the 1985 Mid-Decade Nairobi World Conference on Women to complement the highly popular 'Tech and Tools' pavilion celebrating women's inventions and technical knowledge. In 1983, the newly set up United Nations Commission on Science and Technology (UNCSTD) designated gender as one of its three themes. In doing so, it drew on the expertise developed by the Once and Future Action Network (OFAN), an NGO umbrella organisation of women working in science and technology fields. A Gender Working Group was established with Commissioners from Saudi Arabia, China, Tanzania, Burundi, Romania, Saudi Arabia, the Netherlands and the United Kingdom (Chairperson). An 'Advisory Board' to the Commissioners was set up with senior representation of women in science, national policy and gender advocacy. Over 67 international experts had input into the debate. Nine science themes were distilled in challenge papers. The result was a 'Declaration of Intent' approved by governments at the Economic and Social Council (ECOSOC) (see Box 1). This was then forwarded to the 1995 Beijing Fourth World Conference on Women, with an associated set of 'Seven Transformative Actions'.

The Beijing Platform for Action contained cross-cutting references to issues of gender in science and technology interspersed in its themes. At the parallel NGO Forum, the 'Once and Future Pavilion' celebrated women in science and technology internationally and offered a wide-ranging set of workshops. The UNESCO 1996 World Science Report dedicated one of its five chapters to the consideration of the 'Gender Dimension of Science and Technology'. Its subsequent 1998 World Science Report continued commentary on gender issues, and the 1999 World Science Conference of UNESCO and IUSCU, held in Budapest, had a full theme committed to women in science and technology preceded by four preparatory gender workshops internationally.

At the NGO level, professional associations of women such as engineers, physicians, women veterinarians, women chemists and women in trades have been actively organising national, regional and international networks of support. Many of these networks have mounted websites. OFAN has carried forward from Beijing to promote global action agendas as have several key regional and global science and technology initiatives noted in this Manual.

Increasingly, as economies reposition themselves to compete in the new knowledge-based global economy, the gender gap in entry, promotion, decision-making and attrition in fields of study and remunerated endeavour in science and technology has caught the attention of planners. In some instances, Heads of State have commissioned national assessments of women's participation in science and technology based on calls to action by their Science Advisors or National Science and Technology Advisory Boards (such as Canada's 'Winning with Women'). Ministers of Science and Technology have also called for national reports on the barriers and opportunities for women in these areas (such as the UK White Paper entitled 'The Rising Tide'). In some cases, science and technology research agencies have examined women's barriers in science and established special mechanisms for recruiting, retaining and mentoring top female talent. One example is the establishment of Canada's five NSERC Chairs on Women in Engineering in Universities (see Box 2).

Box 1

Declaration of Intent on Gender, Science and Technology for Sustainable Human Development

The Gender Working Group of the United Nations Commission on Science and Technology for Development (UNCSTD), in its 1995 report on gender equity in science and technology, recommended that all governments adopt a Declaration of Intent by which they agreed to work actively towards the following goals:

- To ensure basic education for all, with particular emphasis on scientific and technical literacy, so that all women and men can effectively use science and technology to meet basic needs.
- To ensure that women and men have equal opportunity to acquire advanced training in science and technology and to pursue careers as technologists, scientists and engineers.
- To achieve gender equity within science and technology institutions, including policy-and decision-making bodies.
- To ensure that the needs and aspirations of women and men are equally taken into account in the setting of research priorities and in the design, transfer and application of new technologies.
- To ensure all men and women have equal access to the information and knowledge, particularly scientific and technological knowledge, that they need to improve their standard of living and quality of life.
- To recognise local knowledge systems, where they exist, and their gendered nature as a source of knowledge complementary to modern science and technology and valuable for sustainable human development.

Currently, there are regional offices of the UNCSTD 'Gender Advisory Board' located in South America and in Africa to facilitate governments implementing the Declaration and Transformative Actions.

Source: UNCSTD-Gender Working Group (1995)

Regionally, trade organisations and co-operative groups such as the Asia Pacific Economic Co-operation (APEC) have paid specific attention to the challenges of women in science and technology. In 1996, APEC Ministers for Industrial Science and Technology held a two hour 'Open Ideas Forum' on this issue in Korea, based on a challenge paper, 'Gender and Science and Technology in Knowledge Based Economies: Some Considerations for APEC' (McGregor, 1996). The outcome was the formation of a 'Gender Working Group', the convening of a regional Statistics Experts Meeting of member economies for attention to the collection of gender-data and sharing of best practices, and the request for an APEC website on gender in science and technology.

Supporting and stimulating these watershed events was the formation within APEC of a Women Leader's Network (WLN) which connects influential women in business, academia, public policy and parliament. The WLN adopted science and technology as one of its three themes of focus. The 1996 WLN Conference in the Philippines, its 1997 Conference in Ottawa and its 1998 Conference in Malaysia developed specific science and technology recommendations to Heads of State and Ministers of Science and Technology. The WLN contributed substantially to the drafting of the APEC Minister's challenge paper for Korea. Collaboration of the WLN with Ministers and APEC is a template for change and collaboration

In summary, there now exists a growing body of Prime Ministerial Reports and Reports by Ministers of Science and Technology containing a rich resource of recommendations. The UNCSTD 'Transformative Actions' and Declaration are being supported by

Box 2

Women in Science and Engineering Chairs (Canada)

In 1996, a unique public-private joint initiative on promoting women in science and technology was announced in Canada. The Natural Sciences and Engineering Research Council of Canada (NSERC) invested $1.25 million to establish five new Chairs for Women in Science and Engineering (CWSE) at Canadian universities, an amount matched or exceeded by contributions from four major private companies. Distributed across Canada, these Chairs have the objective of encouraging the increased participation of women in science and engineering education programmes and in the workplace, including developing strategies to encourage female students in elementary and secondary schools to consider careers in science or engineering. The Chair holder also acts as a role model and contact person for women in these fields. Each Chair holder devotes up to half of her time to the activities of the Chair and the remainder to her normal professorial and research activities at the university.

Activities include:

- participating in public forums for scientists, engineers, employers, educators, researchers and others;
- visits to elementary, junior high and high schools to talk about science and engineering as viable career choices for women;
- meeting with employers of engineers, industry and government to suggest ways in which the climate for women scientists and engineers can be improved;
- working to improve the retention rate of women enrolled in Science and Engineering Faculties and in the workplace;
- discussing with university administrators and faculty members matters related to the learning environment, curriculum and teaching styles that facilitate the integration of women in these fields and the need to value women's contributions;
- consulting with PEO, CCPE, and scientific societies on strategies to increase the integration of women in scientific and professional activities and in the governance of these associations;
- speaking at universities to promote ideals of equity, fairness, professional ethics and harassment-free environments for women students;
- participating in broadcast and print media interviews; and
- being involved in scholarly work such as teaching and research.

regional implementation focal points to facilitate governments. Networks like the APEC Women Leader's Network are available to governments and Ministers as sources of advice and appointment. International umbrella NGO groups like OFAN are spearheading global considerations of gender in science and technology. Governments today are thus in a strong position to take action on gender and science and technology.

A Gender Framework

What is Gender?

Whereas the sex of an individual is biologically determined, gender refers to the socially constructed definition of women and men and the relationship between them. Gender is culture-specific and also varies over time. It determines the conception of tasks, functions and roles attributed to women and men in society, in both public and

private life. There is increasing recognition that society is characterised by a male bias: the male norm is taken as the norm for society as a whole, which is reflected in policies and structures. These policies and structures play a role in reproducing and institutionalising the social construction of gender, which contains an unequal power relationship. Male domination and female subordination is found in most spheres of life, and the tasks, roles, functions and values attributed to men are usually more highly valued than those associated with women.

Men and women are different, but these differences should not have a negative impact on their living conditions and should not discriminate against them. Such diversity should systematically be factored into an equal sharing of power in the economy, society and policy-making processes. In order for there to be gender equality, measures need to be taken so that both women and men have equal opportunities (in education, careers, etc.) and enjoy the same rights, privileges and decision-making responsibilities. Diversity in all of its aspects including class, religion, ethnicity, race or sexual orientation, also need to be taken into account in the elaboration of sound public policy.

Why Focus on Gender?

In 1995, UNIFEM sponsored a meeting of experts to establish guidelines for integrating gender perspectives into the human rights work of UN agencies. The expert meeting referred to gender perspectives as 'those which bring to conscious awareness how the roles, attitudes and relationships of women and men function to the detriment of women' (UNIFEM, 1996). A focus on gender does not ask for special treatment for women, however. It stresses the identification of different needs in the community and the formulation of policies and strategies that address those needs. It thus prioritises equality of opportunity rather than numerical equality and allows for the advancement of gender equality and equity regardless of whether it is women or men whose position needs to be advanced. In some regions and sectors, for example, women may be in a more advantageous position than men. Gender analysis can reveal this and serve to open fair and equitable opportunity for men.

Since gender is a social construct, and social roles are not 'natural,' 'pre-ordained' or 'permanent', this approach also allows for assumptions about what gender means to be deliberately exposed and changed. Society, in order to flourish in the fullest sense, is dependent on the utilisation of all human resources. The participation of both women and men in formulating and implementing policies and programmes will utilise the maximum talent available to a country and facilitate strong and sustainable public policy.

What is Gender Analysis?

Gender analysis involves the collection and use of sex-disaggregated data that reveal the roles and responsibilities of women and men. These data are fed into the policy process to enable assessments of how existing and future policies and programmes potentially affect women and men differently. Gender analysis also involves assessing how gender-inequitable power relations may impact negatively on the achievement of a range of development goals, including the goal of gender equality and equity.

Gender analysis needs to be both quantitative and qualitative. The use of gender sensitive indicators in such areas as participation rates in scientific education and careers and decision-making, and data on the differential impacts of policies and programmes can provide useful quantitative data. This should be complemented by qualitative data, which trace historical, political, economic, social and cultural forces in order to clarify how and why gender differences came about.

What is Gender Mainstreaming?

Gender mainstreaming is the process of bringing a gender perspective into the mainstream activities of government at all levels, including in policies, programmes and projects. It appeared for the first time in international texts after the United Nations Third World Conference on Women (Nairobi, 1985), in relation to the debate within the UN Commission on the Status of Women (CSW) on the role of women in development. It was seen as a means of promoting the role of women in the field of development and of integrating women's values into development work.

After Nairobi, international development agencies and governments promoted mainstreaming as a new strategy for taking women's concerns into account. By bringing women's issues into their mainstream policies, programmes and projects, they hoped that earlier problems of marginalisation would be overcome. Two different approaches to mainstreaming – 'agenda-setting' and 'integrationist' – have since been implemented. The agenda-setting approach aims to transform the thrust of development policy as it brings women's concerns into the mainstream. The integrationist approach merges women's concerns within existing activities without necessarily altering the agenda: it 'adds on' women to pre-existing programmes and policies (UNRISD, 1995). These two concepts are not mutually exclusive and actually work best in combination.

Gender mainstreaming builds on the knowledge and lessons learnt from previous experiences with gender equality policies. Specific gender equality policy is a strategy that directly addresses gender imbalances by taking into account the specific needs of women and men and elaborating policies to meet these needs. Gender equality machineries are the actors that carry out the government's fundamental role in redressing gender inequalities.

Gender mainstreaming, on the other hand, takes equality issues out of the isolation of gender equality machineries and involves more and new actors in building a balanced society. This accelerates and strengthens the process of transforming gender relations in the direction of gender equality. When policies having a large impact on society are devised, the specific interests and values of both sexes are taken into account. As a result, it becomes more visible that gender equality is an issue for both women and men. This requires the systematic use of gender analysis and sex-disaggregated data that can render visible gender differences.

Both gender mainstreaming and gender equality policies are needed if gender equality and equity are to result. The machinery for implementing gender in government should exist both as a stand-alone entity as well as a crosscutting capacity in all departments with science, research and technology policies and programmes. In this way it is similar to environmental policy, for example, which is generally accepted to exist as a sectoral policy, even if environment as an issue is to be taken into account in many policy fields, e.g. agriculture, economy, infrastructure, international trade and development co-operation. Mainstreaming cannot function optimally without 'traditional' equality policy, because this policy forms the necessary medium for mainstreaming.

Why Mainstream Gender in Science and Technology?

Gender mainstreaming is required to implement the 1995 Commonwealth Secretariat Plan of Action on Gender and Development, in particular its objective to accelerate the achievement of women's empowerment in member states. At the United Nations Fourth World Conference on Women (Beijing, 1995), the strategy of gender

Box 3

Dialogue on Women in Science and Technology (Canada/UK)

In May 2000, the Canadian High Commission convened a conference of over 100 women leaders and experts in science, engineering and technology (SET), and the social sciences from Canada and the UK to discuss a broad range of issues and challenges. The purpose of the conference was to provide a forum to address different perspectives on leading scientific and policy issues; to showcase and share the work of leading women in SET in business, public policy, journalism and academia; and to share best practice models for attracting, supporting and promoting women in science. The agreed vision of the delegates was a world where the impacts of science and technology were benevolent and reached women, children and men equitably; and where women played a full and equal role in science policy creation and in the planning and implementation of research, development and decision-making. The conference affirmed its commitment to the following principles:

- Women and men are equally capable of pursuing excellent science, engineering and technology (SET).
- Diversity contributes to, rather than conflicts with, excellence.
- The contribution of indigenous women's knowledge systems is essential to achieving global goals of sustainability.
- Decision-making in SET should reflect the whole range of human perspectives, including those of women.
- All science and technology policies and programmes should be subject to systematic gender-based analysis to identify the differential impacts of technological change on the lives of men and women.
- Issues of global stewardship, the impact of science and technology on society and the ethics of all scientific endeavours must be open to public scrutiny and debate.
- International institutions of governance must include women in SET and adapt to be inclusive, multidisciplinary, and empowered to address ethical issues with effective instruments of enforcement and accountability.
- Both commitment and action are required at all levels to ensure equal and equitable participation for all.

Source: Conference Statement, Women Leaders in Science, Technology and Engineering, 4–5 May, 2000, London, UK

mainstreaming was explicitly endorsed by the Platform for Action (PFA) which was adopted at the end of the Conference. It states that 'governments and other actors should promote an active and visible policy of mainstreaming a gender perspective in all policies and programmes, so that, before decisions are taken, an analysis is made of the effects on women and men, respectively' (para. 229). Many countries have adopted a national plan for gender mainstreaming.

One of the two central conclusions of the 1995 UN Commission on Science and Technology for Development (UNCSTD) Gender Working Group was that 'to ensure that science and technology benefits all members of society, attention must be paid to the respective needs and interests of men and women equitably'. The UNCSTD Gender Report endorsed by the UN ECOSOC called on all governments to address gender in the elaboration of science and technology policies and programmes.

In 2000, the need to further advance the process of mainstreaming gender was recognised in the Outcome Document adopted by governments at the 23rd special session of the General Assembly: 'Women 2000: Gender equality, development and peace for the twenty-first century'. Paragraph 116a of the 'Further actions and initiatives to implement the Beijing Declaration and the Platform for Action' calls on governments to: '[d]evelop and use frameworks, guidelines and other practical tools and indicators to accelerate gender mainstreaming, including gender-based research, analytical tools and methodologies, training, case studies, statistics and information'.

Currently there are several efforts in Commonwealth countries to incorporate gender issues in the mainstream of science and technology policy (see Box. 3). The main focus has been on 'integrating' women, or 'adding women in', through increasing the number of women scientists and policy makers. However, strategies to increase the number of girls and women in science and technology careers often meet with the discouraging reality that, once inside the system, many highly skilled women opt out. A 'supply-side' strategy, while necessary to redress historical imbalances, is not sufficient. Recruitment, retention and promotion of women in science and technology careers and decision-making is a starting point. The commitment to eliminate covert and overt biased behaviours and practices in institutions is also essential. But ultimately, the issue of how science serves society – and who in society is being served by science – must de addressed. Science carries values: it is not neutral. Technology impacts differently upon the lives of women and men and children.

2 The Gender Management System

If the gender mainstreaming and equality principles expressed in the Beijing Declaration and the 1995 Commonwealth Plan of Action on Gender and Development are to be widely understood and effectively applied by governments, these principles need to be systematically introduced into all stages of the conception, implementation and monitoring of national development plans. To this end, the Commonwealth Secretariat is encouraging the establishment of a Gender Management System. This means that the design, implementation, monitoring and evaluations of all policies and programmes should not only ensure equality for all regardless of sex and gender, but should also take into account the contributions that can be made by all stakeholders working in the area. To cover all the issues involved in science and technology, these stakeholders will come from a very broad range of ministries and agencies apart from the Ministry of Science and Technology (where such exists), as well as from non-governmental organisations (NGOs) and the private sector.

At the sectoral level, departments charged with science and technology need to intentionally introduce gender-based analysis at all levels of policy and programme elaboration. Such strategies should span both formal and informal systems of science. Modern science and technology are commonly regarded as the engines of growth in the new knowledge-based global economy, yet traditional and local knowledge systems underpin food security in many nations. Probing the gendered nature of both modern science and traditional knowledge systems will enable policy decision-makers to construct stronger and more sustainable science and technology strategies for the benefit of all members of society.

While many countries have National Women's Machineries (NWMs), most NWMs have not yet strengthened their focus on issues of science and technology policy. The relationship between NWMs and ministries and departments concerned with science and technology takes a variety of different forms. Currently, the majority of national science and technologies policies contain few measures beyond 'recruitment' to address gender imbalance. However, gender integration in science and technology must go much further than this. Training and capacity building are therefore essential. To this end, the Ministry of Science and Technology and other agencies should consult with and also harness the knowledge and skills in gender awareness and sensitisation, gender analysis and planning that exist within the Ministries of Women's Affairs, women's organisations, and Women's Studies Departments at the University and train their staff in order to fully address gender concerns in science and technology.

What is the Gender Management System (GMS)?

The Gender Management System (GMS) is an approach to gender mainstreaming developed by the Commonwealth Secretariat. It is an integrated network of structures, mechanisms and processes put in place in an existing organisational framework to

guide, plan, monitor and evaluate the process of mainstreaming gender into all areas of an organisation's work in order to achieve greater gender equality and equity within the context of sustainable development.

The GMS is intended to advance gender equality and equity through promoting political will; forging a partnership of stakeholders including government, private sector and civil society; building capacity; and sharing good practice. The GMS is described most completely in the *Gender Management System Handbook* (Commonwealth Secretariat, 1999).

What are the Objectives of the GMS?

Objectives of the GMS include the following:

- to assist government and non-state actors in implementing the 1995 Commonwealth Plan of Action on Gender and Development and its Update, the Beijing Platform for Action, and other gender-aware international mandates;
- to strengthen National Women's Machineries (NWMs), and the capacity of NWMs, core and sectoral government ministries, development NGOs, the private sector and other members of civil society to make gender-aware development policies, plans and programmes at all levels, and to facilitate partnership-building so as to create a broad-based national constituency committed to gender equality; and
- to create an enabling environment which takes into account both favourable factors and obstacles to the effective implementation, monitoring and evaluation of gender-aware plans and programmes.

The Enabling Environment

There are a number of interrelated factors that determine the degree to which the environment in which the GMS is being set up does, or does not, enable effective gender mainstreaming. The enabling environment includes the following:

- political will and commitment at the highest level to gender equality and putting in place gender sensitive policies and programmes;
- willingness of those stakeholders and implementers who have never been exposed to issues related to gender or gender issues in science and technology to acquire knowledge and skills in gender awareness, and gender analysis and planning;
- a legislative and constitutional framework that is conducive to advancing gender equality;
- the presence of a critical mass of women in decision-making roles;
- adequate human and financial resources; and
- a supportive civil society.

The Stakeholder Framework

The GMS adopts a stakeholder approach to gender mainstreaming. This recognises that the state is not the only player in efforts to achieve gender equality and equity, but must work in partnership with other social partners or stakeholders. The key stakeholders in a GMS are the NWM, other government ministries and departments, NGOs, the media, academic institutions, professional associations, inter-governmental organisations, donor agencies and women and men in the broader civil society. Within the stakeholder framework, the GMS is based on three broad principles:

- Empowerment: providing representation on decision-making bodies and control over the distribution of resources;

Figure 2 **The Gender Management System**

- Integration: transforming structures that create and perpetuate gender and other inequalities, rather than making piecemeal interventions; and
- Accountability: creating incentive systems that reward and boundary systems that set standards and impose sanctions in order to motivate change.

GMS Structures

Enabling all the key stakeholders to participate effectively in the mainstreaming of gender into government's policy and programming requires the establishment and/or strengthening of formal institutional arrangements within and outside government. These arrangements can be summarised as follows:

- a **Lead Agency** (usually the Ministry of Gender or Women's Affairs or other National Women's Machinery), which initiates and strengthens the GMS institutional arrangements, provides overall co-ordination and monitoring and carries out advocacy, communications, media relations and reporting;
- a **Gender Management Team** (consisting of representatives from the Lead Agency, key government ministries and civil society), which provides leadership for the implementation of the GMS; defines broad operational policies, indicators of effectiveness and timeframes for implementation; and co-ordinates and monitors its performance;

- an **Inter-Ministerial Steering Committee** whose members are representatives of the Lead Agency and the Gender Focal Points (see below) of all government ministries, and which ensures that gender mainstreaming in government policy, planning and programmes in all sectors is effected and that strong linkages are established between ministries;
- **Gender Focal Points** (senior administrative and technical staff in all government ministries), who identify gender concerns, co-ordinate gender activities (e.g., training); promote gender mainstreaming in the planning, implementation and evaluation of all activities in their respective sectors; and sit on the Inter-Ministerial Steering Committee;
- a **Parliamentary Gender Caucus** (consisting of gender-aware, cross-party female and male parliamentarians), which carries out awareness raising, lobbying and promoting the equal participation of women and men in politics and all aspects of national life and brings a gender perspective to bear on parliamentary structures and procedures and matters under debate; and
- **representatives of civil society** (a National Gender Equality Commission/Council, academic institutions, NGOs, professional associations, media and other stakeholders), who represent and advocate the interests and perspectives of autonomous associations in government policy-making and implementation processes.

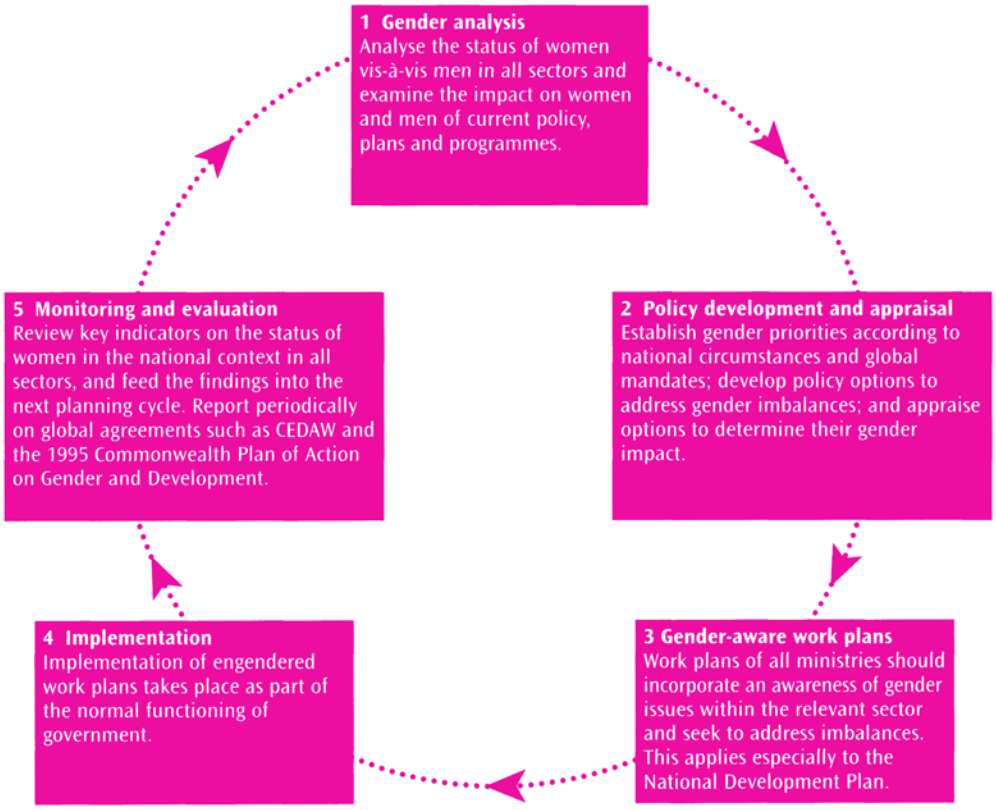
GMS Mechanisms

There are four principal mechanisms for effecting change in an organisation using a GMS:

- **Gender-based analysis (GBA):** GBA is a tool for understanding social processes and for responding with informed, effective and equitable options for policies, programs and legislation. When gender is explicitly considered as a category of analysis, information on the actual realities of women and men, girls and boys, is presented so that similarities and differences can be examined. In addition, information on the nature of relationships in the family, society and the economy is revealed. Using gender-based analysis means taking into account this information in exploring how policy options could impact on individual women and men, and on societal structures. This contributes to an enhanced knowledge base for decision-makers.
- **Gender training:** Many of the stakeholders in a GMS will require training in such areas as basic gender awareness and sensitisation, gender analysis, gender planning, the use of gender-sensitive indicators, monitoring and evaluation. Since the GMS aims at the gradual transformation of organisations and a realignment of the belief systems, power structures and policy and planning processes in them, training must also include segments on overcoming hostility to gender mainstreaming and may also need to include conflict prevention and resolution and the management of change.
- **Management Information System:** This is the mechanism for gathering the data necessary for gender analysis and sharing and communicating the findings of that analysis, using sex-disaggregated data and gender-sensitive indicators. The Management Information System is much more than just a library or resource centre; it is the central repository of gender information and the means by which such information is generated by and disseminated to the key stakeholders in the GMS.
- **Performance Appraisal System:** Based on the results of gender analysis, the GMS should establish realisable targets in specific areas. The achievement of these targets should be evaluated both at the individual and departmental level through a gender-aware Performance Appraisal System. This should not be separate from whatever system is already in place for appraising the performance of employees;

rather the present system should be reviewed and overhauled to ensure that it is gender-sensitive. The Performance Appraisal System should also take into account the level of gender sensitivity and skills (e.g. as acquired through gender training or field experience) of individuals. The Gender Management Team should work in partnership with the central personnel office of government and sectoral personnel departments to ensure that the Performance Appraisal System in place reflects these concerns.

Figure 3 **Promoting Gender Awareness at Each Stage of the Planning Cycle**



Commonwealth Secretariat, 1999: 49

What does a GMS Achieve?

A Gender Management System can have the following beneficial impacts:

- development policies and programmes that work because they take into account the realities of, and draw upon the skills of women as well as men;
- a stronger science and technology human resource base because it seeks to remove systemic barriers to the participation of women and to maximise the full potential of the best and brightest minds in the country regardless of gender
- a fair and equitable distribution of power, resources and decision-making which will introduce diverse perspectives and values into the elaboration of policy and programmes to serve society as a whole;

- government ministries and institutions that are able to respond to the needs of both women and men in their respective sectors;
- staff who are trained and experienced in addressing issues from a gender perspective;
- bridges to partners in civil society undertaking gender scholarship and supporting actions to provide for the full integration of girls and women in science and technology; and
- an efficient and effective mechanism for meeting reporting requirements under international treaties and agreements such as the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW).

3 Global and Commonwealth Mandates for Science and Technology

Global Mandates

Governments have at their disposal a rich array of recommendations and agendas for action already endorsed in Conventions, Declarations and international agreements. Within these documents can be found articles addressing issues of gender, science and technology and suggested strategies for action. This chapter will provide a summary of this valuable resource.

At the most fundamental level, equality between women and men is enshrined in the Charter of the United Nations and the Universal Declaration of Human Rights. It is also inherent in major UN legally binding covenants on human rights, political and civil rights and economic, social and cultural rights. In particular, the 1979 UN Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) further defined the objectives and measures necessary to achieve gender equality in both public and private life. CEDAW recognises that the impact of legislation must be taken into account in determining whether it is discriminatory, and that positive action measures are sometimes necessary to correct historical patterns of discrimination.

In the UN Decade for Women between 1975 and 1985, recommendations specific to gender, science and technology began to emerge. In 1979, the UN World Conference on Science and Technology for Development (UNCSTD) identified only one article in its *Vienna Programme of Action* that was specific to women. But by 1984, the UN Panel of the Advisory Committee on Science and Technology for Development advanced a full agenda of actions related to gender entitled 'Science and Technology and Women' at the Nairobi End-of-Decade Meeting. The *Nairobi Forward-looking Strategies*, in effect from 1985 to 2000, provided a comprehensive blueprint for action on a wide range of socio-economic, political and cultural issues as well as science and technology. The *'Tech and Tools'* pavilion at Nairobi celebrated women's scientific inventions and local knowledge systems.

By the early1990s, the UN Commission on Science and Technology for Development (UNCSTD) adopted gender as one of its three themes. In 1995, the CSTD Working Group tabled its *Declaration of Intent with 7 Transformative Actions* at the UN Economic and Social Council. This agenda for gender in science and technology was also taken to the 1995 Fourth World Conference on Women in Development in Beijing. The 1995 *Commonwealth Plan of Action on Gender and Development* was an additional input to the negotiations at the Beijing Women's Conference.

The 1999 UNESCO Declaration on Science and the Use of Scientific Knowledge and the *Science Agenda – Framework for Action from the UN World Conference on Science* included a full theme on gender in science and technology. In June 2000, the UN

General Assembly held a Special Session to review progress made in implementing the PFA. In the Outcome Document adopted by the plenary, 'Further actions and initiatives to implement the Beijing Declaration and the Platform for Action', governments agreed to undertake a number of actions in the area of science and technology. Many other agreements contain recommendations and priorities for action on gender and science and technology. These include the UN Conference on Environment and Development, Agenda 21 (1992), the UN International Conference on Population and Development Programme of Action (1994), as well as the World Summit for Social Development (1995).

The Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) (1979)

167 countries have ratified as of February 2001, including all but six Commonwealth countries.

Article 1 of CEDAW defines discrimination against women as: 'any distinction, exclusion or restriction made on the basis of sex which has the effect or purpose of impairing or nullifying the recognition, enjoyment or exercise by women, irrespective of their marital status, on a basis of equality of men and women, of human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field'. This definition has been accepted by the Human Rights Committee as applicable to discrimination under the International Covenant on Civil and Political Rights (ICCPR).

Unfortunately, a number of States Parties have ratified the Convention with reservations, some of which are substantive and present an obstacle to gender mainstreaming. The Committee on the Elimination of Discrimination Against Women has called on states to narrow the terms of reservations, to consider whether they are needed and to withdraw them where possible. States are therefore urged to remove reservations or to narrow their scope.

By ratifying CEDAW, States Parties agree *inter alia* to:

- Condemn discrimination against women in all its forms and pursue without delay a policy of eliminating discrimination against women. This includes embodying the principle of the equality of men and women in national constitutions or other appropriate legislation, and modifying or abolishing existing laws, regulations, customs and practices which constitute discrimination against women (article 2).
- Take all appropriate measures, including legislation, in all fields – in particular in the political, social, economic and cultural fields – to ensure the full development and advancement of women (article 3).
- Adopt temporary special measures—which shall not be considered discrimination as defined in the Convention– aimed at accelerating de facto equality between men and women (article 4).
- Eliminate discrimination against women in political and public life, in particular to ensure to women the right to participate in the formulation of government policy and its implementation and to hold public office and perform all public functions at all levels of government (article 7).
- Ensure women equal rights with men in the field of education, including equal access to education at all levels and the elimination of stereotyped concepts of the roles of men and women (including through the revision of textbooks and the adaptation of teaching methods) (article 10).

- Eliminate discrimination against women in employment, ensuring women the right to: free choice of profession and employment; promotion, job security and all benefits and conditions of service; receive vocational training and retraining; equal remuneration, including benefits; and equal treatment in respect of work of equal value. Appropriate measures will also be taken to prevent discrimination against women on the grounds of marriage or maternity and to ensure their effective right to work (article 11).

- Eliminate discrimination against women in rural areas so that they participate in and benefit from rural development on a basis of equality of men and women. In particular, they will ensure that rural women have the right to participate in the elaboration and implementation of development planning at all levels and to obtain all kinds of training, both formal and non-formal, including community and extension services in order to increase their technical proficiency (article 14).

The Nairobi Forward-Looking Strategies for the Advancement of Women (1985)

Participants: Commonwealth Secretariat, all Commonwealth countries except Tonga and Nauru.

The UN Third World Conference on Women (Nairobi, Kenya) called for, *inter alia*:

"The full and effective participation of women in the decision-making and implementation process related to science and technology including planning and setting priorities for research and development and the choice, acquisition, adaptation, innovation and application of science and technology for development."

The Beijing Declaration and Platform for Action (1995)

Although gender in science and technology is not one of the 12 Critical Areas of Concern identified in the Platform for Action (PFA) that was agreed to at the 1995 UN Fourth World Conference on Women in Beijing, there are cross-cutting references to the issue throughout the document. This was largely due to the lobbying and advocacy work of the Once and Future Action Network (OFAN), which was established in 1994 in response to the need for improved co-operation among organisations working in the area of gender, science and technology. The following actions to be taken by governments were identified in the PFA by the International Women's Tribune Centre and UNIFEM (IWTC and UNIFEM, 1996):[1]

Poverty:

- mobilise and enact legislation to protect women's equal access to economic resources, including technologies (60f, 61b).

Education:

- eliminate gender discrimination in education, including universal access to primary education, gender parity in tertiary education and decision/policy-making (80a,b,c,d);
- promote a definition of literacy that includes scientific and technical knowledge (81f);
- provide information to women and girls on the availability and benefits of training programmes in science and technology (82c);

Note

1 Numbers in brackets in the policy documents refer to the paragraph in which the action is articulated.

- diversify vocational training and retention in non-traditional fields such as science, math, engineering, environmental sciences and technology and information technology (82e);
- encourage adaptation of curricula and teaching materials, develop teacher training regarding equity in science and technology teaching (82g), and develop teaching materials to encourage participation of girls and women in technical and scientific fields (82h);
- increase training in technical and agricultural fields to increase income-generating opportunities and participation in economic decision-making in science and technology (82j);
- take measures to increase the number of women in educational policy and decision-making positions, especially in the scientific and technological fields (83f);
- use appropriate and affordable technologies and media to reach rural women in remote areas (83g);
- establish a mechanism to monitor implementation of educational reforms and establish technical assistance programmes (84b);
- provide funding for special programmes in math, science and computer technology (85b).

Health:

- support commitments made at the International Conference on Population and Development, the Social Summit and CEDAW (106a);
- promote ethical and gender sensitive standards by health workers, redesign health training and other reforms to health care practice and education (106);
- link traditional and indigenous knowledge with modern medicine (109b);
- increase the number of women in leadership positions in the health professions, including researchers and scientists (109c).

Armed Conflict:

- reduce military expenditures and reallocate funds for basic needs (E2);
- promote technology transfer and scientific research in the area of mine clearance (143e iii).

Economy:

- undertake reforms to give women equal rights to economic resources, including natural resources and appropriate new technologies and extension services (165e, 166c,e);
- promote gender-sensitive policies and measures to empower women as equal partners with men in technical, managerial and entrepreneurial fields (165q);
- ensure women's priorities are included in public investment (167d);
- develop programmes for training in new technologies, promote vocational training in non-traditional areas and encourage women to take on non-traditional jobs, especially in science and technology (173b, 178g);
- promote women's studies and research in scientific and technological fields (175e);
- recognise and encourage the contribution of research by women scientists and technologists (175h).

Power and Decision-making:

- take measures to ensure women's equal access to and full participation in power structures and decision-making (G1);
- take positive action to build a critical mass of women leaders, executives and managers (192a);
- restructure recruitment and career development programmes to ensure that all women, especially young women, have equal access to managerial, entrepreneurial, technical and leadership training (192f).

Institutional Mechanisms:

- promote an active and visible policy of mainstreaming a gender perspective in legislation, public policies and programmes (202);
- regularly review national policies and programmes from a gender perspective (204b).

Media:

- encourage training programmes for women in the new communication technologies (241a, 242b);
- promote balanced and non-stereotyped portrayals of women in the media (J2).

Environment:

- facilitate and increase women's access to information and education, including in the areas of science and technology (253b, 256h);
- encourage the protection and sharing of the benefits arising from the use of knowledge, innovations and practices of women of indigenous and local communities (253c);
- integrate a gender perspective in the design and implementation of resource management mechanisms and production techniques (253e);
- take gender impact into consideration in the work of the UNCSTD and other UN bodies (254a);
- increase the number of women scientists and technical advisors involved in environmental planning and programming (254d, 256i);
- facilitate women's access to knowledge, skills and environmentally sound technologies to support and strengthen their crucial roles and their expertise in resource management (255b, 256j, 256k, 258a,b,v);
- support research on the gender impact of environmental degradation and hazards (256c, 258b ii);
- integrate rural women's traditional knowledge and practices of sustainable resource management in environmental management and extension programmes (256f);
- sponsor research on women's role in natural resource management (256f, 258b,i);
- raise awareness on environmental and health impacts of technologies (257a).

The Girl Child:

- develop and adopt curricula, teaching materials and textbooks to improve the self-image, lives and work opportunities of girls, especially in mathematics, science and technology (276c);
- eliminate all forms of discrimination which result in harmful and unethical use of medical technologies such as prenatal sex selection and female infanticide (277c);
- ensure equal access to higher education, including vocational and technical education (279a).

The UNESCO Declaration on Science and the Use of Scientific Knowledge

Participants: Over 1,800 delegates representing 155 countries, including approximately 80 Ministers of Science and Technology, Research and Education or their equivalents as well as the Chair and some members of the Commonwealth Science Council (CSC).

The World Conference on 'Science for the Twenty-first Century: A New Commitment', was held in Budapest, Hungary, from 26 June to 1 July 1999 under the aegis of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the International Council for Science (ICSU). Participants agreed that access to scientific knowledge for peaceful purposes from a very early age is part of the right to education belonging to all men and women, and that science education is essential for

human development, for creating scientific capacity and for having active and informed citizens (10). They also noted that there is a historical imbalance in the participation of men and women in all science-related activities (24).

The Declaration on Science and the Use of Scientific Knowledge that resulted from the meeting proclaims *inter alia* that:

- Science education, in the broad sense, without discrimination and encompassing all levels and forms is a prerequisite for democracy and for ensuring sustainable development. It is essential that the fundamental role played by women in the application of scientific development to food production and health care be fully recognised, and efforts made to strengthen their understanding of scientific advances in these areas. It is on this platform that science education, communication and popularisation need to be built (34).
- Equality in access to science is not only a social and ethical requirement for human development, but also a necessity for realising the full potential of scientific communities worldwide and for orienting scientific progress towards meeting the needs of humankind. The difficulties encountered by women, constituting over half of the population in the world, in entering, pursuing and advancing in a career in the sciences and in participating in decision-making in science and technology should be addressed urgently. (42).

Participants at the meeting also developed a *Science Agenda-Framework for Action* from which the following are extracts:

- Initiatives to facilitate access to scientific information sources by scientists and institutions in developing countries should be especially encouraged and supported. Initiatives to fully incorporate women scientists and other disadvantaged groups from the South and North into scientific networks should be implemented (17).

- Science and technology policies should be implemented that explicitly consider social relevance, peace, cultural diversity and gender differences. Adequate participatory mechanisms should be instituted to facilitate democratic debate on scientific policy choices. Women should actively participate in the design of these policies (56).

- Government agencies, international organisations, universities and research institutions should ensure the full participation of women in the planning, orientation, conduct and assessment of research activities. It is necessary that women participate actively in shaping the agenda for the future direction of scientific research (78).

- Governments and NGOs should sustain traditional knowledge systems through active support to the societies that are keepers and developers of this knowledge, their ways of life, their languages, their social organisation and the environments in which they live, and fully recognise the contribution of women as repositories of a large part of traditional knowledge (86).

The Conference stressed that special efforts should be made by governments, educational institutions, scientific communities, NGOs and civil society, with support from bilateral and international agencies, to ensure the full participation of women and girls in all aspects of science and technology, and to this effect to:

- promote within the education system the access of girls and women to scientific education at all levels;
- improve conditions for recruitment, retention and advancement in all fields of research;

- launch, in collaboration with UNESCO and UNIFEM, national, regional and global campaigns to raise awareness of the contribution of women to science and technology, in order to overcome existing gender stereotypes among scientists, policy-makers and the community at large;
- undertake research, supported by the collection and analysis of sex-disaggregated data, documenting constraints and progress in expanding the role of women in science and technology;
- monitor the implementation and document best practices and lessons learned through impact assessment and evaluations;
- ensure an appropriate representation of women in national, regional and international policy- and decision-making bodies and forums;
- establish an international network of women scientists;
- continue to document the contributions of women in science and technology.

To sustain these initiatives governments should create appropriate mechanisms, where these do not yet exist, to propose and monitor introduction of the necessary policy changes in support of the attainment of these goals (90).

The Beijing +5 Outcome Document (2000)

Five years after Beijing, governments met in New York at a Special Session of the General Assembly entitled 'Women 2000: Gender Equality, Development and Peace for the Twenty-first Century' (popularly known as Beijing +5). The Ad Hoc Committee of the Whole produced an Outcome Document: 'Further Actions and Initiatives to Implement the Beijing Declaration and the Platform for Action'. Governments agreed to undertake a number of actions in the area of science and technology, including to:

- consider adopting national legislation consistent with the Convention on Biological Diversity to protect the knowledge, innovations and practices of women in indigenous and local communities relating to traditional medicines, biodiversity and indigenous technologies (106a);
- encourage and support the education of girls in science, mathematics, new technologies including information technologies, and technical subjects and encourage women, including through career advising to seek employment in high growth and high wage sectors and jobs (118i);
- develop programmes that support women's ability to create, access and promote networking, in particular through the use of new information and communications technology, including through the establishment and support of programmes to build the capacity of women's NGOs in this regard (134b);
- capitalise on the new information technologies, including the Internet, to improve the global sharing of information, research, strengths, lessons learned from women's experiences and study other roles that these technologies can play towards that goal (134h);
- facilitate the transfer to developing countries of appropriate technology, particularly new and modern technology and encourage efforts by the international community to eliminate restrictions to such transfers, as an effective means of complementing national efforts for further acceleration in achieving the goals of gender equality, development and peace (135m); and
- recognise the crucial role of and support women and women's NGOs and CBOs in the implementation of Agenda 21, by integrating a gender perspective in the formulation, design and implementation of sustainable environmental and resource management mechanisms, programmes and infrastructure (136f).

Commonwealth Mandate

The Commonwealth Plan of Action on Gender and Development (1995)

Signatories: All Commonwealth Heads of Government

The Commonwealth Plan states as its vision that the Commonwealth works towards 'a world in which women and men have equal rights and opportunities at all stages of their lives to express their creativity in all fields of human endeavour. This world is also one in which women are respected and valued as equal and able partners in establishing values of social justice, equity, democracy and respect for human rights. Within such a framework of values, women and men will work in collaboration and partnership to ensure people-centred sustainable development for all nations' (4.1.1).

To achieve this vision, the Commonwealth will (*inter alia*):

- establish a practical and innovative process which will ensure equality of access and equitable distribution of benefits to women and men in all spheres of social, economic and political life ... ;
- ensure that a commitment to gender equality informs political decisions at the highest level and permeates all the decision-making processes of member governments and the Secretariat;
- ensure the full participation of women in decision-making processes and empower them – through training, education, information, positive and/or affirmative action – to define and shape their societies as equal partners with men; and
- integrate gender considerations into all policies, programmes, and practices for sustainable development and commit sufficient resources to develop and apply appropriate strategies and methods to further this goal' (4.1.2).

"Commonwealth governments agree to put in place national plans to implement the 1995 Commonwealth Plan of Action and to this end have agreed that the strengthening of institutional capacity is the sine qua non of the vision and actualisation of this Plan … Fifteen areas are considered to be desirable components …" (4.4.2), including the following:

1. Establish and strengthen Gender Management Systems (GMS) and National Women's Machineries (NWMs)
   Institutional capacity will be strengthened by:
   - setting up Gender Management Systems;
   - placing NWMs at the highest possible level, either as independent structures or in significant ministries with adequate human and financial resources;
   - ensuring that those appointed have appropriate gender planning and gender analysis skills;
   - providing training where those skills are lacking;
   - establishing focal points for gender planning in all Ministries and major departments; and
   - ensuring that the officers in charge of the focal points are senior officials who will obtain training in gender planning.

   This approach aims to mainstream gender into national and sectoral policies by increasing capacity in gender training, gender impact assessment, gender management and accounting systems and employing gender analysis in all development plans and programmes. The focus on NWMs shall not only strengthen them in their sphere of action, but shall also enable them to formulate and influence policies to address gender concerns.

2. Integration of gender issues in all national policies, plans and programmes:
   Gender policy appraisal and impact assessments should be routinely conducted and any harmful effects on women ... should be addressed.

3. Build capacity in gender planning:
   Develop skills and apply tools for gender planning, policy appraisal and impact assessment, gender budgeting and accounting, project analysis and evaluation. ...

4. Become a model of good practice as an employer:
   Implement training ... set goals ... [and] establish the necessary systems for monitoring and evaluation ...

5. Promote equal opportunities and positive and/or affirmative action throughout the country and consult women on priorities ...

6. Anti-discrimination action:
   Develop policies to eliminate and enact legislation to outlaw discrimination on the grounds of a person's sex. ...

7. Women's rights as human rights, the elimination of violence against women, the protection of the girl child and the outlawing of all forms of trafficking in women and girls.

8. Action for women's participation in decision-making:
   As a moral and strategic imperative, ensure women's participation in decision-making processes and structures ... at all levels ...

9. Gender policy appraisal and impact assessment on macro-economic policies.

10. Action for sustainable development, poverty alleviation and eradication of absolute poverty:
    In addressing sustainable development call on the expertise of women, whose use and care of the environment is central to environmental conservation, in order to reduce poverty and safeguard natural resources. ...

11. Action for human resource development: literacy; training and education; science and technology:
    Undertake diverse and special training as well as informal and formal education programmes directed at women, including programmes to strengthen their self-esteem. Encourage gender-inclusive curricula and devote particular attention to the participation of women in training programmes leading to occupations such as science and technology, industry and commerce.

4 Selected Issues in Science and Technology: The Gender Dimension

Introduction

This chapter explores selected issues in science and technology where a gender perspective provides a fresh way of viewing and formulating public policy. Looking at science and technology through a gendered lens means examining perceptions, practice, policy, impacts and beneficiaries. In doing so, it raises a number of questions: What are the perceptions of science and technology that lead to gender biased practice and policy? And how do gender biases in practice and policy affect perceptions in their turn? How do science and technology policies and programmes impact differently on the lives of women and men? What constitutes scientific knowledge? Whose knowledge has value and who decides what it is worth? Does knowledge have to be validated by science in order to have worth? And how can we promote a greater respect for various knowledge systems? (IWTC, 1997).

Women are usually portrayed as playing a passive role as the beneficiaries of science and technology. In fact, however, women have always played a major role in this area, both as inventors – of the cotton gin, fire escape and snugli, to name just three disparate and practical examples – and as practitioners in their everyday lives (Carr, 2000). A UNIFEM study, conducted in preparation for the 1999 UN World Conference on 'Science for the Twenty-first Century: a New Commitment', provides numerous case studies of women's activities, contributions, inventions and innovations (UNIFEM, 1999). These include women's work in formal and applied science and technology, but also highlight the fact that science is not just something that takes place in a laboratory and technology is not just hardware. Rather, science and technology also take place at the community level, for example when women select plants for breeding or manage energy and other natural resources in the household.

Governments advancing gender considerations in science and technology often stop short. They attempt only to 'add women in,' designing programmes for the recruitment, retention and promotion of women to redress historic imbalances. While this strategy is important, a wide range of challenging and compelling issues reaches well 'beyond the numbers'. These broader issues shift the analysis and emphasis from 'science by whom?' to 'science for whom?' For example, what type of health science is being publicly funded? For whose benefit? In science departments, are the outcomes of research and development priorities targeting women and men in an equitable manner? In technology and trade departments, do business programmes address the specific challenges of women entrepreneurs such as inequitable access to technology, venture capital and trade opportunities? Left unattended, the absence of policy in these areas will ultimately undermine any government's attempts to achieve a constructive, inclusive and lasting approach to sustainable and equitable development.

Appreciating the gender dimension across a broad range of science and technology activities can reveal biases and open opportunities to shape a stronger science policy

for the country. This chapter explores the following issues for their gender implications and suggests steps for addressing inequities:

- Local and Indigenous Knowledge Systems
- The Environment and Sustainable Development
- Agriculture, Biodiversity and Food Security
- Science and Technology, Education, Careers and Decision-making
- The Differential Impacts of Science and Technology
- Biotechnology and Ethical Issues
- Information and Communication Technologies (ICTs)
- Habitat Development
- Natural and Human-Created Disasters

It is important to note that race, ethnicity, class, physical ability, sexuality and age, among other factors, may add a level of complexity to the analysis and to the suggested solutions.

Cutting across all gender mainstreaming initiatives is the need for governments to commit to the systematic and comprehensive collection of sex-disaggregated data. Numerous international fora have remarked on the lack of adequate quantitative and qualitative data on women. This is equally the case in the area of science and technology. The way in which data in science and technology are collected can render women and their issues relatively invisible. At least two sets of data on women are essential for policy-makers: data on participation rates in scientific education and careers and decision-making; and data on the differential impacts on women and men of policies, programmes and priorities.

General Recommendations

- Ministries responsible for science and technology should implement international commitments on gender and science and technology in collaborative co-ordination with the National Women's Machinery (NWM) or agencies dedicated to women's equality.

- The NWM should be strengthened and situated at the highest possible level within government to demonstrate the government's political commitment to achieving gender equality and equity of outcomes. NWMs should be provided with adequate human and financial resources and technical support.

- Governments should put in place institutional structures and mechanisms to integrate gender into all policy-making, planning and implementation processes as set out in their National Gender and Development Action Plan and regularly monitor and evaluate the implementation and impact of the National Plan.

- Training in Gender-Based Analysis (GBA) should be a key strategy integrated into all aspects of policy and programme development, and systematically applied in a manner similar to environmental impact analysis, to ensure that gender mainstreaming takes place. System-wide gender sensitisation and training should be an ongoing process, made available to Gender Focal Points, staff in the NWM, other officials in the wider government structure and key stakeholders, including national/regional research and training institutes and training programmes.

- Monitoring and evaluation of gender awareness in government policies, plans and programmes should be carried out in all science and technology-related sectors, through the use of specially designed tools and instruments, such as gender policy appraisals, gender-aware budgets and gender impact assessments.

- The Commonwealth Secretariat should provide a range of training and resource materials for governments in the area of gender mainstreaming, such as the Gender Management System series, including guidelines for engendering governments' sectoral policies and programmes, and their financial and administrative procedures.

Local and Indigenous Knowledge Systems

Counting women who participate in science and technology usually stops at quantifying only those who participate in the formal, paid economy. Little if any attention is given to women's innovations and scientific contributions in the informal sector. Yet millions of women world-wide, particularly rural women, possess indigenous technical knowledge and practice science every day of their lives. This technical knowledge frequently underpins the food security of the family. As the UNCSTD Gender Report noted, modern science has not adequately recognised the value of local knowledge systems, nor addressed how best to protect and reward communities that have developed these systems over time. The UNESCO Declaration on Science and the Use of Scientific Knowledge and the Science Agenda, which came out of the 1999 UN World Conference on Science also states that:

"It is essential that the fundamental role played by women in the application of scientific development to food production and health care be fully recognised, and efforts made to strengthen their understanding of scientific advances in these areas."

Many activities, such as using a herb to salve a wound, planting certain crops together to deter pests, or cooking a poisonous plant in such a way as to render it harmless are the result of a systematic process of observation, experimentation and adaptation over time. Women are also responsible for many agricultural and environmental innovations including the development of housing materials, the breeding of animals and plants to accentuate qualities, energy technologies, soaps, textiles and medicines. Like other scientific systems, local knowledge systems have developed technology that improves the quality of people's lives. However, they differ from modern science and technology in that they are managed by the users of the knowledge and are holistic (Appleton *et al.*, 1995). Among other distinguishing characteristics, local knowledge systems are rarely supported by public funding, rarely patented or protected by intellectual property rights, not written down and published in scientific journals and not developed for purposes of commercialisation and export.

Frequently, when women's knowledge is seen to be valuable, it is taken over without recognition or remuneration by local or international companies and corporations which make huge profits through the commercialisation of knowledge which is not their own. There is a growing debate over the 'bioprospecting' of multinational drug companies in rainforests in their search for plants and animals for new pharmaceutical products and medicines. While some point to the potential for the development of new medicines that could assist in the fight against disease, others argue that bioprospecting will lead to further exploitation of natural resources to the benefit of multinationals and detriment of developing countries and local communities (IWTC, 1997).

It is estimated that at least 7000 medical compounds used in Western medicine are derived from plants, while more than two-thirds of the world's plant species, at least 35,000 of which have medicinal value, come from developing countries (WEDO, 1995). Knowledge about the properties of these plants is generally found in the communities where they grow. The TRIPS (Trade-Related Intellectual Property Rights) Agreement of the World Trade Organisation (WTO) allows for patents or

ownership claims to life forms, and thus to bioresources, including human genetic material.

Although technically most countries do not allow patents on plants, parts of plants such as genes, cell lines and characteristics are patentable. An example of this is the Neem tree in India, which has been used by women farmers for generations to treat skin infections, control pests and in many other ways. It now has 35 patents in Europe and North America. Similarly, American scientists have isolated a protein from brazzein, a West African berry traditionally used as a sweetener, which they plan to patent and develop into a US$100 billion a year market (Carr, 2000). In many places, such as the Pacific, where the culture is based on joint ownership and sharing, visitors to villages who request botanical material to take home are provided with it gladly. Given the current state of negotiations, it is unlikely that any benefits will accrue to the countries or communities from which the knowledge originated, least of all to the rural women responsible for passing much of the knowledge from generation to generation. This use of local knowledge has been referred to as 'biopiracy'.

Box 4

Inventing and Adapting Food Production and Processing Technologies (Zimbabwe)

In 1957, the Tonga of north-western Zimbabwe were moved to another region because their valley was going to be flooded by a hydroelectric scheme. Soil conditions at the new site were poor, rainfall was low and hunting was prohibited. People were initially unable to produce sufficient food to feed their families, but the Tonga women invented and adapted food production and processing technologies and identified new sources of food. These include 47 indigenous plants whose leaves are used for relish and over 100 tree species with a variety of edible plants.

One of the plants is the tamarind, which was previously relatively unknown in Zimbabwe. The fruit has some nutritional value and can be stored for up to 12 months. The Tonga women process and use tamarind as:

- a flavouring in sorghum or millet porridge (the fruit or leaves);
- a substitute for commercial beverages such as tea and coffee, which are expensive or unavailable (ripe or unripe fruit);
- a snack (the seeds);
- a substitute for or supplement to scarce maize, sorghum or millet meals (the seeds);
- a medicine (concentrated juice is used for gastrointestinal disorders and is thought to cure sleeping sickness); and
- a coagulant (the juice is used to curdle fresh milk).

Tamarind and other fruits are also traded for clothing with agents from outside the area.

Source: Appleton et al., 1995

The prospect of losing control over a crop that they grow, process and sell on a small scale can prevent women from taking advantage of the commercial possibilities of their labour. An example of this is shown by the experience of Tonga women of Zimbabwe (see Box 4). They invented and adapted food production and processing technologies, particularly in the use of tamarind. However, they were prevented from going into large-scale commercialisation by their fear that the fruit would no longer be available to them as a subsistence crop (Appleton *et al.*, 1995). On the other hand, the case of shea butter provides an example of how women can be assisted in order to

benefit from their own knowledge and skills. The butter is made from shea nuts collected by women in West Africa and used traditionally in cooking, as a skin cream and for medicinal purposes. It is also exported to Europe and Japan for use in the making of chocolate, margarine, cosmetics and pharmaceuticals. Seeing the growing demand for this product both locally and internationally, UNIFEM helped women producers to organise themselves into a network in order to access larger markets and negotiate better prices for themselves (Elson, 2000)

Women should be able to reap the benefits of their own scientific and technical knowledge and skills. Their role as intermediaries between the natural environment and society – for example, with regard to food security, sanitation and as producers, users and managers of energy resources – also needs to be valued.

Box 5

An Indigenous Food Programme (Kenya)

A programme that challenges traditional stereotypes of women as passive recipients of technology and projects the reality of them as knowledgeable, innovative partners in agricultural extension is the Indigenous Food Programme in Kenya. Based on the belief that women's knowledge of indigenous food plants is essential to sustainable solutions to malnutrition and food insecurity, the programme builds on their knowledge and skills and provides support to improve their existing food processing technologies. Women have established a seed bank, collecting, drying and packaging seeds for their own use and for sale, and have worked with partner organisations to create a data base of food plant species.

Source: International Women's Tribune Centre, 1997

Recommendations

- Ensure the preservation of local knowledge systems with attention to their gender-specific nature.
- Acknowledge the contributions of local knowledge systems to other science and technology systems, giving particular recognition to 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 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 compensating the women and/or men in communities who generated this knowledge.

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

The Environment and Sustainable Development

"Greater attention to environmental health, especially women's environmental health, in all science and technology development interventions, is essential for sustainable development."

UNGCSTD, 1995

Women's health and environmental health are closely linked. Women's roles in the use of water, preparation of food, and tending of the sick all reveal that they possess considerable knowledge about how to use the environment in a sustainable way. At the same time, however, women's health can be threatened by changes to their local

environment resulting from such things as the introduction of irrigation schemes, hydroelectric dams, monocropping, pesticides and herbicides (Kettel, 1995a). Findings presented at the 1998 World Renewable Energy Congress meeting in Florence, Italy, showed that women are the group most affected by energy scarcity and related environmental degradation, both economically and through negative health impacts.

Women (and children) are also more exposed to the 'indoor air pollution' that comes from burning coal, wood and other fuel for cooking and heating, leading to problems such as lung disease, acute respiratory infection, lung cancer, adverse pregnancy outcomes, chronic bronchitis, and eye conditions (Farhar, 2000). *Energia News*, the newsletter of the International Network on Women and Sustainable Energy has pointed to the fact that 'in most developing countries, cooking is a major, if not the major, use of fuel'. The editors conclude that improved cooking technology would reduce women's fuel gathering burden, conserve energy and lead to better health (Issue 2, May 1997).

Women and men may have a different focus and level of awareness with regard to the eco-systemic associations that link various aspects of nature. Research carried out by the WEDNET team in Africa suggests that environmental perceptions are often gendered, and that the elements of the natural environment known and valued by women and men may be different, regardless of the cultural or regional setting (Kettel, 1995b). The gendered nature of people's perceptions about the environment is not limited to knowledge of different plant and animal species. It is reflected in the prevailing gender-based division of labour, in the various responsibilities and rights that women and men have in the use and ownership of land, trees, animals, plants, and water, and in the different knowledge of particular natural resources and ecological zones.

Ironically, while women own only one per cent of the world's land and have fewer economic rights than men, they play a vital role as the primary managers of both environmental resources and community life (Wee, 1995a). A recent ECOGEN case study, for example, reported that women in Kenya played a central role in helping their community survive a drought that sent every resident into the fields and hedgerows to scour the natural environment for food. Women, as the majority of the poor people of the world, have the biggest stake in protecting the natural resources that provide the basis of their livelihood. They are also less likely than men to have access to alternative economic opportunities.

Over the last few decades, a great deal of scientific research and technological innovation has been devoted improving living standards and raising incomes. Science and technology have allowed the constant testing of nature's limits in pursuit of ever greater efficiency, productivity and profits. However, two profound dilemmas have arisen.

- Many of these scientific and technological interventions, no matter how well meant, have been limited in their success and, all too often, ultimately detrimental to the sustainability of the natural environment. In spite of all the scientific and technological effort, women's poverty, especially compared to men in their own households and communities, has continued to rise.

- Women have been disproportionately exposed to the consequences of environmental degradation, in both rural and urban areas, particularly through their activities in the collection of fuel wood and water, the production of food crops, and through their work in the maintenance of homes and neighbourhoods.

Ignoring the perspectives of women, who are more closely connected with the environment, may mean that the resulting science and technology may not be the

most appropriate for sustainable development. In fact, the invisibility of women's 'landscape' in scientific and technological research and application has had profoundly negative impacts on women's income and well-being. Nature has been viewed through only one eye, and with one side of the collective human brain. Careful use and sustainable management of local – and planetary – ecosystems, however, requires full human sight and insight.

The failure of development planners, scientists and technological innovators alike to recognise that women may see and understand the natural environment differently from men, and have very different interests and goals in the use and management of their local environment, has also had a profoundly negative effect on the sustainable management of local ecosystems. Policies on environmental conservation do not usually take into account the different impact that they will tend to have on women and men and therefore the livelihoods of the communities. For example, policy makers have generally not recognised that deforestation has multiple impacts on women, who typically use forest products as food, fuel, fodder for livestock and medicine. This lack of gender awareness has led to reforestation schemes that have advocated the planting of trees such as eucalyptus which do not provide women with these resources (Wee, 1995a).

Women's views and goals generally include the welfare of three generations, including their children and care giving for older generations. This inter-generational appreciation and accountability, a care ethic embodied in women's work and perspectives, should be accorded comparatively greater weight than the male-derived policy framework currently driving science and technology systems – including the war machinery industry – in the global quest for a sustainable human future. Women's advice and knowledge about cooking, water, food, medicine, and their roles in energy supply and use, can be actively used to improve the effectiveness of sustainable energy technologies and to support sound economic development that improves the quality for families, communities and for the women themselves (Farhar, 2000).

Recommendations

- Take women's environmental health as a starting 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 and policy to meet their 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 their increased access to formal and informal environmental education, and to relevant science and technology expertise and information, as a basis for their increased participation in community-based environmental decision-making.
- Support women's participation in national-level environmental decision-making.

Source: UNCSTD-Gender Working Group, 1995

Agriculture, Biodiversity and Food Security

Gender plays an important role in agricultural production, and involves factors such as who has property rights, who has control, who has access to what, and who does what work (Muntemba and Chimedza, 1995). Although women make up the majority of agricultural workers, only a minority of them have title to the land they work. Agrarian reform programmes of resettlement and land distribution have often failed to recognise the land ownership rights of women heads of household, married women and women

producers with partial or temporary land rights. Women may also be prevented from owning or inheriting property by discriminatory state or customary property and inheritance laws and policies. This in turn limits their access to credit since they have no title to use as collateral.

As predominantly small farmers, women have been largely responsible for activities such as the selection, improvement and adaptation of plant varieties. Women are most frequently solely responsible for the household's subsistence food production and the food security of the family. 'The significant roles that rural women play in the economic survival of their families' is specifically mentioned in the Convention on the Elimination of All Forms of Discrimination Against Women. The partnership between women and biodiversity has kept the world fed through history, and it needs to be preserved and promoted to ensure food security.

Agriculture based on diversity, decentralisation and improving small farm productivity through ecological methods is nature-friendly. Knowledge is shared and other species and plants are seen as kin, rather than 'property'. Sustainability is based on renewal of the earth's fertility and renewal and regeneration of biodiversity and species. While it has become clear that in many countries women comprise the bulk of the labour in agriculture, little has been done practically to ensure that women and their indigenous (or local) knowledge are included in key decision-making processes related to technology definition, development and adaptation. This has far-reaching and potentially harmful implications not only for the broader socio-economic environments, but also for the conservation and sustainable utilisation of agricultural biodiversity.

Typically, rural development efforts focus on incorporating 'modern' science approaches and technologies into policies and programmes, primarily through the transfer of technologies, such as the introduction of hybrid cash crops. For many socio-cultural, economic and historical reasons, these efforts tend to favour better-off rural men, and marginalise poorer rural women. Often, because these crops are not native, they are outside women's knowledge. Cash crops also compete with food crops and receive priority in terms of land and capital investment and labour (Muntemba and Chimedza, 1995). The threat to biodiversity is a real one: over the last century the rapid expansion of industrial and Green Revolution agriculture, with relatively few crop varieties cultivated in monocultures, have resulted in the disappearance of more than 75 per cent of agricultural crop varieties. With the disappearance of harvested crops goes a wide range of unharvested species and 'wild' foods essential for food provision, particularly in times of crisis (Mulvany, 2000). In failing to listen to community wisdom and investigate existing gender-differentiated knowledge and skills, technical experts, planners and policy-makers risk losing the diverse food production systems that conserve farmers' varieties of crops and breeds of domestic animals which form the genetic pool for food and agriculture in the future.

In the global knowledge-based economy powered by corporate competition and trade liberalisation, indigenous knowledge has become the focus for heated discussion in many fora on Intellectual Property Rights (IPR), most notably the WTO Trade-Related Intellectual Property Rights (TRIPS) and the Convention on Biological Diversity (CBD). For the most part, the gender implications of such negotiations have been left off official agendas. NGOs, farmers' groups and indigenous peoples' groups are often the only voices arguing for the need to consider socio-economic contexts as well as gender issues in the negotiations.

Genetic engineering is altering the way that agriculture is practised. The most widespread application of genetic engineering in agriculture is herbicide resistance, i.e. the breeding of crops to be resistant to herbicides. When introduced to farming systems in developing countries, this technology leads to increased use of agri-chemicals

Box 6

The Sustainable Utilisation of Biodiversity for Economic Benefit (Kenya)

In 1991, the National Museums of Kenya (NMK) was designated the National Centre for Biodiversity. Recognising the central importance of rural communities, especially women, in biodiversity conservation, the NMK initiated the Kipepeo Project, a butterfly farming project which is geared towards the sustainable utilisation of biodiversity for economic benefit. The project is based in the Arabuko Sokoke Forest, the largest remaining block of indigenous coastal forest in East Africa, which contains high biological diversity including over 250 butterfly species.

It is now widely recognised that the sustainable use of wildlife is a major motivating force for conservation particularly amongst the economically deprived people in developing countries. The two primary objectives of this project are to raise the economic status of the people living along the forest and to enable the community realise the benefits of conservation. Households are supplied with butterfly larvae and bags made of netting material. The women farmers tie bags in the leafy branches of food plants in the forest near by or in their compound, then change the bags to other branches when leaves are eaten up. About a month later the caterpillars change to pupae, which are then bought from the farmers and exported.

The project has had a number of benefits. The additional revenue that it has brought into the households is not only going towards sustaining families, but also towards future investments such as children's education or animal husbandry. Employment to a small extent has been raised. The project also brings the village women together as a group and, in turn, they have begun to engage in other conservation activities such as the establishment of tree nurseries so as to eliminate forest dependence for poles, fuel wood, fodder, etc.

thus adding to environmental problems. It also diminishes the biodiversity that is the sustenance and livelihood base of rural women. What are weeds for the producers of herbicides are food, fodder and medicine for women. In India, women use 150 different species of plants for vegetables, fodder and health care. In West Bengal, 124 'weed' species collected from rice fields have economic importance for farmers. In the Expana region of Veracruz, Mexico, peasants utilise about 435 wild plant and animal species of which 229 are eaten. The spread of herbicide resistant crops would destroy this diversity and the value it provides to farmers. It would also undermine the soil conservation functions of cover crops and crop mixtures, thus leading to accelerated soil erosion.

Women farmers do not generally buy seeds to grow basic foods but rather save them from one year to the next, selecting those that show desirable traits, such as hardier plants that are resistant to disease. IPRs on seeds have the potential for making seed saving and seed exchange illegal. The attempt to prevent farmers from saving seed is not just being made through new IPR laws, but also through the new genetic engineering technologies. A seed has already been patented which has been genetically engineered to ensure that it does not germinate on harvest, thus forcing farmers to buy seed at each planting season. Termination of germination is a means for capital accumulation and market expansion. The so-called 'terminator technology' provoked significant public outcry and rural women's NGOs were among the leading voices of concern.

Genetic engineering and IPRs can rob women of their creativity, innovation and

decision-making power in agriculture. In place of women farmers deciding what is grown in fields and fed to families, agriculture based on globalisation, genetic engineering and corporate monopolies on seeds has the potential to establish a food system and worldview in which global corporations control what is grown in the fields and what is eaten. In contrast, it is the diversity of local knowledge systems and production systems that has traditionally sustained subsistent family farming strategies where women in the developing world continue to play a central role in food security.

Recommendations

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

Education, Careers and Decision-Making

Action agendas on issues of gender in science and technology often begin with the initial question: 'Science by whom?' Who is studying science? Who is entering science careers? Who is staying? Who is at the table of science and technology decision-making? This is an understandable starting point. A glance at the portraits in the foyers of Ministries of Science and Technology and National Research Centres or a visit to government departments of science, technology and industry renders visible the stark absence of women, particularly in places of position and power in science and technology public policy. The gender gap is visible and tangible.

Recognition of this under-representation of women in science and technology has ushered in analysis and action on two levels. First, research has focused on the school system. Placing the lens on the education pipeline has revealed a number of barriers and challenges to girls that curtail their entry into school, their choice of the science stream and their desire to stay studying science at advanced levels. Secondly, research has focused on women in the science and technology workplace. Placing the lens on careers has revealed a series of systemic barriers in science and technology, not only at the point of employment entry but also at various points throughout the career cycle. Both areas of analysis illustrate the need for a broad attitudinal change (see Box 7).

Science and technology education

A range of factors undermine girls' access to the school system and their subsequent pursuit of science and technology streams of study. At one extreme, obstacles may be rooted in written regulations that restrict the entry of girls into technical or vocational fields. For example, the syllabus of some veterinary medicine schools only decades ago designated a small fraction of admission spots for 'foreigners and women'. In a less overt way, access to schools may be denied to girls because of the absence of funding.

When forced to choose who in the family should receive an education, the preference to train boys rather than girls often prevails in resource-poor countries. Two-thirds of the world's illiterate are women.

Box 7

An Ambitious Strategy for Change (Canada)

In their first gender report, published in 1993, the National Advisory Board on Science and Technology (NABST) in Canada called for a broad attitude change with respect to women's contribution in the scientific and technical fields. The report contended that women were the single most under-utilised resource in the science and technology sector in Canada, and emphasised the importance of the full incorporation of diverse perspectives in science and technology as fundamental if the field is to flourish. It stated that:

- A quality work-force would only be achieved when the potential of the population was maximised by encouraging students of both genders to pursue studies and careers which not only respond to their best ability but also take them to the highest possible level of education and career attainment.
- Every sector of the population must be fully utilised and valued for the diversity it contributes, since diversity and differing perspectives in research, science and technology would foster innovation and a vibrant climate.
- The methods of instruction in educational institutions must respond to the varying approaches to learning demonstrated in different populations in society and by women and men.

NABST contended that the achievement of widespread awareness and effective action on issues of gender in science and technology required the following key components:

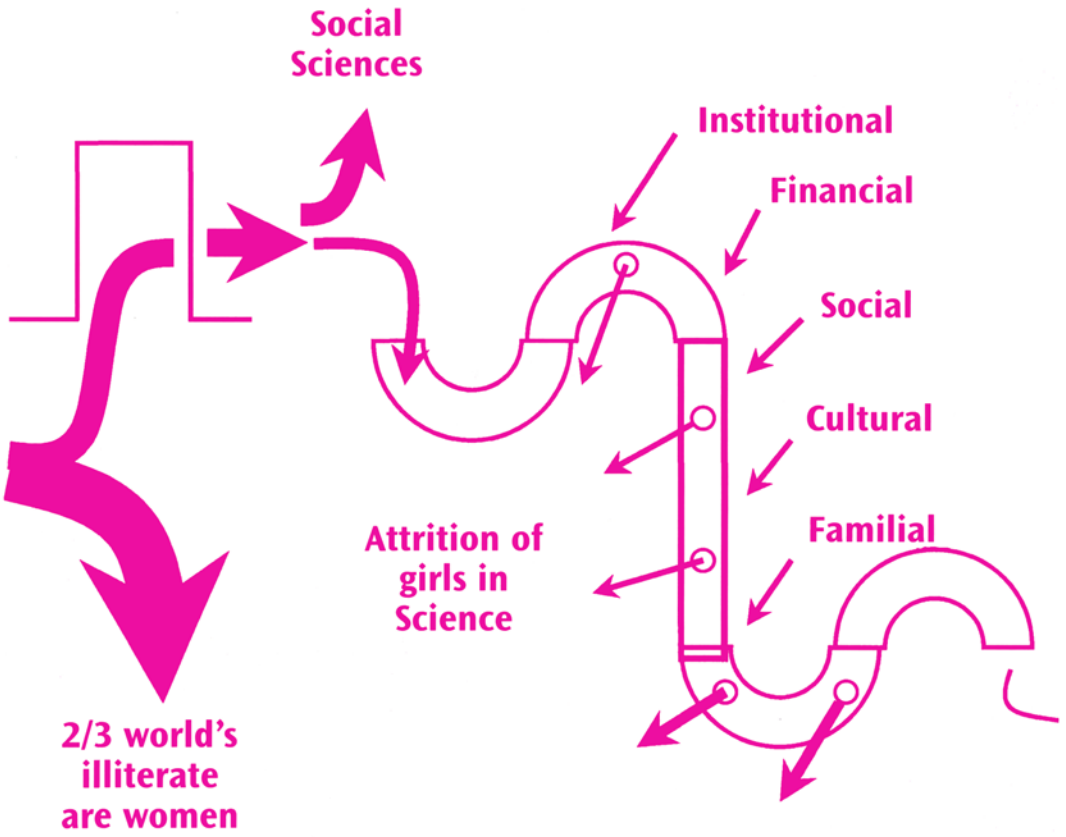
- a commitment from men and women in top positions to attracting women into technical, technological and scientific occupations and to creating women-friendly environments;
- serious attention to heightening awareness of gender equality issues through pertinent and timely education and awareness programmes;
- women involved in the process of change at all levels of education, in the workplace and professional associations;
- co-operation from educators, employers, technicians, technologists, scientists and engineers in order to bring positive change to the image of technical and scientific fields;
- challenging goals within realistic time frames, the incorporation of which should include comprehensive strategies for longer range implementation;
- mechanisms to measure and report on change in the elementary and secondary school system, community colleges and technical institutes, universities, workplaces and professional associations.

The federal government responded in part by creating the Canada Scholarships Programme that reserved 50 per cent of the awards for women.

Of those who do gain access to schools, a smaller proportion of girls than boys obtain training in science and technology. Of those who do enter the sciences, many opt to leave. This phenomenon has sometimes been called 'The Leaky Pipeline' and several factors may contribute to it, including familial and financial pressures, teaching methods, and the lack of links between science and society (see Fig. 4).

Some countries have begun to respond to the fact, shown by research done in Canada, that boys and girls do not respond to science in school in the same way (see Box 7). They often identify distinct problems from the same data, and attempt to solve them differently. Typically, boys dismiss context and select out one aspect of the problem to

Figure 4 **The Leaky Pipeline**



work on while girls value context and take a more holistic approach. Girls also work more co-operatively and are attracted to science that they see as socially relevant. These differences need to be taken into account in curriculum design, which should also reflect the life experiences and interests of girls as well as boys. Studies in Canada and the UK have shown that girls routinely get less attention from teachers and that teachers will often answer girls' questions directly while offering boys information that will allow them to solve the problem themselves (Rathgeber, 1995). Additionally, textbook imaging and vocabulary may be exclusionary, with women barely mentioned in science textbooks and most often shown in illustrations 'as participant observers or as amazed onlookers' (Rathgeber, 1995).

A lack of role models can play a strong role in discouraging girls from pursuing science studies. Biased behaviour by teachers and leaders in school systems can also seriously undermine girls' confidence. Negative stereotyping and a strong pressure against excellence in science because it is 'unfeminine' inhibits and discourages girls, diminishing their self-esteem and reducing their science career aspirations. It also impacts on parents and their role in deciding on their children's education. As noted by the Gender Working Group of the UN Commission on Science and Technology for Development, some parents, teachers and guidance counsellors have the misleading perception that science and mathematics are 'difficult subjects' and not as suitable for girls as for boys. There may also be a parental preference for the education of boys over girls because of cultural reasons and economic constraints, resulting in young girls assuming family and household responsibilities early in their lives. (UNCSTD-Gender Working Group, 1995). Other factors, including teenage pregnancy, may also cause girls to drop out of school.

There is a mutually reinforcing relationship between gender-role stereotyping and access and achievement in the educational system. Yet, when girls are encouraged to study science subjects and targeted for special training, the results can be dramatic (see Box 8).

The sex-disaggregated data now available shows a 'side-streaming' of those girls who do study science and technology towards certain fields and away from others. Males dominate the natural sciences, engineering and agriculture; females are more likely to be found in the social and biological sciences. UNESCO has also found that females generally account for significantly higher percentages of enrolment and training oriented towards commercial and service trades than industrial and engineering trades or occupations (UNESCO, 1995).

Box 8

Interventions in Gender and Science Education (Commonwealth)

An understanding of the different ways in which boys and girls respond to science and technology has prompted interventions within some Commonwealth countries:

- In Australia when a pre-university physics course was started that required the learning of physics to be placed in context, including assessment tasks that enabled young people to demonstrate understanding, young girls suddenly became very good at physics.
- An in-service programme for primary teachers, managed from Currin University, Western Australia, developed the teachers' confidence in their own understanding of science (electricity) and their skills in facilitating gender-inclusive learning for their students.
- A Botswana Road Show was developed to visit schools accompanied by local women scientists and technologists to give girls hands-on experience and to demonstrate that women were doing science-related jobs.
- Within an initial training course in Waterloo University, Ontario, Canada, student teachers were encouraged to question the nature of science and to develop their own understanding of topics through personal enquiry. The anger felt by some young women over their earlier experiences of a science education which made them feel so stupid, was palpable.
- In India, based in Ahmedabad, some 60 women scientists have organised themselves to deliver science informally in rural villages. Science and Technology for Women and Children (SATWAC) bases much of its work in the every day experiences of women and on toys that can be made out of discarded materials.
- A project developed within the National Federation of Women's Institutes in the UK, entitled 'Science, You and Everyday Life', has succeeded in breaking down the alienation many women felt from science. The Federation now has a structure of regional and county science co-ordinators to continue the participation of members in science-related activities.

Source: Harding, Jan (2000b)

Girls' lack of access to science and technology education has multiple impacts. It limits their opportunities to meet their basic needs and improve the quality of their lives and those of their families. It also restricts their access to employment and ability to create businesses. The gender gap also deprives nations of the contribution of many highly talented citizens. Education and training are also key to ensuring women are present at the decision-making tables and are able to assume leadership positions. When women are excluded from science and technology in any culture, that culture is

Box 9

Science, Technology and Maths Education (STME) Clinic for Girls (Ghana)

The Science, Technology and Mathematics Education (STME) Clinic was instituted in 1987 to encourage girls to take up science and mathematics subjects, do well in them and stay with them. It brings together approximately 150-200 girls from secondary schools from all over the country and from other African states for a two-week intensive exposure to the scientific environment. The girls interact with female scientists who are brought in as role models and also visit institutions of higher learning in sciences for a better understanding of the various subject areas as well as industries and scientific research institutions to acquaint themselves with the various job opportunities that exist there. After a one-week survey of science and technology fields, the girls select areas of interest and then work alongside mainly women scientists and technologists for about four days to have a feel of working as a scientist.

The STME Clinic also offers in-service and pre-service training for Science and Technology teachers in gender-sensitive teaching methodologies, including how to involve girls in creative and interesting hands-on science and math activities and the use of everyday examples including games and domestic activities with which girls are familiar, to press home scientific facts and concepts. Teaching approaches take into consideration the fact that women, on average, are holistic learners, use co-operative learning styles and tend to prefer group work. In addition, teachers are shown how to recognise language and teacher-student classroom interaction which are gender biased and given tools to correct this. Gender balanced curriculum materials are also promoted.

Within the first five years of the project, there was a 76% increase in the number of girls who opted for science at the secondary level. While the total number of females studying science at the secondary level still remains small, this is a dramatic beginning.

missing half its talent and capability for solving social problems and improving the life of its people (Hays and Farhar, 2000).

Science education in schools has to serve several purposes, including preparing those students who will go on to study science and technology at university and become scientists and engineers and providing all students with a general understanding of the nature of scientific knowledge. In order to facilitate the latter, it has been convincingly argued that science education materials should be redesigned to focus on 'the role of science and technology in societal development and more specifically on [its] usefulness and relevance ... in everyday life rather than on the capacity of man to master machines' (Rathgeber, 1995). This should include an understanding of basic scientific precepts and the ability to apply them to issues of science in society as informed citizens (see Box 10). This can enable them, for example, to make choices about personal issues such as birth control as well as to decide whether a new technology that is being proposed would be harmful or beneficial. The UNESCO Declaration on Science and the Use of Scientific Knowledge and the Science Agenda, which came out of the 1999 UN World Conference, states that: 'Science education, in the broad sense, without discrimination and encompassing all levels and modalities is a fundamental prerequisite for democracy and for ensuring sustainable development' (UNESCO, 1999).

Box 10

Science and Technology Awareness Group (Australia)

Australia's Science and Technology Awareness Group was established in 1989, with the aim of increasing awareness and understanding of the central role which science and technology plays in Australia's economic and social well-being. The ultimate vision for the programme is a nation whose citizens are well-informed about and comfortable in debating science and technology issues, and whose young people are giving due consideration to extending their formal education in science, engineering and technology beyond the compulsory years of schooling. The programme has five target groups: young people and their teachers; women; industry and business leaders; scientists, technologists and engineers; and journalists and other media.

In order to promote its central goal, the Group uses a variety of inter-related activities, deriving from an overall strategy which has short, medium, and long-term objectives. Activities currently include:

- The Australia Prize
- The Michael Daley Awards for science, technology and engineering journalism
- Science, Engineering and Technology Awareness Raising Projects
- Register of Science and Technology Communicators, published biennially
- FACETS quarterly newsletter for science and technology communicators
- National Science Week

Programme strategy involves delivery of a number of activities aimed at raising awareness, focussing on the target groups. It has an annual budget of approximately $3.6 million, of which $1 million is devoted to Awareness Projects grants.

Scientific literacy equips citizens to actively engage in important debates on the role of science in society, including the setting of appropriate limits to science. It includes both indigenous or local scientific knowledge gained through informal sources as well as institutional or formal knowledge. It is about capacity building as well as confidence building, and educational programmes need to be gender-sensitive, inclusive, people-centred and contribute to a more sustainable practice of science and technology.

Recommendations

- 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 sensitive to gender concerns in terms of language and illustrations.
- Ensure a strong link between the science taught and the everyday lives of girls and boys.
- 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 this activity.
- 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.
- Establish special scholarships for women entering science research and careers.

Science and technology careers and decision-making positions

Many highly skilled women, once launched on science and technology career paths, opt out. An APEC study published by the Human Resource Development Working Group entitled 'What's in a Job? Equity in Human Resource Development in Asia-Pacific Economies' calls for research to understand more fully the reasons behind biased practices in the workforce, including barriers to women created by legislation and regulations.

While the number of women working in traditionally male-dominated fields is increasing, a range of visible and invisible obstacles continues to impede their retention and advancement in non-traditional careers. Strategies to increase the recruitment of women into science and technology careers, while necessary to redress historical imbalances, are insufficient. A supply-side strategy alone will not solve systemic discrimination within institutions. Several important studies have confronted the 'Chilly Climate' in institutions and suggested strategies.

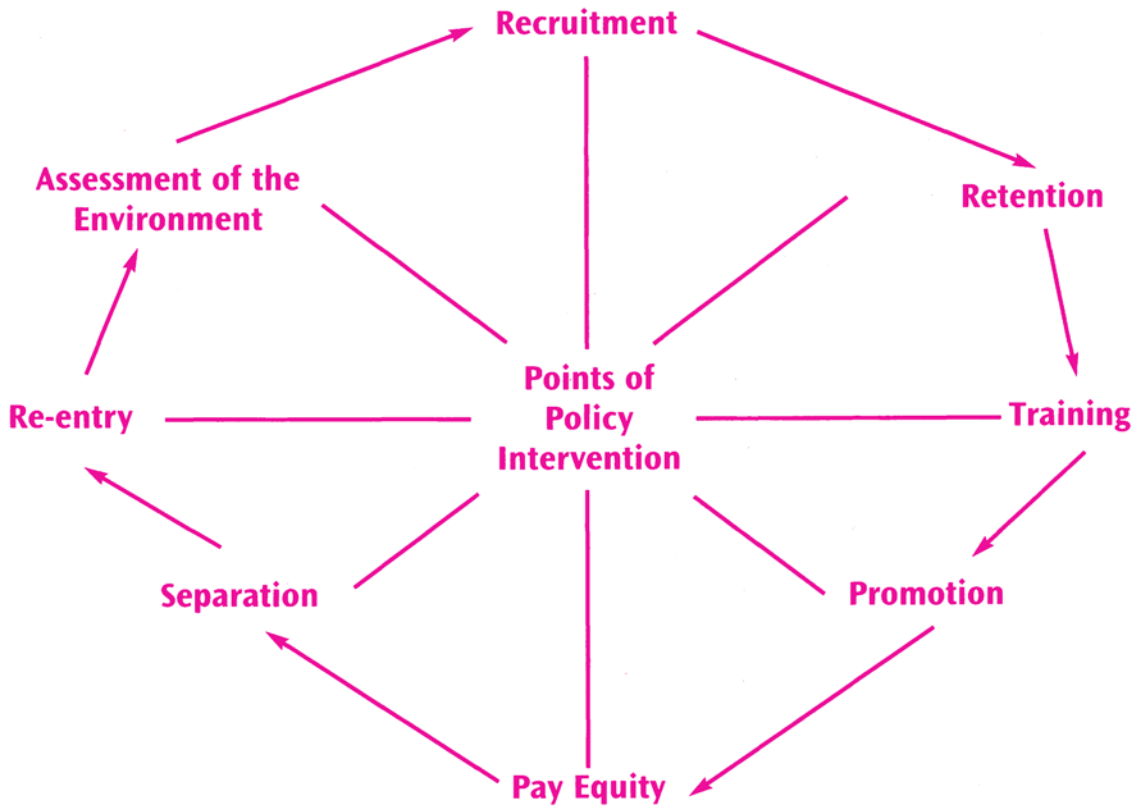
The UNCSTD Gender Working Group identified the removal of obstacles to women in science and technology careers as one of its seven 'Transformative Actions'. The Report set out a series of specific strategies to enhance women's participation, including:

- Alternative work arrangements such as flexible hours, flexible locations and job-sharing, and corporate commitment to on-site child care facilities;
- Maternity and paternity leave policies and promotion criteria to allow for honouring family responsibilities without jeopardising career progression;
- Policies against discrimination and harassment in the workplace;
- Commitment to hiring, promotion and career development of women in science and technology while adhering to the merit principle.

The UNESCO 1996 World Science Report also elaborated a range of policy instruments and innovative strategies to help dismantle discriminatory practices in the workplace. These tools have been designed to create 'Enabling Environments' inside institutions (see Fig. 5 and Chapter 7). Templates and training modules have been designed, corporate policies written and videos produced which can be adapted across companies and countries. Consultants can conduct gender audits on organisations to assist in rendering visible points of discrimination in the system from the time of entry (including entry interviewing) through mainstream corporate policies (sexual harassment, ombudspersons, mentoring, promotion policies, etc.) to the point of exit (severance packages and exit interviews). The competitive imperative to draw on the brightest talent, regardless of gender, has led to the development of increasingly sophisticated tools to evaluate these systemic institutional barriers. Best practices developed to address these barriers constitute a valuable source of case studies and can serve as useful templates.

Historically, men have cultivated and effectively used personal and professional networks. As a result, they have access to well-established routes of influence and career support. Often 'knowing how', the accumulation of technical skills and competency, is a necessary but not sufficient factor in achieving and sustaining success in organisations and careers. 'Knowing who' to turn to for advice, mentoring, role modelling and career development can also be a critical factor (see Box 11). The report of the APEC Working Group on Human Resource Development for Industrial

Figure 5 **Removing Systemic Barriers in the Workplace**



Technology, 'Industrial Technology Training Programmes for Women: Gender Issues and Programme Success Factors', identifies support systems as a key element in overcoming the isolation of girls and women in science and technology and technical and vocational trades.

The Internet offers a myriad of virtual networks for women in science, engineering, and business. Interesting examples include SYSTERS, an international network designed for professional women in computer science; SYSTERS-STUDENTS, a support network for young women studying computers; WISNET for women in science, mathematics and engineering; WITI, a discussion group of women in technology; WNE, a network of women in nuclear science; and WIRED Women for women in IT/Internet-based careers. Other examples of networks are given in Chapter 6.

Recommendations

Institutional barriers precluding an inclusive and enabling environment for women pursuing careers in science and technology should be systematically removed through a series of steps, including:

For the Employer:

- Alternative work arrangements such as flexible hours, flexible locations, and job-sharing opportunities.
- On-site childcare facilities.
- Maternity and paternity leave policies.
- Hiring and promotion criteria and processes allow for family responsibilities to be

Box 11

Women Inventors as Role Models (Malaysia)

In August 1992, a women's section of the Malaysian Inventor and Design Society (MINDS) was established, calling itself LADYMINDS. The following year, LADYMINDS established a National Women Inventors Award. The winner of the 1993 award was Dr. Choo Yuen May, who has to her credit 11 patented inventions, most of which are being used commercially.

Dr. Choo used crude palm oil for four of her inventions as palm oil is the richest plant source of carotenes. With her co-researchers, she developed novel processes including the conversion of crude palm oil and palm oil products into methyl esters, which have been successfully demonstrated to be superior oleochemicals, i.e. derived from oils and fats, as well as environmentally friendly and renewable biofuel, i.e. a diesel substitute. Dr. Choo's most recent patented invention, which she developed alone, is a higher yield process for the production of monoglycerides and diglycerides also using palm oil and palm-oil products. This new process provides lower-cost products with better emulsifying properties of higher value, which are in great demand in the food industry.

Other Malaysian women inventors include:

- Asma Ismail, a university associate professor, who co-invented an antigen to detect salmonella typi, the causative agent for typhoid fever;
- Halmahton Hamdan, a university associate professor, who co-invented Zeolite molecular sieves (an important component mainly for the detergent industry) using rice husk ash, a waste produce;
- Liana Low, a businessperson, who perfected the design of an all-plastic solar heater first invented in Australia and concocted palm-based biodegradable skincare products and cosmetics; and
- Lee Yip Fong, an art and design teacher, who invented a multi-safe clothes hanger whose main feature is a hook to prevent the hanger from being blown off the laundry line in strong winds.

assumed so that maternity, paternity and parental leaves do not jeopardise career progression.

- Promotion of women's careers in science and technology while adhering to the merit principle.
- Policies against discrimination and harassment in the workplace.

For Governments:

- Tax relief for payment of child-minders.
- Pay equity legislation.
- Legislation against discrimination.
- Collection of sex-disaggregated statistics.
- Establishment of focal points for advice on gender in science and technology.
- An increase in the number of women appointed to policy advisory and decision-making bodies.
- Seeking input and advice from women's professional science and technology NGOs and include representatives from these groups on government delegations to meetings.
- Establishment of databases of professional women to provide institutions with a pool of names of qualified women to be considered for appointment to policy and advisory bodies.

- Assistance to non-governmental networks of women in science and technology with the design and mounting and maintenance and funding of websites.

For Academic Institutions:

- Establishment and support networks of female professionals in science and engineering.
- Setting up and support mentoring, role-model and career advisory programmes.
- Providing flexible tenure criteria to accommodate family roles and responsibilities.
- Providing refresher courses and re-entry scholarships for women returning to careers in science.
- Establishing '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).

The Differential Impacts of Science and Technology

Science and technology can bring about profound social change, which is likely to impact differently on the lives of women and men. One of the two central conclusions of the UN Commission on Science and Technology for Development (UNCSTD) Gender Report tabled with ECOSOC and at Beijing in 1995 was the gender-specific nature of technical change. It made the point that: 'To ensure that science and technology benefits all members of society, attention must be paid to the respective needs and interests of men and women equitably'. A more socially equitable distribution of benefits can be ensured by utilising three tools to highlight differential impacts: applying gender analysis to policy elaboration; seeking women's input into programme development; and collecting sex-disaggregated data.

The systematic use of gender-based analysis in the elaboration of policies and programmes in science and technology departments renders visible their differential impacts on women and men. It allows decision-makers to tailor programmes where possible, and provide for compensatory measures where needed. For example, technical change may result in significant dislocation of women in the workplace with repercussions of unemployment, under-employment or de-skilling. A 1967 ILO study of employment looked at different employment sectors where machinery was introduced to activities traditionally done by women. In every case, men either completely replaced women or the activity became sub-divided, with men taking over the tasks that used technology and required greater skill and women doing those that were less skilled (Everts, 1998). Similarly, in the agricultural sector of South Africa, women have traditionally sustained the community through their use of appropriate technology. Far from improving their lives, the effect of modernisation and the development of technologies to improve productivity has been to alienate women from these processes (Ofir, 2000).

Gender analysis in science and technology policies and programmes will ensure a stronger science. For example, when clinical trials are undertaken, the faulty practice of extrapolating results from one gender to the other can be avoided. Having women scientists in decision-making positions would undoubtedly lead to the development of different sorts of research priorities and technology. A recent study on women in science and technology provided documentation of how women apply and utilise existing technologies in innovative and people-centred ways. It also revealed how they approach and prioritise activities; provide unique perspectives; transform science and technology; implement international commitments on gender, science and technology; and add value to science and technology in ways that benefit women, the community, the economy and the larger society (Hays and Farhar, 2000).

The Intermediate Technology Group (ITDG) has noted that women have been excluded,

both conceptually and practically, from the development of technology and its transfer (Harding, 2000a). Women, especially the poorest, need access to improved technologies to reduce the drudgery of their work, increase their productivity and in other ways increase their well-being (Carr, 2000). At the same time, they already use technical skills and knowledge in their daily lives and are themselves the best source of information about which technologies would be appropriate to their needs. Meeting these needs is also meeting government's commitments under the Convention on the Elimination of All Forms of Discrimination Against Women, since the CEDAW Committee has asked states to include in their reports information about appropriate technology being used to facilitate women's working and living conditions (5th Session, 1986).

Participatory research methods reveal a range of indigenous knowledge systems and involve local communities in assessing their own technical needs (see Box 12). An innovative project called 'Do It Herself' trained women with no previous experience in research to gather and compile information on women's technical skills and knowledge of food processing, traditional medicine and technologies used in income generating projects such as the processing of coconut fibre (Appleton, 1995). Their knowledge and connections to the community helped them to uncover a range of women's skills in technology that had previously been ignored.

The absence of consistent and comparable data is a major impediment to designing, developing or defending effective policies and programmes. The UN World's Women's Conferences in Mexico (1975), Copenhagen (1980), Nairobi (1985) and Beijing (1995) all repeated the call for co-ordination and consistency at national and international levels in the collection of statistics on women. Despite these repeated

Box 12

Participatory Research in Action (Trinidad and Tobago)

Data gathered in this study in Trinidad and Tobago were based on a gendered and interdisciplinary examination of the socio-economic, cultural political and ecological factors affecting the sustainable use of the Nariva Swamp, an ecosystem where new strategies needed to be developed for sustainable livelihoods. The primary goal of the project was to empower the communities, with particular emphasis on the women, and participatory research methodologies were therefore employed. By involving community members in the research process, posing problems, validating their knowledge and generating discussions, it was hoped that they would get the confidence to analyse their situation and come up with effective and sustainable development proposals. In the case of women, it necessitated identifying and acknowledging the sources of their oppression and powerlessness and meeting their strategic needs.

The research team (three females and one male) came from different disciplinary backgrounds: Agriculture, Ecology, Economics and Gender Studies. An important feature of the process was that they lived together close to the community for nine months and held nightly discussions on the data gathered by each during that day. This provided an opportunity for refinement and validation. A facilitators' workshop was held to train twelve community members to conduct Participatory Research (PR) followed by a community workshop at which the trained facilitators shared what they had learned with other community members. A further aspect that facilitated community empowerment was the data giveback session to the community and their participation in the workshops held for academics, stakeholders and policy makers.

Source: Centre for Gender and Development Studies, University of the West Indies, Trinidad and Tobago

calls, there persists a scarcity of sex-disaggregated data in science and technology. The degree of difference between girls and boys in both access to primary school and opportunity for higher education may not be readily apparent where there is no consistent and comparable data. Similarly, the differential impacts of policies and global agreements on the lives of women and men may not be clear. The systematic use of gender analysis and sex-disaggregated data can render visible these differences and permit policy makers to put into place programmes to proactively address and alleviate the differential impacts of technical change.

Recommendations

The Commonwealth Secretariat should:

- Liaise with the Gender Advisory Board (GAB) established by the UNCSTD and with GAB 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 into all science and technology policy and programme activities of the department and affiliated research agencies;
- Promote the implementation of the 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 Commonwealth countries;
- 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

Issues concerning science and ethics can be divided into the lack of (or need for) ethics frameworks, both within the scientific research enterprise and for government and intergovernmental bodies; and the ethical implications and impacts of science and technology on the lives of women and men in society. The 1996 UNCSTD Gender Report contended that ethical issues associated with both the conduct of scientific research and the application of the results have a gender dimension that has not been sufficiently recognised or addressed. The Report calls on governments to develop ethical codes of conduct to provide clear boundaries of accepted practice in science.

Medical technologies now touch us intimately at every stage of our lives. Technology gives us the unprecedented power 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 (McTeer, 1999). Our very definition of who we are and what it means to be human is challenged. The essential question has become: How do we balance the ability of science and medicine to enhance our lives with our obligations to protect individual and collective rights? 'We can neither put the genie back into the bottle nor let it go around granting any

old wish. We must give the genie some rules' (Kennedy, 1991).

Many implications of these fast emerging technologies have particular impact on vulnerable populations including women. Ethical issues arising out of the applications of science and technology in society that especially have a bearing on the health and rights of women include: abortion issues, embryo experimentation, cloning, surrogacy, genetic engineering, sex predetermination and becoming subjects in human experimentation. In the context of the new reproductive technologies, for instance, women should be encouraged to be critical of so-called miracle advances and developments and to become more involved in crucial decisions about their bodies and lives.

In 'Setting Boundaries, Enhancing Health', the Canadian Royal Commission on New Reproductive and Genetic Technologies (NRGTs) stated that government reproductive policy 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'.

In the reproductive field and in others, women's studies have shown that the practice of science reinforces sexist, racist, homophobic and class biases, which have become part of the metaphysics of science. Within science, the predominantly male conception of women's nature has caused women to be excluded from the very process of defining themselves. When included, women have been made the object of study. This has meant that women's participation in the definition of science, its ethics, direction and social implications has also been precluded.

Similarly, studies during the last twenty years that have focused on the ideologies, politics, epistemologies and economics of science have shown that the values discourse concerning science (ethics and justice, for example) has yet to take on board the multiplicity of women's experiences and views of the social construction and conception of science. This scholarship asks for a recognition of the ways in which values actually inform the practice and theory of science. From the social structure of the laboratory to the ideology of women's nature, to the gender bias of scientific language, feminist writers and others in science point out the political context and role of contemporary science. Science must be made accessible to more people and the process of its validation should be under greater public scrutiny.

There is a need to acknowledge that science is a human social activity and it is a fallacy to think that because the scientific method is objective, then scientists' objectivity is also guaranteed. There are also examples of misconduct amongst scientists, including falsification (misrepresentation of results), fabrication (of experiments never performed) and plagiarism. In the case of plagiarism, the available data show that women are more susceptible than men to their work being unacknowledged or 'taken over' because they are usually lower in the hierarchy of the scientific enterprise.

Recommendations

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.

NGOs and associations of women is 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 Communication Technologies (ICTs)

The recent technological revolution, centred around the rapid growth and spread of Information and Communications Technologies (ICTs), has been reshaping the material basis of society, as well as bringing about a profound restructuring of economic, political and cultural relations among states (Marcelle, 2000). Indeed the present phase of globalisation and economic liberalisation is very much driven by ICTs, mainly controlled and dominated by multi-national corporations located in the industrialised countries. It would not be an exaggeration to say that, with the global economy increasingly organised around information flows, control of – or at least access to – ICTs is key in competing for a share of the market, with implications for the international division of labour.

While the growth and expansion of the global ICT sector can contribute to human development through their effects on economic, social and political structures and processes, they are not necessarily aligned with the needs of developing countries or women. Discourse on ICTs, gender and globalisation has to be located within the following contexts: an understanding of the forces and interests driving the creation and expansion of ICTs; an examination of the organisational structure and institutional arrangements which facilitate the application of ICTs, particularly in terms of its costs and benefits; and an analysis of the impact of ICTs on social and gender relations at various levels and sectors in society, such as the home, work and society.

The Internet has emerged as an important medium of information and commercial flows today. The majority of the users, however, are in the developed countries. Even though Internet usage is accelerating in developing countries, this is predominantly among the urban elite and, particularly in the poorest countries, ICTs will be an exotic and inaccessible commodity for most people well into the next century (Mansell and Wehn, 1998). An inadequate infrastructure and a lack of resources and the requisite expertise means that 'out of 5.7 billion people, at least 5.6 billion are excluded from the so-called wired or network society' (Mitter, 1998).

Enormous disparities in terms of access to the National Information Infrastructure (NII), a necessary precondition for IT application, are reflected among Commonwealth countries. In 1995 the teledensity (telephone lines per 100 people) in Canada and Australia was 59 and 51 respectively, compared to 0.4 in Ghana and 1 in Papua New Guinea. Internet users per 1,000 people were 41 and 55 in Canada and Australia in

contrast to 0.2 in Solomon Islands and 2.0 in Malaysia. Likewise, the personal computer ratio discloses the immense gap in ownership in terms of the highest (223 per 1,000 in New Zealand) and lowest (0.7 per 1,000 in Kenya) (UNDP Human Development Report, 1998).

Not only is there a wide NII gap between countries, but the principle of universal access is denied within the countries themselves. There is a gender gap between the information 'haves' and the 'have-nots'; the latter are usually the rural poor and women. With women forming the majority of the world's 1.3 billion poor, and owning only 1 per cent of the world's land, their opportunities to access, let alone control ICTs are almost non-existent. In addition, in the last 20 years, the number of rural women living in poverty has increased by 50 per cent, compared to 3 per cent for men, leading to the declaration that 'poverty has a female face' (Wee, 1995b). Women in developing countries thus have to overcome a double burden of marginalisation. A study conducted in 1997 by the Women in Global Science and Technology (WIGSAT) on African women's access to and use of ICTs revealed the gendered nature of the systems within which women seek to meet their information and communication needs. Another study, quoted by the Association for Progressive Communications (APC), claims that male domination of computer networks is as high as 95 per cent (APC Women's Programme, 1997).

The gender biases that limit women's access to science and technology training also result in women's under-representation in high status positions within ICT firms (Marcelle, 2000). At the same time, ICTs have an enormous impact on employment and work, with attendant implications for social and gender equality. The introduction of ICTs leads to a fragmentation of the labour process in manufacturing: low-skilled and repetitive work on the one hand; and an upgrading of workers' high-grade skills in multi-task jobs using ICTs on the other. There is a growth of white-collar jobs in the service sectors, the majority of which are fast utilising ICTs. Some of these positions are filled by young graduate women with the requisite IT and business management skills and training. As a result, there is a growing polarisation of labour between men and women and among women possessing high and low technological skills. In addition to class and gender, age will also be a differentiating factor in the information society, as elderly women and men in the workforce, unless they are provided the relevant training, will find their skills outmoded and unmarketable.

Facilitated by ICTs, restructuring and downsizing are taking place simultaneously with labour flexibility as companies, both local and international, compete in the global economy. This has caused a shift to a combination of regular work with various forms of non-regular, flexible employment which can be undertaken through relocation outside the city centre or to low-wage countries. The core workers in the firm are technologically skilled men and women. The emerging part-timers and sub-contracted workers are mainly women from urban and rural poor communities, or are migrant workers who are low-skilled, low paid and are not protected by existing labour laws. The use of non-regular workers weakens the ability of workers to organise themselves, as well as the ability of unions to organise what falls under the 'informal sector'. The value of women's work, particularly in the industrial sector, is still perceived as inferior and secondary to men's work and is thus not rewarded despite technological changes and increased productivity.

Many countries do not have institutional and policy initiatives to deal with the negative effects of the transition from low-skilled to capital-intensive and high technology industries. Even when new forms of information-intensive work are being introduced, such as teleworking and teletrade, the benefits to women are uneven. Telehomeworking for women might increase their productive and reproductive

load rather than enhancing their quality of life through the combination of work and home. It is often men, as highly skilled professionals, who benefit from telehomeworking, as the gender division of labour spares them the burden of reproductive labour.

Participation in decision-making in production and regulation of the ICT sector is limited. The few groups that do represent the interests of gender equality and sustainable human development are marginalised, occupy low status and are seen to have little legitimacy (Marcelle, 2000). Women employees are usually not consulted when new technologies are introduced in the factory or office floor. It is only in the smaller firms which are ICT intensive, such as software firms, that some form of fluid management practices occur and there is employee participation and co-operation.

New occupational health hazards have been introduced with the advent of ICTs. These include repetitive stress injuries (RSI) and other problems related to work on video display terminals. Women's reproductive health will also be made more vulnerable. With increased competition under the current trade liberalisation regime, workers have been required to push up their productivity, increasing their labour intensity under the gaze and surveillance of the computer which monitors key-strokes and telephone conversations.

Despite the rhetoric of technical and development co-operation, little technology transfer is taking place from the developed to the developing countries. Under the World Trade Organisation agreement on Trade-Related Intellectual Property Rights (TRIPS), firms would have to pay more for technology rights and patents. Software programmes, usually originating from the West, are notoriously exorbitant for those in developing countries. Women who are starting their own businesses do not have the means to access these new technologies.

Participants at a recent international conference hosted by the UN Economic Commission for Africa, *African Women and Economic Development: Investing in Our Future* (Addis Ababa, 28 April–1 May 1998), looked at the gender dimensions of the impact of ICTs in Africa. A debate arose as to whether computers would be useful or an irrelevance to women who had no access to basic amenities such as water. The answer of many of those present was that computers might be the best means of providing women with up-to-date information in a number of different areas, including appropriate technology and markets for the goods they produce. At the same time, participants agreed that it is not enough for women to be simply passive participants in the development and dissemination of ICTs; they must also be decision-makers and actors (Rathgeber and Ofwona Adera, 2000).

Some progress has already been made by NGOs in using ICTs as a tool for furthering women's empowerment, 'to expand their access to information sources, improve the effectiveness of their lobbying, widen the reach of their information dissemination activities and increase the extent to which they are internationally integrated' (Marcelle, 2000; see Box 13). In the field of women's human rights in particular, activists are using computers and electronic communications as tools that are fast becoming an integral part of local and global strategies to demand, protect and defend those rights (IWTC, 1998). At the same time, in addition to using ICTs as tools for achieving practical and strategic objectives, it is important for the gender and development community to become more active in putting forward a critique of the whole area of ICTs and development. Most important, though, is a recognition that strong and effective government leadership is essential for mainstreaming gender considerations into national ICT policy and implementation.

Box 13

Women'sNet (South Africa)

The primary aim of Women'sNet is to enhance the ability of both law and policy makers and civil society to impact on various political and decision-making processes that seek to redress the unequal status of women in South African society. Its development was facilitated by the Southern Africa Non-governmental Organisation Network (SANGONet), which focuses on integrating the provision of an accessible and affordable electronic communications infrastructure with training and other capacity building activity, including the provision of useful information. From the outset, SANGONet earmarked gender and women's issues as a critical area for information development and linking of organisations. SANGONet has worked with its international partner organisation, APC, to provide hundreds of women with technical skills training.

Women's Net has developed into a sophisticated structure that links people and organisations related to gender as well as science and technological issues. Currently, it is involved in a number of projects such as:

- posting new documents and information related to gender equality
- monitoring of gender events in government
- a national events calendar
- participatory policy for UMS
- directory information
- links to relevant sites
- feedback feature
- electronic conferences and mailing lists that are sector-specific

This emphasis on interactive or participatory communication has meant that technology is not left to tell its own story. Definitions and contextual commentary help locate the information. A multimedia approach also ensures that the information circulated by Women'sNet can reach broader communications networks.

www.womensnet.org.za/

Recommendations

- Establish a gender audit team at the Commonwealth level to study the impact of ICTs, and globalisation;
- 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 such payments for the development of ICT infrastructure which should have universal access as its first principle/condition;
- Establish genuine attempts at technology transfer and/or the creation of technology 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 schemes to those made redundant as a result of technological change/restructuring, especially women who find job re-entry more difficult;

- 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 which 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

Mainstreaming gender into the science and technology of habitat development implies not only involving women alongside men in order to make shelter strategies more effective and efficient, but transforming the whole process of human settlements development itself, through a sex-disaggregated, people-centred approach (UNCHS, 1996). Both women and men need to be consulted in the formulation of urban policy and the planning and management of settlements. It is also important to take into consideration that gender intersects with other social relations, including those based on class, race, ethnicity and age.

Current trends in industrialised town planning and modern housing transform and often subvert traditional cultures and household economies, with tragic results for women. Particularly in dense cities in developing countries, more and more women are forced to raise families in substandard high-rise apartment blocks which have been designed for nuclear families, are hemmed in by traffic and pollution, and provide little or no space for self-employment, child care facilities and communal activities.

In many parts of the world, traditional communities consist of household economies, culturally dynamic and ecologically sustainable. The word 'economy' stems from Greek roots: 'oikos nomos', which originally meant 'management of the household'. In many peri-urban and rural societies, women still manage a household that includes not only raising children and performing domestic routines, but also food production in terms of farming and raising livestock and also some kind of home-based business which contributes to the family income. In the urbanising world, habitat-making has lost its communal dimension.

In transforming traditional landscapes, modern town planning has systematically thwarted women's opportunities for creative self-employment, flexible hours, and working at home or close to the children – at best, reducing such jobs to the realm of the 'informal sector'. Women are disproportionately represented among the working poor where they occupy the most poorly paid and insecure jobs. Owing to a misconception that the household consists of a nuclear family, within which the man is the 'breadwinner' doing productive work outside the home while the woman is responsible for reproductive and domestic work, shelter polices have failed to take women's specific needs into account (N'Dow, 1995). The notion that 'men create habitats, women live and reproduce within them' prevails.

Modern urban habitats are developed by the predominantly male-owned and operated

construction, transport, infrastructure and finance sectors. By compartmentalising the realms of economic production, social reproduction, consumption and recreation, modern land use planning has failed to respond to gender-distinct needs. Women have little or no input into the planning of their neighbourhoods. Their key role as the main providers of basic services in poor settlements and as builders and maintainers of shelter and infrastructure remains largely unrecognised. Furthermore, while urban development could have provided innovative opportunities for women to increase social status and ownership, the converse has often happened.

Women are seriously underrepresented in policy- and decision-making when it comes to planning settlements and designing housing programmes. Yet, in many countries the number of female-headed urban households is growing. For single adult households and lone parent families, predominantly headed by women, low income, poor skills and lack of confidence militates strongly against home ownership or security of tenure or occupancy. Female-headed families are over represented in informal settlements in the developing world, and in the rental market in the industrialised countries (UNCHS, 1996). Limited access to and control over land and housing means the lack not only of the security provided by a place to live and grow but also of access to economic benefits, for example the collateral necessary to obtain loans.

Adopting a gender integrated approach to habitat development means meeting both women's practical needs (e.g. water, sanitation) as well as their strategic needs (e.g. greater participation in urban planning). It also seeks to ensure that both women and men have equal access to and control over resources and opportunities. For example, present transport trends increase mobility for car or motorcycle users – usually the prerogative of men – but result in unsafe streets, poor public transport and declining mobility for everyone else. Women's and men's travel needs differ, and women face problems because transport systems are usually designed around the man's journey to work and because transport planning is concerned with mobility rather than accessibility (UNCHS, 1996). A highway cutting through a town means that women on one side may take twice as long to get to the market as those on the other side.

Women play a primary role in cultural transmission, from breast feeding to education to socialisation into adulthood. An African saying, 'It takes a village to raise a child', sums up the crucial supporting part played by the extended family and community. The low-cost solution to modern housing forces women to raise children and perform housework in high-rise cubicles without this community support. Both at home and at the workplace, women's work becomes more alienating. The industrial workplace, where women make up the bulk of production operators, is a place without children. Women at work worry about the children they left at home. In the home, the communal kitchen has been reduced to a modern workbench lined with time-saving machines. Gender-sensitive habitat development can factor for spaces where the extended family can provide that nourishing role envisaged in the African adage.

Recommendations

- Meet government's commitment under Article 46 of the Habitat Agreement to the goal of gender equality in human settlements development. This 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 community.

Natural and Human-Created Disasters

'Programmes and infrastructures that are gender-sensitive are needed in order to effectively respond to disaster and emergency situations that threaten the environment, livelihood security, as well as the management of the basic requirements of daily life.'

United Nations, 2000

Women and men experience disaster, dislocation and social conflict in different ways. When human-created or natural disasters occur, it is women and children who are dislodged and suffer disproportionately. Eighty per cent of refugees around the world are women and their dependants. However, even though women are particularly vulnerable, they can also be extremely resilient as reproducers and – in their role as community managers – crucial in periods of reconstruction. During and after war and disasters, women represent an important potential force for the reconstruction of the social fabric of life in these societies, and they play a constructive part in mediation and reconciliation, particularly at the community level.

Armed conflicts, investment in arms technologies at the expense of health, education and social programmes and the infliction of environmental damage impact differently on women and men. In countries where precious national resources are drained off into military science and technology, the brunt of the removal of critical social programmes and safety nets is borne disproportionately by women. Furthermore, most recent and on-going conflicts are civil wars that make the entire country a war zone and cause a major increase in the number of civilian casualties (from around five per cent in the First World War to 90 per cent currently). When war occurs, it affects most heavily those who, by their assigned social role, provide these social safety nets to society when governments fail to deliver: women.

The world now has 26 million people in the regular armed forces; another 40 million in military service, and a stockpile of 51 thousand nuclear weapons. The Gender and Science and Technology Association (GASAT), India chapter, has examined the gender dimension of nuclear disasters. Other scholars have considered the gender dimension of land mines and the war industry on the lives of women and children.

Natural disasters also inflict a heavy toll on certain societies. Each year more than 130 million people are affected by natural hazards such as floods, earthquakes, droughts and cyclones and the destruction caused by natural disasters increases. Between 1971 and 1995, about 99 per cent of people affected (and 97 per cent of deaths) were in developing countries (Twigg, 1997). Disasters are usually dealt with from a purely humanitarian angle, while natural hazards such as cyclones, droughts and earthquakes have been analysed 'technically and scientifically' within scientific disciplines. An alternative approach that has been suggested to deal with disasters sees mitigation and preparedness as the keys to reducing impact (Ariyabandu, 1999). In this approach, all stakeholders – development planners, donors, researchers, practitioners, and communities – have a role to play. Women are key stakeholders, and their participation

Box 14

The Nuclear Threat and Women's Advocacy Role (Pacific)

Women activists in environment and sustainable livelihood issues in the South Pacific region have formed two regional science and technology-based women's collectives: WAINIMATE, the traditional medicine group, and ECOWOMAN, which is the focal point in the region for OFAN, the Once and Future Action Network, linking women in science and technology around the world. Both WAINIMATE and ECOWOMAN are working to link professional women scientists and technologists and grassroots women who practice science and technology. In some cases they are concerned with preservation of the ecosystems on which they depend for their livelihoods; in others they are collaborating to sustainably use their bioregions for economic activities.

Issues of concern and advocacy by women's NGOs in the region go back some years to women's vigorous protests against French nuclear testing in the region, and now to an ongoing campaign to alleviate climate change and global warming. While France has ceased nuclear tests in the region, there is a considerable body of scientific opinion that expects future impacts to be of concern, both in physical damage to the area and medical effects on the populations. The US nuclear testing in Micronesia 40 years ago is a yardstick by which these threats can be measured. Furthermore, when shipments of high-level plutonium travel from reactors in France to the enrichment plants in Japan, it is next to impossible to avoid the waters of French Polynesia, Vanuatu, PNG or the Solomon Islands (they are banned from the Singapore Straits and the Panama Canal). As citizens of the Pacific, women in science and technology NGOs are expressing their opposition.

is needed in the planning, design and monitoring of relief operations, as well as in negotiations with donors. 'The "bottom line" must be to include women at every level and stage' (Walker, 1996).

Governments have increasingly recognised the importance of including a gender perspective in tackling disasters. They recognise the inefficiencies and inadequacies of the existing intervention methods, which fail to take into account the fact that 'women, more often than men, are burdened with the responsibility of meeting the immediate daily needs of their families. This situation has raised awareness that a gender perspective must be incorporated whenever disaster prevention, mitigation and recovery strategies are being developed and implemented' (United Nations, 2000).

Part of viewing disasters through a gendered lens includes seeing women not as passive victims, but as survivors and innovators whose strength and determination help safeguard their communities and families. Women's and men's different needs, interests, vulnerabilities, capacities and coping strategies need to be recognised. For example, a focus on and an analysis of the gender relations and social norms of different societies and communities is essential for the understanding of survival mechanisms and the development of viable disaster management and disaster mitigation processes. In disaster situations, both women and men are disempowered, and relief workers have to be careful not to further erode their positions. Women are traditionally responsible for the management of the home, food, water and family health. Relief programmes which register only men as heads of households, or fail to take into account that women generally have dependants, may put women under pressure to, for example, provide sex in return for entitlements (Walker, 1996). It is also important to take into account the location of water points, the sites where shelters are constructed and the safety of public spaces for women.

Recommendations

- 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.

5 Gender Mainstreaming in Ministries and Departments Responsible for Science and Technology

The Complex and Cross-Cutting Nature of the Science and Technology Portfolio

Departments mandated to co-ordinate science and technology vary widely with respect to their portfolio of responsibilities. Commonly, a core activity is to ensure that the national science and technology infrastructure is supported and fostered, including human resource capacity building and technology transfer. Trade promotion and investment are often also part of the portfolio, including initiatives pertaining to Small and Medium-sized Enterprises (SMEs) and micro-enterprises.

Research laboratories and science-based policies and programmes also may be dispersed across several departments including Ministries of Energy and Natural Resources, Health, Environment, Agriculture and Industry. Frequently, agencies such as the Statistics Agency, Office of Intellectual Property, Centre of Disaster Management, Tourism Agency and National Advisory Board on Ethics report to the Minister of Industry, Science and Technology. The cross-cutting nature of the science and technology mandate requires that gender mainstreaming be promulgated through inter-departmental science committees as much as it is implemented in the lead Science and Technology Ministry.

The collection of sex-disaggregated data is an important starting point in identifying the gender gap in science disciplines and in positions of decision-making. Historically, governments have initiated their response to the gender gap in science and technology by introducing strategies to fill the science and technology 'supply pipeline'. Initiatives to attract and retain women in science have aimed to increase the numbers rather than investigate the rationale for why women are absent in the first place (or how science might change with increasing numbers of women defining the research agenda). Agendas for action to enhance the numbers of women in science can draw upon the policy recommendations of the Beijing World Conference, the UNCSTD Gender Working Group and UNESCO.

These strategies to increase the numbers, however, represent an important but only initial stepping stone to gender mainstreaming. To help ensure a strong science policy that is serving society equitably and is sustainable for future generations, science and technology decision-makers have at their disposition the powerful tool of gender-based analysis (GBA). The systematic introduction of such an impact analysis filter across federal departments is not new. Since the United Nations Conference on the Environment and Development (UNCED) in the early 1990s, most governments have introduced mandatory environmental impact assessment protocols for all publicly-funded policies and programmes. Similarly, the systematic application of GBA permits science and technology decision-makers to see the differential impacts of their proposals on all sectors of society prior to implementation. Such an 'early-alert system'

will aid decision-makers in ameliorating unexpected or unintended outcomes of science research and projects on vulnerable populations within society that might have otherwise have been overlooked.

Two further dimensions of science and technology policy will become apparent when gender aware practices are required. First, attention will be paid to the valuable contributions made by women's local and indigenous knowledge systems and innovations to western science systems. In a related fashion, intellectual property (IP) offices will become aware of the need to handle community-based knowledge generated over decades differently to individual applications for protection of IP. Secondly, as the ethical implications of research are examined, gender analysis will reveal to decision-makers diverse perspectives and value systems in society.

Governments can be supported strongly in achieving their goal of gender equality by tapping into the rich variety of networks of non-governmental organisations (NGOs) and the flourishing number of websites highlighting the new emergence of women in technology and feminist bioethics (see Chapter 6).

Practical Steps to Mainstream Gender at Multiple Levels

In order to bring women's concerns into the science and technology mainstream and identify gender bias and inequity, it is necessary to operate at several different levels:

1. introducing the systematic use of gender-based analysis for all policies and programmes;
2. establishing gender units in Science and Technology Ministries and science and technology experts inside the national women's machinery (NWM);
3. diffusing responsibility for gender integration beyond focal points and gender units through department-wide gender training and gender guidelines to make gender analysis a routine undertaking by all bureaucratic units and staff members and one that is identified and rewarded in job performance evaluations;
4. setting up an enforcement mechanism for monitoring through a central agency such as the Auditor General.

High-level enforcement sends strong signals throughout the system that gender equity is a priority of political leaders. In some countries, for example, the environmental impact assessment tool mentioned above is monitored by the office of the Auditor General. Ensuring the systematic incorporation of GBA across science departments requires no less corporate commitment. Gender mainstreaming in the machinery of government departments is underpinned by international commitments of governments to gender equity and serves to translate this obligation into action at the level of federal science and technology machinery.

Guidelines and Roadposts

When a gendered perspective is not explicitly and systematically used to inform policy analysis, the analysis will be gender-blind, meaning it is implicitly premised on the notion of a male reality. While often couched in apparently gender-neutral language, it is actually male-biased in that it privileges male needs, interests and priorities in the distribution of opportunities and resources. The following guidelines are therefore suggested to ensure that a gender perspective is brought to bear:

✦ ***Identify problems, issues, and objectives of the policy initiative***
How a problem or issue is defined is not neutral, but will reflect the biases and

assumptions of those who define it. Therefore, the definition of the problem or issue may need to be dynamic, and modified during the research, so that recommendations made will address the real and not the perceived issue. As the problem or issue is re-defined, so the objectives will also change. Does the definition of the problem reflect women's and men's reality and experience? What steps were taken (i.e. who was consulted) to better form a gendered perspective on this issue? Does the explanation of the problem take into account the immediate, underlying and structural/systemic roots of the problem or issue? Have objectives been defined to address each of these causes? Are the objectives generic or gender-specific?

✦ ***Define desired/anticipated outcomes, indicators***
Is the policy intended to be: (i) gender-neutral (i.e. differential impacts are avoided by revising policies so that men and women benefit equally); (ii) gender-specific (i.e. intended to target either women or men specifically to achieve policy goals); or (iii) gender-transformative (i.e. seeking to transform gender relations and identities, a long-term goal with much deeper social and cultural impacts, leading to a more egalitarian society)? Is the intention to integrate gender into pre-existing policy concerns (i.e. highlighting the gender dimension within current policy preoccupations), or to transform mainstream policy agendas from a gender perspective (i.e. evaluating and re-orienting not just the policies, but the institutions that create them and their norms, rules, priorities and goals from a gender perspective?) How will these outcomes be measured? What will indicate to policy evaluators that the desired outcomes have been achieved?

✦ ***Conduct inclusive research***
Sex-disaggregated statistics are essential but cannot be considered the end result of research. Instead, statistics should be the basis for research questions, so that assumptions as to the underlying causes of or trends in the statistics can be investigated and, if necessary, disproved, and the reality of the situation can be revealed. Consultation strategies which are inclusive, dynamic and open are essential. The selection of representatives of social groups should reflect the true diversity of people affected by the policy, avoiding stereotyping or aggregating of groups, so that all voices have an equal chance of being heard. This will likely require scheduling consultations during times and in places which are more convenient for certain groups. Where topics may be sensitive or taboo for women to discuss with men, female researchers should be utilised.

✦ ***Learn from the process***
Questions should also be asked about what has been learned through this analysis. How does it apply to government policy development? What was learned by using a gendered approach which would otherwise have been ignored? What assumptions and stereotypes were revealed, questioned or disproved? What value has been added to the analysis by taking a gender perspective?

✦ ***Set targets***
What have the research results shown must be addressed in order to counter the problem or issue? What can be realistically achieved in the short term? In the long-term? These possibilities will be the targets of the policy or programme.

✦ ***Develop options for recommendations and prioritise them***
What are the possible policy or programme options which could achieve these targets? Can these potential policy options be prioritised? Criteria can be established which reflect the objectives of the policy and can be used to compare the different recommendations developed using gender analysis. Examples of criteria could be: How well does it address the equity objectives? Will opportunities and choices for women be improved? Will systemic causes of the problem be addressed or only the immediate

causes? These criteria can then be used to rank the various options as to how well they can be expected to achieve the objectives and targets set out during the analysis.

- ***Communicate the recommendations***

Has the support and commitment of key decision makers been obtained? A communication strategy may be required in order to create an awareness of the benefits of gender mainstreaming and the policy recommendations, which will in turn produce the support and commitment needed to, firstly, implement the recommendations and, secondly, institutionalise a gender perspective.

Developing an Action Plan

The process of gender mainstreaming can be broken down into four phases:

- Raising awareness
- Process of legitimisation
- Implementation and institutionalisation
- Monitoring and evaluation

Phase 1: Raising Awareness

The profile of the issue must be raised both externally and internally, and the benefits of gender sensitive policy must be clearly demonstrable.

Externally: International fora that have addressed gender equity have resulted in Declarations, Platforms for Action, Statements of Intent and Conventions endorsed by states. Progress reports by governments to international bodies, such as the United Nations and the Commonwealth Secretariat, must be published to highlight progress and best practices. Civil society needs to be engaged in this process. NGOs, public interest groups and the press can provide supporting research and raise awareness of progress and obstacles in closing the gender gap.

Internally: The benefits of gender-sensitive policy must be clearly demonstrable. Removing gender bias in science policy and ensuring that science serves society in an equitable manner must become synonymous with sustainable strategies. Up-to-date, high quality statistics and studies which clearly spell out the need for government to address gender issues in science and technology empowers decision-makers to take effective action. If these do not exist, gender mainstreaming methods can be used to identify the gender gap and differential impacts of policies on society in time for policy makers to adjust their approaches.

Pre-requisite: Without women's human rights written into the laws of a country, very little ground may be gained trying to institute gender-based analysis. Legislation and regulations regarding gender equality should be reviewed to ensure that the fundamental rights of gender equality and equity are being honoured by the government.

Phase 2: Legitimation

Experience in gender issues must exist: Personnel trained in gender issues and analysis are essential to begin the process. If these do not exist, training may be available from the National Women's Machinery (NWM), NGOs or consultants. It is equally important to have gender expertise within science and technology departments, as it is to have science and technology expertise within NWM offices.

Figure 6 **Promoting Gender Equity through Government Structures**

Level of Government	Organisation and Assignment	Reports to:
Prime Ministerial	Request S&T Advisory Bodies to examine issues of gender in science and technology (e.g. Canadian NABST 'Winning with Women').	Prime Minister
Parliament	Require reporting by S&T departments and/or agencies on the outcome of the systematic implementation of GBA using indicators of success.	Parliament through Central Agencies such as the Auditor General or Treasury Board
Inter-departmental	Place gender as a routine agenda item on the agenda of inter-departmental committees on science (with representation from energy, agriculture, natural resources, environment, industry, health, etc.) and request regular updates on progress closing the gender gap.	Ministers of S&T and Secretaries of State for NWMs
Specialised Agencies	Bureau of Statistics should be requested to systematically collect sex-disaggregated data and make all statistics public. Offices of Intellectual Property Protection should include consideration of indigenous knowledge (IK) systems and develop initiatives to address IK and its gender dimension.	Published for public with other national statistics. Developed with aboriginal & indigenous peoples
S&T Departments	Gender Advisory Committees, Action Committees for Women's Issues and Focal Points should help monitor GBA implementation within their department, arrange for gender-sensitivity training, and make recommendations.	Deputy-Minister Assistant Deputy-Minister
Research Councils	Designated Chairs responsible for Women in Science, Technology, and Engineering should promote scholarships for promising female scientists, serve as role models and mentors and ensure GBA is performed on all research proposals (see Box 2, page 18).	S&T Ministers and Board of Directors
National Women's Machinery	Inclusion of S&T expertise into the NWM to ensure that status of women offices are facilitated in their undertakings to include research and action agendas in science including ethical issues arising from research in biomedical sciences and ICTs among others.	Secretary of State for Women's Affairs
Inter-Governmental	S&T Ministers should promote gender equity in economic arenas and regional policy fora such as APEC (see APEC Ministers Meeting in Korea) and collaborate with policy networks like the APEC Women Leaders Network (WLN) to advance regional attention to closing the gender gap in S&T and attaining a sustainable and equitable science system globally.	APEC, MERCOSUR, CARICOM, NAFTA, OECD, etc.

Championing the issue within government: Identify a 'champion' to spear-head the initiative, someone who is well-positioned within government (with regard to key decision makers) and who has the credibility and power to influence others and convince them of the essential need to mainstream gender concerns into government machinery. Because raising the profile of the issue with the government, and subsequent changes in budget and/or policy, may require submitting memoranda to Cabinet or discussion papers, having a champion at the ministerial or deputy-

ministerial level will be essential. A committee may need to be formed to do the groundwork and research and report to the champion.

Seize opportunities where gender can be moved forward on the policy agenda: Link a gender element to another issue which has already gained legitimation with policy-makers, such as human resource development or financial efficiency, to demonstrate how a gender-based analysis will improve the quality of policy and programmes.

Gender must be apparent in the allocation of staff, time and financial resources: Real resources are needed for decisions on mainstreaming gender to be fulfilled. Include gender-based analysis in the budget and plan of the department, which will raise its stature from a special-interest issue to standard operations.

Phase 3: Implementation/institutionalisation

In the case of science and technology, the implementation and institutionalisation will consist of the organisation of the following bodies, which will carry out the major actions to do with research and advocacy, policy and programme. Their work plans and reporting structures should be designed to achieve effective and efficient research and analysis of gender issues in science and technology and reporting of this, along with policy recommendations, to decision makers.

The NWM should collaborate with ministries responsible for science and technology in the staged implementation of a gender-based analysis process, including the development of tools, training materials and procedures, and the monitoring of the process itself. In so doing, the actors involved should draw on the experiences of other governments already using this approach and extensive resource materials developed world-wide. For example, gender-based analysis is being carried out by the governments of Australia, Canada and New Zealand.

Costs for implementing the gender-based approach should be within departmental allocations. These include customary operational costs such as training employees and conducting the analysis, both of which are part of ongoing business costs.

Phase 4: Monitoring and evaluation

Mainstreaming means that gender analysis becomes a permanent part of the planning and policy cycles. When gender-based analysis (GBA) is first being implemented, it should be scrutinised for its value to policy development in terms of staff time, budget, impact and obstacles. This evaluation will help to gauge whether GBA is truly being mainstreamed, what the barriers to this are and how they can be overcome in the next planning cycle. Measuring impact may be challenging since, like environmental impact assessments, the value comes in averting detrimental policies and outcomes. Furthermore, the rationale for policies that respect equity are fundamentally issues of human rights and justice more than human capital strategies. In any case, indicators should be clearly established to measure the effective and systematic use of the tool by all policy-makers.

Mainstreaming Gender in Science and Technology Research

In order to ensure that the research agenda supported by public funds is serving society in an equitable manner and that the impacts and beneficiaries are all clearly identified, GBA can be effectively employed by science and technology decision-makers to answer questions including:

- Have accommodations been made to include all the important informants in the research?
- Are the same questions asked of men and women?
- Is the language used appropriate, respectful and inclusive?
- Is the research based on sexist 'knowledge'?
- Does the research reflect a false hierarchy of characteristics and roles based on stereotypes of gender?

Have accommodations been made to include all the important informants in the research?
In order to include all the important informants in the research, consultations or focus groups need to be arranged at convenient times. Having these meetings at a time when only certain people can attend (e.g. during working hours, in the evening) means that the results will exclude the perspectives of those who could not attend. In communities where education for boys is favoured over that of girls, women's literacy rates will be lower than men's, and women will be less able to take part if interview methods require literacy and numeracy. The same may be said for different economic and ethnic groups within a society if access to education is unequal. And although one group may be able to speak about another, they cannot speak for them. This point is especially important when researching indigenous knowledge and technologies. It is also important that the appropriate person does the consulting. For example, in some cultures women are not able to speak freely and frankly to a man (and there may be cases where the reverse is true).

Are the same questions asked of men and women?
While women are often asked if they have conflicts between family and employment responsibilities, men are rarely asked this. Differential questioning will impose the researcher's own biases and assumptions regarding gender roles on the interviewees. The same question asked of women and men within the same context will often produce different answers, which is very significant and may lead to the creation of new knowledge on an issue.

Is the language used appropriate, respectful and inclusive?
If the research has been done in a way which provides sex-disaggregated data, the vocabulary should reflect this. In English, male terms are often used for generic references, such as 'mankind' instead of 'humanity'. As a rule, use sex-specific terms only for sex-specific references and generic terms only for generic references. If 'female-headed households' are meant, do not write 'one-parent households' which, although technically correct, obscures reality and the results of the research. If research has found parallel experiences between men and women, inclusive generic terms should be used. The same vocabulary should be used to describe equivalent characteristics and behaviours in women and men, girls and boys. For instance, calling a father working full-time the 'bread-winner', while calling a mother working full-time 'absent from children' is a reflection of the researcher's values. Where a profession has been male dominated, so that the title connotes a male professional, adding 'woman-' to the title makes women seem like anomalies. If it is necessary to say 'woman-scientist', 'female doctor', etc., the same should be done for men, i.e. 'male scientist' or 'male doctor'.

Is the research based on sexist 'knowledge'?
Previous knowledge on this topic must be questioned, since it may have been gender-blind or based on male experience and reality. How was this knowledge acquired? Were all perspectives incorporated or is this knowledge reflective of only one social reality? Probing the process which produced the knowledge may reveal that women's perspective has been omitted and that hence, what is known must be revised to take women's reality into account.

The lack of recognition of women's work has left them historically invisible in national census exercises. Women's work needs to be reframed from that of 'home-maker' to recognition of role of reproductive work in society (Waring, 1999). In a similar manner, rendering women's work visible in the rural sector requires recognition of their fundamental role in subsistence farming and food security. Women's innovations are often not apparent; and sometimes pirated and patented. The work of the Intermediate Technology Development Group (ITDG) in exploring women's indigenous innovations and video-taping women's inventions turned the spotlight on a much ignored source of innovation and knowledge.

Does the research reflect a false hierarchy of characteristics and roles based on stereotypes of gender?

For instance, in a study on occupational satisfaction, would it be assumed for a man that being a professional is most desirable and child-rearing would be least desirable, while for a woman, child-rearing would be assumed satisfactory and a professional career may be desirable but not necessary for occupational satisfaction? Choices and desires of women and men should be evaluated using equal standards, and the researcher should endeavour to reveal and break down such stereotypes.

6 Networks, On-line Resources and Selected Institutions

Networks

The variety of information available electronically on gender issues, and specifically on science and technology, is increasing at a phenomenal rate. International, national and regional associations aiming at facilitating global networking among women in the fields of mathematics, engineering, physics, chemistry, bioethics, computer sciences, information technology, medicine and veterinary medicine among other fields of study are numerous. There are special sites particularly tailored to young girls to provide role modelling, mentoring and discussion groups for the future generations. These sites have the goal to spur girls' interest in science and technology and encourage their active involvement.

Women'sNet

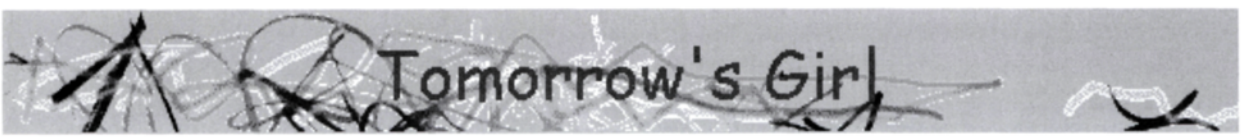
Women sNet is a vibrant and innovative networking support programme designed to enable South African women to use the Internet to find the people, issues, resources and tools needed for women s social action.

NEW COMMUNICATION TECHNOLOGIES

Women sNet is particularly interested in supporting South African women s access to new communication technologies. This page collects resources and information on this topic, with a particular focus on South Africa, Africa, and developing countries.

Articles ◆ Organizations ◆ Bibliographies & Book Reviews ◆ Directories & Databases ◆ Gender & Information Technology Discussion Lists ◆ Telecommunication Policy & Infrastructure

Website: http://www.womensnet.org.za



Tomorrow's Girl isn't any one girl, or any certain type of girl . . . **Tomorrow's Girl** isn't about the way to dress, or what friends to choose, or what things to say to be cool, or what TV shows to watch . . . **Tomorrow's Girl** is about the wonderful ideas, creativity, and fun and laughter within every girl . . . young and old. **Tomorrow's Girl** is about being proud of the things you've done, about being smart and happy with it, about liking school and school activities, and about using technology to communicate your ideas to other young girls.
Website: http://www.tomorrow's-girl.com

On-line Resources

Among the most common on-line resources are focus groups and chat rooms offering subscribers the possibility to tap into global exchanges with experts, share insightful discussions on common interest as well as topics of concern for women covering a wide range of themes within science and technology. Some topics include contemporary reproductive technologies, women and the new global information and communications technology, what constitutes women-specific training on computer sciences, women in evolutionary biology, women in neuroscience, women in physics, mathematics, and engineering, women as web developers, and women ecologists. A number of sites offer mentorship to young professionals.

WEPAN Women in Engineering Programs & Advocates Network

WEPAN is a non-profit educational organisation founded in 1990. WEPAN has a membership of 500 and is led by a 21-person board of directors from academia and industry. Over three million dollars has been raised in support of WEPAN's mission.

Mission: The mission of WEPAN is to be a catalyst for change that enhances the success of women in the engineering professions.

Values: Collegiality/Teamwork • Professionalism • Diversity • Respect • Entrepreneurship • Volunteerism • Integrity

Vision: By the year, WEPAN will be the recognised leader in effecting systemic change to achieve gender equity in engineering education and employment.

Send mail to WEPAN at wiep@ecn.purdue.edu
http://www.engr.washington.edu/~wepan/

Also included within on-line resources are sites dedicated to celebrating the history of women in science. These present biographies of women who had a highlighting role in science and technology. They contain numerous articles, comprehensive lists of bibliography, literature reviews, and research information outlining who is doing what and where. Some exciting sites also include job searches, useful tips, they advertise conferences, and display selected reports from international organisations.

4000 Years of Women in Science

- BIOGRAPHIES: Women who have shaped the world of Science
- PHOTOGRAPHS: Gallery of pictures
- REFERENCES: Extensive lists of references

The Hymn to Ishtar Tablet, Nippur C. 1750 B. C. E." from the University of Pennsylvania Museum, Philadelphia (Neg. #S8-80401)

http://crux.astr.ua.edu/4000WS/4000WS.html

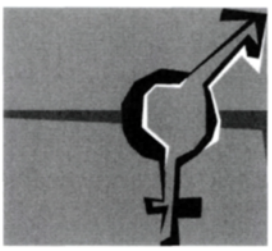
Selected institutes, centres of study and international organisations

Universities internationally are becoming very active in the scholarship of gender, science and technology. They provide governments a rich resource of scholarly research and recommendations to underpin policy reform. Governments should intentionally reach out to universities and seek their partnership and collaboration.

Feminist UNIVERSITY Network

WOMEN'S CENTRES AND
WOMEN'S STUDIES RESOURCES & PROGRAMS

http://www.feminist.org/campus/funstud.html



gender

Visit the Commonwealth

The Commonwealth's vision and mandate is to work towards a world where women and men have equal rights and opportunities in all stages of their lives.

You will find information on the Commonwealth's core activities defined by the 1995 Commonwealth Plan of Action on Gender and Development.

These activities include:
- Gender mainstreaming;
- Economic empowerment through gender aware budgets;
- Democracy and women's participation in decision-making;
- Respect for human rights; and
- Women's potential role in peace building and conflict resolution.

http://www.thecommonwealth.org/gender

United Nations agencies also have focal points dedicated to Gender, Science and Technology. UNIFEM, the UN Voluntary Fund for Women, co-ordinates an interagency committee that meets on a regular basis to exchange ideas and best practices on gender, science and technology.

The 1995 report of the UNCSTD was the product of a gender working group which included a review of the performance of United Nations agencies in the domain of gender, science and technology. The report provided a set of recommendations to ensure an adequate gender analysis and assessment into the design of science and technology policies, programmes and projects. The set of recommendations outlined in the report include the need for UN agencies to ensure that gender, science and technology is formally incorporated into policy; the need for UN agencies to actively recruit professional women into high-level posts with strategic importance for science and technology and explicitly generate programmes for their retention and re-entry; the need for the UN to give full support interagency networking on gender, science and technology; and finally the need to recognise the value of collaborating with NGOs.

Governments should seek to benefit from the wealth of knowledge and work undertaken by UN agencies through their experts.

Gender Advisory Board
UN Commission on Science and Technology
for Development
(UNCSTD)

The Gender Advisory Board was established in 1995 to provide advice to UNCSTD. The board consists of six international gender experts, appointed by the Secretary General.
Seven key transformative actions emerged from the expert advisory reports commissioned by the Gender Working Group. These are:

1. Gender equity in science and technology education
2. Removing obstacles to women in scientific and technological careers
3. Making science responsive to the needs of society: the gender dimension
4. Making the science and technology decision-making process more 'gender aware'
5. Relating better with 'local knowledge systems'
6. Addressing ethical issues in science and technology: the gender dimension
7. Improving the collection of sex-disaggregated data for policy makers

Excellent site to visit: http://gab.wigsat.org/uncstd.htm

Aboriginal women's sites

Status of Women Canada **Condition féminine Canada**

Resources for Indigenous Women around the World

Website: http://www.nativeweb.org/resources/women

Federal Governments and National Women's Machineries

Several Commonwealth governments have developed websites sponsored by their NWM, which contain Gender-based Analysis, guidelines and numerous other gender analysis tools that can be widely shared by other governments.

Gender-based Analysis [GBA]

Français	Contact Us	Search	Home	SWC Site
GBA	What's New	Events	Resources	Links

GBA **Gender-based Analysis**

Gender-based analysis is a tool for understanding social processes and for responding with informed, effective and equitable options for policies, programs and legislation that address the needs of all Canadians.

When gender is explicitly considered as a category of analysis, information on the actual realities of women and men, girls and boys, is presented so that similarities and differences can be examined. In addition, information on the nature of relationships in the family, society and the economy is revealed.

Using gender-based analysis means taking into account this information in exploring how policy options could impact on individual women and men, and on societal structures. This contributes to an enhanced knowledge base for decision-makers.

Canada http://www.swc-cfc.gc.ca/gba-acs/english/about.html

List of Websites

CATEGORY	CHARACTERISTICS	WEBSITE
I. SELECTED SCIENCE AND TECHNOLOGY NETWORKS		
Asia-Pacific Economic Co-operation (APEC) Women Senior Leaders' Network	Proposes mechanisms for integrating gender as a crosscutting concern in APEC	http://www.apecsec.org.sg
Association for Women in Science	Dedicated to achieving equity and full participation for women in science, mathematics, engineering and technology	Tel: 202-326-8940 http://www.awis.org
ENERGIA	International network on Women and Sustainable Energy	Contact: Sheila Oparaocha Tel: 31-(0)33-432-6044 Fax: 31-(0)33-494-0791 http://www.energia.org
FAB (Feminist Approaches to Bioethics)	Aims to develop a more inclusive theory of bioethics encompassing the standpoints and experiences of women	http://www.uncc.edu/fab/text.html
Gender and Science and Technology Association (GASAT)	International association concerned with issues arising from interactions between gender and science and technology	Contact Jayshree Mehta Tel: 91-79-412422 Fax: 91-79-663-6386 http://www.gac.edu/~simpson/gasat/homepage.html
International Federation of Inventors' Associations – Women Inventors Network (IFIA-WIN)	Aims to develop co-operation among women inventor associations and encourage the participation of women and girls in the fields of science and technology	Contact: IFIA Secretariat Fax: 41-22-789-3076 http://www.invention-ifia.ch/ifiawin.htm#top
WIGSAT – Women in Global Science and Technology Network	Designed to increase international networking among women scientists and technologists, especially help promote information-sharing with and among women from developing countries	Contact: Sophia Huyer Tel: 1-905-349-9962 Fax: 1-905-349-2066 http://www.wigsat.org/index.html
WITI: Women in Technology International	Offers news, articles, career info, calendar of events, job announcements, profiles of accomplished women in IT	http://www.witi.org/center http://www.witi.com
WomenAction	Global information, communication and media network that enables NGOs to actively engage in the Beijing+5 review process	http://www.womenaction.org
WomensNet, South Africa	Vibrant and innovative networking support programme designed to enable South African women to use the Internet to find the people, issues, resources and tools needed for women's social action	Tel: 27-11-838-6943/4 Fax: 27-11-492-1058 http://www.womensnet.org.za
Women in Information Technology	List of sites about and for women in the fields of library and information science, information technology, and computer science	http://www.womeninit.net/indexs.html
Women in Statistics	Home page of the Committee on Women in Statistics of the International Statistics Institute	http://laplace.cwru.edu/~mhr/isi/index.html

CATEGORY	CHARACTERISTICS	WEBSITE
Women Internet Researchers	Women who think and write about the Internet and its social implications	http://www.nicoladoering.net/women.html
Women's Network for the Technical and Vocational Education and Training Sector (WINVET)	Provides an electronic forum for the dissemination of current TVET information and discussion of issues, ideas and achievements in this field, and encourages women to be part of a professional forum for women in TVET	Contact: Ildi Szanto E-mail: ildi.szanto@cit.act.edu.au
	Engineering and/or Mathematics	
Association for Women in Mathematics	Nonprofit organisation dedicated to encouraging women in the mathematical sciences	http://www.awm-math.org
AWSEM – Advocacy for Women in Science, Engineering, and Mathematics	Brings together parents, educators and women professionals in science-related fields to kindle and support young women's interest in science, engineering, mathematics and technology	http://www.awsem.com/index.html
Committee on Women in Science and Engineering	Affiliated with the National Academy of Sciences, this site offers extensive links	http://www4.nas.edu/osep/cwse.nsf
IEEE – Women in Engineering	Offers information about membership, job openings, workplace issues, and related links	http://www.ieee.org/organisations/committee/women
IEEE WIE – Institute for Electronical and Electronics Engineers Women in Engineering Committee	Goals include the development of mentoring and educational programs, the publications of relevant information, and special initiatives	http://www.ieee.org/organisations/committee/women
MentorNet	National mentoring network for women in engineering and science	http://www.mentornet.net
NAE/CWE	National Academy of Engineering Committee for Women in Engineering	http://www.nae.edu/nae/cwe/cwe.nsf/Homepage/NAE+Celebration+of+Women+in+Engineering?OpenDocument
NSERC	National Science and Engineer Research Council – Chair for Women in Science and Engineer	http://www.geomatics.ucalgary.ca/cwse
Society of Women Engineers	Stimulates women to achieve full potential in careers as engineers and leaders	http://www.swe.org
SWE: Society of Women Engineers	Active organisation offering a wide variety of services and support to women interested in engineering	http://www.swe.org
WEPAN: Women in Engineering Programs & Advocates Network	Variety of valuable resources related to women and engineering	http://www.wepan.org
	Computer Sciences	
ACMW – Association for Computing Machinery Committee on Women in Computing	Engages in activities and projects that aim to improve the working and learning environments for women in computing	http://www.acm.org/women
Association for Women in Computing	Not-for-profit, professional organisation promoting the advancement of women in the computing professions	http://www.awc-hq.org
Committee on the Status of Women in Computing Research (CRA-W)	Includes a number of useful annotated links to sites/events/statistics of particular interest to women interested in computer science	http://www.cra.org/Activities/craw
SYSTERS	Designed for professional women in computer science, this is a place to organise efforts to change or influence policies affecting women in computer science	Contact: Dr. Anita Borg Tel: 650-812-4496 Fax: 650-812-4969 http://www.systers.org

CATEGORY	CHARACTERISTICS	WEBSITE
Wise-Women	Network dedicated to supporting women who work as, or aspire to become, web designers, developers, and programme	http://www.wise-women.org
SELECTED NETWORKS AND ON-LINE RESOURCES FOR GIRLS		
Against the Odds	'Dedicated to cool girls excited to learn and express their interest in science, technology, and entrepreneurship'	http://nrgen.com/against_the_odds /index.html
CyberSisters	Telementoring project that pairs middle school girls one-on-one with university women to engage more girls in math, science and computer technology	http://www.cyber-sisters.org
Donna Woodka's WWW Home Page	The Internet for Girls: Connecting Girls With Math, Science and Technology. Online topics/resources include encouraging girls in math and science; teaching and parenting with the Internet; online mentors and peer groups; connecting girls around the world; the Internet for girls themselves; Internet safety and etiquette; WWW resources; an annotated equity in education and bibliography	http://www.sdsc.edu/~woodka/ donna.html
Exploring Your Future in Math and Science	Designed for high school aged girls	http://www.cs.wisc.edu/~karavan/afl/ home.html
Girls and Women in Science	Beloit College programme to encourage girls' interest in science	http://www.beloit.edu/~gwsci/gws.html
GirlTECH: Getting Girls Interested in Computers	Collection of resources concerned with spurring girls' interest in mathematics and computer science	http://math.rice.edu/~lanius/club/ girls.html
Math, Science, and Technology Programs for Girls	Chart compiled by the American Association of University Women providing information about projects to improve girls' achievement in math, science, and technology	http://www.aauw.org/2000/models.html
SYSTERS-STUDENTS	Student-oriented version of the SYSTERS list (see above) for female graduate and undergraduate students in computer science	http://www-anw.cs.umass.edu/~amy/ systers.html
TeleMentoring Young Women in Science, Engineering & Computing	An NSF-funded project to build on-line communities of support among female high school students, professional women in technical fields, parents, and teachers	http://www.edc.org/CCT/telementoring
Testing 1, 2, 3; Technology to Girls: Hello?	Article by Corey Hitchcock about girls' often unenthusiastic attitude toward technology. Includes related links	http://www.sfgate.com/cgi-bin/article. cgi?file=/technology/archive/1998 06/22/girls.dtl
WattWorks: Science, Math, and Technology Programs for Girls	Extensive collection of links. Part of the Tomorrow's Girl website	http://www.tomorrow's-girl.com
Women of NASA	Designed to encourage more young women to pursue careers in science, math, and technology. Includes profiles of female scientists, ideas for integrating the site's information into the curriculum and an annotated bibliography. Aimed primarily at K-12, but useful also at the college level	http://quest.arc.nasa.gov/women
WOW'EM: Women on the Web – ElectronMedia	Aimed at high school and college age women who are interested in music, art, math, science, and computers, and ways to combine these interests	http://music.dartmouth.edu ~wowem
Pathways '97: Women in Science, Mathematics and Engineering	Designed to give young women an opportunity to learn about career options in science, mathematics and engineering	http://physics.bu.edu/pathways

CATEGORY	CHARACTERISTICS	WEBSITE
II. SELECTED ON-LINE RESOURCES		
CAWMSET: Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development	Established by the U. S. Congress in 1998 to research and recommend ways to improve the recruitment, retention, and representation of women, under-represented minorities, and persons with disabilities in science, engineering, and technology education and employment	http://www.nsf.gov/od/cawmset
Digital Divide	Highlights four major gaps in technology access and use: schools, gender, race, and the workplace	http://www.pbs.org/digitaldivide
Educational CyberPlayground (ECP)	Resources for women and minorities in science and technology	http://www.edu-cyberpg.com/Teachers/womenminoritiestech.html
Gender, Science and Technology Gateway (GSTG)	Gender Advisory Board is an advisory body to the United Nations Commission on Science and Technology for Development	http://gstgateway.wigsat.org/gw.html
GenTech	Applied research project whose mandate is to create conditions within which girls and women have maximum access to a wide range of new information	http://www.educ.sfu.ca/gentech
Wired Woman	Explores how technology affects women's lives – from our day-to-day challenges to the ways we interpret art, culture, and society	http://www.wiredwoman.com
	Information Technology (IT and ICT)	
Center for Women and Information Technology	Encourages women's and girls' greater involvement with information technology	http://www.umbc.edu/cwit
FACES	International mailing list that connects women activists, artists, critics, theoreticians, technicians, journalists, researchers, programmers, networkers, web designers, and educators	To subscribe, send a short narrative biography, a web link of your work (if you have one), and your full name and email address to Vali Djordjevic at valid@sero.org http://www.rpi.edu/~huffman/faces.html
Girl Geeks: The Source for Women in Computing	Multi-media exploration designed to motivate women and girls to pursue careers in information technology	http://www.girlgeeks.com
Women in Information Technology: An Infobrief	Catalyst, a non-profit organisation, has prepared this compilation of facts and statistics, with source documentation, concerning the underrepresentation of women in the IT workforce	http://www.catalystwomen.org/press/infobriefs/infombatech.html
Women in IT: Net Resources	Network World Fusion has put together this collection of reports, articles, forums, and organisations focusing on women in information technology	http://www.nwfusion.com/netresources/women.html
	Education	
Douglass Project for Rutgers Women in Math, Science, and Engineering	Extensive programme designed to encourage pre-college and college women to study math, science, and engineering	http://www-rci.rutgers.edu/~dougproj/index.html
Gender Equity in Education	Focuses primarily on gender equity in science and math and includes lessons to interest girls in these subjects	http://www.crpc.rice.edu/CRPC/GT/mborrow/GenderEquity/gendsite.html
SWIFT: Supporting Women in Information Technology	Canadian five-year research, action, and implementation project to increase the participation of women in information technology	http://taz.cs.ubc.ca/swift

CATEGORY	CHARACTERISTICS	WEBSITE
	Engineering, Mathematics and/or Physics	
Celebration of Women in Engineering	Designed to call attention to the opportunities and attractions that engineering offers women, it includes information about accomplished female engineers, educational resources, scholarships, a calendar of events and extensive links to related sites	http://www.nae.edu/nae/cwe/cwe.nsf/Homepage/NAE+Celebration+of+Women+in+Engineering?Open Documen
CCWEST – Canadian Coalition of Women in Engineering, Science and Technology	Resources for women and girls in science and technology in Canada	http://www.ccwest.org/english/ccwest.html
Committee on the Status of Women in Physics	Resources, including a speakers list of women in physics, a roster of women and minorities in physics, information about education and outreach programmes	http://www.aps.org/educ/cswp/index.html
Contributions of 20th Century Women to Physics	American Physical Society project documenting women who have made original and important contributions to physics in the 20th century	http://www.physics.ucla.edu/~cwp
Data on Women in Physics	Reports about the education and employment of women in physics and related fields	http://www.aip.org/statistics/trends/wmtrends.htm
WISET: Women into Science, Engineering, and Technology	Provides guides to resources [mostly in the UK] dealing with women's access, participation, and progress in science, engineering, and technology	http://www.shefc.ac.uk/publicat/others/wiset/guides.htm
Women and Minorities in Science and Engineering	Extensive, useful collection of links	http://www.mills.edu/ACAD_INFO/MCS/SPERTUS/Gender/wom_and_min.html
Women in Mathematics	Designed to serve the needs of women mathematicians, it offers advice for graduate students in math and the sciences, career information and related links	http://www.math.umd.edu/~wim
Women in Mathematics	Sponsored by CAMEL, the Canadian Mathematical Society, this site contains information and links of interest to women in mathematics	http://camel.math.ca/Women
Women in Math Project	Offers a valuable array of resources, including a collection of bibliographies; biographies of women mathematicians; job, grant, and scholarship opportunities for women in mathematics	http://darkwing.uoregon.edu/~wmnmath
Women in Science, Engineering, and Technology	British site offering information, support, and statistics to encourage more girls and women to pursue careers in science, engineering, and technology	http://www.set4women.gov.uk/set4women
Women's Issues & Gender Differences in Science and Engineering	Links to numerous studies and resources	http://web.mit.edu/ethics/www/ecsel/abstracts/women.html
	Computer Sciences	
Resources and Information for Women Planning to Major in Computer Science	Information about what computer science is, what preparation is needed to enter the field, why women are underrepresented, and what can be done to encourage more women and girls to study computer science	http://bluegrass.rs.itd.umich.edu/~
TAP: The Ada Project	Information and resources concerning women in computing	http://tap.mills.edu

CATEGORY	CHARACTERISTICS	WEBSITE
Women in Biology Internet Launch Page	Extensive, updated collection of links to sites offering information about female scientists, organisations for women in science, careers in science, and links to the bionet newsgroup women-in biology	http://pingu.salk.edu/~forsburg/bio.html
Women in Computing	Rich assortment of resources concerned with women in computing: academic and research programmes, bibliographies, articles, information about diversity, and professional organisations	http://faculty.washington.edu/marykirk
FOCUS GROUPS/CHAT ROOMS/LISTSERVES/DISCUSSION GROUPS		
Accessibility of Computer Science: A Reflection for Faculty Members	Computer Science professor Dianne P. O'Leary's insightful discussion of the chilly climate for women in computer science. Highly recommended	http://www.cs.umd.edu/~oleary/faculty
ACM's Committee on Women in Computing	Reflects ACM-W's interest in activities and projects that improve the working and learning environments for women in computing	http://www.acm.org/women
ASIA-WOMEN-IT	Forum for the discussion of issues and concerns relating to women in Asia and the new global information and communications technology	To subscribe, send the message SUBSCRIBE ASIA-WOMEN-IT <your e-mail address> to MAJORDOMO @LIST.INFOCOM.SEQUEL.NET
BIOFRAUEN	German-language information and discussion list for/about women in the biological sciences	To subscribe, send the message SUBSCRIBE BIOFRAUEN <your e-mail address> to MAJORDOMO @LISTS.UNI-MARBURG.DE http://stud-www.uni-marburg.de/~Nikoleyc
CCWEST – Canadian Coalition of Women in Engineering, S&T	List (and a site of resources) for women and girls in science and technology in Canada	To subscribe, send the message SUB CCWEST Your Name to LISTPROCESSOR@CUNEWS.CARLETON.CA http://www.ccwest.org/english/ccwest.html
CYBER-FEM	Moderated list. Draws upon current debates in feminist and science studies	To subscribe, send the message SUBSCRIBE CYBER-FEM to MAJORDOMO @HSPHSUN2.HARVARD.EDU http://www.hsph.harvard.edu/rt21
DAPHNET	E-mail network for and about women in science and engineering	To subscribe, send the message SUBSCRIBE DAPHNET to MAJORDOMO @IC.AC.UK
EWM-ALL	List that connects European women academic mathematicians	To subscribe, send the message JOIN EWM-ALL Firstname Lastname to MAILBASE@MAILBASE.AC.UK http://www.mailbase.ac.uk/lists/ewm-all
FIST (Feminism in/and Science and Technology)	Unmoderated list for discussion of feminism and science and technology	Send message with just "subscribe" in the Subject: line to FIST-REQUEST@NIESTU.COM.
GENDER-SET	List for discussion of research on gender, science, technology, and engineering (SET)	To subscribe, see web page at http://www.jiscmail.ac.uk/lists/gender-set.html
GRRLTALK	LinuxChix list for women who are interested in the GNU/Linux operating system, the Open Source Software movement, and/or the efforts of the Free Software Foundation	To subscribe, see web page at http://www.linux.org.uk/mailman/listinfo/grrltalk

CATEGORY	CHARACTERISTICS	WEBSITE
LINUX-WOMEN	List for women who play and work in Linux	To subscribe send email to LW-INFO@NIESTU.COM
MRSWOMEN	List for women in materials science and related fields	Send usual subscription message to LISTSERV@CMSA.BERKELEY.EDU
NOWA.INTERNATIONAL	International list for women who provide computer training to women	To subscribe, send email message to brigitte.hinteregger@nowa.at saying SUBSCRIBE NOWA.INTERNATIONAL in the message body. Include full name and email address
TECHTALK	LinuxChix list for technical discussion among women interested in Linux or in the Open Source Software movement	To subscribe, see web page http://www.linux.org.uk/pipermail/techtalk
WAM	List to assist members of Women and Mathematics keep in touch and share information	To subscribe, send the message SUBSCRIBE WAM to MAJORDOMO @MYSTERY.COM
WEBWOMEN-TECH	List for women involved in the technical side of managing web sites	To subscribe, send a message with just the word SUBSCRIBE in the Subject: header to WEBWOMEN-TECH-REQUEST@NIESTU.COM
WEPAN-L	E-mail list associated with WEPAN, Women in Engineering Program Advocates Network. WEPAN's purpose is to encourage more women to pursue careers in engineering	To subscribe to WEPAN-L, send the usual subscription message to LISTSERV@VM.CC.PURDUE.EDU http://www.engr.washington.edu/~wepan
WIC-LIST	List for members and interested parties of the British-based Women into Computing (WIC), an organisation set up by academics with input from industry to encourage women and girls into computing	To subscribe, see web page at http://www.jiscmail.ac.uk/lists/wic-list.html
WIENET (Women in Evolution Network)	Fosters networking among all people interested in the experience of women in evolutionary biology and science in genera	To subscribe to the list, send the message SUBSCRIBE WIENET Your Name to LISTPROC@WUGATE.WUSTL.EDU Note: the listname, WIENET, must be in all caps
WIGSAT-L	Focuses on international gender, science, and technology issues for NGOs, researchers, policy makers, and anyone interested in gender, science, and technology for development	To subscribe, send a message to WIGSAT-L@LIST.IFIAS.CA with the word SUBSCRIBE in the Subject heading
WIN (Women in Neuroscience)	List that links over 600 women neuroscientists throughout the world. It is affiliated with the Society for Neuroscience	To subscribe, contact Ivy Dunn at IDUNN@P300.CPL.UIUC.EDU
WINVET (Women's Network for Technical and Vocational Education and Training)	Established so that women involved in technical and vocational education in the Asia Pacific Region can access professional information and discuss issues, ideas, and achievements	To subscribe, send the message SUBSCRIBE WINVET to MAJORDOMO @SUNSITE.ANU.EDU.AU
WIPHYS	Moderated list for issues of concern to women in physics	To subscribe, send the message SUBSCRIBE WIPHYS to LISTSERV@APS.ORG.
WISENET	List for women in science, mathematics, and engineering	Send usual subscription message to LISTSERV@LISTSERV.UIC.EDU.
WiseScript	List for people interested in learning client-side JavaScript for use on web pages	To subscribe, see web page at http://www.wise-women.org/about/join

CATEGORY	CHARACTERISTICS	WEBSITE
WiseWomen	High-volume list (20-50 messages per day) which provides a supportive atmosphere to deal with issues of web development and consulting	To subscribe, see web page at http://www.wise-women.org/about/join
WITCH – Women in (the) Computing History	Seeks to augment traditional resources of women's history and histories of computing by being a repository for women's own stories throughout the history of computing	To subscribe, send a message to WITCH-REQUEST@NIESTU.COM with the single word SUBSCRIBE in the Subject header
WOMENINCOMPUTING	List for women interested in computing or working in the computing industry	To subscribe, see web page at http://groups.yahoo.com/group/WomenInComputing
WOMENINSCIENCE	List for women scientists from the United Kingdom and Switzerland	To subscribe, send the message SUB WOMENINSCIENCE to LISTSERV@MILEPOST1.COM http://www.milepost1.com/mailing/lists/WomenInScience.html
WOMENINWILDERNESS	List for discussing women who enjoy outdoors recreation such as mountain climbing, backpacking, scuba diving, wilderness homesteading, etc. and the careers open for women in the fields of natural science	To subscribe, see web page at http://groups.yahoo.com/group/womeninwilderness/join
WOMEN-IN-ECOLOGY	List for women ecologists in academic or related institutions primarily in higher education	For more information or to subscribe, see the WOMEN-IN-ECOLOGY web page at http://www.jiscmail.ac.uk/lists/women-in-ecology.html
Women in Technology	Listing of email lists focusing on women in technology, both local and national	http://www.topica.com/dir/?cid=2303
WOMUNSCI (WOMen UNdergraduates in SCIence)	List for discussing the issue of women's under-representation in science and what can be done to attract and retain women in the sciences, especially at the undergraduate level	To subscribe, send the message SUBSCRIBE WOMUNSCI Your Email Address (Your Name) [e.g., SUBSCRIBE WOMUNSCI janedoe@mycollege.edu (Jane Doe)] to MAJORDOMO @CS.UMASS.EDU
WORLDWIT	International alliance of email lists for women in technology	More information is available at http://www.worldWIT.org
WST-L	List focuses on women, science, and technology internationally	To subscribe, send an e-mail message to WST-L@LIST.IFIAS.CA with the word SUBSCRIBE in the Subject: line. For more information, write to the listowner at SHUYER@IFIAS.CA
WW-TALK	List where women web designers discuss matters off-topic for the WiseWomen list	To subscribe, see web page at http://www.wise-women.org/about/join
PUBLICATIONS: ARTICLES, BOOKS AND BIOGRAPHIES		
4000 Years of Women in Science	Biographies, bibliographic references, photographs, and links to related sites	http://crux.astr.ua.edu/4000WS/4000WS.html
Achieving Gender Equity in Science Classrooms: A Guide for Faculty	Handbook compiled by women science students, science faculty and staff at a consortium of New England colleges	http://www.brown.edu/Administration/Science_Education/Gender_Equity
Barriers for Women in Computing	1998 study at the University of Limerick [Ireland] that seeks to explain women's under-representation in computing and offers suggestions for how to effect change	http://www.ul.ie/~govsoc/barrierstw.html
Biographies of Women Mathematicians	Indexed alphabetically and chronologically	http://www.agnesscott.edu/lriddle/women/women.html

CATEGORY	CHARACTERISTICS	WEBSITE
Books about Women and Information Technology	Extensive, frequently-updated list of books about women and information technology	http://www.umbc.edu/cwit/cwitbooks.html
Books about Women and Technology	Bibliography dealing with women and technology	http://www.library.uiuc.edu/wst_tocs/impact.html
Computing, Diversity and Community: Fostering the Computing Culture	A talk by computer science professor Danielle Bernstein about how to attract and retain women in math, science, and, especially, computing	http://www.kean.edu/~dbernste/Pcsacm.html
The Construction of Gender at UBC Computing Services	Essay by Diane Currie, who works at the computing department at the University of British Columbia. The essay's relevance extends far beyond UBC	http://www.herplace.org/compgend.html
Contributions of 20th Century Women to Physics	American Physical Society project documenting women who have made original and important contributions to physics in the 20th century	http://www.physics.ucla.edu/~cwp
Data on Women in Physics	Page from the American Institute of Physics includes several reports about the education and employment of women in physics and related fields	http://www.aip.org/statistics/trends/wmtrends.html
Diversity in Engineering	1998 talk by William A. Wulf, president of the National Academy of Engineering, on the need for more women and underrepresented minorities in the engineering profession	http://www.nae.edu/nae/nae.nsf/NAE+Publications/Bridge/Diversity+in+Engineering
Educational Pipeline Issues for Women	A still timely article, written by Nancy Leveson in 1990, about the under-representation of women in computer science that does a very good job of setting forth the issues	http://www.ai.mit.edu/people/ellens/Gender/pipeline.html
Female Friendly Science: Including Women in Curricular Content and Pedagogy in Science	Full text of a 1990 article by Sue Rosser that discusses how changes in curricular content and teaching techniques may attract more women to science	http://watt.enc.org/online/ENC2289/2289.html
Gender and Electronic Discourse	Four hypertexts dealing with the effect of electronic discourse on gender and/or the effect of gender theory on electronic discourse	http://english.ttu.edu/kairos/2.2/coverweb
Gender in the Internet Age	The Winter 2000 issue of The CPSR Newsletter, edited by Ellen Spertus and Evelyn Pine, is devoted to exploring "how the Internet and other computing advances subvert or reinforce gender roles	http://www.cpsr.org/publications/newsletters/issues/2000/Winter2000/index.html
Gender Issues in Cyberspace	Chapter 7 of Anita Colyer's Penn State thesis, "A Trip through Cyber Cinema Fandom: The Ethnography of CINEMA-L"	http://www.outreach.psu.edu/users/afc1/thesis/eth.ch7.html
Graduate Women in Science – Sigma Delta Epsilon	Article written by Dr. Susan E. Feinman	http://www.gac.edu/People/orgs/gwis/gwisinfo.html
GREAT: The Effect of Computers on the Gender Gap in Education	Series of articles addressing gender inequality in the classroom, gender disparity in computer-related fields, and the introduction of computers into the classroom, as well as case studies, personal stories, and software reviews	http://www-cse.stanford.edu/classes/cs201/projects-97-98/gender-gap-in-education/index.html
The Incredible Shrinking Pipeline	Prof. Tracy Camp's 1997 paper discussing the declining ratio of women studying computer science as women move from high school to college to graduate school	http://www.mines.edu/fs_home/tcamp/cacm/paper.html
Improving the Graduate School Environment for Women in Computer Science	List of programmes and practices that enhance the quality of the graduate school experience for female graduate students in Computer Science	http://www.cs.washington.edu/homes/soha/GH/list.html

CATEGORY	CHARACTERISTICS	WEBSITE
Java, Women and the Culture of Computing	Paper by computer science professor Danielle Bernstein, published in July 1999	http://turbo.kean.edu/~dbernste/naccq.html
LiveWire: Computer Confidence for Women	A series of approximately 20 enjoyable, well-written columns by Rachel Adelson that explore "the ways that women can become confident and self-sufficient" in dealing with computers	http://www.awc-hq.org/livewire
No Girls Allowed!	Melissa Koch's 1994 article in *Technos Quarterly* describes factors that may cause some girls to turn away from technology	http://www.technos.net/journal/volume3/3koch.html
Reproductive Technologies Web: RT21	Harvard University's Global Reproductive Health Forum, this site offers articles on such issues as Teaching Science and Technology, Globalism and Development; the Medicalisation of Birth; and Race and Reproductive Technologies	http://www.hsph.harvard.edu/rt21
Research on Young Women in Computer Science: Promoting High Technology for Girls	Text of an invited presentation by Dr. Gail Crombie in 1999 to the annual meeting of the Professional Engineers of Ontario	http://cythera.ic.gc.ca/htos/allfemalecs
Stealing the Fire: Women Scientists in Fiction	Essay by Alison Sinclair in issue #47 of BioMedNet's HMS Beagle about the representation of women scientists in contemporary fiction. Followed by links to sites related to women in science	http://news.bmn.com/hmsbeagle/47/booksoft/essay.html
Talking about Leaving: Why Undergraduates leave the Sciences	Computer Science Professor Danielle R. Bernstein offers a summary of this 1997 book by Elaine Seymour and Nancy Hewitt, including a section on gender, along with her own response to the book and the reactions of others	http://www.kean.edu/~dbernste/sumseym.html
Tips for a Massive Academic Job Search	Document by computer science professor Ellen Spertus	http://www.mills.edu/ACAD_INFO/MCS/SPERTUS/job-search/job.html
Valley Girls: Women in Technology	Profiles and interviews with women who work in technology in Silicon Valley	http://www.newmedianews.com/032197/wit_home.html
Where have all the women gone – from computer science?	1998 paper by Dagny Stuedahl and Kristin Braa, Dept. of Informatics, University of Oslo	http://www.ifi.uio.no/~systarb/Jenter.og.IT/iris.html
Women and Computer Science	Ellen Spertus' collection of online papers [including Spertus' classic "Why Are There So Few Female Computer Scientists?"]	http://www.mills.edu/ACAD_INFO/MCS/SPERTUS/Gender/gender.html
Women and Girls Last: Females and the Internet	Janet Morahan-Martin's 1998 paper about the often problematic climate for women on the Internet. Includes reference to research about women and computing	http://sosig.ac.uk/iriss/papers/paper55.html
Women in Computing Newsletter	Articles and information for women in computing, including pieces on breaking the glass ceiling, why male mentors may pass over female candidates, 100 top women in computing	http://www.lantimes.com/wic/content.html
Women in Computer Sciences: Closing the Gender Gap in Higher Education	Research on how to attract and retain women students in computer science by Allan Fisher and Jane Margolis	http://www.cs.cmu.edu/afs/cs/project/gendergap/www/index.html
Women in Science	Annotated Bibliography of Women in Science	http://www.kings.edu/womens_history/emscience.html
Women in the Information Technology Workforce: A Virtual Workshop	Archives of a three-week online discussion sponsored by the National Science Foundation that took place in Fall 1999	http://www.interact.nsf.gov/cise/itwomen.nsf/alltopics?OpenForm
Women Inventors	Brief biographies of a number of women inventors, including some who are relatively obscure	http://www.inventorsmuseum.com/women.html

CATEGORY	CHARACTERISTICS	WEBSITE
Women: Lost in Cyberspace?	Essay by Kenyon College professor Laurie Finke calling attention to the loss of human agency in most accounts of the benefits of information technology and urging more attention both to feminist pedagogy and to information technology's impact on women	http://www.enhanced-learning.org/prox/paper5.html
Women, Minorities, and Persons with Disabilities in Science and Engineering	1994 National Science Publication	http://www.nsf.gov/sbe/srs/wmpdse94/start.html
Women Nobel Prize Laureates	Information and links about all women who have won the Nobel Prize; arranged by field, and then chronologically	http://www.almaz.com/nobel/women.html
CONFERENCES AND SELECTED REPORTS		
Gender Equity for Mathematics and Science	Account of a conference sponsored by the Woodrow Wilson Leadership Program for Teachers	http://www.woodrow.org/teachers/math/gender/
Is the Glass Half Full or Half Empty?	Report in *Scientific American* about a New York Academy of Sciences conference that celebrates the advances that women in science have made over the past 25 years and examines why disparities still exist	http://www.sciam.com:/explorations/1998/051898women/women.html
Report on the 3rd Grace Hopper Celebration of Women in Computing	Succinct, useful account of the Grace Hopper conference held in September 2000, with a focus on the under-representation of women in information technology, especially computer science	http://women.cs.uiuc.edu/events/GHC.html
Research Foundations for Improving the Representation of Women in the Information Technology Workforce	Extensive report arising from an NSF-sponsored 'virtual workshop' held in late 1999 which addresses causes of the under-representation of women in the information technology workforce	http://cise.nsf.gov/itwomen.html
Status of Women Faculty in Science at MIT: A Study	1999 report with recommendations for increasing the number of women and improving their professional lives at MIT – Massachusetts Institute of Technology	http://web.mit.edu/fnl/women/women.html
Tech-Savvy: Educating Girls in the New Computer Age	Summary of a report issued in 2000 by the American Association of University Women about many girls' lack of enthusiasm for computer science and technical careers	http://www.aauw.org/2000/techsavvy.html
UN CSTD (United Nations Commission on S & T for Development)	1995 report of the Gender Working Group for UNCSTD. Includes set of recommendations.	http://gab.wigsat.org/uncstd.html
Who Will Do the Science of the Future? A Symposium on Careers of Women in Science (2000)	Full text of a National Academy of Sciences symposium held in 2000	http://www.nap.edu/books/0309071852/html
Women in Science and Technology Conference (WIST)	Aims to support and encourage women in the pursuit of degrees and careers in S & T. More than 300 college and high school women, along with their professors and teachers, attend each year	http://www.ornl.gov/seer/special/wist.html
Women's Environment and Development Organisation (WEDO) Development (UNCED)	"Lighting the Path to Progress" Women's Initiatives and An Assessment of Progress since the 1992 United Nations Conference on Environment and	http://www.ecouncil.ac.cr/rio/focus/report/english/wedo.html
The 1997 Grace Hopper Celebration of Women in Computing	Post-conference media coverage	http://www.sdsc.edu/Hopper/

CATEGORY	CHARACTERISTICS	WEBSITE
ICWES – 12th International Conference of Women Engineers and Scientists	The Conference is being hosted at the Ottawa Congress Centre, in Ottawa, Ontario, Canada on July 27–31, 2002	http://www.carleton.ca/wise/icwes12/icwes12.html
III. SELECTED INSTITUTES, CENTRES OF STUDY AND INTERNATIONAL ORGANISATIONS		
AAAS (American Association for the Advancement of Science)	Aims to improve the quality of science, mathematics, and technology education, to increase participation of minorities, women, and people with disabilities in science and engineering and to improve public understanding of science and technology. Special focus on girls and women of all colours, backgrounds, and abilities	http://ehrweb.aaas.org/ehr/3_2_0a.html
Asia Institute of Technology (AIT): Gender and Development Programme	Regional institute of learning located in Thailand. One of the major objectives of the AIT Institute Plan is to promote the advancement of women and to strengthen their role in the development process	Tel: 66-2-524-5673/524-5668 Fax: 66-2-524-6166, 516-2126 http://www.ait.ac.th/AIT/schools/serd/gendev/conference.html
Feminist University Network	Women's Centres and Women's Studies Resources and Programmes	http://www.feminist.org/campus/funstud.html
Gender, Science and Development (GSD) Programme, IFIAS	Makes policy recommendations concerning the effects of science and technology on the lives of women. It emphasises North-South co-operation in understanding the role women play in the development and application of science and technology, and studies ways of increasing women's contribution to science and development	Contact: Sophia Huyer at shuyer@wigsat.org Tel: 1-905-349-9962 Fax: 1-905-349-2066 http://www.ifias.ca/gsd/gsdinfo.html
IDRC – International Development Research Centre – Gender and Sustainable Development (GSD) Unit	Works to integrate a gender perspective into all IDRC programmes and initiatives	http://www.idrc.ca/gender
Institute for Women and Technology	Organisation whose mission is to increase the impact of women on technology and to increase the positive impact of technology on women's lives	Contact: Anita Borg Tel: +1 650 812 4496 Fax: +1 650 812 4969 http://www.iwt.org
Institute for Women in Trades, Technology, and Science (IWITTS)	Dedicated to integrating women into non-traditional careers by providing training, technical assistance, and publications to schools and publications to schools and employers	http://www.iwitts.com
IITA – International Institute of Tropical Agriculture – Gender Analysis	Aims to enable readers to explain the objectives of gender analysis, discuss the reasons for gender analysis, identify gender roles, identify needs and constraints faced by women under different situations and analyse your own work for gender sensitivity	http://www.iita.org/publib/trn_mat/irg58/irg581.html
Moscow Centre for Gender Studies (MCGS)	Non-governmental, non-profit research and cultural institution. Women scholars with strong feminist orientation were brought together by their mission to promote gender research and to withstand gender discrimination	http://www.neww.org/fsuwomen/moscow.html
National Women Studies Association	Supports and promotes feminist/womanist teaching, learning, and research	http://www.nwsa.org
NGO Committee on the Status of Women, New York	The NGO Committee on the Status of Women in New York provides a forum for the exchange of information on gender issues that are under consideration by the UN system	http://www.womenact.org

CATEGORY	CHARACTERISTICS	WEBSITE
Third World Organisation for Women in Science (TWOWS)	Independent, non-profit and non-governmental body based at the offices of the Third World Academy of Sciences (TWAS), Italy. Forum aims to unite eminent women scientists from the South and promoting them as S&T leaders	Contact: TWOWS Secretariat Tel: 39-040-2240-321 Fax: 39-040-224559 E-mail: info@twows.org
UNIFEM – Women Making a Difference in S & T	Publication prepared by UNIFEM. Result of a literature search and a survey	Case Studies Websites: http://www.unifem.undp.org/wmdst/ http://www.unifem.undp.org/ec_tech.html
The United Nations – Commission on the Status of Women	One of the first bodies established by the UN Economic and Social Council. Since 1946, it has monitored the situation of women and promoted their rights around the world	http://www.un.org/Conferences/Women/PubInfo/Status/Home.html
Women and the Web: Navigating the Cyber Revolution	Audio and video broadcast of a conference held at Radcliffe College in October 2000	http://www.radcliffe.edu/alumnae/calendar/council.html
Women in Computing Academic Resource	Includes a compilation of colleges and universities that have formal and/or informal programmes for encouraging/retaining women in computer science	http://www.womenswork.org/wcar
IV. SELECTED ABORIGINAL WOMEN'S SITES		
Sapa Dawn North American Indian Lodge	Janet McCloud has written, travelled, and spoken on Indigenous Rights, issues of Indigenous women, and Indigenous Religious Freedom	http://www.alphacdc.com/sapadawn
Native Web	Resources for Indigenous Cultures around the World on women issues	http://www.nativeweb.org/resources/women
Women and Girls' Tech Up	Aims to encourage women and girls – and the organisations which serve them – to use technology to share ideas, opinions, support, creativity and political action	http://www.techup.org
V. SELECTED FEDERAL GOVERNMENTS AND NATIONAL WOMEN'S MACHINERIES		
Australia	Role is to advise the Prime Minister, to develop policy and influence Cabinet and Budget decision-making to ensure women's interests are considered	http://osw.dpmc.gov.au
Canada	Canada's commitment to implementing gender-based analysis is articulated in "Setting the Stage for the Next Century: The Federal Plan for Gender Equality" (1995–2000), which was presented at the Fourth UN World Conference on Women.	http://www.swc-cfc.gc.ca/gba-acs/english/about.html
Ghana	The report is available from the National Council on Women in Development, Accra, Ghana. Published by Freiderich Ebert Foundation, Accra, Ghana, August 1995	http://www.worldbank.org/afr/gender/nbprjgha.html
Iran	Women in Iran – A look at President Khatami's first year in office	http://www.uri.edu/artsci/wms/hughes/khatami.html
North West Territories, Canada	The mandate of the Council is to work towards the equality of women in the NWT through advice to the Government of the NWT; research; public education; advocacy on behalf of women; and assistance to women's groups	http://www.statusofwomen.nt.ca
The Status of Women in Islam	Paper written by Jamal A. Badawi	http://www.iad.org/books/S-women.html
The Philippines	Selection of articles on the status of women in the Philippines	http://www.univie.ac.at/Voelkerkunde/apsis/aufi/statwom.html

7 Tools

Creating Enabling Environments

The following checklist has been adapted from a list identified by the UNESCO 1996 World Science Report of places for policy intervention in order to eliminate overt and covert bias in organisations. The introduction of gender-sensitive policies and programmes in an organisation's cycle of hiring, training, promoting, re-entry and re-skilling can ensure equity through the creation of a gender-inclusive institutional environment. The aim is to remove systemic barriers that inhibit the full participation and contribution of women.

A. Assessment of the environment:

1. Have institutional self-evaluation questionnaires been conducted?
2. Has there been a climate evaluation?
3. Have monitoring surveys been conducted?
4. Are there clear centres of responsibility for equity evaluation, monitoring and reporting?

B. Recruitment

1. Are positions advertised openly and competitively?
2. Are pro-active search techniques used to seek qualified female candidates, using women's professional science and technology networks, other NGOs and the Internet?
3. Are the interviewing teams and recruitment committees gender balanced?
4. Are gender-neutral interviewing techniques, language and formats used?
5. Are targets in place for proactively hiring qualified female professionals?
6. Are study fellowships available to women?

C. Retention

1. Is there a corporate policy on gender with senior management support?
2. Are there equity action plans?
3. Are there enforced corporate policies on sexual harassment?
4. Are there corporate guidelines on language, illustrations and visual materials?
5. Are there high visibility ombudspersons and women represented on grievance committees?
6. Have women been appointed to powerful and high visibility committees?
7. Is there institutional support for professional science and technology women's networks and Internet groups?
8. Are role model and mentoring programmes recognised and supported?
9. Are there supportive employment programmes for spouses and partners?
10. Are there on-site child care facilities and assistance with 'elder care'?

D. Promotion

1. Are there flexible tenure and promotion criteria?

2. Is there succession planning and career counselling?
3. Have equity targets been set with timelines and statistical tracking?
4. Is there regular public reporting of corporate performance?
5. Has a pipeline of female candidates been created?
6. Is the performance appraisal system gender neutral and bias free?

E. Re-entry

1. Is there scope for flexi-time, flexi-location and job sharing?
2. Is there a return to work directory on refresher courses, child-care options, mentors, role models and career counselling?
3. Are there career-break schemes and re-entry courses?
4. Is there a child-care allowance for applicants?
5. Are there progressive parental leave policies?

F. Training and Development

1. Is there gender sensitivity training for teachers, students and staff?
2. Has the curriculum been revised to remove gender biases?
3. Are the language, images and visual illustrations used gender-neutral?
4. Are the diverse ways of doing science and differing gender patterns in communication and learning styles taken into account?
5. Is training provided on gender, interviewing techniques, combating harassment, etc.?
6. Are there executive level internships for women?

G. Separation

1. Are separation packages gender equitable?
2. Are exit interviews conducted with women?

H. Pay and Funding

1. Is there pay equity?
2. Is there equity in research funding?

Structures and Links Survey

This questionnaire is intended as a stepping stone to render visible structure and linkages of gender in science and technology in various government ministries.

Section A: Institutional/Ministerial Structures and Links

1. Does your country have a Department, Ministry or Council that promotes women's affairs in Science and Technology?

2. Does it have a gender focal point/person?

3. Does the Science and Technology Department, Ministry or Council in your country have a corporate gender policy?

4. Does the Department, Ministry or Council have a 'Human Resource Development' (HRD) policy which pertains to women in science and technology or gender?

5. How does the Department, Ministry or Council do gender-based analysis (GBA) on its policies?

6. Does your country have any national programmes that deal with 'local knowledge'? (for example: programmes that deal with traditional methods in farming or medicine). If so, in what way do they acknowledge women's indigenous knowledge?

7. How does your country support women's participation in sustainable development?

8. What training programmes does your country have to promote effective use of natural resources? Does your country collect data on women's participation in these programmes?

9. Do Science and Technology Departments, Ministries or Councils use graphics, visuals and languages in their journals, videos and newsletters that represent women as actively and as often as they represent men?

Section B: Research Agencies/Granting Councils: Structures and Links

1. Does your country have any research agencies or granting councils, such as a Social Sciences Council or an Engineering or Hard Sciences granting council that purposefully promotes women's participation?

2. Does the agency or council have a corporate policy for gender?

3. Does the agency or council have a gender focal point/person?

4. Does the agency or council have a human resource development policy that addresses recruitment, retention and promotion of women in science and technology?

5. Does the agency or council collect statistics on what portion of the funds are awarded to women?

6. Does the research agency or council use gender neutral or gender inclusive vocabulary and visuals in published materials?

7. Has the research agency or council ever given grants for scholarship on women in science or gender issues in science and technology?

8. What measures does your government have in place to ensure/ increase women's participation in science and technology education?

9. What opportunities are available for women scientists to publish their findings?

10. What type of training does your country provide to eliminate sex stereotyping in the media and how visible are female engineers and scientists in the media?

11. Does the agency or research council maintain data on the differential impacts of its policies and programmes on the lives of women and men respectively?

12. If so, what tool is used to determine the differential impacts?

13. Does the agency or council measure whether the results of these projects benefit men and women equally?

14. What type of scholarships and awards are available to women wanting to pursue a career in science and technology?

15. Does the agency or council sponsor role model or mentoring programmes?

Section C: Interdepartmental Links and Structures

1. Does your country have interdepartmental links or structures such as an inter-departmental 'Gender in Science and Technology' committee dedicated to gender mainstreaming?

2. Does the Ministry for Women or Women's Affairs in your country consider science and technology when developing policy?

3. Conversely, does the Science and Technology Department in your country consider gender when developing policy?

4. Has your country worked with other Commonwealth countries in developing gender in science and technology policies?

Section D: Government to NGO Links and Structures

1. Does your Science or Industry Department work with women-based NGOs in civil society?

2. Do government agencies or ministries work with NGOs such as an Association of Women in Engineering when developing policy?

3. How do NGOs ensure women's control over technology and what roles do NGOs play in promoting women in science and technology?

4. Is there co-ordination between government, NGOs and research and development agencies in the formulation of a clear and national policy for women in science and technology?

5. Does your government partner with existing national grassroots women's organisations to introduce and popularise new technology among women?

6. If so, how is this done?

References

APC Women's Programme (1997). 'Global Networking for Change: Experiences from the APC Women's Programme'. Report by the Association of Progressive Communications Women's Programme, 1997.

Appleton, Helen E. (ed.) (1995). *Do It Herself: Women and Technical Innovation*. London: Intermediate Technology Publications.

Appleton, Helen E., Maria E. Fernandez, Catherine L.M. Hill and Consuelo Quiroz (1995) in UNCSTD-Gender Working Group: *Missing Links: Gender Equity in Science and Technology for Development*. Ottawa: IDRC and London: Intermediate Technology.

Ariyabandu, Madhavi Malalgoda (1999). *Defeating Disasters: Ideas for Action*. Sri Lanka: Intermediate Technology Development Group, on behalf of Duryog Nivaran.

Canadian Royal Commission on NRGTS, 'Setting Boundaries, Enhancing Health'.

Carr, Marilyn (2000). 'Gender, Science and Technology for Development in the Context of Globalization', in *AWIS Magazine*, Volume 29, Number (4) pp 13–16, Fall 2000.

Commonwealth Secretariat (1999). *Gender Management System Handbook*. London: Commonwealth Secretariat.

Elson, Diane (2000). *Progress of the World's Women 2000*. New York: UNIFEM.

Everts, Saskia (1998). *Gender and Technology: Empowering Women, Engendering Development*. London: Zed Books.

Farhar, Barbara C. (2000) *Progress on Linking Gender and Sustainable Energy*. Colorado: National Renewable Energy Laboratory.

Harding, Jan (2000a). 'Gender Issues in Science and Technology' in *Commonwealth Secretariat: Paths to Prosperity: Science and Technology in the Commonwealth 1999/2000*. London: Commonwealth Secretariat.

——— (2000b). 'Gender and Science Education' in Commonwealth Secretariat: *Paths to Prosperity: Science and Technology in the Commonwealth 1999/2000*. London: Commonwealth Secretariat.

Hays, Irene D. and Barbara C. Farhar (2000. 'The Role of Science and Technology in the Advancement of Women Worldwide'. NREP/TP-820–28944. Golden, CO: National Renewable Energy Laboratory. http://www.nrel.gov/docs/fy01osti/28944.pdf .

International Network on Women and Sustainable Energy (1997). *Energia News*, Issue 2, May 1997.

International Women's Tribune Centre and UNIFEM (1996). 'At a Glance: Science and Technology in the Platform for Action'. New York: IWTC and UNIFEM.

International Women's Tribune Centre (1997). *The Tribune: Reclaiming Women's Knowledge: Reenvisioning Science and Technology*. No. 57 July 1997. New York: IWTC.

——— (1998). *Rights of Women: A Guide to the Most Important UN Treaties on Women's Human Rights*. New York: IWTC.

Kennedy, Ian (1991). *Treat Me Right: Essays in Medical Law and Ethics*. New York: Clarendon Press.

Kettel, Bonnie (1995a) 'Key Paths for Science and Technology: On the Road to Environmentally Sustainable and Equitable Development', in UNCSTD-Gender Working Group: *Missing Links: Gender Equity in Science and Technology for Development*. Ottawa: IDRC and London: Intermediate Technology.

——— (1995b) 'Gender and Environment: Lessons from WEDNET', in R. Blumberg *et al.*, Engendering Wealth and Well-being, Westview.

McTeer, Maureen (1999). *Tough Choices: Living and Dying in the 21st Century*. Canada: Irwin Law.

McGregor, Elizabeth (1996). 'Gender and Science and Technology in Knowledge-Based Economies: Some Considerations for APEC'. Discussion paper for the Ministerial Forum at the 1st Ministerial Meeting on Regional Science and Technology Co-operation, Seoul, Korea, November 1996.

Mansell, Robin and Uta When (1998). Knowledge Societies: Information Technology for Sustainable Development. Oxford: Oxford University Press.

Marcelle, Gillian M. (2000). Transforming Information and Communications Technologies for Gender Equality. Gender in Development Monograph Series #9. New York: UNDP.

Mitter, Swasti (1998). 'On Questioning the Globality of Knowledge: Information Society and Women's World', paper presented at the AIT-GASAT Regional Conference on Gender and Technology in Asia, 4–7 August, Bangkok.

Mulvaney, Patrick (2000). 'Agricultural Biodiversity and Food Security' in Commonwealth Secretariat: *Paths to Prosperity: Science and Technology in the Commonwealth 1999/2000*. London: Commonwealth Secretariat.

Muntemba, Shimwaayi and Ruvimbo Chimedza (1995), 'Women Spearhead Food Security' in UNCSTD-Gender Working Group: *Missing Links: Gender Equity in Science and Technology for Development*. Ottawa: IDRC and London: Intermediate Technology.

N'Dow, Wally (1995). Foreword to *Women in Human Settlements Development: Getting the Issues Right*. Nairobi: UNCHS(Habitat).

Ofir, Zenda (2000). 'Women: An Underutilised Resource in Science and Technology' in Commonwealth Secretariat: *Paths to Prosperity: Science and Technology in the Commonwealth 1999/2000*. London: Commonwealth Secretariat.

Rathgeber, Eva M. (1995) in UNCSTD-Gender Working Group: *Missing Links: Gender Equity in Science and Technology for Development*. Ottawa: IDRC and London: Intermediate Technology.

Rathgeber, Eva M. and Edith Ofwona Adera (eds.) (2000). *Gender and the Information Revolution in Africa*. Ottawa: IDRC.

Twigg, John (Ed.) (1997). *Development at Risk? Natural Disasters and the Third World*. London: UK National Co-ordination Committee for the International Decade for Natural Disaster Reduction.

UNCHS (HABITAT) (1996). *Gendered Habitat: Working with Women and Men in Human Settlements Development*. Nairobi: UNCHS.

UNCSTD-Gender Working Group (1995). *Missing Links: Gender Equity in Science and Technology for Development*. Ottawa: IDRC and London: Intermediate Technology.

United Nations Development Programme (1998). *Human Development Report*. UNDP: New York.

UNESCO (1995). *World Education Report*. Paris: UNESCO.

—— (1999). 'Declaration on Science and the Use of Scientific Knowledge and the Science Agenda-Framework for Action'. Paris: UNESCO

UNIFEM (1996). 'Report of the Expert Group Meeting on Development of Guidelines for the Integration of Gender Perspectives into United Nations Human Rights Activities and Programmes'. Geneva, 307 July. E/CN.4/1996/105.

—— (1999). 'Women Making a Difference in Science and Technology: Case Studies'. New York: UNIFEM.

United Nations (2000). The Report of the Ad Hoc Committee of the Whole of the 23rd Special Session of the General Assembly, 'Further actions and initiatives to implement the Beijing Declaration and Platform for Action' (A/S-23/10/Rev.1). New York: United Nations.

Walker, Bridget (1996). 'Integrating gender into emergency responses' in *BRIDGE (briefings on development and gender)* Issue 4. UK: Institute of Development Studies.

Waring, Marilyn (1999). *Counting for Nothing: What Men Value and What Women are Worth*. Blah: Blah (2nd edition).

Wee, Vivienne (1995a). 'Women and Sustainable Livelihoods' in Noeleen Heyzer (Ed.) *A Commitment to the World's Women: Perspectives for Development for Beijing and Beyond.* New York: UNIFEM.

—— (1995b). 'Securing our Gains and Moving Forward to the 21st Century', a position paper by DAWN for the Fourth World Conference on Women, Beijing.

WEDO (1995). Who Owns Knowledge? Who Owns the Earth? Intellectual Property Rights and Biodiversity under the new GATT and World Trade Organisation. Primer No. 5. New York: Women's Environment and Development Organisation.

Appendix 1 *Glossary of terms*

Gender

Gender can be defined as the set of characteristics, roles and behaviour patterns that distinguish women from men. These characteristics are constructed not biologically but socially and culturally. The sex of an individual is biologically determined, whereas gender characteristics are socially constructed: a product of nurturing, conditioning and socio-cultural norms and expectations. These characteristics change over time and vary from one culture to another. Gender also refers to the web of cultural symbols, normative concepts, institutional structures and internalised self-images which, through a process of social construction, define masculine and feminine roles and articulate these roles within power relationships.

Gender analysis

Quantitative gender analysis is the collection and analysis of sex-disaggregated data which reveals the differential impacts of development activities on women and men, and the effect gender roles and responsibilities have on development efforts. Qualitative gender analysis is the tracing of historical, political, economic, social and cultural forces in order to clarify how and why these differential impacts, roles and responsibilities have come about.

Gender-aware/redistributive/transformative policies

Gender-aware/redistributive/transformative policies seek to transform existing gender relations by changing the distribution of resources and responsibilities to make it more equitable. These policies involve altering the existing balance of power between men and women, addressing not only practical gender needs but strategic gender interests as well.

Gender-inclusive language

This is language which challenges the assumption/tradition that masculine nouns, pronouns and adjectives include both male and female. Examples of gender-inclusive language are 'staff-hours' (rather than 'man-hours'), 'chairperson' (rather than 'chairman') and 'he or she' (rather than 'he'). Gender-exclusive language, by subsuming the female in the male, acts as both a cause and an effect of the invisibility of women's contribution.

Gender mainstreaming

This term may be conceptualised in two different ways: on the one hand it is an integrationist strategy which implies that gender issues are addressed within the existing development policy, strategies and priorities. Hence, throughout a project cycle, gender concerns are integrated where applicable. On the other hand, mainstreaming also means agenda-setting, which implies the transformation of existing development agenda using a gendered perspective. These two concepts are not exclusive and actually work best in combination.

Gender-neutral policies

These are policies that are seen as having no significant gender dimension. However, government policies seldom if ever have the same effect on women as they do on men,

even if at first sight they may appear to exist in a context where gender is irrelevant. Thus, policies which may appear to be 'gender-neutral' are often in fact 'gender-blind', and are biased in favour of males because they presuppose that those involved in and affected by the policy are males, with male needs and interests. An example would be

Gender perspective

Gender perspective is a way of (a) analysing and interpreting situations from a viewpoint that takes into consideration the gender constructions in society (for women and men) and (b) searching for solutions to overcome the gaps.

Gender-sensitive indicators

An indicator is a statistical measurement that shows the change in a particular context over a given period of time. A gender-sensitive indicator is therefore a measurement of gender-related change over time. For example, a gender-sensitive indicator could show the change in the number of women studying agriculture, relative to men and over a period of, say, a decade. Gender-sensitive indicators can therefore be used to measure the effectiveness or success of a GMS.

Gender sensitivity

Gender sensitivity refers to perceptiveness and responsiveness concerning differences in gender roles, responsibilities, challenges and opportunities.

Gender-specific policies

These policies take into account gender differentials, and target women or men specifically, but leave the current distribution of resources and responsibilities intact.

Gender training

Gender training is a systematic approach to sharing information and experiences on gender issues and gender analysis, aimed at increasing understanding of the structures of inequality and the relative position of men and women in society. It goes beyond awareness-building to actually providing people with the knowledge and skills that they need in order to change personal behaviour and societal structures.

National Women's Machinery

This is a single body or complex organised system of bodies, often under different authorities, that is recognised by the government as the institution dealing with the promotion of the status of women.

Practical gender needs

These emanate from the actual conditions women and men experience due to the roles ascribed to them by society. Often, women's practical gender needs are related to their roles as mothers, home-makers and providers of basic needs. Meeting the practical gender needs of women and men does not necessarily change their relative position in society.

Sex-disaggregated data

This is data collected – via questionnaires, observation or other techniques – that reveal the different roles and responsibilities of men and women. Having data

disaggregated by sex is extremely important to being able to assess the impact of a project on women separately from its impact on men.

Strategic gender needs

These relate to women's empowerment and to what is required to overcome the subordinate position of women to men in society. Such needs vary according to the economic, political, social and cultural context. Most governments now acknowledge the need to create opportunities which enable women to address their strategic needs.

Women's triple roles

Analysis of the gender division of labour has revealed that women typically take on three types of roles in terms of paid and unpaid labour. These roles are: the *productive* role, i.e., market production and home/subsistence production undertaken by women which generates an income; the *reproductive* role, i.e., the child-bearing and child-rearing responsibilities borne by women, which are essential to the reproduction of the workforce; and the *community management* role, i.e. activities undertaken by women to ensure the provision of resources at the community level, as an extension of their reproductive role (Razavi and Miller, 1997: 14).

Gender Mainstreaming in Science and Technology

A Reference Manual for Governments and Other Stakeholders

Gender mainstreaming is the current international approach to promoting equality between women and men.

It is based on the recognition that gender inequality operates at all levels and in all sectors of society, and thus needs to be addressed in the mainstream. It aims to ensure that women and men benefit equitably from all that society has to offer, and are equally empowered to affect its governance and decisions.

The Gender Management System (GMS) is a holistic and system-wide approach to gender mainstreaming developed by the Commonwealth for governments, in partnership with other stakeholders including civil society and the private sector. The GMS is a comprehensive network of structures, mechanisms and processes to enable governments and other organisations to contribute to gender equality through policy-making, planning and activities in all sectors.

This reference manual has been produced to assist governments and other stakeholders in mainstreaming gender in science and technology.

Other topics covered by publications in the Gender Management System Series include:

- Concept and methodology of the GMS
- Using gender-sensitive indicators
- Development planning
- Finance
- The public service
- Education
- Agriculture and rural development
- Information and communications
- Trade and industry
- Legal and constitutional affairs
- Health and HIV/AIDS

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