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Addressing Global Challenges: Focusing Science, Technology and Innovation (STI) Policy and Funding Through a Gendered Lens

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Globally we are facing many challenges related to environment, health, energy, water, and food security – challenges which are exacerbated by conflict, disasters and climate change. We know that women experience these challenges in different ways and use a range of strategies to address them. We also know that science and technology (S&T) have much to offer in addressing these challenges, while science, technology and innovation (STI) also create the conditions for national economic development in general (UNESCO, 2007; Odhiambo, 2010; AAAS, 2000).

As well as using and benefiting from the results of STI, women should be developing and implementing STI solutions as a significant proportion of any nation's human resources base – they are an important pool of talent for science, engineering, technology and innovation. How can we encourage more women to enter and become leaders in the study of these fields, moving into the science, engineering and technology workforce? How do we incorporate a gender perspective into STI research and the development of strategies and products to support a development agenda? How do we provide a gender lens to STI policymaking?

* The views expressed in this paper are those of the author and do not necessarily represent those of the United Nations.

Specifically, STI policies need to be formulated in ways that support development that contributes to women's empowerment and gender equality in three main components:

1. STI that supports women as development actors and beneficiaries
2. Gender equality in science, technology and engineering education, workforce and leadership
3. Women in innovation systems.

These concerns have been the basis of discussion in many international fora: those focused on addressing women's needs, rights, and advancement, as well as those focused on the role of S&T in supporting sustainable development and poverty alleviation. Many successful and innovative programs are being implemented to support these goals at international, regional, and national levels.

Addressing these development challenges will require consideration of a gender perspective not only in the research agenda that is established and in the research that is conducted, but also in the products and processes created to respond to the challenges. Integrating gender dimensions in national STI policies requires integrating gender considerations all along the path of policy development and implementation, including policies that guide national activity, the practices and strategies used to operationalize that policy, and the performance measures that determine effectiveness and impact. The focus should be on approaches that are problem based and multidisciplinary; that draw together the resources of the public and private sectors as well as civil society; and include development of physical, information and human resources to address these mandates (Malcom, n.d.). This paper will provide a brief overview of some of the regional policies in this area; some national, subnational and regional models of implementation, and models and approaches to monitoring and evaluation of implementation.

1. STI for women as development actors and beneficiaries

A wealth of research and analysis has been done to demonstrate that, while women make up the majority of the population in rural areas in many developing regions, and while they handle 60-90% of food production, processing and marketing in the developing world, they have lower levels of education and literacy, as well as less access to land, credit, information, training and other productive resources. They also possess a great deal of the developing world's traditional and local knowledge, which is often undervalued and overlooked. STI can play several roles here: it can validate and improve local knowledge and skills around food production, energy, healing, and natural resource management (UNESCO, 2007; Gender Working Group, 1995).

There is also a role for S&T in reducing labour required by women, for example in the case of providing improved energy sources that will shorten or eliminate the need to walk long distances to collect firewood. It can increase the value of women's production by improving quality and efficiency, thereby increasing income and improving the health and quality of life. For example, an integrated domestic biogas, latrine and hygiene programme in sub-Saharan Africa contributed to "improved health, increased availability of potent organic fertilisers, time savings through the reduced drudgery associated with fuel collection, and environmental benefits (van Nes and Nhete, 2007)".

2. Gender equality in science, technology and engineering, including research institutions, the private sector, government and scientific decision making

Key issues include education at primary levels for girls and boys, getting girls and women into S&T education at secondary and tertiary levels, supporting women's recruitment, retention, advancement and leadership in the S&T workforce in both the public and private sectors, and promoting gender equality in scientific decision making, including national scientific institutions, grant and hiring committees, and government.

3. Women in innovation systems

A neglected area of focus relating to gender equality and S&T is the innovation system. Innovation relates to the role of S&T for promoting long-term economic growth, creativity and research in a country. It involves the ability of countries and their public and private sectors to create, acquire, assimilate, use and diffuse scientific and technological knowledge as a major determinant of competitiveness in the global economy (David and Foray, 2003; Huyer and Hafkin, 2007). Issues for women include preconditions for participation (including access to education, capital and markets), and "innovation by women for women's needs" which involves improving livelihoods of women, adding value to farming products and accessing markets as collectives (Murenzi et al, 2010).

A strong international policy framework exists to implement all of these goals, derived from various topical communities (women, science and technology, sustainable development) and areas of intervention (education, employment, popularization of science, etc.). In addition to the international policies referenced in the Aide-Memoire prepared for this meeting, the "Seven Transformative Action Areas" developed by the Gender Working group of the Commission on Science and Technology for Development (CSTD) endorsed by ECOSOC in July 1995 are based on concrete and evidence-based recommendations for actions in each area. They are intended to support governments to implement policy and programmes which work towards gender equality. The seven Areas are:

1. Gender equity in science and technology education
2. Providing enabling measures for addressing gender inequalities 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 gender disaggregated data for policy makers.[1]

In 2006, the CSTD through its Gender Advisory Board added one more Transformative Action Area. As a result, the CSTD is the only international body to call attention to examining the role and place of women in medium and large innovation systems[2], although some countries such as South Africa and India are doing so at the national level.

[1] http://gab.wigsat.org

[2] Transformative Action Area 8 was added by the Gender Advisory Board in 2006.

Gender Advisory Board, CSTD
Transformative Action Area 8: Equal opportunity for entry and advancement into larger-scale science, technology, engineering, and mathematics (STEM) and innovation systems

Advancement into management and leadership of high level STEM organizations, and the ability to establish and manage successful medium and large-scale enterprises, are important factors for national innovation systems and the ability of countries to compete in global innovation systems. Encouraging women to undertake the design and control of development, production, marketing, and distribution will create jobs and generate wealth, contributing to national economic growth. Steps should be taken to encourage women's participation in innovation systems through their own enterprises as well as active engagement in innovation industry (including information and communications technologies (ICTs) and advanced networks) at senior levels. Related issues include promotion and facilitation of women's inventions, protection of women's intellectual property, and access to capital for industrial/entrepreneurial development, from the level of micro-credit all the way to venture capital.

Transformative Actions:

- Research needs to be undertaken on the effects of trade and globalization on markets and women's production. This includes the need to have reliable access to information on resources, export laws and regulations, cross-border transactions, supply and production networks; as well as market information.
- The implications of trade regimes for intellectual property rights (IPRs) of women and men in developing countries, which is often based on local and indigenous common-property knowledge, need to be better understood and addressed.
- In assessing and taking steps to address current changes in society and economy resulting from globalized innovation and trade systems, gender dimensions should be recognized.
- Governments and agencies should test and investigate appropriate structures, funding, regulation and training to support small, micro and medium business development based on S&T knowledge, technology and innovation systems.
- Detailed analysis and comparison of women's role and leadership in the private sector using reliable data and case studies should be undertaken, at national, local and regional levels, including sectors and industries where women are more or less represented; the willingness of men to work for/with women managers; and perceptions about women's physical or intellectual abilities to participate in certain sectors.

Source: http://gab.wigsat.org

Other important policy fora include the UNESCO World Conference on Science (WCS) in 1999, which provided an important and influential policy platform relating to gender, science, technology and innovation. Paragraph 90 of the WCS Framework for Action contains a comprehensive list of actions for Governments, agencies, the scientific community, and civil society to promote the participation of women in science in education, the workforce, and decision making, including research on and monitoring implementation of best practices, impact assessment and evaluation; and the collection of statistics.

The Millennium Development Goals (MDGs), while not addressing S&T specifically, target a range of goals which can only be achieved if science, technology and innovation are utilised in

the development of products and processes. As a cross-cutting goal, gender equality and the empowerment of women also play a key role in the development and implementation of successful strategies to use science and technology to help achieve targets in all the Goals (see Appendix One).

This international policy framework is supported by an increasing number of regional and national STI policies which target differing areas and sectors, depending on regional context and priorities.[3] The three regional policies discussed here provide a good overview of the three different approaches to gender and STI policy, all of which reflect important aspects of incorporating women and gender balance into STI at the national and global levels.

The Gender Policy of the Southern Africa Development Community (SADC) refers to the importance to "advance women's equal participation in decision making, trade and economy, agriculture and food security, health and HIV and AIDS, education and training and ICT" as a specific policy objective including "equal access for girls and boys to education, especially in science and mathematics" and "enhancing access of women and girls to quality education, including tertiary education, especially in non-traditional subject areas". In relation to poverty, food security and nutrition, the policy calls for research on "appropriate, affordable and beneficial technologies" as well as inclusion of women in programmes to promote food production, processing and accessing natural resources, including promoting their training and employment as extension workers, researchers and agricultural workers.

In Latin America, a workshop on Gender and Science and Technology was organized in 2004 by the Organization of American States (OAS), the Inter American Commission on Women (CIM) and GAB-CSTD under the framework of Inter-American Program on the Promotion of Women's Human Rights and Gender Equity and Equality (IAP). The workshop developed a set of recommendations for the Fourth Summit of the Americas (2005). The recommendations addressed gender mainstreaming of regional science and technology policies programmes, integration of a gender perspective in the creation, acquisition, utilization and dissemination of knowledge; gender equity in education and the workforce, science and technology for economic and social development and a gender equal knowledge society. These recommendations were presented at the Meeting of First Ministers and High Officials of Science and Technology of the OAS which met in Lima, Peru in November 2004. The "Declaration and Plan of Action of Lima", includes the statement:

> Science, technology, engineering, innovation, and education are fundamental to promote the integral development of the countries of the Americas, which encompasses the economic, social, educational, cultural, scientific, and technological fields, as well as job creation to confront poverty, in the framework of protection of the quality of the environment and integration of the gender perspective in policies and to strengthen democracy.

[3] The Organization for Women in Science for the Developing World (OWSDW) and the Gender Advisory Board – CSTD, with funding from Sida, are collaborating on a series of regional surveys to review and assess regional policy frameworks and priorities around gender and STI, as well as the understanding of decision makers of the importance of these issues.

The Lima Plan also includes a commitment to "foster the expansion of human, institutional, and infrastructural capacities to undertake scientific and technological research in a framework of environmental protection, gender equity and equality, and openness to the inter-relation between the public and private sectors". The Summit Plan of Action into which this Declaration was submitted, specifically includes references to improving the quality of science education, including science, technology and innovation in national action plans, and recognizing the role of S&T in sustainable national development. It also includes a commitment to ensure equal opportunities for all to employment, remuneration and access to education and training, and "pay special attention to gender-differentiated needs".[4]

In Europe, the European Parliament in 2008 adopted a report calling for greater efforts to be made to address the under-representation of women in science, raising the target of female representation in 25% for evaluation panels, selection and other committees, as well as nominated panels and committees to 40% of all such positions. This is a non-binding target, raising awareness of the importance of moving towards greater parity. It also called for universities, research institutes and private businesses to adopt and enforce equality strategies and conduct gender impact evaluation in decision-making processes (Cordis News, 2008).

At the national level, a range of STI policies reflect all of these streams of emphasis – South Africa, Brazil, Rwanda, India, Ghana, China and the Republic of Korea are just a few countries which have developed policies in one or more STI areas in attempts to more effectively integrate women and gender into national STI systems. However, unless there is a translation from policy into action at national and local levels, policies will remain ineffective. Unless there is full integration of gender dimensions (both men's and women's) throughout the structure of the enterprise of producing and applying knowledge, unless there are capacity building structures in place, and unless there are systems to monitor and assess progress in gender integration, policies will mean little.

I will here present a range of examples of strategies and models used to implement policies and planning in some of the key areas of gender and STI referred to above, at the national and local levels.

In the case of South Africa, the Department of Science and Technology convened a "Reference Group" to advise it on priorities, key directions and successful strategies. The Reference Group (SARG), was set up in 2003 in response to the South Africa Research and Development (R&D) Strategy which takes as one of its objectives to "increase the number of women and people from previously disadvantaged communities entering the sciences and remaining there", outlining a series of strategies to accomplish this, including promoting excellence in maths and sciences among young women, special programmes for the promotion of women in science, special extracurricular activities to support girls and blacks in maths and sciences. SARG (now SET4Women) is part of the National Advisory Council on Innovation (NACI), made up of stakeholders and representatives of organizations with an interest in the progress of women in science. Its mandate is to monitor and advise the Department of Science and Technology as well as the National Research Foundation which was tasked to set up an R&D capacity-building

[4] Parmentier and Huyer, 2008.

programme for Historically Disadvantaged Individuals (Government of the Republic of South Africa, 2002). The Reference Group was constituted to meet a number of requirements defined to address the priorities of its constituents: diversity of membership, including of race and gender (i.e. several members were male); representation from other regions which could provide advice based on experience (the United States of America, Europe); representatives from different sectors – university, private and civil society. SARG also oversaw the initiation of the first comprehensive sex-disaggregated data collection initiative in the country in S&T, which was also disaggregated by race. The data are updated every four years.

SET4Women is now a 10-person standing committee of the National Advisory Council on Innovation and undertakes a number of regular activities, including regular seminars and symposia on topics in women in science and engineering. The Department of S&T also presents awards in Women in Science to distinguished scientists.

ANNUAL NACI SYMPOSIUM ON THE LEADERSHIP ROLES OF WOMEN IN SCIENCE, TECHNOLOGY AND INNOVATION

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

NACI
NATIONAL ADVISORY COUNCIL ON INNOVATION

The NACI symposium entitled, ***Enhancing the leadership roles of women in science, technology and innovation*** was held on Friday 13 August 2010 at Premier Hotel, Pretoria.

The symposium, which was an initiative of **Science, Engineering and Technology (SET4W)**, sub-committee of **NACI**, was attended by about 100 leaders and aspiring leaders (predominantly women) from a wide variety of institutions and organisations.

The objectives of the symposium were as follows:

- To provide a platform for engagement with women leaders in the STI;
- To identify strategies that can facilitate the participation of women at senior levels in the STI;
- To identify strategies that can be used to enhance women's scientific outputs; and
- To enhance the participation of women in the STI.

Amongst others, delegates shared information on the current status of women as managers in the science, technology and innovation (STI) environment and as leaders of scientific research output in South Africa. The symposium also discussed possible policy interventions and/or strategies to facilitate and enhance the participation and contribution of women in the STI.

The Honourable Minister of Science and Technology, **Mrs Naledi Pandor** opened the symposium with a keynote address and also launched the NACI principles and good practice guidelines for enhancing the participation of women in the science, engineering and technology sector. NACI is of the view that implementation of these guidelines would greatly contribute to improving the participation of women within the SET sector.

Source: www.naci.org.za

Similarly, the Department of Science and Technology in the Ministry of Science and Technology in India convened a Taskforce on Women in Science in 2005. The Task Force was made up of members representing different disciplines of science and institutions, as well as different regions of the country. Its remit was to recommend appropriate measures to promote and encourage women to take up scientific and technological professions; to formulate a time-bound plan of action; to suggest measures to encourage girls in S&T education; to interact with other departments and organizations on implementing gender-enabling measures; and consider and

recommend any other measures to increase the involvement of women in science and technology in the country. The Task Force held 10 meetings in different parts of the country. At each meeting a half day was built in for interaction with local women scientists. Along with a comprehensive set of recommendations for the public and private sectors and research institution to promote the participation of females in S&T, a set of projects was initiated to showcase women's achievements in S&T and to encourage girls and women into S&T fields. These include examination of gender stereotypes in science textbooks, development of a website www.indianwomenscientists.in, and a book and national conference highlighting achievements of women scientists. (Ministry of Science and Technology, 2009)

At the national and sub-national levels, a range of programmes exist to implement, support and finance policies to promote gender and STI initiatives – presented here are a sample of models of activities in specific sectors and levels of STI related to gender equality and women's participation.

1. Gender and STI for women

From work done by the Regional Secretariat for Gender Equity in Science and Technology (RESGEST), we know that in Southeast and East Asia some government agencies are working on the ground to promote gender integration into agriculture, natural resources management programs, as well as rural extension.

1) All-China Women's Federation. The Federation has been very active in promoting the developing of women and children, especially in enhancing women's knowledge of science and helping women out of poverty using science and technology. With Government support it has provided education and skills training to eliminate illiteracy among young women in rural areas, and has worked with women in the central and eastern parts of the country to help them learn new technologies and gain knowledge of the market economy to generate income.
2) Indonesia – The Agency for Agricultural Research and Development (AARD) of the Ministry of Agriculture promotes the integration of a gender perspective in agricultural research. Researchers are trained in integrating gender into research as well as in socio-economic analysis of agricultural programs.
3) The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) is the national policy planning and coordinating council for agriculture and forestry. It is mandated to address gender issues and build institutional mechanisms to support gender and development. It provides training and advocacy with officials, policy makers, planners, program implementers and development workers, including creation of a pool of resource persons and trainers. It publishes and distributes gender-related communications materials and provides support and tools to develop programs on gender and development as well as integrate gender equality into R&D programs and projects (RESGEST, 2004).

Programs pairing women scientists with rural women are also effective strategies to develop technologies that support women in their everyday activities. An example is the Scientific Association for Egyptian Women (SAEW) which provides a venue for women scientists to work

with poor and rural women to bring improved science and technology to the grass roots. This program builds capabilities of both women scientists and rural women in the development and adaptation of S&T and ICT for poverty reduction. The Association was instrumental in the introduction of locally made solar water-heaters, solar cookers, refrigerators and solar dryers into urban communities. Solar dryers were used to dry vegetables for storage and income generation. Solar stills were developed to distil salt water in isolated communities, a particularly useful technology in dry areas. The Association has also promoted the introduction of biogas technology in rural villages (Hassan, 2007).

2. Gender equality in S&T

2.1 Education and research

Brazil is a global leader in the participation of women in STI nationally. Women are today 44% of the workers in the labour force, with an activity rate related to education levels. In 2000, women with university degrees had an 82.3% "activity rate" or representation in the labour force, while the average rate for all women is 45.2%. This was still lower than masculine activity rates – 90.6% for those holding university degrees and 72.6% in average – but they are high compared to other countries in Latin America and the Caribbean. This is the result of a well established science and technology system, strong women's representation– both governmental and nongovernmental – and a regional policy context for S&T development. Recent policy initiatives include the creation in 2003 of a Special Secretary for Policy for Women with Ministerial status which replaced the National Council for the Rights of Women in existence since 1985. The Secretary has built on the work of the Council, and in recent years has taken on S&T as an area of focus. Conferences were organized in 2006 and 2009 on "Thinking gender and science", bringing together an existing network of feminist research groups to discuss the issue of gender in science. The Secretary also awards a prize on "Building Gender Equality" for schools and undergraduate students. Both programs are part of the second National Plan for Politics for Women, addressing the issue of "strengthening the participation of women in an equal, plural and multiracial way in spaces of decision making; motivating the participation of women in scientific and technological areas". (Secretaria Especial de Política para Mulheres. II Encontro Nacional de Grupos e Núcleos de Pesquisas Pensando Gênero e Ciência., in Abreu, 2010). One important strategy for the high representation of women in the science system is the structure of the university system. In 2008 women represented 45% of university teachers at the national level. One reason is that in Brazil all MSc and PhD students accepted in graduate programs of excellence, irrespective of nationality, receive a scholarship; the percentage decreases at schools evaluated at lower levels of evaluation. Additionally, recruitment for public sector universities is by public competition, including achievement of rank of full professorship. These programs among others – including a strong grant system and established S&T institutions – seem to be having some effect: in 2008, women represented the majority (around 60%) in Arts and Linguistics, Health Sciences and Human Sciences. They show equal participation (around 50%) in applied social sciences and biological sciences. Surprisingly, they make up a third of researchers in engineering; exact and earth sciences; and agrarian Sciences (around 30%) (Abreu, 2010). Few countries can make the same claim.

In Canada, a public-private funding scheme has been implemented to promote the role of women

in science; and to encourage young women to take up science and engineering careers, and encourage the private sector to support the development of young women scientists and technologists. Five Chairs have been set up across Canada in co-sponsorship with the federal scientific funding body, the National Science and Engineering Research Council (NSERC). NSERC matches contributions of sponsoring organizations up to a pre-set limit, on an annual basis. Contributions are accepted from industry, government, the university, or any other private or public sector organizations, communities or individuals. Currently there are Chairs at universities in five regions in the country. Recently RIM, makers of the Blackberry, have partnered with the University of Guelph on the NSERC/RIM Chair for Women in Science and Engineering.

Objectives of the NSERC Chairs for Women in Science and Engineering Program

1. Develop, implement, and communicate strategies to raise the level of participation of women in science and engineering as students and as professionals, specifically to:
   - encourage female students in elementary and secondary schools to consider careers in science and engineering;
   - increase the enrolment of women in undergraduate and graduate programs in science and engineering in all Canadian universities and colleges;
   - increase the profile and retention rate of women in science and engineering positions;
   - eliminate barriers for women who wish to pursue careers in science and engineering; and
   - promote the integration of female students and professionals both within and outside academia.
2. Provide female role models who are accomplished, successful and recognized researchers in science and engineering.
3. Develop and implement a communication and networking strategy to ensure a regional and national impact on opportunities for women in science and engineering.

Source: http://www.nserc-crsng.gc.ca/Professors-Professeurs/CFS-PCP/CWSE-CFSG_eng.asp

The Arab world is seeing the rise of efforts to educate women at the tertiary level, through different government-implemented programs. The United Arab Emirates has a policy of free education for females and males at all educational levels. 95% of female secondary school graduate apply for admission at the tertiary level. The Zayed University for women was established in 1998, with colleges in arts and sciences, business sciences, communication and media sciences, education, and information systems, and campuses in Abu Dhabi and Dubai. Several women's higher colleges of technology have been established in the country as well, while several private universities in the country offer separate campuses for men and women. In Saudi Arabia the King Abdullah University of Science and Technology (KAUST) is a high-technology $10 billion campus that serves both female and male students. On campus, women students and faculty are not required to cover their head or face and are able to study and socialize with males. The King has also publicly affirmed his support for co education by firing a hard line cleric who criticized the university as "a great sin and evil" (Ebeid, 2009).

2.2 Workforce

An example of a policy-supporting activity to promote a woman-friendly workplace in the S&T sector is the European Commission WiST2 (Women in Science and Technology) working group which is made up of representatives of the private sector and academic world to discuss the status and working conditions of women in private sector research. The group focuses on reducing the 'leaky pipeline' for women in science and technology, and on building the business case for work-life balance. Several studies have been published to date with an upcoming exercise to identify best practices in Europe and present an overview of initiatives to identify and promote a new working culture and environment in research and technology.[5]

2.3 Advancement, Retention and Leadership

The seventh Framework Program of the European Commission for the funding of science research in the region is currently supporting actions to support cultural and structural change in the way gender and diversity are managed in universities and research organizations. Universities and research bodies applying for funds are expected to develop common actions to incorporate systemic organizational approaches to increase the participation and career advancement of women researchers. "Institutions are encouraged to exchange best practices and create action plans that address essential structural changes, tackle specific organizational problems, and make better use of diversity".[6]

In the United States of America, the National Science Foundation (NSF) provides funds through its NSF ADVANCE Program to increase the participation of women in the scientific and engineering workforce. It attempts to promote this through funding programmes intended to increase representation and advancement of women in academic scientific and engineering careers and leadership. It provides opportunities for both individuals and organizations: Fellows Awards, Institutional Transformation Awards and Leadership Awards. Through ADVANCE awards, NSF seeks to support new approaches to improving the climate for women in U.S. academic institutions and to facilitate women's advancement to the highest ranks of academic leadership.

For example, the Georgia Tech (GT) NSF ADVANCE Institutional Transformation Program from 2001-2006 created an inter-college network of termed professorships to promote communication, mentoring, and exchange among female faculty; it institutionalized a formal training process for committees involved in tenure and promotion decisions; it collected resource-allocation data to assess equity issues and developed a set of best practices; it held annual retreats of women faculty, provosts, deans and school chairs; strengthened and extended the scope and impact of family-friendly practices such as the Active Service Modified Duties process, lactation facilities, and a daycare center; it defined the problem/issues and developed strategies for advancement for women faculty.

[5] http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1297
[6] http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1297

2.4 Decision making

In relation to science decision making, in addition to the national policy level examples discussed here, an interesting model of incorporating gender into science institution decision making and policy structures is the Inter-American Network of Academies of Sciences (IANAS) Women for Science Working (WfS-WG) Group. The Working Group is an advisory body to national academies of science and engineering in the Americas, with members and focal points from 14 academies. It was established in 2010 in response to the Women for Science[7] report of the InterAcademy Council (IAC). The report stressed that science and technology capacity building requires the full engagement of women in S&T from the top decision-making levels all the way down to the grassroots. The InterAcademy Panel (IAP), the global network of science academies, has adopted the IAC report for implementation.

The mandate of the IANAS "Women for Science" Working Group is to advise IANAS and its member academies on fostering a climate in the sciences that is welcoming to women, and to alert IANAS and its academies to the gender aspects and issues encountered in their work and programs. The IANAS Women for Science Symposium sponsored by IAP and hosted by the Mexican Academy of Sciences in Mexico in April 2009 (http://www.ianas.com/mexico_en.asp), was the first step towards creating the Working Group. The WG will work in five key areas:

1) building an inclusive institutional culture in S&T organizations, including science academies;
2) promoting education in S&T for girls and women;
3) increasing the visibility of women scientists/engineers;
4) supporting networking, leadership training and mentoring for women in science;
5) alerting other IANAS programmes concerning implications for women, and to make sure women scientists and women at the grass roots are included as participants.

Areas of focus will be:

- recognition and elimination of barriers to women's careers in science;
- establishment of an interactive web site to promote networking among women scientists;
- enabling academies to exchange information on measures of proven effectiveness;
- developing and assembling online resources and database;
- collecting and analyzing sex-disaggregated data;
- promoting partnerships with relevant organizations in the IANAS region.[8]

3. Women in innovation systems

The Golden Jubilee Biotech Park for Women in India is part of a larger Government of India strategy to promote biotechnology-based entrepreneurship. It comes out of an effort to improve opportunities for women scientists, but also to use science to improve women's lives, by supporting women biotechnology entrepreneurs in developing and marketing products. The

[7] http://www.interacademycouncil.net/?id=11278
[8] www.ianas.org/wfswg/women_en.asp

Biotech Park for Women was launched as a tripartite initiative of the Department of Biotechnology, the Tamilnadu state government, and the M. S. Swaminathan Research Foundation, which provided technical support. The Governing Body of the Park additionally has members from R&D institutions, financial institutions, and women entrepreneurs. The initiative worked with bankers, industry, government and other groups to have credit available, access to technologies, regulatory clearances, approvals and certifications. In addition appropriate infrastructure needed to be developed, such as electricity and phone, roads, transport, etc. The Park offers long and short-term leases, land modules for building factories, project assessment and support, project identification and technology sourcing, consultancy advice, market linkages and training (Nair, 2009).

In another example from India, the Science for Equity, Empowerment and Development programme of the Department of Science and Technology broadly works to provide opportunities to scientists and field works to take up action oriented projects meant to support socio-economic benefits for poor sections of society, through S&T interventions. Past programmes include an initiative on improved fodder cultivation for rural women and Bio Integrated Organic Farm Management (BIOFARM) to benefit small and marginal farmers.[9]

One area where more attention is needed is understanding gender implications, opportunities and benefits in large scale innovation and infrastructure, such as large scale farming and agribusiness, power distribution systems, etc. For example, what are potential opportunities for women in the Rwanda national biogas programme, to help all households and communities in the country develop small biogas power sources (Gender Advisory Board, forthcoming)?

4. Implementation: Funding, monitoring and evaluation

For any policy and programme to have real impact, a system of support, monitoring and evaluation needs to be put in place on an ongoing basis. The ingredients are:

- funding and resource support for gender and STI programmes;
- qualitative and quantitative monitoring of their implementation, including the collection of sex-disaggregated data on recipients, participants and programme impact.

The gender and STI policies and approaches discussed here will only have lasting impact when implementation approaches incorporate a recognition of the imperatives and implications of gender considerations and gender mainstreaming as a priority. The United Nations definition of gender mainstreaming incorporates assessing implications for women and men of any planned actions and policies, as well making the considerations and experiences of women and men an integral part of any policy and action, so that women and men benefit equally. This means that if national implementation approaches for STI are to become authentically mainstreamed, then not only do women need to be targeted as beneficiaries and recipients, but their needs and concerns need to inform the overall problem definition and be factored into the desired solutions.

[9] http://www.dst.gov.in/scientific-programme/s-t_ssp.htm

One example of a national initiative to support, promote and encourage women in science is the National Science Foundation in the United States of America. It has a legal mandate to collect sex-disaggregated data on opportunities in education, training and employment in S&T fields and to incorporate gender research into its work.

The United States of America in 1980 instituted the Science and Engineering Equal Opportunity Act (1980), which states it is national policy that men and women have equal opportunity in education, training and employment in scientific and technical fields. The National Science Foundation is authorized to support and undertake research, data collection and other activities to assess, measure and increase the participation of women in science, technology, engineering and mathematics, including:

- activities designed to increase the participation of women in courses of study leading to degrees in scientific and technical fields;
- programs in science and mathematics in elementary and secondary schools;
- activities in continuing education in science and engineering to provide opportunities for women in the work force or women whose careers have been interrupted to acquire new knowledge, techniques, and skills in such fields;
- research designed to increase understanding of the potential contribution of women in science and technology and facilitate the participation and advancement of women;
- National Research Opportunity Grants and fellowships to women scientists to conduct scientific research;
- demonstration projects designed to encourage the employment and advancement of women in science, engineering, and technology;
- a comprehensive science education program to increase the participation of minorities in science and technology.

The Foundation is also required to:

- prepare and submit to the United States Congress a report proposing a comprehensive policy and program to promote minority participation in such fields.
- prepare and transmit to Congress and specified Federal official a report concerning the participation and status of women in science and technology, including an accounting and comparison by sex, race, and ethnic group, and by discipline, of the participation of women and men in scientific and technical positions.

The NSF program on Research on Gender in Science and Engineering provides funding for efforts to understand and address gender-based differences in STEM education and workforce participation through research, dissemination of research-based innovations, and extension services in education. The overall goal is to support expansion of a more diverse domestic science and engineering workforce. Projects that it supports are intended to increase the knowledge base on gender-related differences in learning and educational experience influencing student choices of careers; assess the influence of pedagogical approaches and teaching styles, curriculum, student services, and institutional culture on causing or closing gender gaps in certain fields; and address the dissemination and influence of knowledge results in the wider community.[10]

[10] www.nsf.gov

More recently, a reassessment of review criteria by the National Science Board for award of grants from the NSF led to the addition of a criterion of "broader impacts" in proposal assessment, with the intention of supporting those initiatives which are meant to address social issues and benefit society at large, in addition to the more narrow "technical merit" criterion.

National Science Foundation
Broader Impacts Criterion: What are the broader impacts of the proposed activity?

- How well does the activity advance discovery and understanding while promoting teaching, training and learning?
- How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?
- To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks and partnerships?
- Will the results be disseminated broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to society?

Source: NSF, 2007

The European Commission is taking a different approach to gender mainstreaming in its research funding in the region. It encourages the collection of sex-disaggregated data in member countries, and has established the Helsinki Group to develop and promote the gendered indicators on human resources. It does this through the systematic introduction of sex and gender in regular statistical measurements of research and development and S&T activities. It also works from the "bottom up" through:

- compiling existing data on women's participation in science;
- developing a global database with primary sex-disaggregated data;
- collection of data;
- development of national profiles on presence of women in science in the European Union member states;
- promotion of five key indicators: numbers, vertical segregation in the workforce (attrition); horizontal segregation (discipline and occupation sector); gender pay gaps; and fairness and success rates (European Commission, 2001).

A complementary initiative is *She Figures* (EC, 2009), a regular publication of data on women's representation in science, engineering and technology research in the European Union member states.

The seventh Framework Program (FP7) of the European Commission has moved away from earlier, separate Gender Action Plans to a gender mainstreaming strategy for the funding of all science research in the region. All programmes mandate a 40% level of participation of women and recommend equal participation of men and women. In order to promote the investigation of gender dimensions of research, it is supporting the development of toolkits and guidelines on

gender dimensions of science research[11] and will bring in experts to consider gender equality actions in programme areas. In terms of specific program support, the FP7 supports actions in pursuit of change (both cultural and structural) in the way gender and diversity are managed in universities and research organizations. Universities and research bodies are expected to cooperate on common actions in order to implement the best systemic organizational approaches to increase the participation and career advancement of women researchers and are encouraged to exchange best practices and create action plans that address essential structural changes, tackle specific organizational problems, and make better use of diversity. Examples of areas supported include:

- recruitment, promotion and retention policies;
- updated management and research assessment standards;
- course content development;
- leadership development;
- supporting policies for dual career couples;
- returning schemes after career breaks.[12]

At the national level, several countries are implementing women-targeted funding schemes for research and education in science, including India, South Africa, the Republic of Korea, and China, while internationally there are a range of fellowship programs targeted to supporting women's education in science fields, including the L'Oreal-UNESCO Fellowships, the Organization for Women in Science for the Developing World doctoral fellowships (funded by Sida), the Schlumberger Foundation Faculty for the Future grants, the International Atomic Energy Agency fellowships, and the Gates Foundation grants for agricultural research in Africa which target women as well as men.

In assessing the impacts and results it may also be important to investigate the potential to measure or assess the extent to which women are participating in and benefiting from STI policies and programmes. One attempt to develop a measurement framework of this kind is the Gender Equality-Knowledge Society (GEKS) framework developed by Women in Global Science and Technology (WIGSAT) with support from the International Network of UNESCO Chairs in Communications (Orbicom) and the International Development Research Centre (IDRC). The framework combines sex-disaggregated indicators from major STI indexes with indicators from ICT and gender equality indexes to arrive at a more comprehensive picture of the enabling conditions, opportunities and benefits that women experience in the knowledge society and in national innovation systems. It provides a benchmarking and assessment framework to understand the rates of women's participation in various sectors of the knowledge society, and the opportunities and barriers encountered. To do this it combines data on STI education, workforce participation, labour force, and technology access among others, with gender equality indicators on economic status, life expectancy, and health etc. to help policy makers make the connection between providing the base enabling conditions for women to the generation of an expanded and diverse workforce that will contribute to national economic development (Huyer and Hafkin, 2007).

[11] See Gender in EU Research Toolkit and Training, http://www.yellowwindow.be/genderinresearch/index_downloads.html

[12] http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1297

One potential area for further exploration is the combination of an approach such as the GEKS framework with an STI-based gender budgeting exercise. Gender auditing/budgeting has proved successful in other sectors and could be a useful tool for gender and STI advocates to raise awareness and provide a monitoring and implementation framework at the national and international levels.

Conclusion

Promoting the "access and participation of women and girls to education, training, science and technology, including for the promotion of women's equal access to full employment and decent work" involves implementing gender equality measures in education, training, and enterprise development as well as in the public and private sector workforce. It also involves the development, adaptation and transfer of technology to the grassroots in ways that will support and enable both women and men to increase their incomes, meet their needs and improve their quality of life.

Some progress has been made in relation to the major policies that have been formulated over the last 15 years since the 1995 World Conference on Women in Beijing, such as the World Conference on Science, the United Nations Conference on Sustainable Development, the World Summit on the Information Society, and the MDGs.

We have the policies, but implementation has proved more difficult. While there are some successes, there remains a great deal to be done. The goals defined and agreed on over the last couple of decades can only be achieved if coordinated efforts among a range of stakeholders – including the public and private sectors as well as civil society – take place at national, local and regional levels. And as has been learned from gender mainstreaming experience elsewhere, implementation will be effective only when supported by adequate resources, capacity building, monitoring (including data collection) and evaluation. Enough models and strategies for action are in place that the international community can assess these efforts, learn from both successes and failures, and move forward.

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Appendix One:
Box: S&T and Gender Implications of the Millennium Development Goals

MDG	S&T Contribution	Gender Implications
1. Eradicate extreme poverty and hunger	S&T can: – Raise agricultural productivity – Improve nutrition – Increase crop yield – Improve soil management – Develop efficient irrigation systems – Stimulate macroeconomic growth, through contribution of sector to economy, effect of investment in ICT on economic growth and job creation It provides the basis for: – Increased market access, efficiency and competitiveness of the poor through micro-level interventions such as village payphones, access to information on improved agricultural information – Increased interactivity to ensure social inclusion of poor and disadvantaged groups – Facilitation of political empowerment through inclusive, informed priority setting, increasing accountability, good governance	– Women are responsible for 60-90% of food production activities in developing regions – Women's entrepreneurial activities in processing and selling food make up a substantial portion of developing country economies – Women possess much traditional knowledge about local seeds, cropping patterns and soil and water management
2. Achieve universal primary education	– Science education should be part of basic education curricula, to develop a science-literate population and the base for a S&T workforce – ICTs facilitate distance learning in primary, secondary and tertiary education; promote remote access to education resources and facilitate other solutions – ICT-based distance training for teachers – Delivery of content and curricula – Streamline administration through ICT applications – Digital libraries and educational resources	– Rates of enrolment of females decreases in higher levels of S&T education – Women are less represented in senior levels of the S&T workforce – ICT are successful tools to facilitate female education through distance-, and e-learning – ICTs facilitate teacher training

	– Need for more educational content development	
3. Promote gender equality and women's empowerment	Improve technologies for women's daily work: – Improve energy – Agricultural technology – Access to clean water and improved sanitation technologies and practices – Technologies (including ICTs) to support women's income-generating enterprises – Influence public discourse and stereotypes on gender equality – Improve women's education – provide access to distance learning – Increase knowledge of women's rights and their participation in decision making – Reduce transactions costs, increase market coverage, provide income-generation in themselves	
4. Reduce child mortality 5. Improve maternal health	– Improve nutrition monitoring and support ICT health applications: – support remote consultation and diagnosis – storage, dissemination of, and access to medical information – coordination of research – training of health workers – disseminating health care information directly to the population through traditional and new media – health and medical software and databases to track vaccination and treatments, coordinate shipment of drugs and health supplies, spread information on treatments and diagnosis – patient education and monitoring – manage drug distribution – provide support networks for patients and families – health management and disease tracking software	– Women possess much of the world's traditional and local knowledge – Women are responsible for health of children – Women would benefit from increased access to basic health and nutrition information – ICT can be a tool to support this
6. Combat HIV/AIDS, malaria and other diseases	– New treatments and vaccines, microbicides – Low-cost generic medicines – Creation of new institutional frameworks to encourage new research collaborations, for example, a synthetic vaccine for Haemophilus Influenzae B Type (Hib) was developed by research	– Women possess much of the world's traditional and local knowledge – Rate of HIV/AIDS infection among females is increasing internationally and in Africa it is higher than that of males – Young women are especially at risk

	collaboration between groups at the Universities of Havana and Ottawa, producing a joint patent. The synthetic version is cheaper and easier to manufacture than the non-synthetic vaccine on the market. – monitor and improve drug quality	– Women are caregivers of the sick
7. Ensuring environmental sustainability	– Integrate scientific with traditional and local knowledge for monitoring and managing ecosystems such as watersheds, forests, seas – Predict and manage the effects of climate change and loss of biodiversity – Develop and improve low-cost technologies for water delivery and treatment, drip irrigation, sanitation – Development of crops requiring less water; drought-resistance crops using conventional breeding and genetic engineering methods – Development of sustainable land management strategies. agricultural systems that conserve biodiversity, and knowledge systems based on proper understanding of needs of households that depend on the ecosystem and indigenous knowledge of existing resources for their survival – Facilitates participation by population in protection and monitoring of environment through networking and information exchange – Provides tools for observing, simulating and analyzing environmental processes – Reduces paper consumption and facilitates telecommuting – Raises awareness of environmental issues – Facilitates monitoring, management and risk mitigation – GIS and spatial information	– Women possess much of the world's traditional and local knowledge – Women are a group which is especially vulnerable to natural disaster – Women's survival skills underpin social responses to crises and disasters – Women are managers of their local environmental resources – Access and rights to land for women are an important land management issue

From: Juma and Lee, 2005; Huyer 2004; Clancy et al, 2002; Khosla and Pearl, 2003.
Source: UNESCO 2007.