



## 4. Technological empowerment of women at the grassroots

*– Engagement of women at the grassroots is essential to worldwide science and technology capacity building. –*

Previous IAC reports emphasized the need for global capacity building in science and technology, particularly the creation in each country of a critical mass of well-educated scientists and engineers (IAC, 2004a; 2004b). In that spirit, the preceding chapters of this report have argued for the inclusion of women among these professionals' ranks. This would make the greatest possible use of humanity's brainpower and—by giving women and men equal opportunities to excel—it would be the right thing to do.

In this chapter, the Advisory Panel offers a different and literally more down-to-earth perspective—unprecedented, to our knowledge, in reports of this type—that is nevertheless complementary to IAC's visions for building a better world. Just as global S&T capacity building requires the creation of a scientific and engineering elite, it also requires the mobilization—the engagement and empowerment—of a countries' ordinary folk, the public. We need to improve public understanding of science and technology so that citizens may be knowledgeably involved in modern S&T-related policy issues. And we especially need to enable the billions of grassroots individuals around the world to apply the fruits of science and technology, such as useful products and services, for growing their countries' economies while improving their own lives.

Such engagement cannot occur while excluding half of the human race. The vast numbers of grassroots women in the rural areas and the urban neighbourhoods around the planet are those who do a great deal—in some countries, the majority—of the daily hands-on work. Therefore these women in the developing world's villages—rural townships and urban enclaves alike—must become engaged in the application of modern technologies. Because they are the teachers of the young, providers of basic nutrition and health care to their families, and farmers and producers of commodities, as well as half of the voting population in democracies, grassroots women are an essential element in building their countries' S&T competencies.



In other words, energizing and empowering grassroots people, women and men alike, is the correct action to take for humanitarian and human-rights reasons. But it also makes eminent economic sense. Elites have a profound influence, of course, on the generation of S&T advances, but everyone else must be capable of putting them into practice.

For example, while the Green Revolution in India was a significant factor in enhancing food-grain production—enabling India to move from dependence on imported food to self-sufficiency—the Green Revolution reached a plateau during the 1990s when intensive farming began to threaten the environment. A more enlightened follow-on approach, according to M.S. Swaminathan, the highly influential Indian plant geneticist and advocate of sustainable agriculture, would be an Evergreen Revolution—a *sustainable* green revolution driven by science and technology—complemented by a Gender Revolution. The latter, a reference to empowerment of the women who do so much of the farming, would ensure their productive long-term access, along with that of men, to the resulting biological and information technologies ([www.mssrf.org](http://www.mssrf.org)).

Similarly, people trying to cope in the fast-growing megacities of the developing world face their own set of challenges. And urban women in particular, just like their rural counterparts, must be recognized for the important economic roles they play. They need to become partners in capacity-building efforts appropriate to their situations.

In essence, this chapter proposes ways of enabling grassroots women in the countryside and the cities to gain scientific and technological competencies that lead to enhanced economic power for themselves and their families, communities, and societies.

### Educating girls

A crucial factor in the establishment of a grassroots S&T base is to ensure girls' access to education. Girls in villages are faced with formidable barriers, including harsh living conditions, as well as cultural and religious traditions—such as leaving home at a very young age to get married—that may preclude or abruptly terminate their schooling.

There are also constraints for girls who remain with their families. While tuition and textbooks at the pre-college levels are often provided at negligible cost in the more prosperous economies, they are frequently a major financial impediment to people in developing countries. Parents generally spend what income they have on educating sons; and even when money is available for educating daughters, these children are often put to work for their families doing a variety of domestic tasks. This practice



leads to poor performance at school or even dropping out of formal education altogether. In Ethiopia, for instance, women have a greater chance of dying in childbirth than of finishing primary education (Wax, 2005).

There is also a vicious cycle at work. A UNICEF project examined barriers to primary education in developing countries and found that 75 percent of children who are out of primary school have mothers who themselves received no education, largely because of poverty. This proportion rises to 80 percent in Asia, the Middle East, and North Africa (UNICEF, 2005). These data emphasize the importance of getting girls into school, especially as they will be the mothers of the future and thus be essential to ending the vicious cycle. Girls' education is essential not only to building a science-literate and more affluent village population but also to launching the education of the next generation of teachers, scientists, and engineers, some of whom will then be available for outreach to the villages.

Education programmes based in developing countries typically face many challenges. These programmes must first aim to convince girls' families that their basic (primary) education is worthwhile. This is difficult to do however if schools are underfunded, teaching materials are insufficient, teachers are unprepared, and girls are ill informed about the benefits of learning about science and technology. In fact, in developing and developed countries alike, there is an urgent need for well-prepared primary- and secondary-level science teachers.

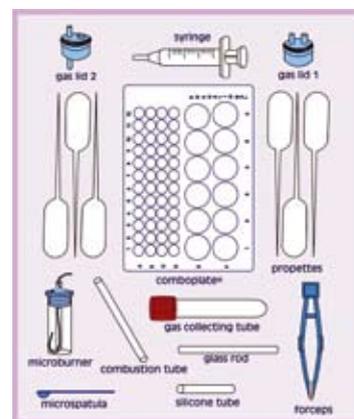
One increasingly popular way to stimulate people's interest in education in general—and in science and technology in particular—is the hosting of community-based activities. Undertaken at schools, community locations, and online, these programmes are typically run by enthusiasts who inspire students (and their parents), act as mentors, and provide career information. Online activities, of course, can reach diverse areas that include but are not limited to villages. One such programme aimed at attracting young people, girls and boys alike, is the pan-African online science magazine *Science in Africa*. Through mechanisms such as poems and lively storytelling, this innovative website builds science literacy and encourages exploration ([www.sciencein africa.co.za](http://www.sciencein africa.co.za)).

Other programmes begin addressing the cost barrier by providing inexpensive science-education equipment—such as the kit depicted in Box 4.1—that also supports girls' preference for learning through hands-on experimentation (Head, 1996).

UNICEF also sponsors multi-country projects to improve girls' primary education. In Gambia and Burkina Faso, mothers' clubs work with schools

#### UNESCO-IUPAC hands-on test kits. Box 4.1

Low-cost hands-on kits in lunchboxes, such as those funded by UNESCO and produced by the University of Witwatersrand in the Republic of South Africa, are effective in spreading an understanding of scientific methods. The microchemistry kit shown here, for example, enables students to carry out experiments easily, and its small size makes it especially beneficial to girls.



Source: RADMASTE Institute, University of Witwatersrand, n.d.



to help reduce the dropout rate of girls. In Ethiopia, teacher training is improving classroom learning. And a plan of action in 34 countries to promote gender-sensitive primary education is being developed and implemented ([www.unicef.org](http://www.unicef.org)).

If girls do manage to acquire a primary education, they face hurdles in obtaining parental permission and the necessary financial support to enter secondary school. Because one major obstacle is families' reluctance to allow an unmarried young woman to leave home, it is important that secondary education not be centralized; in order for high school or its equivalent to be accessible to girls, it must be decentralized.

Thus Turkey's Association in Support of Contemporary Living funds programmes for girls that include the setting up of distance-learning classes and the provision of resources to support their enrollment in primary and secondary schools. Girls in rural areas are also given access to computers and courses in tourism, business, and English. Acquisition of Internet skills and access to online education projects about small businesses and e-government are aimed at helping young women so that they may start their own commercial enterprises and generally be role models for girls in their region ([www.cydd.org.tr](http://www.cydd.org.tr)).

Beyond providing girls with greater literacy and competence for their daily lives and future economic activities, educating them to a higher standard at the primary and secondary levels renders a new generation of women capable of pursuing S&T education at the tertiary level. They may then expand the ranks of women who train others—particularly grassroots women in rural and urban locales—in the skillful application of science and technology.

## Recommendations

- ▶ Academies are called upon to ensure that their public-understanding-of-science efforts include community-based programmes. These initiatives, while addressing virtually all children and adults, must specifically appeal to girls and women.
- ▶ In those cultures where families are unwilling to let unmarried daughters move far from home, the InterAcademy Council, InterAcademy Panel, and academies are asked to advocate that secondary and subsequent schooling be made available locally for girls and young women, along with their access to the needed information technology.



## Empowering women at the grassroots

Mahatma Gandhi had a deep appreciation of the value of educating women: ‘When a man is educated, an individual is educated; when a woman is educated, a family and a country are educated.’ Such imparting of critical skills—in a word, empowerment—has three essential elements: a teaching method that fits the needs and circumstances of the audience; a teacher well versed in the required knowledge, who is able to engage the target audience; and the incorporation of the traditional knowledge and expertise of the students into the capacity-building effort.

Moreover, certain common-sense principles of what technological skills to transfer, and to whom, apply to virtually all grassroots economic endeavours both urban and rural. If a developing country’s agriculture, for instance, is to be sustainable, skilled workers in its farming communities are needed. And given that women perform a large fraction of the farm activities, S&T tools (both literal and figurative) will add great value to the local knowledge of rural women and enable them to face the challenges of sustaining high levels of crop productivity.

Thus rural women who own land may want to learn about seeds, fertilizer, water management, and pest control, while rural women who do not own land may want to acquire skills that enable them to establish businesses that make use of local agricultural processes and products.

## Initiatives at the grassroots

One approach to women’s empowerment is *self*-empowerment by means of local initiatives, especially those undertaken by voluntary or charitable grassroots organizations. Such entities are not only indispensable for providing initial support, advice, and coordination; they are sources of technological skills and new tools and may even facilitate access to city markets for goods that have been produced.

Collaboration among these groups can also direct workers’ newfound skills and confidence by identifying and engaging sources of funding for pilot projects and for the creation of new businesses. Moreover, they can help secure the cooperation and support of government agencies—an important factor for women’s inclusion in science and technology.

Grassroots organizations that arise from the need to meet local women’s needs often function effectively when set up as small cooperatives, thus turning women’s labour into paid employment. The enterprises are more efficient if the women themselves manage the finances and day-to-day operations. Such structures make sense in terms of economics, and they also have important implications for self-confidence and self-reliance.



Important factors for the success and sustainability of such local training programmes are the establishment of an infrastructure, a strong spirit of community participation, and accessibility to all—even to the poorest individuals.

### Research institutes and knowledge centres

The manifold bottom-up initiatives by nonprofit and charitable organizations need to be complemented by sustained actions from the top down. Many governments in the developing world are taking such actions by adopting a two-tiered strategy: formation of a cadre of experts in specialized research institutes, and technology transfer dispersed among local ‘knowledge centres.’

Research institutes are centralized facilities that employ and train scientists and technologists, both resident and visiting. There are many such institutes, particularly in India, China, and Africa, that address agricultural issues in the particular region they serve. Knowledge centres, by contrast, are not research venues but decentralized training facilities that enable local people, typically trained by professionals from the research institutes, to become an essential part of the S&T capacity building of their countries. The IAC report *Realizing the Promise and Potential of African Agriculture* in fact stresses that such networks of research institutes and knowledge centres are the most promising mechanism for cultivating cadres of scientists and engineers who in turn may engage farmers, both women and men, in the capacity-building process (IAC, 2004b).

These networks of relatively large regional research institutes and small and dispersed knowledge centres represent, in effect, wholesale and retail levels of S&T training. While the research institutes concentrate on the production of knowledge, the knowledge centres focus on its distribution and practical application. Thus knowledge centres typically embrace animal science, agriculture, the health sciences, water technology, alternative energy sources, post-harvest operations, and sustainability of the environment. Information technology, an attractive career option in itself, is also an important subject for knowledge centres because it greatly enhances the community’s access to relevant information.

For example, women farmers in South Sumatra are benefiting from Indonesia’s national programme of Warintek Multipurpose Community Telecenters that promote sustainable development through the use of appropriate science and technology (<http://portal.unesco.org>). These noncommercial information technology kiosks, sponsored by the Indone-



sian Ministry for Research and Technology, offer a range of media for distance education and face-to-face education alike. The S&T-focused CD-ROMs, for instance, are geared to meeting local needs; they provide training and advice on crucial aspects of growing and marketing area crops.

In India's Pondicherry territory, the M.S. Swaminathan Research Foundation has established a pilot knowledge centre that is undertaking large-scale field demonstrations and training programmes for resource-poor farmers, principally women. They learn, for instance, about the serious consequences of malnutrition and are provided with knowledge of nutrition-security practices. To reach the largest possible population, a variety of technological and social procedures are being developed for attracting trainees, giving them training, and maintaining contact with them and their communities. And efforts are being made to ensure that administrative procedures involving appointments, training, recognition, and promotion are not slowed down by bureaucracy ([www.mssrf.org](http://www.mssrf.org)).

In Burkina Faso, the UNESCO Chair, Women, Science, and Development in Africa, creates informal, interactive science-education programmes on health, water management, and agriculture, with university professors and students meeting with village women. It has also established a network with universities in surrounding countries (<http://portal.unesco.org>).

## Recommendation

- Academies are urged to commit to and participate in the establishment of knowledge centres where rural women can learn to employ scientific and technological methods in applications, such as agriculture, health care, sanitation, energy production, nutrition, and environmental conservation. Training in information technology is also desirable, and often essential, for accomplishing programmes' objectives. Thus the Advisory Panel recommends that academies counsel national governments to establish training and demonstration projects of these types in rural areas.

## A cadre of women scientists and engineers

Regardless of which entities create or operate a training programme, a reality they must respect is that women in rural communities learn most effectively from women scientists and engineers, especially in cultures where women do not interact with unrelated men. And if these professionals are themselves products of the local culture, they can more easily



establish rapport and act as role models. Moreover, where local training programmes are based on knowledge centres, these women are effective intermediaries between the research institution(s) and the community. Thus a cadre of such women S&T professionals should be established.

Developing countries' universities, often major sources of the national S&T talent pool, have to be more cognizant of this need. The participation of women in agricultural science in Africa, while not negligible, remains low, hovering around 15 percent at the Ph.D. level in Sub-Saharan Africa (20 percent in the Republic of South Africa).

One way to attract more women graduate students is to give them access to leading education institutions, outside their countries, through exchange programmes such as those that mutually exist between African universities and those between African and Western universities. Exchange arrangements of this type are often quite successful. In a period of only five years, the Wageningen University and Research Centre in The Netherlands has granted over 200 master's degrees and 50 doctorates to African scientists, many of whom now occupy senior governmental and university positions in their native countries ([www.wageningenuniversiteit.nl/nl/](http://www.wageningenuniversiteit.nl/nl/)).

In one pan-African programme, called 'Sandwich Ph.D.,' African students undertake thesis research at a host institution elsewhere in Africa or abroad, then return to complete their degree at the home university. The student and two supervisors (one from each institution) collaborate on fitting the capacity-building training to the home country's needs so that she or he, when finished, is prepared to tackle national priorities. In particular, some of these well-trained experts—such as women graduates of the Sandwich Ph.D. programmes—can take on the urgent task of merging modern scientific methods and technologies from universities and research centres with the traditional knowledge of village women of their own culture.

Other programmes are useful for picking up where women's graduate training leaves off. L'Oréal, the international cosmetics company, awards fellowships each year to 15 women—recent Ph.D.s from five continents—for post-doctoral work with foreign experts on research that benefits their native countries and that gives them a head start in launching their careers.

Critical to those careers however is avoidance of the woman researcher's bane—isolation—that results in marginalization and lack of access to places where power resides. Women researchers need to be valued, encouraged, and included every step of the way, not least because of their



crucial role as role models and technology-transfer agents in their country's development.

Two priorities for achieving this goal are to recognize that gender issues are impeding progress and then to take appropriate action. The College of Rural Development at the China Agricultural University, for instance, has established a Women and Development project to ensure that gender issues are considered throughout the agricultural-education system (Gibb, 2001). Similarly, the Consultative Group on International Agricultural Research (CGIAR), whose nearly 8,000 scientists, technicians, and managers bring their talents and expertise to 15 research institutes around the world, has established the Gender and Diversity Program to help its Future Harvest Centres attain staff diversity and, as a result, achieve excellence both in research and management ([www.genderdiversity.cgiar.org](http://www.genderdiversity.cgiar.org)).

## Recommendations

- ▶ The Advisory Panel asks academies to advocate for and support the tertiary education of women in science and engineering. These women may in turn train rural women, in their own cultures, through outreach mechanisms such as local knowledge-based centres that are linked to regional research institutes.
- ▶ The Advisory Panel urges academies and their individual members to support, participate in, and establish collaborations between developed and developing countries that give women scientists, engineers, and science and technology students the opportunities to acquire contacts, build networks, and generally gain greater access to new learning opportunities.

## Roles for the academies

The world's science and engineering academies are well placed to facilitate the transfer of technology from developed to developing countries—in part through the academies' advocacy of research institutes and knowledge centres and in part through fostering science literacy and technological competence among grassroots people. In fulfilling this important role, the academies should keep outreach to women particularly in mind, focusing on the key role that women scientists and engineers must play in the effective transfer of knowledge from research institutes to women at the grassroots.

The Indian Academy of Sciences, for example, is already active in this area through its work in Mission 2007, which aims to enlist one million S&T workers as master trainers. Meanwhile, a complementary priority is to build the audience, thereby expanding the number of grassroots people



who acquire new knowledge and learn to put it to practical use. Thus Mission 2007, in collaboration with a national alliance called Every Village a Knowledge Centre, aims to set up an actual or virtual knowledge centre in practically every one of the country's 600,000 rural villages through the integrated use of Internet, cable television, radio, and print media ([www.mssrf.org](http://www.mssrf.org)).

In such pursuits, it is clear that academies sometimes need to leave their comfort zones and exert leadership in making science accessible and engaging to the general public, women and men alike. In so doing, they take their events and programmes out into the field—into communities that may well be remote—rather than limit their venues to university campuses or research facilities.

Public engagement programmes, in addition to transferring knowledge of S&T developments in order to improve quality of life, also enable the full cross-section of society to be involved in the social and ethical discussions that lead to better-informed policy. And, last but not least, such programmes raise awareness of the opportunities of working in science and technology. Consistent with the thesis of this report, moreover, public engagement in S&T activities are needed so that the interest of women can be gained; so that they can appreciate the scope and benefits of science and technology; and so that they may share their interest, appreciation, and knowledge with their children and neighbours.

The IAC and IAP are uniquely positioned to stimulate the interest of the S&T community's governing bodies in the transfer of science and S&T knowledge and a bottom-up engagement of women in science. And in so doing they can build on earlier IAC reports, which address the issues of competence building, improving the quality of schools and universities, and strengthening existing research centres (IAC, 2004a; 2004b).

Several academies in scientifically advanced countries are already working in partnership with academies and research institutions in developing countries. These relationships, built on existing alliances and methods that have proven effective, can be expanded to explicitly include women at all levels.

In summary, the Advisory Panel urges the academies, individually and jointly, to pursue a multi-pronged, strategic approach to engaging grassroots women in science and technology. That approach includes:

- Providing access to education for girls and women, while improving science education at all levels.



- Empowering women from rural and urban areas by stimulating their interest in S&T-related practical skills that improve their effectiveness and expand their vistas.
- Developing a local infrastructure of knowledge centres and support groups to enable women's access to S&T knowledge that is appropriate to the needs of their communities.
- Supporting the education of women who wish to become S&T professionals. Some of these women may then essentially act as extension or field agents in providing or abetting technology transfer to women at the grassroots.

### Recommendation

- ▶ The Advisory Panel recommends that the InterAcademy Council and InterAcademy Panel become part of, and facilitate the efforts of, diverse organizations to provide women with access to the knowledge and skills needed for contributing to the world's science and technology capacity.