REINFORCING S&T CAPACITY-BUILDING IN DEVELOPING COUNTRIES

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ABSTRACT

Science and technology have long been seen as a key for sustainable development. Facing rapid scientific development in the world, many developing countries are facing tremendous challenges in S&T development. S&T innovation and capacity-building in the developing countries may be affected by many factors, but the most important one is talent fostering and cooperation among the talent. This paper presents arguments on how to foster talent, encourage women's participation in science and technology, and strengthen international cooperation for addressing the common concerns over S&T innovation capacity-building in the developing countries.

Keywords: *Capacity-building, Talent training, Sustainable development, S&T lagging countries.*

1. INTRODUCTION

Science and technology have long been recognized as the primary driving force behind economic and social development, and is a key factor in ensuring national and public security. In the history of human civilization, the dependence of economic and social development on S&T progress has never been as strong as it is today. The energy revolution, marked by green and low-carbon technologies, will play an important role in promoting energy structure change, improving energy-efficiency and tackling climate change. ICT and relevant industries are a major driving force for the recovery of world's economy. Development of life-science and biotechnology will significantly improve agricultural production and human health, and the related industry will be one of the pillars for sustainable development.

The world is now witnessing new profound changes in the pattern of social and economic development mostly because of S&T progress and innovation. In view of the rapid scientific development in the world, most developing countries have exerted themselves during recent years to promoting development of science and technology and improving their capacities for innovation. In doing so, they are confronted with tremendous challenges, including shortage of talent, poor infrastructure, weak capacity in exploration and exploitation of natural resources, environmental deterioration, lack of knowledge of global climate change, and related mitigation and adaptation methodology, etc., which further endanger their sustainable development. In this context, it is imperative for the developing countries to build or enhance the innovation capacity, most importantly, to cultivate and maintain an innovative talented team, and to build a strong force in S&T and application.

2. FOSTERING TALENTS AND RESEARCH TEAMS

In the process of modernization, the developing countries, including China, cannot maintain their conventional modes of economic development, nor can they follow the existing models of the developed countries. Rather, it has been a major strategic issue and a matter of great concern for the developing countries to find new roads to industrialization, which take into account their ground realities and location conditions, and will lead to green, smart, sustainable and shared development, featured by cost-effective production, low-emission and highly efficient resource utilization.

The S&T community shoulders great responsibilities in addressing the future challenges. The urgent demand in a new round of industrial development calls for the readiness of scientists to take up important tasks and achieve more contributions. No efforts should be spared to deepen our understanding on the nature of S&T breakthroughs, enhancing people's qualities through popularization of science and education, and providing momentum for the development of newly emerging industries, through technology innovation and transfer.

S&T innovation has supported China's development strategies, which are based on science, education, innovation and talent. Recognizing this fact, the Chinese Government has set up a series of policies and programmes to encourage the young people studying S&T, even in foreign countries, since 1979 when China officially began to adopt Opening and Reform Policy. In 1996, the China Scholarship Council was founded to provide financial assistance to students and scholars studying aboard. In 2003, a fellowship programme was launched to support self-funded students studying abroad. In the recent years, for reversing brain-drain, the Chinese government and relevant organizations have implemented a lot of programmes to encourage overseas Chinese scholars to return to China, and work in Chinese Academy of Sciences (CAS), universities, and

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enterprises. For example:

- 'Fund for Returnees to get S&T Research Started', was initiated in 1990;
- 'Programme for Training Talents toward the 21st Century', started in 1993, targeting outstanding young teachers returning from overseas studies;
- 'Hundred Talents Programme', launched in 1994 by CAS, has attracted outstanding young scientists with over four years of overseas experience to return and work at CAS institutes;
- 'Chunhui (Spring Bud) Programme', started in 1996, targeting returnees with doctoral degree and outstanding achievements for short-term cooperation;
- 'Changjiang Scholar Incentive Programme', has been providing financial support for young and middle-aged leading scholars who have studied abroad and are invited by Chinese universities as Distinguished Professors;
- 'Programme of Academic Short-return for Scholars and Research Overseas', providing financial support for outstanding Chinese scholars studying or doing research abroad to give lectures or do research in 28 key Chinese universities during their short holidays or return to China;
- 'Fund for Returnees to Start Enterprises in China' and favorable policies for running an enterprise;
- 'National Overseas Eminent Scholar Fund' launched by NSFC, and 'CAS Overseas Eminent Scholar Fund' launched by CAS, to support overseas scholars to conduct research in China and CAS institutes; and
- 'Thousand Talents Programme' for attracting elite scientists to work in China and so on.

As the national supreme academic institution in natural sciences and advanced technology research and development in China, CAS has set up a plan for talent training & recruitment for implementing the Academy's long and mid-term development programme. The programme aims at building up CAS into a base for scientific research and technology innovation that conforms to international standards, to become a centre for training highly innovative researchers and incubating high-tech industries. This would develop CAS into a quality national research institution having first-class research conditions, high-standard management and highly professional staff that could provide strong support for implementing China's national innovation strategy by delivering qualified human resources and generating new knowledge. The package plan includes High-level Talent Recruitment Scheme, Excellent Young Talent Training Scheme, Technical and Administrative Talent Training Scheme, and Overseas Brains Recruiting & Talent Training through International Exchange Scheme.

The Package Plan also encourages young and middle-aged scientists to take an active part in international exchange and cooperation projects, thus broadening their international vision and enhancing their innovation capability. The CAS-sponsored 'Study-Abroad' Program shall be readjusted to focus on bringing up the next-generation of leading scientists and young researchers. The Senior Research Fellowship is designed for strategic scientists and technologists to conduct clearly-targeted international collaborations and return visits focusing on key areas and national priorities; international training opportunities are also made available for excellent young researchers, technical support staff, backbone administrators and tech-transfer personnel through the implementation of international exchange programmes, such as the Visiting Scholarship and Joint Postgraduate Training Agreements. All these programmes should be adapted to the needs for the readjustment of the disciplinary layout and the advancement of S&T innovation in CAS.

In terms of research capacity, more attention needs to be paid to basic and frontier research and strategic high technology development. Without perseverance, it is impossible to make major achievements in this kind of research that requires a lot of hard work. Key strategic high technologies will not be obtained through technology-transfer or import. Original and key technology innovations are sources of national and industrial competitiveness. In order to take a lead in economy and technology development in the future, self-reliance is needed to make original innovative achievements instead of following the path of others or depending on technology transfer from abroad.

3. ENCOURAGING WOMEN S PARTICIPATION

Women as mothers are role models for their children. Empowering women in science and technology innovation is of great significance for future generations. Even though women's engagement in S&T innovation, economic and social development has been expanded with the progress of human society, there are restraints and obstacles to larger participation of women in these fields. In some developing countries, there is still an inadequacy of opportunities for women in S&T, and the potential of

women in making discoveries and inventions are far from being fully tapped, as evident from the low percentage of their women scientists. With majority of them playing dual roles (family/career), women scientists have to take care of their families and nurture their children while dedicating themselves to scientific research, which negatively impacts women in fully developing their creativity to some degree. Despite facing this challenge, women scientists in the developing countries have made important contributions to S&T and innovation, with particularly outstanding performances in medicine, biology, chemistry, interdisciplinary fields between natural and social sciences as well as innovation management.

In order to get more women involved in research, development and innovation, a better legislation and policy environment is needed, coupled with a conducive research and education environment, as well as better social and cultural encouragement.

In this regard, better legislation and policy measure include:

(i) eliminating social prejudice and gender discrimination, making gender equality enforceable by law;
(ii) ensuring equal rights for women in receiving higher education and applying for positions or grants in research and development;
(iii) ensuring equal rights for women scientists to vote, participate, supervise and evaluate; and
(iv) taking into full account the needs, interests, opinions and suggestions of women scientists in making policies law and regulations.

A better research and education environment for women calls for:

(i) setting up special funds for research applicable to women scientists;
(ii) establishing special organizations or institutions that provide assistance, support and guidance to women scientists;
(iii) setting up special funds for education and training of professional women scientists; and
(iv) making sure that all existing research funds and award systems take women participation in ful consideration.

A better social and cultural environment includes:

(i) enhancing the efforts of public media in characterizing the figures of women scientists so as to raise the public recognition of contributions made by women scientists and increase in social support and their respect for their work;
(ii) improving the social service system for mothers and children; and
(iii) increasing self-awareness of women scientists to be equal, independent, confident and creative in thinking, to take full advantage of the social environment to improve their professional skills and innovation capability, to participate in academic exchanges and collaboration, to achieve a balance between the roles of being a wife, a mother and a scientist, to realize their values by taking an active part in S&T innovation activities.

4. STRENGTHENING INTERNATIONAL COOPERATION

We live in a world faced with grave global challenges, such as food security, energy shortage, environmental pollution and climate change. Only with acceleration of institutional and science and technology innovation, can we fundamentally overcome negative effects of the global financial crisis and address these challenges. All the issues cannot be solved by one country or one nation alone. More important now than ever before, international cooperation provides us the best approach for systematic solutions to the complicated problems humankind is faced with. International cooperation may help the world recover from financial crisis and global economic shrinkage through building an improved finance monitoring and warning system; promoting global economic restructuring; protecting international trade and investment, and generating a new and essential driving force through S&T innovation.

Science has become a culture and treasure of the world created by all the nations together, especially for the fundamental science based on big science facilities. From concept formation, preparatory research, components design and development to facility construction, international cooperation is embed in the whole process for big science facility development. Science is beyond the borders, which is flowing within or among all the countries. International cooperation can help the developing countries to improve their scientific capabilities, train their young scientists, and build their research teams.

CAS has given considerable importance to exchanges and cooperation in science and technology with the

developed and developing countries. Based on an equal, mutually beneficial and win-win basis, as well as with clear targets in different countries, international cooperation has diversified in terms of formats, including personnel exchange, data exchange and sharing, bilateral workshops, international conferences, joint centers, project-based scientists groups, joint laboratories, or partnership between institutes. It has been extended from bottom-level scientist cooperation to high-level strategic communication, from bilateral agreements between scientific institutions to multilateral research programmes, and from pure science research to partnership with industries for translational research and technology transfer.

Some of these initiatives are carried out in partnership with The World Academy of Sciences (TWAS). For example, CAS launched the CAS-TWAS Fellowship in 2004. With the establishment of the 'training bases for developing countries' in some CAS Institutes, the fellowship has funded scholars from more than 30 developing countries and regions, such as Bangladesh, Egypt, India, Nigeria, Pakistan and Sudan, to conduct their research in the CAS. A total of 79 Ph.D students, 77 post-docs and 84 visiting scholars have been enrolled under the programme so far. Another noted programme is the CAS-TWAS-WMO Forum (CTWF) on climate sciences, which was incepted in 2000. CTWF provides a platform for scientists (mostly from developing countries) to communicate and gear up the cooperation within developing countries on climate related issues. Since its establishment, CTWF has organized nine international conferences (workshops) with different themes, which are all hot topics related to the climate sciences.

CAS is the founding member of the InterAcademy Council (IAC), a multinational organization of science academies. The IAC produces reports on scientific, technological, and health issues as great global challenges of the time. At the United Nations in February 2004, the IAC released its first report 'Inventing a Better Future – A Strategy for Building Worldwide Capacities in Science and Technology'. This report has been widely adopted within developing countries for enhancing science and technology capacities. The second IAC report, commissioned by the U.N. Secretary-General and published in June 2004, was titled 'Realizing the Promise and Potential of African Agriculture – Science and Technology Strategies for Improving Agricultural Productivity and Food Security in Africa'. The recommendations of this report are being addressed by key agricultural institutions in Africa. The third report was published in June 2006, 'Women for Science'. Academies of sciences within developing countries have sponsored significant workshops on this topic. The fourth report was published in October 2007, 'Lighting the Way: Toward a Sustainable Energy Future', which outlined sustainable energy strategies for developing countries. A fifth report was published in fall 2010: a review of the Intergovernmental Panel on Climate Change (IPCC) as requested by the UN Secretary-General and Chair of the IPCC. The IPCC has adopted key recommendations of this report.

Being one of its founding members, CAS has been working closely with Commission on Science and Technology for Sustainable Development in the South (COMSATS) for capacity-building of developing countries. For example, in 2011, in collaboration with COMSATS and United Nations Educational, Scientific and Cultural Organization (UNESCO), CAS-TWAS-WMO forum (CTWF) organized a joint international training workshop aimed at reinforcing the capacity-building of young research scientists from developing countries.

International cooperation contributes significantly to talent training, and attracting and accumulating talent. Through young scientist groups, partnership groups, bilateral or multilateral workshops on frontiers of sciences, or other kinds of practical cooperation, international scientists work together on the research areas of common interest, jointly conduct experiments, publish papers in internationally peer-reviewed journals, and supervise graduate students or post-doctorate researchers. It is greatly beneficial for the students and young scientists to grow and evolve in an international atmosphere, nurture their interests in science, build their capacity for conducting scientific research, and create a focus on science for their careers.

5. CONCLUSIONS

Self-reliance should be given top priority for S&T capacity-building in developing countries. Strengthening science and technology cooperation and exchanges among developing countries will benefit the overall development of all developing countries. Opportunities should be created for promoting academic exchanges and increasing avenues for education and training, and collaborative research among the scientists, especially for women and young scientists from the developing world. The

rights and interests of women and young scientists should be safeguarded in participating in S&T innovations, and more women and young scientists should be empowered through professional education and participation in scientific research, development and innovation. All the scientists, engineers, and academicians have to work together on building global capacity and assume responsibility for addressing the common challenges, and cooperate on building science and innovation capacity of all nations and regions.