ITEC Programme on SCIENCE DIPLOMACY

9-20 January 2017

New Delhi

RIS
Research and Information System
for Developing Countries
विकासशील देशों की अनुसंधान एवं सूचना प्रणाली

ITEC Programme on SCIENCE DIPLOMACY

9-20 January 2017

New Delhi

RIS
Research and Information System
for Developing Countries
विकासशील देशों की अनुसंधान एवं सूचना प्रणाली

ISBN : 81-7122-130-0

Published in 2017 by:

RIS
Research and Information System for Developing Countries
विकासशील देशों की अनुसंधान एवं सूचना प्रणाली

Core IV-B, Fourth Floor, India Habitat Centre,
Lodhi Road, New Delhi-110 003, India
Ph.: +91-11-24682177-80, Fax: +91-11-24682173-74
E-mail: dgoffice@ris.org.in
Website: www.ris.org.in

CONTENTS

PREFACE

Prof. Sachin Chaturvedi
Director General, RIS

Science diplomacy aims at promoting scientific collaborations among different countries for addressing common challenges for mutual gains. Its role in shaping foreign policy of the nation has become prominent over a period of time, particularly in the context of the South-South Cooperation.

As part of the RIS work programme on capacity-building for developing countries on the issues related to science, technology and innovation, the first Capacity-Building Programme on Science Diplomacy was organised during 9-20 January 2017 under the ITEC/SCAAP programme of the Ministry of External Affairs. There were in all 37 participants from 25 countries.

The programme was designed to let the participants from the different countries have a feel of theory and practice of Science Diplomacy, and also bring in awareness in them to apply it for the mutual benefit of developing nations. Subject experts from some of the leading Indian institutions were also invited.

Renowned speakers from the government, academia, research and media interacted with the participants and were fully involved in technical sessions and group discussions. Critical areas to deliberate upon were identified and eventually status papers of different countries, highlighting regional and global contexts, were brought out. Based on the individual areas of expertise and inclination, four thematic groups were formed-- (i) Science Diplomacy and South-South Cooperation, (ii) SDGs and Science Diplomacy, (iii) Culture and Science Diplomacy, (iv) Individual Country Case Studies for Bilateral Cooperation. This publication contains the contributions by the participants on different aspects of these themes.

We have also included inaugural address by Dr Baldev Raj, Director, NIAS (Bengaluru) in this volume. We are sure scholars, policy-makers and practitioners from developing countries would find this report interesting and useful.

Sachin Chaturvedi

Inaugural Address

Prof. Baldev Raj

Director, National Institute of Advanced Studies (NIAS)

Good morning to all of you and wish you a wonderful year 2017, full of bliss, full of successes, full of contributions which would make the earth truly one earth planet inspite of the differences and diversities. I am delighted to be here. The first initiative which I am sure looking at the elements would grow from its own learnings and from also the importance of this discipline.

In the presence of Prof. Shyam Saran, I am encouraged, at the same time a little nervous. Shyam Saran is the icon in science diplomacy. So humbly he said climate change and nuclear agreement with USA. If you look at these two agreements, the climate change where with his wisdom, with his experiences and deep knowledge, he came up with the concept of common differentiated responsibilities which has taken roots in all the dialogues and has become so important element of discussions as we go along and I think this looks so mathematical. One may say that it is a statement which came from a diplomat but I think it is so mathematical that one would find very difficult to come up with alternates as to how you meet the climate challenge.

Sir, I am honoured to be present in this forum. Thanks, Sachin Chaturvedi. And with Dr. Sadhna Relia with whom I have worked together for many many years, she is known for detailing. I realised that when we were doing the Brics Young Forum, she would come up with a lot of details to make success. She has a good comprehension. She is open minded to listen to many things. That is why perhaps DST in its wisdom has chosen her to pursue the international collaborations. We are looking forward both as RIS and NIAS to work together with DST to enrich science diplomacy and one of the plank on which we want to work is increasing role of diaspora in pursuing the national causes and also in building the bridges with the world to strengthen.

The biggest asset you have is the human beings who have experience and who have the capacity to think and manage the uncertainty. Diaspora is national but at the same time international. There are many links which it is very difficult for us to have. They have the possibilities to cross those bridges with elegance and with less energy. So I think that is the plank on which under the guidance of Ambassador Shyam Saran we built up the thing and I hope we would succeed in moving on that.

I am very fortunate that I am introduced to Dinkar Asthana and so good to know that he is alumni of IIT Kanpur and I am going to tell you how science diplomacy has played such a vital role in building the software of this country where we are considered among the leaders. In fact, without science diplomacy of IIT Kanpur, there is arguably a reason as to whether we would have progressed the way we have progressed. I would have the opportunity to tell you that in some time.

I believe that science diplomacy is an inter-discipline or a trans-discipline even which is with the current level of maturity difficult to study from textbooks and general articles. It is a game of the practitioners who have achieved successes in the science diplomacy and has created in the diverse cultural frameworks, diverse national interest, something common which was for the common good.

If you look at this particular objective of the science diplomacy, you would realise that why you have to be amidst the people who can dialogue, from whom you can learn. And one is reminded of Buddha who after getting enlightenment told to his disciples, please listen to me carefully but please don't practice what I have told you to do. You practice on your own and out of that practice what would come, that would be your way of living. I think it is very important to listen to all the people, speakers who would come but I am sure you are going to come up with something which is relevant to your country, to your frame of thinking and to your inspiration in the future as to how you are going to do it.

So in that context the capacity building programme is very vital. It is unique and looking at the kind of speakers and the topics which you are going to have, I think it is going to enrich. Ambassador Shyam Saran mentioned that in all these kinds of forums where you have persons with diverse backgrounds, experiences coming from different cultures, the biggest take home is the learning which you would have from each other. And you are becoming friends for your lifetime is something which is invaluable. So I am sure that two weeks, a long period relatively to be away from your organisations, free of your responsibilities would give you the opportunity to dialogue with each other and be honest in expression with your challenges and the opportunities which you see and maybe come up with some ideas which would be a feedback to RIS and Ministry of External Affairs to continue to do the programmes as we go along.

I think today when you look at the various science diplomacy discussions, the best I know which I participated for many many years is a programme in Japan where we do science, technology and innovation and it is titled 'The Lights and Shadows of Science and Technology'. We all know that science and technology has many, many positive influences but the history shows that it had many many bad influences also. So lights and shadows is the name and science diplomacy, one programme which has been very eminently attended and always created very academic and useful outputs, I request you to go to the website of theirs and see year to year how science diplomacy has generated the ideas.

One of the ideas which I came back after many years was that when the programme starts in the science diplomacy, it is the ingenuity and the creativity of the individuals who are involved at that stage to create an idea which would grow very large. It is very difficult for most of the people to realise at that time that it would grow to such a great idea that it would influence the country's likes so much.

Let me start with where Dinkar stopped, IIT Kanpur. IIT Kanpur was started as a science diplomacy between USA and India. At that time, the computers were just beginning, I am talking about 1960s. there was a group which was the Kanpur Indo-American Programme where five or six industries from USA had joined together and they said that they would provide a computer to India in IIT Kanpur, the computer was IBM 60 because it had 60 K memory. Today you can laugh at that 60 K memory.

And who were the people who were involved. From India, Prof. V.Rajaraman, very eminent computer scientist. And what was most important because this programme is on capacity building, the people who came at that time, there was Harry Huskey who came from University of California, Forman S.Acton and Irving Rabinowitz, they came from Princeton University and they had decided computer is alright but the capacity building of the young minds would be something which would be extremely important if the computers are to grow, the applications are to grow, they never had the idea that how much it would grow in such a short span.

So there were 24x7 access to this computer, whole lot of programmes were done and V. Rajaraman came up with a book because it was meant to be for the students and the scholars at that time, they came up with a book which was priced at Rs 15, one-fifth of a dollar, one-fourth of a dollar today so that the students can have it, all the students can have it and read it.

You see the hardware, the capacity building, the framework attracting the best of the minds because IIT Kanpur has been an institute which has always attracted the best of the minds as students and those who have been associated with it. So this is a kind of science diplomacy which happens with the minds, which happens with the brilliant idea which even the people who start this don't know where it would go. And today India's aspirations of the digital India are all based on something which started there. People like F.C.Kohli came to IIT Kanpur. People like Narayanamurthy who started the Infosys in Bangalore which has become today corresponding to the Silicon Valley and has inspired many many young people to work in software, it all came out of science diplomacy.

So the message which I draw from this is that all of us with our commitment can come up with something which can grow very large. And which is well within our reach. We need the support of the government, we need the support of the diplomats but it is well within our reach to come up with a proposal like that. I hope this capacity building programme would also encourage all of us through dialogue as to is there something which we can do. Today, something which is very very visible to all of us is the combined responsibility to manage and mitigate climate change and interlinked with it to achieve the sustainability development goals.

If I look at sustainability development goals, to me it is much more difficult as compared to nuclear space and defence technologies. It is my perception. Maybe it is easier to the people who understand it better. The social scientist, humanities, culture, diplomats, maybe it is easy but when I look at the contrast, to me in science, the more varied is the contrast, more difficult is the contrast, I have difficulty to manage. Some amount of contrast makes it visible, the problem and then I feel that I am competent to handle but when the contrast becomes very large, it also challenges me as to how I am going to handle it.

The regions are involved, the economic capacities of the countries are involved, science and technology capacity, diplomacy capacities in different countries but the goal is a goal, goal is common. So what would be required is that science and diplomacy weds together to challenge this. It would create many many different paradigms as we go along to challenge the sustainability development goals. So that means in addition to the capacity building, in addition to the icons which we have in the science diplomacy in all the countries, in addition to the diaspora which we have talked about, we would require the brightest young people to come in science diplomacy. They could either pursue science, either they could diplomacy but they should be sensitive to work at the interface of the science diplomacy and then take it as a challenge to do it.

And I believe that if we are able to challenge the sustainability development goals, the world would be a different place.

I have been a student of studying different civilisations over 5000 years, looking from Mohenjo-Daro to Greece to Mesopotamia to roman, never the inequality was addressed in a satisfactory way. Though human beings can say that they have been able to solve many problems, I think the problems of inequalities were never satisfactorily assessed. Is today an opportune window when we are challenged, when we have resources, when we have a large input of the science and technology and it has become an enterprise to be able to do something which can sustain and grow, would we be able to do it or would it be another opportunity which comes and goes by us? I am sure the human beings, whenever they have taken it as a challenge, to my mind this is the first time that the human beings are taking a combined challenge to address the problems of the climate change and the sustainability development goals, these are huge challenges and I am very confident, I stay very confident this would be addressed but it would not be a linear path, it would be very chaotic and non-linear path. There would be many failures, a few successes till we build a robust platform on which we would be able to go and proceed with this.

So it is very important for us that it is opportune time when we do it.

Let me come to India's experiences in science diplomacy. You see Homi Bhabha, in a way, changed the pathways of pursuing modern science for India. Except for individuals who pursued, J.C.Bose, Meghnad and all those people did excellent science but science as an enterprise, the modern science as the enterprise came with Dr. Homi Bhabha in this country. And he recognised science diplomacy as extremely important at that juncture to build the national aspiration and also at the same time contributed in an immense way to creating a framework for the world to cooperate in a difficult area which is nuclear science and technology. because of his work, because of his characteristic strengths, he was the first president of the Nuclear Science and technology conference which happened in Vienna. You can see the bust of Homi Bhabha in front of the Board of Governors of the IAEA headquarters. In fact, it is argued that he was responsible in taking the IAEA headquarters to Vienna. He was a lover of music and we all know if you are a lover of music, Vienna is the place. If you love coffee and music, I think you can't miss Vienna. You have to go to Vienna and enjoy that.

So he even was instrumental in that. And he found that if I am looking at growing this country to do the high technology and have nuclear energy for society and energy without science diplomacy it would not be possible. he talked to Canada, it was all based on individual friendships and individual trust that a 40-megawatt reactor came to Trombay, Cyrus and out of that we grew the whole science and technology of nuclear energy. Also he used the concept which today we are saying we must pursue. I wish we had pursued all along in these fifty years or sixty years, the diaspora contributing to the nation building. You look at all the people who came at that time to build nuclear science and technology, they were all diaspora. Either they worked partially or they worked full time, they had decided to come to the country and build the country because they were influence and encouraged by the way Homi Bhabha wanted to build this country. I think we need to put momentum, we need to put energy into our some of the thoughts even though they are very good but I think without energy and pace, it dies down very fast. You have to put the pace, energy, direction to be able to realise that.

So I believe the finest example of science diplomacy was set by Homi Bhabha and I think it is all well documented. For any student of science diplomacy, it is worthwhile to study that, that how you can bring from small initiatives, a whole lot of a huge thinking which is sustained over decades. Even today you look at the programmes of the Department of Atomic energy, India, we have changed, we have evolved, we have questioned some of the things but the broad frameworks and the policies and the way of conducting science which Homi Bhabha left, we still follow.

You look at the space which in India and outside India we are all aware of is a great success. All the advanced countries today take pride in coming to India for a reliable launching of their satellites into the space for various purposes. We are the most cost effective, reliable nation for launching satellites of various capacities.

Where did it start? Again Vikram Sarabhai. Another colleague of Homi Bhabha in Indian Institute of Science University system who dared to think big. It started with launching of the rockets which most of the time didn't fly. It started with many failures of the launch vehicles which didn't take off. But again the science diplomacy was at the core and the diaspora was at the core to build the competence of a country which today has taken the mission to the moon, which has taken in an unparalleled way first time success taking a satellite to the Mars. And today if you look at, it is looking at some system of the constellation of the satellites for whatever you think and it has reached every common man.

We talked about the base of the pyramid, we talked about the bottom of the pyramid, we talked of so many things. One area of science and technology which has touched farmers to the fisherwoman and men and to everyone, to the marketer, to everybody, it is the space technology which is again science diplomacy.

So what is the result. What I am trying to convey is that today many countries irrespective of their size and economy, they are realising that without science diplomacy, their thinking or their whole perspective is incomplete. So is it not the opportune time for the professionals and the organisations who are responsible to be proactive, to be providing the funding, choosing the right people, putting a framework so that the time is not lost when the challenges are huge. So I think I see many more opportunities and good examples coming. I noted down when Dr. Sadhna Relia said that why not we put up maybe a series of monographs from each country and the collaborations which changed it. I think that would be very convincing set of our combined thinking to say that what science diplomacy has achieved. Sometimes it is so much that it is lost. And sometimes the people don't see because they feel it was done just by few individuals because it was natural to do. No. it was not natural to do. It was somebody who was thinking very deeply.

Science diplomacy with Russia. We have been strategic partner with very deep understanding for very very long time through thick and thin. Today we build nuclear reactors with Russian collaborations, BVR's. We have whole of our defence apparatus coming from there. On a careful thinking and dialogue, one can say that when you are friends for a long time, you are so competent friends, you have so much demands to be met in your countries, why it didn't go. Is there another paradigm in science diplomacy which is needed to be able to make it ten times more?

When we had a dialogue sometime back, the perspective was that while we did very well to dialogue continuously on strategic, we didn't take the science and technology in these countries to marketplace. There were huge lot of opportunities in both countries where through science diplomacy we could have taken it to the market place. We had also one IIT set up with the collaboration of Russia also, USSR also. Is there something which has grown of that proportion to be able to engulf the whole world and to be able to make a difference. So I think always when you look at that, you have reasons to rejoice and you have reasons to ponder over that things have worked well but certain things have not worked well and what we should be doing with respect to that.

It looks as if you are having various streams and you are trying to make a spider web out of that but there is so much commonality in that spider web also, in the science diplomacy there is so much. The people, if you really look at, who made a difference, they were not smart people, they were people of character. To me it is very very clear, please give me an example if you can find in your country or anywhere in the world, the people who could sow these deep seeds who grew to big oaks, they were all people with character. They were the people who were iconic, the people who had their personal strengths to negotiate at various levels and challenge whenever the difficulties came, they had clarity. And also they were ready to be open, they were ready to dialogue, they were humble. They were learning. They were never having the view that I have found an idea and I am going to pursue it that way and I can narrate you for hours and hours whatever stories I have told that what was their learning capacity which finally shaped the outcomes which as they were very beautiful.

Sometimes you believe that your idea would be lost if you go through the labyrinth of the bureaucracy and diplomacy which is unavoidable in any country and I appreciate because bureaucracy and diplomacy has achieved so much that anybody to say that bureaucrat is delaying, no, bureaucracy is shaping, always bureaucracy is shaping a dialogue and looking at a national purpose, national interest and all that. But sometimes you feel that you can pursue an idea. It is just the right.

I remember, I was in Singapore for a few days in the national university of Singapore and I am talking about 15 years back. Nano technology after Feynman and after the president of USA had declared that it would change almost everything and the big things were involved in India, also the Nano mission was just starting, I was a part of it with Prof. C.N.R.Rao. India and China are the big beneficiaries if Nano technology can go for health, water, food, some of the things which Amb Shyam Saran mentioned. What is the way? It doesn't look like that if we go through the normal channel, it would take some time and it might not go through immediately.

And the vice-president of the National University of Singapore, my good friend, Ramakrishna and the president of the international material research society, we were having a coffee, we said, why not we start a forum of India, Singapore and China, a trilateral initiative where we address Nano technology, we would get the best of the researchers, the companies and share it. And all the people would have to put their money, they would have to come on their own but we will provide them the best of the experiences. Every year it would go to a different country. If the first year it is Singapore, next year it would go to China, then it would come to India and now it has stabilised. Now we are saying that how we can bring in the diplomacy here because the potential is huge. We have done for seven years and it has connected so many institutes and organisations, now we are thinking, can we go to the diplomats and see that there is a huge possibility. Sometime back, as a president of the Academy of Engineering and also the President of all the Engineering Academies of the world, we said that when you talk about the leaders, invariably you talk of the leaders coming from USA, from the West and all that. India and China with a population of about 3 billion, should we not create our own leaders. We can create because the opportunities in these countries are so huge, we'd create. But can we bring the young leaders of the two countries year after year and let them dialogue with each other and let them say as to what they learn from each other and how we can carry on. And it was wonderful.

I was there for five days when the first thing was done in Ahmedabad. Now the next one would happen in Beijing when 20 young people from China and 20 young people from India deliberated as to what are their common inspiration, how these two countries can work together to challenge or create huge opportunities, companies like Microsoft or Google or General Electric, can we create the companies like that to be able to do it together or individually or can we share the experience, can we be in networks.

I am sure that some of these young girls and boys are going to progress to top positions in their countries. And imagine 20 years of already nurturing of that relation till they become very important, where would it take these two countries. It is difficult to make a model, it is difficult to say but I think it is possible. So I strongly recommend as one of the outcomes of this kind of a forum would be that in science diplomacy, can we bring the young people year after year between the few likeminded countries who want to challenge and let them deliberate and I can tell you, all of us who have children and some like me who have grandchildren, we know that your daughter smarter than you and your granddaughter is smarter than both of you. I think the ideas come from these young people. They may not have maturity to carry through but I think that is where the mature people are required to be there. but I think the ideas, their neurons are free to dance, they create impossible ideas and if you are clever enough not to ignore that, I think the way of science diplomacy in the future is going to be connecting the people even at the age of 15, connecting them when they are in the universities.

After all, if you look at science diplomacy enterprise, unless we are able to connect the universities to the high-tech science and technology to the market, it would not sustain. I am very sure it is not going to sustain. And what better idea that these people who are going to walk into the universities are in a university, we enrich them, we empower them, we give them all the ideas and then listen to them like what we do with our children, grand- children, with our doctoral students or undergraduates, that we listen from them as to what we are going to do. Because the challenges are so big, the resource scarcity is there, there is a competition. Whether you agree or not, there is a huge competition between country to country to be able to do on their own and take all the opportunity to themselves. So you need like in any other field, they say 21st century is the century which would be prominently governed by the big data analytics, internet kind of thing, in fact digital, most of it digital but don't ignore the hardware because hardware and software would be together, another area, another time.

But I think the biggest challenge of science, diplomacy is going to arise that whether it is able to be innovative. Within the framework of the countries, what kind of innovations it would be able to do to be able to carry forward the goals which it has done. And I think this would only allow us to provide the enterprise.

That Sadhna Relia mentioned that what could be the innovation? You look at the Centre for Nuclear Research, CERN. How did India start? It was again a few people who decided that we should not miss the opportunity to take part in CERN. Who were the people who contributed? Not the great scientists. It was the young girls and boys from the universities who shifted with their bags to CERN, slept in the CERN labs, and carried out all those difficult experiments and maintained the machine. In the beginning, it was not very easy to run that machine. It is a very complex machine. So you needed a whole lot of people to work on that, coming from different cultures and countries. But India got a confidence to be a player in the international and when the Higgs-Boson particle was there, there are many many Indians who had participated in the discovery of Higgs-Boson.

Laser Inferometer Gravitational waves, many many Indians who have participated without the diplomacy but now it has become a science diplomacy because India is participating as an equal player in the Lego experimental setup which is being done.

And I think we need the innovations at individual levels. Organisations and the countries can produce ecosystems but at the core would remain the individuals who can think differently, who can think out of box and who can carry it forward. To me the science diplomacy is looking for the people who are very innovative to make a paradigm change when, if I may say so, you may challenge it, when the trust in science is not as much as it was in the 19th and 20th century, particularly the 20th century. Because of the various award systems, the scientists are there who have not kept to the ethics. Politicians are viewed in a particular way inspite of their sincerity or lack of it. So in these circumstances it would be some challenges which would be much bigger than what we have envisaged. There are challenges of competing and collaborating, intellectual properties.

Under these things when the challenges are huge, the people are very bright, how do you give them a framework and the opportunity to fail and still accept them. Because innovative people we all know. Alva Edison is given as an example of the most innovative in his times and you continue to get Steve Jobs and people like that who are innovators. They would fail, fail, fail till they make one grand success. In science diplomacy, what is the way to look at the failures. I would call eminent failures, I would not call it simple failures. Just like you can have eminent success, you can also have eminent failure. But are the eminent failures also a part of the learning process. This also is something which one would have to think about as we go along.

So I would like to end by saying that more and more countries are interested to give space for science diplomacy to meet the goals. Diplomats and scientists have never been so close as they are now. They realise that they have to work together to realise the national goals. There are good examples at an international level and national level. What is weak to my perspective at this stage is the role of the universities, role of the learning institutes in the science diplomacy. Unless you have a bedrock of these young girls and boys who are ready to put their minds, first in one discipline and finally shifting to science diplomacy to be able to do that, it would be difficult. And it is also, has to be, to build the characteristics which I mentioned in the beginning that if you want to play any important role, the world has its own criteria of judging you. Unless you have your strengths, you have a capacity to fail, unless you are transparent, unless you can build the relations which last for 30-40-50 years, the outcomes are not likely. Short-term results in science diplomacy are hardly impressive. It is only the long-term when viewed and that means the people have to keep the friendship, they have to keep on solving the problems as they merge and I think if we do that with the ethics being true to our country but also being true to the country with whom we are dealing. Unless you have a character like that where you are respected in both the countries, you cannot build science diplomacy, big projects.

So you have to decide that are you a right person, do you honestly like the culture of the place where you are trying to do something or you are trying to do it only for a shorter cause because it would bring you some glory. If you are ready for that and you feel you are the right person, I think, everybody would come in and they would support you. And I am so delighted that the first course on the capacity building is taking place. I am sure it would grow strength to strength. It would discover many more manifestations and maybe first capacity building programme itself would come with some ideas which would become a game changer to be doing some things together. Thank you very much for the opportunity. I wish you the very best.

National Innovation System of the Republic of Belarus

Kirill Masharski*

Introduction

The challenge of an effective National Innovation System (NIS) would require a complex and a dynamic change in the structure of the organisation; in its innovation activities. Innovation process means a number of interactions among institutions and organisations regarding their functions and aims and also among individuals with their original knowledge and interest.

For building a NIS, it is a must to take into account the specific environment of the nation for which the innovation system would become a part. The point to be noted here is the coherence of the innovation system with the external economic, social and environmental systems. Internal stability of the innovation system also needs to be pursued. It should not be confused with the static state of the system; it is an ability to change dynamically pursuing general aim.

Belarus is a small, open, upper-middle income economy. It is not well-endowed with natural resources, and thus largely relies on the imported energy and raw materials. The country's main activities in the industrial sector are on engineering (agricultural technology and specialized heavy vehicles) and refining (relying on oil supplies from Russia) activities, which depend heavily on the external demand. Trade openness is one of the highest in the region with a ratio of 44 per cent in merchandise exports and GDP in 2009.

The disintegration of the former Soviet Union was accompanied by sharp contraction in output; resulting from losses of external markets and also owing to economic dislocation. The contraction in Belarus was, however, somewhat milder in comparison to other successor states of the Soviet Union; as the domestic

*Lecturer, Belarusian State University, Belarus

policies continued to support demand and manage in reducing impact of post-Soviet economic dislocation. Following a cumulative 40 per cent output decline in 1990-1995, the economy returned to track in 1996, ushering in a phase of rapid expansion when Belarus posted one of the best performances in the Central Innovation System(CIS). In 2000-04, real GDP grew by an average annual rate of 6.8 per cent, accelerating to 9.6 per cent in 2005-08. In spite of a less favourable external environment as a consequence of the worldwide financial crisis and changes in the trade relations with Russia, its economy continued to grow in 2009, albeit at a much reduced rate of 0.2 per cent. Belarusian authorities are following a path of gradual transition towards market economy.

The State has retained significant levers of influence over economy, and privatization of large enterprises has remained limited. In the recent years, authorities have taken many initiatives to improve business environment and promote development of small and medium enterprises. In addition, privatization options are also being considered. State companies continue to dominate production and exports, while rate of creation of new firms is low.

National Innovation System

Innovation in the modern economy is a highly complex process. In accordance with the internationally agreed understanding of the notion of innovation, there are four broad types of innovations: product innovation; process innovation; marketing innovation and organizational innovation. Each type can be associated with different undertakings, and can have various quantitative and qualitative performance characteristics. In addition, every product, which is new to a given market, is also usually considered and counted as an innovation, although the product may have been earlier already introduced to other markets.

For any innovation system to emerge and develop it starts with environment for the innovation, as it provides the overall framework. Next, special attention is to be given to subsystems of the country's NIS, which can be developed further to achieve improvements in the functioning of the NIS .

Belarusian Innovation Potential

To estimate Belarus chances for high rank in the world economic system, the need is to consider objectively its suitability for dealing with the science-intensive production; or the hope would be illusory. The basis of sustainable innovation system depends on the availability of the scientific and research potential.

Belarus has been formerly integrated into the general Soviet scientific and technological framework; ranking high in applied researches in civil industries such as mechanical engineering (29 per cent of all works' costs), electronics (11 per cent), automatics and computer facilities (9 per cent), construction and architecture (8 per cent), chemical technology (7 per cent) (Nehorosheva 1996). Industry is the basis of Belarusian economy: its share in the gross domestic product accounted for 65 per cent. This made Belarus one of the most heavily industrialized countries of the world. Generally, 79 per cent of technologies applied in Belarus related to the traditional level and 21 per cent to the advanced level. Of them, 38 per cent worked out in Belarus (*Development of Science in Belarus in 2000*). About 48 per cent applied technologies were introduced before 1985, and 23 per cent were used in the last years (Slonimski 2001).

Scientific, technical and innovation polices in Belarus are being oriented towards building a National Innovation System. Management of R&D in the country is by realisation of the state scientific and technical programmes in fundamental and applied sciences. Belarus was one of the first CIS members to work out legal base and operate on managing state scientific and technical programmes, which are the major tools at present for setting prior directions for R&D activities.

Applied R&D is mostly carried out in a common framework of: (i)) state scientific and technical programmes (SSTP); (ii)) innovation projects; and (iii)) branch and regional scientific and technical programmes. Sources of the SSTP finances are budget funds, funds of the enterprise, funds of state customers, budgets of the regions and borrowed funds (Anna I. Pobol **year?**). The legal framework for the SSTP consists of more than 150 papers, worked out for different levels of management [participants, several stages, and aspects of innovation process (financing, intellectual property protection, tax, customer, and other preferences, etc.)]. In general, the system of the SSTP is logically built and prospectively-oriented. Yet, the maximum use of its opportunities is expected to be provided by the economic situation and stabilization in a country with market mechanisms.

Environment conducive to innovation

In early 1990s, Belarus declared openly its strategic policy objective to develop an economy based on the science and technology. Since then, more than 25 Laws and Presidential decrees have been introduced; some 40 governmental decrees were issued and many other legal acts were relevantly placed to be contributing to this aim. All these have created an effect of broad awareness and recognition of science and technology for economic prosperity of the country.

In 2007, with the approval of the State Programme for Innovative Development (SPID), the main emphasis was on the innovation, resulting from commercialization of scientific outputs. This programme introduced the concept of national innovation system and governance. Subsequently, substantial efforts were made to organize institutional element of the National Innovation System. Role of different levels of government as well as national and regional level governmental institutions has been defined. The strategic goal of the SPID is for an innovative, competitive, science-based, sustainable and socially-oriented economy of Belarus.

Components of the innovation system

- Laws and regulations;
- National strategic priorities and their translation into programmes at all levels;
- Sources of financing and human resources; and
- Allocation of responsibilities at the national, regional, local as well as the institutional levels for management, organization and control of programmes.

The Concept of the National Innovation System has been developed on the basis of the National Strategy 2020; the Technology forecast 2006-2025 and other strategic documents of the ministries and other governmental bodies. The Science and Technological Policy Committee of the Council of Ministers had approved the concept on 8 June 2006. The concept recognizes sectoral approach as the predominant one in the development and implementation of the science and innovation policy. It rightly points out some of the weak points of the existing NIS; in particular, the entrepreneurial sector, which still does not perform adequately the role of being one of the main catalysts for development of the innovation infrastructure and market.

State programmes of innovation development

The main objectives are creation of globally competitive, innovative, high-tech, resource and energy-saving, environment-friendly economy, ensuring sustainable socio-economic development of the country, and thus enhancing quality of life of Belarusian people.

Key tasks

Creation of new high-tech and knowledge-intensive sectors (biotechnology, nanotechnology, microelectronics, technology, fine chemistry, information technology, new materials, laser-optical technologies, communication technologies, alternative energy, genetic engineering, etc.);

- Creation of new industries, and reconstruction and modernization of existing ones in export-oriented industries (pharmaceutical, chemical, agricultural machinery, wood-working, etc.);
- Creation of new multi-holdings, cluster structures, entry into world's global corporations and alliances, attracting TNCs, reducing material-energy and import-

production, increasing it ecological safety;
- Regional innovation development acceleration;
- Escalation in export potential of Belarus ;to be in the top 30 most competitive countries; and
- Formation of an innovative society (Innovative education).

Recommendations

Science Diplomacy is as like deepening international integration and cooperation can result in improved opportunities for scientific and technological progress and enhanced access to new technologies, including through diffusion of tacit knowledge. These beneficial effects can take place through a variety of channels, including projects, technology transfer to lesser developed sectors and improved employment prospects for scientific staff.

The prevailing understanding of the notion of innovation in Belarus, which is also embodied in the policy domain, emphasizes on the science-based technological innovation. The internationally agreed understanding of innovation is much broader in scope, and distinguishes four types of innovations. From this perspective, the actual coverage of the policy measures that fall into the domain of "innovation policy" in Belarus are probably narrower in scope and coverage than corresponding measures in other countries which adher to a broader interpretation of the notion of innovation. A truncated innovation policy may lead to inefficiencies in performance of the National Innovation System.

Some of the recommendations are as follows:

- Broaden the scope of policy measures and instruments that fall into the domain of "innovation policy," with a view to align national with international coverage of innovation policy and raising efficiency of the policy mix;
- Undertake critical assessment of the innovation policy mix in Belarus with a view to compare its coverage with other countries and identifying mismatches;
- Based on the assessment, plan steps for broadening scope of policy measures and the instruments falling into the domain of "innovation policy" (some policy measures of this type are contained in further recommendations);
- Undertake an awareness-raising campaign related to above changes, targeting policy-makers with responsibility for innovation policy, and all policy-makers and general public.

There is a broad awareness and recognition of the importance of innovation for future growth and competitiveness of Belarus by the authorities. As the result, substantial efforts have been made to organize institutional element of the National Innovation System. There have also been important steps to create essential elements of innovation infrastructure. However, the focus has largely placed on the administrative (institutional) elements of the NIS rather than on the links and interactions among different subsystems (e.g. business, science, education, infrastructure, etc.).

Conclusion

Vitality and effectiveness of innovation systems have always depended on the efficiency of the flow of information among the participants. Access to relevant information is thus one of the vital elements for successful operation of the innovation system at local, national or European level. One of the most effective tools for supporting and encouraging innovations is an information campaign, addressed to businessmen, though it is often kept for a trivial waste of tax bearers' funds.

The accessibility of information becomes useful only when the ability to absorb and integrate the knowledge diffused for the production process. This proves once again, that in an innovation system, responsibilities for knowledge diffusion should be coherently and consistently among decision-makers – universities, research institutes, enterprises, and all intermediate links, as spin-off firms and innovation infrastructure institutions.

Ignoring these features of an innovation process, we risk achieving innovatively cut-off advantages because the country, being not able to deal with advanced environmentally friendly and socially compatible technologies; having no idea of how to improve the situation. It is, therefore, of utmost importance to realise that innovation system needs are somewhat different from just promoting innovations in the industry and development of science-intensive technologies – the background of its success is rather on the innovativeness of the mind of society, involvement of society into innovation process, and society's openness to innovations.

References

Development of Science in Belarus in 2000. Analytical Report. 2001. Minsk: State Committee on Science and Technologies of the Republic of Belarus.

United Nations Economic Commission Innovation performance review. Belarus. http://nasb.gov.by/reference/icp4.pdf

Anna I. Pobol. Building a sustainable national innovation system: case of Belarus.

Irina I. Kolesnikova. The problems of development of national innovation system.

Nehorosheva, L.N. 1996. Scientific and Technological Development and Market. Minsk: Belarusian State Economic University.

Slonimski, A.A. 2001. "Technological Level of Production and Competitiveness of Export Goods in the Republic of Belarus." In Innovative technologies. Theory and Practice (INNOTECH-2001). Gomel: 63-68.

Science Diplomacy for Innovation Policy of Russian Universities

Filipova Irina*

Gvozdeva Daria**

Galitskaya Veoletta***

Introduction

Russian Federation is in a state of economic instability as is the whole world. This fact is for understanding the need for a deep modernization of all sectors of the Russian economy. Development of the strategy for an advanced society and for cultural modernization of the country is an important mission. This can mostly be possible by adoption of innovation technologies. As Science diplomacy can accelerate exchange of technologies, it would be useful for all the participants of the global process.

Research Results

Development of innovation strategies in Russia can be divided into two main phases. At the first phase, which was up to 2014, the Government of Russia created basic elements of innovation infrastructure and supported innovation projects and initiated transformation of scientific sphere. Government programmes were aimed at developing high-tech sectors of the economy and in creating system of institutional development in the innovation sphere including SKOLKOVO (2010), Association of Innovation Regions of Russia (2010), Fund for Infrastructure and Educational Programs (2010), Fund "VEB-Innovations" (2011) and Russian private equity fund (2011).

During the second stage, there has been a rethinking on the functioning of the currently existing system. At present, the main focus is on improving efficiency of state power, promoting development of state-owned companies and private businesses, besides development and improvement of the institutionnal system[1]. Priority goals for 2016 were as follows:

** PhD in Law, Associate Professor, Law Department, Lobachevsky State University, Nizhny Novgorod, Russian Federation, Russia*
*** Expert, Department for Publication Activity, Tomsk Polytechnic University, Tomsk, Russian Federation, Russia*
****Recruitment Specialist, Department of International Affairs, Tomsk State University, Tomsk, Russian Federation, Russia*

- Analysing innovation development programme of state companies;
- Evaluating development of institution activities;
- Investing in research work; and
- Initiating national projects with high innovation constituent.

Programme supporting 21 Russian universities. The Project 5-100 has been initiated. Its objective is to maximize competitive position of a group of leading Russian universities in the global market of educational services and research programme.[2]

At the same time, another programme on fundamental scientific research and forecast of scientific and technological development of the Russian Federation up to 2030 was approved. Thirty-five technology platforms in 13 areas of scientific and technological development in the framework of the Federal Target Program, viz "Research and development on priority directions of scientific and technological complex of Russia 2014-2020" has also been initiated.

Russian universities are making great contributions in the innovation development of the Russian Federation. Being public institutions, the universities are the best suited for transferring knowledge to intellectual capital. They are global, open, dynamic sites with a constant inflow of young people. Universities are the centres of excellence and of creation of new technological industries. They are actively engaged in inventing new technologies and transferring them to relevant companies.

The competitive advantages of the universities as centres of innovations are as follows:

- Availability of technical human- resource base;
- Platform for implementation of multidisciplinary research projects;
- Ability to enroll specialists in new areas of knowledge and skill meeting needs of business community; and
- Becoming interactive platform for economic supremacy on a global scale.

However ,there are following problems which need need to be solved. They are summarized as follows:

- To overcome backwardness, universities need to be leaders for building promisingfuture of students ;
- To eliminate clan system as the administrative authorities of the universities have only limited number of people;
- To stop retaining human resources;
- To overcome narrowness in functions;
- University is considered to be a supplier of employees as well as some ideas and technologies. And the University of the forthcoming future would be a reactor transforming regions, industries and countries; and
- Without adequate horizon of prospects, there would not be necessary resources and results.

For attending to these problems, following are required:

- To focus on the future by firmly adhering to targets of quality of work, which would be evaluated by external visionaries (global professionals);
- To emphasise on cooperation with market and companies;
- To create an advanced HR-market with Russian and global industrial leaders;
- To organize transparency in management;
- To make it open for professionals; and
- To develop management ecosystem contributing in the formulation of universities into centres of regional and sectoral ecosystems, focusing on tools and resources of cluster and sector development.
- The university should be a hub for the implementation of the plans for the National Technology Initiation (NTI). The NTI includes a number of activities at the federal level- aiming at formation of alternative approach to innovation policy of the Russian Federation and also to work with promising markets, rather than with scientific developments and existing industries. The NTI is based on an innovation network approach. It is a

programme of measures, designed to create Russian "champions" in fundamentally new markets and striving to make Russia join innovation and technological leaders by 2035.

- The NTI is divided into two areas-"Markets" and "Technologies"-and each includes a certain group of activities. The technology includes digital design and simulation, new materials, additive technology, quantum communication, sensing, bionics, genomics and synthetic biology, neuroscience, Big Data, artificial intelligence and control systems, and new energy sources.4
- Development Strategy of NTI continues till date. The basic provisions were formulated at the Foresight Fleet in spring 2016. One of the main goals of the NTI was the foundation of university-based integrators (SR) and innovation hubs (LR) for NTI market networks.

This requires transformation of universities according to the following objectives:

- To prepare universities for networking with NTI markets;
- To create a chain of basic NTI universities (consortia members) for solving scientific and technical problems; and
- To transform universities into universities-hubs for synchronizing business needs and opportunities of academic community.

For achieving these goals, following needs to be done:

- Develop tools to attract talent;
- Create tools for transition from fundamental to applied research;
- Participate in formulation of measures for creation of innovation ecosystem;
- Develop measures for promoting professions of scientists and entrepreneurs; and

Create a system of material and non-material incentives to engage in research activities.

Universities should become more active participants in the innovation development of Russia. Countries at large, including Russia, have prioritized formation of global innovation society by developing and integrating "knowledge triangle" (education, research and innovations), large-scale investment in human resource, development of professional skills and research, and also by supporting modernization of education system to satisfy needs of global knowledge-based economy. The development of relations through science diplomacy would help Russian universities achieving their goals. The exchange of innovation technologies would be mutually beneficial for all.

The world has accumulated considerable experience in innovation development. Countries successful in innovation development have a highly developed friendly environment for scientists, innovators, and entrepreneurs. Europe and the United States have a "down-up" innovation ecosystem, founded on the basis of market needs. Asian countries generally set their own innovation agenda "up-down" which is founded on Government supported projects. Western Governments at present are actively investing in specific research and innovation projects directly or through special funds. Priority in public funding allocation is given to fundamental research.

The Russian Federation should be guided by leaders of innovations. The best practice is to create favorable conditions for supporting the innovations. The Federation allocates sufficient funds for supporting innovation but the environment is still not very congenial. Russia spends money for targeted support to innovation projects but development of favourable environment is lacking; which is typical of Asian countries than Western countries. Russia is far behind Western and Asian leaders of innovations in certain civil, public and business institutions.

Problems in the implementation of innovation policy are not felt in the Russian Federation alone. For example, in some countries, lack of proper infrastructure inhibits significantly development of economy. In India, power generation fulfils to the extent of 90 per cent of electricity demand. Shortage of electricity is the reason for decline in revenue by about 6-9per cent per year. The Government of India and governments of other

Asian countries are working on designing effective measures for modernization of infrastructure, including improvement of techno-legal base.

Inconsistencies in the management and complex regulatory framework are the major obstacles for using business opportunities in developing countries of Asia. This indicates that the priority goal of a number of Asian countries is to go in for reforming legal-base. The Government of India has implemented a series of reforms for improving the investment climate. In the framework of "Make in India" campaign, which aims help India to become a global Production Base, the Government has initiated a programme called "red carpet, not red tape". Creation of "Facilitation for investors' Group" should help foreign companies to resolve regulatory issues. The Indian Government also intends to improve its bureaucratic structure by abolishing a number of government committees and byoptimizing allocation of responsibilities to different ministries, which often overlap. Furthermore, the Government plans to simplify tax system of the country.[5]

Similar problems exist in the Russian Federation also. The "intelligent" aspect of innovation culture in Russia is traditionally strong, but public opinion is opposed to scientists and innovators. Dynamics of public interest in scientific topics is negative: the Russian society is indifferent to science. In the Russian Federation only 20 per cent of the respondents are interested in scientific discoveries and technological advances, and in the United States and China the number comes to around 40 per cent. Modern Russian society does not consider it is necessary to develop knowledge- base,

Policy of improving public attitude towards innovation in the Russian Federation should be aimed at young people. Young people are more open to learning and are willing for generation of innovations. In view of this, role of universities is important.

Following are the ways how the Government of Russia can help universities engage young people in science and innovation.

- To use media for promoting achievements of scientists, innovators and entrepreneurs;
- To reshape school and university curricula in a way incorporating relevant disciplines and teaching methods, thereby awakening interest;
- To encourage training and further training of middle-aged men;
- To encourage scientists and innovators for communicating with a wider audience; and
- To create a platform for communication (exhibitions, fora, magazines, public urban spaces, etc.)

Increasing interest in learning and involvement of young people in the innovation sphere would contribute to upgradation of components right at the school curricula. The existing curricula are based on memorization of basic knowledge and checking using standard tests. This does not pinpoint individual talent of each student. It reduces learning outcomes at the university. Young people have an impression that science is a complex and boring thing. Such an attitude towards science and innovation stops development of active life and thus reduces professional opportunities of young people. This is not true typically for Russia but also for the world as a whole. In some countries, need to improve school education system was realized at the level of society. One of them is Finland, which created "educational miracle" in the second part of the twentieth century.

The Russian Federation also has significant examples of implementation of innovation infrastructures in higher education institutions. On the basis of the active participation of the Russian universities, many forms and patterns of scientific and production integrations, such as training, research and innovation systems (TRIS), educational and scientific-industrial complexes (ESIC) and science parks, were created.

At present, Peter the Great St. Petersburg Polytechnic University-one of the leading polytechnic universities in the country-provides training to specialists and researchers to benefit high-tech industries of the national economy. The main strategic partners of Peter the Great St.

Petersburg Polytechnic University are more than 250 industrial enterprises, research institutes, design bureaus and scientific-innovation firms of high-tech industries. The main foreign partners are more than 220 research centres and universities from 37 countries, and 70 industrial companies and organizations from 19 countries. The University has created a unique structure for Russian educational space -- science and innovation institutes (Institute of Materials and Technologies and Energy, Institute of Ecology and Nanobiotechnology).[6]

Tomsk is a good example of how science and education acquires city-forming status, and development of human resource becomes relevant. Despite the dominance of the primary sector in the economy of the Tomsk region, many experts opinionated the need of innovation development for contributing to the modernization of the regions and the country as a whole. There are many programmes in Tomsk, which are vectors of innovation development.

One of the projects carried out in Tomsk was a special economic zone of technology-innovation, created in 2005. Residents of this zone are high-tech companies involved in areas of medical and biotechnology, high-tech development, and information technologies. The prerequisite for the creation of technology-innovation zone in Tomsk was: high concentration of research centres, nanotech production availability and training of innovation specialists in the city high schools. The purpose of the zone was transition towards innovation economy based on the advanced technology development. These technologies should be implemented in all areas of production, which in future would change the region from resource-based economy to innovation-based economy.

Such an approach helped Tomsk in strengthening its position among innovation cities. Transition to high-tech production became noticeable in all areas of industry. According to experts' evaluation, Tomsk is among the Top-3 leader cities at the country level with following indicators-industrialization, informatization, and implementation of innovations. Some experts distinguish Tomsk region as the leading region in establishing a new innovation cluster. A huge contribution for achieving success was made by two leading universities of Tomsk-National viz Research Tomsk State University and National Research Tomsk Polytechnic University. Both were participants of the Project 5-1007.[7] Another example of the serious impact of the university on the innovation development of the region is the National Research Lobachevsky State University of Nizhny Novgorod. This University occupies a high position in the world rankings for research in physics and biology, and it was also a participant in the Project 5-100. The Lobachevsky State University has entered into a strategic partnership with the leading industrial enterprises of the region, research organizations and institutes of the Russian Academy of Sciences. The new direction for development in the Lobachevsky State University is biomedicine. Developing the system and culture of knowledge transfer, introduction of effective mechanisms for the management of interaction between the University and external customers, and forming a team of qualified experts in the sphere of knowledge transfer for an effective socio-economic development of the Lobachevsky State University are the fundamentals for the success of the university's international strategy. The system for supporting knowledge transfer includes the following:- Innovation Technology Centre, Department of technology transfer and business in the field of science and technology; Centre for network integration with external enterprises; Methodological Centre for Knowledge Transfer; and Regional Centre for International Scientific and Technical Cooperation, and Graduate employment centre.

Siberian Federal University(SFU) is another example of successful venture of the Project 5-100. The most competitive educational fields in SFU are: radio engineering, mining engineering, biology and biotechnology, climate change and biogeochemistry. The SFU is planning to focus on the priority sectors which are traditional for Siberian Federal District:- oil and gas sector, energy, biomedicine, environmental management and ecology as well as the development of human capital. The main goal for the University up to 2021 is to become a part of the global market of research and educational services. The University recognizes the need for accreditation and implementation of innovation educational programmes for entring into the global educational space.[8]

A number of universities participated in implementing innovation development programme of the state-owned companies - Bauman Moscow State Technical University, Tomsk Polytechnic University, etc. Every university has been recommended to create a centre of commercialization – technology transfer – that would contribute in the implementation of the patents (other intellectual properties) to economic entities of the Russian Federation. The universities which received the mentioned income are:- Irkutsk National Research Technical University, Kazan National Research technical University named after A.N. Tupolev, National Research University "Higher School of Economics", Gubkin Russian State University of Oil and Gas, Peter the Great St. Petersburg Polytechnic University, Moscow State University of Technology "STANKIN" and others.[9]

On 14-15 December 2016 participating universities of the Project 5-100 presented their innovations at the IV National Exhibition VUZPROMEXPO at Moscow. This annual forum is a platform for exchange and cooperation among universities, research institutes and businesses. Participants discussed about ways for accelerating technology transfer. One of the main ways for achieving it was the establishment of technology parks by participating universities of the Project 5-100 10.[10] The next step is to expand international contacts of universities of the Project 5-100 through science diplomacy. The development of mechanisms of cooperation in science and technology between Russia and other countries of the world is one of the important tasks. Russia understands that cooperation and science diplomacy is a promising way forward for the development of Russian state and society.

Conclusion

Russian universities can become generators of positive changes in Russian society through translation of ideas about the need to introduce innovation technologies in various fields. The main thing that needs to be done is the creation of favourable conditions to accelerate transfer cycle from fundamental to applied research, as well as to transfer of focus of distribution of state support towards the most priority technologies and developments. Main activities in this field include: forming a system for stimulating research and academic teams aimed at encouraging activities in the development of knowledge transfer; developing a knowledge transfer culture and appropriate skills by means of professional development of researchers, academics and administrative staff of the University; and development of a system for international scientific and technical cooperation. International cooperation in the innovation sphere is important. Science diplomacy is one of the important ways of promoting this cooperation. The more mechanisms there are for international exchang e, more opportunities they can create to build links on an international level.

Endnotes

1. Karandashev A.,*et al*. Innovation Policy of University. Program: Leaders of Changes for Global Universities. Moscow School of Management SKOLKOVO, Presentation slides, Moscow, pp. 2-5 (in Russian).
2. National Report about Innovations in Russia 2015. Project. Part II. *View of the Future*, p. 32 (in Russian).
3. Kuznetsov E. Universities 3.0 on NTI. Presentation slides, Moscow, 2016, pp. 2-4 (in Russian).
4. Danilin I., and Mamedyarov Z. *National Technology Initiative: New Focus and Challenges for Realization of Russian Innovation Policy. Year of Planet 2016*. Preliminary version. https://www.researchgate.net/publication/312197696_National_Technology_Initiative_new_focus_and_challenges_for_realization_of_Russian_innovation_policy_in_Russian (in Russian).
5. National Report about Innovations in Russia 2015. Project. Part III. *Seven Secrets of Innovation*, pp. 44-46 (in Russian).

6. Pertaya, M.V. The Role of Universities in the Innovation Development of Russian Economy. Universum: messenger of Herzen University, 2014 vol. 1, pp. 104-115 (in Russian).
7. Galitskaya V., and Bulatova T. Innovation Region in the views of the Community of Experts. Review of Tomsk State University. Philosophy. Sociology. *Political Science*. 2016, n. 4 (36), pp. 280-289 (in Russian).
8. Development Program of SFU for 2011-2021 years. Site of SFU, February 14, 2017. http://about.sfu-kras.ru/node/8232.
9. Pukhova M. M., Gruzina Y.M., Kharchilava K. P. The Role of Universities Innovation Infrastructure in the Region Development in the Russian Federation. *Indian Journal of Science and Technology*. 2016, vol. 9 (42).
10. Universities and technology transfer: Project 5-100 participants present their latest know-how at VUZPROMEXPO. Site of Project 5-100, December 20, 2016. http://5top100.com/news/49691.

References

Karandashev A. *et.al.*2016. Innovation Policy of University. Program: Leaders of Changes for Global Universities. Moscow School of Management SKOLKOVO. Presentation slides, Moscow, pp. 2-5 (in Russian).

National Report about Innovations in Russia 2015. Project. Part II. *View of the Future*, p. 32 (in Russian).

Kuznetsov E. 2016. Universities 3.0 on NTI. Presentation slides. Moscow, 2016, pp. 2-4 (in Russian).

Danilin I.,and Mamedyarov Z. National Technology Initiative: New Focus and Challenges for Realization of Russian Innovation Policy. Year of Planet 2016. Preliminary version. https://www.researchgate.net/publication/312197696_National_Technology_Initiative_new_focus_and_challenges_for_realization_of_Russian_innovation_policy_in_Russian (in Russian).

National Report about Innovations in Russia 2015. Project. Part III. *Seven Secrets of Innovation*, pp. 44-46 (in Russian).

Pertaya M.V.2014. The Role of Universities in the Innovation Development of Russian Economy. Universum: messenger of Herzen University, 2014 vol. 1, pp. 104-115 (in Russian).

Galitskaya V. and Bulatova T. 2016. Innovation Region in the views of the Community of Experts. Review of Tomsk State University. Philosophy Sociology Political Science, n. 4 (36), pp. 280-289 (in Russian).

Development Program of SFU for 2011-2021 years. Site of SFU, February 14, 2017. http://about.sfu-kras.ru/node/8232.

Pukhova M. M. Gruzina Y.M. and Kharchilava K. P. 2016. The Role of Universities Innovation Infrastructure in the Region Development in the Russian Federation. *Indian Journal of Science and Technology*. vol. 9 (42).

Universities and technology transfer: Project 5-100 participants present their latest know-how at VUZPROMEXPO. Site of Project 5-100, December 20, 2016. http://5top100.com/news/49691/.

Role of Science Diplomacy in Procurement of New Nuclear Power Station in South Africa

Sakhile Manyathi*

Introduction

South Africa is poised to embark on an ambitious programme for establishing 20, 000 MW additional power units over the next 20 years and more. This programme aims diversion from coal generation (currently about 90 per cent) to nuclear and renewable sources for ensuring affordable power supply in areas far from coal deposits. The purchase of a fleet of nuclear power stations would be a major opportunity for placing a cluster of high-technology industries supporting the following: (i) manufacturing of PWR reactors; (ii) supply of fuel to reactors; and (iii) civil and maintenance services. This would result in a progressive development of human capacity and infrastructure. Nuclear build would involve establishment of conversion, enrichment and fuel manufacturing capabilities and also in manufacturing key reactor components. Local industries would manufacture pumps, valves and "non-nuclear" components and would be involved in civil engineering aspects. To be successful, nuclear build would require thousands of scientists and engineers, and tens of thousands of artisans and semi-skilled workers; which is where the Science Diplomacy would come to play an important to have nuclear scientists from science diplomatic countries to South Africa; as South Africa does not have enough of world-class nuclear scientists.

Background

According to the WNA (2010), South Africa is the only country in Africa with a commercial nuclear power plant with two reactors - at the Koeberg, accounting for 4 per cent of South Africa's electricity production. Spent fuel is disposed of at the Vaalputs Radioactive Waste Disposal Facility in the Northern Cape province of South

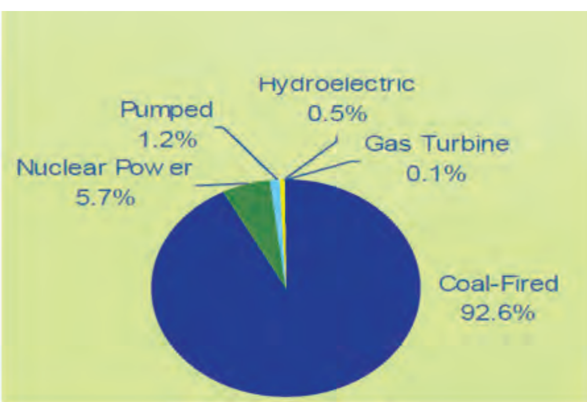
**Deputy Director: Supply Chain Management Training, Department of National Treasury, South Africa*

Africa. The SAFARI-1 tank in pool research reactor is located at the Pelindaba Nuclear Research Centre at Gauteng province of South Africa.

In South Africa, electricity market grew from $1.4bn in 2009 to $5.6bn; and electricity generation is dominated by the state-owned power entity Eskom, which currently produces over 96.7 per cent of the total power used in the country. Eskom has a current nominal installed capacity of 44,175MW. The Government is addressing electricity supply issues with Eskom and Independent Power Producers (IPPs). South Africa needs over 40,000 MW by 2025. Eskom is a part of the Southern African Power Pool, a group of state utilities in Southern Africa, managing electricity matters for the respective Governments; it gives Eskom a great bargaining power over peer countries (Eskom 2013).

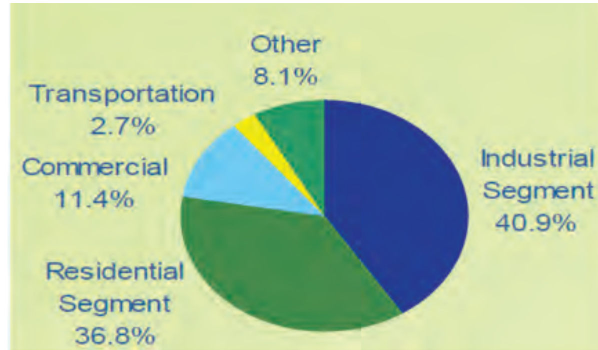
At present, transmission of electricity in South Africa is undertaken by Eskom. The state-owned company has over 28,000 km of transmission lines, spanning the entire country. Electricity distribution is the final stage in the delivery of electricity to end-users, currently undertaken by Eskom, together with the selected local municipalities (Figs 1, 2).

Figure 1: Electricity Production



Source: DME (2013).

Figure 2: Electricity Consumption



Source: DME (2013).

Discussion

Science diplomacy

Science Diplomacy is the use of scientific collaborations among international communities to address common scientific challenges and to build constructive global partnerships and cooperations (Saxena, 2017). Campbell (2012) asserted that scientific cooperation is a useful part of diplomacy which works on problems across borders and without boundaries; cooperation being made possible by international diplomatic language and methodology of science; cooperates in examining evidence which allows scientists to get beyond ideologies and form relationships; and allowing diplomats to neutralize politically explosive situations and tensions.

Role of science diplomacy

According to AAAS (2010), *New Frontiers in Science Diplomacy* report, there are three main roles relating to science diplomacy, and one of them is specifically related to South Africa's following two major scientific projects.

Foreign policy objectives with scientific advice: Science can be used to inform diplomatic decisions or agreements, which can be called science in diplomacy. In this, a scientific study can set out relevant evidence to help resolve disagreements among two or more countries.

International science cooperation: Diplomacy for science often refers to the flagship international projects in which countries come together to collaborate for high-cost and high-risk scientific projects which could not be conducted otherwise by an individual country. It also refers to set of policies, such as those governing international travel to facilitate international science cooperation.

Improving international relations between countries: Science for diplomacy refers to use of science as a means to improve strained relations among countries. For example, science cooperation agreements and joint commissions between the United States and the Soviet Union or China during the cold war very well illustrate the role of science and scientists in diplomacy.

A typical example for South Africa is clearly illustrated when using the second type of science diplomacy role, where huge scientific projects, which are high on risk and costs, are undertaken by the country in the form of Square Kilometer Array (SKA) build and nuclear energy build. However, in this paper, focus would be on the nuclear energy build. South Africa would need international diplomatic science cooperation with countries like India, especially on the project of SKA, and most definitely for cooperation for nuclear energy build from USA, China, France, Russia, Japan, to deliver on these two very risky and costly scientific projects. Therefore, this kind of scientific diplomacy international network would be crucial for ensuring two scientific projects to become a success in the country.

Most recently, in a media statement on 1 February 2017, Eskom's Interim Group Chief Executive Officer, Matshela Koko, stated, "Eskom is pleased to report that the response to the Request for Information (RFI) it issued in relation to the proposed South African Nuclear New Build Programme has been very positive. Some 27 companies have stated that they intend to provide a response to the RFI, including major nuclear vendors from China (SNPTC), France (EdF), Russia (Rusatom Overseas) and South Korea (KEPCO)." This is an indication that more science diplomacy would be needed by South Africa in its quest to deliver first of its kind mega nuclear build in Africa.

Science diplomacy in advancing South Africa's nuclear energy build: Science diplomacy seeks to strengthen interdependence between the interests and the motivations of the scientific and the foreign policy communities. International cooperation is driven often by the desire for accessing the best people, the best research facilities and the new sources of funding; that's what South Africa also needs. Science offers useful networks and channels of communication, which can be used to support wider policy goals. International relations ministries need to place greater emphasis on science within their strategies, and should draw more extensively on scientific advice in the formation and delivery of policy objectives, as was indicated by BRS (2010). In the UK, the appointment of Professor David Clary as the Chief Scientific Adviser at the Foreign and Commonwealth Office (FCO) created an important opportunity to integrate science across FCO priorities, and to develop stronger linkages with science-related policies in other Government departments. Therefore, similar strategies are required by South Africa, wherein mechanisms help achieve the above would include the following:

- Involving more scientists in international relations ministries to advise at the senior and strategic levels;
- Encouraging independent scientific bodies to provide science policy briefings for foreign ministry and embassy staff;
- Encouraging recruitment of science graduates as part of the general intake to the international relations service;
- Ensuring messages regarding the value of science are promulgated throughout foreign ministries and embassies, including all Heads of Mission;
- Incorporating science policy training into induction courses and training for international relations ministry staff and specialist diplomatic training for dedicated science officers;
- Encouraging secondments and pairing among diplomats and scientists internationally; and
- Removing barriers for diplomatic science exchange on South Africa's nuclear energy build.

There are many limitations to science diplomacy which must be taken into account during the commissioning of the two high- risk and high- cost scientific projects, which include regulatory barriers such as visa restrictions and security controls (Joseph 2007). Immediately after 11 September 2001, more stringent travel and visa regimes in the countries like the USA and the UK limited drastically the opportunities for visiting scientists and scholars, particularly from Islamic countries; which if it happens to South Africa, would be a hindrance to nuclear build project. Although efforts have been made to unpick some of these strict controls, still there are significant problems with free mobility of scientists from certain countries. Such policies shut out talented scientists and stop potential opportunities of building scientific relations among countries (BRS, 2010). Security controls can also prevent collaboration on certain scientific subjects such as nuclear physics and microbiology. Although these policies are based on legitimate concerns over the dual use potential of some scientific knowledge, they should also take into consideration diplomatic value of scientific partnerships in sensitive areas to help rebuild trust among nations, especially countries collaborating in major risky and costly projects, like South Africa.

Global trend on nuclear energy

As has been outlined by the WNA (2010), nuclear energy accounts for 15 per cent of world's production of electricity, and in some countries like France, there is no alternative for short term; as 80 per cent of the electricity is from nuclear reactors.

Nuclear energy is the energy held in the nucleus of an atom; obtained through two types of reactions - fission and fusion. Nuclear fission gives energy through splitting of atoms, which release heat energy to generate steam and then that can be used to turn a turbine to produce electricity. All of the present nuclear plants use fission to generate electricity. The fuel most commonly used for fission is uranium; although additional elements such as plutonium or thorium can be used (WNA, 2010).

Nuclear power plants account for 15 per cent of the global electricity generation, and 80 per cent of the installed capacity is in the Organization for Economic Co-operation and Development (OECD) countries like USA, Denmark, etc.; all of this is through nuclear fission. Nuclear energy through fission can release 1 million times more energy per atom than fossil fuels. It can also be integrated into electricity grids, which utilize fossil-fuel generation with a few changes in the existing infrastructure. Nuclear energy has large power-generating capacity and low operating cost, thus making it ideal for base load generation. However, up-front capital costs are intensive and present financial risks for investors. Given to an extended time-frames, power plants must be operated to recuperate costs. Nuclear energy does not emit greenhouse gases. For this reason, it is often seen as a substitute for fossil fuel energy generation, and also a right solution for mitigating climate change (leRoux, 2008).

Nuclear energy build in South Africa

South African Government would need international cooperation and partnership as it doesn't have enough world-class nuclear scientists.

The Minerals and Energy Minister Tina Joemat-Pettersson of South Africa indicated that nuclear build is non-negotiable for South Africa as the country lacks adequate water to support coal-fired power generation; this was stated when many non-governmental organizations (NGOs) and opposition parties had rejected new nuclear energy build while citing among other reasons such as high cost involved (DME, 2011).

According to DME (2011), a Funding Strategy of approximately $5 billion is required - 60 per cent would be invested in advanced manufacturing industries; 20 per cent in technology development and 20 per cent in skill transfer and development. The private sector would lead from the beginning in shallow localization areas (civils), and the funding from the state would be deployed to develop capacity in advanced areas. A coordinated

Table 1: Proposed South African Power Reactors: Draft Updated IPR Base Case

Power plant	Type	Gross capacity MWe	First power
Thyspunt and/or Duynefontein	VVER-TOI? CAP1400?	1360 1360 4080	2037 2039 2041
total		6800	

Source: DME (2011).

approach using expertise in organizations such as the Industrial Development Corporation would be required. It should be noted that the cost estimate to stimulate localization is only about 2.5 per cent of the cost of the new build. In terms of the draft Integrated Energy Resource Plan, an average annual increase in electricity demand is estimated at 2.17 per cent for a high level of energy intensity and at 1.31 per cent for a low level one.

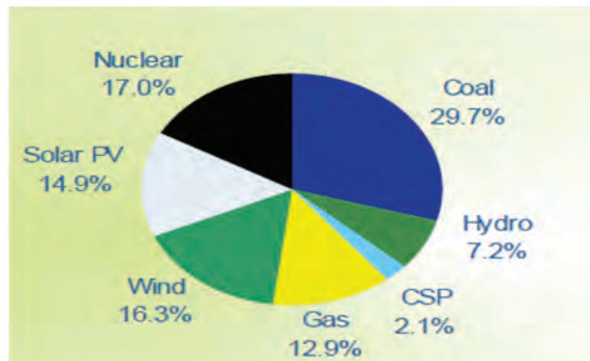
In the 2011 *Draft Integrated Energy Resource Plan for South Africa – 2010 to 2030*, five nuclear prospects were revived for 9600 MWe (in contrast to the data in Table 1); supplying 23 per cent of the electricity. In November 2011, a National Nuclear Energy Executive Coordination Committee (NNEECC) was established for decision-making, monitoring, and general oversight of the nuclear energy expansion programme (Figs 4, 5).

Advantages and disadvantages of nuclear energy in South Africa: China has a huge target for nuclear energy of 80 GW by 2020 but that too came under attack by the NDRC (reform commission of China), which proposed lowering it by substituting it with other renewable energy sources, like solar energy (DST, 2007).

Advantages. *No greenhouse gas emission/air pollution.* Nuclear electricity does not produce any GHG or cause air pollution as it is from combustion of fossil fuels, coal, oil and gas. This makes it an attractive option as the source of cheap, non-carbon-dioxide producing electricity.

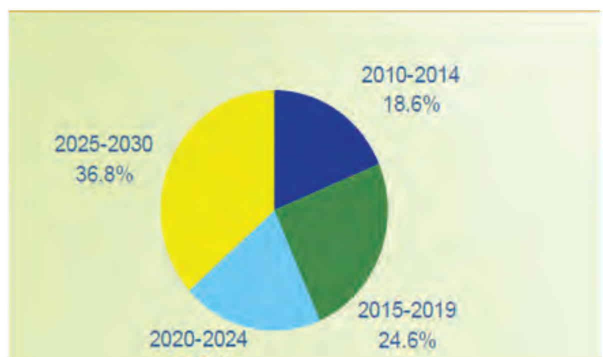
Low fuel cost: Large amounts of nuclear energy can be produced from fission of radioactive elements, like uranium. The cost of nuclear fuel is relatively low compared to other energy sources, like coal and gas.

Figure 3: Planned New Generation Mix 2030



Source:DME (2011).

Figure 4: Time Schedule New Power Generation Building



Source:DME (2011).

Reliability: Nuclear energy is a highly reliable form of energy, almost as good as other fossil fuels. Nuclear power plants, only in exceptional situations, continue to run reliably for the whole day without any changes.

Disadvantages. *Nuclear and radiation accidents.* This is the biggest disadvantage of the nuclear energy, and in 30 years, it happened three times in Japan, Russia and the USA. The fear of a repeat is so great that despite all safety arrangements touted by the nuclear equipment operators and suppliers, this type of energy faces uncertain future.

Nuclear waste disposal: The spent Nuclear Rods of Nuclear Reactors are prohibitively costly and difficult to dispose of. Spent nuclear fuel is very highly radioactive initially and must be handled with great care.

High capital investment, cost overruns and long gestation time. The time to construct a large nuclear power project can take from 5 to 10 years, which leads to time and cost overruns. The Nuclear Plant built in Finland was one of the biggest failures in Project Finance. The reactor was delayed by many years, and led to massive cost and time overruns.

South Africa's new energy mix and diversification

Government is committed to diversify its energy mix, and this includes introduction of renewable energy at a larger scale (DME, 2011).

Incentives for mixed energy generation. According to DME (2013), South Africa gives incentives such as rebates for installation of energy efficiency and demand-side management interventions, tax credits for deploying energy efficiency interventions, and tax credits for investing in green field projects. The South African government has allocated R20 billion to Industrial Development Corporation (IDC) to invest in green projects.

Government policies in mixed energy generation. The following are some policies- Renewable Energy White Paper 2003; Energy Efficiency Strategy 2005; Regulations on Energy Savings Allowance 2011; An Integrated Resource Plan 2010 – 2030; and New Generation Capacity Regulations 2009.

Renewable energy industry. South Africa's renewable energy industry is growing but it is still in infancy. Renewable energy would contribute to a total of 18.2 GW by 2030 (about 42 per cent of the new renewable energy build), comprising wind- 8.4 GW; solar PV- 8.4 GW, CSP- 1 GW and others 0.4 GW. South Africa's Minister of Minerals and Energy is determined to procurement of 3,625 MW across different technologies (diversification).The country has limited natural gas resources (accounts for 3 per cent of energy consumption). South Africa is expecting for the outcome of the assessment of shale gas potential, estimated to be approximately 485 trillion cubic feet by the USA Energy Information Administration. Petro SA (state owned petroleum entity) efforts to source gas for its Gas-to-Liquid facility in Mossel Bay from other African countries are also underway. Integrated Energy Plan 2010-2030 expects imported gas to meet 6 per cent of all new generation capacity and Open Cycle Gas Turbines (OCGTs) to meet 8 per cent (DME, 2011).

Diplomatic Science relations with global country nuclear experts

According to the NIASA (2007), Russia already has a firm presence in South Africa's nuclear sector. Since two decades, Tenex, a subsidiary of Rosatom, is supplying fuel to Koeberg nuclear power plant . Unlike most of the other nuclear plant vendors interested in being picked to supply South Africa in all or in part of its desired 9.6 GW (probably 6-9 units), Rosatom has a complete and running example of the design that it would be most likely to bid in any future tender in South Africa. Novovoronezh 6 reactor has been connected to the Russian power grid in August 2016. Rosatom also has an advantage of a strong order book so far including 42 units; this makes for an attractive sales pitch from the company to participants in its supply chain. Numerous repeat purchases, make it worthwhile to invest in quality control, design engineering and material processing capabilities required to become an approved supplier.

Russian Rosatom would not be alone in trying to make committed nuclear plant deals with South Africa. Westinghouse (USA) and Areva NP (France) have had a long presence in South Africa; the existing reactors at Koeberg were built by Framatome, one of Areva's ancestor companies. Both Westinghouse and Areva have several modern units under construction, but neither yet completed any of their Generation III or Generation III+ reactors. Therefore, there are still to be discovered. South Korea's Kepco, which is currently building four of its APR-1400 reactors in the UAE, would also be a strong contender. Like Rosatom, Kepco's modern export reactor design, APR-1400, has a complete running model to be shown to prospective customers, like South Africa. The unit, Shin Kori 3, was connected to the national grid of South Korea in January 2016; it has nearly a year's worth of operating experience.

Domestic challenges in diplomatic relations with possible bidding countries

The Government's nuclear programme is facing general public opposition. South African Faith Communities Environment Institute (SAFCEI) and Earthlife Africa Johannesburg were in court on the 13-14 December 2016 in a bid to overturn nuclear build programme; which was lost in the court.

The decision to proceed with the construction of a fleet of nuclear power plants in South Africa is destined to become a financially most far-reaching and consequential defining moment of the present administration.

There is a widespread public apprehension for nuclear expansion process. Its roots lie in the extraordinary announcement in 2014 that Russian nuclear agency, Rosatom, secured the rights to build new South African nuclear plants; which was denied by South African Government (INGEROP, 2015).

Critiques by communities to nuclear energy build

The debate surrounding the nuclear project centres was on the following three highly contested questions:

- Is the country's future energy generating potential and demands are such that an expensive nuclear power station building is unavoidable?
- Can South Africa afford associated costs and debt, especially in view of the massive funding demands from other sectors, such as education?
- If approved, would nuclear build result in massive overspending, corruption and beneficiation of politically connected individuals?

Transfer of scientific skills for nuclear energy

The key principle driving technology strategy would be a progressive localization of value chain, through local innovation or technology transfer or through Science Diplomacy programmes with sister countries.

As per the report of skills strategy by the DME (2013), probably the most important aspect underpinning success of South Africa's nascent nuclear cluster is skill development. At full bloom the new build, including industrial localization, would require over 30,000 graduates and over 50,000 artisans. In about five years from now, approximately 4,000 technical university graduates and 5,000– 8,000 new qualified artisans per annum would be required. The current total university enrolment is not enough as there are only about 750,000 learners, with only 30 per cent of them being science and engineering students (DST 2007). It is clear that to compete with other industries and other countries in attracting skills, drastic measures would be required. Key to attracting talent to the industry would be proper outreaching of nuclear cluster vision. Unless young South Africans understand clear and exciting career prospects and Government backs their education and training with resources, these plans are bound to falter. A comprehensive and imaginative communication strategy would be a decisive factor.

The formation of the Nuclear Industry Association of South Africa (NIASA) in 2007 was an important first step (NIASA 2007). The leveraging of supplier relationships (Areva, Rosatom, Westinghouse, etc.) would be critical;

which is the role of Science Diplomacy in transferring technological skills. The emphasis must be on the long-term transfer of skills capacity to South Africa, as it has happened successfully in South Korea over the past three decades. Bilateral relationships with supplier host countries (e.g. France, USA, China, Japan, Russia) as well as key 'South' countries, such as Brazil, India or even all member-countries of an association of five major emerging national economies, Brazil, Russia, India, China and South Africa (BRICS), would also be important. Locally, the identification and proper funding of training and educational institutions, from secondary school-level upwards, directly linked to nuclear build and operating programmes, is essential. Aggressive recruitment of engineers and scientists from abroad, who would contribute a lot on nuclear energy scientific skills transfer, would be of paramount importance (KPMG 2013).

Conclusion

Energy squeeze in South Africa can be turned into advantage in providing drive and funding behind promoting currently resource-based National System of Innovation to a knowledge-based one. Achieving this would require a focused effort. Galvanizing nation behind such a flagship programme would in turn require political vision and dedication in facing competing needs of the South African citizens. The notion of using a power cluster, especially a nuclear power cluster, to leverage economic transformation, may be offbeat in the face of conventional notion of development, particularly where the locus of political discourse lies with the plight of profoundly disadvantaged than to be potentially well-off. This is a choice facing political leadership in South Africa: the need is to be bold and take up the challenge to turn crisis into success, or remain at the mercy of commodity prices in a resource-scarce-based economy.

References

American Association for the Advancement of Science (AAAS). 2010."Science Diplomacy is Crucial to U.S. Foreign Policy". Partnership for a Secure America. Centre for Scientific Diploma

British Royal Society (BRS). 2010. "Miliband urges greater role for science diplomacy". British Royal Society. 30 Jan 2010.

Campbell, C. 2012. "A Consortium Model for Science Engagement". *Science & Diplomacy*.

Department of Minerals and Energy DME. 2011. Integrated Resource Plan 2010-30, Department of Energy's Report, 2011.

Department of Minerals and Energy DME. 2013. Cost of Nuclear Power, Department of Energy's Report by INGEROP, 2013.

Department of Science and Technolgy DST. 2007. National Survey of Research and Experimental Development, 2004/05 Fiscal Year.http://www.dst.gov.za/publications-policies/strategies-reports/reports/RDsurvey_results.pdf.

Eskom. 2013. International Strategies at Securing Uranium Resources, Eskom Report on Uranium Policies 2013.

INGEROP. 2015. Economic Impact of Localisation of Nuclear New Build Programme, Department of Energy's Report by INGEROP, 2015.

Joseph, N. (2007). "Smart Power". Huffington Post. [ONLINE] Retrieved 10 February 2017.

KPMG. 2013. Benchmark of Procurement Framework, Department of Energy's Report by KPMG, 2013.

leRoux, C. 2008. The Eskom New Build.http://www.niasa.co.za/media/manufacturing/events/events-2008/3_eskom.pdf.

NIASA. 2007. http://www.niasa.co.za.TSAPRO.(2008). TSAPRO main document, courtesy of Edwin Ritchken.

Saxena, S.K. 2017. Role of Science in Export Trade. Paper presented at RIS, New Delhi, India.

World Nuclear Association WNA. 2010. Nuclear Power in South Africa. December 2011. Retrieved 17 January 2017.

Space Science and Sustainable Development Goals: Mexico's Experience

Balan Gutiérrez*

Introduction

Like never before, humankind has experienced acceleration in growth and improvement of well-being in the present century. However, most countries still face considerable challenges: poverty; lack of access to health-care, education and basic services; migration, humanitarian crisis, among others; Space science and technology is a valuable tool to override these challenges.

Recognizing that humanity must face these challenges in a cooperative way, the year 2015 was a milestone for International Development Agenda, and some other important instruments were adopted for the forthcoming years. The 2030 Agenda for Sustainable Development and Sustainable Development Goals (SDGs) [1], the Sendai Framework for Disaster Risk Reduction[2] and the Paris Agreement on Climate Change[3] would shape the way for cooperating and addressing these matters; and space science and technology can play a crucial role.

Space technology and applications contribute to socio-economic development in many ways, especially in resolving basic societal needs such as food security (precision agriculture, crops productivity and livestock monitoring, drought observation), education (tele-education, science outreach), health (telemedicine, tele-epidemiology or space medicine), communication (satellite telecommunication services to isolated localities), employment (industry development, entrepreneurship), security (disaster risk management, coastal water resources monitoring), and so on and so forth.

Science and technology's contribution in development has been recognized at the international level. Predecessors of the SDGs included Millennium Development Goals (MDG) and Rio +20 Agenda for sustainable development.[4]

* *Director of International Affairs, Mexican Space Agency, Mexico*

The data collected from artificial satellites has been very useful to fulfill desired societal needs[5], considering their main capabilities as following:

- Telecommunications;
- Earth observation; and
- Positioning.

Regarding SDGs, there are 17 goals and all of them can be supported by space, but not all of the 230 indicators and 169 targets are appropriate for space science and technology. In the following paragraphs, Mexican experience with some examples of current projects in different institutions and their contribution in meeting targets of the SDGs have been described.

Contribution of Space Science to SDGs

The first telecommunication Mexican satellites were launched in 1985. Just a few years ago, the Mexican Government decided to create a national space agency. The mission and vision of the Mexican Space Agency[6] (AEM for its acronym in Spanish) is to promote development and use of space science and technology to improve quality of life of all people living in Mexico. To accomplish its objective, the Agenda for Sustainable Development represent a useful guide to focus efforts and promote socio-economic development in the country.

To end poverty in all its forms is without doubt a mandatory task (SDG 1), and Mexico faces a big challenge in this regard. Almost half of its population lives in poor conditions - 53per cent don't have decent income, 19per cent do not meet minimum mandatory basic education level, 18per cent don't have proper access to health-care, and 23 per cent don't have access to food.[7] In this context, space science can improve living conditions of the people with better employment opportunities, e-education and health services, and with precision agriculture initiatives, among others.

One big task is in providing access to new technologies to isolated communities, and Mexico is working on this with a programme called México Conectado[8]; making available Internet to remotest areas. To-date, there are more than 100,000 connecting facilities (29 per cent through telecommunication satellites), especially schools.

Regarding the objective of fighting hunger (SDG 2), the AEM is working in a precision agriculture project, that includes use of information from earth observation and high accuracy global positioning systems to support decision-making of farmers at the key growth stages - estimating the real need of a crop (e.g. irrigation, nutrients), increasing productivity and outputs, reducing use of fossil fuels and optimizing use of chemicals.

To manage health risk (SDG 3), AEM is working in tele-epidemiology, using remote-sensing images obtained from satellites to identify flora, fauna, temperature and atmospheric pressure to create predictive models for surveillance of vector-borne diseases, in particular, of Chagas disease (one of the most neglected tropical deseases).

Another important task is to promote access to quality education (SDG 4), and Mexico has been using telecommunication satellites for this since 1980s. At present, there are roughly 35,000 reception centres (most of them for secondary education) across the country (Red Edusat).[9]

Regarding the economic development (SDG 8), the promotion of the space industry is a key element to move from a low productivity scenario to a high value-added economy. Since the last few years, aerospace sector in Mexico has grown at an accelerated rate than the whole economy, and at present the country has more than 400 companies and 31,000 employees, which was unthinkable earlier. This means that fostering investment in this field would bring in qualified jobs to local economies.

If we look at the target of encouraging innovation, the AEM is promoting participation of young people in what is called the Space BootCamp®[10], which aims to bring together Mexican talent in an open collaborative multidisciplinary environment to foster creativity and for generation of proposals, to be part of the integrated new programmes and areas related to the space sector. There is also a continuous work programme with local Governments to establish public centres for R&D and promoting clusters for aerospace industry.

Regarding climate change (SDG 13), some public Mexican institutions are working on a system with the capacity to process large number of Landsat and RapidEye satellite images in a fast and automated way to monitor actions implemented in Mexico within the National Strategy for Reducing Emissions from Deforestation and Forest Degradation (this system is called MAD-Mex[11]). In the international arena, Mexico has been interactively active in promoting role of space agencies which can be vital in climate change and disaster management, supporting Mexico's declaration of 2015[12] and subsequent Delhi declaration (2016)[13]; both presented at the COP 21 and COP 22.

Regarding the conservation, restoration and sustainable use of ecosystems (SDG 15), the AEM has worked together with the UKSA in an automated, integrated, user-friendly platform, presenting information about the key indicators of environmental degradation in Bacalar area (South Mexico) in real-time such as the impact of human activitiesalong with mapping and monitoring of mangrove ecosystem and water- bodies.

Conclusion

To have the fair society and in achieving SDGs, an important task is to engage actors from other communities and disciplines and to increase awareness about the importance of space activities while imagining new ways of using satellite data to fulfill social needs.

Another important assignment is to intensify international cooperation, in particular South-South Cooperation, and to foster capacity-building and research and innovation. We must keep learning from advanced space faring nations and also from those with similar conditions and objectives.

For countries like Mexico, we need to have policy and decision-makers support in space activities and then consolidate programmes with adequate legal framework and financial support.

All countries would benefit from space research, technologies and applications. That is why global cooperation in this field is important for not just dreaming, but for achieving a better future.

Endnotes

To know more, visit http://www.un.org/sustainabledevelopment/sustainable-development-goals/

UNISDR, Sendai Framework for Disaster Risk Reduction 2015-2030, available on: http://www.unisdr.org/we/inform/publications/43291

United Nations, Paris Agreement, 2015, available in http://unfccc.int/paris_agreement/items/9485.php

United Nations, The Future We Want, 2012, available in https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf

To find out more about contributions of space science and technology, please go to http://www.unoosa.org/oosa/en/benefits-of-space/benefits.html

http://www.gob.mx/aem/que-hacemos

CONEVAL, Medición de la pobreza. Estados Unidos Mexicanos 2014, available in www.coneval.gob.mx

http://mexicoconectado.gob.mx

http://www.televisioneducativa.gob.mx/red-edusat

https://www.gob.mx/aem/acciones-y-programas/space-bootcamp?idiom=es

http://www.monitoreoforestal.gob.mx/mad-mex/#MAD-Mex

http://summitclimatdisast.iaaweb.org

https://presse.cnes.fr/en/new-delhi-declaration-space-agency-heads-reaffirm-commitment-monitor-greenhouse-gases-emissions

Role of Science Diplomacy in Promoting Research Programmes in Nigeria

Abubakar Bello Usman[*]

Introduction

The Federal Republic of Nigeria, commonly referred to as Nigeria, is a federal republic in West Africa, bordering Benin in the west, Chad and Cameroon in the east, and Niger in the north. Its coast in the south lies on the Gulf of Guinea in the Atlantic Ocean. It comprises 36 states and the Federal Capital Territory, where the capital, Abuja, is located. Its largest cities include: Lagos, Kano, Ibadan, Benin and Port Harcourt. Nigeria is a democratic secular country.

In Nigeria, all the major stakeholders have realised the importance of science and technology (S&T) in driving rapid industrialisation and sustainable development. The government is also convinced that attaining of sustainable development is predicated on the design of an appropriate policy framework, based on the effective knowledge and quality information as well as on the effective scientific foreign collaborations.

National Science, Technology and Innovation Policies

Some of the specific objectives of the policies in Nigeria include, among others, initiating, supporting and strengthening strategic bilateral and multilateral cooperation in scientific, technological and innovation activities across all sectors of the economy. Facilitating acquisition of knowledge to adapt, utilise, replicate and diffuse technologies for growth of SMEs, agricultural development, health-care, food security, power generation and poverty reduction; supporting establishment and strengthening of organisations, institutions and structures for effective coordination and management of the STI activities within a virile national innovation system; supporting mechanisms to harness, promote,

*Assistant Research Fellow, Biotechnology Advanced Research Centre, Sheda Science and Technology Complex, Abuja, Nigeria

commercialise and diffuse globally competitive goods and services intensively utilising Nigeria's raw materials; and promoting activities for effective STI communication and inculcation of STI culture in Nigerians.

International Cooperation in STI

Bilateral cooperation between Nigeria and countries or regions include: Asia-Pacific (China, India, Japan-JICA, Korea-KOICA, etc; and Joint Commissions-Africa and Middle East, Europe, America, INGO, etc. Multilateral cooperations include, among others: the United Nations Development System (UNDS), European Union, Commonwealth Desk; UNESCO Special Plan of Cooperation with Nigeria: Project for Reform of the Nigerian STI System, JICA Technical (Cooperation Project) – Nigeria: Agricultural/ Rural Development Project on Rice Post-Harvest Processing and Marketing Pilot Project in Nasarawa and Niger States (RIPMAPP), African Business Education Initiative for youth (ABE Initiative). Master's Degree and Internship Programme, a JICA Support for National Polio Reference Laboratories in Nigeria 'Laboratory Equipment, Maintenance and Training, ect.

However, it has been observed that S&T policies in Nigeria have not been a critical determinant of national development performance. Also, the country has not fully realized its national objectives of S&T-driven rapid industrialisation and development. This in some part is attributed to ineffective utilisation of international cooperation programmes and poor networking for exchange of know-how among scientists, etc.

Sheda Science and Technology Complex (SHESTCO)

The Sheda Science and Technology Complex (SHESTCO) is a research center under the aegis of the Federal Ministry of Science and Technology. The complex was established for enabling institutions and individuals to undertake a wide range of multidisciplinary researches and developments in a comprehensive and organised manner, and provide opportunities for utilising high technology to contribute to uplift standard of living of the Nigerian citizenry. R&D activities of the complex are planned and organised under four main divisions. These are as follows.

National Advanced Laboratories which consists of:

- Physics Advanced Research Centre (PARC)
- Chemistry Advanced Research Centre (CARC)
- Biotechnology Advanced Research Centre (BARC)

Nuclear Technology Centre, consist of: Multipurpose Research Reactor and Gamma Irradiation Facility.

Science and Technology Information Centre, which consist of: Science and Technology Library.

Molecular and Agricultural Biotechnology Laboratories

Some research activities in these laboratories are as follows:

- Molecular transformation of Wheat [*Triticum aestivum* (L.)] for Drought Resistance, Cowpea (*Vigna unguiculata*) for Insect Resistance, Rice (*Oryza sativa*) for Rice Blast Fungus Resistance;
- Development of Mutant Varieties of Maize and Sorghum Resistant to *Striga hermonthica* through Physical mutagenesis and related biotechnologies;
- Micropropagation of woody plants; and
- DNA barcoding of Nigerian flora for molecular identification and conservation; authentication of herbal products.

Need for Science Diplomacy

Looking at the challenges technical or otherwise at the complex and in Nigeria as a whole, and the broad definition of science diplomacy as cooperation among countries, regions or institutes to solve a complex problem through scientific research, we wish to seize this golden opportunity to present to the Indian government through RIS our interests in building institutional collaborations between the ''Biotechnology Advanced Research Centre (BARC) and the

Sheda Science and Technology Complex, Abuja-Nigeria and other relevant research institutes in India aiming at promoting S&T activities, especially in agriculture (e.g. providing improved seeds for our local farmers), which would result in fighting hunger and ensuring sustainable development. Some research activities which may require diplomatic collaborative efforts by the countries in the South through science diplomacy include: traditional medicine research: herbal drug discovery and development. Nigeria is endowed with rich plant biodiversity to be exploited as potential candidate plants for herbal drug production as used by the locals while, on the other hand, India is blessed with the technology) and crop improvement either through Mutagenesis and related biotechnologies, TILLING, EcoTILLING, Transgenesis, Gene Editing, Marker-Assisted Breeding; etc

The Annexe table illustrates some examples of the research projects at the BARC, which can contribute toward promoting STI in Nigeria for sustainable development.

Table 1: Research Projects in BARC for Scientific Collaboration through Science Diplomacy

1	**Project Title**	**Herbal Drug Discovery and Development**							
1.2	**Goals**	**1. Development of Herbal Medicines for the Treatment of Typhoid Fever** **2. Development of Herbal Medicines for Oxidative Stress and Related Illnesses**							
1.3	**Objectives**	**Activities**	**Inputs**	**Timeline**	**Expected Outcome**	**Target**	**Responsible Parties**	**Role of Sciemce Diplomacy**	**Available Capacities**
	To find Nigerian indigenous plants used the treatment of typhoid fever through ethnobotany To find Nigerian indigenous plants used the treatment of oxidative stress through ethnobotany Laboratory Authentication of Ethnopharmacological claims of these medicinal plants Development of authenticated herbal drugs to be used for the treatment of typhoid fever Development of authenticated herbal drugs to be used for the treatment of oxidative stress and related diseases	Selecting a plant and sample collection Preparation of the plant material and activity-guided isolation of the active compounds Identification of biological targets Validation of biological targets Preclinical studies Clinical trials Formulations for clinical studies	Obtaining potential candidate plants for herbal drug development Getting an efficient bioassay protocol Purchase of consumables, chemicals and reagents Animal house	Six year project 2017-2022	Cheaper, safer and effective authenticated herbal drugs for the treatment of typhoid fever Cheaper, safer and effective authenticated herbal drugs for the treatment of oxidative stress and related diseases	To produce a plant-based medicines for treating typhoid fever and oxidative stress and its related illnesses form Nigerian flora	Biotechnology Advanced Research Centre, Nigeria	Access to standard animal house and equipments Training opportunities for improving technical capabilities	See project 2

Table 1 continued...

Table 1 continued...

2	Project Title	Crop improvement using physical mutagenesis and related biotechnologies							
2.2	Goals	1. Development of mutant varieties of Nigerian local varieties of sorghum and maize resistant to Striga hermonthica 2. Development of mutant varieties of Vigna unguiculata resistant to insect pests							
2.3	Objectives	Activities	Inputs	Timeline	Expected Outcome	Target	M&E Measures	Role Of Science Diplomacy	Available Capacities
	To assess the mutagenic effects of gamma irradiation on Nigerian local varieties of sorghum, maize and cowpea seeds To estimate the optimal radiation dose in order to induce genetic variability in sorghum, maize and cowpea genotypes Development of mutant varieties of sorghum and maize resistant to Striga hermonthica Development of mutant varieties of cowpea resistant to insect pests.	Germplasm collection Irradiation of seed samples Screen house establishment of breeding lines Morphological studies of radio sensitivity of each genotype to different irradiation doses Large scale mutagenesis Growing M_1, M_2, M_3 - - - to rise up to M_4 generation Phenotypic selection of putative mutants of each genotype Genotyping of putative mutants Screening of mutants.	Farmer varieties Irradiation services Screen house facility Seedling bags Labour for handling mutant generations	3-4 year project 2017-2020	Establishment LD_{50} for all the experimental genotypes Development of mutant varieties of sorghum and maize resistant to Striga hermonthica Development of mutant varieties of cowpea resistant of insect pests.	Development of mutant varieties of sorghum and maize resistant to Striga hermonthica Development of mutant varieties of cowpea resistant of insect pests	Success in: Establishment of LD_{50} for all the experimental genotypes Improved mutant varieties of sorghum, maize and cowpea	Availability and access to irradiation services, Growth chamber for tissue culture Funding for labour for handling mutant generations Proper training on plant mutation breeding techniques including mutant gene detection in plants TILLING and EcoTILLING	Human capacities: 2 Directors of Research (A Professor of Biochemistry and a Doctor of plant molecular biology), 3 Research Fellows and PhD students, 4 Technologists, 1 Agronomist. Facilities: Screenhouse, Demonstration farms, PCR, electroporesis machine, Gel doc., UV-Spec, UV transilluminator, electroporator, centrifuges, biosafety cabinet, Incubators, etc.

Table 1 continued...

Table 1 continued...

3	PROJECT TITLE	Crop improvement through biotechnology								
3.2	GOALS	Development of Nigerian wheat varieties that can grow in tropical region								
3.3	Objectives	Activities	Inputs	Timeline	Expected Outcome	Target	M&E Measures	Responsible Parties	Actions To Operationalise The Measures	Role of Science Diplomacy
	To develop a Nigerian wheat variety that can grow in our environment, to alleviate hunger and provide jobs: Through (1) Obtaining local varieties from farmers that are acceptable and preferred for bread pasta etc. (2) To develop an efficient regeneration system for wheat (3) To develop an efficient transformation system	(1) Sample collection (2) Obtaining necessary plasmids for cloning that can confer heat/drought resistance (3) Finding a robust regeneration system for wheat through experimental formulation of different media and hormones composition (4) Cloning: using vectors that have been obtained from IRRI and other sources (5) Transformation of wheat by (a) Direct and (b) Marker free	Obtaining genes for transformation Getting an efficient Agro bacterium transformation system Efficient regeneration system Molecular and Biosafety characterization	Four year project 2017-2020 (Purchasing consumables, reagents materials, Sample collection, Regeneration and cloning of vectors 2018- Transformation work molecular characterization 2019- 2020 Dissemination of varieties	(1) Plantlets obtained from calli and not directly from plantlet formation (2) Efficient transformation system for wheat that can grow in our climate	Develop wheat varieties that can grow in our Nigerian climate, which will reduce foreign import thus saving forex, alleviate hunger and create jobs.	Success in (1) Regeneration system (2) Transformation system (3) Right and correct insertion of genes through molecular characterization (4) Biosafety characterization	Plant Molecular Biology Team, BARC, Nigeria	Availability and access to all needed consumables and Instruments	Obtaining proper Equipments as: (1) -80^{0}C freezer (2) Incubators (3) Shakers (4) Water baths (5) Find funding for BARC laboratory Appropriate training for the plant molecular biology team members on plant molecular techniques

Table 1 continued...

Table 1 continued...

4	Project Title	Crop improvement through biotechnology								
4.2	Goals	Improvement of Nigerian rice varieties for biotic resistance (to rice blast fungus and bacterial disease)								
4.3	Objectives	Activities	Inputs	Timeline	Expected Outcome	Target	M&E Measures	Responsible Parties	Actions To Operationalise The Measures	Role Of Sciemce Diplomacy
	To find local varieties from farmers that are prominent, to get the best varieties. To develop an efficient transformation system To improve local Nigerian rice varieties against biotic stresses to increase production; thereby alleviating hunger and providing jobs and wealth creation	Sample collection Collect necessary plasmids for cloning that can confer such resistance. Finding a good regeneration system for rice varieties: -Different media formulation -Training Cloning: using the latest vectors Pi54RH, Wasabi Defensin contained in the plasmid pEKHSubWT Molecular and Biosafety characterization	Obtaining genes for transformation Getting an efficient Agro bacterium transformation system Efficient regeneration system Purchase of consumables, chemicals and reagents	Four year project 2017-2020 2017 - Purchasing consumables, reagents materials, Sample collection, Regeneration and cloning of vectors 2018- Transformation work molecular characterization 2019- 2020 Dissemination of varieties	An efficient regeneration system for rice. An efficient transformation system for rice Molecular and Biosafety characterization	Improvement of Nigerian rice varieties for biotic resistance (e. g. rice blast fungus and bacterial disease)	See project 3	Plant Molecular Biology Team, BARC, Nigeria	Must obtain the latest and crucially important Pi54RH, Wasabi Defensin contained in the plasmid pEKHSubWT	Same as project 3

Science Diplomacy to Promote Industrial Development in Cambodia

LIN Chankakada*

SOS Sovanny*

Introduction

Cambodia is officially known as the Kingdom of Cambodia, and Phnom Penh is the capital of the country. Head of State is His Majesty Samdech Preah Baromneath Norodom Sihamoni and Head of Government is Samdech Akka Mohasenapadei Techo Hun Sen.

Cambodia was colonised by France and became independent in 1953. The official name of Cambodia has changed several times, following the troubled history of the country. The following names have been used since 1953-Kingdom of Cambodia under the rule of the monarchy from 1953 through 1970; Khmer Republic under the Lon Nol led government from 1970 to 1975, Democratic Kampuchea under the rule of the communist Khmer Rouge from 1975 to 1979; People's Republic of Kampuchea under the rule of the Vietnamese sponsored government from 1979 to 1989; State of Cambodia under the rule of the United Nations transitional authority from 1989 to 1993; and Kingdom of Cambodia again after the restoration of the monarchy in 1993.

If we look at the education sector of the country, we understand that the Royal University of Phnom penh first opened its doors as the Royal khmer university on 13 January 1960. The language of instruction was French during this period. Between 1975 and 1979, the khmer Rouge regime eliminated formal education. Schools and universities were closed and destroyed and teaching services were decimated. The Khmer Rouge targeted the educated, and many of the University's staff were killed.

In 1993, the country held its first national election; however the khmer Rouge existed till 1998. Since 1998, the country has enjoyed full peace and development.

Deputy Cheif of Bureau, Ministry Of Foreign Affairs And International Cooperation, Cambodia

Cambodian Economy

The Cambodia's industrial sector contributed remarkably to country's GDP, which accounted for 26.2 per cent in 2006. Afterwards, this sector experienced a slight drop, and stabilised at 22 per cent in lieu of the changes in the global economic crisis. In 2013, the sector could result in around 24 per cent of the GDP. Over the past 15 years (1998-2013), the average annual growth rate of the sector was around 12 per cent; ahead of the agriculture (4.7 per cent) and the service sectors (8.5 per cent). The industrial sector plays a prominent role in helping country accomplish highest growth (Cambodia's Industrial Development Policy (IDP), 2015).

The industrial sector mainly creates jobs for many Cambodian people. In 1993, the total labour force in the agriculture sector made about 72 per cent while for industrial sector it was 5 per cent. In 2008, the industrial sector accounted for 8.6 per cent of the total employment and in 2012 the total jobs in the sector were 18.6 per cent (IDP, 2015).

It is noticed that the country's economic growth does not really depend on the investment, implying that there is still possibility for more investments. For example, over 70 per cent of growth of GDP depends on private consumption, 21 per cent on investments, 12 per cent on public expenditure, and exports take over the charge of the rest. By the standard of developing countries, the rate of investments should be between 30 per cent and 40 per cent or higher to boost economy to jump to the next level of development. But Cambodia's economic growth depends immensely on the garment, tourism, construction and agricuture . This indicates that more investment is crucial to boost economic growth (IDP, 2015).

Cambodia's Science, Technology and Innovation

Cambodia has done well in economic and social developments in the last few decades, but it still has not fully achieved knowledge-based development.

However, changes are happening. Cambodia's draft National Policy on Science, Technology and Innovation was developed with inputs from different ministries and civil society. UNESCO's Phnom Penh office helped Government to formulate the policy. The draft policy outlines five strategies, involving plans for human resources, infrastructure and institutional development, encouraging research and establishment of a Ministry of Science, Technology and Innovation (IDP, 2015).

The Cambodia's National Science and Technology Master Plan 2014-2020 was launched in October 2014 by the Ministry of Planning with the support from the Korea International Cooperation Agency (KOICA). The industrial innovation is a key focus, particularly in the areas of agriculture, primary industry and information and communication technology (ICT). The Cambodian ICT Masterplan 2020 was also launched in 2014. The plan aligns with the ASEAN ICT Masterplan 2015 to focus on human resources, training and enhancement of digital literacy (including rural people), computer access for government employees, expanded ICT infrastructure, cyber security and more. Specific goal includes that 70 per cent of Cambodian people should be able to access internet by 2020 (KOICA Cambodia, 2014).

Presently, Cambodia also has an Institute of Technology of Cambodia (ITC), which has full capacity to develop human resource in the fields of engineering, technique, science and technology. The institute is working on establish a Science Research Center within its campus of national and international repute for encouraging and supporting research activities, enlarging and strengthening cooperation on research field with Government and private institutions and partner universities, leading and conducting priority research projects, strengthening and expanding capacity of scientific researchers, and offering job opportunities to research professors and students by involving them in research project or offering research partners with the ITC.

Cambodia also has National Council for Science and Technology (NCST), established on 8 September 2014. The NCST plays a crucial role in the development of science and technology in Cambodia. Its establishment underlies the ambition to get the country to be at the same level as the other countries of the region and of the world in terms of scientific and technological developments. NCST is chaired by the Prime Minister, and consists of various Vice-Chairs and members from different ministries and institutions and academies and Cambodia Chamber of Commerce (Darwin Institute for Scientific Research and Development, 2014).

Cambodia's Industrial Development Policy

The Royal Government of Cambodia (RGC) has prepared and adopted the Industrial Development Policy. It is considered to promote country's industrial development, which can maintain sustainable and inclusive economic growth through economic diversification, strengthening competitiveness and promoting productivity.

Implementation of the policy reflects the necessity and the urgency to start a new growth strategy. The policy has been designed to meet structural transformation of domestic economy and changing regional and global economic architectures. The adoption of this policy is fostered by following considerations: (i) the favourable geopolitical alliances in terms of linking Cambodian economy and its industry to the region, especially within the ASEAN Economic Community and regional economic liberalization frameworks; (ii) potential role of industrial sector in promoting growth and creating new jobs in the context of an open economy, a demographic dividend and with major structural changes, which are conducive for industrial growth; (iii) critical role as a policy tool to enhance performance of core economic sectors, like agriculture and services, which would further contribute to boosting economic growth; and (iv) importance of the industrial sector as a focus for initiating structural reforms and governance reforms of key national economic institutions aiming at boosting economic productivity in a long term and backstopping of falling into the "middle income trap" (IDP, 2015).

Cambodia's industrial sector remains weak as most manufacturing activities are still family-based and do not have the capacity to compete in the international market. The weakness can be identified as the lack of diversity in industrial base; an informal and missing middle structure, a weak entrepreneurship; an urban-centered industry; a low value-addition and low-level of technology. Micro-enterprises which make up over 97 per cent do not create many jobs creation and generate only 12 per cent of the total turnover. Large enterprises, which make up only of 0.6per cent create, on the other hand, maximum percentage of jobs and generate 76 per cent turnover. The number of informal enterprises is excessive. Entrepreneurship remains weak and urban-centered; since 2008, over 42 per cent of enterprises have been established. More than 63 per cent of large manufacturing enterprises are in the form of foreign direct investment and are export-oriented. Sixty eight per cent of large manufacturing enterprises are located in Phnom Penh and 13 per cent in Kandal province (IDP, 2015).

Development of the industrial sector is confronted with five key obstacles-(i) lack of leadership, coordination and effective decision-making, especially on all important issues related to inadequate supply of electricity, infrastructure and logistics, human resource and skills as well as other supporting infrastructures; (ii) scarcity of basic technical knowledge and skills crucial to transform an unskilled labour-force into a skilled labour force with the capacity new and high value technical and technological skills; (iii) inadequate preparation of the necessary industrial infrastructure, especially as related to insufficient coordination in physical infrastructure investment such as supply of electricity, clean water, telecommunication network, sewage and public service provision; (iv) limited financial market development that checks financing industrial projects and lack of proper financing mechanism for public and private sector projects; and (v) issues related to labour market and industrial relations, which are important for labour market stability, increase in productivity and better livelihood of workers (IDP, 2015).

The RGC's vision is to transform and modernize its industrial structure from a labour-intensive industry to a skill-driven industry by 2025, through connection with regional and global value-chain; integration of regional production networks and developing interconnected production clusters along with the efforts to strengthen competitiveness and enhancing productivity of domestic industries; thus moving towards developing a technology-driven and knowledge-based modern industry. The realization of this vision would contribute to national economic development, sustainable and inclusive high economic growth, employment creation, increasing value addition and increasing income of the people (IDP, 2015).

Target for Realization on the vision of IDP:

- to increase the GDP share of industrial sector to 30 per cent by 2025 (24.1per cent of GDP in 2013) with manufacturing sector growing from 15.5per cent in 2013 to 20per cent in 2025;
- to diversify export of goods by increasing export of non-textile to reach 15 per cent of all exports by 2025 while still promoting export of processed agricultural products to reach 12 per cent of all exports by 2025; and

to encourage formal registration of 80 per cent of small enterprises and 95 per cent of medium enterprises, and to ensure that 50 per cent of small enterprises and 70per centmedium enterprises have proper accounts and balance sheets (IDP, 2015).

To realise the above vision and targets, the RGC has embraced four strategies: mobilise and attract foreign investments as well as private domestic investments by focusing on large industries; expanding markets and enhancing more technology transfer to develop and modernise small and medium enterprises (SMEs) (expanding and strengthening manufacturing base, modernising registration of enterprises, ensuring technology transfer and industrial linkages); revisiting regulatory environment to strengthen country's competitiveness (investment climate and trade facilitation, market information dissemination and informal fees reduction); and coordinating supporting policies (development of human resource, technical training, improvement of industrial relations, development of support infrastructure such as transportation/logistics and information and communication system (ICT), supply of electricity and clean water, and public, social and financial service) (IDP, 2015).

The strategic approach of the Industrial Development Policy (IDP) is to promote development of manufacturing sector and agro-processing industry through integration of regional and global production chain; positioning of the development industrial zones to ensure critical mass, economic linkages and competitiveness; development of economic corridors streamlining operational procedures for Special Economic Zones (SEZs); and developing new industrial parks and industrial clusters. The scope and key priorities include: new industries or manufacturent which can break into markets providing high value-addition, innovation and competitiveness; promoting SMEs across all sectors; increasing agricultural production to serve to both export and domestic markets; encouraging various support industries for agriculture, tourism and garment sectors in as much as for industries, which are part of the global production value chain; and fifth support industries important for regional production chain and those which are strategic for nurturing future industries (IDP, 2015).

With this strategic approach, the RGC has instituted comprehensive and interconnected policy measures and action plans with well-defined responsible institutions to lead implementation process. These policy measures and action plans actively encompass and promote FDI focusing on improving investment climate, development of SEZs and preparation of industrial zones; strengthening and modernising SMEs, including focusing on their formalisation and provisions for incentives; encourage proper bookkeeping and accounting practices; promoting agro-industrial sector; improving regulatory environment, focusing on trade facilitation measures and export promotion, strengthening of industrial standards and industrial property rights, facilitation of payment of tax obligations, establishment of the labour market and industrial relations; and coordination and integrate supporting policies, focusing on skills and human resource development, science, technology, and innovation promotion, industrial infrastructure build-up and financing measures (IDP, 2015).

In addition to the above policy measures and action plans, the RGC has adopted four key concrete measures to be accomplished by 2018, which form its core strategy to implement the IDP, particularly for enhancing Cambodia's competitiveness and attractiveness. These measures are reducing cost of electricity for targeted industrial zones as well as expanding transmission coverage and improving supply reliability; preparing and implementing a master plan to develop a multimodal transport and logistic system; developing and strengthening a mechanism to manage labour market and skill development; and developing and transforming Sihanoukville Province into a multi-purpose Special Economic Zone (IDP, 2015).

In term of implementation, the RGC would take up multiple roles as strategist, facilitator, supporter and initiator with high integrity and responsibility to arrange and develop mechanisms to lead, coordinate and implement the IDP through a comprehensive reform of the Council for Development of Cambodia (CDC), whereby the institution is fully mandated and is provided with essential functions to make policy decisions; and to prepare and implement plans as well as to address emerging challenges (IDP, 2015). These reforms encompass the following

First relates to strengthening the role of policy leadership of CDC by way of providing guidance and approval in as much as monitoring achievements in the implementation of industrial development plan in coordination with the "Committee for Economic and Financial Policy", the "Private Sector Development Steering Committee" and other relevant specialized institutions, including the establishment of an "Advisory Council for Industrial Development of Cambodia"; second is revising functions and strengthening capacity of the Cambodia Investment Board (CIB) with additional mandate to promote industrial development; third is streamlining functions of the Cambodia Rehabilitation and Development Board (CRDB) to support industrial development in the framework of development cooperation and public investment planning; and fourth is strengthening and streamlining the Government and Private Sector Forum mechanism to publicize information and encourage private sector participation in the industrial development process. The last is to ensure steady progress and effectiveness of the IDP. The Royal Government has developed a monitoring evaluation mechanism by tasking the CDC to prepare and coordinate the following: a quarterly and annual reporting system, and in particular submitting a report to the Council of Ministers every three months on the progress and challenges and needed measures required for immediate implementation; an industrial dispute, resolution mechanism; and an evaluation of the progress and achievements of the implementation of the IDP's four key concrete measures to be realized by 2018 and a comprehensive and broad based mid-term evaluation by 2020 as a basis for review and readjustment for the next phase implementation.

Cambodia's Science Diplomacy to Promote IDP

To promote fruitful implementation of the IDP, Cambodia has been seeking and has achieved various collaborations with its stakeholders, which are discussed as follows.

India has contributed in capacity building of Cambodia by setting up in Phnom Penh in Febuary,2006 a Cambodia-India Entrepreneurship Development Centre (CIEDC and Cambodia-India Centre for English Language Training (CICELT) in August 2007. Cambodia is a major recipient of India's ITEC programme and has utilized around 1000 civilian training slots and about 100 defence training slots till date. Taking note of the increasing demand for civilian training courses, slots for Cambodia under ITEC have been enhanced to 100 from 2011-12. In addition, 15 education scholarships are also offered every year (Ministry of External Affairs of India, 2013). According to Pankaj Jha, Research Director, Indian Council of World Affairs in New Delhi, India, there exists scope to develop manufacturing in the CLMV (Cambodia, Laos, Myanmar, and Vietnam) countries. Mr Sandeep Majumdar, Vice President, Indian Chamber of Commerce in Cambodia pointed out that earlier Indian companies traditionally focused on exporting pharmaceutical products to Cambodia. At present they are beginning to export other items and invest in a broader array of industries. New delegations from India looked for opportunities in Cambodia to invest in textiles, renewable energy, infrastructure and agriculture. The new Indian companies opening in Cambodia promise to provide Cambodian employers with opportunities for vocational and IT trainings (Parikh. T, 2015)

The United States is helping Cambodia to build a stronger capacity in science and technology (S&T). For instance, USAID's newly established development Innovation Lab is playing its role to promote both academic and professional activities in information technology and providing training for consultancy services and project development assistance to Cambodia entrepreneurs and civil society organizations. Additionally, the US government-sponsored academic exchange programme like fullbright programme are bringing American science and technology experts to teach at Cambodian universities and allowing Cambodian students to pursue graduate degrees in computer science, mechanical engineering and agricultural technology at the US schools (*The Cambodia Herald, 2014*).

Visiting Math Lecturer Programme

The U.S. National Academies of Sciences, Engineering and Medicine in cooperation with partners in France and Japan also help build capacity in mathematics education through its Visiting Lecturer Programme. The programme provides advanced undergraduate-level courses and foster productive interaction between mathematics community of the developed world and the developing world *(The Cambodia Herald, 2014)*.

In March 2016, Cambodia and China signed a Memorandum of Understanding on Cooperation in Science and Technology. The deal was signed by Tung Ciny, chairman of the Cambodia's Science and Technology Commission, and Lin Xuwei, Secretary General of the S&T Commission of China's Shanghai Municipality in the presence of Cambodian Minister of Industry and Handicraft. The MoU is valid for three years under which the Chinese side would help train Cambodian officials in science, technology and innovation, which are important for economic development (ASEAN-China Center, 2016).

The Ministry of Planning (MoP) and the Korea International Cooperation Agency (KOICA) have officially launched the "Cambodia National S&T Master Plan 2014-2020" in a ceremony held on 7 October 2014 . The Master Plan, the final product of US$3.5 million grant aid from the Republic of Korea, was handed over from Ms Baek Sook Hee, Representative of KOICA Cambodia Office, to H.E. Chhay Than, Minister of MoP. Under the title of "Project for Cambodia's National Science and Technology Master Plan 2014-2020", Korean experts from academies and private sectors, including those at Korea Institute of S&T Evaluation and Planning (KISTEP), worked with their counterparts at MoP since the last three years from the signing of the agreement in 2011. The Master Plan aims industrial innovation through securing of Science and Technology foundation. Three core industries have been selected for the investigation and analysis – agriculture, primary industries and ICT. Ms Baek Sook Hee said that "this project will provide a lot of benefit for the HRD and capacity building of S&T in Cambodia after the S&T Masterplan has been disseminated". She added that "S&T competitiveness is crucial and Cambodia government needs to pay more attention on it. Through this National S&T Masterplan, Cambodia can further develop and implement the S&T development projects more effectively"(KOICA Cambodia, 2014).

To ensure that Cambodia develops in a balanced manner with stable economic growth, the JICA is focusing its support on strengthening economic base by promoting agriculture, improving infrastructure, enhancing social development through health care and education, and by strengthening governance through legal reform (JAICA Japan, 2012).

Conclusion

Science Diplomacy is an approach of diplomatic relations which focuses significantly on bilateral, regional and multilateral cooperation and partnerships among states in the fields of Science, Technology and Innovation to address mutual challenges regarding development, trade, investment, and technology and South-South Cooperation. As a matter of fact, this training course provided important themes which reflected the real work conducted in India. The themes encompassed research work in science and technology in agriculture and health sectors, climate change, and the role of Science Diplomacy in accomplishing sustainable development goals, technology transfer, South-South Cooperation and blue economy.

For Cambodia, Science Diplomacy is playing a vital role to engage country with other countries via promoting cooperation and partnership in the field of science, technology and innovation to support implementation of the country's industrial development policy which focuses on building human resource, formulating policy, establishment concerned institutions, strengthening the existing institution capacity, and creating exchange programmes on the field and so on.

References

ASEAN-China Center. March 25, 2016. *Cambodia, China ink deal in science and technology cooperation*. Retrieved on 18 January 2017 from http://www.asean-china-center.org/english/2016-03/28/c_135228945.htm

Dawin Institute for Scientific Research and Development. November 29, 2014. *National Council for Sciences and Technology encourages the scientific and technological development of Cambodia.* Retrieved on 18 January 2017 from http://darwinkh.org/national-council-for-sciences-and-technology-encourages-the-scientific-and-technological-development-of-cambodia/

http://www.itc.edu.kh/en/index.php/home/more/32-background/63-strategy.html

IDP. 2015. Industrial Development Policy of Cambodia.

Institute of Technology of Cambodia, Strategy. Retrieved on 18 January 2017 from

JAICA. Japan. April 2012. Country Assistance Policies for Cambodia. Retrieved on 18 January 2017 from https://www.jica.go.jp/cambodia/english/

KOICA Cambodia. October 08, 2014. KOICA and MoP Release Cambodia National Science & Technology Master Plan 2014-2020. Retrieved on 18 January 2017 from http://www.koicacambodia.org/koica-and-mop-release-cambodia-national-science-technology-master-plan-2014-2020/

Ministry of External Affairs of India. 2013. *India-Cambodia relations*. Retrieved on 16 March 2017 from https://www.mea.gov.in/Portal/ForeignRelation/Cambodian_Bilateral_Relations_MFA_ Website.pdf

Open Development Cambodia. December 09, 2015. *Science and Technology*. Retrieved on 18 January 2017 from https://opendevelopmentcambodia.net/topics/science-and-technology/

Parikh, T. 2015. *Cambodia set to benefit as India "Acts East"*. Retrieved on 16 March 2017 from https://www.cambodiadaily.com/news/cambodia-set-to-benefit-as-india-acts-east-103619

Roath, C. *The situation on Science and Mathematics Education in Cambodia*. Retrieved on 18 January 2017 from *english.dnva.no/binfil/download.php?tid=27683*

Royal Government of Cambodia. March 06, 2015. *Cambodia's Industrial Development Policy (2015-2025): Market Orientation and Enabling Environment for Industrial Development*

The Cambodia Herald June 24, 2014. Science and Technology Education Key to Future Economic Growth. Retrieved on 18 January 2017 from http://www.thecambodiaherald.com/opinion/science-and-technology-education-key-to-future-economic-growth-1010/

Mapping Indian National STI to Garner 2030 Agenda for Sustainable Development

B. Chagun Basha*

Introduction

The role of STI in achieving sustainable social, economic and environmental development is widely accepted immensely by all over the globe [ECOSOC, 2014; USC. 2010; The Royal Society, 2012]. However, what really is missing is the policy elements and the action plans, which are to be highly focused on development targets. The United Nations System Task Team on the Post 2015 Development Agenda argues that "debates on how best to promote sustainable and inclusive development are incomplete without a full consideration of issues of STI". In most of the developing and least developed countries, the STI policy has often been pursued independently of the broader developmental agenda. Nevertheless, the scenario is changing surely, as many nations have started recognising potentials of the STI policy research and launched several initiatives to address challenges. This time, as the world has committed to the highly ambitious 2015 development agenda, the challenges are even bigger than before, as there are 169 targets for 17 goals to be achieved by the year 2030.

Some of these targets are crucially important and of utmost priority in many nations at their national level as well. Some of the major challenges in achieving these SDGs include defining relevant and more practical indicators; financing SDGs (initial estimation report indicates a financial shortfall of USD 8.5 trillion over the mandated 15 years for achieving SDGs); discerning potential facilitation and monitoring institutions (micro and macro level); and measuring accurately the progress in implementaion SDGs'. These challenges can be effectively geared with proper channeling of scientific knowledge, technological advancements

DST Science Policy Fellow, Indian Institute of Science, Bengaluru, India

and innovation at the national, regional and international levels. It is abundantly clear that role of the STI is positive and critical at each and every stage of the development. However, the question is, how a nation can harness strong linkages between technology and innovation policies for overall sustainable development and welfare. This issue is a pressing concern in almost all countries.

STI4SD Indicators and Policy Outcomes

Measuring STI is fundamental for the formulation of national innovation strategies. Absence of relevant indicators is often considered a major obstacle for design and implementation of STI policies in developing countries. Indicators would provide information allowing successful translation of activities and outputs of the STI into development. In other words, indicators should be considered as inputs for designing and implementating the public policies. National monitoring of development goals and targets is the most important and should rely on the nationally defined sets of indicators. National ownership at all levels of the SDG framework is critical, and national monitoring must respond to national priorities and needs. Unfortunately, developing and least developed countries have not been very successful in setting up relevant national indicators to measure outcomes of STI activities and development goals. All nations must recognise the significance of (i) creating a highly-mapped atlas of the national STI landscape relevant to SDGs; and (ii) formulating reliable STI for sustainable development (STI4SD) indicators for different target areas. These new sets of indicators would facilitate framing national STI4SD policies (enhanced STI policies aligned with the universal 17 SDGs &169 targets), which would in turn help in achieving development targets and monitoring their progress on the regular basis.

STI mapping for SDGs

Thematic mapping of national scientific activities, technological developments and engineering and innovation capabilities is the first vital step towards harnessing country's STI potential for sustainable development. It includes data collection, classification and mapping of different knowledge producers and knowledge users.

- Data collection on public, private, public–private–partners (PPP) academic institutions, R&D establishments, non–governmental organisations (NGOs), think tanks, plus individual innovators and entrepreneurs, mentors, government policies, angel, venture capital, institutional, and industrial

Figure 1: Mapping STI for SDGs

funding mechanisms, intellectual property rights mechanisms, technology transfer mechanisms, market input, and incentives, awards, and other innovation–recognition mechanisms.

- Classification of collected data-sets and identifying their potential expertise and capabilities for various development related issues, ranging from climate engineering and disaster management to containing international terrorism.
- Mapping categorized data-sets to create an all-inclusive knowledge base (data-base) for each of the 17 SDGs; and further extensive mapping to each of their targets (169 in total for 17 SDGs). Such thematic mapping would help clearly identifying the resources 'we have' and 'we further require' to achieve each of the development target. This would then facilitate formulation of strategic road-maps and then policies.

Dedicated STI4SD Indicators and Policies

Accurate and accessible real-time (or near-real-time) indicators are essential for measuring country's STI capabilities as well monitoring progress of SDGs. The goal/target-oriented thematic mapping of STI landscapes would highlight resource, technology and policy gaps, and produce coherent and easy-accessible data-sets; which would eventually facilitate (i) evaluating existing indicators, (ii) defining more-relevant new indicators and (iii) formulating new 'STI for sustainable development' (STI4SD) indicators and policies. As a matter of fact, macro-level indicators do not always reflect innovative capacity of the nation. The indicators have to be dynamic and at different granular levels (micro as well as macro) to ensure reliable and accurate measurement. The STI4SD indicators are crucial elements to formulate evidence-based and/or data-driven policies. Format suggested for 'STI4SD indicator' for climate action is shown in Table 1. Different STI indicator values are calculated for each target-area of the broader climate change mitigation action. By completing this indicator table, it would be easy to measure capability, current strength and weakness and predict the progress (and trend) and then prepare a draft plan for the future (through STI4SD policies).

Monitoring and Capacity-building

Coordinating and monitoring progress of SDGs is as important as the development efforts. Given the large number of development targets, it would

Table 1: A format illustration–STI4SD indicator table for climate action (Goal 13)

STI Indicators	Goal-13 : Climate Change Mitigation Actions				
	De-carbonized Clean Energy	Affordable Modern Cooking Solutions	Green House Gas (GHG) Emission Reduction	Carbon dioxide (CO2) Emission Reductions	Geo-engineering (Solar Radiation Management (SRM)
S&T Expenditure (% of GDP)					
R&D Expenditure (% of GDP)					
Researchers in S&T (% of work force)					
Human Resource on Innovation Activities					
Innovation Outputs					
Scientific Articles (in %)					
Granted Patents					

be highly ineffective and inefficient to have a single point monitoring system at the national level. Emerging consensus suggests that thematic monitoring and review would be an important complement for official monitoring at the local, regional, national and global levels. To give an Indian example, NITI Aayog[1] acts as a single point national monitoring and coordinating establishment for SDGs in India. Nevertheless, the efforts have been made through MoSPI[2] to disseminate progress monitoring process to different ministries, based on the target areas of SDGs.

In most of the developing and the least developed countries, conducive environment is lacking to enable constant engagement between scientific and policy-making communities. A dedicated multi-level engagement model (at the national and the sub-national level) between different stakeholders of STI and policy-making communities, need to be developed to monitor and measure progress of SDGs. It is also important to identify facilitation institutions to provide a platform for constant engagement among stakeholders, by organizing round-tables, discussion fora and dialogue sessions where scientists and policymakers can understand each other's point of view.

National Science Diplomacy Agenda

Based on the STI strengths and weaknesses evaluated through those cross indicators (STI4SD) discussed in the previous section, countries can start formulating national science diplomacy agenda (to look for opportunities to create cross-border scientific collaborations/exchanges). The 21st century's most pressing issues – identified as global challenges – are international; no one country would be able to solve the problems on its own. The challenges ranging from disaster management, rapid climate change, pollution and livable cities, infectious disease to international terrorism – in one way or the other - have a scientific dimension [Raymond Saner, 2015]. The global problems require global solutions with appropriate willingness and cooperation among nations. It is very important to create a pivotal role for science and technology in foreign-policy-making (Vaghan, 2013). As the power and importance of science diplomacy is recognised by many countries, now they, large and small, developed and developing, are expressing a keen interest in experimenting this special foreign policy component; as the future is going to be completely technology driven in all walks of life. However, without integrating proper strategy at the system level, it is difficult to practice. Effective use of science diplomacy requires a coherent strategy. It is very important for each nation to formulate its own national science diplomacy agenda (Vaghan, . 2012), based on their geo-political, scientific strength and weaknesses, interests and developmental needs.

Endnotes

1. National Institution for Transforming India, Govt of India.
2. Ministry of Statistics and Programme Implementation, Govt of India.

References

ECOSOC. 2014. "*The Crucial Role of Science for Sustainable Development and the Post-2015 Development Agenda*". The scientific advisory board of UN secretary-general, ECOSOC, Open working group on sustainable development goals, other post-2015 related processes.

USC. 2010. "*Science Diplomacy and the Prevention of Conflict*". Proceedings of the USC Center on Public Diplomacy Conference.

The Royal Society. 2012. "*People and the Planet*". The Royal Society Science Policy Center report 01/12,ISBN: 978-0-85403-955-5

Vaghan, C. Turekian. 2013. "*The Making of a Science Diplomat*". Science & Diplomacy Journal, AAAS center for science diplomacy.

Raymond Saner. 2015. "*Science Diplomacy to support global implementation of the Sustainable Development Goals (SDGs)*". Centre for Socio-Eco-Nomic Development (CSEND), Geneva

Vaghan, C. Turekian. 2012. "*Building a National Science Diplomacy System*". Science & Diplomacy Journal, AAAS center for science diplomacy.

Enhancing India-Comoros Bi-lateral Relations in the Field of Education

Chouraihane Ali Soilihi Mmadi*

Introduction

The Union of Comoros, a former French Colony, is an archipelago of four islands (Anjouan, Mayotte, Moheli, and the largest island, Grande Comore). It has 98 per cent Muslim population and 2 per cent Roman Catholics. Its commonly used language is Shikomoro (Swahili dialect). French and Arabic are also widely spoken as official languages. Around 60 per cent of the population is literate. India established its diplomatic relations with the Union of Comoros in June 1976.

India-Comoros Bilateral Relations

The Indian Mission in Antananarivo is concurrently accredited to Comoros, and India and Comoros have always enjoyed close and friendly relations. Both the countries have similar view on regional and global issues. Comoros is a supporter of India's permanent membership of the UNSC; India is looked upon as a role model of development in Comoros. A proposal to set-up a vocational training centre (VTC) in Moroni to impart skills in plumbing, welding, electricity, civil works, IT, etc. is under consideration by the Government of India. The EXIM Bank of India has offered a concessional credit of US$41.6 million for establishment of a power plant in Moroni, and this has been accepted by Comoros. An agreement to implement the LoC was signed on 22 February 2013 at New Delhi. Pan African E-network started its operations in Comoros in September 2010. The Government of India had granted exemption from ban on export of 25,000 tonnes of non-basmati rice to the Union of Comoros to relieve food crisis in Comoros in 2008. In December 2012, the Government of India provided

* *Secretary to the Minister of Foreign Affairs, Comoros*

US$ 100,000 as assistance to Comoros in April 2012 to combat for losses suffered on account of torrential rains. A number of VVIP/High-Level visits to Comoros from India took place during 2004 to 2013 which are (listed at Appendix 'A'). In October 2011, Shri Gurjit Singh, formerly Additional Secretary (E&SA), Ministry of External Affairs, New Delhi, paid a visit to the Island to strengthen existing bilateral relations between the countries and also promised to take necessary steps to strengthen bilateral cooperation between the countries. During the visit, announcement of an offer was made for an additional concessional credit of US $ 35 million for projects to be chosen by the Government of Comoros.

Education in Comoros

The Comorian Ministry of National Education, Research and Arts, headed by Mr Abdou Mhoumadi, is responsible for preparing and implementing government policies in education, teaching, research and to develop and implement its policies, the Ministry of National Education is assisted by a set of departments and services, making up the central administration, which are as follows:

- a general inspection;
- three Commissariats in charge of Education: Ngazidja, Ndzuani and Mwali; and
- Related institutions.

Three National Commissions

The Comorian education system consists of formal and non-formal education. Formal education involves many levels and types of education. It is composed of pre-school, basic education, general secondary education, technical education and higher education. At each of these levels, besides public education, there is a system of private education, which has been developed considerably in the recent years. The non-formal education sector includes literacy and Islamic schools. Taking into account the analysis done in 2012 of the Comorian education system, to be in line with the national strategy documents, the national education policy is based on the following three priorities:

- Advancing towards the goals of Education for all and the MDGs;
- Creating conditions for the optimisation of resources allocated to education; and
- Improving management and results-based management.
- In addition, strategic orientation defined aim to integrate educational system with the development dynamics of the country. These orientations are in line with the global sectoral vision of a convergence between the internal strengths of the system, capacity development, increasing equal opportunities and the management of development aid. In the end, the Ministry of Education need to meet the following challenges.
- Accelerating access to early childhood development initiatives through the integration of renewed Islamic education into the national education system;
- Accelerating universal primary schooling;
- Diversifying and revitalizing secondary education to increase accessibility and equality of opportunities and to improve quality of teaching and learning;
- Promoting science education in secondary schools in view of the challenges of globalisation;
- Diversifying technical education and vocational training through the creation of technical and vocational secondary schools to meet needs of employment and work;
- Establishing vocational training centres to foster learning for jobs for young people for their integration into working life which is a major challenges for the development of the subsector;
- Strengthening capacity of the SVP to increase the accessibility of a large number of students;
- Improving quality of teaching and learning at the SVP to meet country's human resources needs;
- Strengthening capacities and value research at the SVP to face challenge of globalisation; the major challenge for this sub-sector;
- Promoting functional literacy;

- Guaranteeing empowerment of women to eliminate all forms of disparity between men and women;
- Strengthening capacity of the system in resources and putting in place the planning, administration and management tools; and
- Including systematically in all education programmes and projects effective interventions to ensure awareness, recovery and continuity of education during and after emergencies.

Cooperation in education

It is difficult for the Comorian students to travel to India and integrate with the Indian education system where English is used. However, Comorian student's initiative to come to India is appreciable. They can learn English first and then start their education. Many students from Comoros have come to India to learn English and complete their graduation in different subjects. Some of them have even pursued post-graduation courses. Ten years back, there were almost no Comorian students in India. At present, more than 130 students from Comoros are studying in different colleges and cities in India.

Each year the Government of India offers nine scholarships for the benefit of Comorian students, all in the field of education .

The Government of India has also allocated 30 slots under the ITEC programme, which we have not been able to fill completely under this programme. Comorian officials and students in different disciplines have been trained in Computer, English learning, etc. The Government of India provides free training and full hospitality including airfares.

Moreover, the Government of the India under the Indian Council of Cultural Relations (ICCR) provides for scholarships to the students.

A number of young diplomats from the Comorian Ministry of Foreign Affairs took part in diplomatic training course in the Foreign Service Institute with full hospitality.

Conclusion

The Indian government has made commendable efforts in favouring the union of the Comoros in all fields, and more particularly in education. Long lasting development cooperation between the Comoros Union and the Republic of India for science, technology and innovation is a pre-requisite.

Science Diplomacy to Eradicate Hunger and Reduce Poverty in Haiti

Edward Bercy*

Introduction

The Republic of Haiti is a sovereign State located on the island of Hispaniola in the Greater Antilles archipelago of the Caribbean Sea. It occupies the western thirds of the island, which it shares with the Dominican Republic. Haiti is 27,750 square km (10,714 sq mi) in size and has an estimated about 10.6 million people, making it the most populous country in the Caribbean Community (CARICOM) and the second-most populous country in the Caribbean as a whole.

The Government of Haiti is a semi-presidential republic, a multiparty system, wherein the President of Haiti is the head of state, elected directly by the popular elections. The Prime Minister acts as the head of government, and is appointed by the President, chosen from the majority party in the National Assembly. Executive power is exercised by the President and Prime Minister, who together constitute the government.

Due to its geographical location, Haiti is highly vulnerable natural disasters (hurricanes, earthquakes, floods). After having been one of the first Caribbean destinations in the 1950s, 1960s and 1970s, and having missed the democratic transition after the fall of the Duvaliers (François Duvalier called "papa doc" and Jean-Claude Duvalier called "baby doc"), Haiti experienced great political instability. Since 2000, Haiti has faced repeated political and natural disasters, each of which caused growth to plummet for a period of line. The last disaster in date is Matthews Hurricanes which struck southwestern Haiti on 4 October 2016, leaving widespread damage. Haiti, dubbed as "The Pearl of the West Indies" is experiencing a reviving democracy, and is

* *First Assistant, Ministry Of Foreign Affairs, Haiti*

reorganizing and restructuring itself after the violent earthquake of 12 January 2010.

Haiti remains the poorest country in the Americas, and one of the poorest in the world (with a GDP per capita of US$ 846 in 2014) with significant needs in basic services. According to the full reference household survey (World Bank 2012), more than 6 million out of 10.4 million (59 per cent) Haitians live under the national poverty line of US$ 2.42 per day, and over 2.5 million (24 per cent) live under the national extreme poverty line of US$1.23 per day. It is also one of the most unequal countries with a Gini coefficient of 0.61 as on 2012.

Haiti faces important challenges to generate faster growth and fight poverty. Economic growth continues to decelerate from 2.8 per cent in the fiscal year 2014, to 1.2 per cent in 2015, and owning to lower investments, uncertain political environment and a modest recovery of agricultural sector after severe drought it showed 0.8 per cent in 2016.

Importance of Science Diplomacy

The level of poverty and hunger remains critical in Haiti, and it is through the channels of science diplomacy that we can strive to resolve the crippling problems faced. Science diplomacy can be defined as the use of international science-policy collaborations to address common challenges. As such, it is a tool to build bridge between nations and to achieve shared benefits. Many of today's global challenges related to water, energy, food, climate and health are so called 'wicked problems', meaning that they are not confined to any single nation or region and require multidisciplinary solutions through science-policy interface. However, science diplomacy has become an umbrella term to describe a number of formal or informal technical, research based, academic or engineering exchanges.

Science stimulates inherently a global innovation activity, one that transcends language, politics and geography. The phrase 'science diplomacy' has itself evolved, referring to interactions among national states in science to address world challenges. It combines two distinctly different areas of human interest: "science," being non-political evidence based universal language; and diplomacy, a process of managing relations between sovereign states, reflecting their individual national interests.

In January 2010, the Royal Society and the American Association for the Advancement of Science noted that "science diplomacy" refers to following three main types of activities:

- "Science in diplomacy": Science can provide advice to inform and support foreign policy objectives.
- "Diplomacy for science": Diplomacy can facilitate international scientific cooperation.
- "Science for diplomacy": Scientific cooperation can improve international relations.

The growing importance of science diplomacy is reflected in incorporating scientific initiatives in diplomatic negotiations and in governments using scientific advisors in developing evidence based international policies. As such, science diplomacy implies engagement of states or organizations which are supported by nation states, i.e. UN agencies or similar organizations. Notwithstanding such distinctions, academic institutions are central to all forms of scientific collaborations. The aim of science diplomacy is to create "smart" or strategic frameworks to address multilateral issues using scientific collaborations and interventions.

Agriculture in Haiti

Haiti is world's leading producer of vetiver, a root plant used to make luxury perfumes, essential oils and fragrances; provides for half the world's supply. Half of all Haitians work in the agricultural sector. Haiti largely relies upon imports for half its food needs and 80 per cent of the import sector constitutes rice.

Haiti exports crops such as mangoes, cacao, coffee, papayas, mahogany, nuts, spinach, and watercress. Agricultural products comprise per cent of all exports. In addition, the local agricultural products include corn, beans, cassava, sweet potato, peanuts, bananas, pigeon peas, sugarcane, rice, sorghum, and wood.

The agricultural sector represents 25 per cent of the GDP and accounts for over 50 per cent of jobs. However, agricultural occupations are extremely insecure and are forced to live in an Indecorous manner. Over two-thirds of the inhabitants of the rural regions are poor, and agriculture is their main source of vocation and income.

Role of Agriculture Sector

The better way to reduce poverty and eradicate hunger in Haiti is to pool more investments and incorporate science and technology in the agriculture sector, which would resolve issues in the other fields. Also at present, there is a need of programme based cooperation in agriculture which must include: introduction of farming system, use high yielding crop varieties and breeds of livestock animals for reduction of poverty, elimination of hunger and malnutrition, increasing income of farmers, and food security and food safety. Through the enhancement of South-South Cooperation we can solve these problems while developing a vision for rural development. Such a vision should include the following

- **Specific policies:** Access to credit and insurance; technical support; market access and standardization.
- **Research and development:** Strengthening local research institutions; empowering local research groups for strategic sector; and creating Research and Development national system (autonomous technology development) for sustaining national needs of agricultural technologies as well as industries for manufacturing agro-chemicals such as fertilizers, pesticides, etc.
- **Entrepreneurship and innovation:** Big, middle size and smallholder farmers; processors and cooperatives to take up entrepreneurial activities.

Technical Support for Agricultural Research and Technological Innovation Platform (ARTIP) can be developed with the holistic vision of rural development, by strengthening local capacity; management of partnership across all levels; launching projects in rural development with bilateral and multilateral perspective; and gaining experience in management of innovation in rural set-up.

Recently, the new elected President Jovenel MOISE, has given main thrust to agriculture, as a starting point for economic recovery of the country, a vision for abio-ecological agriculture as the driving force of the Haitian economy, creating jobs and generating wealth for the population of which more than 50 per cent lives in rural areas. Science, technology and innovation becoming more important for developing countries as the economy of these developing countries is mostly agriculture based. In addition technology transfer through South-South cooperation can increase value-added content of the production and increase employment in rural areas.

Relevance/importance/Impact of South-South Cooperation

- Many countries engage in cooperation without a detailed institutional framework and operative programmes. This in the long run is not sustainable. For successful cooperation to be realized, it is important to create institutions, and develop mutually agreed programmes, and not just sign agreements (eg. CELAC, CARICOM, ACS).
- South-South cooperation can be an effective tool for promoting development in the developing world as an alternative to aid and donations from the developed world, especially if the developing/emerging economies in the South give a sound leadership.
- Increased collaborations between partner states in the South by sharing development experiences and pooling resources together to provide a big drive for economic development.
- Developing countries need to identify their weaknesses and use more cooperative measures among themselves to address them.
- South-South cooperation still faces numerous challenges, notably problems of diversity,

limited resources and unequal international political and economic order, which must be addressed to reduce world imbalance.

- Though South-South cooperation may not entirely substitute cooperation with the North, but it is going to be the most sustainable and appropriate form of cooperation for developing nations.

Conclusion

Science diplomacy is a dynamic new paradigm of collaboration, and development of science diplomacy is growing in importance due to modern scientific endeavours. It is gaining official recognition from states as a valuable tool in integrating of science and international relations. It encourages communication and thereby breaks down barriers to introduce new layers of interaction for international relations. It provides a sound basis for development and a positive and constructive model for international relations in the future through a framework of diplomacy for science.

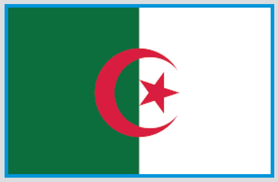
References

www.ihsi.ht (Source in French: Haitian Institute of Statistics and Information Technology)

www.worldbank.com;

www.lenouvelliste.com;

www.ris.org.in;



Algerian Government Policy for Information and Communication Technologies

Benbala

Introduction

The face of the world has changed, and the boundaries between the real and the virtual are dismantling with the advancements of information and communication technologies and their integration into economic and governance circuits. Indeed, advances in the field of information and communication technologies are becoming more and more crucial for the economy and building of information and knowledge society. The government has placed digital development among its imperative priorities, and aims to place Algeria at the heart of this global evolution by providing it with the most innovative infrastructure and means, for large-scale digitization. Convinced that ICT is a crucial contribution to economy, society, environment and public health, the government has defined a public policy to accompany this development process and thereby stimulate economic competitiveness and well-being of all.

The mechanisms and measures put in place and/or to be implemented by the government to achieve targeted objectives, can be summarized around the following topics:

- Implementation of the Broadband & high speed broadband strategy; Satellite telecommunications; Maritime radio navigation; Management of frequency spectrum; The Universal Telecommunications Service; and Mobile phone.

ICT Generalized Use and Strengthening of National Innovation System

With a view to generalization of the use of ICT, particular attention

* *Diplomat, Ministry of Foreign Affairs, Algeria*

The table below gives more details about objectives and mechanisms for implementations

Field	Objectives	Mechanisms and measures
Implementation of the Broadband & high speed broadband strategy	• Completion and modernization of the access network, • Development of new infrastructures, • Improvement of the quality of service and the reception of customers.	• Connection of localities with more than 1000 inhabitants to the Fiber Optic network, • Connecting new broadband clients, • Deploying and Extending the 4G LTE Network, • Realization of the submarine link Oran-Valence, • Realization of fiber optic link Alger/Ain Guezzam.
Satellite telecommunications	• Reducing the digital divide for populations in remote areas, • Geolocalisation and fleet management, a key factor in road safety, • Satellite telecommunications for the prevention and management of natural disasters, • Satellite technologies for health.	• Extension of the IDIRECT platform to meet the needs of the market. • Development of IP voice by extending the platform installed at the Teleport de Lakhdaria. This solution will provide public institutions and business enterprises with Internet, telephony and fax packages on VSAT support. • Launch of the "Internet Residential" project.
Maritime radio navigation	Ensuring the safety of human lives and property in a very specific environment which is the marine environment and contribute to safety in the aeronautical field through the control of radio equipment and the certification of the users of this equipment.	• Development and extension of the radio-communication network to improve the safety of human life and property, • Creation of maintenance centers at the level of the three regions (Algiers, Oran and Annaba) to take in charge all the technical problems specific to the national radio-communication network on maritime, • Creation of new stations and structures for better and wider coverage, • Upgrading of professional skills and the qualification of personnel dedicated to these public service missions.

Management of the frequency spectrum	Ensuring the correct and effective application of the frequency band allocation table in accordance with the nature of the services, zones and regions, as well as the general and technical characteristics of the stations to be operated by the various services.	• Setting up new spectrum control stations in the south (ADRAR) and in the north (Beni-Saf and Ain defla), • Launch of a campaign of measurements in the C, Ku and Ka bands in progress across the national territory, • Creation of a compliance control database, • Establishment of a VPN network for the interconnection of control stations with the supervisory stations.

Source: Adapted from document ***"Government policy in the postal and information and communication technology sector"***, Algerian Prime Ministry, October 2015. http://www.premier-ministre.gov.dz/ressources/front/files/pdf/politiques/mptic.fr.pdf

is given to the development of ICT services for citizens and businesses, thus promoting the emergence of local applications which would contribute in the development of a digital economy and building-up of the information and knowledge society.

Emphasis would also be placed on the development of ICT applications, which would then create enterprises and start-up companies and innovation centres, generating new wealth as well as promotion of industry and research in the ICT sector.

Moreover, strengthening of the national innovation system must bring support for science and innovation through the following:

- Encouraging production of technological knowledge, licensing and purchase of capital equipment;
- Establishment of linkages in University-Industry interactions;
- Access to financial measures for innovative enterprises;
- Strengthening of R & D capacities in companies;
- Establishing appropriate channels of access to information and its sharing through a network open to public and private partners without any distinction.

ICT Projects

Start-ups incubators and technology parks

Incubation of projects as proposed by the National Agency for Promotion and Development of Technological Parks fits in a precedence sequence to actual inception of the company, since it

covers the period that starts from the contemplation of an idea to the achievement of the project, while rolling through a process of conception of the business project.

As such, the incubator of Sidi Abdellah gradually embarked on an entrepreneurial dynamism set by the National Agency for the Promotion and Development of Technological Parks for over four years. It gained exposure on the entrepreneurial platform nationally, given its initial results. Indeed, 18 young ICT companies have been created since the start of the incubation process in May 2010. It continues to support activities by coaching holders of more than 49 business creative projects and 15 new start-ups to be future business leaders.

It should be noted that in this context an international project called "Support to the Ministry of Post and Information and Communication Technologies in the implementation of an ecosystem fostering the development of ICT in Algeria was initiated by the Ministry of Post and Information and Communications Technologies in partnership with the European Union in favour of the National Agency for the Promotion and Development of Technological Parks. A call for proposals was launched on 17 July 2015 on the European Union website, under reference EuropeAid /137426 / IH /ACT/DZ.

The overall objective of this twinning project is the development of economic activities based on ICT and related uses. Its specific objective is aimed at strengthening the capacity of the sector in the implementation of an ecosystem to foster the development of ICT.

Telemedicine

Considering the important role of the ICT in improving the quality of life of individuals, particularly in the health sector, the Government continues to attach great importance to e-health projects, as set out in the sector's strategy.

An ambitious project was initiated in collaboration with the Ministry of Population Health and Hospital Reform, to set up a telemedicine pilot network called "Algeria RT-DZ Telemedicine Network" comprising five hospitals CHU and 12 public hospitals EPH and the National Health Development Agency (NHDA) as focal point, to allowing access to remote healthcare facilities through data transfer or through the direct action of practitioner on the patient, in particular providing tele-consultation, remote diagnosis and tele-training services.

The project consists of setting up a fiber optic telecommunications network, interconnecting several sites of the RT-dz network (operational) and making it available at following levels.

- Interactive systems for remote patient visualization and medical record, at CHU level.
- Interactive systems of remote visualization allowing exploration of patient according to his pathology at the EPH level a videoconferencing system to organize multi-site sessions as well as a streaming system for archiving and dissemination at the level of the NHDA and remote training of health practitioners.

The technical platform has been tested and the network is at present operational.

International Cooperation

Development of the international cooperation is one of the major thrusts of the sector's action plan. In this regard, many actions and measures are being taken for international cooperation aimed at developing and strengthening strategic partnerships with friendly and neighbouring countries and for promoting multilateral cooperations with major regional and international specialized organizations.

By seeking to develop the field of ICT through modernization, adapting and generalizing telecommunications' infrastructure, promoting use of ICT and integrating the society in information and science based economy the objectives sought through international cooperation are reflected mainly in the following projects

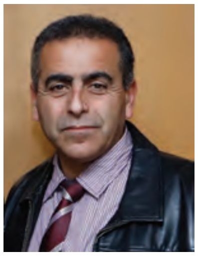
- Appropriation knowledge on new technologies, and know-how,
- Technology transfer, and
- Capacity-building.

Conclusion

At the multilateral level, Algeria, as a member, represented in many meetings, dialogues and international and regional initiatives put across its interests and position in the ICT, with: International Telecommunication Union (ITU) organised by, Universal Postal Union (UPU), United Nations, World Bank, European Union, League of Arab States, Arab Maghreb Union, International Telecommunication Satellite Organization (ITSO), Arab Telecommunication Organization ARABSAT, African Telecommunications Union (UAT), and Pan African Postal Union (PAPU).

South-South Cooperation for Science Diplomacy

The present study discusses scenario of South-South cooperation with North participation as a case study. It has been argued that it would be favourable for the South countries to start forming a sort of coalition amongst themselves for addressing specific scientific or technological projects. This coalition would serve achieving the necessary critical mass that makes the project feasible where possibly heterogeneous countries in the South (in terms of scientific and technological capacity, natural resources, funding potential, international relations) act in synergy. Once the coalition is formed and the project is defined (goals, mechanisms, governance, place, timeframe, finance it can approach North (developed) country/ies seeking well-defined technology transfer and may be funding. In this scenario, South-North cooperation and technology transfer based on the demand



Ibrahim Abdalrahim,
Head of International Cooperation
Higher Council for Innovation &
Excellence, Plo, Palestine

Jamaleddine Ben Abdessmad
Bureau Chief
Tunis Hebdo, Tunisia

Moch. Syaiful Anwar
Researcher
Lipi-Research Center for Metallurgy
and Materials, Indonesia

Mariana Cuneo
Advisor in International Relations
Municipal Government of Canelones
Province, Uruguay

Hendrik
Researcher Cryogenic
Research Center for Metalurgy and
Materials, Indonesian Institute of
Sciences, Indonesia

Karim Tahboub
Board Member
Higher Council For Innovation &
Excllence, Palestine

can be achieved, and undesirable political side effects can be avoided.

The SESAME project is an example wherein Eight South countries (Egypt, Turkey, Jordan, Palestine, Pakistan, Bahrain, Cyprus and Israel) agreed in 2003 to build a synchrotron light facility in Jordan on the model of CERN. The goal of the project was to send scientists from the region to have first-class science and to raise scientific standards by having access to the state-of-the-art technology and experimental facility based in the region at a reasonable cost. The idea came from South as well as North, and was immediately supported by the UNESCO and endorsed by country-leaders. A governance system, where a Council chaired by an internationally renowned scientist (CERN former director) was composed of members from the representative countries. Seventeen observer member-countries from all around the world supported the project scientifically, technically, financially and politically. Further international organizations such as the International Atomic Energy Agency, CERNand ICTP were solid project partners. Science and technology transfer could be achieved through different modalities including training, capacity-building, on-site participation in design, construction, and operation of high-tech modules. Technical and scientific international advisory committees would work together with technical and scientific directors to ensure best practices and a smooth know-how transfer. The total budget of the project, inaugurated in May 2017, is estimated at around $100 million. Member countries have contributed most of this budget and international organizations and some member countries have provided direct funding or in-kind contributions.

Developed countries and international organizations were motivated to support the project mainly due to political reasons and for achieving peace through scienctific channels. Thus, a ground was found for the scientists from member- countries to come onto a single platform overlooking political differences. Although, this seemed difficult to achieve, world-class science can still be achieved and a real high technology transfer on demand can also take place. The role of politically-neutral international organizations was vital, and instrumental for this project.

This project is a vivid example of how technology transfer can be achieved through South-South Cooperation. No single country alone can achieve this, owing to high cost barriers (low feasibility, given the limited number of potential scientists in the country who use such a facility) and owing to the lack of support of North countries.

Essentials for South-South Cooperation

To be able to develop a new form of relationship among countries of the South, a new approach, a new concept and new relations are required with one another based on the honest engagement and common interest.

First of all, we need to know other countries with whom we have to deal with regarding trade, exchange, and even for strategic tie-ups among the Southern and Northern countries.

With one clear vision about the relations as strategic partners, more and more can be built together without conflicts.

The new South-South cooperation requires a leveling of capacities among the various developing countries, with exchange of experiences and knowledge without self-interest of the country initiating the exchanges; as is the case with India as a facilitator and catalyst for this cooperation. It is with these choices and conviction to be independent of the North to a certain extent, developing it's nations with their its own capabilities and technology without the need of learning from the developed countries, can have a new bloc away from capitalist hegemony and attempts to dominate one party at the expense of the other. Underlying this new South-South project is the cultural aspect which must also be seriously taken into account because a society that does not attain a minimum knowledge cannot be at the pace of development with other countries.

In this new approach of science diplomacy, culture must have a place of choice and of first order so that communication among the different actors of the South can be equally perceived by all. Finally, it is by creating this new Southern force, capable of coping with the economic powers, that we can aspire to achieve development based on our own capacities, technologies and without any dependence on others. In this context, India, as an emerging power of the South, part of BRICS, and the new force that can play a major role in South-South Cooperation, being the initiator of this project and promoting it vigorously by investing enormous resources, India would have required credibility for realization of this project for our common future.

India-Indonesia R& D Collaboration on Superconductivity

Superconductor research at the Research Center for Metallurgy and Materials Indonesian Institute of Sciences (RCMM-LIPI) was initially started with the cooperation from LUVATA on manufacturing of Cu-sheathed Nb3Sn superconducting wire in 2006. The RCMM-LIPI has also been collaborating with other institutions within and outside the country such as UI, ITB, the National Academy of Sciences of Belarus, and Hyper Tech. The RCMM LIPI is keen to cooperate with India in the manufacturing of MRI.

Indonesia's MRI market is relatively small and expensive for low-income communities. Only rich people are able to take MRI treatment in Indonesia. Meanwhile, the Indonesian government has sent many radiologists to India for training of instrument and reading of the MRI images. This is a challenge for Indonesian government to provide an affordable cost of treatment for MRI.

India has a network of businesses for manufacturing MRI instrument in which there are components of superconducting wire imported from Hyper Tech (USA). For example, the MRI business in India offers affordable price of about $ 300,000 per unit. The 60 per cent of the cost is allocated to purchase of superconducting wires and cryogenic systems. The remaining cost is allocated to casing, electronics and motors. In developing the South-South cooperation science diplomacy is needed for bridging the technology transfer gaps by promoting R&D Collaborations between India and Indonesia.

Figure 1. MRI in India

The possible scenario in this research collaboration includes technology transfer and techno economic manufacturing of MRI apparatus by Indian companies. The RCMM LIPI contributes to research and development of superconducting wire material in which the outcome of R&D results in the upgrading capability of MRI apparatus.

Meanwhile, this scenario can lead to signing an MoU for collaborating research cooperation between India and RCMM-LIPI to work together in terms of business cooperation in the form of partnerships. The partnerships envision exchange, training, internship and fellowship of students. The RCMM-LIPI would continue to bridge science and technology with business opportunities between Indonesia and India. Through channel of joint venture, technology facilitation mechanism (TFM) can be poured in the agreement between India and Indonesia in the form of Indonesia India Comprehensive Economic Cooperation Agreement (IICECA).

In India-Indonesia's MRI manufacturing, each country has advantages such as improving trade relations, creating professional works, and skills, establishing partnerships, as well as increasing STI (Science, Technology and Innovation).

South-South Cooperation

South-South Cooperation (SSC) refers to cooperative activities among newly industrialized Southern countries and other, lesser-developed nations of the Southern hemisphere.

The activities include developing mutually beneficial technologies, services, and trading relationships. SSC aims to promote self-sufficiency among Southern nations and strengthen economic ties among Southern states whose market power is more equally matching than the asymmetric North-South relationships.

Importance of SSC for these nations

The SSC contributes to economic advances in Southern nations, especially in Africa, Southern Asia and South America and Middle East.

- SSC lacks overtones of cultural, political, and economic hegemony, sometimes associated with traditional North-South aid from the United States, Russia and Western Europe.
- Main players in South- South Model for cooperation are as follows.
  - » Developing countries
  - » Emerging economies
  - » Developed countries of the South
  - » North developed countries

The world is a united entity linked with common interests and responsibilities. The main issue is to address improvising relations among all countries that guarantee equal rights for access to technology development and well being. Being part of the South does not mean alienation from the rest of the world, it is also inevitable to ignore one part of the world "the North" regardless of their past relations towards developing countries. The North holds complete responsibility to assist the South in their quest for development and growth and self-sustainability. A lot of vocalization is coming from the North appealing to guarantee aid assistance and transfer of technology to the developing countries. Science is and could be made available in developing countries, and technology should be made available from and by emerging economies from themselves. The emerging countries should bridge the gaps with regards to technology transfer to developing countries. As technology is the only motor for development science, developing countries could provide additional inputs with regards to their needs and priorities.

Right to acquiring Technology should be based on an international principles and developing countries should be enabled to produce for meeting their entire domestic needs in health, agriculture, water and food. For other higher technology they should plan for later stages of high technology production and start setting up the requisite infrastructure with the aid of the South and financial aid from the South and the North.

The equal rights to enter the international market should be guaranteed to all with preferential treatment to the most disadvantaged countries. As the South is considered North's market, the North should open its markets for the South's production; and not just agricultural production but also technological also.

At the end, to strengthen South-South cooperation, Southern countries should unite their forces and set up a bargaining stance with the North.

South-South Cooperation in Latin-America

Latin America has a long history as the traditional receiver of international cooperation under the model of North-South cooperation. In certain moments of yester years this scheme of cooperation was not only useful but was also successful for most of the countries in Latin America. As consequence of the assistance received from the North, some Latin-American countries assumed a key role and leadership in the continent as the case of Brazil, Argentina, and Chile and so on. At the beginning of the 1990s, the gravitation of new integration processes allowed consolidation in Latin America of a new form of regionalism;

conceived under the European model but at the same time it was the first step towards the South-South Cooperation. As a result of this, innovative vision emerged a new perspective where regional scenario became priority for the Latin-American economies. Subsequently, the implementation of new schemes came of interaction among Latin American countries and regions. Obviously, there were several points in common among them, such as language, historical background, economic issues, short distance for interacting and others subjects of common interest. Therefore, leading countries in Latin America started promoting and strengthening regional trade, knowledge exchange, mutual assistance and other subjects within a South-South view.

In addition, they realized that horizontal integration and cooperation was the only valid option in order to move forward international context and in relationships with developed countries. New stakeholders crossed the boundaries of national and regional policies by setting up a new paradigm in international relations. An unprecedented globalised world pointed the fragility of national and regional economies in the developing countries.

Under that premise linkages between developed and developing countries increased risk of financial and social crisis, particularly for the most vulnerable groups, mainly for those that had received high flows of FDI from the North, besides the presence of multinational companies and other similar situations related to North-South scheme of relations at different levels. Since then, developing countries need to find new alternatives to achieve sustained development.

Thus South-South Cooperation is perceived as an appropriate tool for developing countries to keep aligned with the Goals of the Millennium, especially in specific areas like technology transfer and science education. In that sense, we should work together on the basis of the common interests. The South-South and the Triangular Cooperation and its different variants are a must for developing countries. Capacity-Building is one of the tasks that we may have to develop for sustainable development and good governance, empowering people in our countries at the different stages of this process and consolidation of a democratic system of development in which mutual assistance beyond the geographical distance and cultural exchange are the key points for raising well-being of the societies.

CELAC - The Community of Latin American and Caribbean States

A regional bloc of Latin American and Caribbean was created on 3 December 2011 in Venezuela with the signing of the Declaration of Caracas.

It consists of 33 sovereign countries in the Americas representing roughly 600 million people. Due to the focus of the organization on Latin American and Caribbean countries, other countries and territories in the Americas, Canada and the United States are not included. CELAC is an example of a decade-long push for deeper integration within Latin America. CELAC was created to deepen Latin American integration and according to reduce the significant influence of the United States on the politics and economics of Latin America.

It is seen as an alternative to the Organization of American States (OAS), the regional body founded by United States and 21 other Latin American nations originally as a counter measure to potential Soviet influence in the region.

Working towards South-South Cooperation

Case study: CELAC was organized in Dominican Republic, an International Cooperation Policy Summit on 12 and 13 January 2017.

At the meeting, the Cooperation Group evaluated the design of a platform aimed at structuring capabilities and strengths of public management of member States which may be useful for the South-South Cooperation. Also there was discussion on financing for development and reviewing cooperation with Haiti. CELAC aims to deepen political, economic, social and cultural integration of more than 600 million people living in Latin America and the Caribbean, respecting their diversity, democracy and human rights. The regional bloc is composed of Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Dominica, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay and Venezuela.

Conclusion

While discussing South-South Cooperation, five different scenarios were presented:

There is need to establish a strong South-South coalition before seeking technology transfer from the developed North countries; We must aim at achieving a meaningful South-South Cooperation; avoiding North involvement; Bilateral South-South Cooperation could be for efficient win-win synergies; Emphasis should be on how technology transfer would be optimally achieved through a North-emerging-South flow; and Finally, there is the scenario of multilateral South-South cooperation in the presence of competing poles.

India and Egypt Cooperation- Growing together through Co-operation in Solar Energy

Rabi Abd Elghafar

Introduction

Academic professors define science diplomacy as using scientific collaborations among nations to address common problems and to build constructive international partnerships. We would define it just as it is about notions of growing together which though said in a fewer words has deepest meaning. In other words, every country helps the other to grow as far as possible to achieve a common interest.

India in recent years has proved that it is sincere about this idea through its support to South–South cooperation strategy which helps other developing nations to overcome obstacles in their way towards people welfare. So our target for every stage of science diplomacy is to improve citizens' life as Dr. T. Ramasami, Former Secretary, Ministry of Science and Technology, Govt, of India said that on account of non-sustainability of current resource intense models, it might seem beneficial to design and develop alternate models for developing affordable innovations with people centric priorities for the countries in the stage of economic development. Process of innovation might overlook the purpose of innovation for serving the needs of poor people, residing in low income and low middle group countries.

In Egypt, which is at the crossroads after 25th January revolution, has starved for this kind of cooperation. There is a huge opportunity to go deep in using science of diplomacy to proceed with reforms plans that would not succeed without help from friends, like India. Egyptian economic development plan 2030 needs more than 130 billion dollars to invest in energy sector, especially renewable energy like wind turbine and solar panel.

* *Journalist, Al-Gomhuria Newspaper, Egypt*

While Egypt has an unusually hot, sunny and dry climate, but India has a wide experience in solar energy sector since 1978 has come out with solar panels for tapping solar energy. In the World Bank's 'Doing Business 2017' Report, Egypt leapt to 41st place for 'getting electricity'.

This paper attempted to discuss, how India can support Egypt to improve its solar sector for clean power through science diplomacy. For that purpose we would make a brief review of the history of relationship between the two countries, current situation in both of them, Indo-SSC success stories with other countries and at the end would give some suggestions with regard to future cooperation between Cairo and New Delhi.

Historic Overview

Relationship between India and Egypt has had a general tone of cooperation and cordiality. The political dispensation in India is favourable and supportive towards Egypt since its independence.

India and Egypt share civilizational ties with a long history of people-to-people contacts. Egypt under President Gamal Abdel Nasser and India under the leadership of its first Prime Minister Jawaharlal Nehru were torchbearers of the Non-Aligned Movement (NAM). Their commitment to socialism kept both the leaders and countries drawn towards each other. After the end of the Nehru-Nasser era, the relationship between the two lost much of its old sheen. Subsequent leaderships in both the countries acknowledged the importance of the other, but there was a discernible absence of any meaningful efforts from both the sides to strengthen the relationship.

For India, cordial relations with Egypt present an opportunity to build on historical ties, and also to forge an enduring partnership for meet emerging global challenges in the field of energy security, terrorism and climate change. India has invested about USD 2.5 billion in Egypt, involving 46 Indian companies .

From the special bonhomie of 1950s and early 1960s between New Delhi and Cairo, tone and the tenor of the relationship in recent times has gravitated towards a more pragmatic one, manifesting in booming bilateral trade and robust investments from India to Egypt. Trade has crossed $ 5 billion and India has emerged as Egypt's 7th largest trading partner. India has invested $ 2.5 bn through companies like Alexandria Carbon Black, TCI Sanmar, Dabur, SCIB Paints, Marico and Oberoi Group. New Indian companies from sectors like pharmaceutical, garments and education have established their operations since January Revolution, while Dhunseri Tea and Petrochem are on track with the completion of their PET plant in Egypt. It is important for India to contribute in making Egypt for strong trade partnerships, besides establishing local joint venture researches.

Egypt showed goodwill after 25 January revolution when it established Indo-Egyptian Business Council in partnership with the FICCI. The IEBC agenda is focused on: helping Indian companies for resolving issues in Egypt, supporting Egyptian Government's efforts to protect interests of the Indian companies and find solutions to issues pertaining to security and visa; and exposing Indian members to newer opportunities in Egypt and helping Egyptian companies in their Indian foray. It is expected to catalyze interactions and exchanges between the business enterprises of both countries and their enhancing trade and investment.

So we hope that would help to improve cooperation in a better way than the Bilateral Investment Protection Agreement between India and Egypt signed in November 2000. This agreement was needed for encouraging foreign investment. The growing momentum in ties dictates a need for a double taxation avoidance agreement between the two countries.

Solar Energy in India

During a visit to the Central Electronic Limited company for manufacturing solar panel officials insisted on wearing safety clothes and switching off mobile. CEL, which was established in 1978, has a full support from the government and their yearly gains soared to $ 250 million. India launched the largest solar power plant in the world in Kamuthi (Tamil Nadu) in 2016, which took less than a year to build. The plant produces about 1000 hectares of panels, which can produce 648 megawatts of electricity. When operation of Azure Power began in 2009, India had only 10 MW of installed solar generation capacity. India has more than eight gig watts of installed capacity, and is among the fastest growing markets in the world for solar power;

The growth of India's clean-energy market has triggered significant price drops; power costs for Azure Power's customers have fallen by 74% in the last five years. This benefits customers and creates right conditions for the country to meet its target of raising installed capacity for solar energy to 100 GW by 2022.With almost a quarter of its population still having no access to electricity; India would need an estimated $250 billion new investment to achieve that goal. Most of the funding would have to come from the private sector. Thus, evidently that India's use of solar power is increasing.

In 2015, CNN reported that India has become the first country to operate an airport completely on solar power. That year, the Cochin International Airport installed a solar plant on the unused land near some of its buildings; the airport has not to pay electric bills; instead, it plans to sell its extra electricity back to the state. Other airports in India are also using solar power, including an international airport in Kolkata, which launched a two megawatt rooftop solar energy farm in 2015. At the beginning of 2010, India launched the Jawaharlal Nehru National Solar Mission to increase renewable energy, which includes solar energy. By 2022, the government plans to produce enough solar electricity to power more than 60 million homes. According to the World Resources Institute, Indian government may to increase solar power production from four gig watts to 100 gig watts by 2022.

Indio-French Cooperation Model

PR Fonroche, a joint-venture between PR Clean Energy from India and Fonroche Energie S.a.s from France, commissioned two solar photovoltaic based power plants (5 MW and 15 MW) in Bikaner, Rajasthan. These were awarded to the company under the Jawaharlal Nehru National Solar Mission's Phase I Batch II scheme.

Incidentally, the first of the two projects of 5 MW capacity commissioned in December 2012, was the first Indo-French collaboration in the Indian renewable energy sector. (Under the contract, AREVA was to build two 125 MW CSP plants using Compact Linear Fresnel Reflector (CLFR) technology in Rajasthan. With Areva Solar closing its shutters, only one plant has been realized, and came online during last year. The second unit is said to be in the planning phase) .In another interesting partnership, Bangalore based Enzen Global Solutions Pvt Ltd. (EGSPL) has joined hands with the French company Ciel et Terre to build floating solar power plants in India. The State of Karnataka alone is said to have 36,000 irrigation lakes of more than 24 acres. For expansion in Eastern and North-Eastern India, Ciel et Terre has entered into an agreement with Klystron Electronics, which is one of the leading Electrical Construction House in the Eastern India. Other French companies present in the Indian solar space include the oil major, Total, present through its subsidiary Sun Power. Alstom Power is engaged in four solar power plants of 25 MW for supplying steam-turbines.

Solar Energy in Egypt

Egypt is gifted desert land, with sunny weather and high wind speeds which make a it it country having tremendous potential for renewable energy sources. Egyptian government intends to supply 20 of generated electricity from renewable source by 2022 (wind 12, hydro power 5.8 pt, and solar 2.2).

Government plans utilization of solar at 3.5 GW by 2027, including 2.8 GW of PV and 700 MW of CSP. In addition generation of 7.2 GW (12% of generated electricity) from wind by 2022 is also planned. Significant private sector involvement by taking lead on 67 of the total is expected. Egypt's need at least 7 percent annual growth in electricity production or around 2500 MW/year to meet increasing energy demand, which is critical for its sustained economic growth.

The New and Renewable Energy Authority (NREA) plays a strategic role in government's renewable energy plans. In January, Egypt selected 67 companies to participate in developing 4.3 GW of renewable energy projects; the qualified companies are at present involved in the land allocation process. Presently, the total installed capacity from solar energy is about 45 MW solar Photovoltaic (PV), including 15 MW, distributed in advertisements, telecommunications and irrigation sectors. There are also others plants, including the 1st off-grid power plant with capacity of 10 MW at Siwa, North West of Egypt, 6 MW in Elfarafra and 14 MW PV power plants in Red Sea Governorate. Also, 20 MW for Concentrated Solar Power (CSP), as a solar portion of integrated combined cycle power plant, with total capacity 140 MW is located in Elkurimat.

Solar Energy Resources and Facilities

Egypt's Solar Atlas states that Egypt should be considered a "sun belt" country with 2,000 to 3,000 kWh/m^2/year of direct solar radiation. The sun shines 9-11 hours a day from North to South in Egypt with a few cloudy days.

In 2011, the first Solar Thermal Power Plant at Kuraymat was established, with a total installed capacity of 140MW, with solar share of 20MW based on parabolic trough technology integrated with a combined cycle power plant using natural gas. A 10-MW power plant is operating in Siwa since March 2015, is functioning satisfactorily.

Opportunities in Egypt

GoE has announced an interim target for the first regulatory period (2015-2017) to contract 4300 MW of both solar and wind energies as follows:

- 300 MW for small solar systems PV roof top systems (less than 500 KW),
- 2000 MW of Medium and large size of Solar grid connected PV plants (maximum 50 MW), and
- 2000 MW of Medium and large size of Wind plants (maximum 50 MW).

Sixty seven international and local consortia have qualified for PV projects with a total capacity of 2880 MW, and twenty seven international and local consortia have qualified for wind projects with total of 1670 MW. These projects are under development. Egypt is also considering financing options for the following projects

- Solar-thermal power plant, using CSP technology for both electricity generation and water desalination; solar-thermal power plant for industrial purpose;
- Designing a technical-financial mechanism to promote using solar water heaters in residential sector in Egypt; and local manufacturing of renewable energy equipment.

In November, the Government signed power-purchase agreements (PPAs) worth some €600m ($662m) for approximately 400MW of solar-power capacity.

Among the projects, where we are behind this uptake in capacity is a €8bn ($511.2) deal Germany's Siemens, signed in 2015 with the Egyptian government to build three 4.8 GW combined-cycle gas-fired power plants. The first 4.4 GW of capacity is expected on-line by year-end, with a full 14.4 GW from the combined-cycle plants by mid-2018 (African Brand Link, marketing company, 16 Dec. 2016).

By 2030 MERE expects a total of 51.7GW to be added to the grid, requiring an investment of $135bn. The long-term plan for 2019-30 foresees Egypt building on its goal of 20 percent renewables by 2022; by generating 16 per cent from solar power and 10 per cent from wind, with 49 per cent from oil and gas and 15 per cent from coal.

The Government's ongoing programme of easing electricity subsidies is also expected to help encourage investment which means more burden on Egyptian shoulders. Perhaps Indian science diplomacy would help in this regards.

India helping Egypt through science diplomacy

Transfer of technology

Technological development is an essential component of building productive capacity which strengthens competitiveness to sustain growth. Also, it enables creation of capabilities critical for dynamic learning and achieving SDGs. India already has come a long way; thanks to its exposure to advanced countries like the USA and France. The first stage of cooperation would be direct technology transfer from India to Egypt.

Capacity- building

It involves improving national capabilities for formulation, implementation, monitoring, and review of policies and plans concerning national S&T activities.

Capacity- building in India depends on international training programmes for S&T personnel and better management of technology. Training is important for science managers and decision-makers to remain up to date with the changing needs of the S&T Society.

It is very critical to stimulate interest among the public and get their support for national initiatives in science diplomacy.

India can help Egypt build its capacity by conducting training programmes for post-graduates, especially keeping in view the following parameters:

- Universities in Egypt need labs, including scientists from both the countries, for example.
- Both countries should exchange visiting professors at university and institute levels.
- Establish research missions working jointly in Egypt and India in common research agenda to serve both the countries people.

  Joint R&D for solar energy

Generation of knowledge in developing countries, on most occasions, has largely happened through technological learning, where R&D efforts were primarily directed towards technological learning rather than basic science or path breaking innovations

R&D is largely concentrated in the developed world, and the USA still dominates, with 28 per cent of global investment in R&D. The EU (19 per cent) and Japan (10 per cent) share 29 per cent. China has moved into second place (20 per cent). The rest of the world represents 67 per cent of the global population but just 23 per cent of global investment in R&D.

- India has capacity of R&D but spends less than 1 per cent of GDP on it. In fact, the share of developing countries lately in knowledge generation and transfers is growing.
- Egypt should have a platform to share knowledge with India and with other developing countries.

The main platform for sharing knowledge should be joint research conducted by teams of scientists of both countries.

Research-Academic-Industry Mobility between India and Egypt

India has great cooperation in research and academic cooperation with EU and this should be followed by other developing countries.

- Work-programme for India-EU Call, established jointly by EC and Government of India for balanced advantages to both India and EU. Equal Opportunity for Indian and EU scientists to file India-EU RTD project proposals with DST and EC.
- Joint Selection Process by EC and Government of India with mixed panel of Indian and EU evaluators, co-funding by EC and GoI especially project-based mobility of researchers.
- IPR sharing by India-EU RTD project partners effective.

Conclusion

Egypt should establish an university or instate research for people belonging to both the countries. They should work as research teams among local academicians of countries. Participants from both countries should exchange experience and have cooperative ambitions in securing their research capability

Cooperation for Brahmaputra Water between India and China

Rashmi Srivastava*

Introduction

Our *'Blue Planet'* endures constant natural changes in freshwater systems across the globe, both in terms of quantity and quality. However, these changes are amplified in South Asia due to augmentation of population strain, industrialization, climatic changes, glacier melt and urbanization. In such a scenario, water is the new divide between geopolitical regions. One such region is the *Brahmaputra river basin*, which carries highest volume of water with *586 billion cubic meters* (BCM) *per year* (Reddy, M .S. et. al. 2002). This river system has strategic importance as well, as it passes through *two* Asian giant countries, India and China, along with the other riparian state – *Bangladesh*. This paper, however, outlines the debate of Brahmaputra water sharing between India and China only due to following reasons:

Both, India and China are water-stressed nations, which would be consequently leading to increased food and water insecurity in the near future.

The downstream of the river water is being shared by India and Bangladesh for agriculture, water and livelihood and the upstream riparian of the river is owned by China, thereby, building significant *strategic benefit over the river's flow*.

The *damming and upcoming water division agenda* along the *Yarlung Zangbo* tributary (the Brahmaputra in India) by China may escalate conflict between India and China.

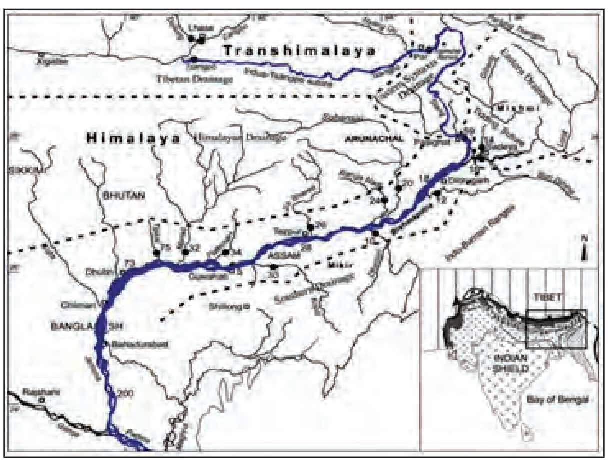
Lack of partnerships and hydrological information sharing between India and China is presently the bone of contention across the South Asian region, due to increased competence for river water resource.

* *Research Associate, Centre for Science and Technology of the Non Aligned & Other Developing Countries (NAM S&T Centre), New Delhi.*

Figure 1: Brahmaputra River flow across Trans - boundary Nations

The trans-boundary flow of Brahmaputra river, across southern Tibet to break through the Himalayas in great ravine (including the Yarlung Tsangpo Grand Canyon) into Arunachal Pradesh (India), well-known as Dihang or Siang and surges towards southwest through the Assam Valley as Brahmaputra and south through Bangladesh as the Jamuna. (Source: The Indian Express)

Figure 2 The Brahmaputra and its major tributaries



Source: **http://www.indiawaterportal.org/articles/coping-floods-and-erosion-brahmaputra-plains)**

The Brahmaputra Water as *the Strategic Resource*

According to the World Bank Report 2015, there has been a brisk increase in the population of China (1.364 billion) and India (1.295 billion), which has intensified demands for food, water and energy manifold. The drastic sprawl of urbanization and water intensive industrialization has also increased pressure on the river water.

Likewise, climatic aberrations and glacial melt in the Himalayas are also responsible for triggering detrimental effects on the regional water reserves and food security, impartially in both the Asian giant nations.

The increasing competition for constructing clean energy resources due to complex web of pollution in both geopolitical nations, is yet another field of concern. Hence, the use of hydropower technique has come into limelight. It would facilitate building green energy economies along with regional engagements.

Regional Instability

As discussed earlier in the paper, China has hydro-supremacy (i.e. upstream riparian) in the region. Its advantage lies in the fact that most of the Asia's rivers originate from this, thus unilaterally securing water supply and future needs through construction of dams and other water diversion plans such as Beijing's consideration of the Grand Western Water Diversion plan at the Great Bend to divert to China's arid north. Experts warn that if this project is successfully implemented then it would significantly decline quantity and quality of river water streaming in India. This is a major threat to aquatic life, agricultural practices and livelihoods downstream, thus, and would disastrously impact Sino-India relations.

Agenda on dam construction has created apprehensions in India. It has led to flash floods and landslides downstream. For instance, in June 2000, the flash flood in Arunachal Pradesh impacted seriously Indian infrastructures and reportedly resulted in 30 causalities and 50,000 people homeless; owing to bursting of a dam in Tibet. Many in India believed that flood was caused deliberately by China to gain leverage over India, which could have obviated by sharing hydrological data with lower riparian state (Yan, 2012). This has further amplified the strife between the two giants.

Besides that, China's upstream activity is not only confined to the above consequences but is leading to massive migration in South Asia region, causing many ethnic conflicts (Zhifei, 2013).

Further, the concerns related to the impact of operationalisation of Zangmu hydro power dam in 2015 (which has hydropower generation of 1,126,00GWh along the Yarlung Zangbo River by China) on the sediment flow of the river, have developed anxiety in India. A senior strategic thinker in India has expressed that the Chinese interventions on the Yarlung would be "most dangerous' for India (Chellaney, 2015). Such perceptions and statements have generated new points of contention between India-China hydro-political relations.

China has made control and manipulation of natural-river flow a fulcrum of its power and economic development. Although promoting multilateralism on the world stage, it has given cold shoulder to multilateral cooperations among basin nations (Chellaney, 2011). So, at present by creating an undulating control over trans-border flows, it is aiming to trap Asia's water and may build hydrohegemony.

Adding to further complexities, China has neither been signatory to any multilateral treaties nor has it been a part of the 1997 UN Watercourses Convention. Thus, creating an impunity for itself against legal hassles.

The Brahmaputra river in Tibet known as Xiabuqu river, tributary of Yarlung Zangbo (Brahmaputra river in China), has been dammed and diverted by China, to construct its most expensive hydro project with an investment of USD 740 million and is scheduled to get completed by 2019. Its installation would cause major concerns in India and Bangladesh, viz. migration, flash floods, reduced sediments flow, etc.

Beijing and New Delhi signed a Memorandum of Understanding (MoU), in 2013 recognizing that transboundary rivers and related natural resources are assets of immense value for the socio-economic development of all riparian states. China has agreed that cooperation on trans-boundary river can be achieved by sharing hydrological data (viz. statistics on water level, discharge and rainfall) with India to forecast floods caused by Brahmaputra in North Eastern India, which would strengthen mutual strategic trust and communication between the II sovereign states. However, India still needs to recognize its geo-strategic location and pursue effectively the novel trans-boundary treaties while reworking on the existing ones. (Indian Express,2016)

Figure 3 China blocks tributary of Brahmaputra to build dam

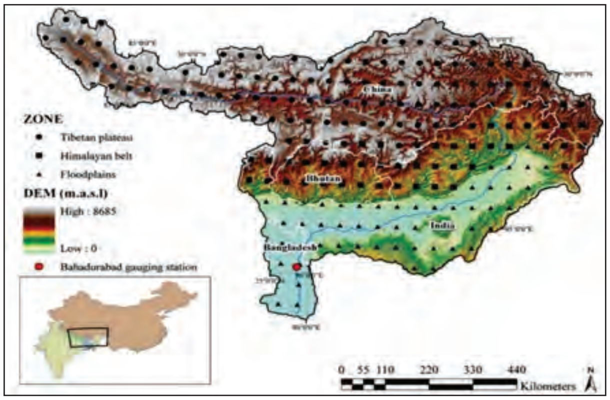
Source: The Indian Express, Press Trust of India, October 1, 2016

Science Diplomacy for Durable Solutions

In view of this geopolitical tension arising out of 'water grab', it is imperative for China and India to come to a mutual understanding wherein benefits from the river basin can be accrued by the both. This is significant to foster sustained regional stability, which can be achieved by the mechanisms as discussed below.

Exchange of scientific information such as transparency in sharing of details of hydrological data, satellite images, maps (as depicted in Figure 4) and statistics (as illustrated in Figure 5), undertaking joint research projects etc. are significant for fostering stronger bilateral relations. For instance, the exchange of geo-database of Orontes River between Lebanon (upstream), Syria (mid-stream) and Turkey (downstream) has enabled in formulating and building successful and inclusive trans-boundary water resources management system and hydro-diplomacy (Ministry of Foreign Affairs and International Cooperation, 2015).

Figure 4 Physiographic Zones of the Brahmaputra Basin



Source: Bandyopadhyay, J., Ghosh, N. and Mahanta, C., 2016)

Figure 5 Topographic Regions of the Brahmaputra River Basin

Topographical region	Area (Sq km)	Geographical location
High Tibetan plateau	293,000	Southern Part of the Tibet province of China
High Himalayan mountains	137,050	Part of Himalayan kingdom of Bhutan and 3 states of India: Arunachal Pradesh, West Bengal and Sikkim
Brahmaputra Valley	56,200	Part of Assam State of India
Lower (Assam) Mountainous Region	37,200	Part of 3 states of India: Nagaland, Assam and Meghalaya
Plains	56,550	Part of West Bengal (India) and part of Bangladesh

These preliminary data would facilitate policy-makers to design appropriate sectoral policies for mitigating and adapting to predictions.

A water sharing treaty between the two neighbours needs to be drafted and formalized to endorse bilateral water cooperation. Defining governing principles for sharing costs and benefits of the water resource development projects in the river basin would be highly desirable for reducing conflict between the co-basin countries. This point could be referred from the Indus Water Treaty of 1960 between India and Pakistan, the 2002 Water Agreement between Syria and Lebanon (wherein hydro-diplomacy/science diplomacy played an integral role and weaker state like Lebanon got the leverage benefits in excess of initial basic expectations), and the Mackenzie River basin transboundary waters master agreement of 1997 between Alberta and the Northwest territories in the Mackenzie river basin.

Implementation of novel Information and Communication Technologies (ICT) in collaboration with the Ministry of Energy and Water, along with policy makers and water experts, could constitute an important basis for discussion to increase awareness and knowledge by sharing data and providing modeling training to plan sustainable water policies (Ministry of Foreign Affairs and International Cooperation, 2015).

For deepening the political discourse, annual dialogue at the national and sub-national levels, among different stakeholders' or institutions viz. policy makers, diplomats, research analysts etc., is the need of the hour (Observer Research Foundation, 2014). It would facilitate in finding an integrated approach towards policy-making, decision-making and cost-sharing across different sectors of the two nations, industry, agriculture, urban development, ecosystems, navigation etc., by taking into the consideration for reducing poverty. Presumably, would enable both the Asiatic giants in building positive collaboration and mutual goodwill.

In addition to the above, it would be appreciated if China changes its strategy from 'responsive diplomacy' to 'preventive diplomacy' to proactively engage with lower riparian states. This would enable in dissolving mistrust and regional tension among the nation states.

An all-basin cooperation is yet another alternative tool for amplifying optimal utilization of the water resources than sub – basin level (Huang, 2015). All-basin reports, data or maps implying to the information which is inclusive of all the tributaries of the Brahmaputra river, viz. Lohit, Kameng, Teesta, Subabsiri, Manas, Raidak, Kolong, Dibang, Jaldhaka and Dhansiri, whereas sub-basin facts are limited to some or major tributaries of the river within specific regions. The current technology makes it more achievable to obtain and gather basin-wide / all-basin evaluation reports and scientific information. By examining and exchanging geo-database, so obtained by assessing basin-wide information pertaining to watershed management (such as drainage area, catchment area, etc.), an integrated and inclusive all-basin cooperation can be established among the co-basin countries. Thus, making it practically viable for nations as well as states to share benefits of hydrological data and sustainably mitigate existing as well as future detrimental challenges.

Further, the geodatabase so obtained would enable to procure financial assistance from international development banks in the hour of need and would facilitate in reconciling national and international water policies to avoid sensitive territorial irritants.

As Kofi Annan said, "...the water problems of our world need to be only a cause of tension; they can also be a catalyst for cooperation....If we work together, a secure and sustainable water future can be our". The negotiations of riparian states should therefore, continue to focus on the benefit sharing and win-win option instead of water-sharing scheme (which usually results in accentuation of conflicts among the transboundary nations), so as to create and show a concrete example of positive synergies contributing to conflict prevention and regional stability.

Conclusion

As a matter of fact, water is a significant critical national asset and is the key to socio-economic development and quality of life for the human race. Forty per cent of the world's population is living at the beginning of the 21st century in trans-boundary river basins (Phillips et al. 2006). Transboundary waters contribute to 50 percent of the world's available water resources (Phillips et al. 2006; Earle et al.2010) and their contribution is even greater in water-stressed areas. While flowing they offer ample opportunities for water utilization, but equally they create barriers. Their management does not take place in a vacuum but rather requires inclusive complex political and economic framework.

Referring above approaches, Brahmaputra river water can, therefore, become a source of cooperation and goodwill among co-basin nations, India and China, by building desired reliable relations needed to setup joint scientific research projects and more extensive hydrodata and information sharing norms (Tenzin, 2015). The tectonic and ecological fragility of the region, thereafter, calls for holistic approaches to accomplish sustainability in utilizing river water.

Finally, a more informed and integrated water management regime that would understand the critical ecosystem services of water in terms of providing food, shelter, clean water and sanitation, sustenance of aquatic ecosystems in the region, can help in the long run to achieve Sustainable Development Goals (SDGs).

References

Bandyopadhyay, J., Ghosh, N. and Mahanta, C. (2016). IRBM for Brahmaputra Sub-basin – Water Governance, Environmental Security and Human Well-being. New Delhi: Observer Research Foundation, p.11.

Chellaney, B. (2011). Water: Asia's New Battle Ground. Georgetown University Press, Washington, D.C.

Chellaney, B. (2015). India must treat water as strategic resource, fight China's throttlehold. Hindustan Times. Available at: http://www.hindustantimes.com/analysis/this-cannot-be-watered-down/story-nc9Uvq2ek3hhenVSnu3HLO.html [Accessed 21st February, 2017].

Chellaney, B. (2013). China's Hydro – Hegemony. The New York Times. Available at: http://www.nytimes.com/2013/02/08/opinion/global/chinas-hydro-hegemony.html [Accessed 19th January, 2017].

Earle A., Jägerskog A. and Ojendal J. (2010). Transboundary Water Management: Principles and Practice, 1st ed. Taylor & Francis.

Huang, Z. (2015). Case Study on the Water Management of the Yaluzangbu / Brahmaputra River, [online] Volume 27:229, p.229. Available at: https://gielr.files.wordpress.com/2015/04/huang-final-pdf-27-2.pdf [Accessed 02nd February, 2017].

Ministry of Foreign Affairs and International Cooperation, (2015). Science diplomacy and transboundary water management - The Orontes River case. France: UNESCO, p.29-214.

Observer Research Foundation, (2014, July). India, China need to institutionalize water resources sharing: Jairam Ramesh. [online] Kolkata: Observer Research Foundation. Available at: http://www.orfonline.

org/research/india-china-need-to-institutionalize-water-resources-sharing-jairam-ramesh/ [Accessed 22nd February, 2017].

Phillips D.J.H., Daoudy M., Öjendal J., Turton A. and McCaffrey S. (2006). Transboundary Water Cooperation as a Tool for Conflict Prevention and for Broader Benefit-sharing Ministry for Foreign Affairs, Stockholm, Sweden.

Press Trust of India. (2016). China Blocks tributary of Brahmaputra in Tibet to build dam. The Indian Express. Available at: http://indianexpress.com/article/india/india-news-india/china-blocks-tributary-of-brahmaputra-in-tibet-to-build-dam-impact-on-india-3059242/ [Accessed 18th January, 2017].

Reddy, M.S.; N.V.V. Char; Mukherjee, S.; Afzal, N.; Qutab, S.A.; Basnyat, D.; Karmacharya, J.; Miah, M.M.; Nickum, J.E.; Rahman, K.; and Rasheed, K.B.S. (2002). Water supply – demand gaps in South Asia, and approaches to closing the gaps. A draft report prepared for the project on 'Water and Security in South Asia'. Johns Hopkins University, Washington D.C. and Global Environment and Energy in the 21st Century (GEE – 21), Hawaii.

Sasi, Anil. (2015). As clearances turn into hurdles, Brahmaputra edge lost to China. The Indian Express. Available at: http://indianexpress.com/article/india/india-news-india/as-clearances-turn-into-hurdles-brahmaputra-edge-lost-to-china/ [Accessed 19th January, 2017].

Tenzin, P. (2015). China, India and Water across the Himalayas. The National Interest, July 29.

Yan, Wang. (2012). The River Wild. News China. Available at: http://www.newschinamag.com/magazine/the-river-wild [Accessed 20th February, 2017].

Zhifei, Li. (2013). Water Security Issues in Sino-Indian Territorial Disputes, South Asian Studies Quarterly 4: 29-34.

Role of Science Diplomacy in Case of Bio-disasters and Epidemics

Anil Kumar Sharma*

Traditionally diplomacy is: (i) the profession, activity or skill of managing international relations typically by a country's representative abroad; (ii) is the art and practice of conducting negotiations between representative of states; (iii) the conduct by Government officials of negotiations and others relations among nations; and (iv) the art or practice of conducting international relations as in negotiating alliances, treaties and agreements. Science Diplomacy is the using scientific and technology collaborations among nations to address common problems and to build constructive international partnerships. Science is global and is beyond geopolitical boundaries. Pursuit of Science is scholarship-driven.

Science and Technology diplomacy is for public and social good. Currently, there is a changing role of science in foreign policy fostering, science diplomats and using science to strengthen relation with the world. Priority for science diplomacy is to solve common problems for enhancing quality of life.

"Many of the challenges we face today are international and whether it's tackling climate change of fighting diseases-the global problems require global solution that is way it is important that we create a new role for science in international policy making to diplomacy to place science at the heart of the progressive international agenda." (Rt. Hon. Garden Brown, MP)

Science can resolve many problems in the world. It enhances quality of life, nutrition, while eradicating poverty, food safety, health and hygiene, drinking water supply; leads to production in agriculture and implementation in animal husbandry, food security, socio-economic welfare of mankind; prevents and control human, plant and animal diseases, control and eradicates

* *Deputy Director, Department of Animal Husbandry, Government of Uttar Pradesh, India.*

communicable, epidemiological and zoonotic diseases of human and animals and public health; and protects environment and climate change and global warming.

The South-South Cooperation (SSC) is a term historically used by policy-makers and academics to describe exchange of resources, technology and knowledge among developing countries; also known as countries of the global south. SSC is a broad framework for collaboration among countries of the South in political, economic, social, cultural, environmental and technical domains, involving two or more developing countries; it can take place on a bilateral, regional, sub regional and inter regional basis.

Buenos Aires Plan (1978) of Action. The SSC has gained momentum and has shown encouraging trends after the adoption of this Plan of Action.

UN Day for SSC is observed every year on 12 September. Issues like food insecurity, poverty, sustainable agriculture, biological diversity can be addressed together through SSC. Lives of billions of people in the South global and beyond can be improved by providing excellent opportunity for mutual beneficial partnerships and economic growth, industrial development and poverty alleviation. The SSC is playing a much bigger role than even before in dealing with food insecurity.

Health has been included in Sustainable Development Goals (SDG), adopted by the UN unanimously in September 2015. India attaches a high priority to 2030 Agenda for SDG for the wellbeing and progress of mankind.

Countries of the global south have similar environmental conditions, similar eco-systems, face similar disasters, diseases and epidemic and pandemic diseases (communicable and zoonotic). They have similar biological conditions and almost same geographical and topographical conditions.

To meet goal of health and hygiene in Southern part of the globe, the SSC may facilitate in overcoming diseases and disasters, bio-disasters and bio-terrorism. Such problems have no solution in isolation but can be resolved through partnerships, collaborations, coordination and technology facilitation mechanisms (TFM).

The SSC may have a viable TFM and STI to mitigate bio-disasters and epidemics on human health. One of the glaring examples of such a kind of cooperation and collaboration is SDMC (SAARC Disaster Management Centre), established in New Delhi (India) for SAARC countries.

Bio-disasters (biological disasters) are directly caused by pathogenic infections transmitted by living vectors. Exposure to pathogenic micro-organisms, toxins and bio-active substances may cause injury, illness or other health impacts; lead to loss of life loss of livelihood and service; and result in social and economic disruptions or environment damage and outbreak of epidemic diseases, plant and animal contagion, insect or other animal plagues and infestations.

Pandemic is an epidemic of existing, emerging or re-emerging diseases and pestilences spreading across a large region, i.e. a continent or even worldwide e.g. influenza HINI (Swine Flu). Bio-disasters (bio-hazards) lead to mass mortality owing to the entry of virulent microbes into a congregation of susceptible people living in a manner benefitting for the spread of infection, e.g. ebola, dengue fever, malaria, measles (all endemic) and cholera and swine flu (pandemic). Bio-disasters of zoonotic significance (e.g. avian influenza – bird flu, anthrax, rabies, brucellosis etc.) need a special attention to be dealt with. Weapons of bio-terrorism are anthrax, plague, tularemia, botulism, cholera, shigellosis, small pox and viral hemorrhagic fever.

The highly pathogenic avian influenza (HPAI) virus causing bird flu is communicable from birds to human being and vice versa. Human to human transmission was observed in Hong Kong in 1997; 376 cases of human infection with HSNI form of bird flu have been recorded in 14 countries since November 2003, mostly in South East Asia. "The highly pathogenic HSNI bird flu virus has passed from human-to-human in China raising farms that the virus may have started to mutate. Experts predict that around 20 per cent of the total world population will fall during the next pandemic of 28 million may need hospital care.

A good surveillance system to track and identity human cases rapidly are needed. Maximum vigil, free flow of information, regarding disease, technology facilitation, collaboration, coordination and mutual trust building are needed at the SSC level. Disasters (especially bio-disasters) are boundary less. These are cross boundary (trans-boundary infection and infestation) such problems can be resolved jointly at equal partnership basis among SSC countries. Disease diagnostic sharing and capacity-building (common vigilance and monitoring sharing) can be addressed under the SSC framework to reduce bio-disaster risks.

Sharing of information on disease epidemiology, diagnostics and management can be augmented through science diplomacy under the SSC.

Science Diplomacy and Its Role in Boosting Biotechnology Development in Peru

Maria Oyola Lozada*

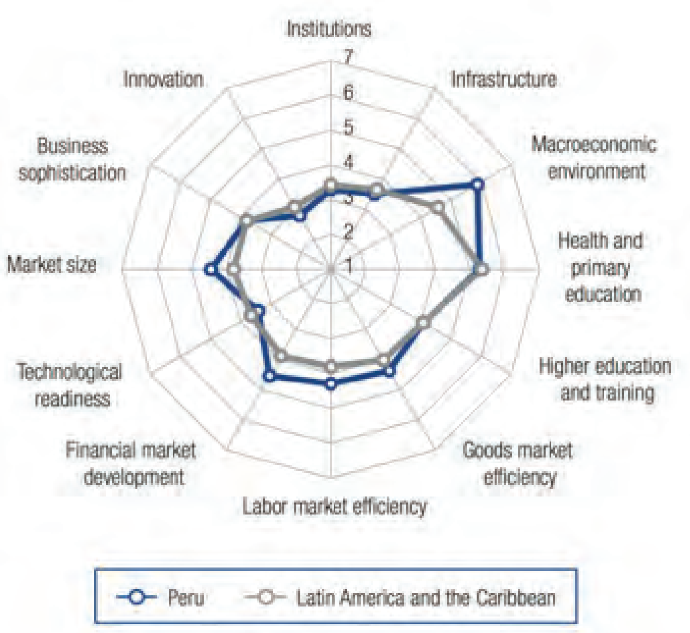
Introduction

The new Peruvian approach considers Science, Technology and Innovation (STI) as the fundamentals to increase national competitiveness and to pursue national developmental goals. According to the reports, the investments of the country in R&D were around 0.10 per cent of the national GDP during the last few years; revealing R&D indicators as compared to the rest of the world, and in particular, to its own region (UNESCO, 2007) (Figure 1). As a result, the STI system in the country remained laggard for many decades affecting its competiveness and indigenous innovative capabilities. The Peruvian Government deployed strong efforts to reverse its negative STI indicators and to repositioning science and research in the socio-political and economic agenda. The National Council of Science, Technology and Technological Innovation (CONCYTEC) is the leading Governmental institution responsible for providing direction, guidance, coordination, supervision and evaluation of public activities (STI) in Peru.

The new strategy of CONCYTEC proposes to focus national efforts on the areas, which due to their defined characteristics, may have a strategic potential for development (CONCYTEC, 2014). Recently, CONCYTEC has generated participative spaces for academia, public and private sectors, to identify essential programmes and projects that would evolve strategies on the lines of action and investment in STI. Biotechnology (BT) is a potential growing sector which would have a direct impact on many areas such as human and animal healthcare, agriculture, environment and industry. Thus, the development of the modern biotechnology in Peru is considered a priority area.

* *Project Assistant, Universidad Peruana Cayetano Heredia, Peru*

Figure 1: Peru, Global Competitiveness Index



Source: World Economic Forum, 2015

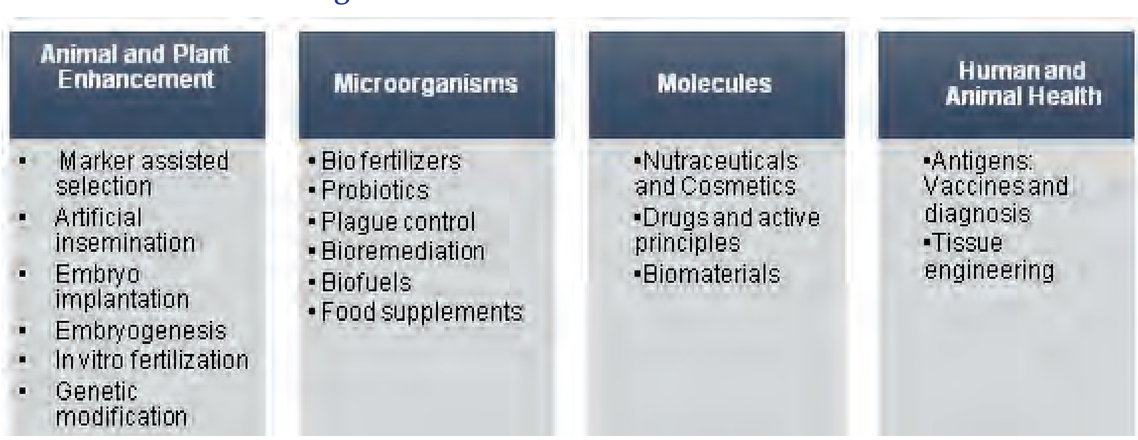
Strategy for Development of Biotechnology

BT has been included among the five main national STI programmes due to its potential use as a tool to improve national competitiveness and to bring in innovative solutions. The CONCYTEC in 2016 announced the launching of the National Transversal Biotechnology Programme (PRONBIOTEC 2016-2021) which aims to promote application of biotechnology as a strategic transversal technology to address the constraints of the country's economic development and national challenges (Consejo Nacional de Ciencia y Tecnología, 2016). This is the first document developed under the stakeholder consultancy that details the Peruvian vision for its BT sector and establishes its goals for the next five years.

Peruvian biotech system

The document reports a deep diagnosis about

Figure 2: Focus areas in research in Peru



Source: PRONBIOTEC, 2015

the current situation of the national innovation system in biotech; and concludes that the country has a weak system in this emerging technology owing to many factors. The Peruvian biotech system has many challenges. The first of the four identified was scarce highly qualified human resource in different areas of BT. Peru can only count on 104 PhDs; 64 per cent of them in health biotech. Also there is a poor indication among academia-government-private sector. There have also been insufficient incentives for innovation in BT. In conclusion, there is a weak BT system in Peru, and it would be a long way to transform this.

Core areas

PRONBIOTEC's envisions that modern biotechnology would be adopted and applied as a driving force for sustainable economic development in Peru. The national efforts need to be focused on four thematic areas: (i) animal enhancement, (ii) microorganisms, (iii) molecules and (iv) human and animal health (Figure 2).

PRONBIOTEC suggests that development of modern BT in Peru would demand specific efforts directed to overcome bottlenecks which restrains the country in reaching its STI goals. The strategy sets up the actions to be implemented around four following important areas:

- Increasing number of highly qualified manpower in biotechnology;
- Improving interaction among government-enterprise-academia in the biotech sector;
- Improving incentives for innovation in biotech; and
- Increasing results of scientific research in biotech.

According to CONCYTEC, the country would have to invest around US$ 162 million during 2016- 2021 for leveraging biotech sector.

Lessons from India's Experience

The early stage

India started visioning its national biotechnology system more than thirty years ago. In 1986, the creation of a separate Department for Biotechnology (DBT) was the first remarkable milestone of the Government to foster national capabilities in this field. It is important to mention that the BT growth has been due to major efforts by the Government. The political decision to allocate biological sciences for catching up with this technology with the rest of the world was timely and it was accomplished with an investment of USD 210 million (Chakraborty & Agoramoorthy, 2010) to fund policies for (i) development of human resource, (ii) creation of appropriate infrastructure, (iii) research and development, and (iv) creation of a regulatory framework (Ministry of Science and Technology, 2016). Afterwards, various institutions in biological sciences for R&D were set up like the National Institute for Plant Genome Research (NIPGR), National Brain Research Centre, the Centre for DNA Fingerprinting and Diagnostics, Institute of Bioresources and Sustainable Development and the Institute of Life Sciences, the Translational Health Science and Technology Institute (THISTI), Institute for Stem Cell Biology and Regenerative Medicine (INstem), National Agri-Food Biotechnology Institute (NABI) and National Institute of Biomedical Genomics (NIBM) (Ministry of Science and Technology, 2016). Also, schemes were mainly centred on manpower development, including training of researchers abroad; creation of the BCIL (Biotech Consortium India Limited) to promote industry interaction; generation of R&D incentives, and development of guidelines and regulations in BT according to the international standards (Padmanaban, 2015).

New biotech frontier

In the past, India was successful in BT to create technologies for addressing issues concerning population and for providing affordable solutions for social welfare. India has been one of the 12 top countries in terms of number of BT enterprises in the world, especially within the health care sector. Some achievements in Indian health biotech include the development of a recombinant Hepatitis B vaccine by Shantha Biotechnics, a local enterprise; synthesis of various human biomolecules for protein therapy; and development of bioinformatics software (Parveen Arora, 2005). Also there are many biological products under development, including inexpensive vaccines against rotavirus. Indian infrastructure, endogenous innovative capabilities and increased investment gave the country positive results to be a key player in global scenario of BT.

The Government of India has launched the novel National Biotechnology Development Strategy (NBDS) 2015-2020, which has been elaborated by the DBT in consultation with the stakeholders (Department of Biotechnology & Ministry of Science & Technology Government of India, 2015). The strategy include guiding prospects, and ten key elements towards transforming India in a world-class bio-manufacturing hub in the areas of health care, food and nutrition, energy and education. The strategy envisions global leadership of India for using biotech to reach social and market interests, supported by a strong infrastructure for cutting-edge R&D and increased skilled manpower. The NBDS also outlines interdisciplinary research in basic as well as translational research in some frontier areas. It prioritizes attraction of global and national alliances and exchange of knowledge among many international institutes. The Government is planning to invest US$ 100 billion in this industry by 2025 to implement the policies and programmes at the NBDS.

Science Diplomacy for STI

Science Diplomacy as a tool to enhance STI capabilities has also captured attention of developed and developing countries. SD is an umbrella term that, according to Dr Nina Federoff, Science and Technology Adviser to US Secretary of State, includes use of scientific interactions among nations to address common problems facing humanity and to build constructive, knowledge based international partnerships (The Royal Society, 2010). SD can be expressed in three dimensions: As contribution of science to foreign policy objectives; Use of science to facilitate international science cooperation; and science cooperation to improve relations among countries. International experiences on SD and strategies for implementation of SD in the foreign policies of countries are well documented. However, the approach of SD among developed and small economies may be contrasting. In emerging economies, aspiration to reach a well-developed innovation system to become a higher value producer contrasts with poor set of advanced skills. Therefore, efforts to strengthen national science and innovation system would require identifying synergistic relationships with regional and international partners to address domestic deficiencies.

Peru aims to construct a knowledge-based economy through intensive use of science and technology and better performance in innovation. Due to the existing gaps in knowledge, funding and infrastructure in fields like biotechnology, there is a need to redesign national strategies to build indigenous science capacity. More sophisticated SD strategies should be considered as mean to boost achievements in STI, and they cannot be separated from broader diplomatic agenda.

India is keen to cooperate and share with developing countries. India established diplomatic relations with Peru way back, and there are increasing economic and business interests between both the nations and they are expected to escalate in the next three to four years by exploring signing of a Free Trade Agreement (FTA) (Sooraj Aurora 2016). Currently diplomatic interests of both rely on trade agreements but there are plenty of opportunities which need to be explored, especially in scientific and technology capabilities. Peru can gain substantially from India's experience in biotechnology and new emerging technologies. Moreover, both countries can mutually collaborate in health, agriculture and biodiversity also.

Conclusion

In order to empower its own National System in biotechnology and take advantage of its natural resources and biodiversity, Peru can turn its current landscape using Science Diplomacy as a mechanism for integration, cooperation and development. The strategy designed by PRONBIOTEC for the next five years can be boosted if it includes alliances with partner countries and increase its scientific cooperation in prioritized areas, especially in capacity-building. In this context, the outstanding performance of India in biotechnology and its desire of helping developing countries would be a unique opportunity that need

References

Chakraborty, C., & Agoramoorthy, G. (2010). A special report on India's biotech scenario: Advancement in biopharmaceutical and health care sectors. Biotechnology Advances, 28(1), 1–6. https://doi.org/10.1016/j.biotechadv.2009.10.007

CONCYTEC. (2014). Crear para Crecer. Estrategia Nacional para el Desarrollo de la Ciencia, Tecnología e Innovación. Retrieved from http://portal.concytec.gob.pe/images/stories/images2014/mayo/crear_crecer/estrategias_crear_crecer_ultima_version_28-5-2014.pdf

Consejo Nacional de Ciencia y Tecnología. (2016). Programa Nacional Transversal de Biotecnología. Retrieved from https://portal.concytec.gob.pe/images/noticias/PRONBIOTEC_FINAL.pdf

Department of Biotechnology, & Ministry of Science & Technology Government of India. (2015). National Biotechnology Development Strategy 2015-2020.

Ministry of Science and Technology. (2016). Department of Biotechnology.

Padmanaban, G. (2015). Growth of Biotechnology in India. Retrieved from http://www.shriraminstitute.org/51st-founder-memorial-lecture.pdf

Parveen Arora. (2005). Healthcare biotechnology firms in India: Evolution, structure and growth. Current Science, 89(3), 458–463.

Sooraj Aurora. (2016). India's Next Free Trade Partner: Peru? Retrieved from http://thediplomat.com/2016/08/indias-next-free-trade-partner-peru/

The Royal Society. (2010). New frontiers in science diplomacy. Retrieved from https://www.aaas.org/sites/default/files/New_Frontiers.pdf

UNESCO. (2007). The Science and Technology System of the Republic of Perú.

Strategies for Implementing Sustainable Development Goals in Azerbaijan and Role of Science Diplomacy

Emin Mammadov*

Introduction

The United Nations adopted unanimously the Sustainable Development Goals (SDGs) in 2015 ,and presently that is the responsibility and commitment of the UN Member States to work for achieving them.

SDGs envisage 17 goals and 69 targets to be reached by 2030 form a pathway for UN Member -States and their Governments for smooth adaption to present circumstances and bettering to new challenges. SDGs are expected to develop and supplement to positive outcomes and lessons of the MDGs.

It is important that all countries participating in this global process should implement relevant strategies, as their effectiveness would be in their primary interest. Timely and effective accomplishment of SDGs we would be able to raise international trust in the UN and its ability for benefiting its Member-States. Meanwhile economic and social policies and conditions can be improved in respective countries by contributing to better living conditions of the people as sustainable development is quite wider in its scopes, encompassing socio-economic policies, health, education, poverty reduction, and many other fields of everyday life.

SDGs should be used as an instrument to achieve present goals as well as to gain a good first-hand experience during the process, which should also be sustainable and useful in future.

Implementation of SDGs

As far as the process of implementation of the SDGs in Azerbaijan is concerned, it should be noted that the Coordination Council has been established in Azerbaijan in November 2016 to organize

* *Diplomat, Ministry of Foreign Affairs, Azerbaijan*

and coordinate work of the aiming Governmental agencies for achieving SDGs. Within the Council, headed by the Deputy Prime Minister, there are a number of Working Groups with specific goals. These groups perform their respective works and meet periodically to assess different activities undertaken, share ideas on future priorities and set out new plans. Every Ministry involved in the process prepares its own Plan of Action as well as report on the work done to be discussed at the general meetings of the Council. The Working Groups report to the Council periodically to manage the overall implementation process and monitoring wherever and whenever necessary.

Azerbaijan is preparing its National Voluntary Report (NVR) on SDGs, and has also learned from the experience of other UN Member States in prioritizing SDGs and the means of achieving them. Some of countries choose starting point of the achieved MDGs others commence only with the new goals, adopted in 2015. Circumstances and ways to achieve goals are probably more or less same in the developing countries, and there is an opportunity to learn from one another for best practices during the implementation and reporting of processes.

After the first stage of reporting by the Member-States on the status of implementation of SDGs, their assessment would be of the work already done and its effectiveness as well for setting new and more tailored made ways to achieve them. It is obvious that permanent monitoring mechanism is essential for timely and effective implementation of the SDGs at the national and international levels

Development Plans and SDGs

Ensuring sustainable economic growth and improving employment opportunities are among the top priorities of the Government of Azerbaijan, and constitute the major part of ongoing economic reforms. Since the last many years, employment opportunities have improved and tens of thousands of new work places have been created and it is an ongoing move. Sustainable economic growth could be managed well in oil and gas sectors. Presently, the main objective is to ensure shifting country's economy from energy resources to more diversified model including agriculture, industry, tourism, information and communication technologies and others. To perform better and more sustainably in this regard, the economic reforms should permanently integrate and effectively use SDGs in developmental policies.

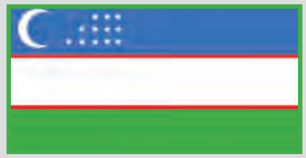
Responsibility and engagement of all players of the process is prerequisite for achieving expected goals at the national and international levels. Negotiation skills with the governmental officials participating in the SDGs implementation process should be improved for better participation in forthcoming activities in the SDGs framework at different levels.

Science Diplomacy for SDG Implementation

As for the scope of the very course on the science diplomacy, the participants should closely consider the way India has performed its development strategies with the assistance of science diplomacy and used new experience at the bilateral level for negotiations among concerned governments besides multilateral cooperation within regional and international organizations. Diplomacy should play an important role within the countries to convince people in the government that achieving SDGs is not just reporting to the United Nations and more work for them, but the new instrument would prioritize their activities and would escalate their performance in a better way. The Governments need to learn how to better utilize this new tool within their internal policies to ensure sustainable socio-economic growth.

Conclusion

There is an increasing thrust for Azerbaijan to align its development plans with UN-Sustainable Development Goals. In the course of this process, the country has recognised targeted plans. Science Diplomacy that India has taken forward would be a good lesson for Azerbaijan to leverage its growth trajectory in all sectors to drive Azerbaijan to accelerate growth rate.



The Role of Science Diplomacy for Strengthening Education in Uzbekistan

Arapov Sherzod*

Adham**

Dilfuza Sattarova***

Introduction

Education is a key for development of the country and in enhancing well-being of society. This sector holds a special place in the national development strategy of the Republic of Uzbekistan, as it determines the quality of national human capital upon which successful implementation of wide-scale policy reforms rests. Simply saying, economic development, social progress and political stability of any society by and large depend on the quality of education, in general, and literary rate of its population, in particular.

It is worth noting that 99 per cent of country's population is literate, and it is primarily due to the effectiveness of 9-year compulsory education. The benefit of this system is that it ensures access to education to all strata of the population. The main cornerstone of the development of national education system has been the National Programme on Cadre Training and the Law on Education enacted in 1997, which embody all important aspects of developing national human-capital.

Science Diplomacy, enabling international research and scientific partnerships and influencing foreign policy through advice and expertise in science, is of paramount importance for Uzbekistan for building sustainable future; developing and managing effective learning environment in universities; and finding innovative solutions to equip young generation with skills requisite for the local and global markets. To achieve this, Uzbekistan is closely cooperating with foreign partners in educational domain through diplomatic channels-developing its ties with foreign countries' educational institutions think tanks and

* *Head of the Department, University of World Economy and Diplomacy, Uzbekistan*
** *Lecturer, University of World Economy and Diplomacy, Uzbekistan*
*** *Senior Teacher, Namangan State University, Uzbekistan*

establishing affiliates of international well-known foreign universities (Moscow State University, University of Westminster, etc.).

The national programme of training specialists and the law on education has been for reforms in the educational system in Uzbekistan. It is oriented to have of a new generation of experts with high professional and general culture; distinguished for their creative and social activity. The programme, among other things, stipulates formation of absolutely new structures, academic institutions and colleges. On 24 February 1998, the Cabinet of Ministers adopted a special decree on establishing lyceums and colleges and managing them. The reason was that students would acquire not only basic but also specialized knowledge on certain disciplines for further training in an institution of higher learning. Within three years, boys and girls mastered 2-3 professions. At present, there are 400 academic lyceums and professional colleges in the republic. There are 246 specialized secondary schools, where 250,000 students master in 170 specialties.

Science diplomacy and policy dialogue

The Ministry of Higher and Secondary special Education (MHSSE) of the Republic of Uzbekistan runs regular international policy dialogue events around the issues of quality assurance in higher education in partnership with foreign educational establishments and international institutions. There high-level discussions bring together government officials, university rectors, key employers and leading institutions and experts from developed countries and Uzbekistan. Science diplomacy efforts of the Republic of Uzbekistan through these platforms are directed at enhancing quality of higher education. To achieve this Uzbekistani long-term relation with international scientific institutions, which promote innovation in science and research.

General Information

Education system of Uzbekistan consists of the following:

- state and private educational institutions implementing educational programmes in accordance with the state educational standards;
- research and teaching institutions performing research-work required for operation and development of education system;
- Government administrative bodies in the field of education as well as their subordinate enterprises, institutions and organizations;
- Education system of the Republic of Uzbekistan is single and continuous, It is realized in the following ways:
- Non-school education;
- pre-school education;
- secondary education;
- specialized secondary and vocational education;
- Higher education;
- graduate education; and
- personnel training and retraining;

The system is generally supervised by the Cabinet of Ministers. It also controls directly some higher education institutions, including Tashkent Islamic University, as well as government is working with its international partners to establish the values in higher education qualifications.

International cooperation is one of the fastest and dynamic developing spheres of higher education in Uzbekistan. Internationalization of higher education is given a high priority by the national authorities in Uzbekistan.

International cooperation is going on in the following (based on the data supplied by MHSSE):[1]

- Establishment of joint higher education institutions;
- Involvement of foreign teachers, scientists in teaching process of Uzbek HEIs;
- Support for incoming and out-going student mobility;
- Support in organization of joint research-works;
- Organization of international conferences

on burning issues of higher, innovative technologies, resources and energy saving; and

- Attracting foreign investments.

For higher education Uzbek universities are involved with the universities of 45 countries throughout the world. At present, higher educational institutions of Uzbekistan are cooperating with more than 10 Indian universities and research centres such as Delhi University, Indian Institute of Finance, GGS Indraprastha University (Delhi), the United Service Institution of India. Partnership in the field of science is developing dynamically; a number of Research Institutes; under the Academy of Sciences of the Republic of Uzbekistan cooperate and conduct joint research with research center in Delhi, Mumbai, and Pune.

Uzbekistan has been a partner of India's ITEC Programme since 1993-94. Currently, 130 slots are being allotted annually. The ITEC Programme has been very well received in Uzbekistan, and areas of training include information technology, English language, management, journalism, diplomacy, small business planning, remote sensing, banking, hotel management, etc. Twenty-five Scholarships are being offered to Uzbekistan annually for various courses in Indian Universities under the ICCR's Scholarship Programmes and one scholarship is for study of Hindi at the Kendriya Hindi Sansthan, Agra.[2]

Moreover the few years research partnerships were established with the UK Universities (University of Bath, Birmingham City University, Cambridge University, and London Metropolitan University) to benefit quality of teaching and learning and respond to national development priorities in the areas of finance, economics, health-care, medicine, English language learning, translation and interpreting.

In the framework of European educational programme, higher educational institutions of Uzbekistan have established close ties with higher education institutions in Europe. There are training courses, seminars, training courses for professors and teachers, master's and doctoral programme in cooperation with universities in the UK, Germany, Austria, Italy, France, Czech Republic, Slovakia, Greece, Spain, Belgium, the Netherlands and other countries.

Currently, 10 Tempus projects are at the stage of completion, 18 projects of Erasmus + and 80 inter-university joint projects on credit mobility are underway. About 40 universities and institutes of Uzbekistan are taking part in projects with higher educational institutions in Europe. The country has developed co-operation in all fields of science and education with universities in Japan, South Korea, Malaysia, Indonesia, India, the Russian Federation and other countries fields of science and education. A number of higher educational institutions have been established to study foreign languages with the assistance of embassies, accredited in Uzbekistan.

One of the key directions of partnership of the Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan is continuing professional development of academic leaders and sharing best international and national practice in developing quality culture in higher education.

To illustrate, since 2015 the British Council has worked with the MHSSE and the Methodology Centre under MHSSE to develop and pilot a new Quality Management programme sharing current thinking and best practice in developing and managing effective learning environment in universities, discussing education standards and expectations and exploring most effective ways to engage students and employers through collaborative learning activities and project work. The Quality Management programme has been developed in partnership with London Metropolitan University, with advice and input from Quality Assurance in the UK, and at present benefitting 500 academic leaders and staff annually.[3]

Inspired by the success of collaboration in professional development in 2015-20, the British Council Centre in Uzbekistan started work on the ICT for Quality Assurance programme with MHSSE and the Head Methodology Centre under MHSSE, and has developed another joint programme; again in partnership with London Metropolitan University and leading

UK e-learning providers. The programme is surveying eight dimensions of e-learning and exploring how ICT can support education in a holistic, meaningful and productive way. It also reviews at how ICT would improve university management and would create a positive collaborative environment in higher education institutions and would share information about Universities with wider stakeholders. This programme is being finalized.

Experience through Science Diplomacy

The Ministers of Education of Uzbekistan take part in the Education World Forum in London every year to share Uzbekistan education reform experience and to strengthen partnerships with leading UK education institutions, as Quality Assurance Agency, UK universities, language schools and education product developers and publishers.

To add new dimensions tor Internationalising Higher Education Programme in 2012-14 the QAPD TEMPUS project was jointly managed, with London Metropolitan University being a lead partner; the project involved the MHSSE, eight Uzbekistan Universities, the University of Peloponnese in Greece and V. Magnus University in Lithuania. The project contributed to curricula reforms in partner universities and developed a concept of Quality Assurance Centres under the auspices of universities in Uzbekistan.

The British Council Centre in Uzbekistan is now acting in consortium for a new Erasmus Plus project – IMEP, which aims to develop a CPD concept for academics in higher education, and through pilots and projects to develop guidelines for employers and students engaged in the higher education system in Uzbekistan.

Researcher Connect programme was started by the British Council in 2015 and aims to build researchers' capacity to work internationally. Precisely speaking, it offers benefits in terms of learning about new methods of academic research to help local researchers to publish papers in international journals, communicating with researchers from different countries and collaborating with international scientific journals. The programme has benefitted 25 selected young researchers and 20 trainers representing higher education institutions from all-over Uzbekistan as well as a network of 450 early stage researchers at the State Science and Innovation Committee. The focus of the training activities so far has been on Writing for International Publications and publishing internationally.

It is worthwhile to mention the role of specialized agencies of the United Nations in improving quality of education in Uzbekistan. The Office of UNESCO in Uzbekistan rendered assistance to the Government of Uzbekistan in improving quality and access to education through of technical assistance, development of standards, innovative projects and creation of a network for exchange of professional information.

Conclusion

The role of science diplomacy in enhancing educational sector cannot be underestimated. Uzbekistan's case can be illustrative in this regard. At the contemporary stage of the development Uzbekistan pays enormous attention enabling international scientific and research partnerships through science diplomacy to strengthen partnerships with leading education institutions of the world, for leading universities, language schools and education product developers and publishers.

Internationalisation of science and research by Uzbekistan government is creating opportunities to develop professional academic leaders and to share best international and national practices in developing quality culture in higher education.

Endnotes

1. Ministry of Higher and Secondary Special Education (MHSSE) of the Republic of Uzbekistan. International cooperation. http://edu.uz/en/pages/xh
2. Ministry of External Affairs of India. http://mea.gov.in/Portal/ForeignRelation/Uzbekistan_July_2016.pdf
3. The British Council Centre in Uzbekistan. Internationalizing Higher Education. https://www.britishcouncil.uz/en/programmes/education-society/higher-education

RIS A Think-Tank of Developing Countries

Research and Information System for Developing Countries (RIS) is a New Delhi-based autonomous policy research institute that specialises in issues related to international economic development, trade, investment and technology. RIS is envisioned as a forum for fostering effective policy dialogue and capacity-building among developing countries on global and regional economic issues.

The focus of the work programme of RIS is to promote South-South Cooperation and collaborate with developing countries in multilateral negotiations in various forums. RIS is engaged across inter-governmental processes of several regional economic cooperation initiatives. Through its intensive network of think tanks, RIS seeks to strengthen policy coherence on international economic issues and the development partnership canvas.

For more information about RIS and its work programme, please visit its website: www.ris.org.in

RIS
Research and Information System for Developing Countries
विकासशील देशों की अनुसंधान एवं सूचना प्रणाली

Core IV-B, Fourth Floor, India Habitat Centre
Lodhi Road, New Delhi-110 003 India., Ph. 91-11-24682177-80
Fax: 91-11-24682173-74, Email: dgoffice@ris.org.in
Website: http://www.ris.org.in

Follow us on:

facebook www.facebook.com/risindia twitter @RIS_NewDelhi YouTube www.youtube.com/RISNewDelhi