Global Partnership in STI for Poverty and Hunger Alleviation

Mohamed H.A. Hassan

President, TWAS and SNAS
IAP-SPEC Conference
Rio, Brazil
27-29 March, 2019

ANTÓNIO GUTERRES
UNITED NATIONS SECRETARY GENERAL

UNTIL's mission: Leveraging emerging technology to transform societies, nations and the humanity as a whole

"The advances of the fourth Industrial Revolution, including those brought on by a combination of computing power, robotics, big data and artificial intelligence, are generating revolutions in health care, transport and manufacturing.
I am convinced that these new capacities can help us to lift millions of people out of poverty, achieve the Sustainable Development Goals and enable developing countries to leap-frog into a better future.

UN Technology Innovation Lab Network (UNTIL)

Partners of the UNTIL

Government, academia, NGOs, and private sector are often involved in the programme eco-system.

Countries targeted: Mauritius, Egypt, Malaysia, Finland

Outline

- **Global Sustainability Challenges**
- **Global Agreements**
- **Global STI Landscape**
- **Global Partnerships**

Global Sustainability Challenges

Global Sustainability Problems

- Most critical crosscutting problems
  - Poverty
  - Climate Change

Rio+10 (2002)

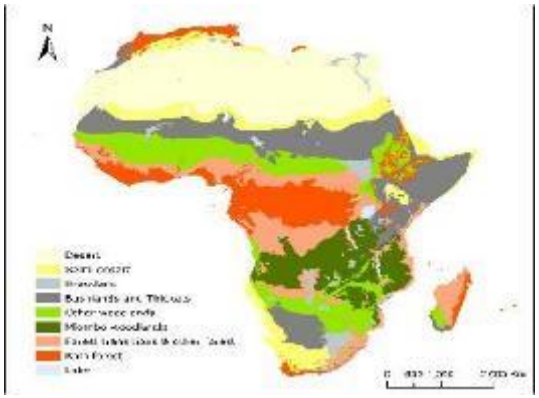
- **Water**
- **Energy**
- **Health**
- **Agriculture**
- **Biodiversity**

Rio+20 (2012)

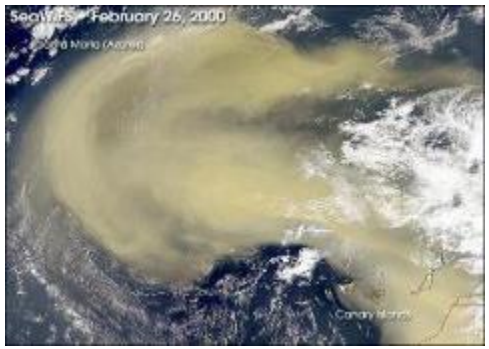
- Cities
- Disasters
- Peace
- Inequalities
- Education
- Jobs

→ **SDGs**

Climate Change



- **Africa is most vulnerable to climate change because of its fragile ecosystem and weak infrastructure and adaptation capacity**
- **Climate change Increases droughts, heat-stress, floods and food insecurity**
- **Global warming increases sand and dust movement in Africa's dry lands**



African Dust : The New CO2? Warming of Atlantic Ocean (NOAA)

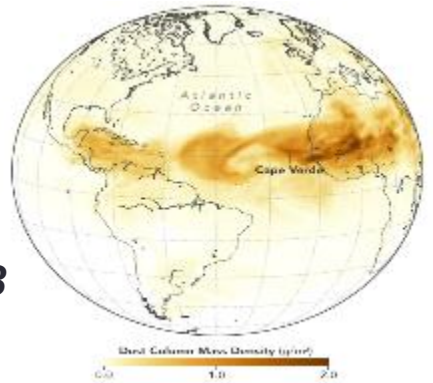
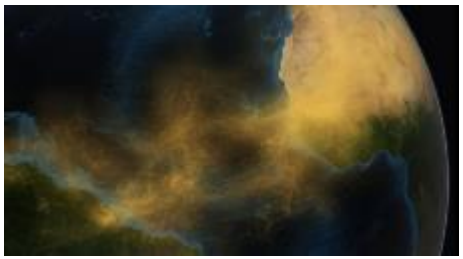


Image 1 July 2018

Sahara Dust Sustains The Amazon Rainforest



NASA study: 2015

Africa's "exports"

182 million tons of dust transported every year —

27 million deposited in Amazon Basin, including **22,000** tons of phosphorous and other top soil plant nutrients

Global Agreements

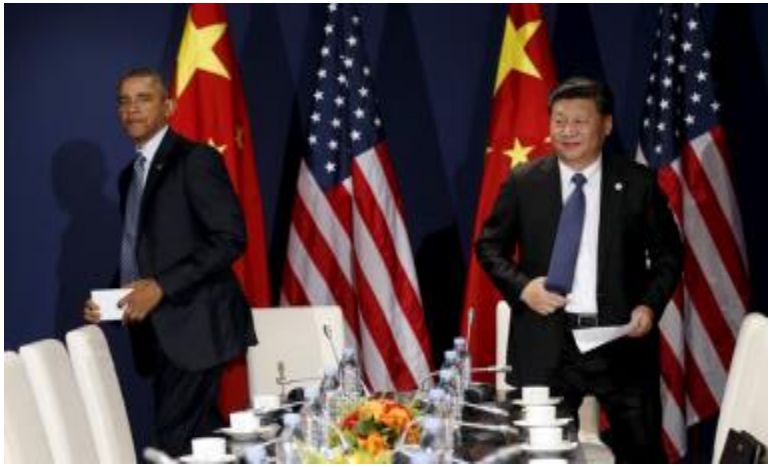
Sustainable Development Goals (SDGs)

2015: All countries adopted 17 SDGs and 169 Targets

- **All nations agreed** to achieve **all** SDGs by **2030**
- **STI and partnerships are Key means of implementation (SDGs 9 & 17)**
- **Agriculture is central to all SDGs, especially: SDGs 1, 2 & 3**
- **Climate action (SDG 13) is essential for all SDGs**

Climate Agreement success: *Paris 2015*

195 Countries adopted universal agreement to limit global warming to two degrees Celsius



COP21: November, 2015

Global initiative to accelerate public and private financing for **clean energy Innovations** to achieve breakthroughs in cost reduction to power the World with clean energy and make it affordable to consumers worldwide, and create green jobs and commercial opportunities

Initiative spearheaded by Bill Gates and supported by 20 Countries and 30 global billionaires

MISSION INNOVATION

24
Members

Australia, Austria, Brazil, Canada, Chile, China, Denmark, European Union, Finland, France, Germany, India, Indonesia, Italy, Japan, Mexico, Nettherlands, Norway, Republic of Korea, Saudi Arabia, Sweden, United Arab Emirates, United Kingdom, United States

Along with 23 other members, Canada has committed to supporting clean energy by:

Doubling federal clean energy investment in R&D

x2
over 5 years

Encouraging private investment
transformative clean energy technologies

Increasing domestic and international collaboration

COP22 *(November 2016)*

Global Action on Renewable Energy

Over 40 countries have agreed to use only renewable energy by 2050

including Afghanistan, Haiti, Philippines, Bangladesh, Honduras, Rwanda, Barbados, Kenya, Saint Lucia, Bhutan, Kiribati, Senegal, Burkina Faso, Madagascar, South Sudan, Cambodia, Malawi, Sri Lanka, Comoros, Maldives, Sudan, Costa Rica, Marshall Islands, Tanzania, Democratic Republic of the Congo, Mongolia, Timor-Leste, Dominican Republic, Morocco, Tunisia, Ethiopia, Nepal, Tuvalu, Fiji, Niger, Vanuatu, Ghana, Palau, Vietnam, Grenada, Papua New Guinea, Yemen and Guatemala

ACTION??

Morocco solar and wind energy mega-projects

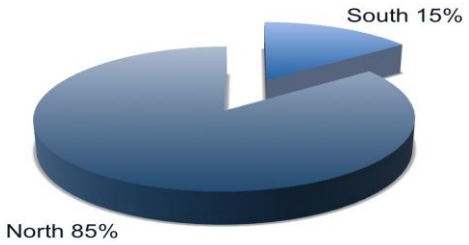
- Ambitious Plan: 42% of energy mix derived from solar and wind energy by 2020
- On track: reached 35% in 2018
- World largest concentrated solar power (CSP) plant: produces 2,000 MW from Saharan sun, costing $9B.
- Africa largest wind farm to supply 2,000 MW costing $4B
- Excellent model for other countries

Grand Ethiopia Renaissance dam (GERD)

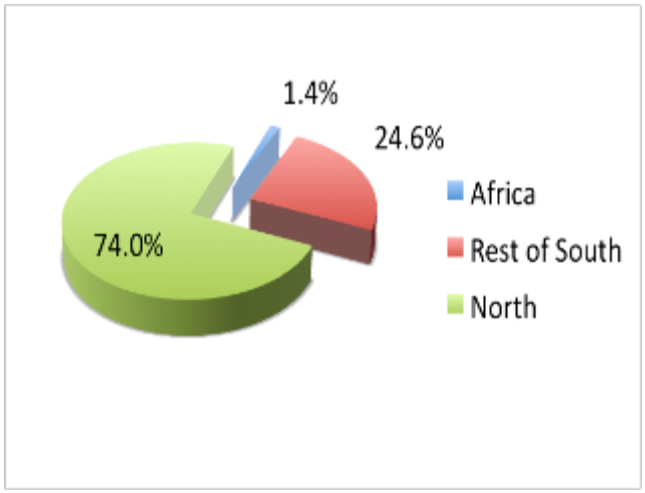
- Largest hydropower plant in Africa
- 6,000 MW dam across Blue Nile in Ethiopia costing about $5 billion in infrastructure- *largely provided by domestic sources*
- Need to overcome serious concerns and disputes with Egypt
- Expected to lift growing Ethiopian population out of poverty
- Regional benefits: transmission lines to Kenya, Djibouti, Sudan…
- **Contracted two Chinese companies to complete construction and start operations in 2020**

Global STI Landscape

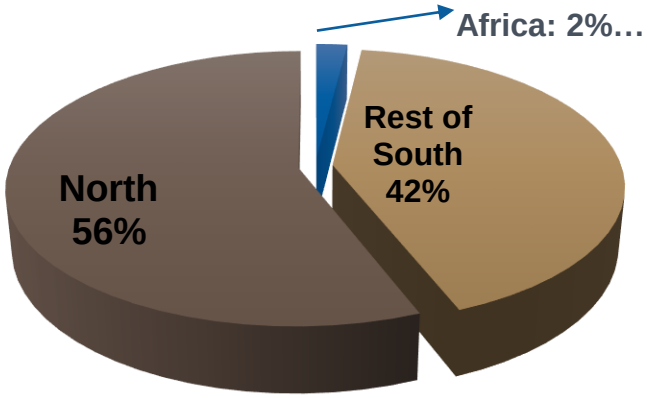
Changing landscape of Global Science



World shares of ISI-listed S&E papers Average (1981-1994)



World shares of ISI-listed S&E papers Average (2003-2007)



World shares of ISI-listed S&E papers (2016)

Source: NSF, 2018

S&E articles in all fields, by country : 2016

Rank	Country	2016 world total (%)	2016 cumulative world total (%)
1	**China**	**18.6**	**18.6**
2	USA	17.8	36.4
3	**India**	**4.8**	**41.2**
4	Germany	4.5	45.7
5	UK	4.3	50
6	Japan	4.2	54.2
7	France	3	57.2
8	Italy	3	60.3
9	South Korea	2.8	63
10	Russia	2.6	65.6
11	Canada	2.5	68.1
12	**Brazil**	**2.3**	**70.4**

S&E articles in all fields, by country : 2016

Rank	Country/Region	2016 world total (%)	2016 cumulative world total (%)
13	Spain	2.3	72.7
14	Australia	2.2	75
15	Iran	1.8	76.7
16	Turkey	1.5	78.2
17	Poland	1.4	79.7
18	Netherlands	1.3	81
19	Taiwan, China	1.2	82.2
20	Switzerland	0.9	83.1
21	Malaysia	0.9	84
22	Sweden	0.9	84.8
----	----	----	----
50	**Algeria**	**0.2**	**96.9**

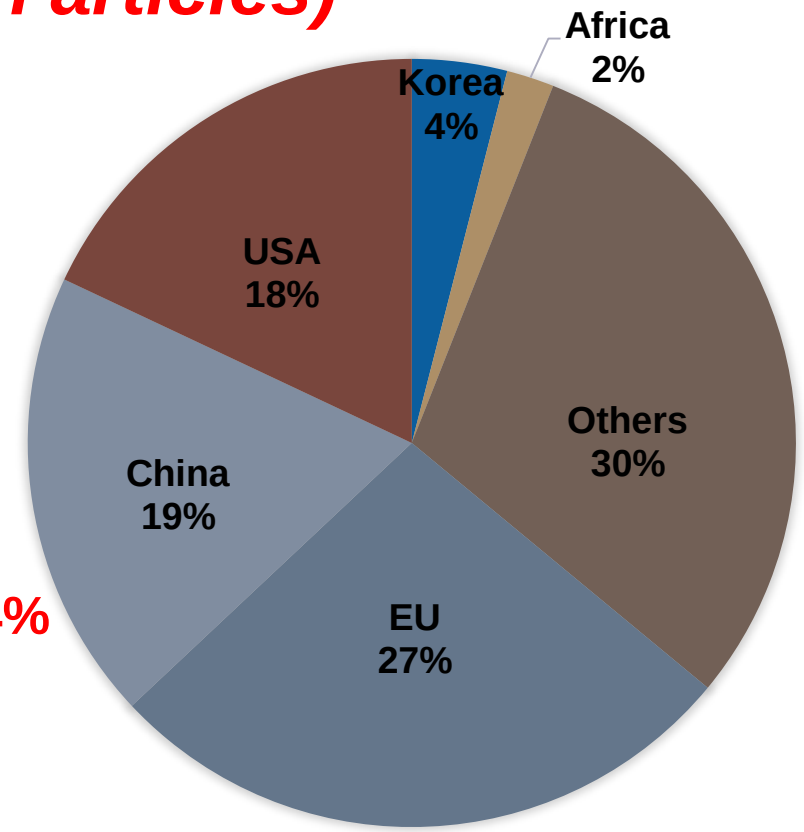
Global Inequalities in R&D Capacities

Global Production of Scientific Publications

(total in 2016: 2.3 million articles)

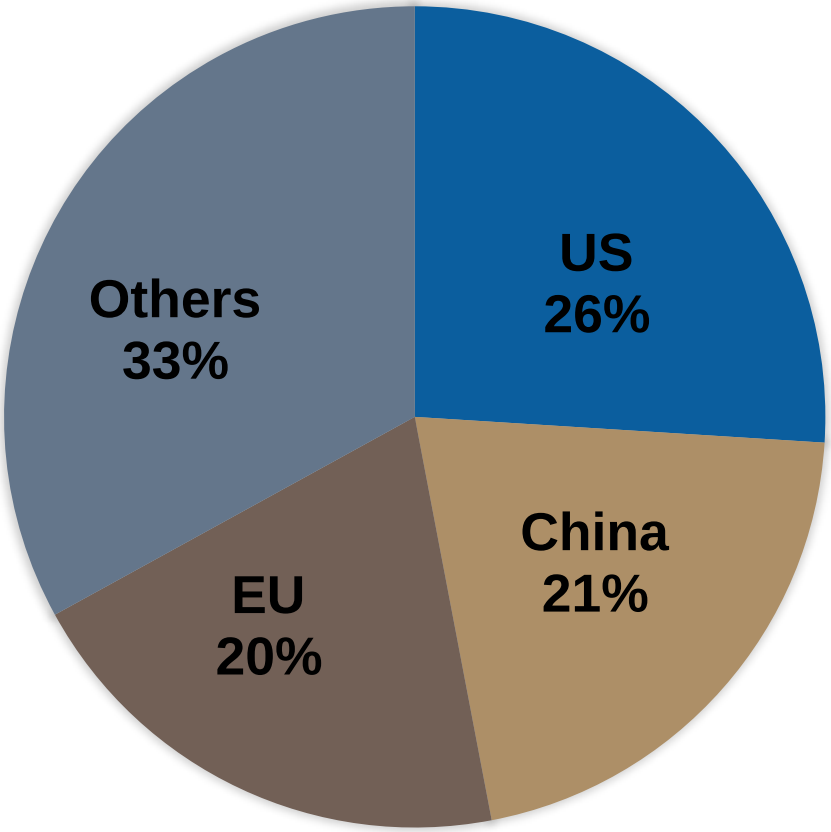
EU : 27%
China : 19%
USA : 18%
Total : 64%

LDCs (48 Countries): 0.4%



Source: NSF, 2018

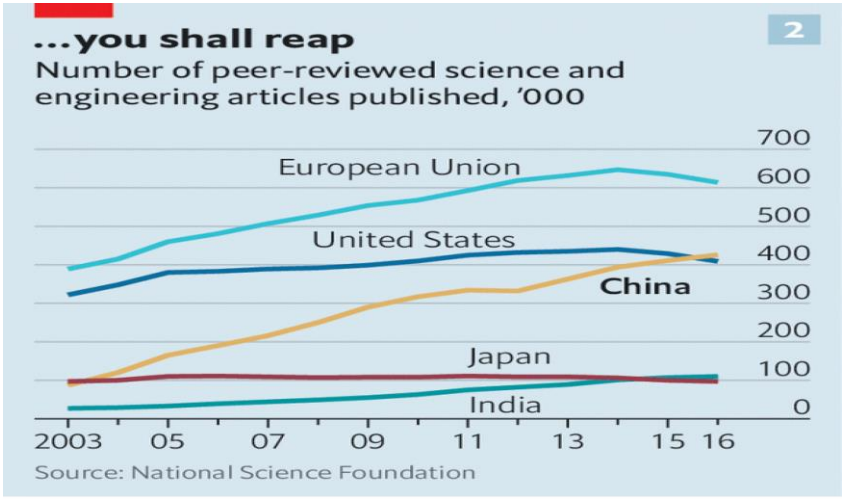
Global R&D Expenditures *(total 2015: $2.9 trillion)*

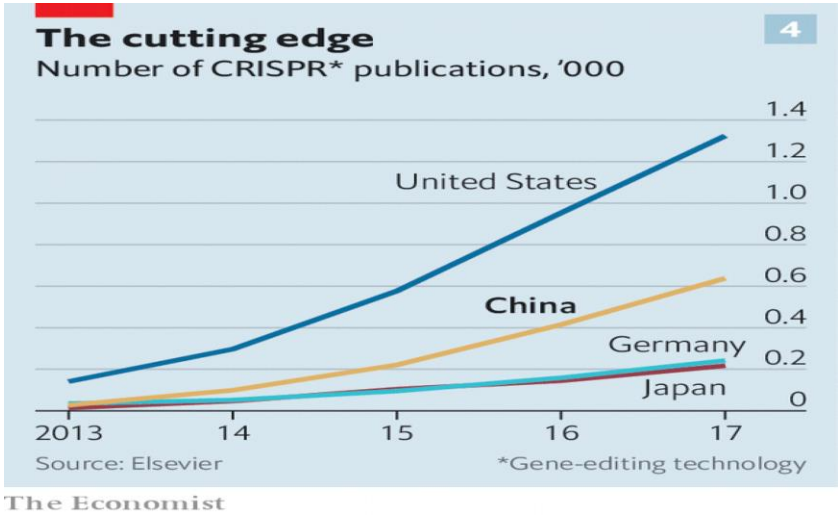


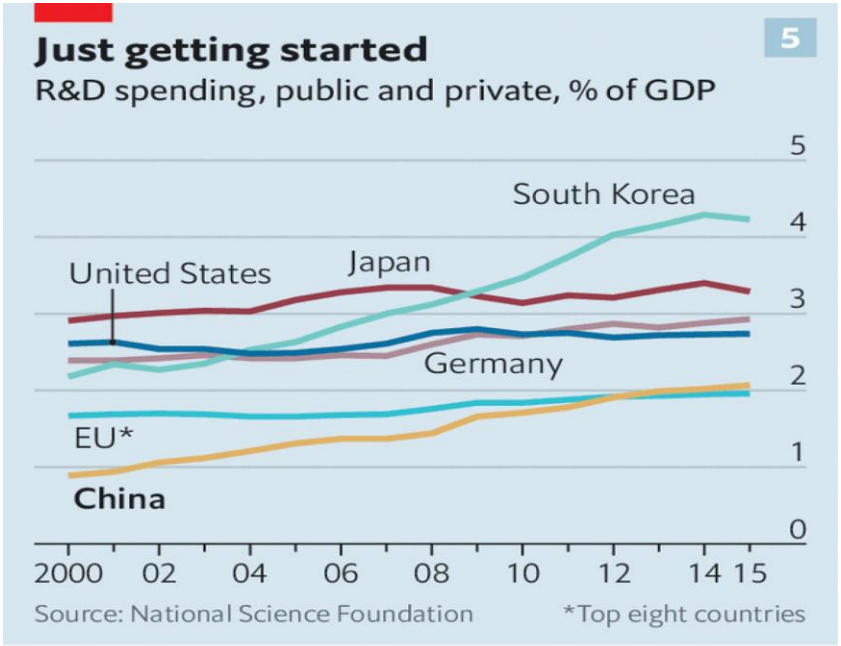
US : 26%
China: 21%
EU : 20%
Total : 67%

Source: NSF, 2018

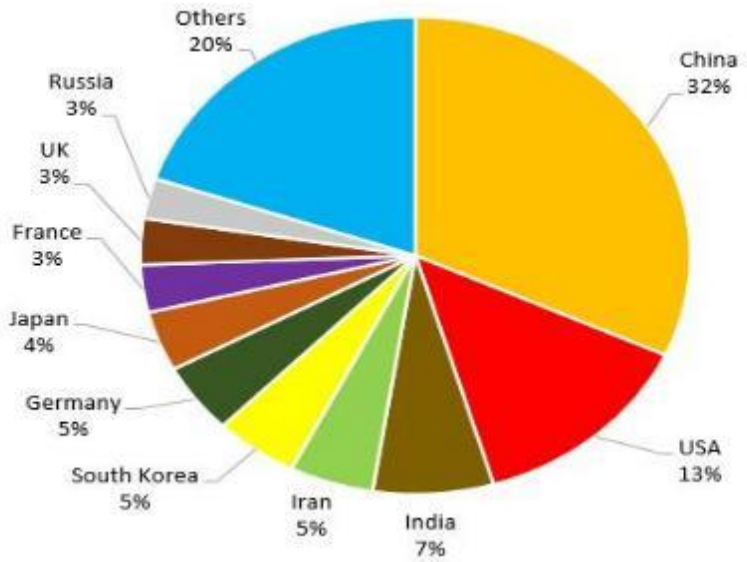
Can China become a scientific superpower?







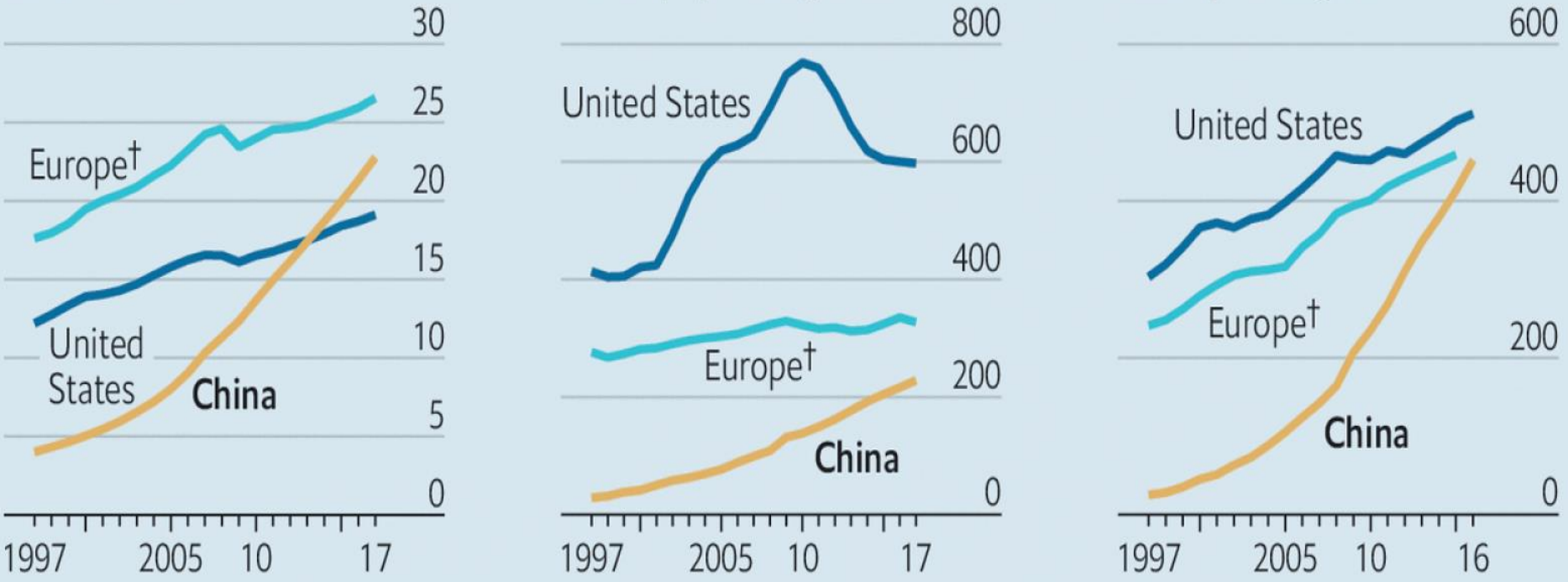
Nanotechnology Articles in 2017



As you sow...

2016 prices

1



Sources: Datastream from Refinitiv; IMF; SIPRI; UNESCO

*Purchasing-power parity †Includes Russia

The Economist

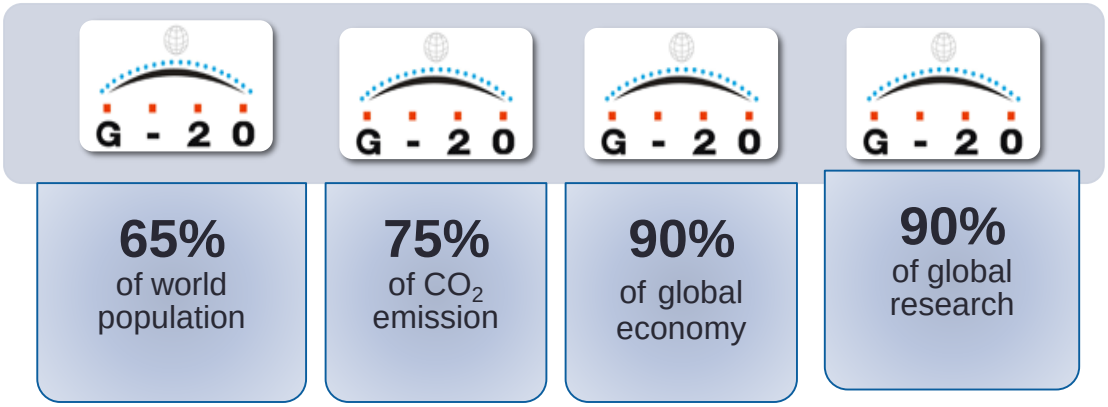
Global Partnership in STI for SDGs

- Developing, deploying and scaling cutting-edge technologies

- Building research, innovation and entrepreneurship capacities

G20 leadership

- **G20 has a special responsibility to lead global partnership for achieving the SDGs**



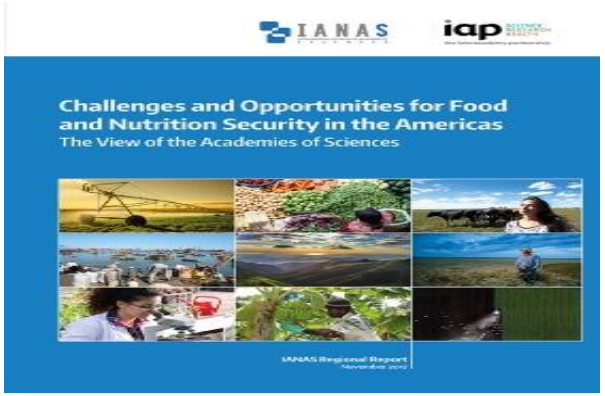
- **10 of G20 countries are DCs: N-S**
- **G20 Action Plan on SDGs**: ***China 2016***
- **Implementation Principles for SDGs**
- **Promoting global partnership for capacity building in DCs: N-S, S-S & Triangular for achieving SDGs**

G20
Argentina
Australia
Brazil
Canada
China
France
Germany
India
Indonesia
Italy
Japan
SouthKorea
Mexico
Russia
SaudiArabia
SouthAfrica
Turkey
UK
USA
European Union

G20 Leaders' declaration: *Building consensus for fair and sustainable development*

- ensure that benefits of technological transformation are widely shared
- Reaffirm commitment to tackling the challenges of food security…to achieving a world free of hunger and all forms of malnutrition.
- promote dynamism in rural areas and sustainable agriculture

- S20 meeting held in Rosario on 24-25 July 2018 on the side of G20 Summit
- IAP organised a session on its 'Food and Nutrition Security and Agriculture' (FNSA) project



IBSA FUND: India, Brazil and South Africa

facility for Poverty and Hunger Alleviation

- cooperation among three G20 developing countries: implementation of south-south cooperation initiatives for the benefit of low-income countries.
- its purpose is to identify replicable and scalable projects that can be disseminated to interested developing countries as examples of good practices in the fight against poverty and hunger

Haiti: 442 youth received vocational training and secured jobs; 400 livelihoods supported in waste management activities

Guyana: 180,000 residents gained access to better solid waste management infrastructure and practices

Zambia: 2,000 smallholder farmers improving productivity, income and nutrition

Sudan: 2,995 young laborers improved their skills and secured jobs

Deploying and scaling frontier technologies

- ***Information and Communication Technologies***
  (Digitization, AI, IoT, Big Data, Drones, Robots)
- ***Biotechnologies and Genomics***
- ***Nanotechnologies***
- ***Renewable Energy Technologies***

- **2018 UNCTAD Technology and Innovation Report:**
  examples on how these transformative technologies can be instrumental in achieving SDGs by all countries

Information and Communication Technologies

Providing farmers with instant access to market information for informed decision on best place and time to sell products

Satellite based information on crop growth, moisture and minerals to selected farmers via mobile phone messages

Drones on the horizon: Transforming Africa's Agriculture

Drones for **precision agriculture** and collecting important Data to support decision making and farmers in Africa

Use of **Big Data** in Agriculture:

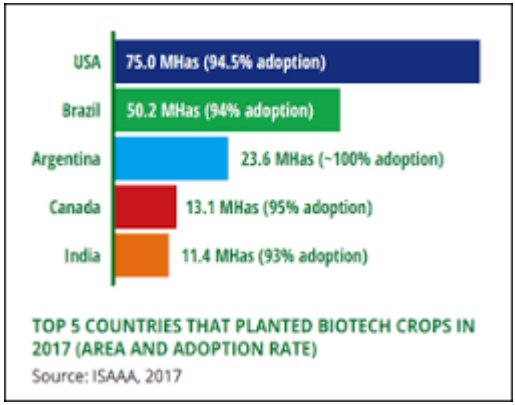
collect and analyze big agricultural data to support researchers, farmers and decision-makers

Agricultural Biotechnology

Benefits

Pest-resistant, drought-resistant and higher crop yields

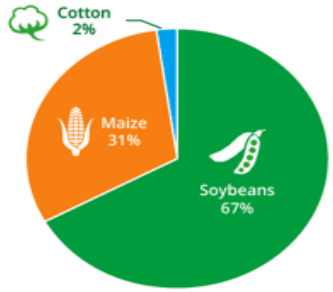
- **Reducing use of insecticides**
- **Increasing nutritional value and vitamin level of crops**
- **Domestication of indigenous and underutilized food crops**



TOP 5 COUNTRIES THAT PLANTED BIOTECH CROPS IN 2017 (AREA AND ADOPTION RATE)
Source: ISAAA, 2017

Genetically Modified Crops

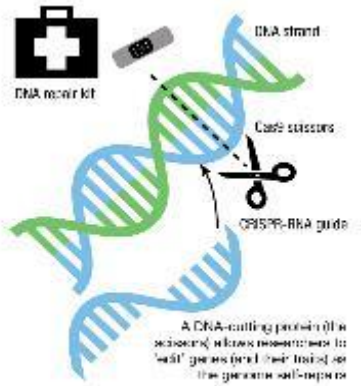
- ***Brazil: second largest producer of biotech crops***
- ***Bt Cotton economic success in South Africa, Sudan, Keya***
- ***South Africa: genetically modified maize***
- ***Uganda: new varieties of Bananas resistant to bacterial Wilt***

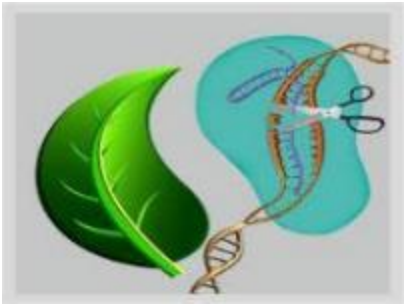


DISTRIBUTION OF BIOTECH CROPS IN BRAZIL (2017)
Source: ISAAA, 2017

Agricultural Genomics

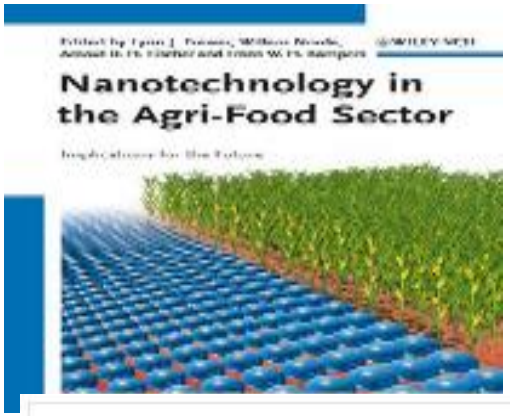
- New agricultural revolution driven by bioinformatics, plant and animal genome sequencing and editing
- New breeding techniques, including gene editing technology, using CRISPR-Cas9, could transform plant breeding worldwide and help smallholder farmers in poor countries to achieve food and nutrition security
- It is simple, affordable and scalable
- Considered by experts as fast and modern form of conventional breeding
- 13 countries, including US, Brazil, Argentina, Canada issued joint statement in support precision biotechnology
- EU: gene edited crops should be regulated like GMO's





Nanotechnologies

- Nanotechnology is one of the fastest growing technologies in the world with applications in SDGs, sustainability challenges and real-world problems
- Improve precision farming through nanotech-based sensors and monitoring systems
- Provide efficient delivery system for water, nutrients and pesticides
- Promise a new generation of more efficient and affordable nanosolar cells
- Provide inexpensive, efficient water purification filters



WIPO | MAGAZINE

Dr. Askwar Hilonga

Tanzanian chemical engineer working at the Nelson Mandela African Institute of Science and Technology built a customized low-cost water filtration system using nanotechnology and sand, that promises to transform the lives of rural communities in Africa

working with local **entrepreneurs** to establish water stations

“I want to be a millionaire. Not in terms of money, but in terms of impacting millions of lives,”

receiving the first **Africa Prize for Engineering Innovation** from the UK’s Royal Academy of Engineering.

Indian scientists develop low-cost arsenic water filter

- 65 million people in Asia (over half of them in Bangladesh) face health risks due to arsenic contamination

- Using **nanotechnology**, scientists at IIT-M have developed an effective and affordable arsenic filter to combat the growing problem of groundwater pollution

Schoolchildren in West Bengal drink water from an Amrit drinking water purification system connected to a hand pump [image by IIT Madras]

Renewable Energies Technologies

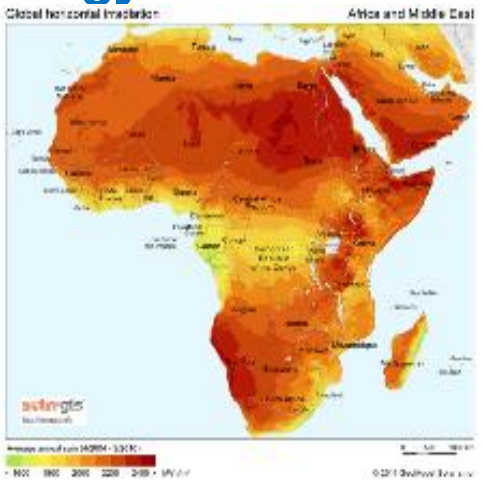
China leads the world in renewable energy investments

- More than $65 billion investment in 2012 (%30 of world total)

- More than $100 billion investment in 2015 (%36 of world total)

- More than $126 billion investment in 2017 (%45 of world total)

Africa has greatest potential and need for renewable energy



- 325 days of bright sunshine in a year
- Large coastline and abundance of wind power and wave power
- Geothermal and hydropower
- 70% of African rural communities have no electricity and need access to small- scale renewable energy systems for basic needs
- Africa needs **global partnership and large investments in renewable energy and rural electrification :**

Rural Electrification: *a human right*

Solar-powered water pumps for drinking and irrigation



Solar electricity for home, school and communications



Solar electricity for cold storage and food preservation



Building research, innovation and entrepreneurship capacities

(both N-S & S-S Partnerships are important)

- **Sustainability Science**
- **Science Education and Science Literacy**
- **Supporting talented students and young researchers**
- **Building institutional capacities**

Sustainability Science

What is Sustainability Science?

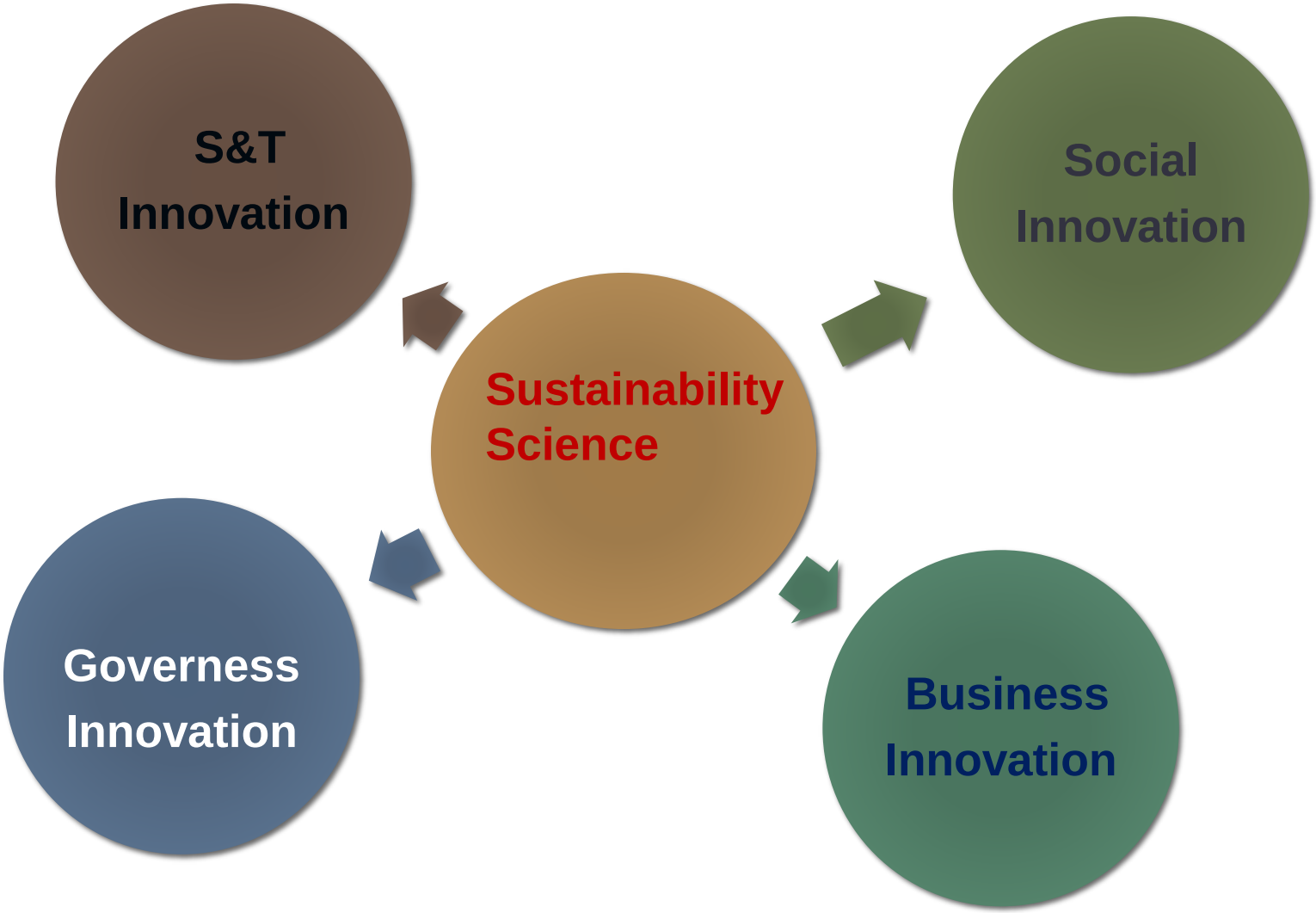
- **New approach to research and education systems that derive solutions to sustainability problems and accelerate green transformation**

- **approach is defined by problems rather than disciplines and is characterised by**:

- Use of problem-driven methodologies, promoting linkages between research and innovation and science and society

- Integration of multiple forms innovation, **including S&T**, **Social and Business Innovations**, leading to sound policy and action

Integrating Innovations



STANFORD CENTER ON POVERTY & INEQUALITY

Poverty and Technology Lab

to reduce global poverty through tech

- Objective: use technology in innovative ways to solve global problems of poverty and inequality.

- Lab bring together Stanford students and faculty, Silicon Valley leaders, and experts in government and nonprofit sectors to incubate technology-based solutions to poverty and inequality

- Teach new classes, entitled "Ending Poverty with Technology," to educate students about technology's potential to address the issue of poverty.

Participants:

- **Computer scientists, engineers, economists, business school professors and sociologists**
- **graduate and postgraduate students**
- **low-income communities**
- **Silicon Valley companies**
- **Government and nonprofit experts**

SS is a New field of Transdisciplinary Research

- **Section on Sustainability Science: PNAS**
- **Sustainability Science Roundtable: NASME**
- **Sustainability Science Journal: Springer-UNU**

platforms for building sustainability science as an academic discipline addressing challenges that existing disciplines have not addressed

- **Sustainability Science in a Global Landscape**

Report by Elsevier and SciDev.net : UN, September 2015

- **Research output in Sustainability Science**

3% of world publications relate to SS
8% annual growth rate

North-South divide: **76%** of publications by high income countries
2% of publications by low-income countries

- **Top Universities offering Degrees in Sustainability Science:**
  Harvard, Stanford, Tokyo, Helsinki,…….

Objetives

- **provide a platform to discuss the contribution of Sustainability Science and Research towards the implementation of the SDGs**

- to mobilize relevant actors government officers, universities, enterprises, NGOs and grassroots organizations working with sustainable development, to gather and deliberate how Sustainability Science and Research can help to achieve the SDGs

Science Education and Science Literacy

New Methods of Science Education

IAP-SEP: Inquiry-based Science Education (IBSE)

- engages students in the learning process through experimentation, promotes their critical thinking and develops their problem-solving skills.
- Includes sustainability issues into teaching (*climate change, disasters, water, energy, food..)*

Source: pinterest.com

China.org.cn China.org.cn, January 8, 2019

- **The future has come: AI in education and poverty alleviation**
- **AI is key to empowering rural education to ensure no student gets left behind**

Promoting Science Literacy: IAP-SEP

Science Centers and Museums

- Interactive science centers and museums are important hubs for "informal", hands-on education
- They bring science to society, promote scientific literacy, stimulate curiosity and develop enquiring minds.
- About 400 million citizens participate yearly in interactive exhibitions organized by nearly 2,500 science canters globally.
- Green Technologies and Sustainability issues should be integrated into interactive exhibits of Science Centers

At least one Science Centre in every country

.

Supporting Students and Young Researchers:

Action by TWAS and OWSD

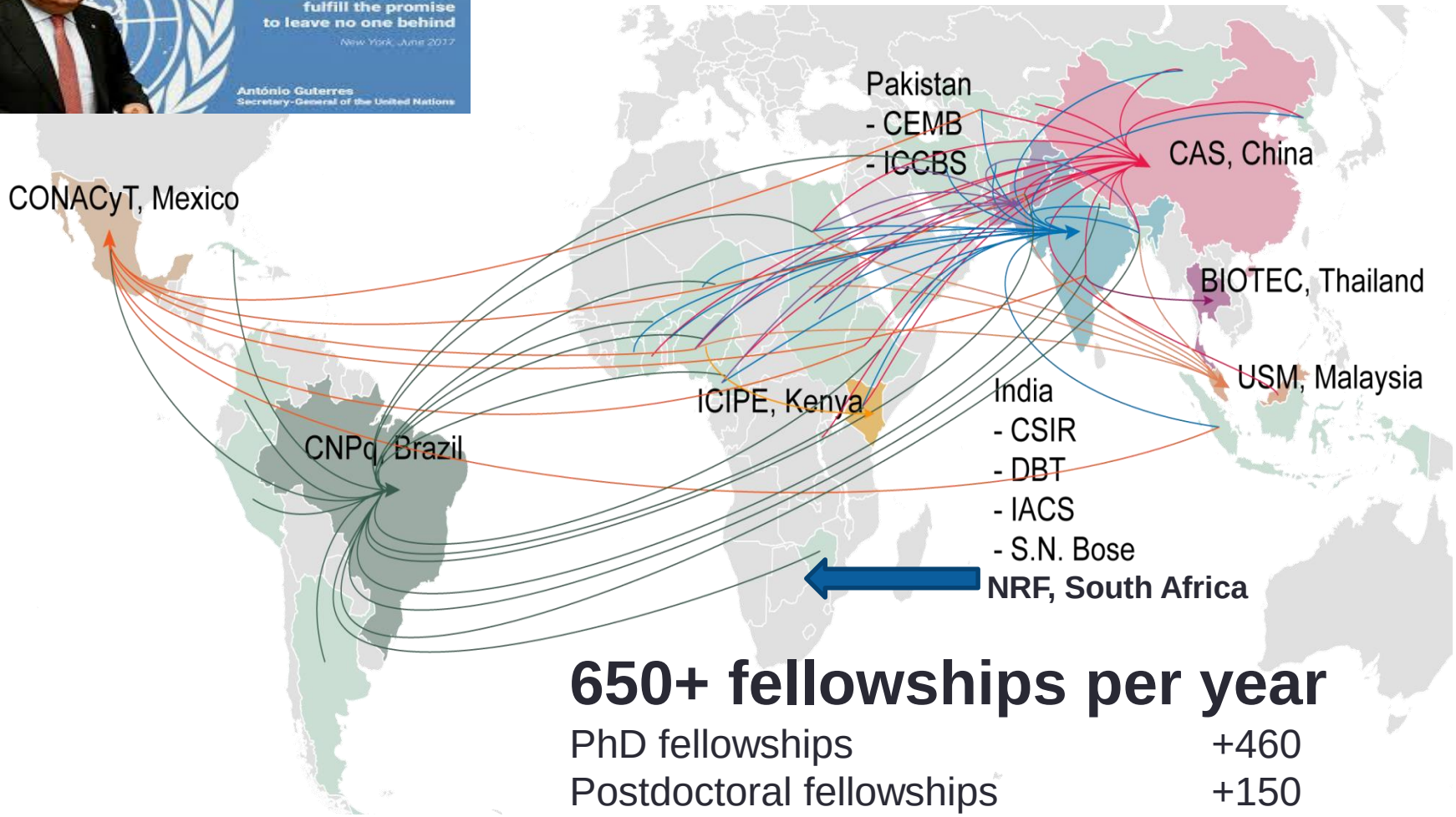
Target Countries

Countries most in need of capacity building

- **66** S&T-lagging countries, including
  - **52** Low-Income Countries (48 LDCs)
  - **14** Lower Middle-Income Countries
- **6** Arab Countries

TWAS S-S Postgraduate Fellowships

Building future leaders and minimizing brain drain



650+ fellowships per year

PhD fellowships	+460
Postdoctoral fellowships	+150
Visiting researchers/professors	+ 45

TWAS-Sida Research Grants

About USD1.5 million per year to young scientists and research groups in Africa and S&T-lagging countries ($ 15-30 K)

2,450 grants awarded to individuals and research units (1986-2017)

Building a career with TWAS support

Emmanuel Unuabonah from Nigeria

Awarded CAS PhD fellowship in China in 2005

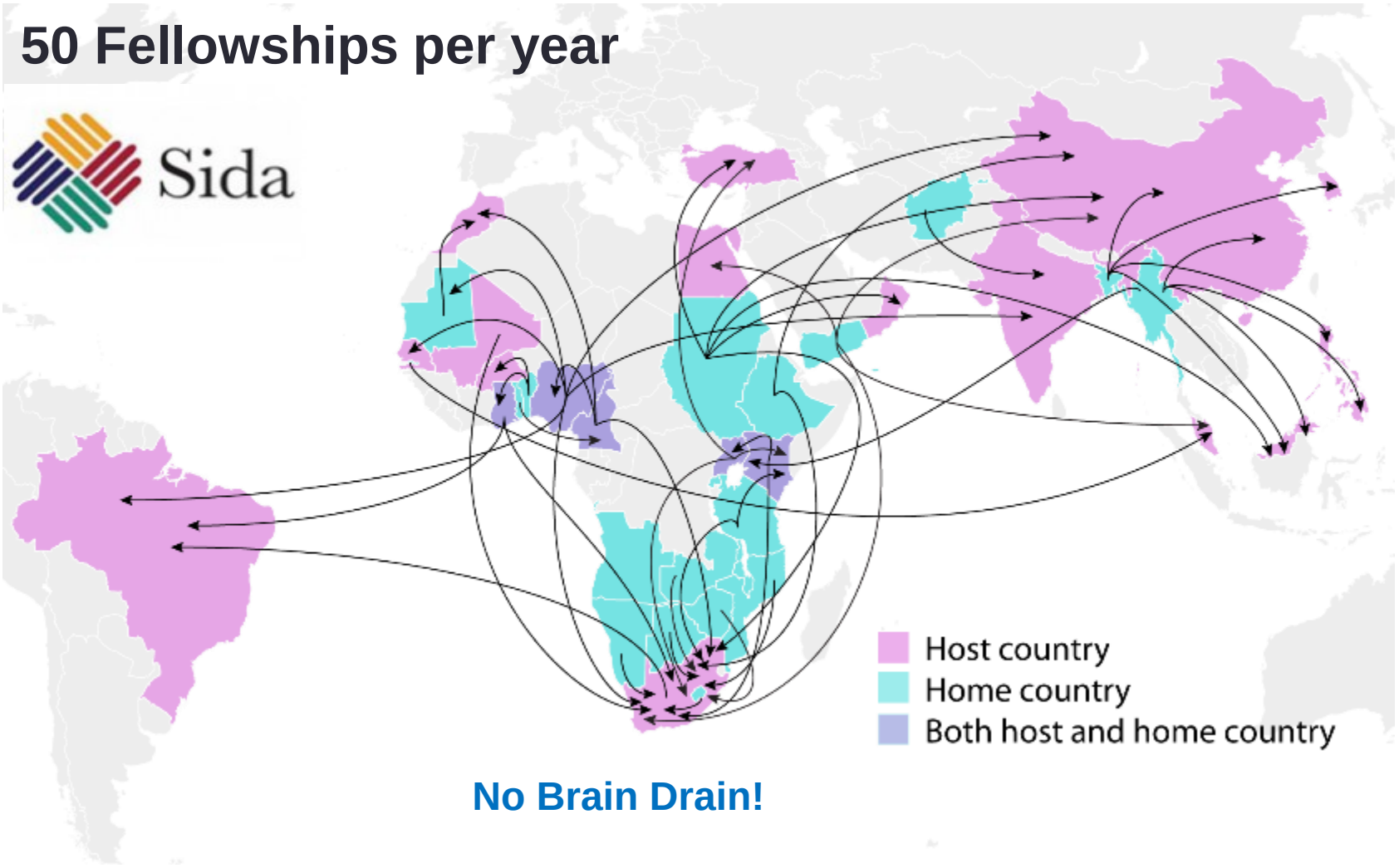
Elected TWAS Young affiliate (2009 to 2013)

Awarded a TWAS Research Grant in 2012

Succeeded in developing an inexpensive new material made of **clay and papaya seeds** to remove harmful metals from water and could provide low cost of clean water to millions of poor people in the developing world

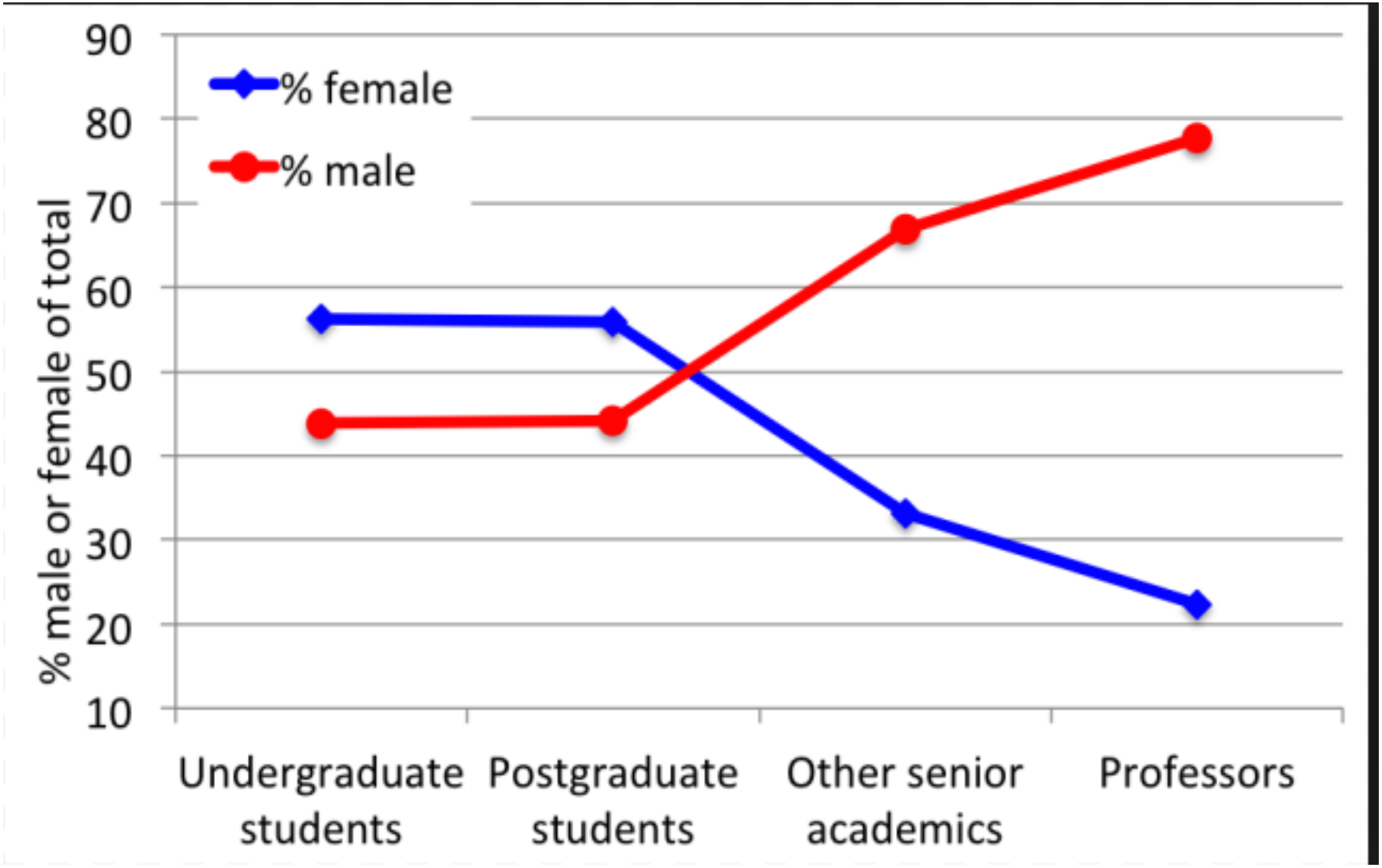
OWSD S-S Postgraduate Fellowships

50 Fellowships per year



No Brain Drain!

Scissors Diagram: gender distribution within carrier stages



Early Career Women Scientist Fellowships

ORGANIZATION FOR WOMEN IN SCIENCE FOR THE DEVELOPING WORLD

IDRC | CRDI
International Development Research Centre
Centre de recherches pour le développement international

- New fellowship program of **50K$** supports early career women scientists to develop and lead important research projects

Sherge Tolessa, Ethiopia
Agriculture

- Selected fellows will build on their leadership and management skills, develop connections with public and private sector partners to potentially convert their research into marketable products or guarantee its impact on a broader scale

Poudel Shobha, Nepal
Social and Economic Sciences

Building institutional capacities

Building Capacities of:

- higher education institutions to attract, train and retain the best and brightest students to research in global problems

- research institutions to develop, adapt and deploy frontier STI to alleviate poverty and hunger

- institutions to scale-up innovations for poverty alleviation and bring them to market

Role of top-class research universities

Each country should have at least one top-class research university:

- to connect research and education
- to set standard for quality and excellence
- to attract best and brightest students
- to link frontier knowledge and innovation to global challenges
- **To adopt integrated innovation approaches in research and education**

University-based Centres of Excellence

TWAS: Research Units of Excellence

- **Research units selected on merit and competition**

- **Toxicology Group, Environment Unit, University of Abomey-Calavi, Benin**

- **Electrochemistry and Polymer Science Group, Department of Chemistry, University Cheikh Anta Diop, Senegal**

- **Institute of Endemic Diseases, University of Khartoum, Sudan**

Africa Centers of Excellence (ACE)

- Launched by WB In partnership with African governments to develop and sustain excellence in postgraduate education

- 46 Centers working in health, energy, agriculture and ICT selected on basis of merit and competition

- Each Center offered $8 million for strengthening research and postgraduate education

WB- **African Center of Excellence for CSA**

Haramaya University, Ethiopia

TECHNOLOGY BANK

UNITED NATIONS

- UN-GA established a Technology Bank for LDCs
- *First SDG target to be achieved (17.8)*
- UN-SG appointed governing Council of UN technology bank and established a trust fund
- Inaugurated in June 2018 at Headquarters in Turkey

- Facilitating mechanism to help LDCs to:
  - *build robust human and institutional capacities in STI*
  - *upscale and market relevant LDCs research, protect and secure their IP at concessionary rates*
  - *Acquire, develop and commercialize technologies critical to achieving the SDGs*

Organizational Aspects

Three interrelated operational units:

STI supporting Mechanism (STIM)

- ***build robust human and institutional capacities in STI***
- ***build capacities to develop, adapt and absorb technologies***
- ***foster development of national and regional innovation ecosystems***

Intellectual Property Bank (IP Bank)

- ***upscale and market relevant LDCs research, protect and secure their IP at concessionary rates***
- ***Acquire, develop and commercialize technologies critical to achieving SDGs at concessionary rates***

Management and Coordination

- ***Establish synergies and coherence among the above two units***
- ***Coordinate with relevant organization***

Key Messages

- SDGs Implementation strategies must be embedded into the National Development Plans to get appropriate funding

- Translating global agreements related to the SDGs into commitments and action is crucial to achieving the SDGs

- STI and Global Partnership (SDGs 9 & 17) are key means of implementation for all SGGs

- **Promoting STI for poverty and hunger alleviation and global sustainability will require** strengthening the **quality** of scientific research and education in universities to train and retain a new generation of talented problem-solving researchers, especially in S&T- lagging countries

- Universities should be encouraged to include Sustainability Science and integrated innovations approaches in their research and education efforts to produce scalable and affordable solutions to sustainability problems

- Developing Countries, in particular, should enhance their capacity in Sustainability Science to advance integrated innovative solutions to alleviate poverty and hunger

- This will require scientific leadership in the south and global partnerships: North-South & South-south to develop and implement joint research and education agendas

- Academies of science under IAP guidance should follow the example of the US national academies to design and implement programs in sustainability science

Thank you

Mohamed H.A. Hassan
hassan@ictp.it