

Opinion

Challenges Facing Scientific Research in Developing Countries: 3. An Attempt at Offering Remedies and Solutions

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To identify points of weakness in any system is to have taken the first step towards progress, while to define specific solutions for these problems is the second step towards success. Finally, to implement these solutions properly and in a timely fashion is the final step towards reaching individual or societal goal of moving forward.

In developing countries, it appears that even the first step towards correction and improvement, i.e., identifying weakness and their natures, is an elusive, difficult move to make. Issues and events are dealt with haphazardly and whimsically. Personal opinions of bureaucrats prevail over those of experts. Structured scientific processes and methodological procedures to define problems and offer solutions are absent.

As an academician in the USA for over thirty five years, I have summoned my experience and expertise to identify major problems with scientific research in developing countries in previous reports [1, 2]. It becomes now imperative that I set forth my humble attempt to propose solutions and remedies for these problems.

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Dates

Received 1 January 2019
Accepted 1 January 2019

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1. The Human Factor

To overcome problems associated with, or encountered by recent generations of scientists in developing countries, I suggest the following:

1. Foreign missions to the developed world, to obtain masters and doctorate degrees, have been on-going for many decades without a measurable or even subtle impact on research in the developing countries. Thus, it has become imperative to seek alternative ways to benefit from contacts with the developed world in this arena. Therefore, I suggest an immediate long-term (not less than 10 years) moratorium on these missions in all disciplines.

In light of the shortage of skilled technicians in developing countries who are necessary to maintain a steady operational levels of modern equipment, I suggest making foreign missions exclusively limited to obtain *Associate* degrees in various technological aspects. Some institutes in the *West* offer two-year programs that entail practical, hands-on experience in various modern technologies. This option, I propose to be reserved only for individuals who are fluent in English, in addition to the language of instruction, according to the host country. Individuals elected for these programs must be top graduates of the best schools of engineering in their developing countries.



2. In order to address problems with proficiency in the English language, written and verbal, among most scientists in non-English speaking developing countries, a certificate from legitimate authorized entities, local or international organizations, attesting to the fluency in the English language, must be a prerequisite for all entry-level jobs in scientific research. Standards must be set at significantly high, internationally acceptable levels.
 3. To maintain awareness of international standards in modern research, every scientist in developing countries, regardless of rank, must pass annual computerized tests on research ethics and regulations in their countries and which must comply with international standards. Examples of important topics include animal use and care protocols, handling of radioactive isotopes, chemical and hazardous waste as well as plagiarism. Failure to participate or pass such tests must result in sanctions against involved individuals such as immediate withholding of research funding and/or suspending all participation in any research activity.
 4. To help create cadres of thinkers capable of identifying important, viable and relevant research topics, scientists, particularly at the junior level, must periodically attend local workshops on how to identify an interesting research idea, write scientific manuscripts and present their data in a way that would ensure their success in publishing in high quality international publications in their discipline. For this purpose, inviting prominent researchers from developed countries to spend 1-2 weeks at a time to meet one-on-one with a limited number of selected junior researchers in order to discuss their research projects, offer suggestions and help guide them in writing their research results for publications.
 5. To embolden motivation, make salaries and *periodic* salary adjustments linked to a merit-based system. In research institutes, financial remunerations should be based on research productivity and quality. In other academic institutions, a percentage of remuneration, to be decided based on teaching and other responsibilities, should commensurate with research productivity and quality.
- In promotions to higher ranks and merit-based salary assignments, I recommend to give extra added value to publications on studies performed in collaborations with counter colleagues from developed countries.

2. Environment and Resources

Here I am offering some remedies that should be implemented in a gradual fashion over time.

1. To optimize the use of available resources and expertise, it may be valuable to establish a national *master list* (Data Bank) of all already existing equipment and experts in each field. Such lists are to be made available to all researchers in each specific field within their country to draw upon expertise and technical help, as needed.
2. Found a central digital library with subscriptions to all possible and relevant modern and up to date e-books and e-journals with free access to interested researchers.
3. Create a technical unit in every research institute staffed with enough skilled technicians out of those who have received practical training in developed countries (see 1.1 above).

Based on type of equipment used in each research institute as well as experience with the nature, type and frequency of their maintenance, each institute should have readily available minimum supplies of spare parts at hands.

4. Explore the possibility of establishing regional (within a country or among several countries), publicly and/or privately funded, small size facilities to produce essential research chemicals and disposable supplies, based on studies of needs of scientists in the concerned geographical area.
5. Establish regional (national and/or across nations) agreements with computer manufacturers to supply, update and service computers to reduce cost. Similar agreements should be established with internationally recognized high-speed internet service providers.
6. Launch national (publicly and/or privately funded) facilities for breeding of “common” as well as genetically altered research animals, according to international standards, where genetic backgrounds of animals produced are well known and documented.

It is without a doubt that the above is not an all-inclusive list of possible or needed solutions and remedies for the ailing scientific research in developing countries. Furthermore, each of these countries is more aware of its specific deficiencies and capabilities, and consequently solutions. However, in order for developing countries to eventually achieve reasonable level of societal maturity and sustainability, it appears they must pledge a 180 degree shift in direction and commit to multitudes of their current efforts in scientific research, for that the latter is their only gateway towards a brighter future. Following the same current prevailing ways will only widen the gap between the developed and the developing worlds, which would make future attempts to catch up with scientific advances, paramount for better living standards, a most difficult task.

Competing Interests

The author declares no competing interests.

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