

damental Research is conducting campus interviews to find suitable candidates for its Ph D programmes in basic sciences<sup>3</sup>.

It will be interesting and necessary to find out why India is stagnating while countries like China and Korea are moving forward and publishing more papers. What will be the long-term effect of such neglect of mathematics on higher education as a whole? A senior professor and Bhatnagar-award winner told me that the teaching at the Master's level in most Indian universities is inadequate. A mathematics professor at IIT Madras, told me that the quality of students coming for Master's programmes in mathematics is poor. They are not sufficiently motivated. I was also told that many applied mathematicians are unable to

choose challenging problems and are merely solving problems which have no bearing on real life situations.

Fortunately, several youngsters from India perform well in the Mathematics Olympiad. As Varadarajan<sup>4</sup> had pointed out several years ago, there is a virtual famine of well-motivated and qualified teachers at the college and university levels.

If the trend is not arrested immediately, we may soon reach a point of no return. A former president of one of our science academies told me that when he spoke about the alarming gap between India and China at a meeting, several people asked him why we should bother about what was happening in China, and said that we in India were doing rather well in our own way. Such complacency

among senior scientists and policy-makers will only make matters worse.

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## An approach to sustainable food security

Food security is an essential feature of a country's independence and sustenance. It depends on self-production of food grains in sufficient quantities and ability to transport and store grains on a large scale, commensurate with population size, economic strength that allows import/export of grains in required quantities, and availability to meet the demand of grains in the international market. An efficient food security system should withstand challenges posed by calamitous weather conditions unfavourable for agricultural production over successive seasons. In the year 2001–02, India produced about 210 million tonnes of food grains, largely sufficient for its 1050 million population. India has proved to be a food-secure nation for about the last four decades. However, in recent years, the precariousness of Indian's food security has become apparent at times of natural disasters. Several approaches need to be pursued to strengthen India's food security.

Self-sustained food security system such as that aimed in India requires food grain production at a somewhat higher level than that which meets the immediate needs, safe storage of extra food grains to overcome any seasonal or pro-

longed deficiencies in production levels and periodic turnover of old grains in storage with grains from fresh harvests. India needs to develop/practice complementary/alternative approaches to achieve reliable food security.

First, India being highly populous and its agriculture characterized by very small per capita arable land size of 0.7 ha, it must progressively increase food grain production per unit area. Seeds of new high-yielding varieties and optimum use of irrigation water, fertilizers and pesticides are the means to achieve this objective. The water requirement of Indian agriculture is largely met by summer and winter monsoons. Any large-scale disturbance in the rainfall patterns leads to drought conditions, adversely affecting the productivity of agriculture practised in different parts of India. Indian plant breeders need to develop varieties of food grains that are resistant to varying levels of drought. The meteorological studies of Indian agro-climates also need strengthening so that whenever necessary, the forecast-dependent, drought-tolerance cultivars may be sown in time during inclement seasons. India must also reduce loss of grains which is estimated at about 10%

of the total annual produce under various stages of post-harvest processing and short-term storage.

Government-controlled agencies are responsible for the procurement and storage of food grains, mainly wheat and rice, and for channelization of stored grains to fair price shops distributed throughout the country, and on occasions to locations where disaster occurs. Such governmental effort is an essential requirement for food security. The total capacity of this system is estimated as equal to the food requirements of the Indian people for a period of about nine months. The system of storage seems to suffer from several kinds of deficiencies. The grains are liable to spoil on account of improper storage conditions. The turnover of old stock by the new one is being overlooked. In this regard, the storage needs to be monitored for quality on a regular basis. Proper record-keeping using modern computational tools and programmes will be helpful in this direction. There is also need for modernization of storage facilities and of new R&D work in this area.

The bulk of the Indian people continue to consume home-made food prepared from whole, broken or powdered rice,

wheat, maize, sundry millets and pulse grains. Most Indian families, including farmer's families, store rice, pulse grains, legume, cereal and millet flours over several days to many weeks. In North India, some families store wheat and other grains in quantities sufficient to meet their yearly requirement and get the grains ground into flours periodically, at weekly or monthly intervals. These traditional habits of the Indian people should now be channelled towards bolstering India's food security.

A survey has revealed that an average Indian family of four persons consumes up to three quintals of cereals and one quintal of legume/pulse grains. About 50% of Indian families live in homes where grains can be stored in metal or earthen containers, safe from water seepage. The stored grains, however, need to be protected against pests. A variety of grain-storage metal containers of different sizes and configurations that protect grains from moisture and allow them to be drawn have been developed by Indian agricultural institutions<sup>1</sup>. Tablets prepared using certain traditional ayurvedic formulations have been found to provide safety to grains against insect infestation<sup>2,3</sup>. Some preparations developed from herbal materials through recent

experimentation have been found to be likewise effective<sup>4-6</sup>. The targeted R&D in safe storage of grains in household environments should aim at giving more economical and effective grain storage structures and safe, pest-control devices for the stored grain.

To meet India's yearly demand for food grains, the Indian families living in seepage-proof homes should be encouraged to store grains in amounts at least two times of their yearly need. Families with low level of income may require one time loan for the procurement of storage vessel(s) and small yearly loans for obtaining grains and pest-control materials. Non-government organizations (NGOs) could develop small/cooperative grains-storage facilities in remote/tribal areas. A national effort involving individual families and NGOs along the outline given above is bound to give a sound second line of support to the Indian government's centralized system of food grain storage and supply.

A strong correlation is observed between economic and political strength and food security among various countries. Food security as a national goal, through participation of people in storage of grains and of farmers for higher agricultural yields, with the use of scientific

methods, can create conditions for the growth of gross national product and employment in the country.

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## Diabetes research in India

This refers to the recent article by Arunachalam and Gunasekaran (*Curr. Sci.*, 2002, **82**, 1086-1097). This is an excellent summary of the current scenerio of diabetes research in India. The authors' efforts in carrying out a critical and nearly-thorough analysis of the research outcome are highly commendable. I am sure this will form an authoritative basis on which future research (and possibly funds) can be directed. I agree completely that there is enormous mismatch between the disease incidence and the quantum of research in our country. It would be important to analyse the reasons behind the poor performance of our country compared to Western countries.

Although overall conclusions arrived by the authors are based on the analysis of publications, this could be influenced by the choice of keywords used. There

seems to be a clinical bias in choosing the keywords; 12 out of 14 keywords used can be related more in the 'clinical context' and therefore only clinical (and not basic) research articles are likely to be retrieved by any abstracting service. A slightly greater share (1.60%) by *BBCI* than by *PubMed* (1.0%) indicates more basic papers are indeed published and therefore retrieved. If the authors wanted to capture basic research papers also (as claimed), the best way to go about is to include keywords such as insulin signalling, insulin sensitivity, glucose transport, metabolism, insulin receptor, leptin and resistin to name a few. Whether the authors are interested in comparing only 'clinical research' in our country is another matter. Besides this, international collaboration has been cited as an index of successful research outcome while the

data do not seem to support this, at least for Indian institutions. The only benefit I see in these collaborations listed in the article, is the timely publication of the data themselves which the foreign authors have done. Finally, I agree with the authors' recommendations of increasing investment and cross-disciplinary research between basic life sciences researchers and medical researchers. For a successful research programme, high quality manpower/expertise and finances are the major requirements, which are (can be made) available in institutions like IISc, CCMB, TIFR, NCBS and ICGEB among others. If we could only convince the medical research workers (including those from institutions already identified in the article) to collaborate with basic researchers from the above institutions, we can improve both the quality and