workshop on ethical issues in international health research. Overall, the workshops provided an opportunity to provoke thought and discuss practical and relevant bioethical issues facing the medical world, both for the providers and the receivers of health care.

Bioethics is a relatively new but rapidly growing discipline in India. There are many reasons for this. Among these are the failures of the government to provide the utopian dream of health for all, and of the regulatory bodies in the medical profession to contribute to optimal and relevant health care. This has led to proactive steps being taken by activists, committed medical professionals and social scientists. The conference achieved its goal of organizing a common platform for health activists to network towards ethical health science in India. The next conference will be in November/December 2007.

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MEETING REPORT

An integrated strategy for food security in the developing countries*

Under the auspices of the 93rd Indian Science Congress, and as a part of the event 'Science, and the UN Millennium Development Goals', a Panel Discussion on 'Biophysical and socio-economic dimensions of food security in the developing countries', was held. The output of the Panel Discussion was the development of an integrated strategy to make use of the synergy between bio-, nano- and information technologies, innovative agricultural and management practices, combined with administrative policies, to achieve the UN Millennium Development Goal of halving by 2015, the number of undernourished people in the world. Out of about 850 million undernourished people in the world, India has 221 million and China has 142 million.

The panelists included: P. M. Bhargava (Vice Chairman, National Knowledge Commission), Jan Lundquist (Stockholm International Water Institute, Sweden), K. Radhakrishnan (Director, NRSA, Hyderabad), Ajay Parida (MSSRF, Chennai), C. V. S. K. Sarma (Principal Secretary, Department of Irrigation, Govt of AP) and H. Hemnathrao (Administrative Staff College of India, Hyderabad). The discussants included Kiran Sharma (ICRISAT, Hyderabad), J. B. Prajapati (Anand Agricultural University, Gujarat), Swarna Vepa (MSSRF, Chennai), S. P. Wani (ICRISAT, Hyderabad) and Hema Achyuthan (Anna University, Chennai).

*A report on the Panel Discussion on 'Biophysical and socio-economic dimensions of food security in the developing countries' held in ANGR Agricultural University, Hyderabad on 6 January 2006.

Three multi-dimensional approaches have been identified as the means to achieve food security in developing countries. The principal themes of the approach, and the activity components of each approach are as follows:

1. More crop per drop (food and water security are inseparable, as food cannot be grown without water. Ways of optimizing the soil–water–plant system, in order to produce more food crops with less water).

- Use of remote sensing, GIS, GPS and VRT (Variable Rate Technology), for making surface water inventories, groundwater mapping, airborne salinity mapping, management of irrigated agriculture, vegetation indices, soil moisture, crop production forecasting, wasteland reclamation, regulation of water rights and aquifer depletion through the use of evapotranspiration and lysimeters, etc. Fragmented farm holdings in the country constitute a serious impediment in the farmer-specific application of remotely sensed soil moisture and other kinds of data applications.
- Development of drought-resistant and salinity-tolerant crop varieties. Use of recombinant DNA technology and methods for transferring (e.g.) salt-tolerant genes (say, from mangroves) into important food crops, such as rice. Gene isolation and development of transgenics in locally adapted cultivars.
- Preparation of hydroclimatic calendar on the basis of the analysis of satellite-based, climate-related information (including ENSO impacts), for use in crop planning.
- Maintenance of soil health. Use of soil microorganisms and micronutrients such as zinc, sulphur and boron, to improve soil fertility and productivity.
- 'Blue' water irrigation – To make irrigation water available on demand, and to price it in proportion to the quantity used per unit area of land. Reduction in conveyance losses. Efficient use of irrigation water through practices such as drip irrigation.
- Use of wastewater and brackish water to grow appropriate crops.
- Use of SRI (System of Rice Intensification) method of rice cultivation, which uses less seed, less water and better harvest.
- Study of how the quality of irrigation water (say, arsenious water) affects food grain quality.
- Rainfed agriculture: The greatest potential for meeting the burgeoning demand for food lies in rainfed agriculture based on 'green' water (soil moisture), and conversion of non-beneficial evaporation to beneficial transpiration through crops, using, for example, on-farm rainwater harvesting, and moisture conservation methodologies. Integrated watershed management can increase crop productivity two- to threefold through productivity-enhancing agricultural technologies (e.g. supplemental irrigation, micronutrient management), and thus break the unholy nexus between drought, land degradation and poverty ('access to affordable water is the first step out of poverty').

2. Food fortification (ways of processing foods to improve their nutrition, so that the same quantity of, say, cereals

could provide nutritious diet to more people):

• Fermentation of cereals, pulses, root crops, vegetables, fruits, milk, meat and fish could create new kinds of foods, which are more nutritious, more digestible, and with therapeutic benefits, while improving the taste, flavour and texture, etc. Fermented foods thus offer a practical solution to malnutrition and ill-health.

• Consumer preferences of food drive the production pattern of foods. Both the poor and the affluent are eating lesser quantities of cereals – the former on grounds of affordability, and the latter on grounds of preferring to eat more meat and fruits. Ways have to be found to address the macronutrient and micronutrient deficiency in the diet of the low-income people, through appropriate food processing mechanisms.

3. Access to food (economic instruments and administrative policies to improve access to food):

• Food availability is a necessary but not sufficient condition for food security. The policy framework for food security involves three elements of availability, acceptability and accessibility. Economic and physical access to food needs to be enhanced.

• Development of micro-enterprises would enhance the purchasing power of people living below the poverty line to buy food.

Governments are urged to formulate incentives to promote drip irrigation, and to grow low water-need crops, such as bajra (in the form of guaranteed prices) and rearing meat animals (e.g. impala, ostrich) with low water consumption. There should be disincentives for rice cultivation in drought-prone areas (such as denying free electricity).

The management system to implement the proposed strategy needs to have three layers to take into account the multi-dimensional nature of the enterprise.

• Policy level ('Top-down' approach) – to serve as a 'think-tank' to integrate and optimize various biophysical and socio-economic factors, and administrative incentives and disincentives. This is essentially at government level, supplemented by NGOs.

• Technology transfer level ('bottom-up' approach) – to design institutional arrangements for adapting the technologies to specific local biophysical and socio-economic situations; to develop mechanisms and modalities of training of all the concerned entities (such as managers, NGOs, stakeholders, financial institutions, Panchayat Raj institutions, etc.)

• Implementation level: to design institutional arrangements for the management of implementation, monitoring and servicing of the micro-enterprises. 'Handholding' with stakeholders where necessary. NGOs will be the principal players.

Customised 'mix' of inputs for improved food security needs to be developed at the level of watershed/mandal/district/state/country, depending upon locally available technologies, agroclimatic conditions, economic policies, public awareness, information and communication technologies, etc. for various regions/countries.

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