

tery of biological phenomenon and holds promise against use of organ preservation in medical sciences.

Notable presentations among oral papers were by A. Jousset (Soil Ecology, University of Gottingen) who spoke on altered soil food web structure within rhizosphere due to toxicity produced by bacteria (*Pseudomonas fluorescens*) as defence against bacterivorous protozoa. C. Laforsch (Ludwig-Maximilians University, Germany) presented the role of DNA barcoding in identifying the ecological and evolutionary characters, for example, crown of thorn evolved in *Daphnia* as a result of coexistence with predator species. T. Gram (Technische Universität, Germany) spoke on the higher competitiveness of spruce (*Picea abies*) compared to beech (*Fagus sylvatica*) for below ground resources because of greater C allocation to mycorrhizosphere by the former than the latter. S. Lively (The University of Melbourne, Australia) presented that quercitol serves as a stable compatible solute and stress metabolite and acts as an insurance policy in *Eucalyptus astringens* under stress conditions (drought, frost) in Australian arid ecosystems. D. H. Haarmeyer (University of Hamburg, Germany) presented that grazing slightly decreased species richness and abundance of endemic vegetation in South Africa, whereas the same increased reproduction of two dwarf shrubs.

A. Saveyn (University of California, USA) spoke on carbon assimilation in stem (i.e. re-fixing of CO₂ present inside

the stem originated from respiration) as a result of highly depleted ¹³C in CO₂ within the stem. G. Hoch (University of Basel, Switzerland) showed that two levels of CO₂ supply (14 and 540 ppm) did not vary the concentration of structurally bound hemicellulose and concluded that it might be re-mobilized as C sources in mature tissue thereby challenging the classical view of C storage in plants. Y. Kasyanov (University of Bayreuth, Germany) spoke on the significance of rhizosphere in carbon cycle and presented ¹⁴C studies that reflect the amount of organics released by roots corresponds to 15–25% of C assimilated mainly by root tips. S. Arndt (The University of Melbourne, Australia) presented that the mineral N is the main N source under intermediate N availability in Australian land-uses and the role of low molecular weight organic N is of less ecological relevance. J. Simon (University of Freiburg, Germany) spoke that girdling of adult beech trees reduced rhizodeposition, and affected N uptake, total microbial biomass and denitrification activity in soil without affecting the abundance of mycorrhizal fungi.

Besides, presentations were made by J. Tenhunen (University of Bayreuth) and others on ecological heterogeneity in complex terrain where the role of biotic, abiotic and social factors were correlated with forest and agricultural productions and services. Tenhunen spoke that mountainous complex terrain represents about 20% of the Earth's terrestrial surface that provide freshwater to about half of

humankind. He spoke on the intensive evaluation of quantity and quality of water obtained from these regions and on further understanding and developing a tool to manage these complex areas. O. Dennis (University of Bayreuth, Germany) spoke on formulating landscape level models of evapotranspiration by using the time series data of water use and heat exchange from eddy covariance studies. Further, he spoke on scaling forest water flux and key physiological parameter with climate variables. T. Koellner (University of Bayreuth, Germany) focused on evaluating multidimensions (i.e. ecological and socio-economic) of ecosystem services through simulation modelling.

Besides, there was a public talk by Erwin Beck (University of Bayreuth, Germany) in German to inform the development of the ecological sciences to the public.

The conference provided an opportunity for researchers to discuss the long standing principles of eco-science, armed with the analytical power of molecular, isotopic analysis and simulation modelling, to play major role in understanding and designing sustainable systems for the future that can provide good living standards, better diet and social stability to the growing population in the 21st century.

S. K. Tripathi, Department of Forestry, Mizoram University, Aizawl 796 009, India. e-mail: sk_tripathi@rediffmail.com

MEETING REPORT

Nutrition security for India: issues and the way forward*

Malnutrition in India is a major health problem. It has a direct impact on the nation's inclusive and equitable growth

*A report of the symposium on 'Nutrition Security for India – Issues and the Way Forward'. The symposium was organized by the Indian National Science Academy, New Delhi on 3 and 4 August 2009. The symposium was supported by the Science for Equity Empowerment and Development (SEED) programme of the Department of Science and Technology, New Delhi.

and development and requires immediate attention. The resistant problem of malnutrition, its aetiology, consequences and measures for achieving nutrition security was the theme of a symposium entitled 'Nutrition security for India – issues and the way forward'.

M. S. Swaminathan (Chairman, M.S. Swaminathan Research Foundation, Chennai) inaugurated the symposium. M. Vijayan (President INSA) chaired the inaugural session. The theme of Swaminathan's talk was 'Achieving sustainable

nutrition security: a road map'. In the programme that followed, an overview of the problem and consequences of the double burden of disease that a country in transition like India faces, was given by Kamala Krishnaswamy (former director National Institute of Nutrition (NIN), Hyderabad). Four presentations that followed dealt with dietary and non-dietary aetiology of malnutrition. G. N. V. Brahmam (NIN) discussed the qualitative and quantitative aspects of Indian diets as revealed by the surveys done by the

National Nutrition Monitoring Bureau and their impact on nutrition status. The non-dietary factors in the aetiology of malnutrition discussed were: (a) the vicious link between malnutrition and infections due to insanitary conditions and poor access to safe drinking water (T. Jacob John, formerly at Christian Medical College, Vellore), (b) interplay of income and probably genetic factors as revealed by unexplained regularities in the anthropometric measures of preschool children, based on NFHS data (Pronab Sen, Ministry of Statistics and Programme Implementation, New Delhi) and (c) lifestyle, mostly in relation to growing problem of overweight and obesity in India (Anura Kurpad, St. John's Institute and St. John's National Academy of Health Sciences, Bangalore).

Subsequent presentations dealt with Government's response – programmes for nutrition security (Prema Ramachandran, Nutrition Foundation of India, New Delhi), and scientific response – transgenic technologies (Deepak Pental, Delhi University), food fortification (V. Prakash, CFTRI, Mysore), and salt fortification for micronutrient security (B. Sesikeran, NIN and S. Ranganathan, Christy Group of Companies, Tamil Nadu). The last speaker Rama Narayanan (Ford Foundation Chair for Women and Food Security) spoke on gendered empowerment for nutrition security. Mahtab S. Bamji, Convener of the Symposium, summarized the presentations. The sessions were chaired by Indira Nath, Manju Sharma, S. Varadarajan, R. P. Sharma, I. P. Abrol, T. Ramasami and Anupa Siddhu, who made valuable comments.

On the second day, several scientists from the disciplines of nutrition, agriculture, health and social activists participated in a panel discussion. About 20 students of Food and Nutrition, and a few others from agriculture and medicine also participated.

In his concluding remarks, T. Ramasami (DST) expressed that food and nutrition security is proactive action against perceived threat – in this case malnutrition. It needs a strategy which can be developed at the top, based on inputs, but action has to be at the family level, for which knowledge has to percolate. While government may be able to tackle generic issues, solutions for individual problems often come from within the community. The issues discussed and the

recommendations made are summarized in this report.

Aetiology and consequences of malnutrition: The term malnutrition implies both under-nutrition and over-nutrition. After more than 60 years of independence, India – a country in developmental transition – continues to battle with pre-transition diseases like infections and under-nutrition. Over 50% of preschool children and 30% adults are undernourished as judged by anthropometric indices and over 70% of women and children suffer from iron deficiency anaemia. Every third child is born with low birth weight, and is condemned to poor mental and physical development and immunity unless rehabilitated within the first year of life. Intrauterine malnutrition epigenetically predisposes to cardiovascular diseases in later life. Almost 60% of deaths due to major infectious diseases are caused by superimposed malnutrition. In India, 36% deaths and 42% DALYs (disability adjusted life year) lost are due to communicable diseases, perinatal and maternal conditions and nutritional deficiencies. Post-transition life-style related diseases like obesity and chronic degenerative diseases are increasing, with India becoming world capital of diabetes. Over 10% Indians are overweight or obese, the incidence being almost 20% in urban areas. Apart from human suffering caused due to morbidity and mortality, malnutrition is severely denting India's productivity and development, and adding to medical expenditure.

Nutrition security implies physical, economic and social access to balanced diet, clean drinking water, safe environment and health care (preventive and curative) for every individual. Education and awareness are needed to utilize these services. Thus malnutrition has a complex aetiology and its prevention requires awareness, and access at affordable price to all the above. Women's health, nutrition, education and decision making through empowerment are important for the nation's nutrition security but these remain neglected due to cultural biases.

Countrywide diet surveys show that Indian diets are qualitatively more deficient in vitamins and minerals (hidden hunger) than proteins due to low intake of income-elastic foods like vegetables, fruits, pulses and foods of animal origin. Nutritious millets are disappearing. Within the family, diet of preschool children is particularly inadequate, due to

ignorance and time constraint on mothers rather than affordability. More than 70% of preschool children consume <50% of recommended amount (RDA) of iron, vitamin A and some B vitamins, particularly riboflavin and folic acid.

Within India, states like Kerala and Tamil Nadu have relatively better nutrition parameters than states with higher calorie intake (Madhya Pradesh) or economic growth (Gujarat, Maharashtra), suggesting that the situation is more complex than mere access to food (calories) or income, important as they are. Time trends suggest that over the years intake of all the food groups and nutrients has declined, but the magnitude of malnutrition has not worsened, in fact there is marginal improvement and severe clinical forms are rare, except anaemia, whose incidence and severity have not changed – in fact marginally increased.

Nutrition-infection is a vicious cycle. Malnutrition reduces immunity and infections and disease reduce appetite, impair absorption and lead to catabolic losses of precious nutrients. Thus, apart from physical and economic access to food, access to clean environment and drinking water are areas of great concern. Increasing incidence of obesity and chronic diseases is due to more sedentary lifestyles, shift to low fibre, high fat refined carbohydrate diets, stress and addictions. Crowded urban areas leave little space for physical activity like walking or play even for children.

Neither government nor scientists can be faulted for being silent spectators. Efforts have been made, but something is missing and the situation continues to be grim. Food grain (wheat and rice) production went up markedly and kept ahead of population till mid-nineties, but is tending to plateau. Unfortunately pulse production has stagnated and per capita availability has declined. There is erosion of millets production and consumption. Milk, fruit and vegetable production has increased markedly with India holding 1st and 2nd positions respectively, but that is not reflected in the diet of the poor due to poor purchasing power, and lack of awareness about their nutritional importance among the producers. Loss of almost 30% of farm produce is occurring due to inadequate post-harvest storage facilities, and food processing for value addition. New technologies for biofortification of crops have been developed

but languish due to uninformed opposition and inability to put in place convincing safety guidelines and measures. Several programmes, missions and acts including a National Nutrition Policy (1993), National Nutrition Plan of Action (1995) and National Nutrition Mission (2001), have been formulated with scientific and technological underpinning. But they have failed to achieve nutrition goals. Some of the reasons are: (1) Nutrition is a poor cousin even in health and agriculture planning and execution; (2) Nutrition improvement is not a stated goal with measurable parameters for monitoring in missions like National Food Security Mission, National Horticulture Mission and even the recent National Rural Health Mission, leave aside others aimed at income, sanitation and drinking water; (3) Top-down approach without preparing the community and making them partners in planning and execution; (4) Poor targeting, accountability, and governance; (5) Inadequate importance to nutrition in school, college and even professional (health, agriculture, social science) education; (6) Neglect of female health, education and empowerment; (7) Vertical programmes with poor convergence and synergy between functioning of ministries and departments.

The way forward: Concentrate on proven interventions which have reduced the scale of malnutrition in less endowed countries. Some of these and other implementable suggestions are: (1) Proper breast feeding and complementary feeding practices, as prescribed by WHO/UNICEF and support systems to enable infant care. (2) Nutrition management during illness, including diarrhoeas. (3) Early detection and effective home-based management of mild and moderate undernutrition and referral and therapeutic

feeding for rehabilitation of severe undernutrition. (4) Full immunization. (5) Women's education, health and empowerment – a life cycle approach. (6) Access to clean environment, drinking water, and food safety. (7) Increased food production using conventional and new technologies, nutritionally oriented cropping pattern, decentralized planning for food production including homestead production of income-elastic protective foods and advocacy for dietary diversification. (8) Distribution of salt fortified with adequate iodine and ensuring its consumption in all areas particularly endemic areas for iodine deficiency. Now that salt double fortified with iron and iodine with proven efficacy is available, it should replace iodized salt. (9) Effective distribution of iron folic acid tablets for pregnant and lactating women, children and adolescent girls and deworming. (10) Bi-annual supplementation of massive dose vitamin A in areas, where vitamin A deficiency is a public health problem. Emphasis should be on promotion of nutritionally well endowed vegetables and fruits for food – food fortification. There is enough pro-vitamin A in dark green leafy vegetables, leafy portion of some vegetables like cauliflower, radish, etc. and yellow orange fruits and vegetables, and they should be promoted. (11) Popularization of the food guidelines for Indians through media and educational blitz. (12) Universalization of public distribution system and broadening the basket with inclusion of millets, pulse and blended oils. (13) Integrated post-harvest management including establishment of silos in every block should receive high priority to prevent wastage and generate employment. (14) Town planning should ensure lung space and place for walking and exercise. All schools should have playground and

physical training. (15) Nutrition should be clearly stated as an important input and output parameter for judging development and should not be treated as trickle down beneficiary of economic and industrial development. It should not get subsumed under curative or preventive health care in general, where emphasis tends to be on chronic diseases and immunization – important as they are. Without nutrition, neither communicable nor non-communicable diseases can be prevented and hence it should have an important status as an independent entity. Malnutrition is the worst form of non-communicable disease. (16) Leadership and efficient governance is required at all levels to ensure synergy through convergence between Programmes/Missions/Acts which impact nutrition directly or indirectly (income, sanitation, drinking water, feeding programmes, etc.) run by different departments/ministries like health, women and child development, agriculture, civil supplies, etc. (17) Planning and execution should be done with community participation and involvement of trained nutrition leaders from the community. (18) Greater dialogue and interaction between nutrition scientists and scientists belonging to agriculture, food technology, medicine, public health, and basic sciences as well as social scientists is needed. (19) National Nutrition Monitoring Bureau (NNMB) which now operates in nine states should cover all the states and have wider coverage, with additional component of nutrition surveillance.

This long wish list should not be curtailed if the dream of nutrition security has to come true.

Mahtab S. Bamji, Dangoria Charitable Trust, Hyderabad 500 020, India.
e-mail: msbamji@gmail.com