MSSRF
Science for Sustainable Development

REGIONAL CONSULTATION ON FARMING SYSTEM FOR NUTRITION

AUG 7-9, 2017

BOOK OF ABSTRACTS

M.S. SWAMINATHAN RESEARCH FOUNDATION

3rd Cross Road, Institutional Area, Taramani, Chennai-113, INDIA
www.mssrf.org

PROGRAMME

MONDAY, AUGUST 7, 2017		
Foundation Day Programme and Inauguration of Regional Consultation on Farming System for Nutrition		
3.00 PM – 5.00 PM		
	Welcome	**Dr. Madhura Swaminathan** Chairperson, MSSRF
	MSSRF Annual Report Presentation	**Dr. V. Selvam** Executive Director, MSSRF
	Release of Publications: 1. Booklet on Farming System for Nutrition 2. 27th Annual Report **Launch of:** 1. e-Archives of the work of Ms. Mina Swaminathan, Distinguished Chair, Gender & Development, MSSRF 2. Tamil Nadu Nutrition Alliance Portal	
	Felicitation and Special Remarks	**Mr. N. Ram** Chairman, Kasturi & Sons Ltd & Trustee, MSSRF
		Dr. Purvi Mehta-Bhatt Deputy Director and Asia Lead – Agriculture, Bill & Melinda Gates Foundation, New Delhi
		Dr. Maria Isabel Andrade Senior Sweet Potato Breeder for SSA & Asia, International Potato Center, Mozambique
		Dr. Trilochan Mohapatra Secretary, Department of Agriculture Research and Education (DARE), Government of India & Director General, Indian Council of Agricultural Research (ICAR), New Delhi

	Keynote Address	**Shri. Krishna Byregowda** Hon'ble Minister for Agriculture Government of Karnataka
	Inaugural Address	**Prof. M.S. Swaminathan** Founder Chairman, MSSRF
	Vote of Thanks	**Dr. N. Anil Kumar** Senior Director, MSSRF

TUESDAY, AUGUST 8, 2017	
9.30 - 11.00 AM	**Technical Session I:** **Theme: Pathways of Farming System for Nutrition (Nutrition Sensitive Agriculture)**
	Chair: Dr. Rajan Sankar Director (Nutrition), TATA Trusts
	Rapporteur/Convenor: Dr. R.V. Bhavani Project Manager, LANSA, MSSRF
	SPEAKERS
	Dr. Anthony Michael Whitbread Research Program Director – Innovation Systems for the Drylands, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
	Dr. Maria Isabel Andrade Senior Sweetpotato Breeder for SSA & Asia, International Potato Center, Mozambique
	Dr. Purvi Mehta-Bhatt Deputy Director and Asia Lead - Agriculture, Bill & Melinda Gates Foundation, New Delhi
	Dr. Narayan G. Hegde Trustee and Principal Adviser, BAIF Development Research Foundation, Pune

11.00 - 11.30 AM	***Tea/Coffee Break***
11.30 - 1.00 PM	***Technical Session I: Continues ...***
	Dr. S.A. Patil Former Vice Chancellor, University of Agricultural Sciences (UAS), Dharwad
	Dr. V.I. Benagi Director of Extension & Director, SAMETI, UAS, Dharwad
	Dr. Vijay Laxmi Pandey Professor, Indira Gandhi Institute of Development Research (IGIDR), Mumbai
	Dr. R.V. Bhavani Project Manager, LANSA, MSSRF
1.00 - 2.00 PM	***Lunch***
2.00 -3.30 PM	**Technical Session II:** **Theme: Agrobiodiversity/Climate Change and Farming System for Nutrition**
	Chair: Dr. N.K. Krishna Kumar Regional Representative - South & Central Asia, Bioversity International, New Delhi
	Rapporteur/Convenor: Dr. E.D. Israel Oliver King Principal Scientist, MSSRF
	SPEAKERS
	Dr. Carl Rangad Vice President, North East Slow Food & Agrobiodiversity Society (NESFAS), Shillong
	Dr. V. Geethalakshmi Professor and Head, Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University (TNAU)
	Dr. S.B. Dandin Liaison Officer, Bioversity International, Bengaluru
	Ms. Vidhya Das Joint Director, AGRAGAMEE

	Dr. G.N. Hariharan Director (Biotechnology), MSSRF
	Dr. E.D.I. Oliver King Principal Scientist, MSSRF
3.30 - 4.00 PM	***Tea/Coffee Break***
4.00 - 6.00 PM	**Technical Session III:** **Theme: Nutritionists' Perspective on Farming System for Nutrition**
	Chair: Dr. Thingnganing Longvah Director in Charge, National Institute of Nutrition (NIN), Hyderabad
	Rapporteur/Convenor: Dr. R. Rukmani Director (Food Security), MSSRF
	SPEAKERS
	Dr. Anura V. Kurpad Professor & Head, Department of Physiology & Nutrition, St John's Medical College, Bengaluru
	Dr. Indira Chakravarty Chief Adviser, Public Health Engineering Department, Government of West Bengal, Kolkata
	Dr. Mahtab A. Bamji INSA Emeritus Scientist, Dangoria Charitable Trust, Hyderabad
	Dr. Lalita Bhattacharjee Senior Nutritionist (MUCH), Food and Agricultural Organization of United Nations (FAO), Dhaka, Bangladesh

WEDNESDAY, AUGUST 9, 2017	
9.00 -11.00 AM	**Technical Session IV:** **Theme: Role of Technology in Farming System for Nutrition**
	Chair: Dr. S.R. Rao Advisor, Department of Biotechnology, Government of India, New Delhi
	Rapporteur/Convenor: Dr. G.N. Hariharan Director (Biotechnology), MSSRF
	SPEAKERS
	Dr. Vilas A. Tonapi Director, Indian Institute of Millets Research, Hyderabad
	Dr. Archana Mukherjee Director, ICAR-Central Tuber Crops Research Institute (CTCRI), Thiruvananthapuram
	Dr. C. Anandharamakrishnan Director, Indian Institute of Crop Processing Technology (IICPT), Thanjavur
	Dr. K.K. Narayanan Managing Director, Metahelix Life Sciences, Bengaluru
	Mr. Ashish Wele Independent - Corporate consultant & Former President, Nirmal Seeds Ltd, Budapest
11.00-11.30 AM	***Tea/Coffee Break***
11.30-1.00 PM	**Technical Session V:** **Theme: Bridging the Gaps**
	Chair: Dr. Indira Chakravarty Chief Adviser, Public Health Engineering Department, Government of West Bengal, Kolkata
	Rapporteur/Convenor: Ms. Nancy J. Anabel Director (Information, Education & Communication), MSSRF

	SPEAKERS
	Dr. Rama Narayanan Consultant, Community Nutrition, Chennai
	Dr. Nitya Rao Professor, Gender and Development, University of East Anglia, UK
	Dr. Gopi Ramasamy Country Director, Centre for Agriculture and Biosciences International (CABI), New Delhi
	Dr. Ram Rajasekharan Director, CSIR-Central Food Technological Research Institute (CFTRI), Mysore
	Mr. Avinash Upadhyaya Deputy Director-Programs, Digital Green Foundation, New Delhi
1.00-2.00 PM	***Lunch***
2.00-3.00 PM	**Technical Session VI:** **Theme: Farmers' Experiences with Farming System for Nutrition**
	Chair: Mr. R Elango, Kuthambakkam, Tamil Nadu **Co-Chair: Ms. Kalaivani Rajendran,** Thanjavur, Tamil Nadu
	Rapporteur/Convenor: Dr. G. Anuradha Principal Scientist, MSSRF
	SPEAKERS
	Ms. KausalBorje Saheli Village, Wardha, Maharashtra
	Mr. GangadharUtagirkar Susund Village, Wardha, Maharashtra
	Mr. Niranjan Khada Koraput, Odisha
	Mr. Ratnakar Nayak Koraput, Odisha

	Mr. Shaji Wayanad, Kerala
	Mr. S. Chinnathambi Kalleri, Thiru Puli Nadu, Kolli Hills, Tamil Nadu
3.00-4.30 PM	**Concluding Session: Policy Support required for Farming System for Nutrition**
	Chair: Prof. M.S. Swaminathan Founder Chairman, MSSRF
	Rapporteur/Convenors: **Dr. R.V. Bhavani,** Project Manager (LANSA), MSSRF & **Dr. R. Gopinath**, Senior Scientist, MSSRF
	SPEAKERS
	Dr. Ramesh Chand Member, NITI Aayog, Government of India, New Delhi
	Dr. Rasha Yousef Omar Country Director, The International Fund for Agricultural Development (IFAD), New Delhi
	Dr. K.M. Nagargoje, IAS Member Secretary, Maharashtra Council of Agricultural Education & Research, Pune
	Dr. K R Jahan Mohan, HOD (APP), State Planning Commission, Govt of Tamil Nadu
	Dr. Lalita Bhattacharjee Senior Nutritionist (MUCH), Food and Agricultural Organization of United Nations (FAO), Dhaka, Bangladesh
4:30 PM	***High Tea***
Concluding Remarks	**Prof. M.S. Swaminathan** Founder Chairman, MSSRF
Vote of Thanks	**Dr. R Rukmani, Director (Food Security), MSSRF**

INAUGURAL SESSION

TRILOCHAN MOHAPATRA

Director General, Indian Council of Agricultural Research and Secretary DARE, Government of India, New Delhi

India's food and nutrition security is under stress due to several inter-related factors that include population growth, urbanization, demographic changes, increased labor costs, high and volatile food prices, natural resource constraints, and climate change. Major aspect of food and nutrition security relates to prevalence of deficiencies in essential micronutrient such as vitamin A, iron, and iodine. Micronutrient deficiencies have the potential to weaken the mental and physical development of children and adolescents and to reduce the productivity of adults due to illness and reduced work capacity. Iron deficiency is considered the leading cause of anemia globally and South Asia has the second largest prevalence of anemia (after Africa) among children and pregnant women, with approximately two-thirds of children and nearly half of pregnant and non-pregnant women affected. The loss in productivity as a result of micronutrient deficiency is estimated to cost India the equivalent to 2.95% of GDP annually. For instance, India has recently published the Food Composition Table 2017 for the first time that has a greater significance for understanding the nutritional utility of different food groups in India. Nonetheless, to achieve food and nutrition security in the sub-continent, an integrated and more innovative development agenda will need to be adopted in terms of strategies, investments, technologies, institutions, and partnerships.

TECHNICAL SESSION I

PATHWAYS OF FARMING SYSTEM FOR NUTRITION (NUTRITION SENSITIVE AGRICULTURE)

CHAIR: RAJAN SANKAR

Director, The India Nutrition Initiative (TINI) and Program Director for Nutrition, TATA Trusts, New Delhi

SPEAKERS

PURVI MEHTA BHATT

Deputy Director and Head, Asia - Agriculture, Bill and Melinda Gates Foundation, New Delhi

India has made significant strides in achieving food security and also progressed in reducing undernutrition. Over the last ten years, the percentage of children suffering from chronic undernutrition has declined from 48% (NFHS 3, 2004-2005) to 38% (NFHS 4, 2014). But the prevalence of undernutrition remains higher than expected given India's GDP, and there are large disparities in progress at a state-level, among different wealth quantile and among women, especially in rural areas. The consequences of continued high levels of undernutrition are not just child morbidity and mortality, but also lower levels of education, productivity, and economic development. This talk shall discuss the analysis of India's persistent challenge of undernutrition and some solutions on how agriculture can play a role in addressing the issue.

The role of food in nutrition: There are two immediate causes of undernutrition: inadequate food intake and disease. Inadequate food intake implies both a quantity and quality dimension. Quantity refers to the amount of energy (typically measured in calories) consumed, whereas quality refers to how rich in macro- and micro-nutrients foods are. People can consume enough calories but still be undernourished because of poor quality diets.

Agriculture-Nutrition Pathways: Agriculture affects nutrition through three primary pathways: food production, agricultural income, and women's empowerment in agriculture. These pathways are influenced by several enablers, including the food market environment; natural resources; health, water, and sanitation; and nutrition and health knowledge and norms. These pathways, and the evidence for them both globally and in India, will be the subject of two presentations during the Learning Session.

Nutrient-rich foods: The recent launch of the Indian Food Composition Tables by the National Institute of Nutrition provides an opportunity to analyze the nutrient composition of key Indian foods. Known nutrient deficiencies in India with known consequences for health or cognitive development include the micronutrients iron, vitamin A, calcium, zinc, folate, vitamin B-12 and macronutrients energy and protein. Other nutrients of interest include thiamin, vitamin D, riboflavin, niacin, and selenium—however, research is currently inconclusive about the burden of those deficiencies or the health impacts of deficiency. Table 2 (to be developed) presents frequently-consumed foods in India with their nutrient values. In general, foods like dairy, eggs, poultry, fish, and pulses are nutrient-rich; foods like rice and wheat are less nutrient-rich. The key concept from a nutrition standpoint is that no single food provides all the required nutrients, and eating multiple foods to achieve a quality diet is paramount.

Summary: The talk will build on national evidences of India to explore opportunities to advance a nutrition-sensitive food system within agriculture and pathways through which agriculture can influence nutrition outcomes. It will highlight some case studies on how agriculture can play a role in assuring affordability and accessibility of year-round diversified, diets that help in addressing the challenge of undernutrition.

ANTHONY MICHAEL WHITBREAD

Research Program (Executive) Director-Innovation Systems for the Drylands (ISD) International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

MANAGING FOOD AND NUTRITIONAL SECURITY OF SMALLHOLDER FARMING SYSTEMS UNDER THE CLIMATICALLY VARIABLE SEMI-ARID TROPICS

Anthony Whitbread, David Bergvinson, Joanna Kane-Potaka, Peter Carberry, R. Padmaja, Shalander Kumar and Kadiyala D. Murthy

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Telangana

Climate variability is a major source of risk in the smallholder farming systems of the semi-arid tropics (SAT) which is home to almost 2.5 billion people. Along with biophysical, socio-cultural-economic and political factors, climate risk contributes enormously to food and nutritional insecurity, economic losses and poverty and is a particular challenge for those whose livelihoods depend on rainfed agriculture in marginal environments such as the SAT. Past and ongoing work has enabled us to understand the impacts of climate variability and change on smallholder agriculture and the perceptions and coping strategies adopted by farmers. While household food and nutritional security needs may be met by highly diversified farms producing a range of products (vegetables, crops, and animal protein), in reality, most farming systems are becoming less diverse with income used to purchase the necessary dietary needs. Supporting smallholder farmers, therefore, to be connected to value chains and using farming systems that are ‘resilient’ to the climate and sustainable should be a major aim of nutrition sensitive agriculture. Fortunately, the commonly cultivated SAT crops often include the ‘smart foods’ (millets and sorghums, pulses) that are both well adapted to

the climatic conditions and have high nutritive values. Such crops can also be dual-purpose, providing food for humans and fodder for animals. In the SAT, crop-livestock systems in particular can provide the necessary resilience to climate risk, enabling synergies between the enterprises to increase overall nutrient and water use efficiency and animal sourced foods to meet dietary requirements. Further enhancing the economic value and market opportunities for the 'smart foods' produced in the SAT could promote this integration. Creating farming systems of the future that are nutrition sensitive, therefore, requires a mix of government (policies, infrastructure investment, extension services) and private sector (input-output markets, risk mitigation instruments) interventions that are designed for the 'risky' context of the SAT.

MARIA I. ANDRADE

Senior Sweet Potato Breeder for SSA and Asia, International Potato Center, Maputo, Mozambique

Food security and malnutrition is a challenge. Although some countries have made progress, malnutrition remains widely present globally. The costs associated with child undernutrition are big. In Africa, challenges of diet-related premature death, poor development and disease remain. In Mozambique, about 43 percent of children under five are stunted due to chronic illness and poor diets and 69% are Vitamin A deficient. In Mozambique alone, child undernutrition costs 11% of its annual GDP. Clearly, we need to shift from feeding people to nourishing them. Farming system should focus on enhancing nutrition. Elimination of hunger and malnutrition require more than transforming the production of food. There is need to assist small holder farmers to build resilience to natural disaster and climate change. Also, there is need to use advances in science and technology to boost yields and strengthening in breaking through technologies such as climate resilient seeds, cultural management and communication. Production potential of sweet potato is not yet realized in sub Saharan Africa where dryspells are common after the growing season. Lack of sweet potato planting material at the beginning of the rainy season is a challenge. Identifying cultivars with ability to survive a 4 to 7-month dry spell is worthwhile in improving seed system in the drought prone regions. The presentation reviews the breeding, seed system, nutrition, agro-processing and promotion done in Mozambique to reach millions of farmers with drought tolerant orange flesh sweet potato to improve the diet of children under-five and women with Vitamin A rich sweet potato and the impact in their life.

NARAYAN G. HEGDE

Trustee, BAIF Development Research Foundation, Pune

MIXED FARMING SYSTEM FOR ENSURING FOOD AND NUTRITIONAL SECURITY IN INDIA

With Indian agriculture accounting for only 15% of national GDP, there has been significant pressure on food security for a majority of the rural population who represent over 60% of the total population. This has been reflected in 15% lower intake of food by the rural population, as against the recommended consumption of 2400 calories per day. Hence, it is essential to address the problem of nutritional deficiency along with food security through sustainable agriculture. The challenge is to enable 117 million small and marginal farmers to enhance their crop production. As most of these families also maintain different species of livestock as a traditional farming practice, mixed farming offers an excellent opportunity to enhance their family income while ensuring nutritional security and enrichment of soil and environment.

With adoption of improved livestock husbandry, which can be a major source of income, farmers can make best use of their land, based on soil productivity and water availability. This will give small farmers the option to cultivate a wide range of cash crops or adopt agri-horti-forage system, which can facilitate efficient recycling of nutrients between agriculture, livestock and human beings. The system can be strengthened further through establishment of Farmers' Cooperatives or Producer Companies for providing technical support and managerial skills to develop efficient value chains for different crops.

Experiences of mixed farming promoted by BAIF Development Research Foundation in different parts of the country, have been very encouraging. In Telangana small farmers could earn Rs. 0.15 million/year from sale of vegetables, while each cow owned by them generated Rs. 18,000 to 20,000 per year. In other states, vegetables were cultivated as intercrop in orchards. Farmers, who could not maintain cows maintained small animals and poultry. Mixed farming was also well suited for women because of light work, which could be managed without neglecting their domestic responsibilities.

V I BENAGI

Director of Extension, University of Agricultural Sciences, Dharwad, Karnataka

MILLET FARMING SYSTEMS

V. I. Benagi and D. P. Biradar, University of Agricultural Sciences, Dharwad

Millets are highly nutritious food crops which are hardy and are resilient to climate changes. Ironically over years, the area under these crops is declining owing to undue focus on mono-cropping systems, commercial crops and high input agriculture.

Minor millets are nutritionally rich and climate smart, and therefore should be given the focus they deserve. In terms of nutrients such as proteins, fibre, minerals or micro nutrients, millets have been proven to be better than wheat and rice. Besides, they need less water to grow and can provide high productivity even in the difficult climate conditions. Most millets can be grown on low fertility soils, some in acidic soils, some on saline soils. Due to all their good qualities, millets are the potential agricultural answer to the climate crisis that the world is facing. Each of the minor millet is a store house of dozens of nutrients in large quantities, which include major and micro nutrients needed by the human body.

In view of all these features that they so amazingly combine, millets can rightly called Miracle Grains. A nutritive analysis of millets vis a vis the major grains such as rice and wheat proves that nutrient to nutrient, millets score highly over the other grains. Compared to rice, they have 30 to 300% more nutritional elements such as calcium, minerals, iron, fibre, beta carotene and many other micronutrients. Millet farms are intrinsically biodiverse. Therefore, farming system development should become the aim over single crop development. The monitoring evaluation and research on millet cultivation must be tailored to this special quality millet farming system.

Their energy requirement from sources such as chemical fertilizer, pesticides, water and power can be near zero. This amazing capacity of the production system must be honoured through offering socio ecological bonus to the millet growing farmers. The urgent and immediate need is to put millets into the public distribution system. The pro millet PDS paradigm must depend on a completely decentralized approach based on the principle of local production, local storage and local distribution. This must be supported by the Government, both in procurement and in storage. This will resolve the question of availability and keeping quality. Government must be provide millet based foods in the ICDS, school meals and welfare hostel programmes. This will overcome the problem of malnutrition of young children, a problem that India faces. All these actions together will open up new markets for millet farmers and help revitalize them.

VIJAY LAXMI PANDEY

Professor, Indira Gandhi Institute of Development Research (IGIDR), Mumbai

CROP CHOICE AND DYNAMICS IN INDIAN AGRICULTURE

S Chandrasekhar, Vijay Laxmi Pandey and Soham Sahoo, IGIDR, Mumbai

Making small farms viable and changing the cropping decisions of small land holders to make it more nutrition sensitive are two of the most pressing needs of policy makers in India. In 2016, the Government of India set a target of doubling the income of agricultural households by 2022 (Government of India 2016a). Among the two key components of the Indian government's strategy are large investments in irrigation and liberalisation of land lease laws.

The objective of this paper using nationally representative survey of Land and Livestock Holdings conducted by India's National Sample Survey Organization (NSSO) in 2013 is two-fold. First, it quantifies the extent to which farmers in the states which are part of the rice wheat system (RWS) and other Indian states diversify towards non-cereal cropon the same plot of land over two crop seasons. Second, the paper seeks to understand the impact of irrigation and liberalisation of land lease laws. The analysis shows that there is a clear stickiness towards cereals in both RWS and other states. We find that expansion of irrigation would lead to an increase in the probability of cereals being grown in both Kharif and Rabi seasons on the same plot of land. We also find that probability of land being left fallow (rice fallow) in the other Indian states drops sharply. Further, allowing farmers to lease in land,would not make a difference in the cropping patterns in the RWS. However in the other Indian states, the probability of growing pulse would increase if a farmer with less than 1 hectare of land were able to increase the operational land to more than 2 hectares. Thus, for a viable and nutrition sensitive agriculture there is need to address on several policies (both price and non-priced) simultaneously keeping the complexities of agricultural system in mind.

R V Bhavani

Programme Manager, Leveraging Agriculture for Nutrition in South Asia (LANSA), M S Swaminathan Research Foundation, Chennai

A FARMING SYSTEM APPROACH TO ADDRESS UNDERNUTRITION

Aliza Pradhan, R V Bhavani, D J Nithya, S Raju, Akshaya Kumar Panda, Prashant Deokar

Farming is the primary source of livelihood for the majority of the population in India and South Asia. The region is also home to a large population of undernourished people. This indicates the potential for leveraging agriculture to impact on nutrition outcomes.

The study is underway in two regions of India, viz., Wardha district of Maharashtra and Koraput district of Odisha, demonstrating feasibility of a Farming System approach to address the problem of undernutrition. The core research question is: How strong is the evidence that agricultural interventions can be pro-nutrition? Following a detailed baseline survey of nutritional status and the available resources, the Farming System for Nutrition (FSN) was designed with a focus on crop and nutrition garden interventions to address the nutritional needs of rural families. The interventions focus on increasing the availability of cereals and pulses by enhancing the production at the farm level, improving diet diversity through on-farm crop diversification and promoting naturally biofortified fruits and vegetables through household and community level gardens especially green leafy vegetables to address micronutrient deficiency. Poultry for greater access to animal source foods in Wardha and fishery in Koraput are supporting interventions. Nutrition awareness is an essential component of the approach.

The paper presents the essential steps taken since mid-2013 to increase the availability of nutrition per unit area and highlights the challenges and constraints.

TECHNICAL SESSION II

AGROBIODIVERSITY/CLIMATE CHANGE AND FARMING SYSTEM FOR NUTRITION

N K KRISHNA KUMAR

Regional Representative, South and Central Asia, Bioversity International, New Delhi

SPEAKERS

CARL OSWALD RANGAD

Vice Chairman (Operations) NESFAS, Shillong, Meghalaya, India

The North East Slow Food an Agrobiodiversity Society (NESFAS) emerged as an outcome of collaborative activities between the IndigenousPartnership for Agrobiodiversity and Food Sovereignty (TIP) Rome and Slow Food International.TIP reaffirms the importance of local food systems and the age-old role of Indigenous peoples as guardians of agrobiodiversity, a role that is intrinsically linked to their cultural identity and to their right to food sovereignty, food and nutritional security. NESFAS sees food as a celebration of Agrobiodiversity.

The North-East India is a biodiversity hotspot which houses about 76% of the biodiversity of India and is the abode of more than 200 Indigenous communities who have lived, and still live in synchronization with nature; yet initial case studies have revealed that in the midst of the abundant biodiversity, malnutrition is prevalent amongst the study groups.

The defence, conservation and continuity of Indigenous Farming Systems in a sensible mix with modern technology coupled with a strong research base to establish the nutritional and other values of indigenous foods and wild edibles along with the accompanying forward linkages, therefore, forms the major mandate of NESFAS.

Working with 41 indigenous communities in the North East, NESFAS works to bring about an intercultural and intergenerational exchange to ensure continuity through its School Garden projects, the Agrobiodiversity walks by school children and community members and through food festivals, biodiversity fairs where seed exchanges take place. Earth Markets and “Mei Ramew Cafes” have become a major attraction. All these activities inculcate a sense of pride and ownership of the indigenous food systems, rich cultural and traditional heritage of the communities. The ‘Chef’s Alliance’ plays a pivotal

role in weaning consumers towards foods produced from farming systems based on agrobiodiversity.

Biomass conversion through composting techniques has been a major activity of NESFAS in its effort not only to play a role in carbon sequestration and climate change management, but also in increasing the soil organic matter and carbon while increasing the soil porosity, water holding capacity and general health of soils and ultimately increasing productivity.

V. GEETHALAKSHMI

Professor, Department of Agronomy, Tamil Nadu Agricultural University, Agricultural College and Research Institute, Madurai, Tamil Nadu, India

It is projected that, to meet the requirement of growing population, 14 % more food needs to be produced by 2050. However, due to over exploitation of natural resources, a level in food grain production has been reached and currently the research is focused on breaking the barrier to increase the yield. In addition to this, agricultural production is expected to be negatively impacted by climate change, especially with more frequent extreme weather events; food production on an average is expected to be decreased by 2% by 2050, leaving a gap of around 16% in meeting food requirement. The agricultural system of today is neither taking care of the environment (24% of GHG emission is from agriculture and it is the major user of fresh water) nor the nutritional needs of the people (almost one fourth of the people suffer from micronutrient, vitamins and mineral deficiencies or affected with obese).

One best management option is improving the agricultural biodiversity with environmental protection, through diversity in crops, trees and livestock that can build resilience within livelihood systems and improve food and nutrition security. The future food supply depends on the exploitation of genetic diversity for crop and animal improvement. There is need to explore the possibilities for using the locally adapted crop varieties for breeding climate-tolerant, with high nutritive value, and to improve ecosystem health by their reduced needs for pesticides and fertilizers. Management options such as organic farming to improve the soil health and ensuring environmental safety, weather based farming decision to reduce the over use of inputs and increasing the production levels by right decisions could be encouraged. Pest and disease management is one of the key issues in the changing climatic conditions as host-pest interactions will change and may need a set new management approach. Diversity at farm level through Integrated Farming System will give an opportunity to recycle the waste from one component as resource for another component, at the same time ensuring round the year employment, increased farm income and balanced nutrition to the farm family.

B. DANDIN

Liaison Officer, Project Office, Bioversity International, Bengaluru and Former Vice-Chancellor, UHS Bagalkot.

MAINSTREAMING NEGLECTED AND UNDERUTILIZED SPECIES FOR NUTRITION, FOOD SECURITY AND CLIMATE RESILIENCE

The relation between man, crops and food habits is as old as civilization itself J. R. Harlan (1975). Selection of crops and refinement of cultivation practices in harmony with the nature continued till the dawn of the 19th century and crops being cultivated were perpetuated to meet the diverse requirements of humankind. However, ever increasing population on the planet has resulted in cultivation of few crops over a larger area with external inputs, or what has come to be referred to as the Green Revolution. No doubt, this system successfully addressed the issue of food insecurity, but at the same time it has resulted in irreversible changes to soil health, environment degradation and large scale loss of biodiversity. Because of fast shrinkage of crop diversity and in turn food basket, hunger, food insecurity and malnutrition besides, the micronutrient deficiencies are becoming the major problems especially in Asia and the Pacific region. Globally, only four crops namely rice, wheat, maize and potato alone account for 60 per cent of human energy supply compared to the past, where about 103 crops use to provide up to 90 per cent of the calories in the human diet. Agrobiodiversity offers huge potential to address malnutrition and agricultural sustainability. Considering the importance of agrobiodiversity in overcoming the dual problems of under and malnutrition and climate change, global organizations like FAO, Bioversity International, WHO etc., have taken a lead in this direction and several consultations have been initiated across the world. The primary scoping and identification of suitable underutilized crops based on the set criteria that emerged from one such expert consultation arranged at Bangkok in Dec 2016 by FAO are presented here.

VIDHYA DAS

Joint Director, Agragamee, Kashipur, Rayagada dist., Odisha

RESTORING TRADITIONAL FOOD SYSTEMS: EFFORTS WITH TRIBAL FARMERS IN SOUTH ODISHA

Traditional land management of tribal communities has had the double advantage of sustaining the rich bio-diversity of these regions, as well as providing a varied and nutritious diet for tribal communities. Over the last few decades, however, tribal ecosystems have suffered much devastation and denudation due to various socio-economic factors and climate change. Tribal farmers are increasingly moving away from traditional systems, and taking up commercial cropping including cotton, eucalyptus, etc. This has affected their nutritional levels, and also endangered the biodiversity that tribal

communities have preserved for generations. Agragamee has sought to address this at several levels through training, eco-village development, as well as through developing eco-logical farming practices for demonstration to the farmers.

These have had far reaching impact, helping farmers understand eco-system principles, and get back to cultivation of traditional crops without the ecological destruction. The process was difficult, as there was little precedent to follow. Just as challenging, if not more has also been the changing of farmers' minds, and helping them understand that traditional crops are better than the current norm of having commercial monocrops everywhere.

The success in these efforts has made a visible impact on farmers' lives, and is also helping to change the eco-system in underdeveloped districts of Koraput and Rayagada in Odisha.

G N HARIHARAN

Director, Biotechnology, M S Swaminathan Research Foundation, Chennai

GENETIC GARDEN OF NATURALLY BIOFORTIFIED CROPS TO COMPLEMENT FARMING SYSTEMS FOR NUTRITION (FSN) TO ADDRESS HIDDEN HUNGER

In India, iron, iodine, vitamin A and D, folate, zinc, and selenium deficiencies are among the most common micronutrient deficiencies. While FAO recommends diet supplements and food-based approaches to eradicate micro nutrient malnutrition, it highlights that in the long-term, food based approaches are more likely to be sustainable.

Edible plants serve as the largest supplier of human nutritive elements and minerals. There are over 20,000 species of edible plants in the world yet fewer than 20 species now provide 90% of our food. However, there are hundreds of less well known edible plants all around the world that are both delicious and nutritious. All these plants show enormous varietal diversity or genetic diversity. This genetic diversity serves as a pathway for plant populations to adapt to changing environments. With more genetic variation these nutrient rich plants add additional nutrients, taste, flavour and colour, and improve the overall value of the food. The narrowing of diversity in crop species contributing to the world's food supplies is a potential threat to food and nutrition security The development of sedentary agricultural societies and further rise of modern agriculture have led to a decline in the total number of plant species on which humans depend for food, particularly the wild, semi-domesticated, and cultivated vegetables and fruits, spices, and other food plants that historically supplemented the staple crops and provided micronutrients thereby strengthening food security.

Genetic Gardens of Biofortified Plants in different locations that collect, conserve and multiply locally adapted varieties of naturally nutri-dense, biofortified plants can be a solution to address this problem. The genetic gardens should have the following functional values.

1. Living germplasm repository to conserve the genetic diversity
2. Provider of elite nutri-rich germplasm to the farming community for augmenting the farming system to be nutrition sensitive.

3. Facility to create awareness to collect, conserve, cultivate, consume and commercialize biofortified plants

Success of a Farming Systems approach to address malnutrition requires the support of a grid of such gardens.

E.D. ISRAEL OLIVER KING

Director In charge, M S Swaminathan Research Foundation Regional Centre, Jeypore, Koraput dist., Odisha

LINKING AGRO BIODIVERSITY AND FARMING SYSTEMS FOR NUTRITION – OPPORTUNITIES AND CHALLENGES IN SMALL HOLDER'S CONTEXT

Agrobiodiversity improves productivity and makes agriculture more resilient, sustainable and reduces climate risks. They provide diverse, healthy and nutritious diets and improve rural livelihoods. Agro-biodiversity is a key source of food, nutritional and livelihood security of the small and marginal farmers especially in the hilly terrains. In the recent decades, rapid agro-biodiversity loss in these regions, have been limiting their access and affordability to nutri-dense foods. In such hunger hotspots, the M.S. Swaminathan Research Foundation has been facilitating agro biodiversity centric participatory research and development processes through integrating them in Farming systems. The paper discusses the role of Agro biodiversity in small holder system and drivers of agro biodiversity loss and impacts in food systems in hidden hunger hotspots. In addition, methods and best practices adopted in integrating agro biodiversity in farming systems are discussed. The paper elaborates opportunities and challenges in integration of agro biodiversity in farming systems in the context of small holder farmers.

TECHNICAL SESSION III

NUTRITIONISTS' PERSPECTIVE ON FARMING SYSTEM FOR NUTRITION

CHAIR: DR. THINGNGANING LONGVAH

Director in charge, National Institute of Nutrition, Hyderabad

SPEAKERS

DR. ANURA KURPAD

Professor & Head of Physiology and Nutrition, St John's Medical College, Bangalore, India

India is facing a dual burden of nutritionally related health problems, and food quality, rather than quantity is one of the key issues. This topic is now of global relevance as it applies both to the nutritional needs of beneficiary populations across the developing world as well as to the nutritional quality of commodities currently available to meet the needs of human health through the human lifecycle. Many recent meetings of international organizations are beginning to address these issues. For example, the FAO released a Dietary Protein Quality Evaluation Report in 2011, which was a prelude to the 2012 WHO technical note on foods for the management of moderate acute malnutrition in children.

While concerns about the quantity of diet (in energy terms) are being addressed through the National Food Security Act (2013), the uncertainty over the quality of diet that will be provided, does potentially impact the nation's health, economy, agriculture and nutrient security. India has moved to a position of self-sufficiency in the production of cereal food grains. Millets and pulses on the other hand, have registered only a modest increase, such that the availability of millets and pulses has almost halved since 1950. It is therefore not altogether surprising that India, which has successfully aimed at food and grain security, has now to face the challenge of improving the quality of thegrains and foods it produces. This particularly centres on the production, selection and distribution of pulses and millets, along with green and coloured vegetables. A farming system for nutrition particularly impinges on three critical areas of public health and nutrition in India. These are 1) the persistence of a high proportion of low birth weight babies, and the relatively high proportion of stunted and underweight children, with implications for immediate and future morbidity and mortality, 2) the persistence of anaemia and

micronutrient deficiencies, with respect to iron and vitamin A, and 3) the large-scale increase in non-communicable metabolic disease, particularly diabetes.

From a nutritionist's perspective, food quality should have at least 2 domains: the density of nutrients in the food, and their bioavailability (including the amount of anti-nutritional substances). Research in agriculture usually does not address these domains, and such an integration will be very useful. From the perspective of public health, quality food production must be linked to its availability and consumption – this requires serious thought. Finally, from a more holistic appraisal, addressing the factors that reduce quality food consumption, like poverty and education, and the factors that increase nutrient demand, like an unsanitary environment, must go hand in hand with the foregoing considerations.

INDIRA CHAKRAVARTY

Chief Adviser, Public Health Engineering Department, Government of West Bengal

IMPACT OF AGRICULTURAL AND HORTICULTURAL INPUTS ON NUTRITIONAL STATUS OF COMMUNITIES

Two studies on impact of Agriculture and Horticulture on nutritional status are shared in the paper.

The first study, supported by the Planning Commission, Government of India, covers the impact of mono and multiple cropping patterns on health and nutritional status. The study was conducted in four villages, viz. Banbhanda, Bamnidih, Hanspur and Barrah of two blocks viz. Balarampur and Barabazar in Purulia district in West Bengal. The parameters were nutritional status of children (anthropometric and clinical estimations); Immunization; Vitamin A Prophylaxis; Morbidity profile etc. The study indicated that the cropping pattern did not have a significant impact on the nutritional status. Other compounding factors may have had an impact.

The second study supported by FAO of the United Nations, assessed the impact of horticultural input through home gardening covering 1500 households in Balarampur, Hura and Barabazar blocks of the same district on the vitamin A status of the community. A central nursery was first created for providing support for seed, seedlings, fertilizers etc. to the households. The parameters assessed were GLV cultivation and intake; Vitamin A (Bitot Spot and night blindness); KAP of community etc. The study indicated that selective horticultural input along with other health interventions help to alleviate micronutrient malnutrition like Vitamin A deficiency.

Subsequently a food processing unit was created which lead to a huge success of the project, with involvement of CADC. Nearly 110 acres of orchard farming was initiated on fallow land to support the food processing unit.

MAHTAB S. BAMJI

Director Grade Scientist (Retd.), National Institute of Nutrition and INSA Hon. Scientist, Dangoria Charitable Trust, Hyderabad.

Agriculture is often viewed for income, and export of farm produce. The importance of agriculture for ensuring food security (except perhaps calories and proteins) is missed. Food security enshrines access at affordable cost to all food groups, at all times and for all individuals to ensure a balanced diet. Balanced diet should provide the right blend of energy, protein and micronutrients, viz. vitamins and minerals. Country-wide diet surveys done by the National Nutrition Monitoring Bureau (NNMB) and others point to gross inadequacy of micronutrients (the hidden hunger) in Indian diets which are cereal based with inadequate intake of legumes (pulses), vegetables and fruits, and animal products. Protein requirement is often met if calorie requirement is met, but calorie adequacy does not ensure micronutrient sufficiency. Protein quality is also an issue. Nutritious millets (besides pulses) have missed the green revolution. With policies like subsidised rice through public distribution system, millet eaters have shifted to rice which is less micronutrient dense than millets.

The problem of micronutrient deficiencies can be remedied through medicinal supplements, food fortification or food-food fortification- dietary diversification. All three have a place depending on the need and situation. But dietary diversification through a farm- based approach is more sustainable, and empowering if properly implemented.

For the past, several years, the Dangoria Charitable Trust has tried to promote nutritionally sensitive and environmentally sustainable farming system in select villages of Medak district (Telangana) by persuading farmers to divert small plots of land from traditional paddy and sugar cane, to growing micronutrient-rich vegetables and fruits, besides pulses and millets, using green methods of farming. Emphasis is on home consumption particularly by women and children. Household diet surveys, show marked improvement in the consumption of green leafy vegetables, but not other vegetables, since home grown produce replaces what would be purchased from the market. 25-50% vegetables are sold since income is important. However, while non-participating households show decline in consumption of vegetables over time, participating households are shielded against rise in market price of most vegetables.

Small backyard poultry (4-5 birds) with high egg yielding breeds (farmers pay for the birds), showed significant improvement in household consumption of eggs. Few eggs produced are generally consumed at home. To ensure food security, economic security is also important. Otherwise home-grown, protective food will be marketed rather than consumed.

DR LALITA BHATTACHARJEE

Senior Nutritionist, Meeting the Undernutrition Challenge Programme (MUCH), Food and Agricultural Organization of the United Nations (FAO), Dhaka, Bangladesh

FAO LESSONS LEARNED FROM FOOD BASED NUTRITION STRATEGIES

Integrated farming systems to improve food and nutrition security have been implemented as part of food based nutrition strategies in Asia. These have been large scale, offering lessons in multi sectoral, community-based nutrition programming. The programmes have had nutrition or nutrition-related objectives, spanning a range of outcomes from reducing the prevalence of malnutrition or improving household food security and dietary diversity and infant and young child feeding.

FAO projects in Bangladesh, Lao PDR and elsewhere provide evidence of the ability of integrated food systems to contribute to nutritional gains. The projects used existing institutional arrangements and mechanisms with planning at sub national and community levels linked to policy support. Multiple strategies were used related to the production, acquisition and utilization of foods aiming to diversify diets and meet household nutrient needs focusing on the first 1000 days of life. Efforts were directed towards creating an environment of food production for consumption and equipping farmers with the knowledge, technologies and skills to grow process and prepare healthy foods for nutrition and income.

Integrated home gardens included horticulture, fish ponds and backyard poultry; community-based nutrition education, training and cooking demonstration for improved dietary intake of a variety of foods by households, women and children, increase in protein and micronutrient intake to impact on women's chronic energy deficiency and children's nutritional status.

In Laos, household and children's dietary diversity improved with decline in rates of children's underweight from 23% to 15.9% over an 18- month period. In the Bangladesh projects over 60% of the households practiced appropriate infant and young child feeding as compared to 1/3 of non-project areas. Child nutritional status showed underweight declining from 30.6% % to 23.9% during a three-year period.

To create an enabling environment for nutrition sensitive programming there is need to adapt current international nutrition recommendations into national policies and guidelines.

TECHNICAL SESSION IV

ROLE OF TECHNOLOGY IN FARMING SYSTEM FOR NUTRITION

CHAIR: S.R. RAO

Advisor, Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi

Department of Biotechnology, as early as 1998, recognized the importance of genetics and breeding of crops including application of new biotechnology tools and techniques in enhancing the nutrition value of agriculture crops and their importance in public health. The introduction of golden rice in India for research purposes to develop Indian lines with high carotenoid content was the initial project to be started at 3 institutions (IARI, New Delhi; ICAR-IRRI, Hyderabad; and TNAU, Coimbatore) aiming at introgression breeding in local varieties with elite events. Following this initiative, DBT launched major multi-institutional programmes for screening the germplasm and marker assisted breeding of rice, wheat and maize and millets for high zinc, iron and protein content. These projects were funded for long period of 15 years. The International Bio-fortification Programme sponsored by Bill Gates and Melinda Foundation launched in 2004 had synergistic effect with the efforts of DBT.

As a result, today, improved inbreds of maize containing high protein and kernel β-carotene ranging from 8.6 to 17.5 µg/g have been developed. Hybrids developed showed enhanced kernel β-carotene as high as 21.7 µg/g, compared to 2.6 µg/g in the original hybrid. Rice with zinc levels 22-24 ppm compared to 8-20 ppm in normal rice lines was developed and released in Chhattisgarh by State Agriculture University to 2000 farmers for cultivating for production of value added products such as popped rice and rice flakes. Bread wheat and durum wheat genotypes with high yield and high micronutrient concentration in optimum soil zinc have been developed. Projects have also been funded jointly with other National and International agencies in sorghum, pearl millet, foxtail millet and finger millet to develop high Zinc and Iron level containing varieties/hybrids simultaneously addressing level phytate limiting bioavailability. Today, validating the nutrient levels and yield performance for varietal registration and release for cultivation is routinely handled with expertise in NARS of India.

It is understood that globally 2- 3 bio-fortified crop varieties are being released for cultivation every year. So far bio-fortified crops have been released in 27 countries (18 in Africa, 4 in Asia, 4 in LAC) and are under testing in 43 countries for Vitamin A, Iron and Zinc. Banana, Lentil Cowpea and Potato are also target crops for bio-fortification. Marker assisted breeding integrated with conventional breeding is normally employed technology. The progress has been slow in golden rice, Vitamin A rich banana etc., due to ambiguity in commercialisation of genetically engineered crops and public perception issues. New plant breeding technologies including genome editing of plants, cis-genics, and other site directed nucleases; genomics based plant breeding technologies are currently employed for altering or modification of nutrients levels. There are also technological and policy challenges for realising the success of bio-fortification programmes on a large scale.

SPEAKERS

VILAS A. TONAPI

**Director, ICAR-Indian Institute of Millets Research,
(Indian Council of Agricultural Research)
Rajendarnagar, Hyderabad**

MILLETS AS HARBINGERS OF FARMING SYSTEM REVOLUTION IN DRYLANDS FOR NUTRITION SECURITY

The linkages between agriculture and nutrition are well known from ancient times. But the paradox of high economic growth accompanied by a much slower decline in undernutrition in India is well recognized. A large population particularly in rural areas continues to suffer from hidden hunger, i.e., micronutrient deficiency and protein-energy malnutrition. Millets also termed as Nutri-cereals, contribute substantially to food and nutrition security and are highly nutritious. To address nutrition security of the country's population, it is very much important to address most critical components of value chain development through focused programmes and R&D. Further it is an ideal case if beneficiary with agriculture–nutrition linkages can value add the output for various stakeholders. Accordingly, an operational research programme is needed to be conceptualized and implemented with integration of agriculture, health and nutrition, to address undernutrition in the country.

Technology led interventions in millets can lead the way to provide both food and nutrition security across drylands. The interventions for nutri-cereals will go a long way in establishing nutrition security across India through millets which are powerhouse of nutrition and are climate resilient smart crops. Millet cultivation is the chief support of rainfed farming that provides food, feed, fodder and fuel, hence known for whole plant utilization. They are either grown as pure crop or intercropped with pulses and oilseed crops. Such a farm is a composite and nutrient-packed farm. Despite these attributes millets have lost their importance in terms of both production and consumption in India mainly due to patronage given to fine cereals rice and wheat in production, procurement and distribution systems. As seeds for millet revolution have been sown in the country, apart from technology intervention, following policy interventions are most essential:

1. Incentives for nutri-cereals farming systems for cultivating millets.
2. Support for creation of millets FPOs.
3. Farm gate processing support
4. Provision of small ware housing for storage for clusters after creating FPOs.
5. Incentivizing millet value chains for linking farmers to markets.

ASHISH WELE

Independent Corporate Consultant, Debrecen Hungary
(Former Consultant, Asia Strategic Alliances, HarvestPlus Washington D C and Ex-President Niirmal Seeds)

BRIDGING THE GAP BETWEEN AGRICULTURE AND HUMAN HEALTH: BIOFORTIFIED PEARL MILLET – AN INDIAN SUCCESS STORY

Micronutrient deficiencies, known as hidden hunger, are caused by a lack of dietary vitamins and minerals, afflicting more than two billion individuals globally. Their effects can be devastating to both children and adults, leading to mental impairment, poor health, lower productivity, and death, and perpetuating cycles of poverty, food insecurity and undernourishment. While there are multiple interventions that effectively fight against micronutrient deficiencies, most do not consistently reach the rural poor in developing countries who are most deeply affected by this problem.

Biofortification, the process of breeding nutrients into food crops, provides a sustainable, cost-effective strategy for delivering micronutrients to rural populations in developing countries. HarvestPlus is the global technical leader in implementing a new strategy—biofortification—to help overcome malnutrition. Its mission is to increase micronutrient uptake among those bearing the highest burden of micronutrient deficiency, i.e., the rural poor. Biofortified food crops represent a unique opportunity to put a solution directly into the hands of smallholder farmers and rural consumers, creating a local, sustainable, resilient capacity to improve food security and nutrition.

Unlike the continual financial outlays required for traditional supplementation and fortification pro¬grams, a one-time investment in plant breeding can yield micronutrient-rich plants for farmers to grow around the world for years to come. It is this multiplier aspect of biofortification across time and distance that makes it so cost-effective. Poor farmers grow modern varieties of crops developed by agricultural research centers supported by the Con-sultative Group on International Agricultural Research (CGIAR) and by national agricultural research and extension systems (NARES), and disseminated by nongovernmental organizations (NGOs) and govern¬ment extension agencies. The biofortification strategy seeks to put the micronutrient-dense trait in the most profitable, highest-yielding varieties targeted to farmers and to place these traits in as many released varieties as is feasible. Moreover, marketed surpluses of these crops make their way into retail outlets, reaching consumers in both rural and urban areas.

For biofortification to be successful, three broad questions must be addressed:

1. Can breeding increase the micronutrient density in food staples in high-yielding backgrounds to reach target levels that will have a measurable and significant impact on nutritional status?

Conventionally-bred biofortified crops have been released in 30 countries globally and are in multi-location testing in 55 countries. Importantly, each crop is competitive with comparable non-biofortified varieties (high yield, pest/disease resistant, climate smart, price) to appeal to farmers and consumers. Many biofortified varieties, developed by HarvestPlus, have met agronomic requirements and have been released since 2011.

These varieties provide a regular, safe source of vitamin A, iron and/or zinc—three micronutrients considered essential to human health by WHO.

2. When consumed under controlled conditions, will the extra nutrients bred into the food staples be bio¬available and absorbed at sufficient levels to improve micronutrient status?

Results of efficacy trials have been published or presented at conferences establishing the efficacy of high iron beans and pearl millet, and high provitamin A sweet potato, maize, and cassava. Several efficacy trials are in process for high zinc wheat and pearl millet; an efficacy trial for high zinc rice is being planned. Bioavailability studies for cassava, maize, and rice have shown provitamin A to be much more bioavailable in staple foods than in fruits and vegetables.

3. Will farmers grow the biofortified varieties and will consumers buy and eat them in sufficient quantities?

Since 2011, HarvestPlus and its partners have delivered biofortified crops to more than 2 million farming households in Uganda, Rwanda, DRC, Zambia, Nigeria, India, and Bangladesh—focusing on staple foods most widely grown and consumed in these countries. Operational research also shows that farmers, consumers, and policymakers will adopt biofortified crops.

For biofortication to become mainstreamed as a core activity of a range of global institutions, it is necessary eventually that:

- Consumers demand high mineral and vitamin content in their staple foods;
- A wide range of national and international public officials recognize the significant impact of biofortification for improving and sustaining public health, and the high economic return to investments in biofortification
- Agricultural research, public and private, include high mineral and vitamin content as core plant breeding objectives; varietal release committee make minimum levels of minerals and vitamins a requirement for approval for release – in addition to the standard agronomic traits such as high yield.

TECHNICAL SESSION V

BRIDGING THE GAPS

CHAIR: INDIRA CHAKRAVARTY

Chief Adviser, Public Health Engineering Department, Government of West Bengal

SPEAKERS

RAMA NARAYANAN

Consultant, Community Nutrition

BUILDING COMMUNITY UNDERSTANDING ON NUTRITION SENSITIVE AGRICULTURE FOR SUSTAINABILITY

Sensitizing the community to existing nutritional condition along with the opportunities available for dietary mitigation through locally available seasonal varieties of foods is key to linking nutrition with agriculture. Enlarging the household food basket through changes or innovations in the production and consumption patterns poses several challenges namely technical, social, economic, environmental and political. All of these need to be addressed holistically to find effective solutions to nutritional problems. The facilitator who engages with the community cannot be a mere technocrat. The role of the facilitator is to help the community to examine the traditional and modern scientific knowledge to addressing nutritional problems in the context of existing social realities and to form strategies for overcoming the same.

The extension approach builds the capacity of the community through imparting scientific and technical knowledge. In the developmental approach besides scientific knowledge, the capacity of the communities are built towards problem solving. In this approach community members are helped in reflective action - set priorities in working towards a 'malnutrition free' state, identify bottlenecks, form and carry out strategies and examine the progress in the light of their goals.

In the long run, nutritional problems are addressed through improved household food production with the judicious use of natural resources along with a demand and utilization of available Government entitlements. This involves collective action by the community as a whole. The community is not a homogenous entity and is divided on the lines of class, caste and gender. Participation of both men and women as well as all sections of the population in addressing nutritional concerns is essential to a problem-

solving approach. In moving towards nutrition security, community action may go well beyond the boundaries of the village to the larger world outside.

NITYA RAO

Professor Gender and Development, School of International Development, University of East Anglia, Norwich, UK

GENDERED TIME, SEASONALITY AND NUTRITION: INSIGHTS FROM TWO INDIAN DISTRICTS

Considerable attention is placed on women's work in nutritional studies, given women's central role in reproduction – child-bearing, child-care and child-rearing. Similarly, employment data indicates women's high work participation in agriculture, a phenomenon referred to as the feminisation of agriculture, albeit as labourers and family workers, rather than independent cultivators. This paper points to the ways in which gender, in particular, women's work, mediates the links between agriculture and nutrition. Women, however, are not a homogenous category, and their social identity shapes their agency vis-à-vis their men and other external actors, as well as the tensions and trade-offs inherent in these linkages. The paper argues that unless we recognise the ways in which gender and social identity mediates work patterns across farming systems, time use, decision-making and access to services, we will not be able to adequately support differently positioned women, across farming systems, in attaining satisfactory nutritional outcomes.

GOPI RAMASAMY

Country Director, Centre for Agriculture and Biosciences International (CABI), New Delhi

GENDERED TIME, SEASONALITY AND NUTRITION: INSIGHTS FROM TWO INDIAN DISTRICTS

Nearly 1 billion people go hungry every day. At the same time, an estimated 30-40% of crop production is lost each year to pests and diseases. Reducing crop losses by just 1% could go a long way in closing this gap. CABI helps smallholder farmers to improve their crop yields, tackle pests and diseases and find safer alternatives to pesticides. By promoting integrated solutions, we improve access and encourage efficient and effective use of inputs, promote good agricultural practices, address trade barriers and connect farmers with markets.With more than 100 years' experience of promoting best practice in agriculturaldevelopment and a member base of 48 member countries and operations

in over 70 countries, CABI has been on the forefront to make a difference towards global issues like food securityand environmental protection.

As communication and transport connect the world, regional issues can become global challenges, making it imperative that we share scientific innovation, technology and information. Our Flagship programme – Plantwise has till date reached 4.5 million farmers globally with practical plant health information through its Plant Clinics.CABI India alsoserves as the hub for severalICT backed initiatives globally including the Direct2Farm programme wherein over 450000 farmers accessed the service for their daily information needs. Several smaller initiatives including the mKisan, Café Móvel, e-Zaraatand Kitchen Garden Skills project have shown strong impacts. CABI-led consortium was also appointed as the global content provider to the mNutrition initiative – a DFID funded project that aims to improve the nutritional status of more than three million people in 14 countries in South Asia and sub-Saharan Africa. Under the programme, country specific content frameworks have been developed to pinpoint the key nutritional issues, interventions, crops and livestock that can be supported through mobile messaging. CABI also hosts the secretariat for Global Open Data for Agriculture and Nutrition (GODAN) since 2014.

RAM RAJASEKHARAN

Director, Central Food Technological Research Institute (CFTRI), Council of Scientific and Industrial Research (CSIR), Mysore

INTEGRATED RICE PROCESSING IS THE FUTURE OF FOOD AND NUTRITION SECURITY

Our country produces about 125 Million tonnes of paddy annually. This grain, which is the staple food of millions, is milled in over a hundred thousand modern mills spread across the nation. The mill owners and more importantly the mill mechanics are not formally trained but have gained knowledge by virtue of their “on-the-job” experience. Thus, there is a strong and urgent need to set up a Centre to formally train them in this segment. There is a need for the trained manpower. In this scenario, it has been decided to set up a Global Centre for Rice Processing Technology at CSIR-CFTRI. This would establish the missing but vital link between the milling sector and academia and bring about the much-needed synergy between them. This would not only be the Centre of Excellence for capacity building but also serve as a research centre for the stakeholders to get their problems addressed. A competent milling sector would go a long way in making our country stronger and self-sufficient. Further, the by-product (rice bran) utilization may also be integrated as a part of the mill to build the nutritional security. Rice bran oil, oryzanols, plant proteins, dietary fibre and glycemic index modulator are the products envisaged in the rice mills. The integrated milling approach will ensure the future of food and nutrition security of our nation.

AVINASH UPADHYAY

Deputy Director-Programs, Digital Green Foundation, New Delhi

DIGITAL GREEN APPROACH TO IMPROVE NUTRITION SENSITIVE AGRICULTURE

Digital Green, a non-profit organization uses information communications technology (ICT) with women's and farmers' groups to strengthen agriculture extension. The Digital Green approach for agriculture involves (a) participatory identification of content and local production of low cost videos to improve agriculture practices; (b) group discussion that uses the videos as a basis for mediated instruction, where a mediator encourages the audience to discuss the video content; and c) follow-up home visits to support and monitor the adoption of the practices or behaviors being promoted through the videos. Digital Green's approach has shown an increase in the adoption of improved agricultural practices by seven-fold compared with the traditional extension approach. On-cost per adoption basis, the method is ten times more effective per dollar spent than the classical extension systems. Digital Green adapted its ICT based agriculture extension platform for improving nutritional outcomes and address the adverse consequences of maternal and child undernutrition. The challenge was the absence of robust evidence on how agriculture programs improve nutritional outcomes. The early results revealed that the acceptability of human mediated nutrition videos among women group members and front line health workers is strong and the medium is valued by the community members. The approach benefits from high levels of trust, belief and enthusiasm and behavior change is taking place, the difficulty was to concretely confirm to what extent this is occurring due to challenges in verification of adoption of nutrition behaviors.

The talk will share this experience on how Digital Green's video based participatory agriculture-extension approach is working through women groups for improving women's' nutritional knowledge and outcomes.

CONCLUDING SESSION

POLICY SUPPORT REQUIRED FOR FARMING SYSTEM FOR NUTRITION

CHAIR: M.S. SWAMINATHAN

Founder Chairman, MSSRF

SPEAKERS

RASHA YOUSEF OMAR

Country Director, The International Fund for Agricultural Development (IFAD), New Delhi

About IFAD and its commitment to SDG 2 and UN Nutrition Decade for Action on Nutrition- "Improving the nutritional level of the poorest populations in developing countries" is a principal objective of the Agreement Establishing IFAD. To achieve this, IFAD seeks to combine solid technical knowledge, robust partnerships for policy engagement, with the provision of loans and grants to leverage and improve the effectiveness of national investments in nutrition-sensitive agriculture. More specifically, IFAD committed to mainstream nutrition in about half of its loans and grants and in all its country strategies. In this abstract, the terms nutrition-sensitive agriculture (taken in its broader meaning and covering crop, livestock, fisheries and forestry) and farming system for nutrition will be used interchangeably.

Lessons learned from investments in support of nutrition-sensitive agriculture – Currently IFAD supports nutrition sensitive investments across Africa, Asia and Latin America. Lessons derived from the portfolio point to the following 3 key lessons and their policy implications:

Firstly, integrated rural development projects that have addressed food security and nutrition in combination with women empowerment and provision of basic needs such as water, sanitation, improved housing for households and access to primary health, have been the most successful in reducing chronic malnutrition. Hence policies and strategies that promote multi-sectoral coordination between Health, WASH, Agriculture, and Women Empowerment sectors are required to address undernutrition in a significant way.

Secondly, a nutrition lens needs to be applied to the design and implementation of agricultural investments to take into account nutritional outcomes at each stage of the

value chain, for producers and consumers. Two sets of policies and strategies are important here and leverage both production and consumption aspects: promoting diversification and integration among the various components of the farming system; creating a market among both producers and consumers for healthy and nutrient rich foods.

Thirdly and most importantly, women make up a large percentage of the workforce in agriculture and food systems in developing countries. Evidence shows that women's education, social status, health and nutritional status, and control over resources are key factors that influence outcomes on household nutrition, in particular of children. Hence policies and strategies should promote affirmative measures for women formal and informal education, easy access to agriculture and nutrition extension services, and registration of assets such as homestead land and farm land in women's name.

The 3 key messages for policy support to nutrition sensitive agriculture will be further elaborated upon and illustrated with examples during the panel discussion.

K.M. NAGARGOJE

(I.A.S.), Director General, Maharashtra Council of Agricultural Education and Research, Pune

Malnutrition in India is a complex problem. It has socio economic, dietary and cultural determinants. Lack of awareness, biases, and ignorance are also impediments in reducing malnutrition. There appears vicious circle of intergenerational malnutrition which is determined by low BMI mothers of tender age facing early pregnancies and delivering low birth weight babies. These LBW babies continue neglect and lead malnourished status with poor growth indicators as child, adolescent and subsequently adult. This is more pronounced in females because of neglect and social biases. When the large population is adversely affected by malnutrition the generation will be less productive both physically and intellectually for building strong society and nation. The availability, access and choice for right food will certainly help to reduce the gap for requirement of energy, protein and micro nutrients. Farm system is the main source of cereals, pulses, fruits and vegetables, animal products, fish and poultry based foods.

As per NFHS 4 (2015-16), infant mortality rate (IMR) of country is 41 and under 5 mortality rate is 50. Institutional birth proportion is 79%, however interstate variations are there. Children receiving full immunization and Vitamin A supplement is nearly 60 to 62%. Children below 3 years who were breast fed in one hour of birth were 42%. The total children of age 6 to 23 months receiving adequate diet was 9.6%. Under 5 age children who were stunted, wasted and underweight are 38, 21 and 36% respectively.

Consumption surveys in tribal district (Nandurbar) of Maharashtra have revealed 34% gap in consumption of cereals and pulses. The consumption of leafy vegetables as a source of β-carotene is 60% less than the RDA. Hence malnutrition in tribal areas is a unique challenge. The ignorance, less years of schooling and adverse socio-economic factors with inadequate food availability seems important causes for high proportion of malnutrition in our country.

If the Agricultural Universities, State Agriculture Department with strong partnership of farming community take up task of modifying cropping patterns, build concepts in society to grow what children and family members need should be inculcated in society. Kitchen gardens, few poultry birds and fish ponds can add availability of nutritious food for the families. Creating awareness and executing the change should become the main focus of farming system.

M.S. SWAMINATHAN RESEARCH FOUNDATION

3rd Cross Road, Institutional Area, Taramani, Chennai – 600 113, INDIA
Phone: +91-44-2254 2792 (Direct), 2254 1229, 2254 1698, 2254 2698, 2254 2699
E-mail executivedirector@mssrf.res.in
Web: www.mssrf.org