Alliance

National Consultation on

Plant-based Local Food Systems for Health and Nutrition

Proceedings and Recommendations

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of

National Consultation on
Plant-based Local Food Systems for Health and Nutrition

October 22, 2021

Organized by

Alliance of Bioversity International and International Center for Tropical Agriculture (CIAT), India Country Office, New Delhi
Indian Society for Plant Genetic Resources (ISPGR), New Delhi
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad
Trust for Advancement of Agricultural Sciences (TAAS), New Delhi

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Preface

A National Consultation on "Plant-based Local Food Systems for Health and Nutrition" was organized in virtual mode on October 22, 2021. The meeting was organized by the Indian Society of Plant Genetic Resources (ISPGR), New Delhi; Alliance of Bioversity International and International Center for Tropical Agriculture (CIAT), India Country Office, New Delhi under its UN Environment implemented GEF Project; in collaboration with International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, and Trust for Advancement of Agricultural Sciences (TAAS), New Delhi. Purpose of the consultation was to provide a forum to experts and various stakeholders to deliberate on issues related to research and development in the context of local plant-based food systems production and consumption to address nutrition security in the country. The webinar was attended by over 150 participants representing academia, policy-makers, research managers, private sector and non-governmental organizations (NGOs). This document summarizes the deliberations held during the meeting and lists the major recommendations which emerged out of intensive discussions.

The organizers are very grateful to Dr R.S. Paroda, President, ISPGR, and Chairman, TAAS, for conceiving the event, chairing the consultation and sharing his rich experience; and Dr T. Mohapatra, Secretary, Department of Agricultural Research and Education (DARE) & Director General (DG), Indian Council of Agricultural Research (ICAR) for sharing his views as Chief Guest during the inaugural session. Dr Juan Lucas Restrepo, DG, Alliance of Bioversity International and CIAT, and Dr Jacqueline d'Arros Hughes, DG, ICRISAT are gratefully thanked, for their remarks as Guests of Honour. The financial support from the UN Environment GEF Project of the Alliance of Bioversity International and CIAT and ICRISAT in organizing the webinar is sincerely acknowledged. The success of the meeting is equally attributed to intellectual support provided by distinguished Co-Chairs, Speakers, Panellists and Moderators and each one is gratefully acknowledged. We thank all the dignitaries and delegates who participated and contributed in the National Consultation.

All the members of the organizing committee are immensely thanked for their help in smooth conduct of the event. Support provided by the staff of ICAR-National Bureau of Plant Genetic Resources (NBPGR) (Mr V.K. Mandal) and ISPGR (Mr Sunil Bhardwaj and Mr Arup Das) in technical and logistic matters is sincerely appreciated.

Core Organizing Committee

Abbreviations/Acronyms

ABS	Access and Benefit Sharing
AI	Artificial Intelligence
BAIF	Bharatiya Agro Industries Foundation
CBD	Convention on Biological Diversity
CBSS	Community Based Seed System
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CSB	Community Seed Bank
CWR	Crop Wild Relatives
DAC&FW	Department of Agriculture Cooperation and Farmers' Welfare
DARE	Department of Agricultural Research and Education
DDG	Deputy Director General
DG	Director General
DRI	Deendayal Research Institute
FAO	Food and Agriculture Organization of the United Nations
FPO	Farmers Producer Organisation
FSII	Federation of Seed Industry of India
GI	Geographical Indications
GoI	Government of India
GRAVIS	Gramin Vikas Vigyan Samiti
HS	Horticultural Science
IAC	International Automotive Components Groups
ICAR	Indian Council of Agricultural Research
ICMR	Indian Council of Medical Research

ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technology
IFPRI	International Food Policy Research Institute
IIHR	Indian Institute of Horticultural Research
IIMR	Indian Institute of Millets Research
IIPR	Indian Institute of Pulses Research
IoT	Internet of Things
IPR	Intellectual Property Right
ISPGR	Indian Society of Plant Genetic Resources
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MoA&FW	Ministry of Agriculture and Farmers Welfare
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoH&FW	Ministry of Health and Family Welfare
MT	Million ton
NARES	National Agricultural Research and Education System
NARS	National Agricultural Research Systems
NBA	National Biodiversity Authority
NBPGR	National Bureau of Plant Genetic Resources
NEH	North-East Hills
NGB	National Genebank
NGO	Non-Governmental Organization
NIN	National Institute of Nutrition
NP	Nagoya Protocol
NPM	Non-Pestiside based Management
NRCSS	National Research Centre on Seed Spices
NTFP	Non-Timber Forest Products
NW	North-West
ODOFP	One District One Focus Product
PDS	Public Distribution System

PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
PPV&FRA	Protection of Plant Variety and Farmers' Rights Authority
R&D	Research and Development
SAU	State Agricultural University
SDG	Sustainable Development Goals
SSTC	South-South Triangular Cooperation
TAAS	Trust for Advancement of Agricultural Sciences
THAS	Tribal Heritage Agriculture System
UN	United Nations
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Background and Context

The COVID-19 pandemic, in addition to being an unprecedented health crisis, brought to the forefront vulnerability of our society to food insecurity affecting both social and economic dimensions with far-reaching consequences. Health co-morbidities, shortage of food owing to lockdowns as well as shutdown of transport brought spotlight on local food systems that are good for health and nutrition security.

India is bestowed with diverse agro-ecosystems and rich agrobiodiversity. However, major manifestations of agrobiodiversity – cultural, culinary and curative – and consequently the locally adapted food systems are under threat, including indigenous knowledge. Unfortunately, at present, only three crops – rice, maize and wheat – meet nearly 60 per cent of calories required by humans from plant-based food system globally. The pandemic highlighted the fragility of such a uniform food basket, stereotyped food habits and homogenous production and supply chains.

Ideally, food systems should provide the consumers: (i) adequate amount of food, both affordable and accessible; (ii) adequate quality and quantity of macro and micronutrients for good health; (iii) enjoyable, satisfying diets to fulfil cultural needs; and (iv) food produced using sustainable cultivation practices, ensuring future generations to continue producing food locally and at lesser costs.

In the light of the above, there is need to shift spotlight from production/ productivity to nutritional security and associated health benefits. This has been now acknowledged globally. The 2019 'State of the World's Children Report' by UNICEF reveals how a triple burden of under nutrition, micronutrient deficiency, and obesity seriously threatens development of children and economies. Further, the 2018 'Global Nutrition Report' by WHO revealed that India is projected to lose 46 billion USD just on account of malnutrition by 2030. As per Global Health Index by IFPRI, India stands 96th out of 107 countries as 40 per cent of children below 5 years

are undernourished. The 'State of Food Security and Nutrition in the World, 2021' has a tagline "*Transforming food systems for food security, improved nutrition and affordable healthy diets for all*". As rightly pointed out by the Global Panel on Agriculture and Food Systems for Nutrition, poor diet is the world's number one health risk (27%).

Concomitant to economic development, India has witnessed greater dependence on a few cereals in diets and agricultural production systems, thus, resulting in a declining intake of native foods in cuisines that are healthy like millets, pulses, fruits and vegetables. Paradoxically, while malnutrition burden of India continues to be a daunting challenge, on the other hand dietary patterns are changing with rising levels of household incomes resulting in increased obesity. Both the dimensions should, therefore, be kept in mind while designing policies and programs aiming at transition towards sustainable, nutritious, resilient and inclusive local food systems. A Government of India report on 'Food and Nutrition Security Analysis, India, 2019' shows that despite rapid economic growth, declining levels of poverty, enough food even to export, and a multiplicity of government programs, malnutrition amongst the poorest shall remain a high priority to be addressed by the Government.

Post- COVID-19 devastation, wise societies and governments aim to build sustainability into country's agricultural system while producing those foods that are good in quality from a nutritional and health perspective. Need of the hour is to reform India's food systems if we intend to nourish our populace with high quality diets and at the same time protect the environment. Food habits, cultivation and market must, therefore, go back to recognizing the importance of local food systems. However, this requires identifying the core areas of correction, innovation and implementation as well as charting a new sustainable path of action. Out of 17 United Nations Sustainable Development Goals (SDGs), adopted in 2015, goals of no poverty, zero hunger, good health and well-being for people, and responsible consumption and production directly address household food, nutrition and health security. The National Agricultural Research and Education System (NARES) in India must, therefore, reinvent and realign on-going programs to achieve SDGs while laying greater emphasis on local food systems.

Addressing the food systems challenge is going to be multi-disciplinary, multi-modal and multi-layered. However, the action has to begin right now by charting a path with immediate, medium-term and long-term goals. Despite a multitude of public funded programs to address nutrition and health, our progress appears to be unconnected and not advancing at the speed or scale required. Reforming the food systems is

going to be more complex and rather difficult task requiring a clear strategy for "A Decade of Action". It must aim at accelerating sustainable solutions–ranging from crop priorities, cropping systems, traditional cuisine, healthy foods, post-harvest technologies, value chain and the economics.

Objectives of the National Consultation

To address precisely the issues related to plant-based local food systems, the Alliance of Bioversity International and International Center for Tropical Agriculture (CIAT) and the Indian Society of Plant Genetic Resources (ISPGR) in collaboration with International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and ICAR-National Bureau of Plant Genetic Resources (NBPGR), Trust for Advancement of Agricultural Sciences (TAAS) organised a National Consultation on **"Plant-based Local Food Systems for Health and Nutrition"** on October 22, 2021. This virtual event was also a part of the 2nd International Agrobiodiversity Congress, November 15-18, 2021 (www.eatgrowsave.org). The overall aim of the consultation was to identify options and devise an action plan for achieving good health through plant-based local food systems. Specific objectives were to:

- Assess possible options to make our food systems healthy, nutritious, balanced and sustainable,
- Identify opportunities to create diverse value-chains that can promote greater use of plant-based local food systems, and
- Prioritize players and action points for intensifying research on plant-based local food systems.

The meeting was held in three main sessions: (i) Inaugural session to set the context (ii) Thematic presentations by eminent speakers, and (iii) Panel discussion involving experts and stakeholders. The entire proceedings were recorded and the video of recorded proceedings featured as a side event during the 2nd International Agrobiodiversity Congress, held in virtually (https://www.eatgrowsave.org/) during 15-18 November 2021. This document provides an overview of the various sessions and a synthesis of major recommendations that emerged out from the discussions.

Inaugural Session

The inaugural session was Chaired by Dr R.S. Paroda, President, Indian Society of Plant Genetic Resources (ISPGR) and Chairman, Trust for Advancement of Agricultural Sciences (TAAS) and Dr T. Mohapatra, Secretary, Department of Agricultural Research and Education (DARE) & Director General (DG), Indian Council of Agricultural Research (ICAR) was the Chief Guest. Dr Juan Lucas Restrepo, DG, Alliance of Bioversity International and CIAT and Dr Jacqueline d'Arros Hughes, DG, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), were the Guests of Honour. The inaugural session was moderated by Dr Bhag Mal, Secretary, TAAS and Former South Asia Coordinator, Bioversity International.

Dr Anuradha Agrawal, General Secretary, ISPGR and Principal Scientist, ICAR-National Bureau of Plant Genetic Resources (NBPGR), welcomed all the dignitaries and participants on behalf of the organizers and briefly provided the context of the meeting. The consultation was structured into Inaugural Session, Thematic Presentations, Panel Discussion and Concluding Remarks. Giving the background and setting the context, Dr Agrawal emphasized on the importance of plant-based local food systems for health and nutrition and the need for organizing this important expert consultation which was supported by the ICRISAT and UN-GEF Project coordinated by the Alliance of Bioversity International and CIAT. She said that topic of the National Consultation gained greater significance in the COVID-19 situation. In addition to being an unprecedented health crisis, the pandemic has brought to forefront the susceptibility of our society to food insecurity. The shortage of food owing to lockdowns and unavailability of transport due to COVID-19 have necessitated to go for local foods systems. Societies and governments were aiming to build sustainability into agricultural systems, while producing foods that are nutritionally secure, and at same time protecting the environment. The National Consultation was a step in the direction to assess possible options to achieve this, and also seek action points for intensifying research, identify opportunities to create diverse value chains to promote greater use of plant-based local food systems. Actions for reforms in food systems are challenging and need to begin right now by charting

a pathway with short-, medium- and long-term goals.

Guest of Honour, **Dr Juan Lucas Restrepo**, DG, Alliance of Bioversity International and CIAT, thanked the organizers for holding the important consultation. He appreciated the long-standing collaboration between the CGIAR (including the Alliance) and Government of India, national research institutions of ICAR, ISPGR, and others, especially during the 1st International Agrobiodiversity Congress (IAC 2016) and continued association for the 2nd IAC in Nov. 2021. He said that the topic of the Consultation was very important for the Alliance as they strongly believe in the potential of plant-based local food systems to ensure household health and nutrition. He informed that plants make up 80 per cent of the food we eat and produce 98 per cent of the oxygen we breathe. Of course, plants depend also on fresh water availability, healthy soils and complex relationships with beneficial microorganism that inhabit in those soils in order to thrive. All these physical, chemical and living elements interact with each other and form the agricultural ecosystems and this is where the agricultural biodiversity is housed. Loss of this diversity puts at risk the ecosystem functioning and thereby food security. The recent report by FAO on 'State of the Biodiversity for Food and Agriculture' warns that diversity in food production is declining worldwide, including plant diversity, with three major crops providing more than 50 per cent of the world's plant derived calories. In a short span of 48 years (1961 to 2009) human diets have become increasingly homogeneous dominated by these and few other staple crops that are rich in energy but generally poor in micro-nutrients. Hence, current day consumption lacks micro-nutrients which are richly found in foods such as fruits, nuts and seeds and vegetables, especially in the diets of the poor people. Lack of nutrients essential to human health perpetuates malnutrition. Loosing nutrient rich plant varieties also undermines the resilience of our food systems to pests, diseases and climate change. He informed that CGIAR recognizes the importance of plant-based local food systems to address environmental, health and nutritional crisis and is already working to reverse these trends. The Alliance is working with national and local authorities, national research institutions, farmers' and communities to safeguard native crops and local varieties in India by developing nutritional profiling and value chains to promote their use on farm and in the kitchen. He further mentioned that as part of the new 'One CGIAR' strategy, work is being undertaken on developing a new initiative as part of the new prospectus to keep generating knowledge, innovation and support for policy to reduce malnutrition by increasing access to vegetables and fruits for the poor. India is one of the eight centers of origin of cultivated plants with high genetic diversity of at least 172 domesticated species and with

22 different agrobiodiversity hotspots. Preserving this biodiversity on farm and in genebanks is essential to ensure food security, nutrition and future options in the country. India has 45,000 diverse plant species spread over 16 different agro-climatic zones. Research says India is the largest producer of dry beans like legumes and pulses which account for 34 per cent of area and 24 per cent of production, which alone provides adequate raw material for alternate protein products.

Dr Jacqueline d'Arros Hughes, DG, ICRISAT as Guest of Honour in the inaugural session said that the consultation was important as a recent report indicated that India ranked 101 out of 116 in global hunger index, down from 94 in the previous year. The number of people going hungry has increased since 2014. An estimated 821 million people were undernourished in 2017 or every ninth person is undernourished. Over 90 million children under the age of five are dangerously underweight. The prevalence of undernourishment has remained virtually unchanged in the past three years at a level slightly below 11 per cent. This reversal in progress sends a clear warning that urgent action must be taken. Hence, the crisis needs to be acknowledged to work collectively for a solution. Since agriculture and health are intimately connected, the situation is both a crisis and an opportunity. She said that the solution lies in transforming our food systems to ensure safe and nutritious food which is available, accessible and affordable. What is a little more challenging is that we have to start today working to ensure food and nutrition security for a world with approximately 10 billion population in 2050. She said that there are several underutilized species, minor millets and wild species which have high nutritional value and need to be included in our daily diets and mid-day meal scheme for the children. She also suggested to involve the chefs of the big hotels in promoting millet based products so that the use of nutritious diets promoted. ICRISAT has been working on this which is also required at a global level to be kind of movement to mainstream nutricereal in big hotels of the world, and CGIAR system can play important role.

The Chief Guest, **Dr T. Mohapatra**, Secretary, DARE & DG, ICAR in his address said that keeping in view the United Nations Sustainable Development Goals (SDGs), there was urgent need to develop not only sustainable agriculture but also sustainable food systems. For this diversification of diets and production system are needed for meeting the goal of 'Nutrition and Health for all by 2030'. He said that the ICAR and State Agricultural University (SAU) system was already working on many local food systems, wherein >150 horticultural plant species and >20 under-utilized crop species are being researched upon. He said there was need to strike a balance between land devoted to staple foods with that diverted to

growing "nutritional and healthy" species. For this, he suggested critical analysis be carried out, since it involves socio-economic aspects. He urged that awareness needs to be increased for mainstreaming diversified diet systems for better nutritional outcome, which was deeply ingrained in traditional food systems of India in the past. A major requirement to achieve diversified agriculture would be strengthening seed systems for the non-staple crops, which would require both public and private sector to come forward. He also emphasized on the need for scientifically assessing and documenting nutritional status of the local food systems as well as their agro-ecology. Mainstreaming of local foods through adequate marketing would also require attention, besides policy intervention. Currently, the policy narrative and production systems, including market infrastructure, credit facilities, input availability, and extension services, are largely focused on staple grains – rice and wheat. The government needs to shift investment in these arenas to focus on non-staples such as pulses, coarse cereals, fruits, vegetables, meat and fish, which in turn, facilitate diversification of a smallholders farmers, and resulting into higher and more stable incomes. Investment should particularly target pulses and coarse cereals, as they are more resilient to drought stress and also are excellent sources of nutrition. It requires more funding for research, community involvement, processing and value-addition. He drew attention of CGIAR system to have focus on this aspect and allocate suitable funding. He informed that the Hon'ble Prime Minister of India has given a call for 'one district, one product' and 'vocal for local' for a paradigm shift. In view of this, there is need to pay greater attention to research on processing and value addition of local crops and development of biofortified varieties in staple crops. India has already developed ~85 biofortified crop varieties in staple crops to enhance nutrition outcomes. The biofortified crop varieties need to be mainstreamed through policy interventions, public awareness and mid-day meal to school children for addressing the problem of malnutrition.

As the Chair of the inaugural session **Dr R.S. Paroda**, President, ISPGR, and Chairman, TAAS, thanked the Chief Guest and Guests of Honours for their insightful remarks and flagging various important issues that need to be addressed on priority. He informed that when COVID pandemic started in 2020, an open letter was sent to the UN system, from eminent experts comprising academicians (including himself), noble laureates, leaders of the National Agricultural Research Systems (NARS), world food awardees, Padma awardees in which, it was emphasized that time is right that we do not depend on import of food, but give emphasis on local food systems. It was also emphasized that there is need for policy advocacy on urgency to safeguard our local food system,

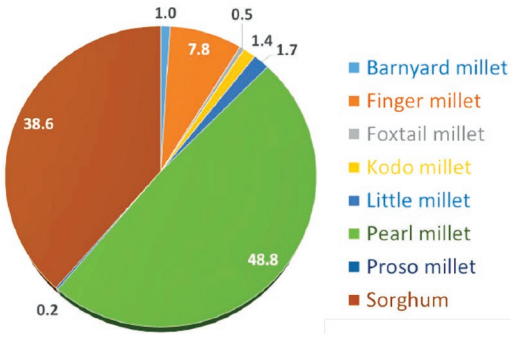
otherwise they will be lost forever. He provided the example of loss of several local species being vanished from drier parts of western India (Rajasthan) which are not found presently. Pearl millet has been replaced with wheat and rice in these areas in the food systems. Many of these local crops have remain neglected in terms of research also. We must think of 'more from less for more' and provide food security for the poor where local food systems play very important role, as they are sustainable and resilient when grown in their niches. Dr Paroda said there is also need for greater thrust on their conservation, exchange and utilization through higher production and consumption around plant-based food system. India has more of vegetarian population and people depend more on plant based protein. There is need for more aggressive approach to lay emphasis on local food system and especially those species which provide us nutrition and immunity. Dr Paroda also urged that to mainstream nutri-cereals, Chefs of big hotels should be involved for developing millet-based menus and recipes. Need of the hour is to reform India's food systems if we intend to nourish our populace with high quality diets and at the same time protect the environment. In fact, access to nutritious foods is lagging, despite increasing demand. While access to cereals in India has increased due to the persistent focus of Green Revolution-era food scarcity policies and staple grains, access to more nutritious in diverse foods is limited. Investment should particularly target pulses and coarse cereals, as they are more resilient to drought stress and also are excellent sources of nutrition. Dr Paroda opined that organizing the expert consultation was very timely and hoped the deliberations would result in some good recommendations and way forward for promoting the plant–based local food systems in India.

Technical Session – Status and Strategies for the Future of Local Food Systems

The technical session was Co-Chaired by **Dr P.L. Gautam** and **Dr A.K. Singh**, and moderated by **Dr Prem Narain Mathur**.

Millets and other Nutricereals

Dr V.A. Tonapi, Director, ICAR-IIMR, Hyderabad, presented the above thematic topic, focusing on strategies that could be put in place to build sustainable future local food system around millets and other nutricereals.



Proportion of area (%) under various millet crops in India

(Source: Estimates from Directorate of Economics and Statistics, Department of Agriculture & Cooperation, Government of India)

Due to reduction in the food basket focused mainly on major crops like wheat, maize, rice and soybean, malnutrition has become a time bomb as many crops cultivated in earlier years have been discontinued. Further, these nutri-cereals are the answer for climate change as they need less water and also have enormous health benefits being rich in complex carbohydrates, micronutrients, fibre and thus useful in overcoming many lifestyle diseases (gluten-allergy, diabetes, stress, cancer, hypertension, obesity etc.). He informed that crops like 'jowar' or sorghum (*Sorghum bicolor*), 'bajra' or pearl millet (*Pennisetum glaucam*), 'ragi' or finger millet (*Eleusine corocana*), 'kangani' or foxtail millet (*Setaria italica*), kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense*), proso millet (*Panicum miliaceum*), barnyard millet (*Echinochloa esculenta*), browntop millet (*Brachiaria ramosa*), teff millet (*Eragrostis tef*), and fonio millet (*Digitaria exilis*) have been the traditional food for 590 million people in Asia and Africa, dating back to about 3000 B.C. The millets map of

States	Millets
Andhra Pradesh	Jowar/Foxtail
Chhattisgarh	Kodo Millet/Kutki
Gujarat	Bajra
Haryana	Bajra
Jharkhand	Jowar/Ragi
Karnataka	Jowar/Ragi
Kerala	Ragi/Little Millet
Madhya Pradesh	Kodo Millet/Kutki
Maharashtra	Ragi/Jowar
North Eastern States	Small Millets
Odisha	Ragi/Little Millet
Punjab	Little Millet/Foxtail Millet/Ragi
Rajasthan	Bajra/Sorghum
Tamil Nadu	Bajra/Small Millets
Telangana	Jowar/Foxtail Millet
Uttarakhand	Ragi/Barnyard Millet
Uttar Pradesh	Bajra
West Bengal	Foxtail Millet/Jowar

Millets diversity map of India (ICAR-IIMR)©

India shows that every state has certain species which are grown in pockets ranging from plains to hilly areas. Dr Tonapi opined that local food systems based mainstreaming of millets could be built into each of these states. An analysis between pre- and post-Green Revolution period shows that area under millets in India decreased by 20 m ha, but productivity increased by 2.5 times, which is how in spite of loss of area India could produce the same amount of grains. Till 1970, millets were 20 per cent of total food grain basket, currently reduced to 6 per cent. India produces >17 mt millets (80% of Asia's and 20% of global production) with an average yield of 1,239 kg/ha, which is little higher than the global yield (1,229 kg/ha). Hence, India' leadership in millet production can help mainstream these crops, especially keeping in view the fact that 2023 is designated as the "International Year of Millets" by the UN General Assembly. At a global level, India contributes to 100 per cent production in kodo, little and barnyard millets, 53 per cent in finger millet, 45 per cent in pearl millet, 7 per cent in sorghum, 2 per cent in foxtail and 1 per cent in proso millet. This shows a need for mainstreaming the policy for production in small millets. He further apprised that the major millets (pearl millet and sorghum) contribute almost about 87 per cent, 8 per cent by ragi and remaining by small millets in terms of area under cultivation in India. Hence, more focus needs to be given to small millets, as they are more nutritious than cereals.

Other nutricereal of importance is 'kuttu' or buckwheat (*Fagopyrum* spp.),

Nutritional value and products of Buckwheat

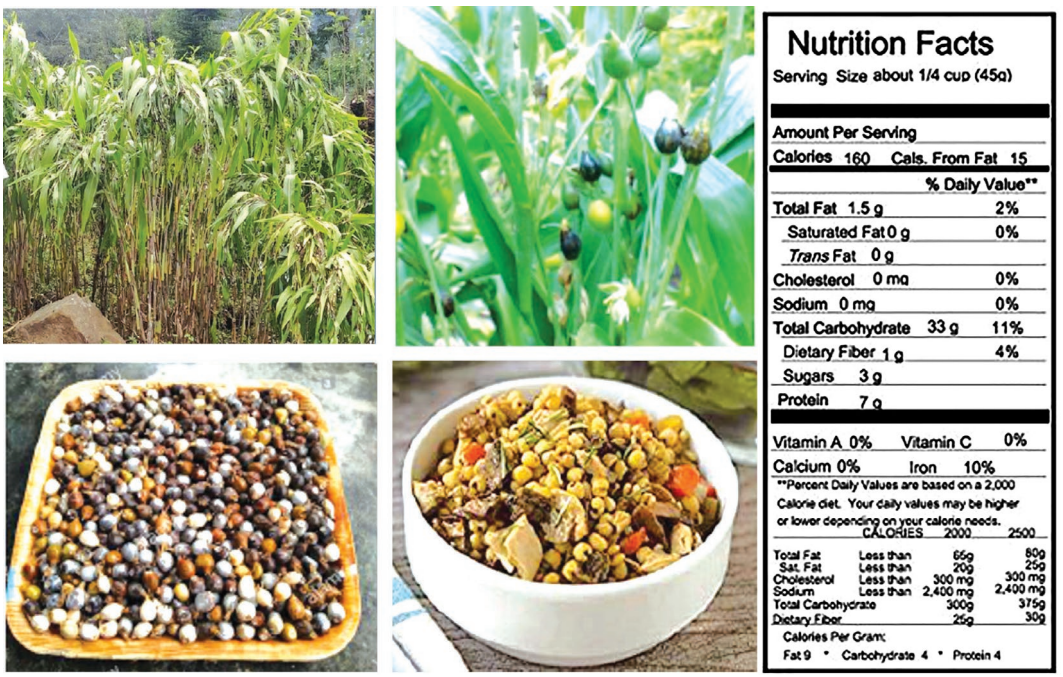
Nutritional value and products of Amaranth

especially for hilly regions of Arunachal Pradesh, high reaches of Himachal Pradesh (Chamba and Bharmour areas) Jammu and Kashmir. These are very important crops in terms of nutrition. There are already efforts to mainstream them through value-addition efforts, but more needs to be done to bring them back into the food plate.

Another important crop that requires attention is 'ramdana' or amaranth (*Amaranthus* spp.) with a huge potential in terms of nutrition, highest level protein, fat and other dietary fibers. It has two important aspects- squalane which is the super antioxidant and second is a very active form of vitamin E (tocotrienol). There is already a landscape available for amaranth cultivation in Uttarakhand, Himachal Pradesh and Gujarat which can be expanded to Karnataka, Tamil Nadu, Maharashtra, Andhra Pradesh and Telangana, where it can be easily mainstreamed because there is already a value-chain available.

Job's tear (*Coix lacryma-jobi*) (also known as adlay millet or tear grass) is another crop which provides high biomass and also the grains which have very high nutraceutical and medicinal properties, besides being good fodder. Some efforts have been made in value addition programs and is a potential species for in mainstreaming.

Dr Tonapi then discussed some of the reasons for decline in area and consumption of the millets and other crops. These include (i) poor policy



Plant, seeds and nutritional value of Job's tear

support for coarse cereals coupled with favourable policies for the cultivation of oilseeds such as sunflower and soybeans and cash crops such as cotton became more profitable, driven by yield increases and higher prices spurred by growing consumer demand; (ii) on the consumption side, in urban areas, an increase in incomes, change in consumer tastes and preferences of fast food chains and ready-to-eat food products, easy availability of rice and wheat on subsidized rates through public distribution system, social status attached to fine cereals; and (iii) extension efforts towards the cultivation of millets were relegated to the background coupled with market failure which led to a failure to capture the nutritive value of millets. However, now concerted efforts are being made to bring nutricereals back in terms of food for all as they can act as a shield against nutritional deficiency and provide for nutritional security overcoming anaemia (iron deficiency), B-complex vitamin deficiency, pellagra (nicotinic and deficiency).

Further, Dr Tonapi said these crops provide better water foot print, better carbon foot print and also security in terms of food, feed, fodder and biofuel (green energy). They are the answer for the Sustainable Development Goals 2, 3, 12 and 13 which address zero hunger, healthy lives, sustainable consumption and climate change. He suggested a seven-step strategic approach related to these crops comprising (i) enhancement of production and productivity; (ii) validating nutrition and health benefits; (iii) value addition processing and recipe development; (iv) entrepreneurship and collective development; (v) awareness creation, especially in terms of branding, labelling and promotion; (vi) international outreach; and (vii) policy interventions for mainstreaming of these crops.

The monoculture system of farming needs to get diversified with millets by increasing research related to evaluation and breeding of the native germplasm and mainstreaming them into crop improvement programs. There is need for promotion of awareness about the importance of biodiversity amongst scientists, students, teachers and general public along with more thrust by government on policies for effective biodiversity conservation, e.g. by giving subsidies to farmers for the alternative crops and old crop cultivars cultivation. Currently, there is enormous policy support for developing and mainstreaming bio-fortified varieties. Instead of bio-fortifying major crops, possibly investing more in these forgotten crops that are already more nutritious would be better. The second green revolution has to happen from the drylands which constitute 48% of the area, by scaling up the recombination breeding, hybrid technology and conservation agriculture.

Dr Tonapi concluded by providing key areas for future strategy. These were (i) More R&D allocation on millets (at least double); (ii) developing a consortium on hybrid millets;

(iii) focus on increasing production and productivity by strong public-private partnership; (iv) South-South collaboration is important especially with Africa, as value chain is totally absent there. The mainstreaming of millets in non-traditional areas like Uttar Pradesh, Punjab, Haryana is desirable, as very high yields are expected based on data of trails by IIMR. Therefore, creating a market around these crops will help to mainstream these millets and a transition of food system will be achieved by creating a snowball effect which would help to address malnutrition. Also a shorter food supply chain which is very important to reduce the carbon foot prints and more focus needs to happen towards urban agriculture not only the millets or nearby local systems but also other crops including horticulture. Scaling up of the innovation requires a political will and good food policy by the government. If consumer feels that he is benefited, these food systems will definitely become under mainstream automatically and dietary diversity would be achieved. Changing the food behavior is a very-difficult task and would require time because changing the peoples' behavior is an important aspect. As the International year of millets (2023) approaches we are getting ready to position millets globally as the staple food in order to improve and change the local food systems also.

Major and Minor Pulses

Dr N.P. Singh, Director, ICAR-IIPR, Kanpur, spoke on the importance of legumes. He drew attention about lack of nutritious food (hidden hunger) especially to children who are either under nourished or obese, coupled with the fact that majority of the people in India are vegetarian and our diets lack minerals and micronutrients. Data indicates that about 800 million people are under-nourished, >50 per cent pregnant women are anaemic, >80 million children (<5 years) suffer from disorders like marasmus and kwasiokar. The food that Indians consume normally consists of cereals eaten with grain legumes (pulses). In India, eight crops are treated as a major grain legumes – chickpea (*Cicer arietinum*), pigeon pea (*Cajanus cajan*), mung bean (*Vigna radiata*), urd bean (*Vigna mungo*), lentil (*Lens culinaris*), peas (*Pisum sativum*), groundnut (*Arachis hypogaea*) and soybean (*Glycine max*), the later two also used for oil besides sources of minerals and proteins. Pulses are grown in India in ~ 26 m ha area, with annual production of 25-26 million t, short of 4-5 million t that is either imported or remains as deficit. While pulses are well-known as being rich sources of protein, but very recently biochemical profiling shows that they are also very rich in minerals particularly iron and zinc that provides opportunity for become integral part of the food. Pulses have some anti-nutritional factors like phytates, lectin, trypsin inhibitor which cause indigestion when consumed in large quantity, but can be overcome by traditional practices like soaking, boiling, sprouting, dehusking, pressure cooking and roasting.

Increase in pulse production in India in the last one decade could be achieved due to good practices like seed hub concept, scaling up of technology and

Current Population of India	~ 1.21 billion
Expected population by 2050	~ 1.69 billion
Current per capita availability	42 g/capita/day
ICMR recommendation	52 g/capita/day
Present demand (@52 g./capita/day)	~28 m t
Present production (2017-20)	23-26 mt
Production of Pulses up to 2010	12-14 mt

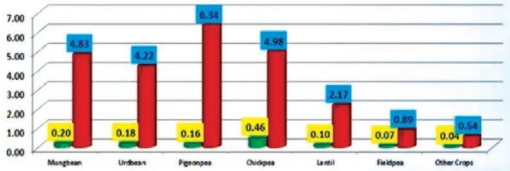
Increasing Trends in pulse production

Crops	Production (m tons)		Increase m. tons (%)
	2014-15	2020-21	
Chickpea	7.33	11.99	+ 4.66 (63.57%)
Pigeonpea	2.81	4.28	+ 1.47 (52.31%)
Mungbean	1.50	3.09	+ 1.59 (106.0%)
Urdbean	1.96	2.38	+ 0.42 (21.4 %)
Lentil	1.04	1.45	+ 0.41 (39.42%)
Total Pulses	17.15	25.72	+ 8.63 (50.32%)

Reduction in Imports of Pulses

Years	Quantity (mt)	Value (Rs: Crore)
2013-14	3.18	11036.75
2014-15	4.58	17062.94
2015-16	5.80	25619.06
2016-17	6.61	28523.18
2017-18	5.67	19052.65
2018-19	2.59	8289.59
2019-20	2.97	10527.35

Quality seed produced & Areas Covered under SHP



Current status of pulse production in India

Varieties Developed by NARS

Crop	No. of varieties
Chickpea	218
Pigeonpea	158
Mungbean	141
Urdbean	83
Lentil	52
Fieldpea	48
Rajmash	16
Cowpea	17
Guar	16
Horsegram	11
Mothbean	07
Lathyrus	04
Total	771

Varieties Developed by IIPR Kanpur

Chickpea (9)	DCP 92-3, Shubhra, IPC 2006-77, IPC 2004-01, IPC 2004-98, IPC 2005-62, IPCK 2004-29, IPC 2010-72(Atal), IPC 2011-112 (Keshav)
Pigeonpea (4)	IPA 203, IPA 206, IPH 15-03 (Hybrid), IPH 09-5 (Hybrid), IPA 15-2
Mungbean (13)	PDM 11, Moti, Samrat, Meha, IPM 02-3, IPM 02-14, IPM 410-3, IPM 205-7, IPM 302-2, IPM 2K 14-9, IPM 312-20, IPM 409-4, IPM 512-1
Urdbean (7)	Basant Bahar, Uttara, IPU 2-43, IPU 07-3, IPU 11-02, IPU 13-1, IPU 10-26
Lentil (12)	Priya, Sheri, Noori, Angoori, IPL 526, IPL 316, IPL 220, IPL 321, IPL 315, IPL 225, IPL 329, IPL 534,
Fieldpea (13)	Adarsh, Vikas, Prakash, IPF 04-26, IPFD 10-12, IPFD 11-5, IPFD 12-2, IPFD 2014-2, IPFD 6-3, IPFD 9-2, IPFD 12-8, IPFD 13-2, IPF 16-13
Rajmash (4)	Uday, Amber, Utkarsh, Arun
Total 63	

Landmark varieties

Varieties	Special feature
IPM 205-7 (Virat)	Super early mungbean variety
IPL 220, L 4717	High Fe and Zn fortified lentil variety
IPH 15-03, IPH 09-5	Pigeonpea hybrids
IPFD 10-12	Green seeded variety
IPC 2005-62	High protein contents (26.47 %)
PDAT 16	Short duration pigeonpea
Phule Vikram, NBeG 47, RVG 204, Pusa Parvati, JG 24	Machine Harvestable chickpea
Super Annigeri 1, Pusa Chickpea 20211	MAS Product, wilt resistant chickpea
PDL 1; PSL 9	Salinity tolerant lentil

Improved varieties in some selected pulses

commensurate policy support. More than 700 varieties have been developed with not only higher yield but also with resilience to biotic and abiotic stresses.

Biofortified varieties like those of lentil (IPL 220) has 25.8 per cent protein with high iron (94 mg/kg), zinc (57 mg/kg) and selenium (630 µg/kg) and chickpea IPC2005-62 with 26.7 per cent protein, when eaten with rice becomes excellent balanced food. Green peas variety (IPFD 10-12) has been developed which is as tasty as vegetable peas, with high productivity and is one of the alternative for the canning peas. A hybrid variety in pigeon pea (IPH 15-03) with 30-40 per cent higher yield and a very good processing quality has great potential. Many biotechnology based products in chickpea have been developed with more resilience to drought and biotic stresses.

In contrast to millets, demand in pulses is high but production is low. Due to development of many value added products (gluten-free, diabetic, vegetarian, nutrient-rich diets) consumption has increased as also exports. To increase local foods particularly pulses, dietary diversification, biofortification of major and minor pulses is required. In the last 30 years, cultivation of pulses had declined but now the pulse production is picking up very well. Pulse milling by-products which were earlier discarded are now commercialized especially in bakeries, diversifying our diets. ICAR-IIPR has developed different agri-business incubators.

The future outlook for food legumes in food systems would require: (i) improvement in the productivity and quality of pulses with less anti-nutritional factors; (ii) biofortified varieties; (iii) specialty pulses (e.g. sprout specific varieties of chickpea and mungbean; (iv) food legume (major and minor) as functional foods; (v) improve post-harvest processing for value added products; (vi) government sponsored promotional schemes for pulses.

Fruits and Vegetables

Dr B.N.S. Murthy, Director, ICAR-IIHR, Bengaluru, apprised about the current scenario of Indian horticulture since fruits and vegetables makes about 70-80 per cent of the whole horticulture production system. The value of a horticulture crops crossed about INR 1000 billion per year. However, the small holdings dominating Indian farming system become limiting, as supply chain and export get impacted. To get voluminous output, collective farming is required for which appropriate government policy is needed. As India is bestowed with congenial agricultural climatic conditions suitable for large number of fruit crops. There are several fruit crops (>200), of which 7-8 are the major ones. But there are several other minor fruit crops which have high nutritional value, from local production

Cowpea

States	Varieties
Andhra Pradesh	DCS 47-1, DC 50, TPTC 29, CoVu-702 Co (CP-7), PCP 0306-1
Gujarat	Gujarat Cowpea 3, GC- 4, Pant Lobia-3, Pant Lobia-4, TC 901
Karnataka	DCS 47-1, DC 50, TPTC 29, CoVu-702 Co (CP-7), PCP 0306-1
Maharashtra	PCP 05040, Pant Lobia-3, Pant Lobia-4
Tamil Nadu	DCS 47-1, DC 50, TPTC 29, CoVu-702 Co (CP-7), PCP 0306-1
Rajasthan	RC-19, RC 101, Pant Lobia-4 and Pant Lobia-5, GC-4
Kerala	DCS 47-1, DC 50, TPTC 29, CoVu-702 Co (CP-7), PCP 0306-1
Uttarakhand	Pant Lobia-1, Pant Lobia-2, Pant Lobia-3, Pant Lobia-4,Lobia-5
Haryana	Hisar cowpea-46, RC 101, Pant Lobia-3 and Pant Lobia-4

Horsegram

States	Varieties
A.P. & Telengana	CRIDAVARDHAN (CRHG 22), CRGH-19, CRHG-4
Maharashtra	Phule Sakas and Pratap Kulthi-2 (AK 53)
Rajasthan	Pratap Kulthi-2 (AK 53), AK 42
Chhattisgarh	Indira Kulthi-1, CK-3, CK-2
Karnataka & Kerala	CRIDAVARDHAN (CRHG 22), CRGH-19, CRHG-4
Tamil Nadu	CRIDAVARDHAN (CRHG 22), CRGH-19, CRHG-4
Hilly areas	VLG 8, VLG 10, VLG 15 and VLG 19

Guar

States	Varieties
Gujarat	RGC 936, RGC 1002, RGC 1003, HG 563, HG 2-20, HG 884
Rajasthan	RGC 197, RGC 936, RGC 1002, RGC 1003, RGC 986, RGC 1038, HG 884, RGC 1031, RGC 1055, RGC 1066, HG 2-20
Haryana	HG 870, HG 2-20, HG 884
Madhya Pradesh	HG 870, HG 2-20, HG 884

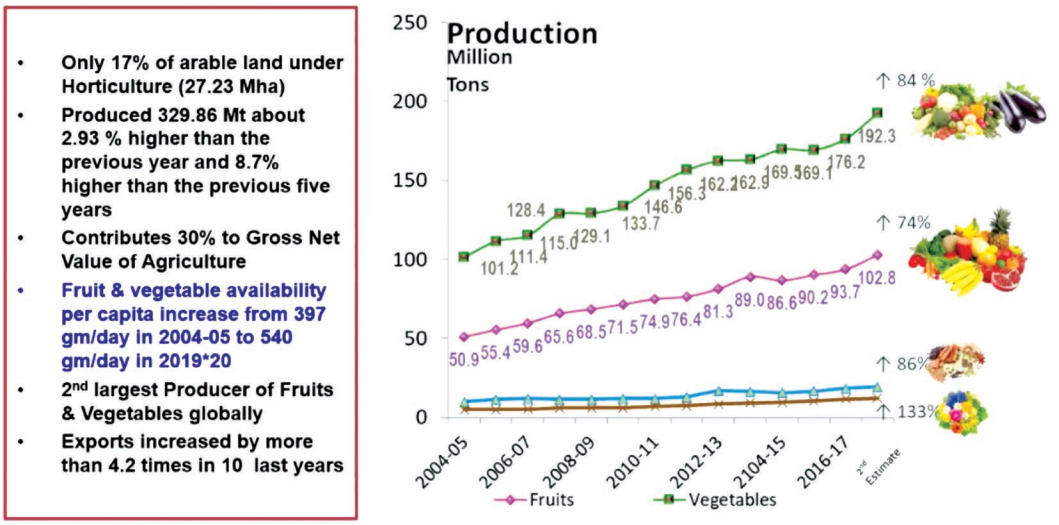
Mothbean

States	Varieties
Rajasthan	RMO 435, CAZRI Moth 2, CAZRI Moth 3, RMB 25, RMO 423, RMO 257, RMO 225-1
Gujarat	RMO 40, CAZRI Moth 2, CAZRI Moth 3, GMO 2
Maharashtra	CAZRI Moth 2, CAZRI Moth 3

Improved varieties in some minor pulses

systems which need to be promoted. For example, sour sop is gaining importance due to its anti-cancerous property and *jamun* (*Syzygium cuminii*) where few farmers earn INR 40,000-50,000 from a single plant.

Dr Murthy discussed the development of a "Genetic garden of biofortified crops" which would contain valuable germplasm of naturally biofortified crops as well as through breeding, also may serve as a centre



Value of Output of Horticulture Crops (At 2011-12 Prices /2019-20 crop) 10 Lakh crores

Horticulture Status in India

for conservation and education. This is to address the most common natural deficiencies in India (iron, iodine, vitamin A, folate, zinc and selenium). He informed that ICAR-IIHR is a premier organization on horticulture in the country, working on over 50 different horticulture crops, which including fruit crops, vegetables, flowers, mushrooms etc. The institute is dedicated to work for the cause of farmers and has a system of popularizing local fruits and vegetables by conducting national horticulture fairs and diversity fairs.

The ICAR-IIHR is facilitating local communities in maintaining the local species and mainstreaming by research work e.g. brinjals, sword beans and amaranthus. Geographical indications (GI) have been assigned to 89 agricultural crops since March 2018, of which 75 per cent are horticultural crops (36 fruit crops and 11 vegetables) and majority of them are from Maharashtra, Karnataka and Tamil Nadu. Government of India recently introduced the programme for bringing in the local fruits (12) to mainstream both for production and marketing of these crops. Under the 'One District One Focus Product (ODOFP)' scheme of the government, under which >400 districts are allocated for horticultural crops .

Dr Murthy narrated some of the success stories of mainstreaming farmers' varieties by linking biodiversity to livelihood security. In district Tumkur, one jackfruit plant called 'siddu' which is very good in terms of quality and the farmer has actually multiplied these crops and making lot of money by selling the planting material (earned about INR 2.2 million in span of 3 years). Similar examples exist in tamarind (*Tamarindus*

1. Mango-Ratual
2. Papaya- Coorg Honey Dew
3. Phalsa- Kanpur
4. Custard Apple-Balanagar
5. Pumelo-Devanahalli
6. Guava- Alahabad apple
7. Jackfruit- Redbulb
8. Sapota-Kalipatti
9. Citrus- Medica
10. Bael-Faizabad
11. Tamarind
12. Aonla

Locally produced fruits with high nutritional value or other potential

indica), and spine gourd (*Momordica dioica*). Under the program of linking biodiversity for prosperity, 75 per cent revenue generated goes to farmers and 25% to the ICAR-IIHR. Under "Seed village" program, ICAR-IIHR gives planting base material to farmers under the supervision of scientists to produce the quality seeds. These are purchased back by IIHR and later sold to farmers as a truthfully labeled seed. Farmers also face the issue of requirement of comprehensive package for agro-management.

Dr Murthy concluded that since international inter-dependence for fruits and vegetable is the rule, not the exception, there is a need for better gene bank information system, genetic resource distribution data is to be shared, conservation including safety backup of germplasm is required. There is urgent need to stop erosion of diversity and ensure sustainability, by including farmers and communities in planning, decision making and execution processes. Shift planning and resource allocation priorities from *ex situ* to *in situ* conservation is also required.

Seed Spices

Dr S.N. Saxena, Director, ICAR-NRCSS, Ajmer, elaborated on the usefulness of seed spices for health and nutrition. He informed that seed spice denotes annuals whose dried fruits or seeds are consumed as a spice and which are characterized by pungency, strong flavour with either sweet or bitter taste. Most seed spices are grown in arid and semi-arid regions of India including Rajasthan and Gujarat, parts of Madhya Pradesh, Uttar Pradesh and Telangana. India is the largest producer,

consumer and exporter of spices as a whole and seed spices particularly. Out of 109 spices known globally, India produces 63 spices due to its versatility of climate and out of these, 20 spices are classified as seed spices. NRCSS is working mainly on cumin or '*jeera*' (*Cuminum cyminum*), coriander or '*dhania*' (*Coriandrum sativum*), fennel or '*saunf*' (*Foeniculum vulgare*), fenugreek or '*methi*', (*Trigonella foenum-graecum*), carom seeds or '*ajwain*' (*Trachyspermum ammi*), celery (*Apium graveolens*), dill or '*sowa*' (*Anethum graveolens*), caraway or '*shahijeera*' (*Carum caraway*) and black caraway or '*kalonji*' (*Nigella sativa*). During last two decades there has been 2.5 fold increase in area (2.122 m ha) and 4.5 fold increase in production (2.063 mt). Export of seed spices during last 15 years to more than 30 countries is only 20-25 per cent of our total production, fulfilling 50 per cent of the world demand. During 2020-21 pandemic period, India exported seed spices to the tune of INR 53.65 billion, which is almost 20 per cent more than the previous year.

Historically seed spices have been used as pharmaceuticals, fragrances, flavor compound and agro-chemicals. In current times, these are gold mines of possibilities in the search for beneficial bioactive compounds for pharmacology and other health related issues. Seed spices are easily available and are good source of secondary metabolites like

Medicinal importance of seed spices

Crop	Major constituents	Major medicinal uses
Cumin	Cumin aldehyde, Cuminal	Neurodegenerative diseases (Parkinson's disease), chronic inflammatory diseases
Coriander	Linalool	Diuretic , inflammation diseases (edema), sedative
Fennel	Anethol, fenchone	Gastroprotective, antimicrobial
Fenugreek	Diosgenin	Anti diabetes and cardiovascular disease
Ajwain	Thymol	Medical disinfectant , carminative
Anise	Anethole	Gastroprotective, antimicrobial
Caraway	Carvone	Antibiotic properties, aromatherapy and antifungal
Celery	Limonene	Weight loss, prevent cancer, treat cancer, and treat bronchitis.
Dill	Carvone, Dillapiole	Antibiotic properties, aromatherapy and alternative medicine
Nigella	Nigellone, thymoquinone	Respiratory diseases, flatulence, diarrhoea, haemorrhoids

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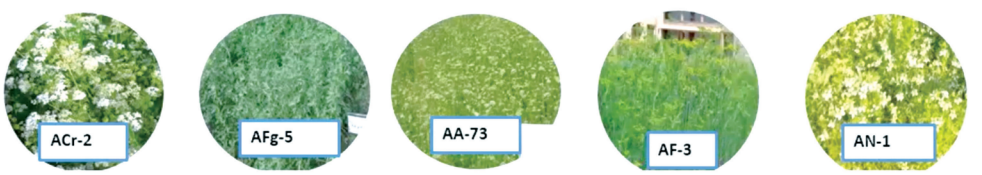
Curative properties of seed spices

vitamin, minerals, phenolics, carotenoids, alkaloids, saponins, terpenes, and other health related compounds. Seed spices possess medicinal and therapeutically potential properties such as digestive stimulants, hypolipidemic, anti-diabetic, antioxidant, etc. During the COVID19 pandemic, consumption of seed spices particularly nigella, 'ajwain', cumin, coriander increased significantly because they are categorized as immunity boosters in some ayurvedic preparations.

Dr Saxena elaborated on the mandate and research activities at ICAR-NRCSS. The institute has 2,331 accessions of germplasm of seed species which have been used for developing 24 new varieties, so far. The institute has also carried out chemo-profiling of these spices, along with studies on animals for medicinal properties. Currently institute is working on developing a strong value-chain from production to consumer, by applying new technologies such as cryogenic grinding of seeds or steam distillation to retain flavour and quality.

For the way forward, Dr Saxena provided following suggestions: (i) exploitation of seed spices as potential source of natural antioxidants, essential oil and oleoresins for developing health promoting nutraceuticals and value added products; (ii) characterization and documentation of medicinal wealth of seed spices; (iii) GI tagging (e.g. *Sirohi* fennel, *Barmer* cumin, *Haroti* coriander, *Nagori pan methi* etc.); (iv) Production of clean and safe (organic) seed spices following good agricultural practices; (v) newer extraction technologies;

Variety	Specific trait	% increase (Yield and EO)
Ajmer Coriander-2	Stem gall disease resistance	6.72
Ajmer Coriander-3	Higher yield/ Powdery mildew resistant	24.6
Ajmer Fennel-3	Higher yield and essential oil content	12.6 & 18.5
Ajmer Ajwain-73		25.9 &7.27
Ajmer Celery-2		23.2 & 17
Ajmer Nigella-1	Higher yield and total oil content	18.3 & 33.76
Ajmer Fenugreek-5	Higher yield	11.1
Ajmer Green Coriander-1	Leafy purpose during offseason	29.73



Seed spices varieties developed by ICAR-NRCSS, Ajmer

and (vi) strengthening of post-harvest processing and value-addition for its commercial exploitation.

Plant-based Nutrition Security

Dr S. Devindra, ICMR-NIN, Hyderabad, provided a statistical overview on food and nutrition security, SDGs and impact of COVID19 pandemic on poor, malnourished population. To address these problems he said that locally available plant foods (minor food crops and wild species) are rich in protein, micronutrients and vitamins and can fill in the gap of nutritious food. Therefore, there is a need to revive them and distribute their seeds to farming communities. Exchange of seed of indigenous plants within communities can boost some of the traditional crops cultivated on small farms to contribute substantially towards mitigating hunger and malnutrition. Intensification of agricultural systems has led to a substantial reduction in the genetic diversity of domesticated minor plants consequently, tribal communities have lost access to numerous local plant which otherwise ensured food access and availability. Multi-grain food with magnitude of combinations is the recent addition to our food basket and is available in different market innovated forms because it is healthy with high nutritional value. Locally available plant food recipes are prepared as per choice of consumers who appreciate the modem foods but who are not are aware of traditional dishes. Keeping in view this concept, ICMR-NIN has developed 'my plate' concept to meet the requirement of balanced diet for the community. 'My plate' advocates eight different kinds of foods (as exchanges) from four distinct food groups, to be consumed in a day by an individual. One half of the plate should comprise fruits and vegetables, leafy vegetables, roots and tubers and other vegetables. A quarter plate should be cereals and the remaining quarter plate should consist of protein rich foods such as pulses, legumes, eggs, flesh foods and nuts; followed by moderate amounts of varieties of vegetable oils/ fats. A glass of milk or milk products such as curd, paneer etc. should accompany the plate.

The technical session was concluded with remarks by the Co-Chairs. **Dr A.K. Singh** said that despite massive agricultural and horticultural production in India, more than 200 million population is suffering from various degrees of malnutrition (low food intake as well as high calorie intake). The issue is complex as it not only relates to economic access to food but also lack of awareness and other related issues. The cost of commodities like fruits, vegetables and spices is beyond the buying capacity of a significant proportion of the people, while at the same time obesity is also on the rise for another set of population. He urged that as green revolution increased production and productivity of major cereals, similar action is required to mainstream the less known nutri-species, and diversified diets

mentioned during the session by the various speakers. For this good quality planting material, matching production and plant protection technologies, market intelligence, linked supply chain system would be required to be put in place. He informed that ICAR is making concerted efforts towards this, with >150 horticultural species. For this cost, scalability, seed production and safety of commodities are the key factors. Further, India also has great export potential for both tropical and temperate species. He assured that ICAR is making strides towards achieving this through several interventions, including digital and mechanized agriculture.

In his summation, **Dr P.L. Gautam** said that there is a need to re-introduce plant based local food systems in our diets for ensuring good health and nutrition. The major recommendations emanated from the session include: (i) awareness generation about crops in local food systems, production and handling, their recipes, knowledge about nutritional and anti-nutritional factors; (ii) documentation and popularization about local food systems; (iii) capacity building including human resource development (curricla in colleges, extension system etc.); (iv) policy related support, such as inclusion of these crops in mid-day meal programs, public distribution system (PDS), and various other schemes of the government and increased R&D investment in these crops.

Panelists' Views

The panel discussion was Co-Chaired by **Dr R.S. Paroda**, and **Dr Stephan Weise** and moderated by **Dr Sunil Archak**.

Dr Ashok Kumar, Director, ICAR-NBPGR, Delhi, highlighted the role of ICAR-NBPGR in local food systems by focussing on wild edible plants and under-utilized species. The ICAR-NBPGR has major programs on wild edible germplasm including wild fruits, vegetables and their crop wild relatives, as well as on underutilized species, of local/indigenous importance. In the recent past, three hotspots of biodiversity namely, the Andaman & Nicobar Islands, Western Himalayas and North-East India, have been extensively targeted for collection of germplasm. In the Western Himalayan region, the NBPGR identified 55 wild relatives of 23 temperate fruits and documented their consumption and gathering patterns among tribal communities, distribution, important traits, utilization potential and possible strategies for their effective conservation. Distribution of diversity in soft fruits [*Rubus*, *Ribes* and *Fragaria*] in North-Western Himalayas, and prospects of their conservation are being investigated. Domestication feasibility of some minor wild fruits is also being explored in five species, namely *Diospyros lotus, Rubus ellipticus, Corylus jacquemontii, Myrica esculenta* and *Prunus mira*.

Based on ICAR-NBPGR's recent exploration and collecting missions in the Andaman & Nicobar Islands, potential economic species and semi-domesticates worth considering as future crops include *Alpinia conchigera* (rhizomatous spice), *Garcinia speciosa* (table fruit resembling mangosteen) *Curcuma roscoeana* (cut flower), *Macaranga nicobarica* (food wrapper), *Pandanus leram* (food resource), *Gnetum gnemon* and *Champereia manillana* (leafy vegetable trees). Besides, unique variability (~100 accessions) has been captured in several cultivated crops like *Citrus*, taro and giant taro, greater yam, potato yam, small bitter gourd, red fleshed guava, highly aromatic Malabar galangal, ginger, turmeric, wild and cultivated betel vine, lemon grass. This diversity has very useful traits and can enrich the existing cultivars to combat biotic and abiotic stresses, as well as enrich their nutritive value. For example, a primitive brinjal from Little Nicobar may offer bacterial wilt resistance. Similarly, taxa of seeded *Musa* collected from Nicobar have been found resistant

to *Fusraium* wilt (Race 1) prevalent in Kerala. Many potential wild edible fruits like *Artocarpus chama, Diospyros crumenata, Dracantomelon dao* and *Garcinia cowa* have been established in the the NBPGR field gene bank in Kerala. Collections of *Manilkara littoralis* and *Syzygium samarangense* have been used by social forestry department for testing feasibility of raising a coastal bioshield.

In the North-East Region of India, the ICAR-NBPGR has identified 14 underutilized vegetable crops with good potential for commercialization such as *Clerodendrum colebrookianum*, *Gynura cusimbua, Plukenetia corniculata*. A large number of minor and under-utilized fruits species with high nutrition and local significance include *Machilus edulis*, *Docynia indica* and *Elaeagnus conferta*.

Germplasm amassed in the genebank of the ICAR-NBPGR is being systematically characterized on a large scale, for not only agronomic, biotic and abiotic stress traits, but also for nutritional quality. Biochemical profiles of CWR are being compared with the cultivated varieties to nutritive value and health benefits, with encouraging results. The NBPGR is also establishing and strengthening field genebanks. At Issapur farm and Jodhpur regional station, 50 species of minor fruits of sub-tropical and semi-arid region of indigenous importance have been raised, including those of Indian jujube (*Ziziphyus* spp.), Indian woodapple (*Aegle marmelos*), Indian gooseberry (*Phyllanthus embelica*), citrus, *Manilkara hexandra, Grewia asiatica, Carissa carandas, Madhuca longifoila*, etc.

The ICAR-NBPGR also coordinates the All India Coordinated Research Network on Potential Crops. Which has 13 centers across the country. The major thrust of research has been to address the local needs of region specific under-utilized crops. In addition, significant efforts are also made for introducing and acclimatizing new potential crops. Agronomic trials on major underutilized crops like grain amaranth, rice bean, spiny gourd; industrial plant *Jatropha curcas* and tree species *Simarouba glauca*, are being taken up.

Another new initiative of the ICAR-NBPGR has been repatriation of local landraces/varieties of staple crops (wheat, rice, french bean, foxtail millet and soybean) lost due to replacement with high yielding varieties. Heirloom varieties (conserved in genebank) are being repatriated to promote on-farm conservation, in several villages in various states of India. Workshops and training for 'On-farm conservation awareness' is being organised periodically, especially for the benefit of tribal communities, with very enthusiastic response. Also, a network of custodian farmers across Kerala has been identified who cultivate and maintain landrace diversity in rice, taro, greater yam, mango, jackfruit, banana, cassava, vegetables, native and exotic fruit trees and medicinal plants. Volunteer farmers are supplied

germplasm of their choice for augmenting diversity in home gardens. Thus, the NBPGR is making concerted efforts to ensure food and nutritional security by collecting, conserving and utilizing genetic diversity of crops of indigenous, commercial and regional significance. The National Genebank of NBPGR has ~0.47 million accessions and medium- to long-term conservation.

Dr Rajeev Varshney, Director, Center of Excellence in Genomics & Systems Biology, ICRISAT, Hyderabad, said that the recent COVID-19 pandemic and several other drivers have put the world off track to ending world hunger and malnutrition in all its forms by 2030. The latest FAO report "The State of Food Security and Nutrition in the World 2021" estimates that between 720 and 811 million people in the world faced hunger in 2020 – as many as 161 million more than in 2019. Nearly 2.37 billion people did not have access to adequate food in 2020 – an increase of 320 million people in just one year. This undermines the urgency for exploring wide array of interventions and diversifying our local food systems for ensuring health and nutrition security in closest possible manner in near future. Access to nutritious foods is lagging, despite increasing demand. While access to cereals in India has increased due to the persistent focus of Green Revolution-era food scarcity policies and staple grains, access to more nutritious in diverse foods is limited. The demand for more nutritious foods is certainly present, as evidenced by higher expenditures on fruits and vegetables, milk products, meat, eggs and fish. However, this demand is not translating into increased calorie intake from these food groups. Instead, calorie intake from cereals, which decreased from 71 per cent in 1993-94 to 61 per cent in 2011-12, is being replaced by processed foods, beverage, oils and fats, reason being limited consumption of more nutritious foods like protein rich pulses and micronutrient rich fruits and vegetables, is the high and fluctuating prices for these foods. Changes in dietary patterns have therefore led to the consumption-production disconnect, adding to the nutritional challenge. Policies, as a result, must prioritise making these nutritious foods affordable by encouraging increased production of such foods.

Strengthening local food systems will not only ensure easy access but also will be more viable economically, through a four pronged approach as follows.

(i) **Crop diversification:** Nature gave us 30,000 types of edible plants, but farmers today grow only about 170. Unfortunately, at present, only three crops– rice, maize and wheat- meet the nearly 40-60 per cent calories required by human from plant based food systems. Considering the importance of diversifying our food basket, millets are a good option. In India, traces of millets have been found in the archaeological sites of Harappa and Mohenjo-Daro, and several ancient

Indian scriptures refers to millets. For many years, millets were a part of our daily diet. Today, there is a growing realization among Indian farmers that cultivating millets requires fewer inputs and it is also an economically viable option, especially in harsh and dry environments. This is supported by the new-found knowledge on the health benefits of millets. Also, over the last few years, the Indian government has been making extensive efforts to encourage the cultivation of millets. There is an urgent need to promote the nutritional and ecological benefit of millets to consumers, producers, and decision-makers, to improve production efficiencies, research, and development investments and food sector linkages. Institutes like ICRISAT, IIMR, NIN and many other organizations are working on this aspect. The declaration of 2023 as the "International Year of Millets', will fuel all these efforts.

(ii) **Plants-based protein foods:** To nourish a country like India which has largest number of protein deficient people, we need to address protein deficiency and getting protein through animal meat or through plant-based food systems. As per requirements of ICMR and WHO, a healthy individual needs about 52 g proteins per day. However, per capita consumption of pulses have come down from 60 g per day in the 1950s to 38 g per day as the pulses have become expensive because of higher demand and lower production. In recent years, the production has remained almost stagnant at 18 million t for several years, now raised to 25 million t, but still short of the demand. Organizations like ICRISAT and ICAR with several decades experience and proven record in advancing research for crops including grains and legumes can play a pivotal role in steering global efforts towards plant-based local food systems for health and nutrition security. ICRISAT works on chickpea and pigeon pea that are important source of proteins. In general, the commercial varieties have ca. 20 per cent proteins. Therefore, these pulses can not only play an important role to improve human health but also to industry in the new space of plant protein-based meat by providing the raw material. Therefore, work in the direction to enhance consumption of crops like pulses (enhance per capita consumption) would require increasing pulse production by using modern breeding approaches and also protein content using advanced scientific approaches including systems and synthetic biology.

ICRISAT's recent work on 3,000 chickpea genome project has provided several lines up to 32

per cent protein content. Work in future entails remaining the linkage drag between yield and protein content by using genomics tools and modern breeding approaches.

(iii) **Policy interventions:** Requirements of policy interventions from Central and State Governments– like mid day meal, subsidy on local food, etc. is reiterated. Agencies like ISPGR, TAAS, NAAS and others in India can influence these policy interventions.

(iv) **Awareness and popularization:** From the society and fashion perspectives, social media is very important, especially to influence young generation. In this context, currently "locovarism" is a new trend. Locavorism is an effort to eat more sustainably – local foods defined as food consumed no more than 160 km from where it was grown. In this context, neither food, nor we need to travel and this keeps food fresh, meaning they arrive on the plate full of nutrients and flavour and also contribute to save CO_2 emissions. Indian wellness expert Rujuta Diwekar is a big supporter of locovarism and it is hoped that scientists too can contribute in this direction.

Mr Bharat Kakate, President & Managing Trustee, BAIF, Pune, mentioned a policy-oriented report from the High Level Panel of Experts on Food Security and Nutrition (HLPE, 2014) presents a synthesis of existing evidence about the causes of food losses and waste and suggests action to reduce the losses in order to improve food and nutrition security and the sustainability of food systems. According to this report, a sustainable food system 'gathers all the elements (environment, people, inputs, processes, infrastructure, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food and the outputs of these activities, including socio-economic and environmental outcomes. In this context, it is necessary that we adopt approaches, strategies and practices that can ensure us "Healthy Society/People, wholesome food, and flourishing Nature/Planet", and all these three things need to be seen as a continuum. Moreover, recent changes in food preferences, policy push towards circular, green and bio-economy and Nature Based Solutions, also need to be seen as an opportunity to transform food system and create livelihoods for rural communities. It has been now well established that plant genetic resources are heritage of human kind. Since ages, farming communities have been using this amazing diversity for various therapeutic and food and nutrition purposes. Therefore, there is need to protect, document and revive such plant-based food culture once again in the light of emerging issues.

To address some of these issues, BAIF Development Research Foundation (www.baif.org.in) has introduced

multiple programmatic approaches and interventions aiming at conservation and revival of plant-based, local food systems. Some of the proven and tested interventions are given below:

- Revival of Tribal Heritage Agriculture Systems (THAS), building upon inherent and food related traditional knowledge of tribal communities and rural women.
- Scientific studies to identify nutrition traits of crop landraces and wild edible plants, and conservation of promising germplasm in partnership with tribal clusters.
- Establishment of community managed seed banks for easy availability of planting material and seeds by local communities.
- For promoting wild and local vegetables and indigenous seeds, BAIF has adopted four "C" approach i.e., Conservation, Cultivation, Consumption, and Commercialization.
- Promotion of nutrition rich crops (millets, wild vegetables, tubers, pulses and oil seeds) and establishing nutri-gardens for increasing dietary diversity and year-round availability of nutritious food.
- Documentation of plant-based indigenous food recipes for better health and nutrition and dissemination of such information.
- Promotion of Non-Timber Forest Products (NTFP) based livelihood and improved nutrition through developing nurseries, plantation, and semi-processing food recipes.
- Adoption of NPM (Non-Pesticide based Management) practices, preparation of plant and dung based, bio-pesticides.
- Adoption of agro-ecology approaches in farming system in rural and tribal regions.
- Providing capacity building and technical support for conservation and promotion of agrobiodiversity for nutrition security in the context of climate change.

Dr J.C. Rana, Country Representative, India Office, Alliance of Bioversity International & CIAT, New Delhi, said that according to Indian Philosophy, '*Anna*' or food is an aspect and gift of the 'Supreme God'. Therefore, it should be treated with great respect. However, in the present time, traditional food concepts have been changed drastically in our society because of our contemporary lifestyle. Increasing populations, continuous and unsustainable cultivation patterns compounded by escalating climatic variability have resulted in limited access to optimal production to farmers in general and marginal and smallholders, in India. Continuous cultivation of a few dominant crops and varieties has eroded environmental sustainability of food production, increased pest risks, partly contributing to the increased frequency of invasive pests and diseases

in recent times. The replacement of locally adapted crops and varieties by the market dominant ones has increased food insecurity, and the ability of the landscape to support food systems. Together, these threaten crop diversity and food security especially for local farming communities and their production systems. Climate change is gradually reducing water and nutrient efficiencies of available food crops and micronutrient rich crops such as vegetables and fruits. These system shocks generally affect the marginalized fractions in society disproportionately and increase social inequality. Rural households, resource poor farming communities and vulnerable groups such as women and the youth bear the effects of these changes.

Estimates suggest that globally 80 per cent of the seeds upon which smallholder farmers in developing countries depend are farm-saved and obtained through informal channels of distribution and exchange. These farmers which are primarily dominated by women farmers play key roles in Community Based Seed Systems (CBSSs) although their roles are often neglected by research and development actors, policies and programmes. This high level of farmer seed autonomy masks the fact that almost everywhere farmers varieties (FVs), landraces, traditional crops and local seed systems are under stress. Agricultural intensification and commoditization, privatization of natural resources and the strong concentration and expansion of corporate power in the life science industries (including the seed industry) are forces contributing to a decline in local, collective management practices of plant genetic resources for both conservation and sustainable use.

In some parts of the country rice and wheat are being consumed in all three meals of a day which primarily coming from PDS. Currently, PDS basket is lacking in diversity. Therefore, it is important to either breed biofortified varieties of these staple food crops that are nutrient dense (but not an easy job) or mainstream landraces or native varieties which are inherently nutrient rich, socially and locally adapted and accepted for their taste, flavours, cooking quality nutritional attributes, shelf life and may more.

Mainstreaming FVs and improving their seed systems through Community Seed Banks (CSBs) and further linking those production systems to various market channels have emerged as possible solutions in response to concerns about the loss of biological diversity in agricultural systems, the impacts related to climate change. While undertaking nutritional profiling of rice landraces in UNEP-GEF project, we found that there are large number of varieties which have significantly higher nutrient content than their improved allies. Landraces such as 'Gita', 'Kolajoha', 'Karhani', 'Raskadam' showed low glycemic index and high iron content i.e., >5 mg/100 g. In pearl millet landraces namely '*Chinana*' and

'*Gadhwal bajri*', have protein content >13.0 per cent, oil >8.0 per cent with high content of minerals *viz*. calcium (>28 mg/100 g), iron (>8.5 mg/100 g), zinc (>3.5 mg/100 g). Another landrace '*Peeli Bajri*' which is preferred for its taste and good keeping quality of flour has high content of starch 62.5 per cent with high amylopectin 37 per cent thus highly suitable for popping. Not only this, even breeding low rancid varieties is a challenge in '*bajra*' and landraces that were grown by the farmers with low rancidity level have been identified, thus enhancing shelf life of bajra flour. Similarly, in finger millet landrace '*Dhindakiya*' from Uttarakhand has high amount of starch (66 per cent) along with high level of total phenols and antioxidant activity.

It is now well proven that women take care of traditional crops and varieties and play an important in the management of local seed systems, but their contribution is generally neglected. Their understanding on the mainstreaming of FVs and the actual and potential roles of CSBs may be viewed as part of national strategies to strengthen seed and food security. There is need to develop and test options for improving the functioning of existing CSBs (technical and organizational aspects) and investigate if and how these CBSSs can be made a viable option to not only to meet the quality seed requirement but also to how conserve traditional crops and varieties. Opportunities exist to improve the functioning of existing CBSS operations in terms of effectiveness and efficiency, to establish and reinforce connections with other actors in the field of conservation and sustainable use of agricultural biodiversity (seed and knowledge exchange, technical support, options to add value) and to develop an enabling policy environment (incentives for the establishment and strengthening of community supported agriculture and seed systems).

Dr Prakash Tyagi, Executive Director, GRAVIS, Jodhpur, informed that Gramin Vikas Vigyan Samiti (GRAVIS) is a Non-Governmental Organization working in rural India in the States of Rajasthan, Uttarakhand, and the Bundelkhand region of Uttar Pradesh. GRAVIS believes in participatory community development that blends traditional knowledge and modern sciences and that promotes equality. Major focus of their work is on enhancing water, food and nutrition security and on improving health status of communities reaching out to over 1.5 million people.

Dr Tyagi said that in order to achieve nutrition and food security, there is an urgent need to document tribal/ local community food system to better understand health and nutritional benefits. A good example is the local food systems of Nicobar tribes of Andaman and Nicobar Islands, who have survived and maintained their health over thousands of years with traditional and local food systems mainly based on bread fruit, pandanus,

noni, coconut, diversity of tuber crops, perennial and seasonal leafy vegetables, etc. Many of wild fruits and other economic plant species which are locally consumed in the NW Himalayas and NEH Region need to be domesticated for introduction in the agriculture stream as they are the rich sources of important minerals and nutrients. In this context, there is strong need to undertake ecogeographic survey to document indigenous minor fruits, tuber crops and local leafy vegetables growing naturally across many agroclimatic zones of the country. This should be followed with value-addition and market linkages for increased awareness and improved consumption in local and urban markets. Programs should also be undertaken for their *in situ* conservation with incentives to tribal or other community who conserves those crops.

Custodian farmers/communities preserving local food crops/systems should be explored especially in biodiversity hotspots, their crops be purified and genetically augmented, nutritionally profiled, documented and they should be incentivized for their efforts for on-farm conservation. The GI tags for nutritionally precious species in niche areas may be facilitated and possibly linked with market chain. In addition to solely depending on farmers in achieving the food and nutrition security through local food system, strategy have to frame to include non-farm community in achieving nutritional and food security. For instance, detailed study on different group of plants, which are suitable for cultivation in home garden needs to be undertaken. Crops, vegetables and fruit plants have to be identified that are well suited for each community food system as well as adapted to various agroclimatic condition.

Specific suggestions for expanding/ strengthening local plant-based nutrition security interventions are:

1. To take an equity-based approach with greater emphasis on needy and neglected areas such as arid zones of India.
2. To develop a dynamic and organized knowledge collection and correction/ modification mechanism and to ensure widespread dissemination reaching the last mile.
3. To promote low-cost and sustainable nutrition-sensitive agriculture and horticulture within existing farming practices.
4. To optimally balance the energy and resources between food security initiatives and water security interventions, as targeted at safe drinking water and water availability for crops, complimentary to each other.
5. Need for increased policy support for these crops, for example increase use in mid-day meal scheme and PDS, and better price support for cultivation of such crops, which are normally low-yielders.
6. Capacity building programmes for value-additions of local food

systems, their marketing, including preparation of diversified recipes for promotion in hotels and other food outlets.

7. Enhanced R&D investment and increased participation and linkages of stakeholders, academia, industry, and professionals.
8. Development of entrepreneurship for production of value-added products and marketing.

Mr Atul Jain, Secretary, DRI, Chitrakoot, said that in the Deendayal Research Institute the concept of strengthening local food systems has been at the core of activities. The social and cultural practices associated with local foods have a important role, as the people also have emotional bonds with them. Therefore, local communities have stake in the conservation of local plant species as their socio-economic needs, in fact survival, are linked to them. Rural communities prosper if local biodiversity flourishes. Their dietary habits and food systems become rich and nutritious. Many religious events are associated with local biodiverse nutritious foods, especially those offered to deities. Cultural manifestation of local foods is very important in conservation and use of species. Festivals-based menus tend to promote local foods, that are inherently nutritious, which helps to combat malnutrition. There is need to scientifically study traditional food recipes used in festivals, to ascertain their nutrient composition.

Concluding Remarks

The Co-chairs provided their concluding remarks. **Dr Stephen Weise** said that great richness of plant-based food system exists, however, there is a need to make much better use of this diversity. It is a huge opportunity but are we adequately mainstreaming it? We are often confused as to what we mean by better utilization of this diversity. On one hand we have the commoditization approach wherein one to three crops or varieties (healthy and nutritious) are taken and mainstreamed to more commercial approach to compliment the more staple crops. On the other end of the spectrum there are the local foods and food systems. How can we preserve and use that diversity without saying that one or the other needs to be mainstreamed? Looking at the overarching diversity in different ecosystems and environments, solutions in one region (e.g. dessert ecosystem) may not be suitable to a contrasting system (e.g. hill ecosystem). How does one value and keep moving forward to use the diversity without having to choose one or few crops for mainstreaming? Both approaches are very important and valid. Depending on the space being occupied by institutions/organizations, the type of R&D support required would vary with these perspectives. Conceptual clarity would help in moving forward in doing the advocacy and helping the policy framework at local and national level to play a role in supporting this endeavour.

Dr R.S. Paroda summarized the discussion stating that there is no dearth of local agrobiodiversity in relation to food systems. However, there is a need to study and prioritize them in terms of which ecoregions they are occurring. One recipe may not fit for all. What is important in terms of nutritional needs of a region should then be considered as high priority for species to work on their collection, conservation and utilization. It has also been clearly brought out that plant-based food systems are likely to be more relevant and useful for those addressing the concerns of hunger and malnutrition, especially in developing countries. It is always desirable to depend more on plant-based food systems which are good for health and nutrition. The need for nutritious food required greater awareness amongst the various stakeholders (scientists, managers, NGOs, and private sector). More research has to be intensified for which investment would be needed. In developing nations R&D support

should be enhanced. In addition, qualified human resource should look at these species and work to get them mainstreamed, in an ecoregion-wise rather than one size fits all.

In order to promote production and consumption plant-based local food systems, policy advocacy is an urgency. Policy-makers must understand that we need to emphasize the role of under-utilized plants ('plants for future'), so that they are also supported for R&D. This is more important in the context of adverse conditions due to climate change and COVID-19 pandemic. More efforts to be made to re-prioritize based on available resources. With participation of local people, traditional knowledge to be documented and opportunities to be provided to local people for value-addition of their products and their market linkages. Today, there is a need for nutritious food in contrast to the days of 'Green Revolution', when food *per se* was required to overcome hunger. To ensure sustainability, the nutritious food need to be produced where it is to be consumed, rather than relying heavily on imports and exports. It is also important to embrace the role of NGOs and civil societies as well as private sector in order to intensify the action necessary to promote the local food systems. New mechanisms would be required not only for policy advocacy but for advisory services also for the people to make sure that these useful resources are further improved, conserved and effectively utilized.

The meeting concluded by a formal vote of thanks by Ms Sonal Dsouza, Program Officer, Alliance of Bioversity International & CIAT, India Country Office, New Delhi.

Recommendations

The National Consultation resulted in the following broad recommendations on scientific, developmental and policy matters related to promoting local plant-based food systems.

01 Tapping Crop Genetic Diversity

- Carry out eco-geographic survey of local plant biodiversity for its nutrition value (crops, fruits and vegetables) and systematic documentation leading to collecting, conservation and enhanced use.
- Develop specific participatory collaborative programs with academic and research institutions, extension personnel and grassroot workers for promoting local agrobiodiversity.
- Create pilot experiments and collect empirical data across different agro-climatic zones and diverse socio-economic and cultural settings on local food systems.
- Increase productivity using modern biotechnology, such as genomics and gene editing, especially in legumes and horticultural crops.
- Incentivize *in situ* conservation of local food crops in a participatory network mode for local people as well as indigenous communities involving local government bodies.

02 Diversification of Farming Systems, Enhanced Production and Productivity

- Promote farm diversification through low-cost nutrition-oriented agriculture and horticulture, particularly adopting traditional farming practices and incentivizing such cultivation through linking with various government welfare schemes.
- Mainstream the local plant species such as nutri-cereals including expansion to non-traditional areas/ecosystems.
- Establish an equity-based approach with greater emphasis on neglected areas such as arid zones, by optimally balancing the resources between food security initiatives and water security interventions.
- Access to quality seeds/planting material of local plant species and strengthening community seed systems with proactive involvement of seed hubs and SAUs located in the region.
- Set up assured supply of seeds of improved varieties of local food crops, including the bio-fortified ones along with critical inputs through seed agencies and state departments of agriculture.
- Establish institutional as well as organic linkages among farmers, organisations, community seed banks and national genebank to repatriate cultivars of native nutritious crops, which are no more available for cultivation.

03 Nutrition and Health through Value Addition

- Strengthen research to profile and document local plant species for nutritional parameters, including therapeutic properties and bioactive compounds, as well as to conduct of clinical trials for bioavailability and nutritional epidemiological information on processed foods.
- Commission research to improve post-harvest traits of nutri-rich crop cultivars and facilitate developing ready-to-use or value-added products and processing techniques thereof.
- Attract investments for nutrition profiling and to develop complete value chain *i.e.*, from production to pre- and post-harvesting to processing to market to consumption (plough-to-plate).
- Devise low-cost local processing and value addition techniques to ensure higher profit.
- Identify farming communities for GI registration of nutritionally unique local food crops in their niche areas in order to get benefitted through better market opportunities.

04 Encouraging Entrepreneurship / Farmer Producer Organisations (FPOs)

- Encourage and incentivize the cooperative or collective FPO-led farming systems, and the entrepreneurs in diverse ecosystems, engaging effectively the farmer communities, youth and women and creating better access to market through shorter-supply chain, alternative retail structures and eNAM.
- Regulate markets, trade and prices in a way that local crops will still be affordable, available, and adequate to meet the local community needs for domestic consumption.

- Make license issuance procedure much simpler and easy for entrepreneurs, processors, start-ups, and service providers for supply of local food products.

05 Awareness Creation - Branding, Labelling and Promotion

- Create awareness among producers and consumers through public awareness using multimedia (social, print and electronic), documentary films, publications; organizing agrobiodiversity fairs, exhibitions, road shows, kitchen carts, cultural events, and endorsement by celebrities.
- Enhance awareness and knowledge on the traditional food system at all levels from schools to policy institutions level to equip people with knowledge and skills to promote, cultivate, consume, and conserve the local food species.
- Develop and distribute recipes, in local languages, of foods prepared from local plant species and assist in scaling-up by the processors and establish quality standards at all stages to ensure greater use by the consumers.
- Build training modules for different stakeholders and conduct capacity building programs regularly. Organize national and international conferences on local food systems for knowledge sharing and building linkages and partnership.

06
Policy and Partnership

- Create evidence-based enabling policies in favour of native food crops for their mainstreaming so as to support smallholder farmers – also in order for India to emerge a global hub, especially for millets, legumes, spices and medicinal plants.
- Incorporate local foods, especially millets, soybean and horticultural crops while implementing National Food Security Mission Program, including emphasis on them in the public distribution system and mid-day meal scheme supported by Government of India.
- Develop robust demand-driven Seed System involving the Private Seed Sector to make quality seed available in adequate quantity to the farmers at their doorstep.
- Mobilize higher and targeted investments in research and innovation capacities, technologies and infrastructure development for promoting local food systems that are in alignment with the national priorities.
- Encourage participation and establish participatory stakeholders' platform, including research, academia, industry, professional communities, NGOs, and farmers/farmer communities. For example, co-investment and in-kind support can be ensured by developing right partnerships/ networks among the national organizations like ICAR, ICMR, CSIR and others. This would demand effective coordination and convergence through effective planning and monitoring at the national level.
- Strengthen South-South Cooperation (SSC) for knowledge sharing, joint R&D, germplasm exchange and technology transfer.

Program

I. INAUGURAL SESSION (14.00-14.35 IST)		
Chair:		**R.S. Paroda**, President, ISPGR & Chairman, TAAS
Chief Guest:		**T. Mohapatra**, Secretary, DARE & DG, ICAR
Guests of Honour:		**Juan Lucas Restrepo**, DG, Alliance of Bioversity International and CIAT **Jacqueline d'Arros Hughes**, DG, ICRISAT
Moderator:		**Bhag Mal**, Secretary, TAAS
14.00-14.04	**Welcome and Context of the Consultation**	**Anuradha Agrawal**, General Secretary, ISPGR, & Principal Scientist, ICAR-NBPGR, Delhi
14.04-14.11	**Address by Guest of Honour**	**Juan Lucas Restrepo**, DG, Alliance of Bioversity International and CIAT, Rome
14.11-14.18	**Address by Guest of Honour**	**Jacqueline d'Arros Hughes**, DG, ICRISAT, Hyderabad
14.18-14.28	**Address by Chief Guest**	**T. Mohapatra**, Secretary, DARE & DG, ICAR, Delhi
14.28-14.35	**Remarks by Chairperson**	**R.S. Paroda**, President, ISPGR and Chairman, TAAS, Delhi
II. THEMATIC PRESENTATIONS (14.35-16.05 IST) **Status and Strategies for the Future of Local Food Systems**		
Co-chairs:		**P.L. Gautam**, Former Chairman, NBA & PPV&FRA **A.K. Singh**, DDG (HS), ICAR
Moderator:		**Prem Mathur**, Consultant, Kirkhouse Trust and UNDP
14.35-14.50	Millets and other Nutri-cereals	**V.A. Tonapi**, ICAR-IIMR

14.50-15.05	Major and Minor Legumes	**N.P. Singh**, ICAR-IIPR
15.05-15.25	Fruits and Vegetables	**B.N.S. Murthy**, ICAR-IIHR
15.25-15.40	Spices and Medicinal Plants	**S.N. Saxena**, ICAR-NRCSS
15.40-15.55	Plant-based Nutrition Security	**S. Devindra**, ICMR-NIN
15.55-16.05	Discussion and Concluding remarks by Co-Chairs	
III. PANEL DISCUSSION (16.05-17.00 IST)		
Co-chairs:	**R.S. Paroda**, President, ISPGR & Chairman, TAAS **Stephan Weise**, Managing Director, Asia, Alliance of Bioversity International and CIAT	
Moderator:	**Sunil Archak**, Editor-in-Chief, ISPGR & National Fellow, ICAR-NBPGR	
16.05 – 16.11	**Ashok Kumar**, Director, ICAR-NBPGR, Delhi	
16.11 – 16.17	**Bharat Kakate**, President & Managing Trustee, BAIF, Pune	
16.17 – 16.23	**Prakash Tyagi**, Executive Director, GRAVIS, Jodhpur	
16.23 – 16.29	**Atul Jain**, Secretary, DRI, Chitrakoot	
16.29 – 16.35	**Rajeev Varshney**, Director, Center of Excellence in Genomics & Systems Biology, ICRISAT, Hyderabad	
16.35 – 16.41	**J.C. Rana**, Country Representative, India Office, Alliance of Bioversity International & CIAT, Delhi	
16.41-16-57	Discussion and Concluding remarks by Co-Chairs	
16.57 – 17.00	***Vote of Thanks by*** **Sonal Dsouza**, Alliance of Bioversity International & CIAT, New Delhi	

List of Organizers and Invitees

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1.	**Dr. R.S. Paroda** President, Indian Society of Plant Genetic Resources (ISPGR), New Delhi & Founder Chairman, Trust for Advancement of Agricultural Sciences (TAAS) Avenue II, Indian Agricultural Research Institute, Pusa Campus, New Delhi - 110 012, India *raj.paroda@gmail.com*	
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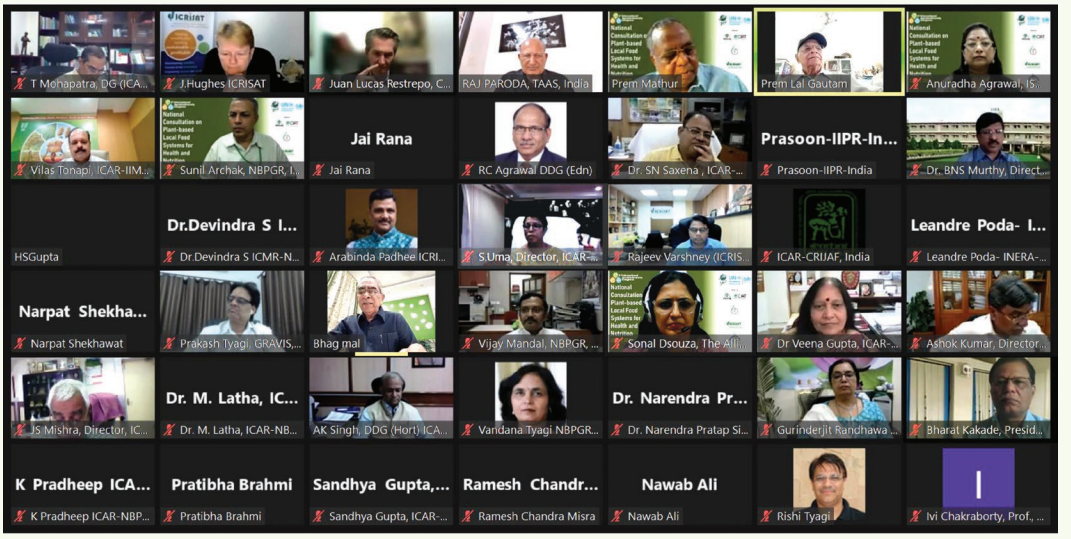
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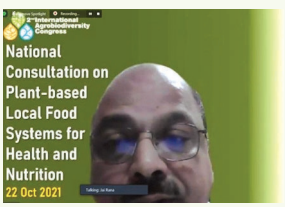
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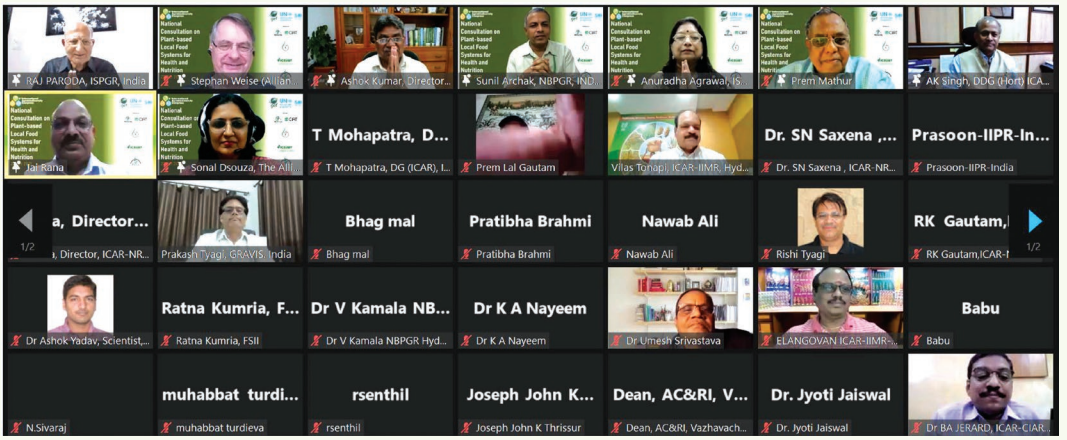
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