Sustainable Horticulture Development and Nutrition Security

volume III

Food and Nutrition Security

Prem Nath
SUSTAINABLE HORTICULTURE DEVELOPMENT AND NUTRITION SECURITY

Volume III: Food and Nutrition Security

Compiled by

Dr. Prem Nath

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Dr. Prem Nath Agricultural Science Foundation (PNASF), Bengaluru, India
Dedicated to

All stakeholders engaged in horticulture and in attaining nutrition security in the developing world.

—PNASF
In the wake of national and global call on promoting nutrition security, horticultural crops have emerged as promising providers of nutrient-rich food resources. During the last 50 years, the production and consumption of fruits and vegetables have increased significantly, followed by the increase in human population across the globe.

But the fact remains that about 805 million people are suffering from hunger and malnutrition and over three billion people are suffering from micro-nutrient deficiencies, which calls for immediate remedial measures towards healthy life of the people.

In order to promote production and consumption of fruits and vegetables, there is a need for taking concrete steps toward sustainable horticultural development, which will sustain food and nutrition security of the people.

The PNASF has the mission to promote agricultural education, research and development with major focus on food and nutrition security. Between 2009 and 2016, the PNASF had prepared and published 5 volumes of the Basics of Human Civilization- Food, Agriculture and Humanity. During 2017, the PNASF launched another book series on Food and Nutrition Security. The Volume I namely, *Attaining Food and Nutrition Security in the Developing World* was published recently. The Volume-II of this series, namely *Cycle of Nutrients, Nutrition and Nutrition Security in Earth, Plant, Livestock and Human* is in the press. The present Volume-III, *Sustainable Horticultural Development and Nutrition Security* is being published now.

The present volume has 9 chapters, 32 articles by 21 authors/co-authors of national and international repute. The PNASF acknowledges their valuable contribution with gratitude and thankfulness.

The valuable messages provided by known personalities, Shri. T.B. Jayachandra, Minister for Law, Parliamentary Affairs and Minor Irrigation, Government of Karnataka; Shri M.V. Rajasekharan, former Union Minister of State for Planning, Government of India; and Dr. D.L. Maheswar, Vice-Chancellor, University of Horticultural Sciences, Bagalkot, Karnataka; are very much welcomed and gratefully acknowledged by the Board of Trustees of the PNASF.

We are highly grateful to the Technical Team and Editorial Board consisting of Dr. C.P.A. Iyer, Dr. O.P. Dutta, Dr. K.R.M Swamy, Dr. B.S. Prabhakar, Mr. P.N. Krishnamoorthy and Mr. P.B. Gaddagimath who made unfailing efforts to review and edit the book. All of this was not possible without the support of the secretariat staff, Mrs. Vanita Vinay, who worked hard on the details of the publication.

On behalf of the Board of Trustees, I express my gratitude to PNASF Senior Scientific Councillors for their valuable suggestions. The contribution of the Technical Advisory Committee members during the brain storming sessions on the preparation of the book is appreciated very much.

On behalf of the PNASF, I extend my thanks to Scientific Publishers, Jodhpur, who readily agreed to make this joint publication in this beautiful form and presentation.

May 20, 2017

Prem Nath

Chairman, PNASF, Bengaluru,  
Former Asst. Director General,  
Food & Agriculture Organization of the United Nations (FAO-UN)
MESSAGE

Horticulture plays an important role in health and welfare of the people. The state of Karnataka, has been one of the leading states of the nation in producing horticultural crops and the state has been the first one to recognize its underlying significance and to establish the Department of Horticulture in the Ministry of Agriculture to support the growers, entrepreneurs and consumers alike.

In the present world, about 805 million people are suffering from hunger and malnutrition and over 3 billion people are suffering from micro-nutrient deficiencies leading to serious human diseases. Horticultural products are the major source of micro-nutrients and hence, play an important role of horticulture in human nutrition and nutrition security. FAO & WHO have already recommended 400g of fruit and vegetables per capita per day for improving human health.

The P.N. Agricultural Science Foundation (PNASF), Bengaluru has been doing pioneering work in preparing and publishing valuable books related to Food, Agriculture, Horticulture and Food and Nutrition Security and other important aspects related to Food and Agriculture/Horticulture. The present book entitled, “Sustainable Horticulture Development and Nutrition Security”, meets the demand of the information and technology on the subject required by the readers in the present context of Food and Nutrition Crisis. The book attempts to cover all aspects on this subject for the benefit of policy makers, academicians, researchers, teachers and farmers.

I take this opportunity to congratulate PNASF, and thank all authors for bringing out this useful publication.

(T.B. Jayachandra)
MESSAGE

I am indeed overwhelmed to learn, that Dr. Prem Nath Agricultural Science Foundation, founded and chaired by one of the outstanding and very distinguished agriculture and horticulture scientist of the world repute is preparing a new book entitled, “Sustainable Horticulture Development and Nutrition Security”, in response to national and global call by all stakeholders for integrating a very serious, ever increasing problem of hunger and nutrition crisis.


Dr. Prem Nath at his advanced age keeps everybody inspired by his dedicated and committed work and by his unbelievable contributions in the field of science and technology, especially agricultural and horticultural sciences. I pay my tributes to him.

(M.V. Rajasekharan)
MESSAGE

I am delighted to write a message for the book entitled “Sustainable Horticulture Development and Nutrition Security”, is a pioneering effort to collate and provide information in one compilation. It is heartening to note that, Horticulture legendry Dr. Prem Nath, Chairman, PNASF, for publishing the book in the wake of national and global call for mitigating hunger and nutritional crisis, for the benefit of stakeholders and society.

Malnutrition is the largest threat to Global Health; Over 900 million people in the world are undernourished. Despite India’s 50% increase in GDP since 1991, more than one third of the world’s malnourished children live in India. Among these, half of them under 3 are underweight and a third of wealthiest children are over-nourished. The World Bank estimates, that India is one of the highest ranking countries in the world for the number of children suffering from malnutrition.

The relationship between human being and food is permanent, and the resources of food may survive in nature without human intervention, but human being cannot remain alive without food. Thus, addressing issues of food and nutrition security attains its priority among the major issues of food, clothing and shelter for human kind. Moreover, dealing with health issues becomes equally important in the wake of prevailing diseases and health disorders. Recent experimental studies by the WHO has concluded, that adequate consumption of vegetables and fruits prevents certain non-communicable diseases, such as, cancer, blood pressure, diabetes and above all growing obesity among young and old in many regions of the world. In this connection, horticulture sector plays an important role in food security, nutrition and health security and employment generation and its impact on economic growth.

Horticulture is the fastest growing sector, contributes to poverty alleviation, nutritional security and have ample scope for farmers to increase their income and helpful in sustaining large number of agro-based industries, which generate huge employment opportunities.

Rapidly growing demand for horticultural products, especially burgeoning market for processed fruits and vegetables, as well as booming floriculture market is an evidence
of the phenomenon which is expected to accelerate horticultural growth in the country. Consequently, horticulture is set to assume a greater role and importance within the agriculture sector and eventually in the national economy. As a result of a number of thoughtful research, technological and policy initiatives and inputs, horticulture in India, today, has become a sustainable and viable venture for the small and marginal farmers. Besides, this sector has also started attracting entrepreneurs for taking up horticulture as a commercial venture. Therefore, there is a great scope for accelerating agricultural development through expansion of horticultural crops.

I compliment the editors for compiling the selected articles from national and international lead sources to bring out a most essential and needful book with a coverage of quite relevant and appropriate subjects, which will contribute in pursuit of ones quest to find solutions for sustainable horticulture development. My best wishes for praiseworthy publication.

Place: UHS, Bagalkot

(D. L. Maheswar)
Dr. Prem Nath obtained his Ph.D. Degree in Horticulture from the Kansas State University, Manhattan, USA during 1962. Since then, Dr. Nath has been serving in different national and international institutions, in various capacities and in different countries, in food and agriculture sector for more than 50 years.

As Professor and Senior Scientist, he served at Indian Agricultural Research Institute, New Delhi; University of Udaipur, Rajasthan; Indian Institute of Horticultural Research, Hessarghatta, Karnataka and at Nigerian Institute of Horticulture Research, Ibadan, Nigeria during the period 1962-79.

As FAO Research Team Leader, he served at Nigerian Institute for Horticultural Research, Nigeria; National Centre for Horticultural Research and Development Centre, Saudi Arabia; and National Agricultural Research Authority, Yemen Arab Republic during the years 1979-90.

During 1990-94, Dr. Nath served as FAO Regional Team Leader for Asia and Pacific, Middle East, North Africa and Europe Services, Agricultural Field Operations Division, FAO, Rome.

Dr. Prem Nath served as the Special Adviser for Food Security to Director General, FAO, Rome (1994-96). He had a diplomatic position as FAO Resident Representative, Myanmar during 1996-98.

As International Senior Executive, Dr. Prem Nath retired as the FAO Assistant Director General and Regional Representative at the FAO Regional Office for Asia and the Pacific, Bangkok, Thailand by the end of 1999.

Since 2000, Dr. Nath continues to serve as the Chairman of the Dr. P.N. Agricultural Science Foundation (PNASF), Bengaluru. During November, 2002, Dr. Nath was nominated as Convener of the Vegetable Science International Network (VEGINET) by the General Assembly of the International Conference on Vegetables (ICV-2002), and during November, 2009 he was nominated as Chairperson of VEGINET by the International Conference on Horticulture (ICH-2009). During 2012 and 2014, he was nominated as the Chairperson of the SEA VEG Coordination Committee in Thailand.

With the mission to promote agricultural education, research and development with focus on food and nutrition security, the PNASF was launched during the beginning of the new millennium (2000), and has made significant achievements under the Chairmanship of Dr. Prem Nath. He organized successfully two international conferences (International Conference on Vegetables ICV-2002 and International Conference on Horticulture ICH-2009) and also was instrumental in organizing FAO International Workshop on Urban and Peri-urban Agriculture for Asian Countries (UPA-2005); SEAVEG/DOA/AVRDC/ AARNET/VEGINET/ HSSI Regional Symposium on High Value Vegetables in Southeast Asia (SEAVEG-2012) in Chiang-Mai, Thailand; FAO/PNASF Regional Workshop on Strengthening Urban and Peri-urban Agriculture towards Resilient Food system in Asia (UPAFSA-2013) at Bangkok, Thailand; and ISEC/PNASF Seminar on Development Trends in Urban and Peri-urban Agriculture, August 2013, Bengaluru. He also assisted
other national and international institutions to organize symposia on Horticulture/Agriculture and actively participated in then.

During his research career, Dr. Nath developed a number of vegetable varieties which were widely adapted by growers and as professor, he guided a number of M.Sc. and Ph.D. students.

During his career, Dr. Nath led and assisted in establishing a number of research institutions in horticulture and agriculture in India, Nigeria, Saudi Arabia and Yemen Arab Republic. He developed and guided a number of national, regional and inter-regional field projects on food and agriculture to its success in different countries.


The Basics of Human Civilization-Food, Agriculture and Humanity, the brain-child of Dr. Prem Nath was laid out by him in 5 volumes, and he is the author of number of papers in these volumes. Dr. Prem Nath is the author of Volume-IV: Humanity with the title, “Humanity in Humans, by Humans and for Humans in Securing Food for All”.

The latest publication of Dr. Prem Nath is the **Volume-I**, of the *Food and Nutrition* series, namely, “**Attaining Food and Nutrition Security in the Developing World**” (2017).
**THE TECHNICAL AND EDITORIAL TEAM**

**Dr. C.P.A. Iyer** obtained M. Sc and Ph.D. degrees in Horticulture from the Post Graduate School, I.A.R.I., New Delhi and did his post doctoral research at the Institute of Horticultural Plant Breeding, Wageningen, the Netherlands, in 1965-66.

Dr. Iyer served as Geneticist (Fruits) at the Indian Institute of Horticultural Research, Bengaluru, in 1968 and later became the Head of the Division of Fruit Crops at the same Institute. He was the All India Project Coordinator for fruits and coordinated research project on fruits on an all India basis. Subsequently appointed as Director, Central Institute of Horticulture, Lucknow, India.

Dr. Iyer was the International Horticulturist of FAO in a Mango Project of UNDP/FAO in Bangladesh. Subsequently, he was a FAO Consultant for many projects in Nigeria, Myanmar and Bangladesh. Dr. Iyer has traveled extensively worldwide.

Evolved many hybrid varieties in mango, guava and papaya. Dr. Iyer was invited by the CSIRO, Australia to take up the prestigious McMaster Fellowship to organize the Australian National Mango Breeding Project, which he successfully carried out in 1994. Dr. Iyer has published more than 200 papers in scientific journals. Has guided many students for their M. Sc and Ph.D. degrees.

**Dr. O.P. Dutta** obtained his Ph.D degree in Horticulture from the University of Agricultural Sciences, Bengaluru during 1981.

He has thirty three years of research experience in breeding tropical vegetables for high yield, nutritional qualities and resistance to multiple stresses, twenty five years of experience in hybrid seed production, breeder seed production and production of tropical vegetables and sixteen years of experience in Research Management as Head, Division of Vegetable Crops at IIHR, Bengaluru; planned organized and monitored the activities of 8 Research Laboratories having 18 projects and 17 scientists in the Division of Vegetable Crops at IIHR, Bengaluru.

At Namdhari Seeds Pvt. Ltd., Bengaluru he has developed commercially viable 54 varieties in tropical vegetables, such as, tomato (4), hot pepper (3), watermelon (20), melon (10), gourds (6) and beans (11), gaining 70% market share at the national level.

He has established a sound vegetable seed production system in Bangladesh under the FAO Vegetable Seed Project (GCP/BGD/025 and 028/DEN) jointly funded by DANIDA and Belgium Government 1996-1999. He has provided technical guidance pertaining to vegetable production, vegetable seed production, vegetable breeding to SAARC countries, under SAVERNET programme.
Dr. K.R.M. Swamy is a former Principal Scientist and Head, Division of Vegetable Crops, IIHR, Bengaluru. He obtained his Ph.D. in Horticulture from University of Agricultural Sciences, Bengaluru, in 1984. He has worked in ICAR Research Institutes for 33 years in various capacities. His field of specialisation is Vegetable Breeding, Collection and Conservation of Cashew Genetic Resources, Cashew improvement, Vegetative Propagation of Cashew and Nursery Management. He has handled several research projects and has contributed in the development and release of four high yielding vegetable varieties and three high yielding cashew varieties. He has established the National Cashew Gene Bank (NCGB) at NRC for Cashew, (presently Directorate of Cashew Research - DCR), Puttur, for 451 clonal germplasm accessions of cashew, standardised the “Softwood Grafting Technique for Cashew” and recommended the same for commercial multiplication of cashew varieties; established “Cashew Scion Banks” for 25 released varieties of cashew; established “Cashew Nurseries” both at Shantigodu and Puttur campuses of NRCC. Dr. Swamy has over 200 publications to his credit, which include 39 research papers, 24 seminar/symposia/conference papers, 28 book chapters, 77 popular articles, 22 technical bulletins, 5 extension folders, 5 teaching manuals, 1 technical report, authored/co-authored 5 books and edited/co-edited 8 books/souvenirs.


Dr. Prabhakar took a Study Tour on “Advanced training in protected cultivation of vegetables and flowers, USA and Canada”, 1991; As an accomplished agronomist, he contributed significantly in realizing the potential yield of vegetable varieties and hybrids grown in the open field, as well as under protected cultivation using hydroponics organic, inorganic production technologies to a sole crop, and in horticultural based cropping systems.

In his academic career, he guided several M. Sc. & Ph. D. students in Horticulture from University of Agricultural Sciences, Bengaluru and is the author of more than 100 research publications, scientific abstracts, popular articles, technical bulletins, chapters in books and videos.
Mr. P.N. Krishna Moorthy obtained B. Sc (Agri) and M. Sc (Agri. Entomology), in 1972 and 1976, from University of Agricultural Sciences (UAS), Bengaluru.


Associate and PI of the USIF project on “Insect Pest Management in Vegetable crops utilizing thresholds and statistical models” (1992-1997) funded by USDA. Worked in the “South Asian Vegetable Research Network” (SAVERNET) on the IPM of vegetables sponsored by ADB through AVRDC, Taiwan. CC-PI of National Agriculture Technology Project (NATP) “Validation and Promotion of IPM in selected crops in different agro-ecological regions- Vegetables” (2001-2004), Co-PI of the NATP project “Production of pesticide free vegetables” (2000-2004).

Mr. Pulakeshi Basayya Gaddagimath obtained his post graduate in Organic Chemistry from Karnataka University, Dharwad in 1978 and served as a Lecturer in Kittle Science College, Dharwad till 1982. His interest in Mass Communication made him to leave the teaching job and join post graduate course in Mass Communication and Journalism in 1982 as a regular student and graduated from Karnataka University Dharwad in 1984.

During his post graduation in Mass communication and Journalism, he served many national news papers until he joined as Jr. Scientific Officer, at Directorate of Oilseed Research, Hyderabad in 1985. He joined the Indian Institute of Horticultural Research, Bengaluru in 1989, as Information and Publication Officer.

As a media person he has anchored/conducted more than 40 T.V. programmes and live programmes on Doordarshan on various aspects of agriculture. He was also a consultant for developing scripts for documentaries and interactive CDs and has scripted more than 10 documentaries on rural water supply and sanitation. Apart from a good number of official publications at IIHR, Bengaluru and DOR, Hyderabad, he has authored two books, edited four books (two international), published three books and written many technical and popular papers.
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ABBREVIATIONS

AARNET: The ASEAN-AVRDC Regional Network
ACC: 1-Aminocyclopropane-1-Carboxylic Acid
ACOTTA: Autonomous Council of Technology Transfer in Agriculture
ADB: The Asian Development Bank
AEs: Agri-Entrepreneurs
AFTA: The ASEAN Free Trade Area
AICRPs: All India Coordinated Crop Research & Improvement Programmes
AIDS: Acquired Immune Deficiency Syndrome
AIR: All India Radio
Al: Adequate Intakes
AMUL: Anand District Milk Producers Union Ltd. (Anand Milk Union Limited)
ANBC: Annual Net Bank Credit
AOA: Agreement on Agriculture
APEDA: Agricultural and Processed Food Products Export Development Authority
APMC: Agricultural Produce Market Committee
ARIMA: Auto Regressive Integrated Moving Average
ARMF: Automate Agricultural, Rural & Micro-Finance
ASI: Agribusiness Systems International
ASLA: American Society of Landscape Architects
ATMA: Agriculture Technology Management Agency
ATP: Adenosine Triphosphate
AUP: Administrative Use Permit
AVRDC: Asian Vegetable Research and Development Centre (The World Vegetable Center)
BARC: Bombay Atomic Research Centre
BAS: Biologically Active Substances
BBMP: Bruhat Bengaluru Mahanagara Palike
BDA: Bengaluru Development Authority
BESO: Building Energy Saving Ordinance
BGGCOMS: The Bengaluru Grape Growers’ Cooperative Marketing and Processing Society Ltd
BGREI: Bringing a Green Revolution to Eastern India
BHOPCOMS: The Bengaluru Horticultural Producer’s Cooperative Marketing and Processing Society Ltd.
BMRCL: Bengaluru Metro Rail Corporation Ltd.
CA: Controlled Atmosphere
CAM: Crassulacean Acid Metabolism
CBOs: Community Based Organizations
CBSE: Central Board of Secondary Education
CCTVs: Closed-Circuit Television
CDCP: Certified Data Centre Professional Training Programme
CDI: Centre for Development Innovation
CITYNET: Regional Network of Local Authorities for the Management of Human Settlements
CMC: Christian Medical College
CN: Cetane Number
COAG: Committee of Agriculture meeting
CODEX: Careful Obliging Dependable Easygoing Xenial
CPB: Colorado Potato Beetle
CPCRI: Central Plantation Crops Research Institute
CPI: Consumer Price Index
CPRI: Central Potato Research Institute
CRS: Corporate Social Responsibility
CSA: Community gardens, Community Supported Agriculture
CSIRO: Commonwealth Scientific and Industrial Research Organisation
CSRI: Central Scientific and Industrial Research
CT: Cholera Toxin
CVDs: Cardiovascular Diseases
CWR: Crop Wild Relatives
DAC: Department of Agriculture and Cooperation
DARE: Department of Agriculture Research and Education
DBM: Diamondback Moth
DDG: Deputy director General
DDT: Dichlorodiphenyltrichloroethane
DI: Dissemination Index
DIHAR: Defense Institute of High Altitude Research
DLHS: District Level Health Surveys
DNA: Deoxyribonucleic Acid
DOA: The Department of Agriculture, Thailand
DRDO: Defence Research and Development Organization
DRIs: Dietary Reference Intakes
DSCL: DCM Shriram Consolidated Ltd.
DSS: Decision Support System
DTH: Direct-To-Home
EARs: Estimated Average Requirements
EBMUD: East Bay Municipal Utility District
ECB: European Corn Borer
ED: Electro-Dialysis
EEI: Extension Education Institutes
EFILWC: European Foundation for the Improvement of Living and Working Conditions
EIU: Economist Intelligence Unit
eNAM: e-National Agriculture Market
EPN: Entomo Pathogenic Nematodes
ESG: Environmental Support Group
EU: European Union
F&V: Fruits and Vegetables
FAO: Food and Agriculture Organization of the United Nations
FELDA: Federal Land Development Authority
FFV: Fresh Fruits and Vegetables
FHFI: Fight Hunger First Initiative
FIFA: Federation International de Football Association
FIGs: Farmer Interest Groups
FLDs: Frontline Demonstrations
FPO: Farmer Produce Organization
FRCs: Food Retail Chains
FVCC: Fruits and Vegetable Consolidation Center
FYM: Farm Yard Manure
GA: Gynaecological Age
GAIN: Global Alliance for Improved Nutrition
GAPs: Good Agricultural Practices
GCMMF: Dairy Cooperatives of Gujarat - Gujarat Cooperative Milk Marketing Federation Ltd.
GDP: Gross Domestic Product
GEAC: Genetic Engineering Approval Committee
GHG: Greenhouse Gas
GIDC: Gujarat Industrial Development Corporation
GIS: Geographic Information Systems
GM: Genetically Modified
GMOs: Genetically Modified Organisms
HACCP: Hazard Analysis and Critical Control Points
HDP: High Density Planting
HOPCOMS: Horticultural Produce Cooperative Marketing Society Ltd.
HPR: Host Plant Resistance
HRD: Human resource development
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>HSM</td>
<td>Hub and Spoke Model</td>
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<tr>
<td>HSST</td>
<td>Horticultural Science Society of Thailand</td>
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<tr>
<td>HVA</td>
<td>High-Value Agriculture</td>
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<tr>
<td>IARI</td>
<td>Indian Agricultural Research Institute</td>
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<tr>
<td>ICAR</td>
<td>Indian Council of Agricultural Research</td>
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<tr>
<td>ICDS</td>
<td>Integrated Child Development Services</td>
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<tr>
<td>ICH-2009</td>
<td>The International Conference on Horticulture</td>
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<tr>
<td>ICM</td>
<td>Institute of Commercial Management</td>
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<tr>
<td>ICMR</td>
<td>Indian Council of Medical Research</td>
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<tr>
<td>ICN-2</td>
<td>The International Conference on Nutrition</td>
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<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
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<tr>
<td>ICV-2002</td>
<td>International Conference on Vegetables-2002</td>
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<td>IDE</td>
<td>International Development Enterprises</td>
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<td>IFOAM</td>
<td>International Federation of Organic Agriculture Movement</td>
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<tr>
<td>IFP</td>
<td>Integrated Fruit Production Guide</td>
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<tr>
<td>IFPRI</td>
<td>International Food Policy Research Institute</td>
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<tr>
<td>IHR</td>
<td>Indian Institute of Horticultural Research</td>
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<tr>
<td>IIPM</td>
<td>Integrated Production and Protection Management</td>
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<tr>
<td>IISc</td>
<td>Indian Institute of Science</td>
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<tr>
<td>ITs</td>
<td>Indian Institute of Technology</td>
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<tr>
<td>INM</td>
<td>Integrated Nematode Management</td>
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<tr>
<td>IOBC</td>
<td>International organization for Biological and Integrated Control of Noxious Animals and Plants</td>
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<tr>
<td>IoT</td>
<td>Internet of Things</td>
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<tr>
<td>IPM</td>
<td>Integrated Pest Management</td>
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<tr>
<td>ISOCARP</td>
<td>International Society of City and Regional Planners</td>
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<tr>
<td>ISRO</td>
<td>Indian Space Research Organization</td>
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<tr>
<td>IT</td>
<td>Information technology</td>
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<tr>
<td>ITC</td>
<td>Indian Tobacco Company Limited</td>
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<tr>
<td>ITD</td>
<td>Innovations in technology dissemination</td>
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<tr>
<td>ITK</td>
<td>Indigenous Traditional Knowledge</td>
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<tr>
<td>ITPB</td>
<td>International Tech Park Bangalore</td>
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<tr>
<td>IWM</td>
<td>Integrated Weed Management</td>
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<tr>
<td>KAPC</td>
<td>Karnataka Agriculture Price Commission</td>
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<tr>
<td>KCC</td>
<td>Kisan Call Centre</td>
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<tr>
<td>KU</td>
<td>Kasetsart University</td>
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<tr>
<td>KVKs</td>
<td>Krishi Vigyan Kendras</td>
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<tr>
<td>LED</td>
<td>Light-Emitting Diode</td>
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<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
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</tbody>
</table>
LGBT: Lesbian, Gay, Bisexual and Transgender
MAHA FPC: MAHA Farmers Producer Company Ltd.
MAP: MapShots AgStudio Mobile Application Platform
MAS: Marker Assisted Selection
MDG: Millennium Development Goal
MDGS: Millennium Development Goals
MFI: Micro Finance Institution
MIDH: Mission for Integrated Development of Horticulture
MLE: Market-Led Extension
MRTN: Maximum Return To Nitrogen
MSP: Minimum Support Price
MSSRF: M. S. Swaminathan Research Foundation
MT: Metric Ton
MYRADA: A Bengaluru-Based Non-Profit Organization
NABARD: National Bank for Agriculture and Rural Development
NARES: National Agricultural Research and Education system
NATP: National Agricultural Technology Project
NBFC: Non-Bank Finance Company
NCDEX: National Commodity and Derivatives Exchange
NCDs: Non-communicable diseases
NCERT: National Council for Educational Research and Training
NERWA: North East Residents Welfare Associations
NF: M/s Namdhari Fresh
NFSM: National Food Security Mission
NGOs: Non Government Organizations
NGT: National Green Tribunal
NHANES-III: The Third National Health and Nutrition Examination Survey
NHB: National Horticultural Board
NHM: National Horticulture Mission
NMAET: National Mission of Agricultural Extension & Technology
NOx: Mono-Nitrogen Oxides
NPOP: National Programme for Organic Production
NPV: Nuclear Polyhedrosis Virus
NSC: National Seeds Corporation
NRC: Nutritional Rehabilitation Centre
NSC & SSCs: National and State Seed Corporations
NSKE: Neem Seed Kernel Extract
NSP: Neem Seed Powder
 NSSO: National Sample Survey Organisation
 NSW: New South Wales
 OECD: Organisation for Economic Cooperation and Development
 OFTs: On-Farm Testing
 OHCPIB: Organic Horticultural Crops Production Information Bank
 PDAs: Personal Digital Assistants
 PHC: Pre-Harvest Contractor
 PHT: Post Harvest Technology
 PLRV: Potato Leaf Roll Virus
 PM: Particulate Matter
 PMFBY: Pradhan Mantri Fasal Bima Yojana
 PMGSY: Prime Minister’s National Rural Roads Program
 PNASF: Dr. Prem Nath Agricultural Science Foundation
 PPb: Parts Per billion
 PPV&FR: Protection of Plant Varieties and Farmer’s Rights
 PRA: Pest Risk Appraisal
 PSL: Priority Sector Lending
 PSL: Priority Sector Lending
 PTC: Perimeter Trap Cropping
 PTM: Potato Tuber Moth
 PVP: Plant Variety Protection
 QTLs: Quantitative Trait Loci
 R&D: Research and Development
 RBI: Reserve Bank of India
 RDAs: Recommended Dietary Allowances
 RDI: Recommended Dietary Intake
 RE: Retinol Equivalent
 RETA: Regional Technical Assistance
 RIDF: Rural Infrastructure Development Fund
 RKKs: Rallis Kissan Kendras
 RKVY: Rashtriya Krishi Vikas Yojana
 RNA: Ribonucleic Acid
 RO: Reverse Osmosis
 RTF: Alternatively Ready To Fruit
 Rubisco SSU: 5-Bisphosphate Carboxylase/Oxygenase Small Subunit
 SAFAL: The Largest Organised Retail Network of Fruits and Vegetables in the National Capital Region of India
 SAMETIs: State Agricultural Management Extension Training Institutes
 SAM: Severe Acute Malnutrition
SAPPL: Shree Ajit Pulp and Paper Ltd.
SAR: Systemic Acquired Resistance
SAUs: State Agricultural Universities
SCERT: State Council for Educational Research and Training
SDGs: Sustainable Development Goals
SEA VEG: Southern East Asia Vegetable Symposium
SEP: School Feeding Programme
SFCI: State Farms Corporation of India
SFI: Syngenta Foundation India
SHG-BL: Self-Help Group Bank Linkage
SHGs: Self Help Groups
SJM: Swadeshi Jagaran Manch
SLA: State level Association
SMS: Spent Mushroom Substrate
SMSP: Sub-Mission on Seeds & Planting Material
SO₂: Sulphur Dioxide
SOC: Soil Organic Carbon
SPFS: Special Programme for Food Security
SSCs: State Seeds Corporation
TCDC: Technical Cooperation among Developing Countries
TDM: Time-Division Multiplexing
TDZ: Thidiazuron
TERI: The Energy Resource Institute
TLCV: Tomato Leaf Curl Virus
TOT: Transfer of Technology
UAV: Unmanned Aerial Vehicle
UILs: Upper Intake Levels
UN DESA: Department of Economic and Social Affairs of the United Nations
UNDP: United Nations Development Programme
UN-DSEA: UN Department of Economics and Social Affairs
UNESCO: United Nations Educational, Scientific and Cultural Organization
UNIBPGR: United Nations International Board for Plant Genetic Resources
UNICEF: United Nations Children’s Fund is a United Nations programme
UNO: United Nations Organization
UP: Use Permit
UPA: Urban and Peri-urban Agriculture
UPAFSA-2013: Regional Workshop on Strengthening Urban and Peri-urban Agriculture towards Resilient Food System in Asia
UPH: Urban and Peri-urban Horticulture
URBACT: European Exchange and Learning Programme Promoting Sustainable Urban Development
USAID: United States Agency for International Development
USDA: United States Department of Agriculture
USGBC: U.S. Green Building Council
VCM: Value Chain Model
VEGINET: Vegetable Science International Network
VHT: Vapor Heat Treatment
WFP: World Food Programme
WFS-1996: World Food Summit-1996
WHO: World Health Organization
WST: Wireless Sensor Technologies
WTO: World Trade Organization
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