



## Centre for Fruitful India (CFI) Initiative: Harnessing Fruit-Tree Diversity as a Nature-Positive Solution for Food and Nutrition Security and Planetary Health

**Minutes and Action points  
CFI's scientific Committee meeting (24-02-25)**

**The Alliance of Bioversity International and CIAT**



## **Who participated:**

### **Present offline:**

1. Dr V. B. Patel (Assistant Director General, Indian Council of Agricultural Research), New Delhi
2. Dr Suresh K Malhotra, Vice Chancellor Maharana Pratap Agricultural University, Karnal, Haryana
3. Dr R. Uma Shaanker, Professor and Emeritus Scientist (Retd) and Co-Founder ATREE, Bangalore, Karnataka
4. Dr Geeta Joshi, Scientist & Assistant Director General (Media & Extension), Indian Council of Forestry Research and Education, Dehradun, Uttarakhand
5. Dr Rekha Warriar, Senior Principal Scientist, Institute of Forest Genetics and Tree Breeding, Coimbatore.
6. Dr Ruchika Singh, Executive Program Director - Food, Land and Water, WRI India. New Delhi
7. Dr T Longvah, Centre for Indigenous Peoples' Food Systems, based in Dimapur, Nagaland.
8. Dr G Ravikanth, Sr. Fellow & Convenor, ATREE Academy, Ashoka Trust for Research in Ecology and the Environment, Bengaluru, Karnataka
9. Dr J C Rana, Country Director, The Alliance of Bioversity International and CIAT, India Country Office, New Delhi
10. Dr Prem Mathur, Technical Advisor (Agroecology and fruit trees), The Alliance of Bioversity International and CIAT
11. Dr Smitha Krishnan, Sr. Scientist, The Alliance of Bioversity International and CIAT
12. Dr Sarika Mittra, Consultant, The Alliance of Bioversity International and CIAT
13. Dr Harinder Vishwakarma, Consultant, The Alliance of Bioversity International and CIAT
14. Sonal Dsouza, Associate Manager - Partnerships Asia, The Alliance of Bioversity International and CIAT
15. Gaurav Srivastava, Programme Assistant, The Alliance of Bioversity International and CIAT
16. Disha Sanwal, Programme Coordinator, Centre for Fruitful India, The Alliance of Bioversity International and CIAT

### **Present online:**

17. Dr Stephan Weise, Managing Director for Asia at The Alliance of Bioversity International and CIAT
18. Dr Umesh Maheswari, Founder of the 'Fruitful India Fund'
19. Dr Chris Kettle. Principal Scientist, Multifunctional Landscape, The Alliance of Bioversity International and CIAT

### **Absent:**

20. Dr. Prabhat Kumar, Horticultural commissioner, Government of India.
21. Dr. Sanjay Kumar Singh, Deputy Director General, Indian Council of Agricultural Research.
22. DR. Gina Kennedy, Principal Scientist, Periodic Table of Food Initiative; Food Environment & Consumer Behaviour (FECB), Alliance of Bioversity International and CIAT.
23. Dr. Ruchi Pant, Head of Climate adaptation, NRM and Biodiversity, UNDP India office.
24. DR. Prakash Tyagi, Executive Director, Gramin Vikas Vigyan Samiti (GRAVIS), Jodhpur, Rajasthan.

## **Executive Summary:**

The Centre for Fruitful India (CFI) aims to enhance the availability and affordability of nutritious fruits, address malnutrition, and promote sustainable agricultural practices. The first Scientific Committee (SC) meeting focused on building partnerships, integrating fruit trees into agroecological systems, developing precision management technologies, and promoting climate resilience in fruit cultivation. The meeting emphasized the importance of diversifying fruit cultivation practices, supporting national policy frameworks, and selecting strategic fruit species for cultivation.

### **Key points discussed include:**

1. **Building Partnerships:** Collaborations with academia, government institutions, NGOs, civil societies, farmers, and the private sector are crucial for resource mobilization, knowledge sharing, policy support, community engagement, and market access.
2. **Integrating Fruit Trees into Agroecological Systems:** Implementing agroforestry systems, selecting suitable species, diversifying fruit tree species, and adopting proper soil and water management practices are essential for sustainability.
3. **Developing Precision Management Technologies:** Enhancing water and nutrient use efficiency through advanced tools and techniques can make fruit cultivation more affordable, sustainable, and profitable for smallholder farmers.
4. **Climate Resilience and Mitigation:** Developing climate-smart technologies and resilient fruit varieties can help farmers sustain fruit production, ensuring long-term sustainability, better access to nutritious fruits, environmental protection, economic stability, and climate change mitigation.
5. **Expanding Horizons in Fruit Cultivation:** Approaches such as rooftop gardens, vertical gardens, community gardens, agroforestry systems, home gardens, roadside plantations, orchards, cluster farming, and forest fringes can enhance fruit availability and accessibility while fostering community engagement and environmental conservation.
6. **Supporting National Policy Frameworks:** Collaborating with policymakers to advocate for supportive policies and engaging local communities and stakeholders to ensure initiatives meet community needs.
7. **Strategic Selection of Fruit Species:** Growing indigenous fruits like Mango, Guava, Custard Apple, Lemon, Jackfruit, Bael, and Tamarind, etc. as well as exotic fruits like Avocado, Blueberry, Dragon Fruit, Fig, Kiwi, Mangosteen, Passion Fruit, Rambutan, and Strawberry, etc. can enhance nutrition security, environmental sustainability, and economic stability.
8. **CFI's Agroecological Priorities:** Focusing on diverse agroecological zones such as Eastern and Western Himalayas, Indo-Gangetic Plains, Black Soil Regions, Deccan Plateau, Eastern Ghats, Western Ghats, and Arid and Semi-Arid Zones, where health related issues for poor people are severe, can address malnutrition and promote sustainable fruit cultivation.
9. **Fruit Diversity Promotion:** CFI's communication and media strategy comprises a website as an information hub, social media interaction, and the organization of national conferences and workshops to involve stakeholders and promote fruit diversity.

### **Suggested action plan:**

The Centre for Fruitful India (CFI) will partner with local governments and organizations to create roadside fruit tree plantations, collaborate with CSIR and ICAR for nutraceutical programs using indigenous fruits, and run awareness campaigns on their nutritional benefits. Additionally, panchayats will be engaged to allocate land and identify suitable crops for cultivation in wastelands. CFI will focus on developing and promoting precision management technologies for fruit cultivation, support startups

in using IoT-enabled irrigation and nutrition management systems and facilitate the transition from research to practical application through technology enablement. Emphasis will be placed on post-harvest management and the creation of value-added products, hosting festivals and awareness programs focused on indigenous fruits, expanding social media presence, and improving livelihoods by ensuring these fruits are affordable for low-income families. Clear success metrics will be defined to monitor progress and impact over the next eight years, focusing on agroecology research and positioning CFI as a technology hub to promote innovation in fruit cultivation

The meeting concluded with a commitment to advancing fruit cultivation as a nature-positive solution to benefit both people and the planet.

The invited SC members were welcomed by **Jai Rana**, Country Representative, Alliance of Biodiversity International and CIAT with presenting CFI-themed fruit baskets to participants, followed by a round of self-introductions. During his welcome remarks he introduced Alliance of Bioversity and CIAT as a part of CGIAR (Consultative Group on International Agricultural Research), which is a global partnership that unites international organizations engaged in research about food security. He gave the background of the Alliance formation in 2019, where Bioversity International and CIAT joined forces to create the Alliance of Bioversity International and the International Centre for Tropical Agriculture (CIAT), a global organization building on their complementary mandates and long collaboration, to respond to today's global challenges of climate change, biodiversity loss, environmental degradation, and malnutrition.

**Stephane Weise**, Managing Director for Asia at the Alliance of Bioversity International and CIAT, delivered the opening remarks. In his address, he provided historical context on the evolution of the Alliance, tracing its roots from the International Plant Genetic Resources Institute (IPGRI) to its current form as the Alliance of Bioversity International and CIAT. He emphasized that this transition reflects a pragmatic shift toward addressing the interconnected challenges of food security, nutrition, and environmental sustainability.

Welcoming participants and acknowledging their contributions to CFI, Stephan highlighted the Alliance's extensive work in conserving and utilizing fruit genetic resources. Since the 1990s, the Alliance has led multiple initiatives focusing on tropical fruit species in South and Southeast Asia and temperate fruit species in Central Asia. These efforts include creating an inventory of priority fruit species across regions, conserving traditional varieties, and enhancing farmer livelihoods through biodiversity restoration. He cited partnerships with key donors such as the Asian Development Bank (ADB), Australian Aid (AusAid), and UNEP-GEF, as well as collaborations with national partners in these regions. In five Central Asian countries, Alliance is working over the past 15 years promoting conservation and sustainable use of temperate fruit species (apples, grapes, pomegranates, and apricots). This project has resulted in the establishment of over 50 nurseries, producing more than 1.5 million seedlings annually leading to improved land reclamation and habitat restoration.

In India, the Alliance established a Field Genetic Garden in 2015 in collaboration with the University of Horticultural Sciences, Bagalkot, featuring species from the Western Ghats as a living laboratory. Additionally, the Alliance has been actively engaged in gender-responsive research, recognizing the critical role of women in conserving and utilizing fruit tree biodiversity. This includes knowledge exchange on grafting techniques, traditional fruit cultivation practices, and conservation of endangered varieties, such as the traditional mango orchard in Chittoor, Andhra Pradesh, which preserves over 18 mango varieties which are at risk of extinction.

Drawing from this wealth of experience, while highlighting the Alliance's ongoing initiatives, particularly in fruit tree cultivation, he expressed gratitude to Umesh Maheshwari, founder of the 'Fruitful India Fund', for supporting the Center for Fruitful India (CFI) Initiative. Stephane recognized CFI as a significant milestone in promoting fruit tree cultivation as a nature-positive solution and reaffirmed the Alliance's commitment to its successful implementation.

## Summary of Insights:

1. *Strengthen biodiversity conservation efforts* – Leverage the Alliance’s expertise to promote the conservation and use of fruit genetic resources for food security, nutrition, and environmental sustainability.
2. *Expand partnerships and donor support* – Continue collaborations with international organizations, national partners, and funding agencies to scale up fruit tree conservation and cultivation initiatives.
3. *Promote sustainable livelihoods* – Support farmers through biodiversity restoration, land reclamation, and the establishment of nurseries to enhance economic and environmental resilience.
4. *Advance gender-inclusive approaches* – Recognize and strengthen the role of women in fruit tree biodiversity conservation through targeted research and capacity-building programs.
5. *Facilitate knowledge exchange and capacity building* – Encourage the dissemination of traditional and innovative techniques and material exchange, to enhance fruit tree cultivation.
6. *Ensure the success of CFI* – Commit to the long-term implementation of the Centre for Fruitful India (CFI) Initiative as a model for sustainable fruit cultivation and food security.

**Umesh Maheshwari**, Founder of the ‘Fruitful India Fund’, shared the genesis of the Centre for Fruitful India (CFI) initiative, driven by his deep concern for malnutrition, particularly among children from low-income families. He emphasized that nutritious fruit trees serve as a natural and accessible source of essential nutrients. His vision is to address malnutrition in India by promoting fruit tree cultivation, ensuring that fruits are widely available and affordable while simultaneously contributing to climate change mitigation. Umesh underscored that CFI serves as a catalyst to bring together diverse stakeholders and facilitate innovative fruit cultivation methods. Unlike traditional agricultural approaches focused solely on production, he stressed the importance of enhancing accessibility - ensuring that fruit reaches those who cannot afford it. He expressed his appreciation for the formation of a Scientific Committee (SC), which unites experts from diverse fields, reinforcing the initiative’s collective strength.

He recounted the early stages of this initiative, explaining how he first realized the critical role of fruit trees in tackling malnutrition as fruits provide direct access to nutrition, as they do not require complex harvesting, processing, value addition, or marketing, making them an immediate food source for low-income families. Reflecting on climate change awareness in the early 2000s, he acknowledged that while research and development in clean energy solutions, such as solar panels, had progressed, their manufacturing processes contribute to environmental pollution. This realization led him to view fruit tree cultivation as an alternative, nature-based solution that simultaneously addresses both human development and environmental sustainability. He subsequently established a small fund to support such initiatives in India.

His initial step involved engaging with The ‘Nature Conservancy’ to assess India’s existing initiatives and gaps. While India had made significant progress in addressing malnutrition and environmental concerns, Umesh identified the need to integrate efforts, encourage knowledge-sharing, and explore new directions beyond traditional fruit research. He advocated for expanding fruit cultivation beyond farms, exploring alternative spaces such as rooftops, roadside and community lands plantations, and forest fringes. This approach would maximize accessibility, ensuring that fruit trees are integrated into urban and rural landscapes. Through this vision, he collaborated with the Alliance of Bioversity International and CIAT to establish CFI India (Safal Bharat), a platform dedicated to promoting fruit trees as a sustainable solution

for both nutrition security and climate resilience. In conclusion, he expressed his confidence in the knowledgeable and dedicated team supporting this initiative. He emphasized that through collaborative efforts, the initiative can successfully achieve its milestones.

#### **Summary of Insights:**

1. *Fruit Trees Diversity as a Solution to Malnutrition* – Nutritious fruit trees provide an accessible, cost-effective, and nutrient-rich food source, particularly for low-income families.
2. *Beyond Production: Focus on Accessibility* – The initiative prioritizes making fruits widely available and affordable rather than just increasing production volume.
3. *Nature-Based Solutions for Climate and Health* – Fruit tree cultivation serves as a dual-purpose strategy, addressing malnutrition and environmental sustainability simultaneously.
4. *Innovative Approaches to Fruit Cultivation* – Expanding beyond farms to rooftops, roadside and community lands plantations, and forest fringes can enhance availability in both urban and rural areas.
5. *Collaborative and Multi-Stakeholder Approach* – Bringing together scientists, policymakers, farmers, and organizations ensures a comprehensive and sustainable impact.
6. *Knowledge Sharing and Capacity Building* – Encouraging exchange of best practices and traditional knowledge can strengthen fruit cultivation efforts.
7. *Holistic Approach to Sustainability* – Addressing food security, nutrition, biodiversity conservation, and climate resilience in an integrated manner is key to long-term success.
8. *Empowering Local Communities* – Strengthening community participation in fruit tree planting enhances ownership, engagement, and long-term sustainability.
9. *Commitment to Innovation and Growth* – The initiative aims to explore new directions in fruit research and cultivation, moving beyond traditional agricultural models.
10. *Unified Vision and Dedication* – With a knowledgeable and committed team, achieving the initiative's goals and milestones is both feasible and impactful.

**Chris Kettle**, Principal Scientist at the Alliance of Bioversity International and CIAT, delivered a video message in which he apologized for his physical absence and expressed appreciation for the participants' contributions in advancing the Center for Fruitful India (CFI) mission. He highlighted that as the project evolves, the focus is now on enhancing fruit accessibility. He emphasized that the Scientific Committee (SC) plays a crucial role not only in providing scientific insights but also in addressing broader challenges related to food security, nutrition security, and sustainability. He stressed the importance of collaborative efforts to achieve these shared objectives.

#### **Summary of Insights:**

1. *Acknowledgment of Participants' Contributions* – Recognized the importance of collective participation in driving CFI's mission forward.
2. *Evolving Focus of CFI* – The project is shifting towards enhancing fruit accessibility for broader impact.
3. *Strategic Role of the Scientific Committee (SC)* – Beyond providing scientific inputs, the SC is instrumental in tackling food security, nutrition security, and sustainability challenges.
4. *Need for Collaboration* – Achieving CFI's objectives requires shared efforts and interdisciplinary cooperation.

**Prem Mathur**, Technical Advisor (Agroecology and fruit trees) at the Alliance of Bioversity International and CIAT, introduced the Centre for Fruitful India (CFI), outlining its vision, mission, aims, and objectives. His presentation, titled "*Promoting the Cultivation of Fruits for People and the Planet*", emphasized the

importance of fruit cultivation for both human well-being and environmental sustainability. He highlighted three key challenges in food and nutrition security: (i) *Accessibility* – Ensuring a diverse range of nutritious fruits is available; (ii) *Affordability* – Making these fruits economically viable for all, especially low-income families; and *Food & Nutrition Security* – Addressing gaps in fruit availability and consumption in India. Dr. Mathur provided a structured overview of CFI’s theoretical framework and progress, stressing the need for cross-disciplinary research to enhance fruit tree cultivation and improve food security. A summary of his presentation include:

**Objectives of CFI:** (i) Supporting cross-disciplinary research to address gaps in fruit tree cultivation and consumption; (ii) Promoting and disseminating research on improved fruit cultivation and consumption; and (iii) Establishing a CFI multistakeholder platform to bring together key actors in the field.

**CFI Action Plan:** To achieve its objectives, CFI is focused on: (i) Identifying and catalysing research to enhance nutritious fruit availability; (ii) Prioritizing thematic research areas for maximum impact; (iii) Securing and funding research efforts; (iv) Disseminating research findings to stakeholders; and (v) Raising awareness among policymakers, consumers, and funders.

**Theory of Change and Targets:** CFI as a research catalyst that integrates fruit tree biodiversity into government policy, civil society, and agriculture, contributing to: (i) Increased use of fruit diversity for nutrition security; (ii) Innovations in fruit cultivation to improve productivity and sustainability; (iii) Greater access to nutritious fruits, especially for low-income families; (iv) Sustainable cultivation methods that protect the environment; and (v) Conservation of fruit biodiversity, mitigating climate change and securing local and global benefits.

**Stakeholder Involvement:** Achieving these targets requires collaboration among key stakeholders, including: (i) *NGOs and civil society* – Advocacy and community engagement; (ii) *Private sector* – Investment in research and production; (iii) *Farmers* – On-ground implementation and adoption of best practices; (iv) *Academia* – Scientific research and innovation; and (v) *Government agencies* – Policy support and funding.

**CFI Governance Structure:** Dr. Mathur outlined the committees managing the CFI initiative and include: (i) *Executive Management Committee* – Oversees governance, provides strategic direction, and ensures external expertise input; (ii) *Advisory Board* – Guides the long-term vision and policy direction, mobilizes resources, and supports national priorities; and (iii) *Scientific Committee* – Ensures scientific rigor, contributes to planning, evaluates project strategies, and reviews research.

### **Summary of Insights:**

1. Fruit cultivation is vital for food security and environmental sustainability.
2. Key challenges include accessibility, affordability, and food security.
3. CFI works to improve fruit availability through research, collaboration, and policy.
4. Cross-disciplinary research and multistakeholder platforms are essential for CFI’s goals.
5. CFI's Theory of Change emphasizes biodiversity, innovation, and better fruit access for low-income families.
6. Committees within CFI ensure governance, scientific guidance, and policy advocacy.

His presentation sets the foundation for advancing fruit cultivation as a nature-positive solution to benefit both people and the planet.



**Disha Sanwal**, Programme Coordinator CFI, Alliance of Bioversity International and CIAT, outlined the social media strategy for CFI and its communication channels. She provided an overview of the CFI India website, which is currently under development. The website will feature several key sections, including: (i) Partner Us" Section: This may later be renamed "Partners" and will provide details on collaborations; (ii) Resource Hub: A dropdown menu will offer access to publications, databases, blogs, videos, research articles, podcasts, and other relevant materials; (iii) Gallery and Social Media Integration: The site will showcase images and provide links to social media platforms; and (iv) Promoters of Fruit Diversity Page: This section highlights CFI's mission and role in promoting fruit diversity for improved food and nutrition security. Additionally, she presented CFI's Social Media and Communication Strategy, which aims to engage various stakeholders through platforms like LinkedIn and Twitter. The strategy includes: (i) Sharing thought leadership content, partnership updates, success stories, and educational materials; (ii) Localized campaigns and live-streamed events to boost outreach; and (iii) Encouraging active engagement with research content, articles, and interviews on LinkedIn.

### **Summary of Insights:**

1. *CFI Website Development*: The site will serve as a central hub for information, partnerships, and resources on fruit diversity.
2. *Resource Hub & Social Media Strategy*: The platform will offer educational content, research materials, and updates to engage stakeholders.
3. *Promotion of Fruit Diversity*: CFI is positioning itself as a leader in promoting diverse fruit cultivation to enhance nutrition security.
4. *LinkedIn and Twitter Engagement*: These platforms will be used to share research, events, and success stories, while encouraging public participation.
5. *Encouraging Collaboration*: The website and social media channels aim to bring together policymakers, researchers, NGOs, and the public to support CFI's mission.

**V.B. Patel**, ADG Horticulture, ICAR, presented on "**Golden Revolution: Ushering Prosperity with Horticulture – Fruits Cultivation**," emphasized the significant role of horticulture science in driving India's agricultural progress, particularly through fruit cultivation. During his presentation, Dr Patel describe the progress made in horticulture sector, with focus on fruit production, challenges faced and suggested action to be considered for sustainable production of fruits in India, which are presented below:

*Golden Revolution and Horticulture Science*: The presentation highlighted the Golden Revolution, underscoring the importance of horticulture-led growth in India's agricultural prosperity, indicating that horticulture science has played a pivotal role in transforming India's fruit cultivation landscape.

*India's Horticultural Progress*: India's horticultural sector has seen a substantial leap, growing from 25 commercial crops in 1950 to over 210 crops in 2024-25. India now contributes 12% to the global share of fruits and vegetables.

*Research & Institutional Support*: Various research organizations, including ICAR institutes, National Research Centers (NRCs), and All India Coordinated Project (AICRPs) on various fruit trees, State Agricultural Universities (SAUs), and international collaborations, are driving fruit crop research. Over the past five years, significant advancements have been made, including bioreactor technology for bananas, backed by substantial financial investments.

*Vision for VIKSIT BHARAT 2047*: The presentation describe ambitious goals set for India's horticulture sector by 2047, including: (i) Increasing productivity from 15.45 MT/ha to 20.2 MT/ha; (ii) Reducing post-

harvest losses from 15% to below 5%; (iii) Expanding fruit processing from 3% to over 20%; and (iv) Enhancing the Gross Value Added (GVA) share of horticulture to 35%.

*Strategies for Growth and Sustainability:* (i) Technology interventions, policy reforms, and area expansion are crucial for driving horticulture growth; (ii) Enhancing productivity through crop improvement (genome editing, trait identification) and resource management (IoT, AI, mechanization); and (iii) Promoting crop diversification with high-value crops like berries, walnut, fig, and underutilized species such as jackfruit, Bael, and Annona.

*Health and Nutritional Benefits of Fruits:* (i) The presentation highlighted key fruits such as mango, pomegranate, jackfruit, Annona, aonla, and kokum, emphasizing their nutritional value and health benefits; and (ii) The need for mainstreaming minor horticultural crops due to their high nutritional potential was also emphasized.

*Pre-Harvest and Post-Harvest Management:* (i) Adoption of AI-based fruit maturity detection and shelf-life enhancement technologies; (ii) Promotion of value-added products with smart packaging, labelling, and traceability; and (iii) Integration of a circular economy by utilizing crop residues efficiently.

*Trade and Export Strategies:* (i) India's fruit trade trends from 2013-14 to 2022-23 indicate significant growth; (ii) Strategies to boost exports include developing export-oriented varieties, enhancing post-harvest infrastructure, diversifying export markets, and collaborating with global agencies for trade promotion.

*Import Substitution and Self-Sufficiency:* (i) Reducing reliance on imports by increasing domestic production of high-value temperate crops like apple, walnut, peach, and date palm; (ii) Development of sea route protocols for exporting perishable fruits such as grapes and mangoes; and (iii) Expansion of propagation material production to increase cultivation tenfold by 2047.

*Challenges and Research Needs:* Overcoming constraints in fruit research such as: (i) Prolonged juvenile phases of trees - requiring advanced breeding techniques; (ii) Limited disease-resistant genetic resources - necessitating international germplasm exchange; (iii) Need for climate-resilient varieties and mechanized farming solutions; (iv) Infrastructure and budget constraints - requiring policy support & funding; (v) Strengthening intellectual property (IP) management and private sector partnerships.

### **Summary of Insights:**

1. Horticulture Science is a key driver of India's Golden Revolution, ensuring food security, nutrition, and economic growth.
2. India has made significant strides in horticulture, with a major share in global fruit and vegetable production.
3. Technological advancements such as genome editing, AI, and IoT can enhance productivity and sustainability.
4. Crop diversification is essential for improving farmer incomes and food security.
5. Nutritionally rich fruits like mango, pomegranate, and jackfruit must be promoted for public health benefits.
6. Post-harvest management and processing are critical to reducing losses and increasing value-added products.
7. Trade and export strategies should focus on developing export-oriented varieties and expanding market access.
8. Reducing import dependency by enhancing domestic production of high-value fruits.

9. Policy support, funding, and research collaborations are needed to address challenges in fruit research and production.
10. A holistic and integrated approach involving scientific innovation, policy reforms, and farmer participation will drive India's horticulture success.

**S.K. Malhotra**, Vice-Chancellor of Maharana Pratap University of Agriculture, in his presentation underscores the significant potential of India's horticulture sector in enhancing agricultural productivity, reducing import dependency, and increasing farmers' incomes through strategic interventions in production, processing, marketing, and logistics. A holistic approach, including infrastructure development, policy support, and technology adoption, is essential to position India as a global leader in horticulture. The details of key areas covered by him are described below:

*Global Horticulture Scenario:* (i) Global fruit and vegetable production stands at approximately 1,850 million tonnes, accounting for 22% of total global food production; (ii) Developing countries experience post-harvest losses of up to 44% due to supply chain inefficiencies; (iii) Only 7-8% of total global fruit and vegetable production is traded internationally.

*India's Horticulture Sector:* (i) India is the second-largest producer of horticultural crops; (ii) The horticulture sector occupies 18% of agricultural land and contributes 33% to Gross Value Added (GVA); (iii) India achieved its highest-ever horticulture production of 351 million tonnes in 2022/23 from 28 million hectares; (iv) Despite significant production, India's share in global horticulture trade remains low: 1.7% for vegetables and 0.5% for fruits; and (v) Post-harvest losses in India range between 20-44% due to inadequate infrastructure.

*Production vs. Processing in India:* (i) India leads in horticultural production but lags in processing, with only 3% of produce being processed; (ii) Farm mechanization levels remain below 50%; (iii) Export shares of key fruits include: Pomegranate (7%), Mango (6%), Grapes (4%), Banana (1%), Apple (0.5%), Pineapple (0.2%); (iv) Strategies to reduce horticultural imports include promoting domestic production of exotic fruits, improving planting material, and investing in infrastructure; and (v) India imported 7.2 lakh tonnes of fresh fruits in 2022, doubling from 3.6 lakh tonnes in 2021.

*Horticultural Trade and Agricultural Export Policy:* (i) India's major fresh fruit imports in 2023 include apples (413,000 tonnes), oranges (153,000 tonnes), kiwis (67,247 tonnes), pears (25,000 tonnes), and others; (ii) The Agriculture Export Policy aims to increase agricultural exports from US\$30 billion to US\$60 billion and eventually reach US\$100 billion; and (iii) Focus areas include diversification of export products, value addition, indigenous crop promotion, and market access facilitation.

*Strategic Interventions in Horticulture:* (i) *Infrastructure Development:* Establishing post-harvest management systems, cold chains, and horticulture clusters; (ii) *Mechanization and Technology:* Promoting farm mechanization and precision agriculture techniques; (iii) *Market Intelligence and Branding:* Strengthening the horticulture database, developing market linkages, and promoting cluster branding; and (iv) *Cluster Development:* Leveraging geographical specialization to enhance market-led horticultural growth, wherein Government of India has identified 55 horticulture clusters based on the fruit crops, with 12 selected for a pilot launch.

*Agro-Climatic Zone Based Planning:* (i) India has been divided into 15 agro-climatic zones and 20 agro-ecological regions for scientific resource utilization; and (ii) Regional planning is emphasized for specific fruit crops to optimize production efficiency.

*Targeted production areas for key fruits include:* During his presentation, he also highlighted the target suitable areas for production and includes: (i) Mango: Uttar Pradesh (Amroha, Unnao, Faizabad, Bijnor, Muzaffarnagar); (ii) Guava: Madhya Pradesh (Shajapur, Chhatarpur, Ujjain), Uttar Pradesh (Bareilly, Agra, Sambhal, Moradabad); (iii) Papaya: Gujarat (Anand, Chhota Udepur), Andhra Pradesh (Chittor, Anantapur), Tamil Nadu (Erode, Dharmapuri, Salem, Tiruppur).

*Indigenous and Exotic Fruit Promotion:* (i) Shared globally important exotic highly nutritious fruits such as: Avocado, Blueberry, Dragon Fruit, Fig, Kiwi, Mangosteen, Persimmon, Passion Fruit, Rambutan, and Strawberry, where India needs to reduce the import through promoting their cultivation; (ii) plan is also submitted for locally produced fruits with high nutritional value and a list of 11 crops including Mango, Papaya, Phalsa, Pumelo, Guava, Jackfruit, Custard Apple, Lemon, Bael, Tamarind and Aonla were suggested; (iii) High-nutritional-value indigenous fruits suggested include: Mango (Ratual), Guava (Allahabad), Custard Apple (Balanagar), Lemon (Kagzi), Jackfruit (Red Bulb), Bael (Faizabad), and Tamarind (Godhra); and (iii) Recommended strategies include nutritional profiling and validation of health benefits for therapeutic applications.

*Crop Diversification and Pre-Production Interventions:* (i) Shifting a portion of staple crop cultivation to high-value horticultural crops can enhance farmers' incomes; (ii) Encouragement of Farmer Producer Organizations (FPOs) for improved market access; (iii) Adoption of Good Agricultural Practices (GAP), Integrated Pest Management (IPM), and precision farming techniques; (iv) Expansion of soil and plant nutrient testing laboratories and real-time market intelligence platforms; and (v) Strengthening compliance with global export standards including Sanitary and Phytosanitary Measures (SPS), Maximum Residue Levels (MRL), and Technical Barriers to Trade (TBTs).

*Post-Harvest Management and Value Addition:* (i) Establishing decentralized post-harvest infrastructure at the farm level; (ii) Expanding cluster-level storage, processing, and transportation facilities; (iii) Promoting value-added horticultural products and packaging innovations; and (iv) Developing traceability systems through Blockchain and IoT for better market positioning.

*Logistics, Marketing, and Branding:* (i) Strengthening cold chain and transport infrastructure for domestic and export markets; (ii) Utilizing alternative transport methods such as Krishi Udan, Kisan Rail, and Inland Waterways; (iii) Establishing digital and e-commerce platforms to facilitate market linkages; (iv) Developing and promoting distinct 'Cluster Brands' with a focus on quality assurance and sustainability; and (v) Supporting Geographical Indication (GI) registration and targeted marketing campaigns.

*Nursery Development and Planting Material:* (i) India has 4,554 fruit nurseries, including 1,580 government-run and 2,974 private nurseries, of which 1,000 are accredited; (ii) Annual average production of fruit plants stand at 1,387 million, meeting 35-40% of demand; and (iii) Expansion of planting material availability is crucial to increasing horticultural area coverage.

*Achieving Self-Reliance in Horticulture:* (i) Adoption of advanced crop improvement and precision farming technologies; (ii) Strengthening protected cultivation techniques to mitigate climate-related risks; (iii) Enhancing post-harvest handling and processing capacity to reduce losses; and (iv) Promoting indigenous crops and diversifying production systems to enhance sustainability.

*Expansion of Indigenous Crops:* (i) Notable indigenous crops and targeted expansion areas include: **Aonla:** Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Rajasthan, Uttarakhand; **Karonda:** Maharashtra, Punjab, Uttarakhand, West Bengal; Seabuckthorn: Ladakh, Himachal Pradesh, Arunachal Pradesh; Jamun: Bihar, Gujarat, Karnataka, Maharashtra, Rajasthan, Tripura, West Bengal; and **Jackfruit:** Andhra Pradesh, Chhattisgarh, Karnataka, Odisha, Tripura.

### **Summary of Insights:**

1. There is a need for reducing imports of fresh fruits, which have doubled since 2021.
2. India has a strategic plan for horticultural crops to achieve self-reliance by reducing imports of exotic fruits, promoting indigenous crops, and implementing technological interventions.
3. There is great potential in both exotic and local indigenous fruit crops with high nutritional value.
4. The role of branding, marketing, Farmer Producer Organisations, and self-help groups is crucial in the entire value chain of fruits, along with processing and medium-scale industries to ensure remuneration to farmers.
5. Various technological interventions are important for boosting production and availability of fruit crops and attaining self-reliance in horticultural crops.

**Smitha Krishnan**, Sr. Scientist, Alliance of Bioversity International and CIAT, presented "Diversity for Restoration (D4R)". The presentation introduced an approach for selecting suitable tree species for restoration and cultivation, emphasizing species selection, seed sourcing, and climate adaptability. The key points emerged from her presentation are as follows:

*The Need for Land Restoration in India (Rationale):* A third of India's land is degraded or facing desertification, India aims to restore 26 million hectares by 2030, current restoration often uses inappropriate or limited tree species, the importance of using the right seeds from the right sources, agroforestry can boost green cover and livelihoods, and a variety of approaches are needed for effective restoration.

*Tools for Achieving Restoration Goals:* A forest restoration tool was introduced to match site conditions with restoration objectives. Websites supporting restoration efforts: [www.diversityforrestoration.org](http://www.diversityforrestoration.org) – Focuses on seed systems, species selection, and site matching; [www.cacaodiversity.org](http://www.cacaodiversity.org) – Supports agroforestry planning; and [www.myfarmtrees.org](http://www.myfarmtrees.org) – Includes vulnerability mapping.

*D4R Tool – Supporting Decision-Making:* The D4R tool answers key questions: (i) which tree species match restoration objectives? (ii) Which species are climate-adapted for both present and future conditions? (iii) Which species are resistant to local stress conditions? and (iv) Where can suitable seeds be sourced?

*How the D4R Tool Works - Inputs required:* location of the planting site, local stress conditions, restoration objectives, and climate change scenarios. The various outputs generated includes Recommended species combinations, best seed sourcing locations, and propagation techniques.

*Habitat Suitability and Climate Adaptation:* (i) Species distribution is modelled using species occurrence data and environmental conditions; (ii) BiodiversityR package is used for an ensemble modelling approach; and (iii) Future species distribution is projected under five climate models and three emission scenarios (RCP2.6, RCP4.5, RCP8.5) for 2050s and 2070s.

*Seed Collection Strategy:* The D4R tool proposes a climate-resilient seed sourcing strategy to ensure long-term sustainability.

*Agroforestry and Additional Tools:* (i) Cacao and Coffee Agroforestry: [www.cacaodiversity.org](http://www.cacaodiversity.org) aids in designing cacao agroforestry systems; and Recommended planting designs consider shade percentages; (ii) Additional Agroforestry Features: (i) Cost-benefit analysis over 30 years; (ii) Pest and disease management strategies, Climate adaptation measures, including the use of suitable rootstock materials; (iii) Genetic diversity databases for agroforestry species; and (iv) Information on nurseries, planting densities, and spatial arrangements.

*Target Regions and Pilot Phase:* D4R tool focuses on specific restoration target regions: (i) Pilot phase goals such as - 400,000 trees planted, 5,000 hectares restored, 4,000 direct beneficiaries, 1,000 restoration partners registered, Use of blockchain for verification and incentives for smallholder/community restoration; and (ii) Timeline such as: Pilot launch, app deployment, first payments, and scaling through partnerships with One Acre Fund and Acorn.

*Key Focus Areas for Scaling up includes:* (i) Integration of restoration tools, (ii) Verification and Incentives for restoration, (iii) Cost-effective restoration methods, (iv) Gender equity, livelihoods, nutrition, and climate considerations, (v) Seed systems, species selection, and site matching, (vi) Agroforestry planning (tree species, densities, spatial arrangements).

*Proposed Stakeholders and Funding for Scaling in India:* (i) Stakeholders involved: Ministry of Agriculture and Farmers Welfare, Ministry of Environment, Forest, and Climate Change, NGOs (BAIF, ATREE, FES, etc.), Farmer Producer Companies, and Centre for Fruitful India; (ii) Proposed Funding - \$334,000 USD from the Ministry of Agriculture and Farmers Welfare for developing the D4R tool for India is requested.

### **Summary of Insights:**

1. Restoration efforts in India need a more diverse and climate-adapted approach.
2. The right species selection and seed sourcing are crucial for successful reforestation.
3. D4R provides a science-backed, data-driven decision-support tool for tree species selection.
4. Agroforestry plays a vital role in balancing restoration with economic benefits.
5. Collaboration among government agencies, NGOs, and farmer organizations is key to scaling the impact.
6. Technology (decision-support tools, blockchain verification) is improving restoration efficiency.

**Sarika Mitra**, Consultant, Alliance of Bioversity International and CIAT presented Species Distribution Modelling (SDM) of fruit trees in India, used for predicting potential species distribution under projected climate change scenarios. The presentation begins with an introduction to the 2047 food production targets, emphasizing food and nutrition security, affordability, and accessibility. It highlights that over 300 fruit species are grown in India, with 75-80% of production under dominant species (around 15). New species like avocado and dragon fruit have been introduced.

The importance of Species Distribution Modelling (SDM) was discussed, explaining how it helps predict the distribution of species under current and future conditions. SDM uses mathematical models to predict the distribution of species across geographic space, using environmental data such as climate and soil. However, the limitations of SDM are also addressed, including the quality of environmental data, the need for sufficient and reliable species presence data, and the complexity and accuracy of the models. The presentation then delves into the species occurrence data, mentioning sources like the Global Biodiversity Information Facility (<https://www.gbif.org>) and additional datasets from

colleague researchers. It lists the species that were modelled in the study, along with their common names.

The environmental data used in the study includes climate data from WorldClim (<https://www.worldclim.org/>), soil data from SoilGrids (<https://soilgrids.org/>), and topography data from the Digital Elevation Model. Future climate data for the year 2050 is also considered, using both SSP2-4.5 and SSP3-7.0 scenarios. The results section begins with a focus on *Garcinia indica* (Kokum), describing its characteristics and benefits. The presentation then discusses the model results, likely including visual representations such as maps or graphs to illustrate the predicted distribution of various fruit tree species. It also includes response curves for bioclimatic variables and future predictions for *Garcinia indica*. The presentation concludes with a discussion on high and low predictions or scenarios related to the study.

### **Summary of Insights:**

1. Species Distribution Modelling (SDM) is crucial for predicting the distribution of fruit tree species under current and future conditions.
2. The study highlights the importance of managing the diversity of tropical fruit species in India.
3. Environmental data and species occurrence data are essential for accurate SDM.
4. The results provide insights into the distribution and growth of various fruit tree species, with a focus on *Garcinia indica* (Kokum).
5. Future predictions and scenarios help understand the potential impact of climate change on fruit tree species distribution.

**Discussions and outcomes:** Discussions were held on the following thematic areas and suggestions are described below:

#### **A. Building Strong Alliances for CFI:**

Building partnerships is crucial for promoting the Centre for Fruitful India (CFI) mandate widely and ensuring its impactful implementation. Partnerships bring together diverse stakeholders, including academia, government institutions, NGOs, civil societies, farmers, and the private sector, to collaborate on shared goals. This collaborative approach enhances the reach and effectiveness of CFI's initiatives. Based on the presentation followed by discussion, Following role of building partnerships were identified:

- **Resource Mobilization:** Partnerships help in pooling resources, including funding, expertise, and technology, which are essential for large-scale projects. Collaborating with organizations like the Indian Council of Agricultural Research (ICAR), the Council of Scientific and Industrial Research (CSIR) and Indian Council of Medical Research (ICMR)-National Institute of Nutrition (NIN) can provide access to advanced research and development capabilities.
- **Knowledge Sharing:** Partnerships facilitate the exchange of knowledge and best practices among stakeholders. This includes sharing innovative cultivation methods, traditional knowledge, and research findings, which can improve fruit cultivation techniques and outcomes.
- **Policy Support:** Engaging with government agencies and policymakers through partnerships can help in advocating for supportive policies and regulations. This ensures that the initiatives align with national priorities and receive the necessary policy backing.
- **Community Engagement:** Collaborating with local communities, NGOs, and civil societies ensures that the initiatives are inclusive and address the needs of the target populations. This enhances community participation and ownership, leading to sustainable outcomes.

- **Market Access:** Partnerships with the private sector can help in developing market linkages and value chains for fruit products. This ensures that farmers have access to markets, improving their livelihoods and economic resilience.

Building partnerships for promoting the Centre for Fruitful India (CFI) mandate widely has a significant impact by enhancing the availability of nutritious fruits, addressing malnutrition and food security challenges. These partnerships promote sustainable cultivation practices, contributing to environmental conservation and climate resilience. Improved market access and value chains result in better income opportunities for farmers, enhancing their economic stability and reducing poverty. Collaborative research efforts lead to innovations in fruit cultivation, processing, and distribution, driving continuous improvement and adaptation to changing conditions. Overall, partnerships ensure a holistic approach to development, addressing multiple aspects such as nutrition, health, environment, and economic growth simultaneously.

Based on the interaction and suggestions made by CFI SC members the following key strength were identified, as these organizations have the expertise and resources to support the promotion of nutritious fruit cultivation in India:

1. **Indian Council of Agricultural Research (ICAR):** They have extensive research and institutional support for fruit crop research and have been driving advancements in horticulture.
2. **Indian Council of Forestry Research and Education (ICFRE):** They focus on forest diversity restoration and have expertise in fruit tree biodiversity.
3. **Horticultural Universities:** They contribute significantly to various aspects of fruit cultivation research and innovation, provide education and training to various stakeholders, and advocate for supportive policies and regulations that benefit fruit cultivation.
4. **ATREE (Ashoka Trust for Research in Ecology and the Environment):** They are involved in research and conservation efforts related to fruit tree biodiversity.
5. **WRI India:** They work on food, land, and water programs and can be a valuable partner in promoting fruit cultivation.
6. **Alliance of Bioversity International and CIAT:** They have been actively engaged in conserving fruit species, enhancing farmer livelihoods, and promoting gender-responsive research.

## **B. Strategic Focus Areas for CFI Research:**

The following priority research themes were presented for discussion and finalisation, where CFI should focus to serve as a research catalyst in promoting cultivation of nutritious fruits for improve access and affordability for resource-poor people and planet health:

### **1. *Role of fruit trees in agroecology:***

During the discussion it was emphasised that fruit trees cultivation plays a pivotal role in agroecology intensification and improved fruit cultivation, contributing significantly to the health of both people and the planet. In agroecology, fruit trees enhance biodiversity, improve soil health, and reduce the need for chemical inputs, fostering sustainable farming practices. Therefore, integration of fruit trees into



agroecological systems ensures a holistic approach to sustainability, benefiting both human health and environmental well-being. Some best practices for achieving this integration effectively suggested are as under:

- *Agroforestry Systems*: Implementing agroforestry systems, where fruit trees are grown alongside crops, can optimize land use and improve overall farm productivity. This approach helps in maintaining soil fertility, reducing erosion, and providing shade for other crops.
- *Selection of Suitable Species*: Choosing the right fruit tree species that are well-adapted to the local climate and soil conditions is crucial. This ensures better growth, higher yields, and resilience to pests and diseases.
- *Diversification*: Planting a diverse range of fruit tree species can reduce the risk of crop failure due to pests, diseases, or adverse weather conditions. It also promotes biodiversity and ecological balance.
- *Soil and Water Management*: Implementing proper soil and water management practices, such as mulching, drip irrigation, and rainwater harvesting, can enhance the growth and productivity of fruit trees. Such practices need more research support for small and marginal farmlands.

Integrating fruit trees into agroecological systems ensures a holistic approach to sustainability, benefiting human health and environmental well-being. Best practices for achieving this integration include implementing agroforestry systems, selecting suitable species, diversifying fruit tree species, and adopting proper soil and water management practices.

## **2. *Developing precision management technologies:***

During the discussion, it was agreed that developing precision management technologies plays a crucial role in enhancing water and nutrient use efficiency. These technologies are designed to minimize input costs, making fruit cultivation more affordable, sustainable, and profitable for smallholder farmers. By optimizing the use of water and nutrients, precision management technologies ensure that resources are used efficiently, reducing waste and environmental impact. This approach not only lowers the cost of production but also improves the overall yield and quality of fruit crops. Additionally, precision management technologies support sustainable farming practices by promoting the use of advanced tools and techniques, such as drip irrigation, soil moisture sensors, and nutrient management systems. These innovations help smallholder farmers achieve better productivity and profitability while maintaining ecological balance and conserving natural resources. The following action were suggested:

- *Invest in Precision Management Technologies*: Support the development and implementation of precision management technologies to enhance water and nutrient use efficiency. This can help smallholder farmers reduce input costs and improve the affordability, sustainability, and profitability of fruit cultivation.
- *Promote Advanced Tools and Techniques*: Encourage the use of advanced tools and techniques which can help optimize resource use, reduce waste, and minimize environmental impact.
- *Support Sustainable Farming Practices*: Advocate for sustainable farming practices that maintain ecological balance and conserve natural resources.

- *Provide Training and Resources:* Offer training and resources to smallholder farmers on the use of precision management technologies and advanced farming techniques.
- *Facilitate Access to Technology:* Ensure that smallholder farmers have access to the necessary technology and tools to implement precision management practices.

Providing support in developing precision management technologies plays a crucial role in enhancing water and nutrient use efficiency, making fruit cultivation more affordable, sustainable, and profitable and helping smallholder farmers achieve better productivity and profitability while maintaining ecological balance and conserving natural resources.

### 3. **Diversifying and innovating:**

The Centre for Fruitful India (CFI) mission emphasizes the importance of diversifying and innovating agricultural practices by introducing novel planting materials and developing innovative supply chains for value-added products. This approach enhances farm diversification, reduces the risk of crop failure, ensures a steady income stream, enables off-season production, and increases farmers' livelihood. Additionally, it promotes value addition, contributing to the economic stability of farming communities, and supports sustainability and climate resilience by reducing dependency on a single fruit species. Overall, this strategy aligns with CFI's objectives of enhancing fruit availability round the year, improving food security, and promoting sustainable agricultural practices.

#### **Following research and development Plan are suggested:**

- *Development of Novel Planting Materials:* This involves researching and creating new varieties of fruit crops that are resilient to pests, diseases, and adverse weather conditions. These novel planting materials will help farmers diversify their crops and reduce the risk of crop failure, ensuring a steady income stream throughout the year.
- *Innovative Cultivation Practices:* The plan includes the development and implementation of innovative cultivation techniques that improve fruit plant yield and quality. This may involve precision farming, integrated pest management, and sustainable irrigation methods.
- *Collaborative Research:* CFI will collaborate with agricultural research institutions, universities, and industry experts to conduct research on fruit cultivation and value addition. These collaborations will facilitate the exchange of knowledge and expertise, leading to the development of cutting-edge solutions for farm diversification and sustainability.
- *Pilot Projects:* To test and refine new planting materials and cultivation practices, CFI will initiate pilot projects in various agroecological regions. These projects will provide valuable insights into the effectiveness of the innovations and help in scaling up successful practices across the country.
- *Data Collection and Analysis:* The plan includes the collection and analysis of data on targeted fruit crops performance, market trends, and environmental impact. This data will inform decision-making and help in the continuous improvement of farming practices and supply chains.
- *Farmer Training and Support:* In collaboration with national partners, CFI will provide training and support to farmers on the use of novel planting materials and innovative cultivation practices. This

will empower farmers with the knowledge and skills needed to implement the research findings effectively.

By focusing on these areas, the research and development plan aims to enhance farm diversification, improve crop resilience, and promote sustainable agricultural practices, aligning with CFI's mission of enhancing fruit availability, improving food security, and promoting environmental sustainability.

#### 4. **Climate resilience and mitigation:**

Climate-smart fruit cultivation technologies are essential for sustainable fruit cultivation. These technologies ensure that fruit crops can withstand the challenges posed by a changing climate. In this context, Importance of climate resilience and mitigation approaches in sustainable fruit cultivation, which are essential for achieving the Centre for Fruitful India (CFI) mission, were discussed in great details. The suggested approaches include developing climate-smart fruit cultivation technologies and resilient varieties that can withstand extreme weather conditions, pests, and diseases. By adopting these technologies, farmers can maintain consistent fruit production, contributing to long-term sustainability, improved accessibility and affordability of nutritious fruits, environmental protection, economic stability, and climate change mitigation.

To achieve CFI's mission, it's essential to focus on climate resilience in sustainable fruit cultivation. This means developing climate-smart technologies and resilient fruit varieties that can endure extreme weather, pests, and diseases. These methods help farmers sustain fruit production, ensuring long-term sustainability, better access to nutritious fruits, environmental protection, economic stability, and climate change mitigation.

#### 5. **Developing new models for fruit cultivation:**

Developing new models for fruit cultivation across urban, peri-urban, and rural areas can significantly contribute to the Centre for Fruitful India (CFI) mission. Following are some innovative approaches that were discussed and suggested, which can be easily adopted by local people:

##### **Urban Areas:**

- *Rooftop Gardens:* Utilizing rooftops for fruit cultivation can maximize space in densely populated urban areas. Fruits like strawberries, avocado, dwarf citrus trees, etc. can thrive in containers and raised beds on rooftops.
- *Vertical Gardens:* Vertical gardening techniques can be employed to grow fruits like berries, grapes, passion fruit, etc. on walls and fences. This method saves space and adds greenery to urban environments.

- *Community Gardens*: Establishing community gardens in urban neighbourhoods can provide residents with access to fresh fruits. Fruits like figs, pomegranates, guavas, etc. can be grown in shared spaces, promoting community engagement and healthy eating.

#### **Peri-Urban Areas:**

1. *Agroforestry Systems*: Integrating fruit trees with other crops in agroforestry systems can enhance biodiversity and productivity. Fruits like mangoes, papayas, bananas, etc. can be grown alongside vegetables and grains.
2. *Home Gardens*: Encouraging peri-urban residents to cultivate fruit trees in their home gardens can improve food security and nutrition. Fruits like lemons, oranges, mulberries, etc. are suitable for small-scale cultivation.
3. *Roadside Plantations*: Planting fruit trees along roadsides can provide shade, reduce pollution, and offer fresh fruits to passersby. Fruits like jackfruit, tamarind, custard apple, etc. can be grown in these areas.

#### **Rural Areas:**

1. *Orchards*: Establishing orchards in rural areas can support large-scale fruit production, providing additional income opportunities for farmers.
2. *Cluster Farming*: Promoting cluster farming, where groups of farmers grow specific fruit crops, can enhance productivity and market access.
3. *Forest Fringes*: Utilizing forest fringes for fruit tree cultivation can contribute to biodiversity conservation and provide additional income for rural communities.

Innovative models for fruit cultivation across urban, peri-urban, and rural areas, contribute significantly to the Centre for Fruitful India (CFI) mission. These approaches collectively enhance fruit availability and accessibility while fostering community engagement and environmental conservation.

## **6. Supporting national policy framework:**

The Centre for Fruitful India (CFI) will work with policymakers to advocate for supportive policies by building partnerships with government agencies, research institutions, and civil society organizations. CFI can also leverage its expertise to collaborate with partners, facilitating knowledge exchange and implementing policies that support sustainable fruit production, enhance food security, and promote environmental conservation. These collaborations will pool resources, share knowledge, and promote innovative fruit cultivation practices.

Engaging policymakers ensures CFI's initiatives align with national priorities and receive policy backing. Advocacy involves presenting scientific evidence highlighting the benefits of fruit cultivation for nutrition security, environmental sustainability, and economic stability. Involving local communities strengthens the advocacy process. Involving local communities and stakeholders is crucial for strong

policy support. By engaging with farmers, leaders, and others, CFI ensures its initiatives meet community needs, building trust and promoting sustainable fruit cultivation.

Collaborating with policymakers aligns CFI's initiatives with national priorities and secures policy backing. This includes presenting scientific evidence on the benefits of fruit cultivation for nutrition, sustainability, and economic stability. Demonstrating these impacts helps advocate for supportive policies. Involving local communities and stakeholders is crucial for strong policy support. By engaging with farmers, leaders, and others, CFI ensures its initiatives meet community needs, building trust and promoting sustainable fruit cultivation.

### **C. Strategic Selection of Fruit Species for CFI:**

Selecting fruit species adapted to local conditions helps crops withstand pests, diseases, and extreme weather, ensuring sustainable production. Integrating these trees into agroecological systems benefits human health and the environment. This aligns with the Centre for Fruitful India's mission to improve fruit availability, food security, and environmental sustainability.

Discussions emphasized the nutritional value and research challenges of Indian fruits like Mango, Guava, Custard Apple, Lemon, Jackfruit, Bael, and Tamarind. Despite their nutrient richness, research is hindered by limited funding, climate variability, genetic diversity preservation, and market issues. Addressing these is essential for combating malnutrition and promoting sustainability. Current Indian studies focus on leveraging these fruits' nutritional benefits to enhance health and environmental sustainability through cultivation.

Several exotic fruits have been recommended for their benefits to farmers, given their high market demand, nutritional value, and adaptability to various regions. These fruits include Avocado (*Persea americana*), Blueberry (*Vaccinium corymbosum*), Dragon Fruit (*Hylocereus undatus*), Fig (*Ficus carica*), Kiwi (*Actinidia deliciosa*), Mangosteen (*Garcinia mangostana*), Kokum (*Garcinia indica*), Passion Fruit (*Passiflora edulis*), Rambutan (*Nephelium lappaceum*), and Strawberry (*Fragaria × ananassa*). The cultivation of these fruits can significantly boost farmers' incomes, enhance nutritional security, and promote environmental sustainability.

Summary of the nutrition values of these species are presented in the Table below:

S.No	Fruit plant	Nutrition profile
<b>Indigenous fruit species</b>		
1	Mango	Mangoes are rich in vitamins A and C, dietary fibre, and antioxidants. They are known for their high nutritional value and health benefits.
2	Guava	Guavas are an excellent source of vitamin C, dietary fibre, and antioxidants. They are also rich in vitamins A and E, potassium, and folic acid.
3	Custard Apple	Custard apples are high in vitamins C and B6, dietary fibre, and potassium. They also contain antioxidants and are known for their health benefits.
4	Lemon	Lemons are rich in vitamin C, dietary fibre, and antioxidants. They are also a good source of potassium, vitamin B6, and folic acid.
5	Jackfruit	Jackfruits are high in vitamins C and A, dietary fibre, and potassium. They also contain antioxidants and are known for their nutritional benefits.
6	Bael	Bael fruits are rich in vitamins A and C, dietary fibre, and antioxidants. They are also known for their medicinal properties and health benefits.
7	Tamarind	Tamarinds are high in vitamins B1, B2, and B3, dietary fibre, and potassium. They also contain antioxidants and are known for their nutritional benefits.
<b>Exotic fruits consider for cultivation</b>		
8	Avocado	Avocado is rich in healthy fats, vitamins E and C, potassium, and fibre. It is suitable for cultivation in regions with moderate temperatures and well-drained soils. Avocado has a high market demand and can be profitable for farmers <sup>1</sup>
9	Blueberry	Blueberries are known for their high antioxidant content, vitamins C and K, and dietary fibre. They can be grown in cooler regions with acidic soils. Blueberries have a high market value and can be a profitable crop for farmers.
10	Dragon Fruit	Dragon fruit is rich in vitamins C and B, fibre, and antioxidants. It thrives in warm, dry climates and can be cultivated in arid and semi-arid regions. Dragon fruit has a growing market demand and can be profitable for farmers.
11	Fig	Figs are a good source of dietary fibre, vitamins B6 and K, and minerals like potassium and calcium. They are suitable for cultivation in regions with warm temperatures and well-drained soils. Figs have a high market value and can be profitable for farmers.
12	Kiwi	Kiwi is high in vitamins C and K, dietary fibre, and antioxidants. It can be grown in cooler regions with well-drained soils. Kiwi has a high market demand and can be profitable for farmers.
13	Mangosteen	Mangosteen is rich in vitamins C and B, fibre, and antioxidants. It thrives in tropical climates with high humidity and well-drained soils. Mangosteen has a high market value and can be profitable for farmers.
14	Passion Fruit	Passion fruit is high in vitamins A and C, fibre, and antioxidants. It thrives in warm, humid climates and can be cultivated in tropical and subtropical regions. Passion fruit has a growing market demand and can be profitable for farmers.
15	Rambutan	Rambutan is rich in vitamins C and B, fibre, and antioxidants. It thrives in tropical climates with high humidity and well-drained soils. Rambutan has a high market value and can be profitable for farmers.
16	Strawberry	Strawberries are known for their high antioxidant content, vitamins C and K, and dietary fibre. They can be grown in cooler regions with well-drained soils. Strawberries have a high market demand and can be profitable for farmers.

The Centre for Fruitful India (CFI) will focus on both indigenous and exotic fruit species to enhance nutrition security, environmental sustainability, and economic stability. Indigenous fruits like Mango, Guava, Custard Apple, Lemon, Jackfruit, Bael, and Tamarind are nutrient-rich and suited to local conditions, addressing malnutrition and promoting biodiversity. Exotic fruits such as Avocado, Blueberry, Dragon Fruit, Fig, Kiwi, Mangosteen, Passion Fruit, Rambutan, and Strawberry have high market demand and nutritional value, benefitting farmers and supporting sustainable agriculture.

#### **D. CFI's Agroecological Priorities:**

Agroecological zones (AEZs) are regions defined by their climate, soil, and topography, which influence the types of crops that can be grown and the agricultural practices that are most suitable. India is divided into 15 agro-climatic zones by the Planning Commission, and the National Bureau of Soil Survey and Land Use Planning (NBSS & LUP) has classified India into 20 agro-ecological regions based on soil, climate, and physiography, each with distinct characteristics that make them suitable for different types of agriculture, including fruit cultivation.

Based on discussion, it was suggested that to effectively address the challenges of malnutrition and promote sustainable fruit cultivation, CFI should prioritize its focus on diverse agroecological zones across India in a phased manner. The following regions were identified, where CFI can have its focus during early stage of its implementation:

- Eastern and Western Himalayas Region
- Indo-Gangetic Plains (IGP)
- Eastern Plateau and Hills (Chhota Nagpur Region)
- Central Plateau and Hills Eastern Ghats
- Western Ghats
- Arid and Semi-Arid Zones

To effectively address the challenges of malnutrition and promote sustainable fruit cultivation, CFI will prioritize its focus based on the diverse agroecological zones of India. By acting as a research catalyst focusing on suggested approaches and regions, CFI can address the challenges of malnutrition and promote sustainable agricultural practices across India, ensuring that poor communities have access to nutritious fruits.

Based on discussion and agreement, the following three zones are identified where CFI can focus during the first phase of its implementation over the two year cycle:

1. *Arid and Semi-Arid Zones*: The arid and semi-arid zones of India encompass regions characterized by low and highly variable precipitation, extreme temperature variations, and high evaporation rates. These zones include states such as Rajasthan, Gujarat, Haryana, Maharashtra, Karnataka, and Andhra Pradesh.
2. *Deccan Plateau*: The Deccan Plateau zone in India includes Maharashtra, Karnataka, Andhra Pradesh, Telangana, and Tamil Nadu, characterized by their unique geographical and climatic conditions. These states have a semi-arid climate, making them suitable for growing a variety of fruit crops.
3. *Black Soil Regions (BSR)*: The Black Soil Regions (BSR) of India, also known as the Deccan Trap region, primarily cover parts of the states of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, and Tamil Nadu. These regions are characterized by their rich, dark soil, which is highly suitable for growing diverse fruit species.

#### **E. Promoting Fruit Diversity: CFI's Media and Outreach Plan:**

The Centre for Fruitful India (CFI) has created a communication and media strategy to engage stakeholders and promote fruit diversity. This includes a website serving as an information hub with sections like "Partner Us" and a Resource Hub containing publications, databases, blogs, videos, research articles, podcasts, and more. The site will also feature images and links to social media showcasing CFI's mission.

CFI's social media strategy on LinkedIn and Twitter will share thought leadership content, partnership updates, success stories, and educational materials. Using localized campaigns and live-streamed events, CFI aims to engage policymakers, researchers, NGOs, and the public in supporting its mission. Following suggestions were made during discussion:

- Utilize social media for internal use and public education, providing examples such as avocado's role in addressing malnutrition.
- Include public education as a key component of CFI initiatives.
- Develop and regularly assess a strategic, targeted communication approach for audiences and messaging.
- Mention government officials on social media to advocate for policy changes supporting fruit tree plantations.
- Present awareness programs and success stories to encourage policy adjustments.

#### **F. Organizing National Conferences and Workshops:**

Organizing a national conference or consultation workshops of researchers and implementers is crucial for several reasons. Firstly, it provides a platform for diverse stakeholders to come together, share knowledge, and collaborate on identifying focal themes for the Centre for Fruitful India (CFI). This collective approach ensures that the themes are comprehensive, addressing various aspects of fruit cultivation, nutrition security, and environmental sustainability. Secondly, these events facilitate the identification of suitable partners who can contribute to the successful implementation of CFI activities. By engaging with researchers, policymakers, NGOs, and the private sector, CFI can build strong partnerships that enhance resource mobilization, knowledge sharing, and policy support. Additionally, these conferences and workshops help in announcing research grant calls based on the focal areas



identified, ensuring that funding is directed towards priority research themes that have the potential to make a significant impact. Overall, these events play a vital role in fostering collaboration, driving innovation, and advancing the mission of CFI.

Regarding the organisation of the first national conference, it was proposed to align the CFI conference with International Fruit Day, celebrated annually on July 1st. This day promotes fruit consumption and raises awareness about their nutritional benefits and importance for health and well-being. Additionally, it was suggested to include a session focused on policy aspects.

It was agreed that the conference will be held over two days during the week of June 16, followed by a consultation workshop with various stakeholders in New Delhi, India. If feasible, a field visit may be organised for one day. It was also proposed to organise an Email and WhatsApp group discussion for regular interaction and follow-up to ensure the successful organisation of the conference.

The members assured full support for the organisation and subsequent implementation of the conference. A detailed conference structure will be prepared by the CFI PMU unit after approval by the CFI Advisory Board, which is scheduled for April 3, 2025.

Two-day conference will take place during the week of June 16, 2025, in New Delhi to promote fruit consumption and its health benefits, with an additional focus on policy discussions., followed by a stakeholder consultation workshop and a potential field visit. To facilitate coordination, an Email and WhatsApp group discussion will be established, and the CFI PMU unit will develop a detailed conference structure.

## **General discussion and suggestions:**

After the discussion, the suggestions and their respective action plans were proposed as follows:

### **1. Enhancing Nutrition and Sustainability through Fruit Tree Plantations:**

- Roadside fruit tree plantations can benefit people, wildlife, and ecosystems.
- Implement programs like “Fruits in Public Spaces” for schools, villages, and wastelands.
- Advocate for planting fruit trees in colleges, such as IIT Jammu.
- Engage panchayats to allocate land for fruit cultivation.
- Launch programs for analyzing indigenous fruit nutrition and promoting them locally.
- Partner with CSIR and ICAR for nutraceutical programs using indigenous and exotic fruits.
- Prioritize fruits for their superior nutrition and unexplored market potential.
- Address anaemia and stunting by introducing nutrient-rich fruits in diets.
- Promote high-nutrition cultivars linked with programs like Bhojan Abhiyan.
- Explore fruits like kiwi and persimmon for longer shelf life.
- Promote non-caloric food for nutrition.
- Map suitable crops for wastelands and create micro-level district plans.
- Connect markets for sweeter, locally grown fruits like dragon fruit.
- Emphasize indigenous and nutritional exotic fruits with market demand.
- Increase awareness of locally abundant seasonal fruits.
- Promote lesser-known nutritious fruits through videos and educational campaigns.

- Incorporate fruits into school meal programs to tackle malnutrition.
- Research value-added products with minimal nutrient loss.
- Create a focused initiative to collect carbon sequestration data for target fruit crops.

## **2. Technology and Innovation in Fruit Cultivation:**

- Develop precision management technologies.
- Encourage Internet of Things (IoT) -enabled irrigation and nutrition management through startups.
- Facilitate startups in implementing advanced fruit cultivation technologies.
- Act as a technology enabler to resolve research application gaps.

## **3. Post-Harvest Management and Value-Added Products:**

- Develop value-added products to address post-harvest losses.
- Focus on early-bearing varieties for local supply chains.
- Undertake studies relating to measurable nutritional impact of fruits.
- Conduct nuanced analyses on post-harvest management and agroecology impacts.
- Support the value chain for value-added fruit products.

## **4. Community Engagement and Awareness**

- Focus on accessibility and affordability of fruits for low-income families, avoiding duplication of ICAR and GOI efforts.
- Showcase awareness programs and success stories to drive policy shifts.
- Focus on livelihood improvement as a core aspect.
- Extend CFI's social media presence to platforms like Instagram.
- Organize festivals celebrating indigenous fruits.
- Combat myths and raise awareness about indigenous fruits using social media.

## **5. Success Metrics and Strategic Positioning:**

- Establish success metrics for CFI over the next eight years.
- Narrow the scope of agroecology-related research and position CFI as a technology incubator

The action plan for CFI includes defining clear success metrics to monitor progress and impact over the next eight years, focusing on agroecology research, and positioning CFI as a technology hub to promote innovation in fruit cultivation.