



# **Roundtable on LIFE**

## **Lifestyle for Environment**



**on  
24th November, 2021, New Delhi**



**International Life Sciences Institute India**





REPORT

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**International Life Sciences Institute India**





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## **Introduction**

**At the COP-26 Meeting held recently Hon'ble Prime Minister Mr. Narendra Modi had given the Mantra of LIFE- Lifestyle for Environment. He said that he wanted this to become a mass movement to enable the country reach net zero carbon emission by 2070.** Inspired by his advice ILSI India organized a Roundtable on “LIFE - Lifestyle for Environment” on November 24, 2021 in Virtual Mode. The Roundtable was chaired by Prof. P. K. Seth, Chairman, ILSI India and Co-chaired by Dr. B. Sesikeran, Trustee, ILSI India Board and Chairman, ILSI India Centre of Excellence – K-FFIG.

The impact of lifestyle on environment is enormous. The issues under Lifestyle and Environment of relevance to this Roundtable included dietary practices which in turn have intricate association with Food, Agriculture and Nutrition. These activities have carbon footprints and it needs to be discussed as to how sustainable environment friendly practices can be adopted as a contributor towards PM's mantra and mitigation of carbon footprints. A new study has shown that food production globally contributes 35% of Greenhouse Gas Emission (GHGe) and food system produces emissions that are equivalent to approximately 17.3 billion metric tons (17.318 teragrams) of carbon dioxide yearly.

The key objectives of the Roundtable were to:

- ❖ Identify the steps to be taken in different sectors and action to be initiated by the stakeholders towards mitigating GHGe.
- ❖ Discuss if Agriculture, Nutrition and Dietary Habits, Lifestyle, Food Processing and Packaging, are impacting the environment.
- ❖ Recommend the Way Forward

The Roundtable was addressed by 10 leading experts including : Dr. M. S. Sheshshayee, Professor and Head, Department of Crop Physiology, University of Agricultural Sciences; Dr. Kamala Krishnaswamy, Former Director, National Institute Nutrition (ICMR); Dr. Jagmeet Madan, Principal, Professor, Department of Food Nutrition and Dietetics, SNTD Women's University & National President, Indian Dietetic Association; Dr. Parmeet Kaur, Chief Dietician, All India Institute of Medical Sciences; Ms. Satvika Mahajan, India Policy Specialist, The Good Food Institute; Dr. B. K. Nandi, Senior Food Safety and Nutrition Officer, FAO RA, (retd.); Dr. H. N. Mishra, Professor of Food Technology, Agricultural and

Food Engineering Department, IIT Kharagpur; Dr. Srinivasulu Naladala, Leader - Innovation, Technology and Quality, General Mills India Private Limited; Dr. Rajeswar Santayya Matche, Chief Scientist and Head, Food Packaging Technology Department, CSIR-CFTRI; and Dr. V. P. Sharma, Chief Scientist and Professor AcSIR, CSIR-Indian Institute of Toxicology Research.

The Roundtable mainly discussed innovative approaches and mitigation strategies for GHGe particularly in the areas of Agriculture, Nutrition and Dietary Habits, Lifestyle, Food Processing Activities, Waste Management and Packaged Water. Around 130 participants registered from India and other Asian Countries representing, Government, Research Institutes, Industry and Academic Institutions.

## SECTION ONE

### **Opening Session**

#### **Welcome Address**

**Ms. Rekha Sinha, Executive Director, ILSI India**

In her *Welcome Address* Ms. Rekha Sinha gave a brief description about ILSI and ILSI India. She informed that ILSI India is an entity of the International Life Sciences Institute (ILSI) with headquarters in Washington DC., provides scientific and financial assistance to the South Asian region. It works on the most pressing health issues in the region, with headquarters in New Delhi. Four thematic areas are mainly addressed by ILSI India: Food Safety, Risk Science and Toxicology, Nutrition, Health and Wellness, Sustainable Agriculture and Nutrition Security.

ILSI India works on a tripartite basis i.e. with scientists from Government, Academia and Industry. It functions by sponsoring Scientific Meetings (Workshops, Conferences and Webinars), Sponsoring Research, Bringing out Publications (Scientific Journals, Stand-Alone Monographs), and Organizing Training Programs. ILSI India has performed exceptional work in the areas of Nutrition and Health, Agriculture Sustainability, Environment and Climate Change, Food Safety and Risk Assessment.

#### **Opening Address**

**Prof P. K. Seth, Chairman ILSI India**

In his *Opening Address* Prof. Seth explained how Lifestyle contributes and could impact the Environment. He referred to a new study which showed that the food system generates about 35% of total global man-made greenhouse gas emissions. Animal based foods-meat, poultry and dairy products, including growing crops to feed livestock and pastures for grazing – contributes 57% of emissions linked to the food system. The other 14% of agricultural emissions comes from products not used as

food or feed, such as cotton and rubber. Among animal-based foods, beef is the largest contributor to climate change. It generates 25% of total food emissions, followed by cow milk (8%) and pork (7%).

Raising plant-based foods for human consumption contributes 29% total greenhouse emissions. Rice is the largest contributor among plant-based foods, producing 12% of the total greenhouse gas emissions from the food sector, followed by

wheat (5%) and sugarcane (2%). Rice stands out because it can grow in water; so many farmers flood their fields to kill weeds, creating ideal conditions for certain bacteria that emit methane. This study was published in Nature Food Journal. Furthermore, he emphasized that there is a greater need for discussion on innovative

approaches and mitigation strategies for GHGe: Agriculture, Nutrition and Dietary Habits, Lifestyle, Food Processing Activities, Waste Management, Packaging and Water. He felt that the focused discussions will help in drawing a blue print in reducing the carbon foot prints due to life style activities.

## **Observations**

### **Dr. B. Sesikaran, Trustee, ILSI India Board & Chairman, K-FFIG**

Dr. Sesikaran gave an *overview* about how Lifestyle is linked to Environment. The important component of Lifestyle is food that humans eat and the food that humans eat drives the agricultural practices and these agriculture practices drive agriculture demands and these agriculture demands drive the water requirement and other environmental issues. So, this chain of events is a continuing process of what human do and its effect on Environment.

Dr. Sesikaran mentioned that adapting small lifestyle changes in day-to-day routine will help in mitigating GHGe. For example, Millets can be incorporated in the food plate

as they have lots of benefits. They have good nutritional value and require less water. He mentioned about the COVID-19 outbreak and the close link between the kind of meats human consume and increased exposure to zoonotic infection. Antimicrobial resistance is also one of the outcomes of practices relating to livestock raising and effect on human health as well as environment.

He pointed out that all humans, animals and environment are interlinked and strategies or recommendations which are formed should collectively provide solution to mitigate the effects of GHGe.

## SECTION TWO

**Innovative Approaches & Mitigation****Strategies for GHGe:**

***Agriculture, Nutrition and Dietary Habits, Lifestyle, Food Processing Activities, Waste Management, Packaging and Water***

**1. Nutrition and Dietary Habits to Mitigate the GHGe**

**Dr. Kamala Krishnaswamy**, Former Director, National Institute of Nutrition (ICMR), Hyderabad made a presentation on “Nutrition and Dietary Habits to Mitigate the GHGe”. She shared data from the Indian GHG Emission Factsheet: India (USAID-2019). According to the Factsheet, India produces around 2.65 billion tonnes of GHGe. Out of this Energy constitutes 68.7% GHGe, Agriculture 19.6% GHGe, Industrial process 6.0% GHGe and Land Use and Deforestation 1.9% GHGe.

Dr. Kamala Krishnaswamy mentioned that many studies show that changes in the Nutrition and Dietary Habits are very essential to mitigate GHGe. She informed about some of such studies. These are given below:

- a) **Report on “Food in the Anthropocene: the EAT–Lancet Commission on Healthy Diets from Sustainable Food Systems - 393(10170): 447 – 492”** : In this

Report, Prof. Walter Willet, from Harvard T.H. Chan School of Public Health, Harvard Medical School, summarizes that the “Transformation to healthy diets by 2050 will require substantial dietary shifts. Global consumption of fruits, vegetables, nuts and legumes will have to double, and consumption of foods such as red meat and sugar will have to be reduced by more than 50%. A diet rich in plant-based foods and with fewer animal source foods confers both improved health and environmental benefits.”

Healthy diets can not only impact population health but can also reduce environmental footprints associated with food systems. Agriculture-encompassing all aspects of crop production including horticulture, livestock production and rearing, fisheries, forestry and food processing, preservation, packaging, transportation and food waste drive the climate change.



- b) Environmental Impacts of Dietary Shifts in India: A Modeling Study Using Nationally-Representative Data , published by Aleksandrowicz....and B. Kulkarni et al, in Environment International Journal - 2019, 126: 207-215 :** This Study assessed the benefits from dietary change in India as prescribed in the Dietary Guidelines for Indians, 2011.

This study showed that shifting to dietary guidelines as per requirement, a minor increase in dietary energy (3%), with larger increases in fruits (18%) and vegetables (72%) intake, with baseline proportion of dietary energy from fat and protein being adequate, does not change significantly the climate footprints. Meeting the recommendations of the dietary guidelines slightly increased environmental footprints by about 3% – 5% across GHGe (4%), blue and green water footprints (WFs,) (3% and 5% respectively) and land use (LU) 4% . However, these were national averages. Changing to healthy diets among those with dietary energy intake below recommended guidelines would result in increases of 28% in GHGe, 18% and 34% in blue and green WF, respectively and 41% in LU. Decreased environmental impacts were seen among those who currently consume above recommended dietary energy (–6% to –16% across

footprints). If the whole population were to shift to affluent diets, it would enhance (19 –36%) across the climate change indicators.

- c) The Carbon Footprints of Dietary Guidelines Around the World:** The population around the world is growing and so is the need for food, water and land. A Seven Country Modeling Study, was published by Kovacs et al, (from Philadelphia, Duke University, University of Michigan and Tulane University, USA) in Nutrition Journal 2021: 20 (15), 1-10. The carbon footprint of dietary guidelines was calculated (kg of CO<sub>2</sub>-eq) from daily food group recommendations for a 2000-kcal diet pattern for each country,. FAO food balance sheets were used for each food group. Diets and FBDG (Food Based Dietary Guidelines) varied across countries. Carbon footprint of these guidelines also varied. India had the least carbon footprint due to lesser amount of protein foods, dairy, fat and fruits recommended in 2011 as compared to Western countries.
- d) Dietary Greenhouse Gas Emissions of Meat-Eaters, Fish-Eaters, Vegetarians and Vegans:** This Study was conducted by Scarborough et al, British Heart Foundation Centre on Population Approaches for Non-Communicable Disease Prevention, University of Oxford, UK and



published in 2014 in journal *Climate Change* 125: 179–192. This Study provides evidence on how dietary patterns lead to GHGe and GWP (Global Warming Potentials).

This study's objective was to calculate GHGe from high meat eaters (>100g /d) to low meat eaters (<50g/d) , fish eaters, vegetarians and vegans. The authors concluded that dietary GHGe in self-selected meat-eaters had a gradient and were approximately double as compared to those in vegans and higher than in fish eaters and vegetarians. These results suggest that plant based diets are more climate friendly.

- e) **Carbon Footprints of Indian Food Items:** This study by Pathak et.al, from Division of Environmental Sciences, Indian Agricultural Research Institute, New Delhi published in 2010 in *J. Agriculture Ecosystems and Environment* 139, 66-73 estimated the GHGe during the lifecycle of several foods which dominate the Indian plate. The GHGe which occurred at the production phase was 87% of which methane was predominant (71%). A comparison between the production of rice and wheat staples showed that the former emitted 2.8-3.4 times more GHGe than chapatti preparation from wheat. These differences occurred in other food categories as well. The

recommended balanced vegetarian and non-vegetarian diets for men and women were assessed for emissions; the vegetarian diet for females emitted 20% lesser GHG whereas non-vegetarian meals for both men and women emitted 40% higher GHGs than vegetarian meals.

A non-vegetarian meal with mutton in the Indian context emitted 1.8 times more GHGe than a vegetarian meal followed by a chicken, ovo vegetarian and lacto- vegetarian meal. Replacing mutton with vegetarian or poultry sources could bring down emissions. However replacing it with milk may not be as effective. Although environmentally milk could be substituted, it should be borne in mind that milk is an important source of several nutrients. Mitigation strategies focusing on shift in dietary practices from animal based to crop based food must retain the nutritional quality. Furthermore, within crops, choosing those which conserve resources such as millets and legumes should be preferred to water intensive crops such as rice.

- f) **Dietary Carbohydrate Intake and Mortality: A Prospective Cohort Study and Meta-Analysis :** The findings of a meta-analysis study published in the *The Lancet Public Health* 2018, 3(9):e419-28 by Seidelmann et al highlight how

carbohydrate restricted diets that allow for a greater intake of protein and/ or fat sources for the purpose of weight-loss affect longevity outcomes. Further the study also analyzed the outcomes of carbohydrate substitution with animal- and plant-based sources. Both high (>70% of energy from carbohydrate) and low carbohydrate (<40% of energy from carbohydrate) diets were found to be detrimental to life expectancy. In addition, animal-based carbohydrate restricted diet had increased risk than a plant based carbohydrate diet. Risk of mortality was lowest in those who were consuming 50-55% E from carbohydrates along with food groups such as vegetables, nuts, peanut butter, and whole-grain breads.

- g) **The Double Climate and Health Pyramid also known as the “Double Pyramid”:** This was designed by the Barilla Center for Food and Nutrition through careful and meticulous examination of scientific literature in 2009 to make informed planet centric food choices. (Barilla Foundation & Research Unit on Nutrition, Diabetes and Metabolism, University of Naples Federico II, 2021: 7- 59). The food choices not only help in maintaining a sustainable environment but also enhance food security while paving way for prevention of non-communicable diseases and under nutrition. The global double pyramid

advocates a predominantly plant-based diet composed of more whole grain cereals, fruits, non-starchy vegetables than an animal-based diet since both the carbon food print and susceptibility to diseases are lower with vegetarian diets. The South Asian food pyramid is based on the dietary patterns of several cultures including India, Nepal, Bhutan, Sri Lanka. Pakistan and Bangladesh. Whole grains such as sorghum, millets and brown rice are recommended. Protein sources from legumes and pulses, dairy especially milk as fermented milk have been promoted for frequent consumption. Refined cereals and rice have the largest climate impact and they are also detrimental to the Asian Indian phenotype for non-communicable diseases.

Further, Dr. Kamala Krishnaswamy added that the more recent **Dietary Guidelines for Indians** (to be published in 2022 by ICMR|NIN ) , may further positively impact GHGe. The recently published **Nutrient Requirements for Indians** ( ICMR |NIN ), 2020 has reduced total calorie intake in adults, particularly for sedentary individuals. **ICMR|NIN My plate for the Day** ([https://www.nin.res.in/downloads/My\\_Plate\\_English.pdf](https://www.nin.res.in/downloads/My_Plate_English.pdf) ) and Hemalatha et al (ICMR|NIN- What India Eats, 2020 ) recommend 40-45% E from cereals and millets to promote

diversified nutrient dense foods. Whole grains (50% of cereals) have also been added to **My Plate** recommendations. Pulses /legumes with egg/poultry and meat contributing 14-17% E, dairy 300ml/d (10 -11%E) preferably fermented, nuts and oil seeds 30g/d -11% E , fruits and vegetables 400- 500g/d (10 - 11%E) have been advocated to provide more quality proteins, micronutrients and fiber for 2000 kilocalorie diet.

In her Closing Remark, Dr. Krishnaswamy said that it is very important to have “Nutrition Sensitive Agriculture, Agriculture Sensitive Nutrition and Nutrition & Agriculture to be Climate Sensitive” enabling climate smart solutions for agriculture and diversification of foods for promotion of health and productivity.

## **2. Strategies or Innovative Approaches in Nutrition and Dietary Habits to Mitigate GHGe**

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**Dr. Jagmeet Madan**, Principal, Professor, Department of Food Nutrition and Dietetics, Sir Vithaldas Thackersey College of Home Science (Autonomous), SNTD Women's University and National President, Indian Dietetic Association, Mumbai, made a presentation on "Strategies or Innovative approaches in Nutrition and Dietary Habits to Mitigate GHGe".

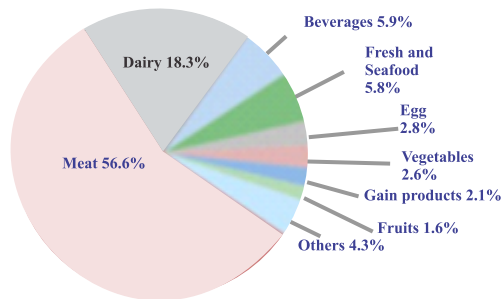
She mentioned that adaptation to Plant-based diet and plant-based protein will contribute to lower GHGe. A plant-based diet is one which consists of all minimally processed food items such as Fruits, Vegetables, Whole Grains, Legumes, Nuts and Seeds, Herbs, and Spices And Excludes All Animal Products, Including Red Meat, Poultry, Fish, Eggs, and Dairy Products. The sources of Plant based protein are Whole Grains, Pulses, Legumes, Nuts and Oilseeds.

There is ample amount of evidence which support how changes in nutrition and dietary habits will reduce the GHGe. They are:

- **A Study on "Can Diets Be Healthy, Sustainable, and Equitable? By**

**Jessica Fanzo (Lead Author)**, Berman Institute of Bioethics and Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, and School of Advanced International Studies, Johns Hopkins University, Washington, DC, USA reviews the evidence on global dietary intake and trends in dietary patterns over time and examines the association between diets and health, environment, and equity. The findings of the study shows that diets now serve as a significant risk factor for the global burden of disease and death. Diet-related non-communicable diseases and rising obesity are increasingly prevalent, affecting much of the global population. At the same time, the food system is producing food in ways that are not aligned with planetary health. Inequity restricts access to healthy diets and is associated with broad social determinants. Therefore, Plant-based diets (Mediterranean or Provegetarian) is a good option to achieve an overall sustainable diet which is associated with reductions in GHGe, land use, and water use.

### Diets High in Calories, Added Sugars, Saturated Fats, Processed Foods, and Red Meats are Less Environmentally Sustainable.



GREENHOUSE GASES CONTRIBUTION BY FOOD TYPE IN AVERAGE DIET

Fanzo, J., & Davis, C. (2019). Can Diets Be Healthy, Sustainable, and Equitable?. Current obesity reports, 8(4), 495–503. <https://doi.org/10.1007/s13679-019-00362-0>  
[https://css.umich.edu/sites/default/files/Carbon%20Footprint\\_CSS09-05\\_e2020\\_0.pdf](https://css.umich.edu/sites/default/files/Carbon%20Footprint_CSS09-05_e2020_0.pdf)

[www.drjagmeetmadan.com](http://www.drjagmeetmadan.com)

**Healthy, plant-based diets** - associated with reductions in GHG emissions, land use, and water use.

**Plant-based diets (Mediterranean or Provegetarian), - A good option to achieve an overall sustainable diet.**



Figure 3 - Sustainable Diets

- **Indian Dietary Habits and GHGe:** India's dietary carbon footprint is 1.6 to 1.8 times lower than the EAT-Lancet report recommendations on Food, Planet, Health that suggests a diet rich in plant-based foods and with fewer animal source foods for both improved health and environmental benefits.
- **A Study on “Greenhouse Gas Emissions and Water Footprints of Typical Dietary Patterns in India” by Rosemary F. Green, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, UK,** quantify the GHGe and water usage associated with distinct dietary patterns: Study result shows that there was substantial variability between diets: the rice-based patterns had higher associated GHGe and green water footprints (WFs), but the wheat-based patterns had higher blue WF. Regression modeling showed

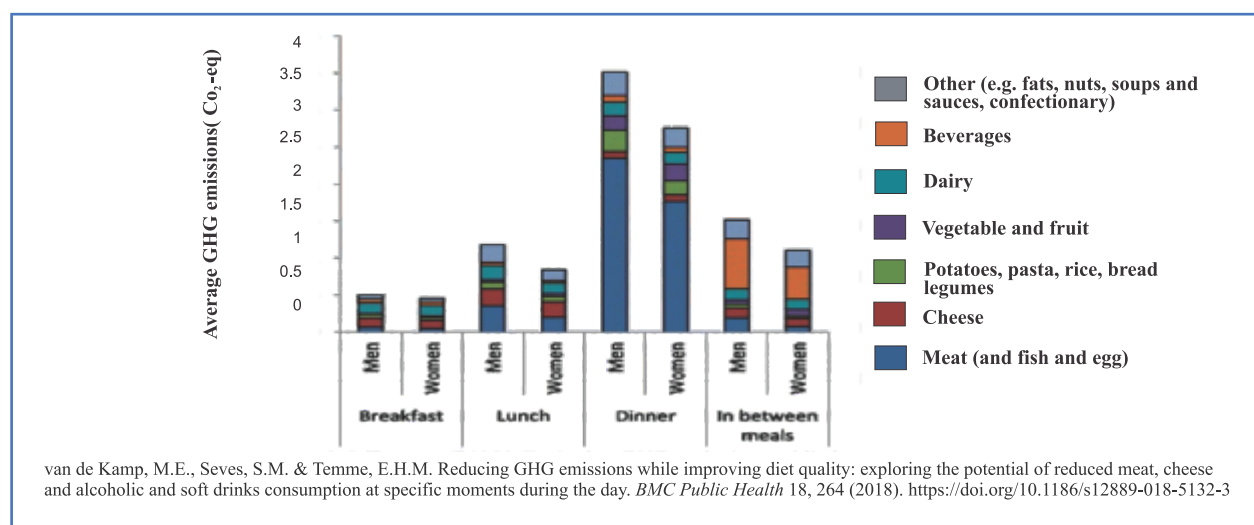
that the Rice & meat pattern had the highest environmental impacts overall, with 0.77 (95% CI 0.64–0.89) kg CO<sub>2</sub>e/capita/day (31%) higher emissions, 536 (95% CI 449–623) L/capita/day (24%) higher green WF and 109 (95% CI 85.9–133) L/capita/day (19%) higher blue WF than the reference Rice and low diversity pattern. Diets in India are likely to become more diverse with rising incomes, moving away from patterns such as the Rice and low diversity diet to patterns such as the Rice and meat diet may become more common, and the environmental consequences of such changes could be substantial given the size of India's population. Further, as global environmental stress increases, agricultural and nutrition policies must recognize the environmental impacts of potential future dietary changes.



- **The National Institute for Public Health and the Environment (RIVM), BA, Bilthoven, The Netherlands, reported a study on “Reducing GHG Emissions while Improving Diet Quality: Exploring the Potential of Reduced Meat, Cheese and Alcoholic and Soft Drinks Consumption at Specific Moments During the Day” in 2018:** According to the study the mean habitual daily dietary GHGe in the highest tertile of dietary GHGe was 6.7 kg CO<sub>2</sub>-equivalents for men and 5.1 kg CO<sub>2</sub>-equivalents for women. The scenarios with reduced meat consumption and/or replacement of all alcoholic and soft drinks were most successful in reducing dietary GHGe (ranging from – 15% to – 34%) and also reduced saturated fatty acid intake and/or

sugar intake. Both types of scenarios lead to reduced energy and iron intakes. Protein intake remained adequate. Further, low GHGe and nutritious replacement foods might be needed in order to meet energy and iron requirements.

- **“The Impacts of Dietary Change on Greenhouse Gas Emissions, Land Use, Water Use, and Health: A Systematic Review” by Lukasz Aleksandrowicz (Lead Author)** – This review the evidence on changes in GHGe, land use, and water use, from shifting current dietary intakes to environmentally sustainable dietary patterns: This review reveals that environmental and health benefits are possible by shifting current Western diets to a variety of more sustainable dietary patterns.



**Figure 4 - Mean Daily GHG emission (kg CO<sub>2</sub>-eq) of Food Groups per Consumption Occasion in Reference Scenario**

- **Study on “Large-Scale Microanalysis of U.S. Household Food Carbon Footprints and Reduction Potentials” published in Journal Environmental Science and Technology (2021)** suggest three key strategies to reduce Household (HH) Food Carbon Footprints (CFs):

1. Lowering the over-purchasing in small (one- or two-person) HHs can achieve two-thirds of the recognized carbon emission reduction potentials;
2. Reducing the intake of snacks, ready-made food, and drinks leads to as much as, if not more, carbon emission reduction than changing diets; and

3. More attention needs to be paid to reduce the carbon intensity of food items with large purchased volume.urchase behavior.

Dr. Jagmeet suggested key important take home messages for nutrition and dietary practices priorities to mitigate GHGe are: adapt plant based diets; poshan with local and seasonal through home grown kitchen gardens (PaushanVatika); incorporation of Millets in diets instead of Rice and Wheat; revisiting traditional methods of cooking and processing; reviving Indian herbs, condiments and spices; decreasing food waste; and regulating purchase behavior.

### **3. Sustainable Diets for Reducing GHGe**

**Dr. Parmeet Kaur**, Chief Dietician, All India Institute of Medical Sciences, New Delhi mentioned that our daily food choices have an impact not only on our health but also on the climate. The climate change and non-communicable diseases is major global challenge- both in India as well globally. It is crucial to address these issues. The following points need to be considered to mitigate GHGe:

- a. Sustainable diets should be adapted to mitigate GHGe, as sustainable diet contributes to low environmental impacts, promotes food system security and leads to healthy life for present and future generations.
- b. Environmentally sustainable diet should be based on dietary recommendations of “My plate for the day” by National Institute of Nutrition, India.
- c. Pulses / legumes consumption should be promoted by reducing selling price. This will increase availability and affordability of pulse to the large segment of population and hence results in low GHGe.
- d. A wide variety of fish should be consumed and a policy on fish can be developed particularly for coastal region.
- e. Consumption of whole grains, millets, local available foods should be promoted to reduce GHGe. Regional / state wise

- flexible options that better align dietary patterns with public health and ecological goals should be adapted.
- f. Food waste should be avoided. Recycle food waste.
- g. Overconsumption of energy and excessive consumption of discretionary foods high in saturated fat, added sugar and salt and / or alcohol. As, in the longer term overconsumption of such foods is found to be associated with an increased risk of obesity and chronic diseases and consequently increased carbon footprints.
- h. Dieticians can facilitate dietary changes and promotes information about foods which have low GHGe impact and promotes good health.
- i. A recipe booklet can be prepared using healthy foods which have lower carbon footprint.
- j. Optimizing school meals will also lead to mitigation of GHGe and promote healthy and sustainable pathway for future generation.
- k. To conclude, it is time we recognize the environmental impacts of type and amount of food we eat considering the planet and our health. Therefore, sustainable diet planning should focus on following dietary options:
- Reduce consumption of red meat and avoid processed meats.
  - Consume dairy products in moderation.
  - Prefer plant proteins such as beans, pulses/legumes, soya, nuts & seeds and whole grains.
  - Favor consumption of seasonal and locally available vegetables & fruits. Avoid air- freighted, pre- packaged and prepared fruits and vegetables.
  - For hydration opt for tap water, tea or coffee over soft drinks.

## **4. Agriculture**

**Dr. M. S. Sheshshayee**, Professor and Head, Department of Crop Physiology, University of Agricultural Sciences, Bengaluru presented his view on “Agriculture to Mitigate GHGe”. He pointed out that Rice paddy cultivation is a major source of GHGe and this arises because Rice is grown under flooded conditions.

A Rice variety called DAKSHA, developed by Department of Crop Physiology, University of Agricultural Sciences GKVK, Bangalore is a Rice variety that has an

ability to harness water from deeper layers of soil and has higher abilities to use water efficiently and requires less water. Such varieties have sustained yield and reduce GHGe substantially. Dr. Sheshshayee suggested that following aerobic cultivation practice can help reduce GHGe; and Rice cultivars suitable for this Agronomy can be developed by breeding for physiological traits, DHAKSHA is one such rice cultivar now becoming popular and more efforts are needed to develop such varieties and to popularize their cultivation agronomy.



## **5. Alternate Proteins- A Smart Solution to Mitigate GHGe**

**Ms. Satvika Mahajan**, India Policy Specialist, The Good Food Institute, Mumbai talked about the “Alternate Protein a Smart Solution to Mitigate GHGe”. She made the following observations:

- a) The impact of dietary shift on environment requires a bold visionary action to steward public and ecological health. An important aspect which requires major paradigm shift is protein production. The current mode of meat production is highly resource intensified and utilizes vast resource. Hence, protein production as a means for dietary diversification is an urgent need for India.
- b) To ensure nutrient and climate secure future the alternative protein or smart protein is huge promising solution. The diversification of the protein will build a more secure system. They are produced from plant, micro-organisms or from animal cells. They are more efficient in terms of water energy, land energy and GHGe. The smart protein will act an excellent vehicle for supply nutrients.
- c) The Institute of Chemical Toxicology is setting up a Research Centre which will be focused on Cultivated and Fermented derived Proteins. To support this innovation a policy frame work is required to facilitate the smart protein products in the market. She also mentioned that Singapore is the first country which used alternative protein as a smart solution to reduce their reliance on food import and around 30% of their nutritional needs are met by locally available food. Similarly other countries like Israel, Japan, US, Australia and New Zealand are adapting similar framework.

## **6. Lifestyle**

**Dr. B. K. Nandi**, Senior Food Safety and Nutrition Officer, FAO, RAP, (retd.), Kolkata presented his views on “Lifestyle to Mitigate GHGe”. The following suggestions were made by him:

### **a) Measures to Mitigate GHGe:**

- Elimination of pollutants and toxicants in air, water, soil, buildings, manufactured goods, and food.
- Preservation of biodiversity and protection of endangered species.
- Conservation and sustainable use of resources such as water, land, air, energy, raw materials, and natural resources.
- Rooftop solar heating.
- Shifting from meat-intensive diets to

largely plant-based diets in order to help mitigate biodiversity loss and climate change.

- Establishment of nature reserves for recreational purposes and ecosystem preservation and clamping on illegal fishing.
- Sustainable and less polluting waste management including waste reduction (or even zero waste), reuse, recycling, composting, waste-to-energy, and anaerobic digestion of sewage sludge.

#### **b) Lifestyle Changes to Mitigate GHG Emissions:**

- Individual action - recent studies have identified the following actions that would have the greatest impact on lifestyle of an individual's Greenhouse Gas Emissions: Eating a Plant Based Diet. Beef is the most Greenhouse Gas (GHG) intensive protein in the world (with, for example, 20 times the impact on land use and GHG emissions of beans), and this behavior is unsustainable.
- Reducing Food Waste.
- Reducing air travel, living car free, reducing family size.

- Complete elimination of use of Plastic.
- Controlling water, air and chemical pollution.

#### **c) International Efforts to mitigate GHGe:**

- Kyoto Protocol: The Kyoto Protocol was adopted on 11 December 1997. Owing to a complex ratification process, it entered into force on 16 February 2005. Currently, there are 192 Parties to the Kyoto Protocol. In short, the Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets. The Convention itself only asks those countries to adopt policies and measures on mitigation and to report periodically.

Dr. Nandi concluded that Lifestyle and GHGe are inextricably linked with one another. To achieve United Nations Sustainable Development Goals including “Food, Nutrition Security and Health for All” Lifestyle has to be considered as an important factor for mitigating GHGe.

## 7. Food Processing Activities, Packaging and Waste Management

**Dr. H. N. Mishra**, Professor of Food Technology, Agricultural and Food Engineering Department, IIT Kharagpur, made a presentation on Green Technologies in Food Processing and Packaging.

Prof. Mishra informed that green technology is also called environmental technology or clean technology because it is environmentally friendly. This green technology could be developed and used in a way that does not disturb environment or destroy natural resources. This green technology plays a very pivotal role in food sector.

His presentation highlighted the following points:

- Share of different sectors in GHGe: Deforestation 15-18%; Farming 11-15%; Transport 5-6%; Processing and Packaging 8%-10%; Freezing and Retail 2-4%, Waste 3-4% and other non-food related emission 43-56%.
- The common operations in food processing with environmental impact are:
  1. Raw Materials procurement which includes transport of ingredients, storage of ingredients and refrigeration/ freezing storage.
  2. Processing: there are three levels of processing Primary, Secondary and

Tertiary. This includes Blanching, Heating, Drying, Irradiation, Concentration, Freezing, Chilling, Chemical Preservation etc. According to Compton et al, 2012, Heating and Cooling process needs are the largest consumers of energy in the food processing industry.

There are some emerging alternative technologies such as Bio preservation: Bacteriocins, Organic acids and Probiotics; Electromagnetic waving heating: Microwave technology and Radiofrequency technology; Electric and magnetic fields: Ohmic heating, Moderate electric field heating and inductive heating and Non-thermal technologies: Pulse electric field, HPP, Ionizing/ UV Radiation, High intensity pulsed light; Ultrasound, Ozonization, Cold plasma processing and Membrane technology (Ngadi et al, 2012).

3. Packaging: It covers packaging material including non-biodegradable, High energy manufacturing/recycling of packaging materials and waste generation. Packaging material includes:
  - Eco- friendly packaging materials like Bio- plastics which can be used to replace petroleum-based plastics with green plastics or bioplastics (degradable plastics). For example, poly-3-

hydroxybutyrate-co-3-hydroxyvalerate (PHBV) is a biodegradable, nontoxic, biocompatible plastic produced naturally by bacteria and Chitosan a natural polysaccharide derived from the shells of crustaceans.

- Edible Packaging: Edible film is thin, continuous or unbroken sheets made up of edible substances- natural polymers like soy or milk proteins, starch etc. It can be placed in between food element, act as a food wrapper and a pocket to hold a food and reduce usage of non-biodegradable polymers. It prevents oxygen absorption and offer physical protection. For example edible water bottle made from sea weeds.
- Tailoring packaging properties to reduce food waste and losses by:
  - a. Modified Atmospheric Packaging (MAP) technologies.
  - b. Active and intelligent packaging: Time temperature; integrity indicators; freshness indicators ; Biosensors and Chemical sensors.
  - c. RFID-Barcode technology.
  - d. Nano composite packaging materials.
    - Zero Discharge waste management: in this process the food processing waste is filtered or segregated into solid waste and liquid waste. The solid waste is further divided into organic waste or non-biodegradable waste. The organic waste is further treated with enzyme/

SCF, MW extraction of bioactive compounds which produces bioactive and compost whereas non-biodegradable waste is recycled or reused as a building material. The liquid waste is first treated with anaerobic treatment and then it is filtered with membrane filtration. After filtration with membrane filtration the waste goes through a process of Ozonization and then this can be used again.

#### 4. Storage and Distribution

Prof Mishra referred to eco-designing in food processing given by Sonesson et al, 2010. The purpose of eco-design is to prevent or design out adverse environmental impacts throughout the life cycle of the products or service systems. Eco design means the integration of environmental consideration in the product development process. This includes use of environmental friendly raw materials, efficient use of raw materials, cleaner production options, optimization of packaging, effective distribution system and environmentally sound use of the products that mitigates GHGe.

The challenges in adoption of green technologies are:

- a. Environmental friendly is not equal to economic profit. This means Eco-friendly options are expensive than conventional options. There is a need to find balance.
- b. Increasing global population: sustainable methods should increase food yields.

- c. Shifts in mindset is very important. Consumer have to consciously choose greener options in spite of high price. Preference should be on adopting sustainable diets- locally produced with less environmental impact.
- d. Funding is required in Research and Development (R & D) to develop new technologies and facilities to commercially implement already developed technologies.

## **8. Industry Perspective In Reducing GHGe**

**Dr. Srinivasulu Naladala**, Leader - Innovation, Technology and Quality, General Mills India Private Limited, Mumbai talked about the “Industry Perspective in Reducing GHGe”. He said that climate change presents risk to humanity, environment and livelihoods. Changes in climate not only affect global food security but also impact the supply of raw material. This influences the ability to make food people love and deliver value to

the shareholders.

He informed about the science-based goals set by industry. These include reducing absolute GHGe across the full value chain. He also informed that his company's policy on climate focuses on mitigation, adaptation, disclosure and advocacy and has established a framework to track and reduce greenhouse gas (GHG) emissions across their value chain.

## **9. Bioplastics**

**Dr. Rajeswar Santayya Matche**, Chief Scientist and Head, Food Packaging Technology Department, CSIR-CFTRI, Mysuru made a presentation on “Bioplastics”. His presentation highlighted the advantages of using bio-based products. These included: reduction in fossil fuel dependency (e.g., drop-in plastics); environmental benefits in terms of GWP (Global warming potential); simplified waste management and returning carbon to soil as compost. Further anaerobic

digestion of biodegradable plastics can produce large specific energy and contribute to achieve an optimal ratio of carbon to nitrogen in the process. Biodegradable plastics could replace non-degradable plastics in products that are likely to leak in the environment, potentially mitigating plastic pollution. Hence, Bioplastics are suitable for reuse, mechanical recycling, organic recycling, and energy recovery.



Dr. Matche concluded that:

- a. It can be expected that the bioplastics industry will receive incentives to grow, develop new technologies and materials, and scale-up its production to greater volumes.
- b. Once larger productions are achieved and larger volumes of bioplastics are circulated, more assessment will be undoubtedly required to understand the sustainability of these materials.

Polymer	Biobased	Biodegradable
Polylactic acid (PLA)	Yes	Yes
Starch blends, thermoplastic starch (TS)	Yes	Yes
Polyhydroxyalkanoates (PHAs)	Yes	Yes
Polybutylene succinate (PBS)	Yes / No	Yes
Polyurethanes (PURs)	Yes / No	Yes / No
Polycaprolactone (PCL)	No	Yes
Polyvinyl alcohol (PVA)	No	Yes
Polybutylene adipate terephthalate (PBAT)	No	Yes
Polyethylene Furanoate (PEF)	Yes	No
Bio-polypropylene (bio-PP)	Yes	No
Polytrimethylene terephthalate (PTT)	Yes	No
Bio-polyethylene terephthalate (bio-PET)	Yes	No
Bio-polyethylene (bio-PE)	Yes	No
Bio-polyamides (bio-PAs)	Yes	No

Figure 5 - Lists of Bioplastics and Indication of Bio-Based Origin & Biodegradability

## 10. Water and Sustainability: Changing Dynamics of Lifestyle to Mitigate GHGe

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**Dr. V. P. Sharma**, Chief Scientist and Professor AcSIR, CSIR- Indian Institute of Toxicology Research, Lucknow made a presentation on “Water and Sustainability: Changing Dynamics of Lifestyle to Mitigate Green House Gases Emissions (GHGe)”.

Dr. Sharma informed that the data from last seven decades, reveals that the global population living in cities increased from 0.8 billion (29.6%) to 4.4 billion (56.2%) and is projected to reach 6.7 billion (68.4%) by 2050. This will lead to more demand for water and emphasized the need for adopting measures to reduce water wastage, reduce water usage and follow water harvesting.

He also suggested adopting innovative technologies/ approaches to mitigate

GHGe; reducing water extraction, addressing issues relating to microplastics and micropollutants including endocrine disrupting chemicals (EDCs) and bringing out policy on water and sustainability. Further, the technological interventions e.g. using biofilm reactors / sensors for micro toxicants for judicious water utility, groundwater extraction, seawater desalination, increased water storage, inter-basin water transfer, improved water-use efficiency etc. should be adopted. He emphasized that integrated water resources management should be adopted at all levels and water-related ecosystems should be restored. Introducing waste water regulatory requirements in the waste water ordinance for the treatment of micro pollutants will be useful.

## SECTION THREE

### Way Forward

The following recommendations were made by the Panel of Experts and Participants for mitigating GHGe through changes in Agriculture Practices, Dietary Habits, Technologies for Food Processing and Packaging and Lifestyle. It was pointed out that:

- Since rice cultivation is a major source of GHGe emission from agriculture, only such Rice varieties should be used that have an ability to harness water from deeper layers to soil and has higher ability to use water efficiently.
- Transformation to healthy diets by 2050 will require substantial dietary shifts. Global consumption of fruits, vegetables, nuts and legumes will have to double, and consumption of foods such as red meat and sugar will have to be reduced by more than 50%. A diet rich in plant-based foods and with fewer animal source foods confers both improved health and environmental benefits.
- Shift from current national food consumption patterns in India to healthy diets by adoption of dietary guidelines can impact GHGe, blue and green water footprints and land use, Millets can be used instead of Rice and Wheat.
- Conservation of sustainable use of resources such as water, land, air, energy, raw materials and natural resources is essential. Adoption of waste management including waste reduction, reuse, recycling, composting, waste-to-energy, and anaerobic digestion of sewage sludge will be beneficial.
- Substantial increase in water-use efficiency across all sectors will be instrumental in reducing the number of people suffering from water scarcity.
- Water quality can be improved by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
- Environment friendly packaging material should be used. Bioplastic is example of one such material for use. Bioplastic intended to be used a polymer should meet the criteria of being bio-based and biodegradable.
- Green food processing technologies should be used.
- Focused Research and development activities be taken for innovative technologies for developing new varieties of food crops, vegetables and fruits which require less of land and water, packaging and storage of food material to avoid losses without impacting the environment



## **Acknowledgement**

ILSI India thanks **Prof. P. K. Seth**, Chairman, ILSI India, **Dr. B. Sesikeran**, Trustee, ILSI India Board & Chairman, K-FFIG and the speakers: **Dr. Kamala Krishnaswamy**, Former Director, National Institute of Nutrition (ICMR), Chennai, **Dr. Jagmeet Madan**, Principal, Professor, Department of Food Nutrition and Dietetics, Sir Vithaldas Thackersey College of Home Science (Autonomous), SNDT Women's University and National President, Indian Dietetic Association, Mumbai, **Dr. Parmeet Kaur**, Chief Dietician, All India Institute of Medical Sciences, New Delhi, **Dr. M. S. Sheshshayee**, Professor and Head, Department of Crop Physiology, University of Agricultural Sciences, Bengaluru, **Ms. Satvika Mahajan**, India Policy Specialist, The Good Food Institute, Mumbai, **Dr. B. K. Nandi**, Senior Food Safety and Nutrition Officer, FAO, RAP, (retd.), Kolkata, **Dr. H. N. Mishra**, Professor of Food Technology, Agricultural and Food Engineering Department, IIT Kharagpur, **Dr. Srinivasulu Naladala**, Leader -Innovation, Technology and Quality, General Mills India Private Limited, Mumbai, **Dr. Rajeswar Santayya Matche**, Chief Scientist and Head, Food Packaging Technology Department, CSIR-CFTRI, Mysuru and **Dr. V. P. Sharma**, Chief Scientist and Professor AcSIR, CSIR- Indian Institute of Toxicology Research, Lucknow for their contributions.

**Rekha Sinha**  
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## **About ILSI India**

### **International Life Sciences Institute India**

[www.ilsi-india.org](http://www.ilsi-india.org)

**ILSI India** is an entity of the International Life Sciences Institute (ILSI), headquartered in Washington DC. It is a scientific non-profit organization. ILSI India provides scientific inputs and secretariat assistance to the South Asian Region, which includes Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

**ILSI India activities** primarily focus on local and regional issues and involve leading national and international experts in the deliberations. ILSI India is the leader in the region in focusing attention and devoting resources on critical areas in food and water safety, nutrition, risk assessment, harmonization of food regulations, improvement in the health profile of malnourished children and women, and agriculture sustainability including biotechnology. Special attention is given to the importance of complementary foods and food fortification. All activities follow Principles of Scientific Integrity which are part of ILSI Mandatory Policies.

**ILSI India** carries out its mission through sponsoring workshops, symposia, conferences, seminars, training programs, research projects, and publications.

**ILSI India works** closely with scientists from academia, public and private sector.. ILSI India's Board of Trustees is comprised of individuals from industry, academia, government and research organizations who bring a range of expertise, experience, and perspective to their work defining and achieving ILSI India's goals. These individuals are unpaid volunteers who take their scientific and fiduciary responsibilities to the organization seriously. They serve on ILSI India's Board of Trustees as individuals and do not represent their employers. Country Committees have been established in the South Asian Region for management of country programs.

**ILSI is a global, non-profit federation** dedicated to generating and advancing emerging science and ground-breaking research to ensure foods are safe, nutritious and sustainable, and that they improve planetary and human health and well-being in the 21st century. ILSI convenes scientists at the forefront of research on nutrition, food safety and sustainability, and operates within a framework of the highest principles of scientific integrity. ILSI's trusted experts and volunteers around the world work synergistically and transparently across academia and the public and private sectors.

**ILSI envisions a future** where its thought leadership positively impacts health and sustainability through decisions informed by science and provides input to overcome global food challenges through collaboration across sectors.

**ILSI's work is guided by its Code of Ethics, Scientific Integrity and Organizational Standards of Conduct.** ILSI accomplishes this work through its **worldwide network** of ILSI Entities. ILSI's scientific publications are duly recognized all over the world. They include the journal *Nutrition Reviews* and the book *Present Knowledge in Nutrition*. Please visit [www.ilsi.org](http://www.ilsi.org) for more information on ILSI and its network.

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- ➡ Micronutrient Status of COVID-19 Hospitalized Patients.
- ➡ Factors Affecting Brain Development and Health – A Lifecycle Approach.
- ➡ Efficacy of Nutraceuticals (Probiotics or Prebiotics or Synbiotics) in the Prevention or Treatment of COVID-19.
- ➡ Dairy Food Consumption and its Relation with Metabolic Syndrome and Diabetes in Asian Adults.

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