1 Introduction

If conservation of natural resources goes wrong,

Nothing else will go right.

-M.S. Swaminathan

According to Krahn *et al*., (2021), health has been perceived as a dynamic state of equilibrium that encompasses physical, mental, social, and existential well-being, allowing individuals to adapt to various lifestyle and environmental circumstances. In general, health is defined as the capacity to effectively respond to diverse environmental situations, utilizing optimal affective, behavioral, and cognitive responses, while actively avoiding undesirable ones. It is crucial to maintain this balance to achieve overall well-being and adaptability in the face of changing conditions.

The fundamental requirement for all human beings to sustain life is the consumption of food (Colin, 2016). However, the global food system is currently confronted with several challenges in its endeavor to provide an adequate food supply while mitigating its adverse impact on the environment. One of the primary objectives of the food system is to provide affordable and nutritious food. However, a significant obstacle lies in meeting the needs of a growing population, projected to reach approximately 9 billion by the year 2050 (UNESDA, 2017). The task at hand requires sustainable solutions that address the increasing food demand while minimizing environmental consequences. Such sustainable solutions may entail a balance between affordability, nutritional value, and environmental sustainability.

MacDiarmid *et al*., (2011) have opined that people in the contemporary world consume food that creates adverse effects on both health and environmental factors. Increased revenues are accompanied by a higher level of dietary intake of meat, milk, oil, salt, and processed food. At the same time, food globalisation

degrades the environment and reduces biodiversity while increasing high energy, and low-varietal and significant nutritional costs in diets (Foresight, 2011).

Hawkes (2008) highlighted the fundamental transformation in the acquisition, preparation and consumption of food, the established procedures for animal husbandry and crop production, as well as the supply, processing, and distribution of agricultural products. This has resulted in a major environmental impact on landscapes, land and water resources, biodiversity, and the global climatic system.

Alleyne *et al*., (2013) highlighted that the growth in obesity and, therefore, non-communicable diseases, including cardiovascular disease, diabetes, and hypertension, as a consequence of urbanisation and rising sedentary lifestyles is unprecedented. The data indicate that such health problems in low, medium, and high revenue nations have increased alarmingly irrespective of their revenue status.

According to WHO (2018), the global nutrition-related health statistics reveal that overweight rates among adults were 1.9 billion, underweight rates among adults were 462 million, wasting rates among children under 5 years old were 52 million, the extreme wasting rate among children was 17 million, stunting rates among children were 155 million, overweight or obesity rates among children were 41 million.

India faces a challenge with 17.3% of children less than the age of 5 suffering from wasting, greater than the average of Asia (9.1%) and among the largest in the world. The prevalence of overweight children under the age of 5 is 1.6%, and India is 'on the way' to prevent an increase. With 5.1% of adults (18 and older) and 2.7% of adult males living with obesity, the government has demonstrated an increase in its obesity objective. India's obesity prevalence is 8.7% for women and 6.0% for men, which is lower than the regional norm. Simultaneously 8.3% of adult women and 9.1% of adult men are expected to suffer from diabetes (Global Nutrition Report, 2020). According to the National

Family Health Survey (NFHS, 2019), children under the age of five account for about 27%, of whom 20% are wasted and 24% in Tamil Nadu are underweight.

Godfray *et al*., (2020) revealed that meat is a rich source of energy and protein and a number of vital elements such as iron, zinc, and vitamin B12, including protein and micro-nutrients. If a wide range of other foods are accessible and consumed, adequate intake of these nutrients may be obtained without eating meat.

According to Micha *et al*., (2010), the global average per capita consumption of 42 g/day of unprocessed red meat and 14 g/day processed meat (which includes both red and white meat) hides great regional differences, with high-income (60 to 91 g/day) and Latin American (27 to 44 g/day) countries eating the most, and Africa (7 to 34 g/day) and Asia (4 to 7 g/day) eating the least. Food balance sheets from the same year indicate higher red meat consumption (approximately 68 g/day, after adjusting for waste), although this includes some processed meat.

The relationship between levels of meat (red and processed) intake and mortality, as well as major and common illnesses such as cardiovascular disease, type 2 diabetes and certain forms of cancer was evaluated (Keller *et al*., 2014). The risk of mortality for males with the highest intake (highest compared to lowest quintiles) of red meat (hazard ratio 1.31 95% CI 1.27 to 1.35) and processed meat (HR 1.16 95% CI 1.12 to 1.20) was 16% greater than that for those with a lower intake (Sinha *et al*., 2009).

Stockstad (2010) opined that except for a few poverty-saving nations, the majority of the world is transitioning from plant-based diets to diets extremely high in raw foods, meats and dairy products. This trend is particularly apparent in the urban middle classes. Americans, who constitute only 4.5% of the global population, consume over 15% of the world's meat production.

International Agency for Research on Cancer (IARC, 2015) estimated that 34,000 cancer deaths per year worldwide may be caused by high meat diets, which could be attributable to 50,000 cancer deaths annually worldwide if the associations with red meat are found to be causal. Based on the IARC study, average consumption of processed meat in Western Europe would result in a 9% increase in the risk of colorectal cancer. High intake of processed meat may also increase the risk of stomach cancer, but there is no strong evidence that it increases the risk of other types of cancer.

Unhealthy diets adversely affect the environment. While high levels of milk, meat, fish and other seafoods, nuts and dry fruits might constitute a nutritious diet, they cannot be eco-friendly (Garnett, 2016).

At the global level, the environmental and planetary consequences of food systems are severe. While industrial and agricultural revolutions have expanded food production, these developments have come at a significant environmental cost. Food production places major demands on natural resources—utilizing approximately 70% of the available freshwater supply and 38% of the world's land. Notably, the livestock industry alone consumes about 70% of global farmland (Development Initiatives, 2017). Agricultural land expansion is a known driver of deforestation (CAT Decarbonisation Series, 2018).

Phillips *et al*. (2018) identified agriculture and food production as significant contributors to ongoing biodiversity loss. Human beings now constitute 36% of the biomass of all mammals, livestock account for 60%, while wild mammals make up only 4%.

Globally, the food system contributes approximately 30% of total greenhouse gas emissions (GHGEs). With the global population projected to exceed 9 billion by 2050, the Foresight Project (2011) anticipated that food and agriculture would increasingly contribute to climate change, especially through the growing demand for transporting, storing, and consuming resource-intensive foods like dairy and meat.

GHG emissions from livestock are largely determined by feed inputs. Estimates indicate emissions of 0.8–2.4 kg CO2eq per kg of milk, 1.7–6.6 kg CO2eq per kg of eggs, 2.5–6.9 kg CO2eq per kg of poultry meat, and 10–20 kg CO2eq per kg of mutton and lamb (Bellarby *et al*., 2013).

Furthermore, agriculture and related land use changes account for about one-quarter of annual GHG emissions. Over half of all vegetated land is dedicated to food production. This situation threatens both planetary and human health. Despite the negative environmental effects of the global food system—such as deforestation and GHG emissions—many people remain undernourished or lack access to nutritious food (WRI, 2018).

Per capita meat consumption varies significantly across regions. In contrast to the global average of 38 kg per year, U.S. citizens consume approximately 124 kg per capita annually. In Africa and South Asia, where the nutritional burden is greatest, meat consumption is substantially lower: 8.5 kg/person/year in Africa and 3 kg/person/year in Bangladesh (Stockstad, 2010).

The IPCC (2019) has demonstrated that anthropogenic carbon dioxide emissions have significantly contributed to climate change. Emission sources are closely tied to local economic activities. Major emitters include energy generation, heating, industry, and the agri-food sector (IPBES, 2019).

According to FAO (2020), agricultural output alone contributes 10–12% of all anthropogenic GHG emissions and continues to increase. Emission contributions vary by region: Asia accounts for 44%, Africa 15%, Australia 4%, Oceania 5%, North America 9%, and North and South America combined contribute about 17%.

Sims (2011) reported that approximately 30% of global energy usage is attributable to food systems. Beyond the energy required to operate the entire food supply chain, food systems are responsible for one-third of global GHG emissions, particularly CO2 (Smith *et al*., 2014). Moreover, agriculture is a major

source of non-CO2 emissions, accounting for 57% of total anthropogenic non-CO2 emissions globally and 90% of nitrous oxide emissions (Saunois *et al*., 2016).

Global Panel (2015) emphasized the urgent need to transition from current food systems to more sustainable ones in light of these global challenges. A climate-smart diet integrates synergies among nutrition, adaptation, and food system mitigation outcomes. The climate-smart nutrition sector is primarily rooted in two areas: climate-smart agriculture (CSA) and nutrition. Innovative interventions are required to simultaneously address agricultural and nutritional needs.

In response to these challenges, the EAT-Lancet Commission convened 37 leading scientists from 16 countries, representing various disciplines including human health, agriculture, political science, and environmental sustainability, to define targets for healthy diets and sustainable food production (EAT-Lancet Commission Report, 2019).

The Commission proposed the "Planetary Health Diet," a model that aims to sustain both human health and environmental well-being. This diet emphasizes reduced consumption of meat, fish, eggs, and refined grains, while recommending increased intake of vegetables, greens, fruits, and whole grains (Willett *et al*., 2019).

The EAT-Lancet Commission (2019) described the planetary diet as a global dietary pattern in which half of the plate consists of fruits, vegetables, and nuts, while the other half includes whole grains, plant-based proteins, unsaturated vegetable oils, limited amounts of meat and dairy, some added sugars, and starchy vegetables.

Planetary diets are generally higher in dietary fiber, magnesium, folic acid, vitamins C and E, iron, and phytochemicals. They are typically lower in calories, saturated fats, cholesterol, omega-3 fatty acids, vitamin D, calcium, zinc, and

vitamin B-12 (Devey *et al*., 2003). Evidence suggests that vegetarians have lower rates of cardiovascular disease (CVD), obesity, type 2 diabetes, and certain cancers (ADA, 2007). A planetary diet increases the intake of protective vitamins and phytochemicals while reducing consumption of harmful dietary components linked to chronic disease (Dewell *et al*., 2008).

The planetary health diet is adaptable to individual nutritional needs, cultural traditions, and personal preferences—including vegetarian and vegan diets. However, to meet global dietary goals by 2050, significant shifts are required. These include reducing unhealthy food intake (e.g., red meat and sugar) by over 50% and doubling the intake of healthy foods like nuts, fruits, vegetables, and legumes. Regional food options will influence the nature of these dietary changes (Willett *et al*., 2019).

Springmann *et al*. (2018) reported that plant-based diets are increasingly prevalent across many regions. For example, 19% of individuals in the Asia-Pacific identify as vegetarians, compared to only 5% of Europeans and 6% of Americans (Statista, 2020).

Janssen *et al*. (2016) noted that motivations for adopting plant-based diets include socio-cultural norms, peer influence, and health concerns. However, long-term adherence may depend on the level of acceptance and internalization of these diets (Ruby, 2012). Key motivators for adopting plant-based diets include health outcomes, animal welfare, and environmental sustainability (Jabs *et al*., 2008). Yet, challenges remain—particularly a general lack of awareness about the benefits of plant-based diets and the risks of excessive meat consumption (Corrin *et al*., 2017).

Sustainable diets, especially plant-based diets, have gained significant attention as environmentally responsible alternatives to traditional Western diets high in animal products (Willett *et al*., 2019; Nelson *et al*., 2016). According to Harvard (2018), plant-based diets can follow several forms: flexitarian (includes

occasional animal products), pescatarian (includes seafood), lacto-ovo-vegetarian (includes dairy and eggs), and vegan (excludes all animal products).

Rosenfeld (2018) emphasized that dietary habits are often tied to personal and cultural identity. In many communities, meat consumption is influenced by tradition or religious beliefs. Family, peer groups, media trends, and food marketing significantly influence dietary choices (Jabs *et al*., 2008; Hawkins *et al*., 2020; Gittelsohn *et al*., 2012).

Sustainability entails meeting the current needs of local populations without compromising future generations or degrading the environment (Hajian *et al*., 2021). The interdependence of human and ecosystem health is well established (TEEB, 2018).

Fanzo (2018) observed that although the global food system is essential for health and nutrition, it places immense pressure on land, water, air, and biodiversity. Johnston *et al*. (2014) and Mason and Lang (2017) noted that the concept of sustainable diets, which integrate public health and environmental objectives, emerged during the 1980s.

FAO and WHO (2019) defined sustainable healthy diets as those that support individual health and well-being, have low environmental impact, are culturally acceptable, accessible, affordable, and safe.

Burlingame *et al*. (2012) reiterated that sustainable diets are nutritionally adequate, safe, and healthy, while promoting environmental and economic sustainability. FAO (2019) identified various factors affecting food consumption, including geography, income, urbanization, culture, religion, and food marketing.

Sustainable diets consider the mutual impacts between human nutrition and food systems, including agricultural, environmental, social, and economic dimensions (MacDiarmid *et al*., 2012).

The EAT-Lancet Commission (2019) emphasized that global efforts must align with two overarching objectives: improving human health and ensuring environmental sustainability. In alignment with these goals, the United Nations Sustainable Development Goals (SDGs) aim to eradicate poverty, protect the environment, promote prosperity, and eliminate hunger and malnutrition. Similarly, the Paris Agreement addresses both climate change and its direct implications for human health.

According to the IPCC (2019), achieving the Paris Agreement's goal of limiting global warming to below 2°C—preferably 1.5°C—requires decarbonizing the global energy system. This includes transforming food systems to deliver negative emissions and preserving natural carbon sinks.

Multiple studies suggest that a global shift toward healthier, sustainable diets can mitigate climate change, address food insecurity (IPBES, 2019), reduce biodiversity loss (FAO, 2020), improve health outcomes (GNR, 2020), and lower premature mortality (FAO Europe, 2020; WWF, 2020).

The UK Sustainable Development Commission (2009) recommended reducing meat and dairy consumption, lowering intake of nutritionally poor foods and beverages, minimizing food waste, increasing seasonal and local fruit and vegetable consumption, sourcing fish from sustainable stocks, and promoting organic food. While some guidelines remain contested, they highlight key strategies for environmental benefits.

The Chicago Council (Nugent, 2011) advocated addressing stunting by balancing animal-source food intake, improving access to fruits and vegetables, meeting the nutritional needs of at-risk populations, and mitigating health risks across the life course.

The Foresight Project (2011) outlined policy measures to shape dietary behaviors. These include disseminating best practices, investing in research, embedding sustainable food production in development strategies, acknowledging

land limitations, safeguarding fish stocks, encouraging sustainable intensification, incorporating environmental economics, minimizing food waste, and strengthening evidence-based policymaking.

Health professionals must craft and promote core messages that facilitate sustainable and healthy dietary behavior. Specific sectors such as fisheries (Clonan *et al*., 2012) should be scrutinized when designing dietary communication strategies. Dietitians and nutritionists play a vital role in delivering these messages and must understand local food choices and nutritional needs within economic constraints.

According to Chew *et al*. (2016), digital innovations in health, such as web-based (eHealth) and mobile (mHealth) interventions, are expanding. mHealth encompasses mobile phones and digital assistants. Early uses included SMS and voice messaging, but smartphone apps now offer automated features that support health interventions.

The widespread adoption of smartphones and app accessibility makes them powerful tools for transforming nutritional behaviors and outcomes (Heron *et al*., 2010). Benefits include real-time interaction, personalized treatment, and scalable impact across diverse groups (Hekler *et al*., 2015; Servick, 2015).

However, most commercial nutrition apps lack empirical validation (Bardus *et al*., 2016). Rivera *et al*. (2016) emphasized the need to assess the effectiveness of app-based interventions before deploying them as public health tools.

Owens (2005) highlighted that smartphone apps, when designed with persuasive interfaces, can influence behavior and lifestyle changes. Overall, integrating mobile technologies presents a promising avenue to enhance quality of life through improved dietary and lifestyle practices.

Hence the study was carried out with the primary objective of promoting a sustainable food ecosystem by following a planetary health diet and the secondary objectives were,

- To analyze the knowledge, attitude, and practice of Planetary health diet among selected subjects
- To calculate carbon and nutritional Footprint of the food consumed by selected subjects.
- To develop and evaluate an e-application in promoting planetary health diet.
- To create awareness on the importance of planetary health diet and analyze the Post – knowledge about planetary health diet among selected subjects.

Hypothesis

The following Hypotheses were tested:

Null hypothesis:

1. There is no relationship between the knowledge of the subjects and the practice of planetary health diet.
2. There is no difference between pre and post knowledge, attitude, and practice of planetary health diet among subjects.

Alternate hypothesis:

1. There is a relationship between the knowledge of the subjects and the practice of planetary health diet.
2. There is a difference between pre and post knowledge, attitude, and practice of planetary health diet among subjects.