

Sustainability and Dietary Change: An Analysis of Indian Food Consumption Patterns

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Abstract: Indian consumption pattern is diversifying towards high value agricultural products in search of a nutritious and healthier diet. The study analyses the trends of changing Indian food baskets in terms of social (nutrition), economic (affordability of a healthy diet) and environmental (global warming potential) sustainability. In terms of nutrition, the study finds that against a recommended calorie intake of 2503 kcal, the highest monthly per capita expenditure (MPCE) section of urban and rural population is consuming 3143 and 3184 kcal respectively. The lower MPCE section consumes only 65% of what is recommended as a healthy diet by LANCET. A comparison of the Indian diets with the LANCET recommended diet finds the environmental impact of the latter to be 1.3 times that of the actual intakes by Indians. The cost of the LANCET diet is 1.6 and 1.2 times the cost of the actual intake and recommended diets in India respectively. While the Indian diet is environmentally more sustainable, a nutritious diet of the global standard is beyond reach of the poor. Concerted efforts are required for facilitating an affordable, accessible and sustainable diet.

Keywords: Affordability, Consumption pattern, Environment, High value agricultural products, Nutrition, Sustainability.

INTRODUCTION

The global agricultural and food systems have evolved from food inadequacy and are working towards achievement of nutrition adequacy in terms of acceptable standards. However, these are facing challenges of sustainability environmentally, socially and economically. Intensification of agricultural production, increasing populations, fast pace of urbanisation

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and changing lifestyles have all contributed to changing production and consumption compositions affecting not only the diets but also adding environmental pressures on the limited natural resources. Therefore, sustainability of the food system has become a big concern. According to United Nations (2020), 'Sustainable Development Goal (SDG) 2 Zero Hunger aims to end hunger, achieve food security, and provide an improved nutritional status through sustainable agriculture'. There is a close association between the unhealthy diets and lifestyles and the growing occurrence of non-communicable diseases (NCDs) in the developing countries. The focus of sustainable development should be not only a consumption of healthy and fresh food but also to develop sustainable patterns of consumption that remains in sync with the food production ecosystem.

According to FAO and WHO (2019) report on guiding principles of a Sustainable diet, "diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations are sustainable". Literature supports that sustainable diets aid in achieving improved health outcomes through better nutritional diets, and encourage environmental and economic stability through low-impact and affordable, accessible food (Johnston, Fanzo and Cogill, 2014). An Australian case study on sustainable diets proposed three guiding principles while developing sustainable and healthy diets: (a) the consumption of non-essential food choices like that of high energy dense and packaged food should be reduced both from the dietary and environmental perspective, (b) a diet rich in plant-based food items is both ecologically and health wise beneficial, and (c) food which is consumed above the calorie requirement adds pressure on natural sources and adds on to the GHG emissions (Friel, Barosh and Lawrence, 2013).

Low carbon and plant-based diets including more of fruits and vegetables, grains, etc., are considered to be sustainable owing to their positive impact towards reducing the global warming (O'Malley *et al.*, 2019; Sabate & Soret, 2014). Animal-based diets especially meats from ruminants tend to have the largest environmental impact in the form of GHG emissions, land use, and nutrient pollution. This is considered to be 100 times more than the whole grains (Clark & Tilman, 2017; Poore and Nemecek, 2018). Fish as a part of non-vegetarian diets has lower environmental impacts due to a wide variety of fish production systems adopted like aquaculture etc. MMP and poultry also have been found to have lower environmental impacts in comparison to meat but higher environmental impacts than most plant-based foods (Clark *et al.*, 2020).

Rapid urbanisation of Indian economy has led to an increase in income of consumers leading them to spend their additional disposable incomes

on diversification in their food baskets, luxury goods, etc., which were initially not affordable. Reasons like increasing workforce participation in urban jobs, increasing entrepreneurial culture in India (Dana, 2000), availability of convenient food items, larger number of nuclear family set ups, etc., have also encouraged the trend of eating away from home. Adding to this demand are the increasing number of food startups and entrepreneurial set ups in the Indian arena that are procuring fresh agricultural products like fruits, vegetables, milk, eggs, etc., and providing them at the consumer's doorstep. Although the diversified consumption baskets have indicated a move towards inclusion of more high value agricultural products (HVAP) like milk and milk products (MMP), meat, fish and eggs (MFE), fruits and vegetables, but this trend is not uniformly distributed across all sections of society and has also come at an environmental cost of green-house gas (GHG) emissions and food wastage. India is currently facing the issue of triple malnutrition– at one end of the spectrum is the issue of stunting and underweight in children (most prevalent in the lower end of the society) and on the other the problem of obesity and diabetes of both the children and adults (mostly experienced by the more affluent sections of the society). Several studies in the past have highlighted the changes in the composition of the food baskets in India (Mittal, 2006; Pandey *et al.*, 2020; Srivastava, 2013). Rising incomes, increasing urbanisation, changing food preferences owing to diversified food choices, opportunity costs of time owing to women participating in workforce have been extensively cited as reasons that have contributed to the diversification in the consumer's food basket. In developing countries this shift in food consumption is evident from the declining relevance of cereals and the increasing importance of HVAPs. Gulati *et al.*, (2006) defined HVAPs as agricultural goods with a high economic value per kilogram, per hectare, or per calorie, including fruits, vegetables, MMP and MFE.

According to the International Comparison Program, World Bank, 71.5% of India's total population cannot afford a healthy diet (Herforth *et al.*, 2020). An Indian on an average will have to spend 74% of their food expenditure to afford a nutritionally adequate diet (Herforth *et al.*, 2020). Across the world, three out of four categories of HVAP, fruits, vegetables and animal products are considered to be the most expensive. The LANCET research shares that in South Asian countries, the HVAP basket of commodities will cost maximum to the consumer with fruits and vegetables taking a share of 31.3%, followed by meat, eggs and fish (18.9%) and dairy products (13.8%) (Headey *et al.*, 2020).

In the backdrop of changing consumer awareness about nutrition, increased affordability of consumer segments and global concern on

sustainable development, the consumption patterns of the Indian population may be critically examined for the purpose of designing future predictions and policy implications. The objectives of the present study are to:

- (a) Analyse the consumption trends and nutritional patterns of the Indian food baskets;
- (b) Evaluate the above baskets through the lens of economic, social and environmental sustainability.

The study is divided in the following sections: Section 2 lays out the data used and methodology adopted to undertake the analysis. Section 3 which is divided into two parts– first part discusses the findings about the food consumption pattern in India and the second part evaluates this pattern from three sustainability aspects. This is followed by conclusions of the study.

THE STUDY: DATA AND METHODOLOGY

The pattern of consumption expenditure at household levels across the nation has been analysed using the quinquennial surveys of the National Sample Survey Organization (NSSO). The reports of four major rounds namely 50th, 55th, 61st and 68th round (NSSO, 1996, 2001, 2006, 2014a) have been explored using percentage analysis to establish the changes in the consumption basket of an Indian consumer across the income levels and food groups. For the analysis of consumption on the basis of difference in income levels, income classes have been divided into deciles as taken in NSSO surveys. The expenditures of the four categories of HVAP have been projected till 2020 using the compound annual growth rate (CAGR) in view of the non-availability of data beyond 2011-12. To substantiate the expenditure pattern on food consumption, more recent time series data on private final consumption expenditure has been used (National Accounts Statistics, 2019)

A comparison of LANCET diet (Appendix 1) has been done with the Nutrient Intake report of 2011-12 (NSSO, 2014b) in order to understand the social (in terms of nutritional adequacy) sustainability effects of the Indian diets. Nutritional adequacy has been limited to calorie intake in the study. Simple differences and percentage differences have been calculated to establish the comparison (Sharma *et al.*, 2020). For the purpose of spatial comparison, the Indian food consumption has been divided into urban and rural categories. Within urban and rural categories, the highest and lowest MPCE classes have been compared in order to compare the food and calorie intake by the richest and poorest 5% of the consumers respectively.

In order to measure the environmental impact of the Indian diets, the carbon footprint of all the food items has been measured (Pathak *et al.*, 2010) in terms of the Global Warming Potential (GWP), which is a combination of all the GHG emissions caused by a product and therefore acts as a single unit of comparison of carbon footprint caused by the food products (Umich.edu, 2020). Five types of diets have been included– the diets consumed in the urban and rural areas based on the NSSO 2011-12 report, recommended intake given by the National Institute of Nutrition (NIN) (ICMR and National Institute of Nutrition, 2011) broken into vegetarian and non-vegetarian diets and the LANCET recommended diet. This is done in order to understand the GWP impact of the non-vegetarian components. In order to maintain uniformity of measurement of all the food items, eggs, which are sold by numbers were also converted into weight of eggs (1 egg= 50gms). India's Food Based Dietary Guideline (FBDG), as given by NIN, includes the following food categories: starchy staples, pulses, MFE (protein sources), dairy, fruits, vegetables, fats and oils and sugar. For estimation of the environmental impact, the starchy staples have been broken into rice and cereals in order to capture the difference in the GHG emissions by rice and cereals. Appendix 2 gives details of the recommended serving size and number of servings for each of the group as per the ICMR-NIN guidelines.

For assessing the economic cost of the referred diets against the actual intake, prices have been taken from the International Comparison Program of the World Bank (Headey *et al.*, 2020). India belongs to the set of countries in the South Asian umbrella and therefore prices as given for the South Asian group of countries have been used in this paper. Cost of the LANCET diet, diet as per the guidelines of NIN and actual intake based on NSSO data has been calculated and compared.

RESULTS AND DISCUSSION

Food Consumption Trends in India

The GDP per capita of India experienced an increase of 8.6% from 1994 to 2012. During this period although the monthly per capita expenditure on overall consumption increased, there has been a decline in the share of expenditure on food consumption. Rural India has experienced a decline of 23% as compared to the urban areas where the decline is approximately 30%. This trend is in conformity with Engel's Law which states that with an increase in income the share of expenditure allocated to food tends to decline. Within the food basket, the share of non-cereals in the monthly per capita expenditure (MPCE) has been on a consistent rise for both rural and

urban areas. The share of cereals declined from 38.5% in 1993-94 to 24.6% in 2011-12 in rural areas and from 25.7% to 15.5% in the urban area (Table 1). Non cereals contribute 74.4% and 84.5% to the total food expenditure of rural and urban consumers in 2011-12.

Table 1: Food Item Wise Share in Monthly Per Capita Expenditure in Rural and Urban Areas

<i>Food Item</i>	<i>1993-94</i>	<i>1999-2000</i>	<i>2004-05</i>	<i>2011-12</i>
Rural				
Cereals and their substitutes	38.5	37.6	32.7	24.6
Pulses	6	6.4	5.6	6.4
Edible Oils	7	6.3	8.3	7.8
Milk and Milk Products	15	14.7	15.3	18.7
Vegetables	9.6	10.4	11.1	9.9
Fruits and Nuts	2.8	2.4	3.4	7.7
Meat, Fish and Eggs	5.3	5.6	6	7.3
HVAP (iv-vii)	32.7	33.1	35.8	43.6
Beverages/ Processed food	6.6	7.1	8.2	11.9
Food	62.1	59.4	55	48.6
Non Food	37.9	40.6	45	51.4
Urban				
Cereals and their substitutes	25.8	23.9	24	19
Pulses	5.6	5.9	5	4.5
Edible Oils	8	6.5	8.1	6.2
Milk and Milk Products	17.9	18.1	18.6	20
Vegetables	10	10.6	10.5	10.8
Fruits and Nuts	4.9	5	5.5	8
Meat, Fish and Eggs	6.2	6.5	6.4	8.6
HVAP (iv-vii)	39	40.2	41	47.4
Beverages/ Processed food	13.2	13.2	14.6	21
Food	54.7	48.1	42.5	38.5
Non Food	45.3	51.9	57.5	61.5

Source: Author's calculations from 50th, 55th, 61st and 68th rounds of NSSO reports

With greater modernisation, opportunities for women in jobs tend to increase thereby leading to an increase in the opportunity cost of women's time. This leads to an increase in demand for time saving processed food (Popkin, 2006). With gender inclusion in the workforce, lesser time is spent on cooking food at home and dependence on convenience and easy to cook food has increased. A similar trend can be observed from the Table 1 where one of the categories of food that has experienced a constant increase is processed food which has increased more prominently in the urban sector (13.2% in 1993-94 to 21% in 2011-12). Another major reason that has contributed to this trend is a massive growth in supermarkets especially in the urban cities which tend to offer greater variety of snacks with added sugar and salts and processed meat (Mathur and Pillai, 2019).

Another category that has experienced an increase in share in food expenditure of consumers is the HVAP basket. Within this MMP and MFE have shown a steeper increase as compared to the fruits and vegetable category. This clearly indicates that although the consumer has begun to diversify the basket but the emphasis is more on livestock. The overall expenditure share of HVAP has increased from 32.7% to 43.6% in rural areas and 39% to 47.4% in urban areas during the 19 year period. Within this the maximum change has been observed in MMP and MFE for both the rural and urban areas.

Classifications of food consumption pattern across the different income levels also indicate a similar shift from cereals towards an increase in share of expenditure on the HVAP category. Table 2 shows that for rural areas, fruits, MFE along with the processed food category show the maximum increase in the share of expenditure on food. In the urban areas, share of

Table 2: Changing food consumption pattern Rs./person/month of poor and rich in rural and urban areas in India

<i>Changing food consumption pattern Rs./capita/month of poor and rich in rural and urban areas in India</i>						
<i>Food Items</i>	<i>Rural</i>					
	<i>Lower Expenditure group (30%)</i>			<i>Upper expenditure group (30%)</i>		
	<i>1993-94</i>	<i>2011-12</i>	<i>CAGR</i>	<i>1993-94</i>	<i>2011-12</i>	<i>CAGR</i>
Cereals	213.65	496.53	5%	319.01	736.41	5%
Pulses and Products	27.79	108.35	7%	67.93	220.33	6%
Edible oils	28.73	140.2	9%	76.57	298.05	7%
MMP	25.02	155.85	10%	239.08	909.78	7%
MFE	15.02	107.85	11%	68.01	510.5	11%
Vegetables	42.66	265.82	10%	98.06	521.78	9%
Fruits and Nuts	5.34	40.26	11%	45.78	370.21	12%
Beverages, processed food etc.	17.41	219.35	14%	81.69	869.61	13%
Total Food	411.3	1723.96	8%	1113.37	4917.77	8%
<i>Food Items</i>	<i>Urban</i>					
	<i>Lower Expenditure group (30%)</i>			<i>Upper expenditure group (30%)</i>		
	<i>1993-94</i>	<i>2011-12</i>	<i>CAGR</i>	<i>1993-94</i>	<i>2011-12</i>	<i>CAGR</i>
Cereals	213.39	538.86	5%	293.46	854.26	6%
Pulses and Products	35.9	139.96	7%	83.8	268.07	6%
Edible oils	43.93	186.91	8%	123.49	371.05	6%
MMP	54.55	295.66	9%	357.65	1290.51	7%
MFE	27.91	183.47	10%	107.79	491.26	8%
Vegetables	55.2	311.14	10%	161.22	682.29	8%
Fruits and Nuts	12.49	92.04	11%	115.95	812.51	11%
Beverages, processed food etc.	40.9	306.5	11%	308.81	2303.34	11%
Total Food	536.12	2316.4	8%	1665.27	7724.05	8%

Source: Author's calculations from 50th, 55th, 61st and 68th rounds of NSSO reports.

expenditure on processed food has increased the maximum followed by fruits, vegetables and MFE. This result is in sync with the overall trend of diversification in food basket.

Figure 1 depicts the change in the composition of the food basket with an increase in income. It can be observed from the figure that as we move towards a higher income class the share of commodities like fruits and vegetables, MMP and MFE tends to increase both in rural and urban areas. The share of the highest income group in food expenditure in urban areas was 27% and that in rural areas was 40%. The expenditure allocated towards the HVAP category by the richest class was 45% and 44% in the rural and urban areas respectively. This gap between the expenditure on food and that on the HVAP category is higher for the lowest income groups who tend to still continue to spend a greater proportion of their food expenditure on cereals. This can be owing to reasons like higher prices for the HVAP products, easy availability of the cereals from excess production at home to name a few. None the less these patterns still indicate a transition from the starch-based diets to those comprising of fruits and vegetables and animal-based proteins with an increase in income (Sharma and Jain, 2011).

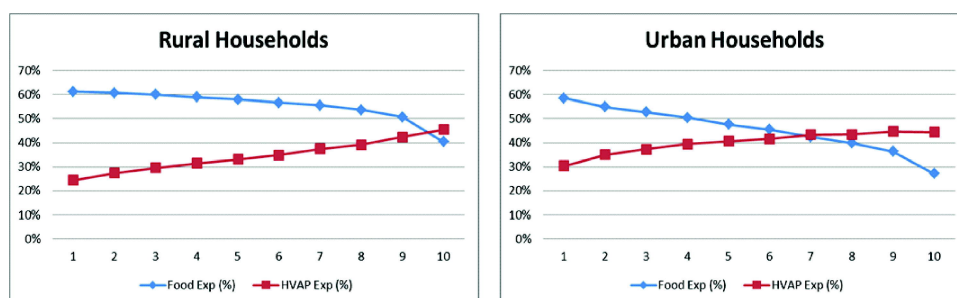


Figure 1: Change in the Expenditure (%) on Food and High Value Agricultural Products (HVAP) by different classes of income in 2011-12

Source: Author's calculations.

Using the NSSO data for MMP and MPE from National Dairy Development Board (NDDB.coop, 2011), the CAGR was calculated to be 0.08 for urban areas and 0.09 for rural areas respectively. The CAGR for fruits and vegetables was taken from the report of Confederation of Indian Industries (CII)– 0.11 for both rural and urban areas (CII and Mc Kinsey & Co., 2013). The proportion of MPCE on the HVAP has been on a constant rise as exhibited in the Figure 2.

The expenditure on the four categories of HVAP together forms 50% of the total projected expenditure on food for the year 2018-19 for rural areas

and 59% for the urban areas. Expenditure on MMP and vegetables show more prominent rising trend than the fruits and MFE. Recent studies on geographical distribution of the dietary patterns of Indian society have found that the intake of animal based products like poultry and beef (<10g per capita per day) and fruits (<50g) is quite low as compared to the dairy intake (>100g) across all states with the exception of the north east (Chaudhary and Krishna, 2021).

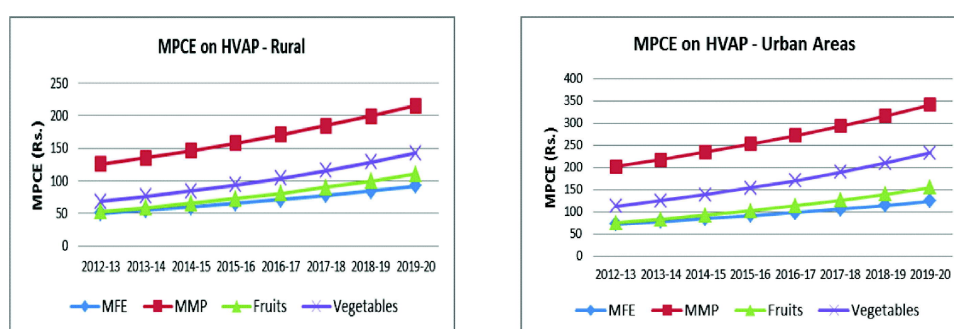


Figure 2: MPCE on HVAP from 2012-2020 on the basis of the CAGR of expenditures on MMP, MFE, fruits and vegetables

Source: CII and Mc Kinsey & Co., (2013), (NDDDB.coop, 2011)

This trend can be confirmed by analysis and comparison of the expenditure pattern based on the private final consumption expenditure (PFCE) (National Accounts Statistics, 2019). The PFCE data is a time series data and therefore it was used in substantiating the increasing trend of expenditure on HVAP in the recent years. The analysis of annual PFCE consumption expenditure data shows that contribution of HVAP basket in the total food consumption expenditure has increased to 60.5% in 2019 (Table 3). On analysing the timeseries data on PFCE (at current prices) from

Table 3: PFCE on Food and HVAP food items for the years 2011-2019 and their CAGR

Year	Food	Fruits	Veg	MMP	MFE
2011	11763	1726	1448	2576	1050
2012	13605	1983	1652	2960	1225
2013	15836	2413	2024	3245	1478
2014	17058	2674	2305	3746	1678
2015	17894	2672	2356	4148	1805
2016	20757	2911	2438	4520	2218
2017	21913	3263	2762	4686	2597
2018	23226	3333	2674	5093	2855
2019	25976	3638	3507	5502	3073
CAGR *	0.092	0.086	0.103	0.088	0.126

Source: *Author's calculations based on National Accounts Statistics, (2019)

2011-2019, using CAGR, it can also be confirmed that the rate of growth of annual per capita expenditure on the food item is lower at 9.2% as compared to that of the HVAP basket which has increased at a rate of 9.8% over the 9 year period. Within the HVAP basket, expenditure on vegetables (10.3%), MFE (12.6%) and milk (8.9%) are higher as compared to that on fruits.

The above analysis of the food consumption pattern indicates that though the consumption expenditure on food as a percentage of total consumption expenditure has reduced, the share of the HVAP in the food basket has increased. The category of processed food and beverages has also exhibited an increasing trend. Increase in per capita income level, urbanisation, increased and improved availability, awareness of healthier diets can be some of the reasons for the same. However the distribution of consumption pattern is uneven especially between the higher and lower MPCE groups and therefore affordability of the diversified food basket remains an issue.

Sustainability of the Indian Diets

Social Sustainability

The Indian diet has been considered to be one of the most nutritionally diverse and rich diets. Paradoxically, India still has a very high prevalence of undernutrition on one hand and obesity and other NCDs on the other. A rural-urban diversification and income wise comparison of existing nutritional intake (in terms of calorie) from the Indian diets vis-à-vis the LANCET referred diet shows that urban and rural consumers in India are way behind the minimum criteria of a sustainable and healthy diet from a nutritional perspective. Both the urban and rural consumers on an average are consuming calories lower than that recommended by the LANCET except for the highest MPCE groups of both the rural and the urban areas as shown in Figure 3. Against a recommended calorie intake of 2503 kcal, the highest MPCE section of urban and rural population is consuming 3143 and 3184 kcal respectively. The lower MPCE section consumes only 65% of what is recommended as a healthy diet by LANCET.

Cereals contribute 47% and 58% to the total calorie intake for the rural and urban areas respectively against 32% suggested by LANCET diet. The recommended share of HVAP basket towards the calorie intake is 696 kcal. However, the share of HVAP products in the total calorie contribution is drastically low especially in the rural areas (327 calories) and for the lower income groups (162 kcal in urban areas and 124 kcal in rural areas) which is also indicative of a low nutrition-rich diet. Within the HVAP bucket, LANCET recommends an intake of 204 kcal from fruits and vegetables.

Other than the richer sections of the society, Indians on an average consume only 40% of what is recommended and the lowest MPCE sections consume less than 25% of what is recommended. A study of the NSSO reports emphasises that disaggregated analysis of items within vegetable and fruits food group reflects that potatoes and bananas account for a large portion of these food groups respectively (Minocha, Thomas & Kurpad, 2018). Intake of all the sources of protein (dairy, MFE and pulses) is below the recommended intakes across all areas and sections of the society. In spite of only 20-30% of Indians claiming to be vegetarians, intake of MFE especially meat is only 24% of what is recommended.

Another major area of discrepancy between the two sets of diets is the intake of calories from processed foods. Urban households in the higher income groups consume 30% of their calorie requirements from processed food.

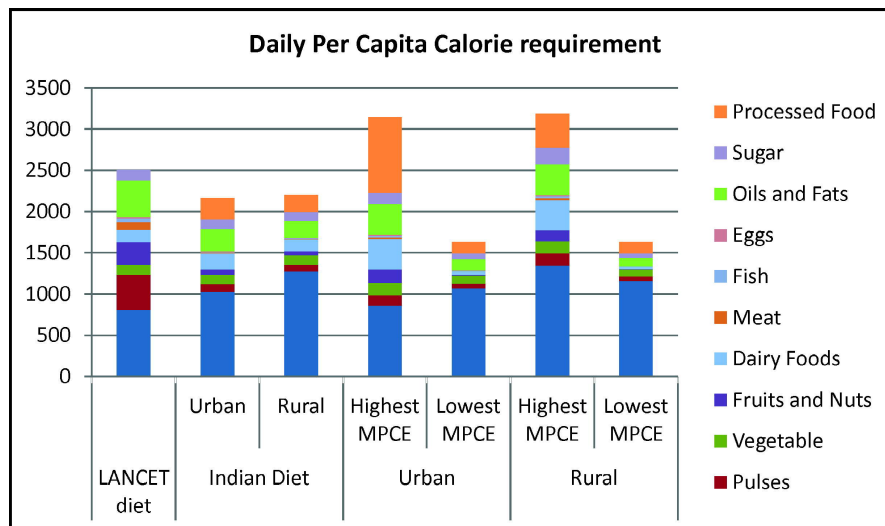


Figure 3: Food Item Wise Calorie Intake - Comparison of the LANCET Diet Vs Indian diet

Source: Sharma *et al.* (2020), Note: vegetable include potato and cassava, legumes consist of pulses and groundnuts, fruits and nuts (other than groundnuts) categories have been combined.

The Indian diet is capable of being nutritionally sustainable owing to the diverse variety of food in the Indian culture. However it has not been able to support the nutritional needs of the consumer because of factors like urbanisation, increase in income, opportunity cost of time spent by women at work, emphasis on consumption of fast moving convenience

food. The high cost of the diverse diet vis-à-vis low cost and easy availability of convenience food have come across as one of the major factors for a low intake of sufficient micronutrients in the diet (Darmon & Drewnowski, 2015). A diet that consists of fruits, vegetables, and plant-based unrefined carbohydrates has been found to lower the chances of NCDs and also encourage a sustainable pattern of consumption (Petersen *et al.*, 2017)

Economic Sustainability

To assess the economic sustainability, affordability of a diet is measured in terms of calories and nutrients per penny (Drewnowski, 2019). A comparison of the three diets – recommended by the LANCET, dietary guideline for Indians and the actual intake based on 2011-12 NSSO data, reflect that the first two are expensive than what average Indian consumer pays for their food intake. The cost of the LANCET recommended diet (\$ 2.8) is 1.6 times that of the cost of the actual intake (\$ 1.8) and 1.2 times of the cost of diet recommended as healthy by NIN (\$2.3) (Figure 4).

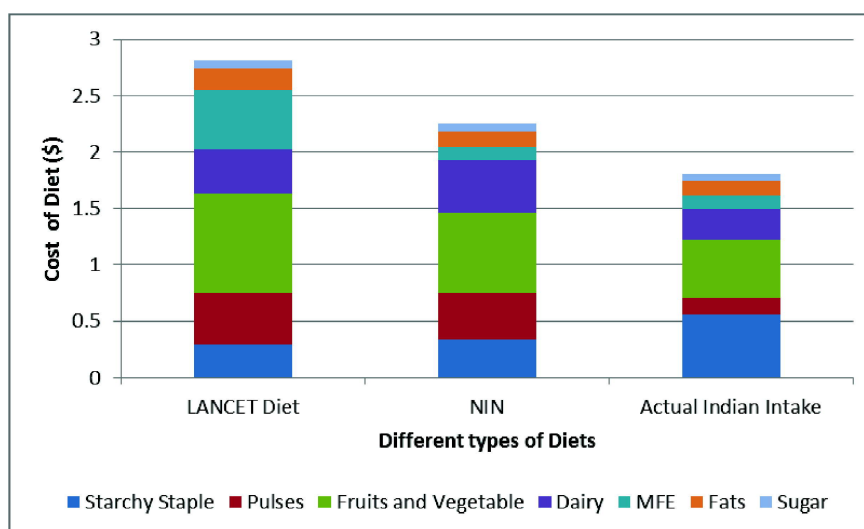


Figure 4: Affordability in terms of Cost of the LANCET recommended diet vis-à-vis the Indian Dietary Guideline and actual intake

Source: Hirvonen *et al.*, (2019)

The LANCET recommended diet costs a total of Rs 34 per person per day which is almost 3 times what the lowest MPCE class of rural areas and 2.5 times of poorest urban consumers spends on their food. Calories derived from cereals are much higher than those recommended in the reference diet. This can be owing to the availability of cereals at a subsidised rate

through Public Distribution System (PDS) (George and McKay, 2019). The cost of recommended quantity of fruits and vegetables intake as per the LANCET diet is Rs 178.5 in the rural and Rs 179.84 in urban areas, which given the per capita spending scenarios of different income classes, will be affordable only by the richest 10% section of the urban consumers. The high costs of healthy food may be one of the deterrents to their consumption. Evidence of similar pattern of unaffordability of diets rich in HVAP by the economically weaker sections of society have also been highlighted in several studies (Bai *et al.*, 2021; Barosh *et al.*, 2014; Mathur & Pillai, 2019). An increased price of protein-rich items like MFE and MMP can be attributed to greater demand for these HVAP (Sekhar, Roy & Bhatt, 2018). Similarly, the highly seasonal supply of fruits and vegetables and the lack of a storage infrastructure add to the reasons why fruits and vegetables, processed meat, etc., end up being costlier and therefore less affordable.

Environmental Sustainability

Comparison of GWP of existing diet pattern, recommended patterns by NIN and that of the LANCET diet showed that both the diets consumed in rural-urban India and the diet recommended by NIN emit lower amounts of GHG vis-à-vis the LANCET recommended intake. The LANCET diet emissions are 1.3 times that consumed by Indians in rural and urban areas and 1.5 times the non-vegetarian diet as per the dietary guidelines. This reinforces the finding of the recent LANCET study that finds India's environmental impact of the current diet in terms of carbon footprint to be 1.6 times lower than the recommended LANCET diet.

Figure 5 exhibits that meat followed by rice and MMP are the greatest contributors to the environmental impacts of the food consumption patterns in India. Rice contributes to 49% and 34% of (GHG) emissions in vegetarian and non-vegetarian diets respectively. The second major contributor to the GHG emissions is MMP in a vegetarian diet and meat/ mutton for a non-vegetarian one (Pathak *et al.* 2010). The emissions in the Indian diets are dominated by rice and animal sourced food along with dairy; whereas plant based and wheat based diets have lower GHG emissions and water footprints (Athare, Pradhan & Kropp, 2020). Studies have indicated in the past that though the Indian consumers have diversified towards poultry products like MFE for their protein requirements, still the level is significantly below the world average (Sharma *et al.*, 2020) thus causing lower levels of GHG emissions compared to the developed countries.

The analysis of the food consumption pattern in India revealed that there is a diversification from cereals to inclusion of HVAP in the food basket of the consumer. Cereals still remain the major provider of the calories

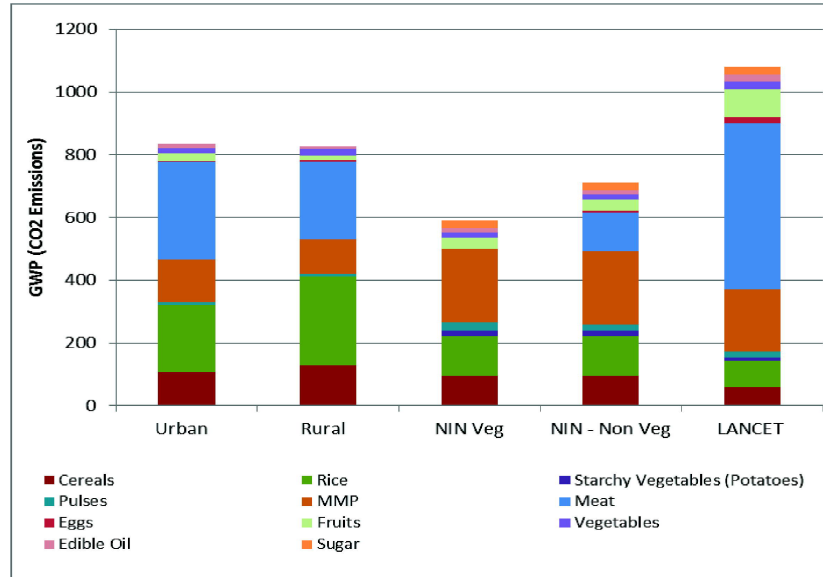


Figure 5: Contribution of Different Diet Patterns in India vis-a-vis the LANCET diet to towards Global warming

Source: Pathak *et al.* (2010).

to a typical Indian consumer, though MMP, MFE and processed food are the three non-cereal categories that have experienced an increase in the overall food expenditure. A comparison of Indian diets with the LANCET diet indicates that Indians consume much less quantities of fruits, vegetables, pulses than recommended. The reasons for the same can be higher prices of fruits and vegetables, availability of cereals and sugar at a subsidised rate through PDS (George & McKay, 2019), a slower rate of production of pulses leading to a decline in the per capita availability (Sharma *et al.*, 2020) and so on. Although the consumption of MFE has increased marginally with increase in incomes and urbanisation, it is still significantly below the level of world consumption. This may be one of the reasons for the Indian diets to report the lowest carbon footprint of 0.86 kg CO₂ per day as against the 1.36 kg of the LANCET recommended diet (Kovacs *et al.*, 2021). The land foot print of Indian diet is much lower than the US diets owing to comparatively much lower consumption of animal – source food (Peters *et al.*, 2016). However, the water foot print in Indian dietary patterns is observed to be much higher due to irrigation requirements of crops like rice, sugar and wheat (Harris *et al.*, 2019). The comparison of different types of diet in terms of carbon footprint reinforces the findings that the vegetarian diets support lower GHG emissions.

However, substitution of animal protein in non-vegetarian diets with protein from milk will not be effective as GHG emission by milk during production is substantial (29.1 g per kg of fresh product) (Pathak *et al.* 2010). Therefore alternatives like soy milk, legumes etc. will have to be substituted without disturbing the nutrient balance of the diet.

CONCLUSION

The study finds that Indian food consumption patterns are shifting away from cereals and staples and the share of the HVAP basket and processed food is on the rise. In spite of this shift, the Indian diet lacks in terms of sufficient nutritional intake with the levels of fruits, vegetable and MFE (especially meat) being far away from the recommended intake levels. The consumers in the lowest MPCE bracket are found to be consuming only 10% of HVAP against the recommended levels of 28% as part of their total food consumption. The richest section of consumers satisfies 30% of their calorie requirements from processed food. Therefore a paradox in terms of insufficient availability and accessibility of nutritionally dense food at one end and lack of awareness and easy accessibility owing to urbanisation at the other end is evident.

While promoting nutritional security, sustainable diets are environmentally safer because of lower animal-based and more plant-based content. However, higher costs are associated with the consumption of these diets especially in developing countries like India, making affordability a major concern. Our study reveals that Indian food intake is nutritionally inadequate, unaffordable due to high prices and inaccessible owing to a longer supply chain. On the environment front, the study reveals that the Indian diets fare better than the western diets because of lower consumption levels of non-vegetarian source of proteins. With greater emphasis on intake of animal based proteins to improve nutrient intake in India, optimisation of Indian diets in terms of their affordability, health effects along with minimum environmental impact, will be a top priority.

An important policy implication of the findings is to address the nutrient inadequacy by making available the diversified diet to all sections of the society with minimum risk to the environment. One of the ways in which this can be achieved is by reducing the food wastage in the supply chain of the agricultural products especially the HVAPs which are highly and easily perishable in nature. Efforts need to be put in both the production and the consumption side. Technological innovations in the space of production like use of hydroponics, kitchen gardening, community gardening should be encouraged to not only reduce the environmental burden in terms of land use but also make the seasonal fruits and vegetables available at

affordable prices all year round. Indian agricultural start-ups may play a very important role in making agriculture and final consumption more sustainable by direct procurement from farmers and removing the middlemen from the value chain, providing cold storage facilities and thereby reducing the food wastage, providing fresh product right from farm to the customer at affordable prices. Further research on the factors impacting the consumption pattern of different food groups is required to gain disaggregated insights into the consumption pattern and designing relevant nutrition policies.

The present study attempted to examine the patterns of consumption from a triple sustainability approach. Future studies can be undertaken to expand the scope of the social sustainability of the Indian diets with respect to the long-term health effects, gender dimension, and cultural acceptability and so on. Extending the enquiry to incorporate the production aspects will help make an overall assessment and design plans to make the diets more sustainable during the production life cycle of a product. Appropriate policy designs and behavioral changes can improve the journey towards a sustainable future through sustainable consumption practices and patterns for the people of a developing country like India.

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



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Appendices

Appendix 1: Composition of the EAT LANCET Diet, Source: (LANCET, n.d.)

	Macronutrient intake grams per day (possible range)	Caloric intake kcal per day
 Whole grains Rice, wheat, corn and other	232	811
 Tubers or starchy vegetables Potatoes and cassava	50 (0-100)	39
 Vegetables All vegetables	300 (200-600)	78
 Fruits All fruits	200 (100-300)	126
 Dairy foods Whole milk or equivalents	250 (0-500)	153
 Protein sources Beef, lamb and pork	14 (0-28)	30
Chicken and other poultry	29 (0-58)	62
Eggs	13 (0-25)	19
Fish	28 (0-100)	40
 Legumes Legumes	75 (0-100)	284
Nuts	50 (0-75)	291
 Added fats Unsaturated oils	40 (20-80)	354
Saturated oils	11.8 (0-11.8)	96
 Added sugars All sugars	31 (0-31)	120

Appendix 2: Dietary Guidelines as suggested by ICMR – National Institute of Nutrition

<i>Food Item</i>	<i>Serving Size (g)</i>	<i>Number of Servings</i>
	<i>Men</i>	
Starchy Staples	30	12
Proteins (pulses, eggs, fish, meat)	30	3
Dairy	100	3
Fruit	100	1
Vegetable (including dark green leafy vegetable)	100	3
Oils and Fats	5	6
Sugar	5	6
	<i>Women</i>	
Starchy Staples	30	9
Proteins (pulses, eggs, fish, meat)	30	2.5
Dairy	100	3
Fruit	100	1
Vegetable (including dark green leafy vegetable)	100	3
Sugar	5	6

Source: Dietary Guidelines for Indians: a manual, 2011