FUTURE PROSPECT OF PACKAGED SUSTAINABLE FOOD IN INDIA

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Abstract: The last few years’ Indian food sector shows its strength in global level especially the growth in packaged food industry. Many sectors of food production, India ranks first place in the world. Globalisation in India opens the new trade and employment opportunities, which encouraged rapid urbanisation, and consumerism. Simultaneously the new lifestyle composition highly influenced the food conception patterns of Indians by greater consumption of packaged foods. In this context, this study analyses the structural transformation of Indian food sector and introduces the construal concept of packaged sustainable food in India. The term packaged sustainable food is the unification of sustainability, food, and its package. It has multidimensional in nature as the food and food package must have to embrace the concept of sustainability from its production to consumption and disposal or recycle. In this respect, this study examines the challenges and opportunities interrelate with packaged sustainable food in India. Also, it explores the complex relationships between production and consumption of the food as well as the food packages and its impacts in India consist with environmental, economic and social perspectives. The central aspect of the research is to demonstrate the significance of packaged sustainable food in India. Indeed, this study concludes that in India, packaged sustainable food have indispensible future.

Index Terms - Sustainable Food, Sustainable Packaged Food, Globalisation, Green Revolution

1. INTRODUCTION

Before availability for consumption, food has undergone two significant segments, such as manufacturing processes and value-added processes. Manufactured operations denote the transformation of original physical properties of raw agriculture products, animal husbandry or fishing into edible and commercially valuable products. In contrast, value-added processes incorporate addition of improving shelf life, conserve, ready for consumption as well as availability with high quality of the edible food products at the right time and place to meet the consumer preferences. It is a variety of operations that are used to add value to the raw food materials and transformed into edible products. Hence, food produced through a system of chain activities that are known as the food system. Again, from end to end a food system directly or indirectly integrated with ecology and has responsibility for a substantial share of economic activity with the aspect of the culture (King & Backus, 2011). Historically, people from all over India follow various processing methods of local food by tradition due to the diversity of the country. Traditionally, agriculture and industry have been contemplated as two distinct sectors in India based on its features as well as its economic role. The emergence of food processing industries narrowed this gap. In India, food processing sector consists of unorganised cottage industries and organised processed food industries.

The traditional food processing methods of India that harmony with nature in which they live to preserve the food for later consumption as well as conversion to forms desired by the user. In contrast, Globalisation in India opens the way to trade liberalisation and foreign direct investment in Indian markets. Consequently, this leads to various socio-economic changes in Indian food sector such as intensive food production and contemporary food processing, new ways of food storages, an emergence of retail food chains, fast food outlets, augmentation of advertising and marketing of branded food products, online food market etc. Besides, the key facilitators of these observed transfigures are increased the number of women in the workforce that results in multiple family incomes. Again this influenced the traditional Indian family life and routines, especially in the preferences of cuisine as well as changing food cultures. Rapid urbanisation, as well as rural to urban migrations, strengthens this change. For instances, increased trends in shifting of shopping from Kirana stores (small neighbourhood grocery store in India) to supermarkets and hypermarkets (Tripathi, 2008) in urban areas. Whereas in rural India, food consumption is deeply embedded in local culture; even then the trends show consumption of branded processed foods are increasing (see, Rangan, & Rajan, 2005; Gupta & Jain, 2014) than the organised retail sectors and online shopping. These exhibit the rapid urbanisation and Globalisation in India intensify the demand for industrial processing of food that leads to the modern food processing methods and results in the food processing industry to link between the farmers and consumers through a global market.

The purpose of this research is to introduce the concept of packaged sustainable food and explore its prospect in India. In consist with this abstraction, the study organised in three segments. The first section reviews the structural transformation of the food sector in India through six distinct periods since independence to the current era. The second section explores the theme and concept of packaged sustainable food and explains its significance in India. The third section is about the challenges and opportunities of packaged sustainable food in India that further distinctly examined across various perspectives of environmental, economic and social aspects. The fourth and final segment of the study focuses on the results and conclusions that included the policy support required and scope for further research in India based on the concept of packaged sustainable food.

2. METHODOLOGY.

This research has been conducted using both quantitative and qualitative methods based on secondary data. The data has been compiled through document search methods, journal articles, workshop and seminar papers, various books, other published works, and internet sources. The economic indicators, measurements, and performances mainly sourced from distinct reports by the Government of India. Based on the findings, some broad observations are included in this paper.
3. OBJECTIVES OF THE STUDY

The primary objectives of this research are:

1. To analyse the composition of the Indian food sector.
2. To discuss the theme, concept and significance of packaged sustainable food in India.
3. To study the challenges and opportunities of packaged sustainable food in India.

4. STRUCTURAL TRANSFORMATION OF FOOD SECTOR IN INDIA

Agriculture is the backbone of the Indian food sector as it ensures the country’s food security. Accordingly, many studies have been conducted to analyse various aspects of the agro-food industry of India. The remarkable studies like Chand & Parappurathu (2011) and Kannan & Sundaram (2011) are categorized the decades into distinct phases to identify and outline the agricultural growth. However, this study followed the category of six different periods as Pre-Green revolution (1951-52 to 1967-68), Green revolution (1968-69 to 1980-81), Wider Dissemination (1981-82 to 1990-91), Early Liberalisation (1991-92 to 1996-97) and Post Liberalisation (1997-98 to 2001-02) and Globalisation Era (2003-04 onwards). It analysed as well as highlighted the trend changes as follows.

4.1 Pre-Green Revolution

The major challenge in the food sectors is the imbalance of food supply and demand. Historically there are several reasons for this. For instance, the industrial age led a transition from manual labour based systems to machine-oriented, which cause the urbanisation and rapid per-capita income growth in the economy. It created social and economic change and emerging of the middle classes results from discretionary income to spend on its food preferences (Gunderson, 2001; McCraw & Mac Craw, 1997; Freeman & Louça, 2001). The technology and threshing machine freed-up agricultural labours from the fields into the factories (Alfranca et.al., 2003). Also, the production of essential commodities like foods and clothes increased during the industrial development in Europe especially Britain (Hobsbawm & Wrigley, 1999) and food consumption demand convinced through the agricultural revolution, which precisely concurs with the industrial revolution (Crafts, 1985). At the same time, the situation in India was quite different during the era of industrialisation of western countries. During the British period, the industrial development in India was not only slow but also top-sided in its character (Kuchhal, 1981). Maddison (1998) point out that, English merchants had their economic interests as well as political security and India became a primary market for goods and supplies of raw materials. The Britishers profoundly attracted the availability of fresh Indian fruits and vegetables as they know there is a massive demand for them in western countries. But the long distance between destinations made the complication. Later Mr B.C. Sinha established ‘The Bengal Preserving Company’ in the year of 1910 in Muzaffarpur, West Bengal, for preserving and canning of fruits such as mango, litchi, pineapple etc. (Playne, 2013). It considered the first food processing company in India. One remarkable contribution by the British government in India has they introduced food grain rationing in 1939, first, in Bombay and, expand later, into other cities (Mooij, 1998). Thus, the Pre-Green revolution period denotes the crucial days of the country as far as food is concerned. The growth and productivity of India’s agricultural sector subjected to variation across regions of the country due to its diversity. Also, it is dependence on monsoon and other climatic parameters. The newly independent India (1947) perceived the chronic shortfall of the required quantity of food and crisis in food production due to the long history of colonial mismanagement in the agricultural sector. The peoples of India hurt a prolonged food crisis between 1939 and 1952 (Collingham, 2012).

4.2 Green Revolution

The periods of 1947 to 1952 India faced a real scarcity and famine in the country, and the governments rely on food import (Sherman, 2013). To overcome this emergency, Government of India in those days initiated a campaign of growing more food through technology-driven agricultural production and later that lead into the ‘Green revolution’. Rapidly food-grains policy committee impose to incite the steps to phase out food import by increasing domestic agricultural production (Chopra, 1988). The opening move improved the Indian Agricultural Research Institute by providing funds and scientific support by Rockefeller Foundation in the mid of 1950s. (Seshia & Scoones, 2003). The mid-1960s, the government, executed the Green revolution as a new agricultural strategy (Frankel, 2015). The three major components of the Green revolution were an extension of farming areas, encourage the double-cropping in existing farmlands, revitalise the usage of seeds with high-yielding varieties. The high-yielding varieties of wheat that implemented in India were brought from CIMMYT in Mexico. (Pinnstrup & Hazell, 1985). According to Fujita (2012), it was efficient for the weather conditions in northern India. During these periods, Government of India was set up Agro-industrial Corporations to develop agro-processing and generate additional employment opportunities in rural India. But most of them were deflected from its actual aim and chosen a secure priority of sale promotion of agricultural machinery, fertilisers, pesticides, etc.

4.3 Wider Dissemination

The years 1981-82 to 1990-91 considered as the period of Wider Dissemination of technology in the agricultural sector of India. Trends in the use of no animate power equipment like tractors, power tillers, self-propelled planting and harvesting machines, diesel engines and electric motors, etc. expanded more. Also, this phase begins the diversification of food grains sector into milk, fishery, poultry, vegetables, fruits etc. that supported the agricultural share of GDP during the 1980s (Chand, 2003). A considerable increment of subsidies to the agriculture sector was witnessed in these years. The investments into the agriculture by the farmers became a rising trend, as well as investment by the state into the agricultural infrastructure development, started a decline in real term (Mishra & Chand, 1995). Besides, Chaturvedi (2002) state that the annual growth rate of investment in public research knocks down these periods. The two significant incidents included in this period. One, a hike of production in the eastern region, and two, improvement in the production of oilseeds in the central part of the country. In 1988, the central government established a new ministry of Food Processing Industries for the adequate development of the food processing sector in India. Also, between1980s-90s witnessed the widespread change in the government policies towards import the technology and private foreign alliance, especially in the food allied industries like the collaboration between Pepsi and Punjab agro Industries Corporation. Again, most of the Indian as well as international brands of processed foods, packaged foods, convenience foods and soft drinks have been launched during these periods. Kellogg (breakfast foods), Nestle (coffee, chocolate, Maggie - convenience food), Hindustan Lever (hydrogenated edible oil); Lipton, Brooke Bond (Tea leaves), Kissan (jams and squashes) Britannia, Parle (biscuits), Coca-Cola etc. are the some of the examples (Goyal, 1994; Alli, 2015).
4.4 Early Liberalisations

Since 1991, India invaded into economic reforms through trade liberalisation. Hence, the year up to 1996-97 considered here as Early Liberalisation period. Before 1991-92, the agro-food policy was food self-sufficiency by strict regulations in imports and exports that used to balance the gap between domestic demand and supply. The new liberalisation policy opened liberalisation in imports and exports of agriculture goods. It monitored according to the global agriculture trade competition (Chand, 1999). The significant events of this period were the completion of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), subsequently; India becomes a member of the World Trade Organisation (WTO) in 1995. These incidents accelerate the trade liberalisation policies and Globalisation in India as well as highly influenced India’s agro-food sector. Again, this period also witnessed the emergence of agricultural biotechnology leading the way by the private sector in alliance with multinational players (Seshia & Scoones, 2003).

4.5 Post-Liberalisation

The second phase of liberalisation (1997-98 to 2001-02) aimed complete Globalisation in India appraise here as Post-Liberalisation periods. The Post-Liberalisation period addressed significant structural changes in the agro-food sector in India. In 1997, the Government of India introduced ‘Decentralised Procurement of food grains to intensify the efficiency of procurement and public distribution system in India. The main highlights of this scheme were: (1) procurement operations become the responsibility of the state government on behalf of the Government of India, who responsible for buying food grains mainly rice and wheat with a minimum support price (MSP). (2) restructure the universal public distribution system (PDS), which dates from the 1940s to the targeted public distribution system (TPDS). TPDS aims to sell the food grains under a central issue price (CIP) mainly targeting the food subsidies to the poor and reducing the fiscal deficit. There are two different CIPs are fixed, one for the families below poverty line (BPL) and the other for above poverty line (APL).

In 2000, the Government of India introduced a new scheme of a lower price for the poorest of the BPL householders named Antyodaya Anna Yojana. This scheme aimed to provide food grains of 25 kilograms per month initially. Later since the year 2002, it increased into 35 kilogrammes at the cost of Indian rupee two per kilogramme for wheat and Indian rupee three per kilogramme for the rice to each most impoverished family.

4.6 Globalisation Era

Following post-liberalisation period since 2003-04 onwards here considers as Globalisation era in India. Al-Rodhan & Stoudmann (2006) defined that “Globalisation is a process that encompasses the causes, course, and consequences of transnational and transcultural integration of human and non-human activities”. Globalisation drives by the internationalization of changes in the structure of production, expansion of trade and services and flow of international capital (Mrak, 2000). A clear transition of the Indian economy from being agriculture-driven to essential service oriented is the prime result of Globalisation in India. It is also an observed process of diversification begins in crop pattern from food grains to non-food grains. These decades witnessed the potential branded products, which become the driving force in the Indian food market. Consequently, cottage and small units of traditional food processing industries became marginalised due to the cutthroat competition as well as the lack of new marketing techniques, inability to maintain bulk food processing, standardisation, and poor hygiene. After a decade, in September 2013, the Parliament of India passed the National Food Security Act – 2013, which also known as Right to Food Act. This act describes “An Act to provide for food and nutritional security in human life cycle approach, by ensuring access to adequate quantity of quality food at affordable prices to people to live a life with dignity and for matters connected therewith or incidental thereto” (NFSA, 2013). Although, lack of identifying eligible targeted consumers, the financial viability of fair price shops, and leakage of food grain are continuing as significant issues (Mahapatra & Mahanty, 2018).

Another significant leverage during these periods in the agricultural sector is the development of information and communication technology (ICT). The rise of the Indian IT industry began during the 1990s (Pattnaik, 2013), and it has become synonymous with Globalisation. However, the availability of low-cost hardware and increased coverage of communication network in rural areas is crucial in the implementation of ICT. In 2004, Government of India started Kisan Call Centres across the country allotted with a typical toll-free number to provide extension services to the farming community. In 2013, Government of India launched an SMS portal for farmers. Unstructured Supplementary Service Data ( USSD), Interactive Voice Response System (IVR S), buyer seller platform through the internet (website - http://mikisan.gov.in/) etc. are some of the developments in of ICT in the agricultural sector by the state. According to the telecom Regulatory Authority of India, mobile telephone connections in rural areas is about 38 crores, and the availability of internet in the countryside is still deficient. These prompt the government to initiate mobile services as a useful tool in ICT.

5. PACKAGED SUSTAINABLE FOOD: THEME AND CONCEPT

Food is one of the essential biological needs for human survival. Production of adequate food depends on farming, and it is a vital part of the natural ecosystem. Thus, food production is fundamentally an ecological activity and utilisation of natural resources. Agriculture and farming activities are human-managed ecosystems. In addition to the fulfilment of basic need, food is the way of human livelihood. Food production and its consumption consequently impact on all the aspects of social, economic and political viability. Hence, it is closely related to human wellbeing and socio-cultural equity. At the same time, both wellbeing and socio-cultural stakes are systematic and continued functioning of an ecological system that included all living organisms. The lack of food supplies to meet the feeding demand of growing human population at present and future is the fundamental challenges of the food production. The limited span of further agricultural land extension and environmental risks such as pollutions and climate changes makes this as a stubborn task to overcome the challenge. The only and great opportunity is the right management and conservations of the natural resources and assures the availability, access, utilisation and stability of food apart from any discrimination. It is nothing but the way of sustainability. The wide range of sustainable farming is possible in rural areas as well as urban as rural landscapes support locally productive ecosystems. Also, the rural community is traditionally affectionate to the agricultural activities for their livelihood. In contrast, urban food consumption depends on the rural agrarian production that less directly and most indirectly through processed foods. However, it is crucial to promoting rural agricultural development and protecting local food production is indispensable to human wellbeing. And equally, significance to assure the sources of essential nutrition during manufacturing as well as consumption. Thus, food is nutritious substances that embed with cultural, geographical and local ecosystems apart from its acceptable global taste. Again, the quality and safety of food is also an essential aspect as like the nutritional factors. Food has to be free from any contaminants and natural decaying. Local food production and consumption are reducing the risk of food quality and safety. But the long distance between farm to consumer, the duration between production to consumption and food miles are the critical matter in food distribution, especially in urban areas. Thus, a sustainable food system results: “safe, healthy, and nutritious...
for consumers; food production and processing by reducing energy consumption; respects the highest standards of animal health; affordable food for all sectors of society; support rural economies; the diversity of rural culture by emphasising local products; and minimise food miles' (Sedlacko et al., 2013).

In this regard, two aspects have been taken into consideration for this research. First, sustainable food is the outcome of a sustainable food system. At the same time, sustainability is a credence characteristic of food products, it cannot be seen or tasted, and the product reorganisation is an extremely significant factor in sustainable food choice. For instance, the term organic food can include in the concept, but in the broad sense, sustainable food does extend from the restriction of 'organic'. Hence, sustainable food can be examples as fair trade food, organic food, local food and seasonal food. Second, the importance of the package that fundamentally prolongs the life of food and keeps food fresh includes protect the food from various damage and contamination, minimise the food loss, ease of transport, storage, labelling, and marketing. Here labelling is needed to emphasize because it has a significant role in identifying sustainable food products and providing the information to the consumers. It not only helps to differentiate among the other food products but also reduce the 'Greenwash' through a proper display of authorised logos and certifications. Also, the environmental impacts of food packages derive from the disposal of municipal solid waste and the relevant pollutions. The maximum packages of food products are meant for disposal after the usage and not for any reuse. It is noteworthy because food is the major products typically consumed within a short duration every day and consequently increase the accumulation of food package waste. Therefore, a food package must be undergone the principles of fit-for-purpose, resource efficiency, low-impact materials, and resource recovery. In short, there is no virtuousness if the food is produced sustainably unless their packages become environmentally friendly. It shows, the need for production and processing of packaged food in the way of environmentally, socially and economically sustainable and ensure no more prolonged hunger of the poor people (Von Braun, 2007; Mitchell, 2008; Godfray et al., 2010) and to be obtaining the food with sufficient nutrition and energy from their diet necessary for health and growth (FAO, IFAD & WFP, 2015).

Hence, this study put forward the concept of 'packaged sustainable food' (Jasheena & Kumar, 2019) that integrates all the ideas of sustainable food with sustainable packaging, which reduces the environmental impact and ecological footprint. The term 'Packaged sustainable food (PSF)' aim sustainable food that should be safe, healthy, accessible, affordable, acceptable for all consumers with a 'sustainable package'. Sustainable package help efficiently protects, recognise, distribute and market and to provide safe and convenient use of its content. Thus, packaged sustainable food embraces the concept of sustainability in food and food packaging in such a way that adds 'sustainable value' to the product that integrates several sustainable components to enhance a community's environmental, economic and social well-being. Packaged sustainable food (PSF) is defined as "Any food group and beverage that locally and seasonally produced through sustainable farming, free from preservatives and adulterants and respecting animal welfare along with sustainable packaging, that aim to promote healthy-nutrition food, minimise food loss, and reduce solid waste". In simple words 'Packaged Sustainable Food' is sustainable food with sustainable packaging.

5.1 Significance of Packaged Sustainable Food in India

These days, India becomes a remarkable global level in food production. During the year, 2011-12 Rice and Wheat production crossed 100 million tons and 90 million tons respectively. The facts and figures show that India ranks first place in the world in the production of Milk, Pulses, Ginger, Bananas, Guavas, Papayas and Mangoes and second in the production of Rice, Wheat, Vegetable and horticulture products (MOFPI, 2015). Also, in parallel to these achievements, the food processing industry in India is developing with fast growth. Food processing sector in India performance under mainly into three categories, such as agricultural and horticultural produce, processed foods and beverages and food and beverage retail. The big players in this sector are the renowned branded companies, and many of them are either multinationals or domestic brands. Even then, most of the food processing companies are highly fragmented under the unorganised sector. Also, the employment among an urban and rural population in relevant to the food processing industry is an essential factor. Food processing sector in India has a total of 37,175 registered factories that generates employment to 16.88 lakh persons (COA, 2018; MoA, 2015). Also, there is a remarkable growth registered in Foreign Direct Investment (FDI) to 15.7 Billion USD in 2014-15. Also, expectations of growth characteristic of food and drink processing by reducing energy consumption; respects the highest standards of animal health; affordable food for all sectors of society; support rural economies; the diversity of rural culture by emphasising local products; and minimise food miles' (Sedlacko et al., 2013).

Figure-1

Growth in FPI & Agriculture at 2004-05 Prices

Again, the average annual growth rate of exports in the food processing sector between 2009-10 and 2013-14 was 20.53 per cent, which indicates the export value has been increased (MOFPI, 2015). Also, there is a remarkable growth registered in Foreign Direct Investment (FDI) in the food processing sector of India. Due to the trade liberalisation policy, up to 100 per cent Foreign Direct Investment (FDI) is permissible in for all the processed food products other than items reserved for Micro and Small Enterprises (MSEs). As per the Government of India, it was increased from 70.17 Million USD in 2007-08 to 3,982.88 Million USD in 2013-14. Also, expectations of packaged food
products are growing comparatively with the food products that were sold loose among the Indian consumers (Sehrawet & Kundu, 2007) due to marketing and brand sensitive. Increased demand for industrially processed food and winning consumer trust on packaged food lead to gradually keeping away the Indian consumers from homemade freshly processed foods; even homely cooked foods to some extent. Thus, Food packaging is considered as an essential element to ensure the quality (Preedy et al., 2011) from growing, harvesting, processing, transporting, marketing, consuming and disposing of food and food packages. The other side of the coin unveils that, increased purchased intention towards packaged foods results in substantial environmental impact through the disposal of municipal solid waste and pollution (Marsh & Bugusu, 2007). Also, unhealthy food consumption makes saviour health risks and more extensive health care expenditure (Pingali & Khwaja, 2004).

6. PACKAGED SUSTAINABLE FOOD IN INDIA: THE CHALLENGES

The concept of packaged sustainable food is distinctly relying on its sustainable way of production and environmentally friendly packaging. Also, the sustainable way of food and food package production is immensely integrated with various perspectives of environmental, economic and social aspects. Based on this approach, the following significant challenges are highlighted in this study.

6.1 Environmental Perspective:

a) The Impact of Green Revolution

In India, Green revolution strongly supported to increase domestic agricultural production and weed out the dependency on food imports (Chopra, 1988). It opened an opportunity for vital technological uplift in the Indian agrarian sector (Frankel, 1971; Farmer 1977; Conway & Barbier, 1990) and shift the cropping patterns for both wet season and winter crops that lead to attaining the food self-sufficiency (Singh, 2000). The Green revolution in India exploited the successful implementation of technology-driven agricultural production by high-yielding crop varieties (HYVs), especially rice and wheat (Evenson, & Gollin, 2003). The rapid popularity of these crop varieties was due to its ability to produce two, sometimes even three, crops per year. The famous high yielding varieties used in those days were characterised as highly responsive to inputs like chemical fertilisers and water. This brought real and substantial increases in production. The Green revolution era not only highlighted by an extension of high-yielding varieties (HYV) but also considered multiple cropping programs, integrated development of dry areas, plant protection measures, increased use of heavy fertilisers and new irrigation concept, etc. (Fujita, 2012; Tripathi & Prasad, 2010). The multiple cropping systems within a short period diminished the soil productivity to support plant growth in its healthy environment. Therefore, it can be observed that (Table-1) agricultural practise of HYV also increases irrigation and the usage of heavy fertilisers. It shows development in increased use of pesticides, fertilisers, and canal irrigation systems in India are linked to Green revolution and as it was required to supporting high yielding seed varieties of those days. Especially on the environmental perspective, these developments were inadequate to achieve the growth sustainably, even though the Green revolution has helped out India’s self-sufficiency in food.

b) Chemical fertilisers and Depletion of soil fertility

Chemical fertilisers are played a significant role in India’s agriculture sector to achieve the food self-sufficiency of the country. But it is a fact that either excessive or continues the use of non-organic fertilisers causes serious harm to the environment, thereby bringing health hazards in animals as well as human beings. Again, the use of chemical fertilisers adds nutrients directly to the soil to support sudden soil fertility and increase plant growth instead of a natural process of decomposition. The potential sources of chemical fertilisers are natural radionuclides, and heavy metals that may cause accumulation in soil and plants absorb these through the ground and they can enter the food chain (Savci, 2012). Thus, Foods grown up with synthetic fertilisers causes various health risks in humans, likewise animals. The studies indicated that there is a growth of 69.8 tons in 1951 to 28,122.2 tons in 2011 in concern with the total quantity of fertiliser distributed annually in India. Currently, India stands the second largest country among the consumption of fertilisers in the world after China and projects to increase to about 41.6 million tons of demand by 2020 in the country (Sharma & Thaker, 2011). Besides, the rapid industrialisation without concern about environmental and local geological importance is a challenge. For example, the study conducted by Krishna & Govil (2004) shows that the Pali industrial area, (in Rajasthan, India) contaminated with heavy metals at a high-level concentration in soil. The striking point is that the Pali area is the part of the catchment of Bandi River, which is the only river responsible for maintaining the groundwater recharge during all the seasons. It increased the high-risk possibility of widespread contaminated water over the area. Although soil is the utmost sources of mineral nutrients ensure environmental sustainability and crop productivity. Thus, the management of land in a sustainable way is a prime challenge to achieve food security.

Table-1

<table>
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<tr>
<th>Year</th>
<th>Area Under Irrigation (Million Hectares)</th>
<th>Production (Million Tones)</th>
<th>Yield (Kg/Hectare)</th>
<th>Area Under Irrigation (%)</th>
<th>Over all consumption of fertilisers (Tones) (N+P2O5+K2O)</th>
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<td>208.60</td>
<td>1715</td>
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c) Role of Pesticides

Pesticides production started in India in 1952, and now the country becomes second-largest manufacturers in Asia after China (Mathur & Tannan, 1999). India has an established system to regulate the use of insecticides under the Insecticides Act, 1968. However, the Government of India proposed as a step towards promoting safe use of pesticides by introducing ‘Pesticides Management Bill 2008’, that will replace the existing act once it has to be passed by the legislative (PRS, 2009).

![Figure-2](https://example.com/figure2.png)

**Figure-2**

Consumption of Pesticides in India 1955 – 2001

The trend on the consumption of pesticide in Indian agriculture shows the decline between the periods of the 1990s-2000s compared to the previous decades (Figure-2), but the recent trends of 2001s -2013s shows hike (Table-2) in the usage, which needs to take into account. Overall consumption of pesticides in India is the lowest among the rest of the other countries (Figure-3). Per capita consumption of pesticides in India is 0.6 kg/ha, where china stands on 13 kg/ha and seven kg/ha in the USA. The report by TSMG & FICCI (2013) points out that, lack of awareness and lower accessibility and purchasing power of farmers are the primary reasons for low consumption of pesticides in India.

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<tbody>
<tr>
<td>Consumption (TGM*)</td>
<td>47.2</td>
<td>48.30</td>
<td>41.00</td>
<td>40.67</td>
<td>39.77</td>
<td>41.51</td>
<td>43.63</td>
<td>43.86</td>
<td>41.82</td>
<td>55.54</td>
<td>52.98</td>
<td>56.09</td>
</tr>
</tbody>
</table>

*Technical Grade Material / Thousand Tones

Source: Department of Agriculture & Cooperation, New Delhi.

![Table-2](https://example.com/table2.png)

**Table-2**

Consumption of Pesticides the recent trends in India 2001 – 2013

However, several studies demonstrate that the pre-harvest application of pesticides increases the health risks (see EFSA, 2015), for example, application of herbicides, fungicides, and insecticides create toxic chemical contamination in crops. Once it used as food, it results with very harmful effects in a gradual, subtle way over time as inflammation damages cellular systems throughout the body (Samsel & Seneff, 2013). Again, the analysis of human blood samples collected from Punjab revealed the existence of pesticide (DDE and DDD) residue in human blood (Bedi et al., 2015; Sharma et al., 2015). Similar studies also conducted in various places in India (ICMR, 2001; Subramaniam & Solomon, 2006; Kaushik et al., 2012). Organochloride residues in Indian soil are a matter of concern currently because of...
its large scale production and usage over the past decades (Chakraborty et al., 2015). Also, according to Pure Earth (2015), there are seven million people at risk of exposure to pesticides globally, with an estimated burden of disease of one million the disability-adjusted life year (DALY). All these shows increased growth in food production encouraged the application of chemical fertilisers, as well as pesticides to maintaining soil fertility and crops, are a significant challenge in India.

d) Improvident Irrigation methods

The primary sources of water for agriculture sector are rainfed conditions and irrigation system. Both can impact significantly on agro-food productivity. According to the Food and Agriculture Organisation, it takes 1000-3000 litres of water to produce just one kilo of rice. The overall consumption of water in the agro-food sector is interlinked with soil and seeds. In India, the water resources are classified into rivers and canals; reservoirs; tanks & ponds; ‘beels’ (a lake-like wetland with static water), oxbow lakes, derelict water; and brackish water. Only after independence, the development of irrigation for agricultural growth and socio-economic benefits became a priority requirement in India. The irrigation system in India is classified into Major, Medium, and Minor that determined by cultivable command area (CCA). Major and medium projects depend on surface water resources, whereas Minor irrigation projects have both surface and groundwater. The total ultimate irrigation potential in India is 140 M. ha. As compared to major & medium irrigation, minor irrigation is higher by 22.96 M. ha, which contributes more than 79 per cent of the total ultimate potential of minor-irrigation (CWC, 2013). The analysis also shows (Table-1) the area under irrigation expanded 18.1 per cent in 1951 to 47.8 per cent in 2011. The total irrigation potential from surface and groundwater sources would be about 139.9 M ha. (CWC, 2014). As stated by Boyce (1988), the level of water control evaluates the performance of the water system that offers to farmers within a command area. The water control is the capacity to apply the water at the right time to the crop at the right level of quantity and quality to meet soil leaching requirements and the crop needs (Freeman et al., 1990). In relevance to this, Shah (2011) point out that inadequate maintenance and system management, especially below the outlet decline in public irrigation management performance in India. It shows an efficient irrigation system means the completion of a specific task with the minimum use of water or use the equivalent amount of water with more production (Descheemaeker et al., 2013). Prolonged studies are revealed that poor drainage and over-irrigation are the reasons for waterlogging and salinisation (See for examples Pandey, 2013.). Also, it causes polluted run-off and over-extraction of water that leads to the degradation of ecosystems. Besides, the major-irrigation system in the agriculture sector in India depends on large dams. There are 5187 Dams in India and out of which 4839 are completed (CWC, 2013). These lend a hand to increase the developments in agriculture, hydropower, flood control, rural, urban and industrial water demands. But in contradistinction, the challenges relevant to biodiversity, climate regulation; groundwater recharge, nonuse values of rivers; fisheries etc. that have profoundly affected natural as well as human communities have been sidelined. Indeed, rivers are not only a channel of water but also moving systems carrying sediment, ecosystems, nutrients, organisms, energy, and cultures and lot. The various studies indicate that every new construction of large dams is creating environmental and social issues. Again, Dandekar (2014) coined that, the dams built on the upstream rivers causes sinking and shrinking river deltas and loss of biodiversity that affected who inhabit the deltaic. For example, during the past century, there has been over 94 per cent reduction in Indus delta sediment, over 30 per cent reduction in Ganga-Brahmaputra delta sediment, 94 per cent reduction in Krishna’s sediment, 95 per cent reduction in Narmada, 80 per cent reduction in Cauvery, 96 per cent reduction in Sabarmati, 74 per cent reduction in Mahanadi, 74 per cent reduction in Godavari, etc. Thus, dams repeatedly have negative environmental impacts and change the hydrological cycle, including the disruption of migratory fish production (Dugan et al., 2010).

e) Overexploitation of groundwater

The irrigated agriculture in the country is dependent on more than 60 per cent on groundwater that almost twice the surface water-irrigated farms (Livingston, 2009). Data as on 31st March 2011 revealed by CGWB shows that out of 6607 groundwater assessment units, the safe are 68 per cent, semi-critical around 11 per cent, critical units are three per cent and around 16 per cent are categorized as overexploited (CGWB, 2014). The satellites study by NASA found that between 2002 and 2008 more than 109 cubic km of groundwater disappeared in India. It shows that groundwater levels have been declining an average of one metre every three years or one foot per year, especially the northern Indian states of Rajasthan, Punjab, and Haryana (Cook-Anderson, 2009). Again the other studies used remote sensing data from NASA’s Gravity Recovery, and Climate Experiment shows there is a depletion of eight per cent which is more than the annual recharge rate of groundwater level over 11 years, from 2002 to 2012 (Chinnasamy & Agoramoorthy, 2015). The studies like Tiwari et al. (2014), Dasgupta, et al. (2014) and Richey et al., (2015) are the other examples for the groundwater level of India. Various studies point out that Green revolution affected resource availability of groundwater in India; even it increased self-sufficiency in agricultural production (World Bank, 1999; Singh, 2000; Molle et al., 2003; Fujita, 2012). CWC (2013) estimated that Per Capita Water Availability is declined from 1816 Cubic Metre in 2001 to 1544 Cubic Metre in 2011 as per the population census. It demonstrates the significance of sustainability in water resources. Nevertheless, the study by UNICEF (2013) emphasises that the key challenges addressed by the water sector in India are unpredictable rainfall distribution, inefficiency in water use, uncontrolled use of groundwater, water pollution from various sources and decreasing water quality.

f) The Climate Change

From the past few decades, climate change became a worldwide phenomenon due to several reasons. Various scientific studies are proving that increased emissions of Greenhouse gases from industry and transportation, deforestation, rapid changes in land use and land management, etc. are the main reason for the rapid climate change. According to these studies, increased level of pollutants, particularly emission of carbon dioxide (CO2) and chlorofluorocarbons (CFCs) attributed to the Greenhouse effect and further causes for the rise in temperature of the atmosphere of the earth that known as global warming. The Inter-Governmental Panel on Climate Change has projected that the temperature to be increased between 1.1 °C and 6.4 °C by the end of the 21st Century (Solomon, 2007). Global warming can affect either positively or negatively to various types of crops that grow in regional areas. In India, there are two significant cropping periods following, such as Kharif and Rabi. During the south-west monsoon months of July to October is considered as the Kharif cropping season whereas the winter months of October to March is advised as Rabi cropping season. Both cropping seasons depends on weather conditions. Also, climate changes can be impacts on irrigations, solar radiations, cropping pattern, the generality of pests, as well as livestock farming. Thus any exceptional changes in climate system immensely effect on food security and livelihoods in India. For example, the absence of proper adaptations, potato production in India may decline by 3.16 per cent in the year 2020 and further 13.72 per cent in the year 2050 due to the impact of climate change and global warming (Singh et al., 2008). Besides, the increase of temperature in 20c decreases rice produces in the high yield areas about 0.75 t/ha and about 0.06 t/ha in the low yield coastal regions (Sinha & Swaminathan, 1991).
The other studies, like Pathak et al. (2003); Aggarwal, et al. (2009) also point out the upcoming variations in agricultural production due to the impact of climate change. Therefore, an adequate awareness of climate change consequences and updating knowledge about the weather forecast is adequately essential for mitigation and adaptation to reduce the vulnerability of agriculture production (Pathak et al., 2012). Nevertheless, most of the Indian farmers cannot access valuable information as well as adaptive capacity due to the socio-economic circumstances. It is one of the most critical challenges in the agro-food sector in India that indicate the requirement of more development in education, transfer the knowledge, technical resources, etc. mainly in rural areas. The climate change and its impact not only affect food production but also in the food processing and various stages of the food supply chain. The Food and Agriculture Organisation identifies that climate change will impact human health and livelihood assets through food distribution channels, as well as change purchasing power and market flows. In this context, packaged sustainable food has a vital role in reducing global warming and climate change. Packaged sustainable food can address global warming issues significantly in the entire food value chain by the usage of eco-friendly packages and recycle the packaging material with affordable cost but without compromising the performance. In other hands, it also helps to protect from exposure to gases, moisture, temperature (Marsh & Bugusu, 2007) as well as new microbiological threats related to climate change (Jaczsens et al., 2010) on the food safety perspective.

g) Food Package Waste

The packaging industry is one of the fastest-growing sectors which shows about 13 – 15 per cent average annual growth rate, and it is a sixth largest packaging market in the world with the output of USD 24.6 billion sales in 2011 (Indiapack, 2016). The figures explore the outcome size of the production, which is significantly vital as usual packages are disposable, especially food packages. It is a fact that the role of food packages is unavoidable in the various stages of the food supply chain. But at the same time, it causes accumulation of municipal solid waste and relevant pollution once it commonly was thrown away. The most popular package materials are paper, fibreboard, plastic, glass, steel and aluminium and sometimes mixed materials also use. The environmental impact of food packaged materials is based on its degradation properties and period that took for the degradation. Thus, food packaged materials are classified into bio-degradable and non-biodegradable. The data from various sources shows that Per capita waste generation increasing by 1.3 per cent and an annual increase in waste generation is around five per cent in India. Also, approximately more than 42.0 million tons of municipal solid waste emerge annually in India. The prevailing trend in India is the direct dumping of untreated packages in lands. It causes savour environmental and health problems to humans and animals (Goorah et al., 2009). The food package wastes produce Greenhouse gases and enhancing global warming. Also, it can clog the water storm and causes a flood. Besides, thrown away waste packages may ingest by animals, birds as well as fish. Some of the studies also proved that food package wastes cause the accumulation in the population of algae and degrade water and soil quality. Burning of plastic food package waste also causes chemical toxicity through inhalation. Moreover, decomposes of food wastage impact on global climate change. It has been estimated that prevention of every tone of food wastes that equivalent to potential save 4.3 tons of CO2.

6.2 Economic Perspective:

a) Policy Strategies

The food needs based on population growth and always the matter of social issues in pre-independent India. The rate of agriculture growth was recorded the fifty years before the independence was about one per cent per annum in India (Tripathi, & Prasad, 2010) or even a negative growth was recorded in the entire first half of the 20th century (Blyn, 1966; Kurosaki, 1999). After independence, the growth of the food sector in India highly influenced by the policies of various governments time to time and its nature of implementation through Five-year Plans. Most of them are denoted in name of multiple colours such as Grey revolution (for fertiliser), Green revolution (for food grains), White revolution (for milk/dairy), Blue revolution (for fish / marine products), Brown revolution (for milk/dairy), Pink revolution (for onion), Round revolution (for potato), Yellow revolution (for oilsseeds), Red revolution (for meat & tomato), Silver revolution (for egg/poultry), Golden revolution (for horticulture) etc. (Dastagiri et al., 2014). All the policies and programs emphasised on scientific methods. Among these, Green revolution was most popular due to its significant role in fulfilment to achieve the self-sufficiency in the food sector. Significant intensification of the farm mechanisation inputs in the agriculture sector was behind this achievement. Generally, agriculture workers are the cornerstone of the Indian agro-food industry; at the same time, their income is low and employment irregular due to the seasonal characteristics of agricultural. Although, the trends begin in high farm mechanisation, causes to decreases the interactions of agrarian workers engaged in crop production and gradually they forced to find other professions for their livelihoods especially new expansions of food workers. It transmutes impact on inherent in the system of family farming. For instance, the usage of tractors increased from 7.49 per cent in 1971-72 to 30.21 per cent in 1991-92 and, in contrast, the contribution of agriculture workers declined from 15.11 per cent in 1971-72 to 6.49 per cent in 1991-92 (Singh, 2006). Human Development Report 2015 by UNDP shows there is a tremendous move of work opportunities rapidly from agriculture to urban centres (HDR, 2015).

New economic reforms in India targeted a rapid growth associated with the global market through the possibility of trade liberalisation in Indian agro-food sector. More than the theoretical, the empirical approach shows that the focused growth of agricultural productivity in India diversified into cash crops farming with the prime objective of exports rather than the local consumption and nutrition. For example, exports of agriculture and allied products lifted from 2.5607 Billion US dollar in 1987-88 to 6.6262 Billion US dollar in 1997-98 (RBI, 2006). Also, from the year 2006-07 onwards the trend of shift from food grains to non-food grains such as fruits and vegetables, oilsseeds, fibres and condiments and spices (Kannan & Sundaram, 2011) and the widespread cultivation of ‘Bt cotton’ (Naik et al., 2005) accelerated due to the rapid commercialisation of agricultural production. Indeed, various trade agreements opened new opportunities for many Indian farmers to occupy in production for the export market. Although, volatile nature of the global market prices impacted directly to the farmers. Consequently, the majority faced cutthroat competition from imported agricultural products (o’Brien et al., 2004) as they need to become more speculative as well as competitive. The examples like liberalisation of trade in edible oils and oilsseeds (Shiva, 2000) and agrarian crisis results in the form of a series of suicides of farmers (Reddy & Mishra, 2008) are subject to an examination of the negative impact of globalisation in India in relevance with production. On the other hand, India is still one of the countries to substantial numbers of hungry and malnourished people in the world. The report of Department of Agriculture & Cooperation (Government of India) shows that the share of agriculture, forestry, and fishing into the GDP of India declined sharply from 19.0 per cent in 2004-05 to 14.6 per cent 2010-11 and a further decrease of 13.9 per cent in 2013-14 at 2004-05 prices (Agricultural Statistics at a Glance-2014). According to Ramakumar (2009), low-yield growth of crops and deprivation of trade in many non-cereal crops causes a decline in per-capita agricultural output and income. Again, Bhalha & Singh (2009) point out that the noticeable decrease in investment in rural infrastructure including water management and
negligible approach in scientific research by the state in the agricultural sector was the prime cause of slowdown of growth of yield and output. In contrast, Ahluwalia (2002) states that the agriculture sector in India have benefited from trade policy changes, and an alternate argument is distinctly a misinterpretation. Still, he agreed that public investment in the agricultural sector declined. Of course, the various food policies so far followed in India make way for new development in the production of the agro-food industry. But it becomes a challenge as this is not in the means of sustainable food production as well as self-sufficient food economy of the country. Indeed, one of the significant arguments introduced to support the globalisation policy was that it would make an ultimate growth in agriculture. But in fact, the observations based on the value of output 2004-05 prices from various decades emphatically indicate that the share of agriculture in GDP continues to decline (Table 3).

Table 3

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<tbody>
<tr>
<td>Cereals</td>
<td>4.2</td>
<td>3.4</td>
<td>3.5</td>
<td>2.4</td>
<td>1.5</td>
<td>1.0</td>
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<tr>
<td>Pulses</td>
<td>3.0</td>
<td>0.7</td>
<td>3.4</td>
<td>0.8</td>
<td>0.3</td>
<td>0.8</td>
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<tr>
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<td>1.8</td>
<td>7.4</td>
<td>4.4</td>
<td>2.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Sugars</td>
<td>3.3</td>
<td>4.1</td>
<td>4.2</td>
<td>2.4</td>
<td>9.4</td>
<td>1.7</td>
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<tr>
<td>Horticulture</td>
<td>2.6</td>
<td>4.2</td>
<td>3.1</td>
<td>5.7</td>
<td>3.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Non-Horticulture</td>
<td>3.2</td>
<td>2.7</td>
<td>3.0</td>
<td>2.1</td>
<td>1.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Livestock</td>
<td>1.0</td>
<td>3.3</td>
<td>4.8</td>
<td>4.0</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Fishing</td>
<td>4.7</td>
<td>3.1</td>
<td>5.7</td>
<td>7.1</td>
<td>2.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Agriculture &amp; Allied</td>
<td>2.3</td>
<td>2.4</td>
<td>3.0</td>
<td>3.1</td>
<td>2.6</td>
<td>2.4</td>
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</table>

Source: Department of Agriculture and Cooperation & Directorate of Economics and Statistics

Besides, the neo-liberal policies not only discouraged the multi-cropping and cultivation of the local food products for self-consumption but also encourage the import of essential crops. It results in volatile domestic food prices due to uncertain international food commodity prices. The significant controversy is that the automatic stabilisation of food prices was ensured in the universal PDS by fair price shops that could control over the market price raise whereas, in the TDPS, BPL quotas low and fixed prices and APL priced out of the PDS (Swaminathan, 2009). Demeaning to control the food market price in the country by the state resulted due to this policy. Mooij, (1998) coined that according to the viewpoint of left in India, the people cannot always entirely depend on the open market for food as it is an essential need, which the state has the responsibility to distribute more equally. They have been against the TDPS policy. The targeted PDS has one-sided, which caused the rise of food grains prices and other essential commodities to both APL and BPL (Anand, 2006; Rajagopalan, 2010). However, the critiques about TDPS cannot refuse as simple as that because access, availability, stability utilisation and nutrition security of food is also a matter of social equality in the way of sustainable development of a country. The study conducted by RBI points out that, in recent period Food inflation became stiffened in India particularly in the case of protein sources of food that based both plant and animal sources (Sonna et al., 2014). Again, the biggest challenges in TPDS are unreliable recognition of households under CIP for targeting of subsidies to the genuinely needy (Srivastava, 2004; PEO, 2005; Swaminathan, 2009). Also, leaking delivery system is another issue. According to Economic Survey 2014-15 (ES, 2015, p. 23.), the leakages in the PDS are very high particularly in the APL segment; that is about 15 per cent for rice and 54 per cent for wheat.

b) Food Production and Processing

According to the Ministry of Agriculture (Annual Report, 2015), India has a geographical area of 328.73 million hectares; of which 195.2 million hectares reported as the gross cropped area of the country. During 2013-14, agriculture and allied sectors contributed approximately 13.9 per cent of India's GDP (at constant 2004-05 prices). India census 2011 shows 56.6 per cent of the people were dependent on agriculture for their livelihoods whereas there is a significant reduction in the agriculture workforce in the last decades. For example, the 68th round of the National Sample Survey-2011/12 (NSS, 2014) reported that rural males engaged in the agricultural sector declined from 81 per cent in 1977-78 to 59 per cent in 2011-12. Similarly, female workers decreased from 88 per cent in 1977-78 to 75 per cent in 2011-12. Lower profit from farm produce and attractive remuneration in non-agriculture sectors are considered as the primary reasons. Also, various employment guarantees schemes in the non-agricultural sector encouraged this trend. At the same time, the food processing sector is high labour-absorptive and less capital intensive. However, improper processing technology and lack of proper storage facilities are the challenges of the food processing industry in India. Food losses in the supply chain also one of the prime issue. Food loss is the degradation of quantity and quality of a food or both of a produced food from harvest to consumption. An estimation in 2009 by CIPHET, Ludhiana shows that total prices of 'harvest and post-harvest losses' from major agriculture productions were of 44,143 crore loss per annum (Nuth et.al., 2018). According to them, most of the wastage is happening in fruits and vegetables, pulses and cereals. The term loss defers from damage, as damage limit the use of the food products whereas loss results unfeasible usage. Food loss can be possible at any stages from harvesting, collection, threshing, grading or sorting, cleaning, drying, transport and distribution storage, processing, packaging, to Marketing and Selling. Thus, explicit control over food loss needs to consider the hardest challenges that point out the significance of sustainable packaging in the relevant supply chain stages.

6.3 Social Perspective:

a) Shifts in consumption patterns and Nutrition Outcomes

The era of globalisation in India provides more opportunities for modern job patterns, increased incomes, and improved infrastructures that closer to global trends. At present, these became the driving force of urbanisation, which profoundly influenced consumer food preferences. The intensification of the female workforce and high disposable income to spend results a diversification from home-cooked foods into semi-prepared foods and ready to eat foods (Pingali & Khwaja, 2004). The food consumption patterns are interlinked with the budget share of food; the staple share of calories; and caloric intake as compared with poor households, wealthier households are more...
sensitive to changes in caloric requirements in India (Eli & Li, 2015). In rural India, food consumption pattern varies amongst socioeconomic groups (Gupta et al., 2014). According to him, the high-income class shows a greater diversity of food intake with more nutritionally secure diet comparative with low-income category, who have a poor diet than the national average and the other groups. Besides, rapid urbanisation and globalisation influenced Indian consumers to a great extent. For example, the economic growth changes the taste preferences; as a result, there is a shift in traditional food commodities consumption to processed and high-value commodities (Meenakshi, 1996; Rao, 2000). Also, the changes in the consumption patterns are related to income expenditure on food (Table-4).

Table-4  
Percentage Share in Consumer Expenditure

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<tbody>
<tr>
<td>Share of Gram &amp; Cereal (subs in food total)</td>
<td>38.8</td>
<td>37.7</td>
<td>33.1</td>
<td>29.7</td>
<td>25.3</td>
</tr>
<tr>
<td>Share of Pulses, Milk, Edible Oil, Eggs, Meat &amp; Fish, Veg. and Fruits (in food total)</td>
<td>45.4</td>
<td>46.3</td>
<td>50.0</td>
<td>50.9</td>
<td>54.1</td>
</tr>
<tr>
<td>Share of other food (in food total)</td>
<td>15.8</td>
<td>16.2</td>
<td>17.1</td>
<td>19.4</td>
<td>20.6</td>
</tr>
<tr>
<td>Share of food (in total consumption)</td>
<td>63.2</td>
<td>59.4</td>
<td>55.0</td>
<td>53.6</td>
<td>48.6</td>
</tr>
<tr>
<td>Share of non-food (in total consumption)</td>
<td>36.8</td>
<td>40.6</td>
<td>45.0</td>
<td>46.4</td>
<td>51.4</td>
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<tbody>
<tr>
<td>Share of Gram &amp; Cereal (subs in food total)</td>
<td>26.1</td>
<td>26.0</td>
<td>24.0</td>
<td>22.6</td>
<td>19.5</td>
</tr>
<tr>
<td>Share of Pulses, Milk, Edible oil, Eggs, Meat &amp; fish, Veg and Fruits (in food total)</td>
<td>52.7</td>
<td>52.4</td>
<td>53.9</td>
<td>54.5</td>
<td>54.8</td>
</tr>
<tr>
<td>Share of other food (in food total)</td>
<td>21.2</td>
<td>21.2</td>
<td>22.1</td>
<td>22.9</td>
<td>26.0</td>
</tr>
<tr>
<td>Share of food (in total consumption)</td>
<td>54.7</td>
<td>48.1</td>
<td>42.5</td>
<td>40.7</td>
<td>38.5</td>
</tr>
<tr>
<td>Share of non-food (in total consumption)</td>
<td>45.3</td>
<td>51.9</td>
<td>57.5</td>
<td>59.3</td>
<td>61.5</td>
</tr>
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</table>

*Source-NSS Report No. 555 (68/1.10/1)*

From the Table-4, it can be observed that the demand increase in proteins and fats richer food like Milk, Edible Oil, Eggs, Meat & fish etc. and there could be a decline in the consumption of traditional foods like rice cereals etc. Again, one of the consumer studies for buying packaged food shows that most of the Indian consumers prefer taste as the first prior category of key decision-influencers followed by convenience, health, and ideology. At the same time, the second preference was affordability and quality (Ojha et al., 2012). Also, the study indicates that majority move towards purchasing of organic or luxury versions. However, the comparative analysis suggests that the consumption pattern was increased towards processed foods, particularly in packaged food (Figure-4).

Figure-4
Packaged Food Industry Data

The Figure-4 shows that the average per capita spending on packaged food has been increased from 9.6 per cent in 2005 to 19.3 per cent in 2013. Also, the study by ASSOCHAM (2015) conducted in various cities in India shows that most of the parents, both working with children below five years in the towns preferring easy-to-prepare meals at least 10-12 times per month due to the work pressure and they need to save the time. Also, amongst the respondents, about 89.5 per cent of the nuclear family feels that they do not have the free time to spend in the kitchen and 72.6 per cent of the bachelors prefer convenience food due to the less cost, easy preparation, and consumption in the busy life. The changes in the food consumption pattern may increase the chance of health risks. It has to consider that the increased intake of proteins and fats richer food (See, Table-4) mostly converted into industrially processed food. It may reach to the consumer in the form of convenience food or ready to cook food. These conversions make the chance of nutrition loss and low in fibre contents. Also, it tends to contain sugar, fat, sodium, added vitamins and minerals etc. that typically high in calorie. Again, maintaining nutritional balance is the biggest challenge in commonly packaged food because in a bulk industrial method while it processed or cooked, there is no control over it. Also, contents of artificial flavours and preservatives and food additives reduce the neutrality of the food, but it becomes an essential part of most of the packaged food.
b) Food safety: Evidence and Issues from Pesticide contamination in soft drink

The presence of pesticides in food and beverages also results in potential impacts on food safety, food security and public health. For example, parathion-contaminated wheat flour consumption caused the death of over 100 people, which considered as India's one of the first confirmed case of food poisoning due to pesticide application reported from Kerala (Karunakaran, 1958 cited in ICMR, 2001). The market availability of various processed foods profoundly influenced the diversification consumer food preferences in India. But on the other side of the coin, it also increased food safety risks. For instance, the studies conducted during 2002-2003 by Centre for Science and Environment (CSE), an NGO based in New Delhi, explore that the samples of bottled water collected from Mumbai and Delhi found residues of deadly cocktail pesticides. Also, they found pesticide contaminations (Figure-5) in some of the soft drinks sold in India (Mathur et al., 2003). Again, the similar studies conducted during 2006, and that also claim the presence of pesticides in soft drinks (Johnson et al., 2006; Garcia-Reyes et al., 2008). It also absorbed that (Figure-6) most of the soft drinks are multinational brands manufactured in India.

Note: EU MRL for bottled water is 0.0005 ppm

Source: Mathur et al 2003

Figure-5
Pesticides in Soft Drinks in India, 2003

Source: Centre for Science and Environment, New Delhi, India.

Figure-6
Pesticides in Soft Drinks: Comparison of Same Brands in India & USA

After the reveal of the study by Centre for Science and Environment, In August 2003, Government of India set up a Joint Parliamentary Committee (JPC) on ‘Pesticide Residues in and Safety Standards for Soft Drinks, Fruit Juice and other Beverages’ to review the issue. The JPC recommended independent testing of various samples of soft drinks under the reputed government laboratories. They also found the presence of pesticides in the tested samples in India. Still, out of 12 brands 06 brands are reported as within or below the EEC Limits, where are the studies by CSE shows all tested 12 brands are higher than European Economic Community (EEC) standers (Table-5).
The observations are highlighted here as they were directly involved in media attention and public argument. Apart from these, multiple reviews have reported the consequences of the presence of pesticides in food produced in India. One of the examples is studies of Dikshit & Mishra (1985). They found traces of pesticides in unprocessed potatoes, which was the residues of carbaryl and endosulfan persisted above their tolerance limits. The other examples such as market samples of grapes (Reddy et al., 2000), groundnut stalk (Reddy & Divakar, 2007), okra and brinjal (eggplant) fruits (Arora & Singh, 2004), mango fruits (Arora et. al., 2006), wheat (Rani et al., 2006), animals slaughtered for purpose of meat (Vijayan et al., 2006), amongst the various fish species of Ganga river (Samanta, 2006), cucumber (Singh et al., 2007) are showing the more or less the presence of pesticides in various food commodities. At the same time, Pandey et al. (2010) analysed different dry fruit nuts such as walnut, almond Pistachio nut, coconut, chilgoza, etc. and reported that all the samples are found free from endosulfan residues (see Tayade et al., 2013). It shows that dry fruit nuts are comparatively riskless to health. But take into account that it only a small part of our food consumption. However, the above studies indicate that to keep more accuracy on standardisation gives a much more stringent toxicity classification for individual substances and updating the regulations in food sector compare with developed countries are quite essential in India. Again, the real packaged sustainable foods never use any chemical pesticides at any stages of food supply chain system, in spite of it encourage biological pest control or application of biopesticides in the way of organic farming.

### 7. PACKAGED SUSTAINABLE FOOD IN INDIA: THE OPPORTUNITIES

Historically India was a country with a sustainable farming system since the transformation of Indian agriculture into 'modern agriculture'. Nevertheless, an inherited tradition of a sustainable farming system increases the vast potential for sustainable food production in India. The most recent trends show the dynamic progress on market demand for sustainable food in India. According to APEDA, Government of India (2016) in India, the organic certified production area includes 15 per cent cultivable area with 0.72 million Hectares and remaining 85 per cent (3.99 million Hectare) is the wild area that using to collect minor forest products (Yes Bank & Ingenus, 2016). Also, India ranks 10th place in terms of cultivable land under organic certification among the top ten countries. The data for 'organic products' in India shows that (Table-6) majority of the production aimed for cash crops than the food crops. However, in general, the overall performance can be considered as the pre-growth phase of new trends. Again, the government of India initiated to promoting organic food in the country through the National Project on Organic Farming (NPOF) scheme. NPOF provides Standards and regulations for 'organic products' including accreditation of Certification Bodies as well as India Organic logo (Figure-7). An estimate suggests by ASSOCHAM and TECHSCI Research shows India's organic food market has potential to grow more than 25 per cent annually to touch $1.36 billion by 2020 (Economic times, 2015). These days, individual farmers, NGOs and community based organisations come forward to promoting locally adapted farming systems and sustainable farming practises. Adarsh Bio Organic Farm in 15 Hectares located at Village Dhaura, Sohna in Gurgaon District of Haryana, Centre for Sustainable Agriculture - a professional resource Organisation registered as Trust in 2004 in Hyderabad, India, the promotion of 'Rishi-Krishi' Techniques etc. are some of the examples. Agricultural research Organisations consist of two main streams in India. First, the institutions under the Indian Council of Agricultural Research (ICAR) at the national level and the State level the Agricultural Universities. Apart from this, other agencies such as scientific organisations, private or voluntary organisations, various Ministries and Departments at central and state level are involving either directly or indirectly into the research and development activities. However, the Indian Council of Agricultural Research (ICAR) considered as the most responsible institutional body for research and education in the agricultural sector in the country. All these are the golden opportunities to develop a better system of a sustainable way of food productivity in India.

### Table-5

Comparison of the Results of CFL (CFTRI), Mysore and CSE, New Delhi and CFL, Kolkata

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Brand</th>
<th>CFL (CFTRI), Mysore</th>
<th>CSE, New Delhi</th>
<th>CFL, Kolkata</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Pesticides Residues OC+OP (mg/L)</td>
<td>No. of folds higher than EEC Limits</td>
<td>Total Pesticides Residues OC+OP (mg/L)</td>
<td>No. of folds higher than EEC Limits</td>
</tr>
<tr>
<td>1.</td>
<td>Limca</td>
<td>0.000029</td>
<td>Below EEC limits</td>
<td>0.0148</td>
</tr>
<tr>
<td>2.</td>
<td>Diet Pepsi</td>
<td>0.000266</td>
<td>Below EEC limits</td>
<td>0.0071</td>
</tr>
<tr>
<td>3.</td>
<td>Pepsi</td>
<td>0.000025</td>
<td>Below EEC limits</td>
<td>0.0187</td>
</tr>
<tr>
<td>4.</td>
<td>7 Up</td>
<td>0.000584</td>
<td>1.6</td>
<td>0.0166</td>
</tr>
<tr>
<td>5.</td>
<td>Fanta</td>
<td>0.000087</td>
<td>1.7</td>
<td>0.0214</td>
</tr>
<tr>
<td>6.</td>
<td>Mirinda Lemon</td>
<td>0.000211</td>
<td>4.2</td>
<td>0.0352</td>
</tr>
<tr>
<td>7.</td>
<td>Mountain Dew</td>
<td>0.00102</td>
<td>2.0</td>
<td>0.0141</td>
</tr>
<tr>
<td>8.</td>
<td>Thums Up</td>
<td>0.00100</td>
<td>2.0</td>
<td>0.0111</td>
</tr>
<tr>
<td>9.</td>
<td>Coca Cola</td>
<td>0.002</td>
<td>4.0</td>
<td>0.0223</td>
</tr>
<tr>
<td>10.</td>
<td>Mirinda Orange</td>
<td>0.00171</td>
<td>3.4</td>
<td>0.0196</td>
</tr>
<tr>
<td>11.</td>
<td>Sprite</td>
<td>0.001628</td>
<td>3.2</td>
<td>0.0055</td>
</tr>
<tr>
<td>12.</td>
<td>Blue Pepsi</td>
<td>0.00263</td>
<td>5.2</td>
<td>0.0147</td>
</tr>
</tbody>
</table>

Note: EEC limit for total pesticide residues: 0.0005 mg/L.

At the same time, some of the big players in the Indian packaged food industries like ITC taken a remarkable approach in their corporate strategy policies to promote sustainability. Use of environment-friendly raw materials and printing with non-toluene and non-ketone based inks are examples of the attitudes towards sustainable packaging by ITC (ITC, 2015). Currently, India following Plastic Waste (Management and Handling) Rules, 2011 to manage the plastic waste, which has proposed to replace with a new rule ‘Plastic Waste Management Rules, 2016’, aimed with a broad spectrum of implementation. The new regulation suggests that “carry bag made of virgin or recycled plastic, shall not be less than fifty microns in thickness”. However, the previous rule recommended forty microns in thickness. Also, the new proposed rule suggested the extension of its application from town-municipal areas to local-rural areas (Gram Panchayats), including every waste generator, manufacturers, importers, and producers. One of the advantages of the new draught rule is the inclusion of responsibility of the generator, which is neglected in the currently following rules. According to the government, a complete ban on plastics in all uses is impractical and undesirable. The reason being there is no suitable eco-friendly product alternative has been found as on time. Nevertheless, The Government of India anticipate that increasing thickness of plastic carry bags also increases the cost around 20 per cent that will reduce the supply tendency of free plastic carry bags along with the product sale by the retailer. Also, this facilitates the collection of plastic wastes and intensifies its possibility of recycling. The rules instructed that “recycled plastic or products made of recycled plastic shall not be used for storing, carrying, dispensing or packaging foodstuffs” (PIB, 2016). Again, plastics in contact with foodstuffs and drinking water must be without any added pigments (colourless) or with an updated version of Indian Standard: IS 9833: 1981. However, the various analyse show that there is a golden opportunity opened for packaged sustainable food in India.

8. RESULTS & FINDINGS.
From various gathered information and evidence, this study summarises the following key findings.

1. The Green revolution enhanced increased productivity of high-yielding varieties (HYVs) of crops through industrial farming techniques. It caused uncontrolled usage of chemical fertilisers and pesticides as well as extravagant irrigation methods such as overexploitation of groundwater. Consequently, it results in a reduction of the local nourished soil area available for further cultivation and leads to deforestation for new agriculture land. It negatively impacted the agricultural environment and biodiversity and became one of the responsible factors of climate change in India.

2. Neoliberal reforms distinctly impacted on production, distribution and consumption of food in India. Since the past decades, the trade liberalisation policy does not intensify the agricultural share of GDP in the country. Food production becomes over-commercialised in India. One of the main reasons for this is the changes from a universal public distribution system (PDS) to the

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Table-6
Data for Certified Organic Production in India (2013-14)

| Total organic certified production area | 4.72 million Hectare |
| Total quantity produced | 1.24 million MT |
| Total volume exported (including organic textiles) | 194088 MT |
| Total Value of total export (including organic textiles) | 403 million US $ |
| Major exported countries | USA, European Union, Canada, Switzerland, Australia, New Zealand, South East Asian countries, Middle East, South Africa, Oil seeds (Soybean): 70%, Cereals & Millets (other than Basmati): 6%, Processed food products: 5% |
| Share of organic products exported (in percent) | Basmati Rice: 4%, Sugar: 3%, Tea: 2%, Pulses and Lentils: 1%, Dry fruits: 1%, Spices: 1% |

Source: http://apeda.gov.in/
targeted public distribution system (TPDS). Similarly, globalisation enhanced rural to urban migrations and changes in the occupational structure in India. Farming became one of the least professional choices. It led to busy urban lifestyles and affected the food consumption pattern. Also, it results in increased usage of industrially processed food and packaged food in India.

3. There are two significant issues in the Indian food sector highlighted in this study as follows. One is lack of updating and variations in standardisation, regulations, monitoring and execution of food safety measures on food and drink; insufficient food testing labs; inadequate awareness about the food contents amongst the consumers in India, especially in the case of processed and packaged food and beverages. Two, the direct dumping of untreated packages in lands which become the prevailing trend in India. It again increases environmental issues.

4. Even though Indian traditional conscious, awareness of sustainability in food and food packaging, inventiveness from NGOs and environmental activist groups; interferes of media; new schemes by governments have a vital role in ensuring good health and well-being for the whole population of the country.

9. DISCUSSIONS

The trends in the agro-food sector in India from the past few decades indicate that the time limit has been crossed to rethink about the way we followed. Several variables are often used to interact with the agro-food sector in India. Some of them made more complex and sometimes fragile this sector. It has been happening in the name of betterment by the various ideologies for the political benefits. The arguments and debates whatever it may be the reality are that the path currently India chooses to achieve the goals in the agro-food sector, moving in a misunderstood way. Eventually, correlate with higher population growth, there is an increase of urbanisation leads to wealth, higher purchasing power, and higher consumption of processed food (Tilman et al., 2001; Assessment, 2005). It results in tremendous changes in the food system and its supply chain. On the other side of the coin, the demand for water and energy, lack of agricultural lands, the effects of substantial climate change, lack of interest in farming by the new generation are affecting the food system. (Parry et al., 2007; Schmidhuber & Tubiello, 2007). The challenges impacted not only on the ‘quantity of the food’ but also the ‘quality of the food’. The reason being, food in terms of quantity and quality used to express a concept of food security. According to 1996 World Food Summit, “Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. Community Research of the European Commission points out that, food quality, food contamination, and reduction in a healthy balanced diet are the three core issues in the food and drink sector (EC, 2000).

Today, the packaging is an unavoidable element, especially in the case of food. Change in the food consumption pattern encouraged the popularity of packaged food. Indian traditional food system enhances the sustainable way of food preparation and consumption. In contrast, the increased popularity in packaged food may lead to change in the harmony of family food patterns and eating habits. Thus, packaged sustainable food can always encourage the choice of ‘sustainable food’ as well as the ‘way of consumption’ through proper awareness of a sustainable lifestyle. Alongside, biodegradation of food packages became the socio-environmental issues in the current scenario. It shows, not only the food content but also the food package must become sustainable. Indeed, ‘sustainable packages’ can overcome these challenges. It has to be achieved through either reusable, recyclable or compostable of the food packages. Hence, the adaptation of packaged sustainable food can be a suitable solution for human well-being. Minimise food packages are one of the proposals to reduce environmental impacts. Nevertheless, the packaging of food also depends on the nature of food and requirements of food transportation.

Concurrently, most of the customers tend to compare the food products to the neighbouring products at the point of sale. Thus, an identification requirement of sustainable food is an important matter to recognise ‘real’ sustainable food among other food products. For example, there is a chance of commingling of ‘real’ sustainable food products with other unsustainable food products in conventional general stores and supermarkets. In contrast, the exclusive shop that only sells sustainable foods can minimise food packaging due to the identity of the shop. Again, the information from the packaging of the products profoundly influences their food purchasing decisions at the point of purchase. Thus, the label of sustainable food and drink products highly required. Also, the food label must be permanent, easily visible, clear and easy to read, easy to understand and not misleading. It has to fulfill the basic principles of food label requirements such as product name, the quantity of content, nutritional information, ingredients, date of manufacture, expiry, and details of manufacturer or distributor etc. The food packaging keeps the contents safe without tampering it until the purchase by the consumer. It helps to reduce the risk of food adulteration as well as avoid misleading. Hence, the packaging is very significant for all types of sustainable foods. On the other hand, the majority of the Indian farmers are not directly linked to final consumers. They sell their products to intermediaries who manage the processing, packaging and distribution of food to the market. At the same time, the packaging industry in India is performing independently. Indeed, choices of sustainable food packages are responsible for the food and agribusiness industries. Unfortunately, many of them least concerned about it at present. Thus, growth in sustainable food production can enhance the sustainable packaging industry as well. According to the proposed concept, the packaged sustainable food sector is multi-functional. It always has a role in balancing human wellbeing through economic growth as a livelihood provider of a country. Hence, the packaged sustainable food sector must ensure profitability, environmental health, social and economic equity. Nevertheless, it highly depends on a ‘sustainable agro-food sector’, which meets the needs of present and future generations for its products and services that would contribute food security in a manner of environmentally, economically and socially responsible over time (FAO, 2014).

The detailed analysis of the various past reviews coined that achieved ‘food self-sufficiency’ of the country so far is not denoting a real ‘food security’. Because the actual ‘food security’ must have to be achieved through a sustainable food system. It is essential to sustain the harmonious relations between the environment and human development of the country. Thus, sustainable farming and the promotion of packaged sustainable food products are an alternative way to overcome current challenges. It can help the rehabilitation of biodiversity quality of India and Indian farmers. Public policy by the government, which is enhancing sustainability, is crucial to support the sustainable food system of the country. Also, the majority of consumers in the urban community in India prefer packaged food for their convenience. It is due to the new lifestyle adoption. It shows the rapid urbanisations and shift in food consumption patterns have increased the significance of packaged sustainable food.

Indeed, food is the substance which directly connected to health. The consciences about food and its multiple impacts of social, economic and environmental problems also increased. In this day and age, the farmers, food processors, and consumers are also awakening to the importance of sustainability and its application to food from the experience of various health-related issues. Even, the government schemes like Rashtriya Krishi Vikas Yojana (RKVY) well attempt to support the sustainable manner of food production in India. It helps
in narrow ways, but it is considerable. However, all these progress are in a very nascent stage. All these recent trends in India show better opportunities for 'packaged sustainable foods'.

10. CONCLUSIONS.

The current study concludes with the following arguments. The current food production based on intensive farming needs to convert into a sustainable farming system that ensures healthy crops and livestock with minimal environmental damage. Also, reducing the food mile can meet through promoting local and seasonal food availability. Compare with first; the second argument is the most crucial challenge because the available land for local farming decreased in a considerable amount in India due to rapid urbanisation. Also, it cannot be practically applied to all types of foods, for example, seafood. Hence, the significance of sustainable food packaging is emerging. The proper sustainable food packaging is not only protecting the food but also can ensure the quality and freshness of the food up to a certain level. Even the food produced from locally, storage also be possible for the minimum days. But most of all, two significant challenges are also remaining, that have to adequately addressed. First, there is a requirement of changes from consumption of global 'urban' food style to the sustainable and healthy traditional Indian food diet. Second, put an end to throw away culture of food packaging since many food packagings are single-use food wrapping. Thus the current study emphasises the significance of proper consumer awareness towards packaged sustainable food.

However, after analysing the relevant data and information, the overall findings of this study lend support to introduce the new concept of 'Packaged sustainable food' (PSF). PSF integrate all the concepts of sustainable food with sustainable packaging. Packaged sustainable foods reduce the environmental impact and ecological footprint. Hence, it is crucial to promote packaged sustainable food, which is safe and nutrition-based; its content adds 'sustainable value' to the product that integrates several 'sustainable components' as well as minimise the environmental impacts. For precisely the same reasons, this study underlines that there is an optimistic prospect for packaged sustainable food in India.

10.1 Policy Implications

Unless the proper policy implications have not supported, an active adaptation of packaged sustainable food becomes crucial in everyday practical life. The reason being, in most cases, sustainability and a profit-oriented business do not proceed hand in hand. Similarly, it is not an easy job in India like country compares with high-income countries that have less population. With that in mind, the following policy actions recommended.

a) Awareness through education: Overall awareness about sustainability and environment is vital. Sustainable agriculture, food production and sustainable way of food consumption must be a subject in the various school education levels. Crops and livestock, animal welfare, protection of wildlife, global warming, food quality safety and security, diet-related health concerns etc. need to become an essential part of knowledge. It has to start from primary education.

b) Research and Development: Public sector agricultural research is a solid foundation for sustainable food production. The government has to do a high rate of investment in research and augmentation for the sustained increase in food productivity. Cervantes-Godoy & Dewbre (2010) point out that; the sustainable growth of agricultural productivity impacts poverty reduction, whereas the industry and services sectors, do not help on this. Government at central and state level needs to initiate a research policy that attracted by more young research scholars in the area of packaged sustainable food. It can be done in two ways. First, Government of India shall initiate to facilitate a link between the Department Of Agricultural Research and Education (DARE) and Union Grant Commission (UGC) to provide increased fellowships to the researchers. Second, UGC needs to create a wide scope that goes hand in hand with all the universities in India and national as well as international agricultural research institutions to emerge the research programs in the area of sustainable packaging and sustainable food.

c) Sustainable food Subsidies: Government policies towards subsidies need changes from the current pattern. The core concept of the policies must be the implementation of nutrition-based food subsidy schemes. It must be focused on increasing sustainable agricultural productivity per unit of land. The government has to gradually reduce and stop the subsidies for chemical fertilisers and pesticides. At the same time, the subsidies for organic fertilisers and bio pesticides need a sudden increase that linked to minimum support prices. It is vital to decrease the cost of the sustainable way of food production as well as sustainable food consumption.

d) Green Tax: Need a reduction on taxes on packaged sustainable food. Also, decrease the taxes on the shops those who exclusively sell sustainable food products. It will encourage food retailers to trade more sustainable foods.

e) Sustainable Food Procurement and Distribution Management System: Government has to be initiated to start local procurement centres in district level exclusively for sustainable food products. The current warehouse of Food Corporation of India (FCI) can be utilised for this by the union government. Also, the respective state government can start these warehouses where the FCI does not have the provisions. The local farmers can directly supply their products to these sustainable food procurement centres. The procured food product can be supplied as per the local requirement as well as to be adjusted, with the neighbouring places to compensate for the local food demand. Distribution and sales of these sustainable foods can be done with sustainable packages through ‘fair price shops’ or ‘fair trade markets’. Besides, it is important to improve the facilities of storage centres, particularly for vegetables and aqua farming products. Also, a separate centre may utilise for aquafarming products and livestock products.

f) Certification and Authentication: Certification and authentication are the backbones of sustainable food as they need to assure its originality. Food product assessment for its originality is always a stubborn task. So, it is better and more practical to certify food product farms. Depends on the nature of a farm, combined expert team of authorities represented from government’s department of agriculture, aquaculture, livestock, health, irrigation etc. have to visit periodically and confirm the sustainable way of production for certification with the help of the local government. A unique identification logo like India organic along with geographical indication needed compulsory on the food packages.

g) Regulations on food packages: Testing protocol and evaluation procedures for food packages are requisite for food-contact applications to evaluate the suitable purity for its intended use and to meet all specifications. It includes chemical and microbial contamination, the structural integrity of the food package materials and fit for reuse, recyclable, degrades etc. Also, the ban on
the production of plastic carry bags particularly less than 70 microns and promotion of biodegradable packaging products, jute and paper bags manufacturing industries, recycling industries etc. are essential and immediate.

**h) Support for Sustainable packages:** Increased production of sustainable package materials, recycling and waste management are essential to eliminate the plastic packages. Schemes for concessional credit can implement by governments through public banks, especially for cooperative societies, women entrepreneurs and women’s self-help groups etc. The campaign against the use of plastic bags needed from school level.

10.2 Scope for Further Research

The concept of Packaged Sustainable Food (PSF) is extensive and multidisciplinary. It underplayed with social, economic and environmental aspects such as ecological impacts of industrial agriculture, pollution by fertilisers and pesticides, soil loss and degradation, loss of biodiversity, feedstock production systems, rural agricultural communities, food production system effects on natural resources, locally owned business and employment opportunities, the family farm system of agriculture, Green marketing, etc. Among this, the study suggests to prioritised issues for research in India such as regaining, conservation and protection of soil quality; conservation and protection of agricultural lands and water bodies; development of high responsible seeds to the organic fertilisers and organic pesticides; safe utilisation biotechnology; sustainable irrigation systems; livestock and the well-being of animals; safe and effective sustainable food packages; waste management on food packages; sustainable food transportation methods; protection from food losses; health and nutrition food production and processing.

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