ABSTRACT

The Food Processing Industry in India rests on two strong pillars of the Indian economy - Agriculture and Manufacturing, which are the key sectors of a developing nation. The “Sunrise Sector” as it is being rightly deemed, is currently going through a positive transition, where in policies are being amended, conducive investment eco-system is being created and all efforts to set up the required infrastructure are being made. This paper attempts to analyze the demand supply gap in the production of agricultural products and agro processing industry and foresee the emerging technology from Investment point of view. For the study secondary data has been used. To simplify the study only 3 vegetables tomatoes, onion and potatoes have been taken. The data analysis clearly brings forth dire need of investments in food processing. Madhya Pradesh being a lead producer of so many fruits and vegetables in the country, still the food processing capacity in the state is very low indicating huge scope of investment in the sector. To keep the food processing costs in check it is also very necessary to use the latest technology available.

Keywords:

1. Introduction

Agro-processing industry, with its strong forward and backward linkages, has manifold contribution to agricultural and economic development. The significance of the agroprocessing industry can be gauged from its benefits to consumers, producers, agriculture and economy as a whole. The agro-processing industry can function as catalytic agent to bring about take-off in agriculture and ultimately in economy as a whole. India has successfully attained self-sufficiency in food, and benefits from marginal surplus in production. It is among the leading global producers of fruits and vegetables, milk, cereals, and wheat. Despite its strong agricultural production base, a significant amount of food produce gets wasted in India due to inadequate infrastructure such as packaging facilities, storage, transportation, cold chain, and low levels of processing. According to the Ministry of Food Processing Industry (MoFPI), post-harvest losses account for US$1.5 billion (Rs 92,000 crores) annually.

1.1 Food Processing scenario – Global & India

The processed food industries are valued at over $2 trillion dollars globally and consist of over 400,000 businesses. India is the second largest food producer in the world after China. According to government estimates for the fiscal year 2015-16, the country’s total food market is valued at US$39.71 billion and is projected to double in the next 10 years. Overall, less than 10 percent of the total food produced is processed into value added products in India. In comparison, the US and China process 65% and 23% of their produce, respectively. Similarly, other developing countries such as Thailand, Philippines, and Brazil process as high as 30, 78, and 70 percent of their produce, respectively.

1.2 Scope and Necessity of Food Processing In India & MP

Currently, food processing accounts for almost one-third of the total food market in India. The food processing industry is valued at US$258 billion, and is the fifth largest industry domestically in terms of production, consumption, export, and expected growth in the country. It contributes to around 14% of manufacturing Gross Domestic Product (GDP) and 13% of India’s total food exports. According to a 2017 report by the Associated Chambers of Commerce and Industry of India (ASSOCHAM), the country’s food processing industry is expected to reach US$482 billion by 2020, driven by growth in organized retail, changing consumer behavior, and increasing consumerism in tier II and tier III cities. As in other countries, India’s food processing is categorized into six major segments as shown in the table 1 below.
Table 1. Status of Processing of various Food products in India

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Segment</th>
<th>Components</th>
<th>Levels of Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dairy</td>
<td>Whole Milk powder, skimmed milk powder, condensed milk, ice cream, butter and ghee, cheese</td>
<td>35%</td>
</tr>
<tr>
<td>2</td>
<td>Meat and Poultry</td>
<td>Frozen and Packed (Mainly in fresh form), egg powder</td>
<td>20% buffalo meat, 6% poultry</td>
</tr>
<tr>
<td>3</td>
<td>Fisheries</td>
<td>Frozen and canned products mainly in fresh form</td>
<td>8%</td>
</tr>
<tr>
<td>4</td>
<td>Fruits and Vegetable processing</td>
<td>Beverages, juices, concentrates, pulps, slices, frozen and dehydrated products, potato wafers and similar products</td>
<td>2%</td>
</tr>
<tr>
<td>5</td>
<td>Consumer Foods</td>
<td>Packaged food, aerated soft drinks, packaged drinking water and alcoholic beverages</td>
<td>NA</td>
</tr>
<tr>
<td>6</td>
<td>Grains and Cereals</td>
<td>Flour, bakeries, starch, glucose, cornflakes, malted foods, vermicelli, beer and malted extracts, grain based alcohol</td>
<td>NA</td>
</tr>
</tbody>
</table>

Table 1 Source MOFPI

The production levels of fruits and vegetables are quite clear from the above stated 2015-16 production highlights. India’s vast agricultural resources alone create huge potential for investments in its food processing and equipment industry.

1.3 Review of Literature

In a view of its role in the economic development of a country, many research works have been conducted on various aspects of the agro-processing industry.

J. Wilkinson and R. Rocha in their study on, "The Agro-Processing Sector: Empirical Overview, Recent Trends and Development Impacts" found that Agro-processing industry plays a fundamental role in employment creation, income generation and promotion of socio-economic development.

A study conducted by FAO on “The Importance of Agro-Industry for Socioeconomic Development and Poverty Reduction” argued that rather than focusing on agricultural productivity only, policy makers must consider the competitiveness of the entire agro-value chain e.g. supporting small agro-producers and SMEs, enabling market access and developing a supportive institutional environment.

In a study, "Supply Response and Investment in the Canadian Food Processing Industry", Ramon E. Lopez holds that food processing industry constitutes a major direct market for the domestic farm sector and hence the dynamism of agriculture depends on development in the food processing industry.

Akhter Ali Niaz et.al. (2005) reported that the present study was carried out in March-April 2004 to determine the profitability of potato, onion and tomato production in Mastung, Kalat, and Pishin and KillaSaifullah districts in upland Baluchistan, Pakistan. A total of 90 farmers were interviewed. Analysis of the costs and returns revealed that the three vegetables are all profitable. Comparative analysis revealed that tomatoes are more profitable, followed by potatoes and onions.

Singh (2005) reported that using data collected for the agricultural year 1997-98, this study analyses the production and marketing of selected vegetables (tomato, onion, arbi, okra, brinjal [aubergine], and potato) in Madhya Pradesh, India. Examined in detail are the following: production costs and returns; marketable and marketed surplus; marketing costs, channels, margins and efficiency; and production and marketing problems.
In another study on "Retrospect and Prospects of Chickpea Processing Industries in Maharashtra - An Empirical Analysis", R.D. Shelke and A.A. Chavan conclude that the efforts should be made to introduce improved management practices and high technology for improving the recovery of finished products.

Anant Ram Verma’s study on, "Economics of Processing and Marketing of Gur in District of Indore, Madhya Pradesh", have revealed that the share of the producer in the consumer’s rupee can be increased by preventing illegal unauthorized deductions by eliminating a large number of intermediaries.

S.D. Sivakumar, R. Balasubramniam and N. Srinivasan, in their study, “Growth Linkage Effects of Agro-Industrialization” conducted in Dhrmapuri district of Tamil Nadu, consider agro-industrialization with strong rural urban growth linkages concludes agro-industrialization as a means of development strategy.

1.4 Research Methodology

a) Broad Objective
Objective of this paper is to analyze the demand supply gap in the production of agricultural products and agro processing industry and foresee the emerging technology from Investment point of view.

b) Methodology of this paper
We have taken up descriptive methodology of research. For the study secondary data has been used. Data has been collected from the MP Vision Document 2013. To simplify the study only 3 vegetables tomatoes, onion and potatoes have been taken.

2. Scope for Food processing industry in MP

2.1 Fruits and Vegetable Production in Madhya Pradesh
Madhya Pradesh is a one of the leading states in production of vegetables and fruits in India. Graph - 1 depicts the production of vegetables in Top 10 leading producers in the country. Madhya Pradesh ranks third in the production of vegetables with the total production of 15,568 MT, which amounts to about 9% of the vegetable production in India.

The top 10 states, which lead in production of fruits, are shown in the graph-2. Uttar Pradesh, Andhra Pradesh and Maharashtra are the leading producers while, Madhya Pradesh holds the 7th position in the country with the total fruits production accounting to 5783 MT which is about 6% of the total fruit production in India. Mango, Guava, Orange, Papaya and Banana are major fruit crops grown in Madhya Pradesh.
2.2 Major Vegetable Produce of Madhya Pradesh

Major vegetable crops grown in Madhya Pradesh are Tomato, Onion, Potato, Green peas, cauliflower and Okra. In India, MP is the leading producer of Tomato followed by Andhra Pradesh and Karnataka. Among the total vegetable production in the state, Tomato accounts for 13 percent. Tomato is a highly perishable crop with a very short shelf life of about 1 week under normal conditions and 2 weeks under cold storage conditions.

Onion is also one of the important vegetable crops in India and due to abundant production in last 2-3 years, the onion prices have fallen to bare minimum Rs. 2 / kg resulting in farmer’s distress across the state. Madhya Pradesh is the second largest producer of Onion in the country next to Maharashtra. Onion contributes to 23 percent of total vegetable production in the state.
Potato is also an important vegetable crop in the state. Madhya Pradesh falls within the Top 5 potato producing states in the country. Share of potato production in total vegetable production is about 20 percent in MP.

Looking at the current processing capacity figures of the 3 vegetables, we find that the food processing units are negligible with respect to the available production post consumption. The processing potential figures indicate the earnest requirement of food processing units in Madhya Pradesh. Looking at the processing potential figures, we see that it is nearly 50% of the total production.
If this amount of the vegetable is not used in consumption nor food processing then this implies that a huge amount of vegetables gets wasted as all these vegetables are perishable. Due to abundant production in last 2-3 years, the onion prices have fallen to bare minimum Rs. 2 / kg resulting in farmer’s distress across the state. Since there is no technique of preserving onions, the bumper crop is getting rotten. If we would have had food processing units catering to onions then scams like 2017 onion procurement scam will not happen.

2.4 Challenges faced by India’s Food Processing Sector

- **Poor supply chain linkages:** India’s agriculture market has a long and fragmented supply chain that results in high wastage and high costs, especially due to seasonality, perish ability, and variability of produce.
- **Infrastructure bottlenecks:** The export related infrastructure for agro-produce is grossly inadequate, especially at sea ports and airports. More than 30 percent of the produce from the fields gets spoilt due to poor post-harvesting facilities and lack of adequate storage infrastructure.
- **Lack of skilled manpower:** The agricultural workforce is inadequately skilled across different levels of food processing.
- **Low adherence to quality standards:** India lacks basic standardization and certification infrastructure. Given the size of the food processing industry, there is a huge gap in the availability of laboratories, trained manpower, and certification agencies.

3. Investment Climate in Madhya Pradesh

- Madhya Pradesh is centrally located and well connected by North, South, East, West corridors passing through MP.
- Around 100 agricultural farms with an area of over 20,000 acres available on lease to investors
- It is known for its abundant natural resources including forest, minerals, rivers and valleys, is endowed with a rich forest cover. It has 11 agro-climatic zones, 5 crop zones and a varied land types, 4 soil types to suit production of any crop and water resources distributed across 51 districts of the state.
- The state is endowed with favorable combination of soil type, rainfall, sun light and temperature to suit new crops
- Wheat, Paddy (Rice) and Coarse-cereals are the major crops produced in Madhya Pradesh. The state is also a major producer of fruits (such as Banana, Citrus fruits [Lime and Lemon, Orange], Guava etc.) and vegetables (such as Potato, Onion, Tomato etc.).
- Major spices produced are Ginger, Chilies, Turmeric, Garlic, Coriander etc.
- Madhya Pradesh also has a large livestock population contributing to the production of Milk, Eggs, Fish and Meat.

3.1 Available infrastructure in the state for Food processing

- Ministry of Food processing Industries, GOI have identified Indore, Chhindwara, Sagar, Shajapur, Dewas for creation of agro-processing clusters of Fruits and Vegetables under Kisan Sampada Yojana. Currently food processing Industries are just concentrated in four major cities of MP, i.e. Bhopal, Indore, Gwalior and Ujjain.
2 Mega Food Parks, 1 Logistic Park and 7 food parks in MP

- These food parks will have all the common facilities expected in an industrial park along with common facilities needed for the agro industry like:
  - Cold Storages / modified atmosphere cold storages
  - Warehousing facilities
  - Milk Chilling plants
- All the food parks will have excellent rail and road connectivity
- Apart from above an Agri based SEZ is being established near Jabalpur

3.2 Key drivers of growth in food processing

- **Consumer spending on food**
  The Indian food and grocery market is the world’s sixth largest, with retail contributing to 70% of the total sales. On an average, Indians spend 31% of their total earnings on food and grocery. In contrast, consumers in the US spend only 9%, while in Brazil and China, the expenditure on food is 17% and 25%, respectively.

- **Change in consumer taste and preference**
  With growing awareness, health consciousness, need for convenience, and improving lifestyles, the share of processed food is gradually and steadily increasing on consumer plates across the world. In India, this change is bolstered by rising per capita income, a large young population (60% below 35 years of age), deeper retail penetration, and a growing number of nuclear families. India’s demand for processed foods was therefore, expected to increase to about 8.5% by the end of 2017.

- **Growth in food exports**
  There is a rise in the demand for Indian processed food in the international market. In addition to changing consumer tastes in foreign markets, approximately 30,843,419 people of Indian origin live abroad (Ministry of External Affairs, India). According to government estimates, Indian exports of processed food and related items rose at a compound annual growth rate (CAGR) of 11.74% during 2011-16, reaching US$16.2 billion.

- **Availability of cheap workforce**
  India has a relatively cheaper workforce that can be effectively utilized to set-up a low production base for the domestic and export market. Production costs in India are lower by about 40 percent in comparison to most developed and developing countries.

3.3 Government support

The government of India recognizes the need to encourage India’s food processing sector given the country’s immense potential. Accordingly, the Indian government has allocated nearly a billion dollars under the twelfth five-year plan (2012-17) to implement various schemes for the promotion and development of the food processing sector:

- **Foreign Direct Investment (FDI) policy:** The government has permitted 100 % FDI for trading through e-commerce and manufacturing of food products through automatic route.
now allowed in multi-brand food retail and India is looking to double food processing levels to 20%. According to the Department of Industrial Policies and Promotion (DIPP), the food processing industry has received around US$7.47 billion of FDI in the period April 2000 to December 2016.

- **Fiscal benefits:** The government offers several fiscal incentives to small and medium enterprises for setting up food processing facilities. Some of these incentives include capital subsidies, tax rebates, and reduced customs and excise duties. Additionally, the government has constituted a fund of US$312 million (Rs 2000 crore) with NABARD to provide concessional loans to mega food parks and units established therein.

- **Increased focus on Infrastructure:** The government has established 60 fully equipped Agri-Export Zones (AEZs), in addition to 42 mega food parks and 128 cold chains, to boost agriculture and food processing exports. Under 2016-17 Union Budget, the federal government allotted US$19.65 million for developing mega food processing parks. Moreover, in November 2016, the Food Safety and Standards Authority of India (FSSAI) launched a major scheme to upgrade food testing laboratories in India.

- **Revamped national mission on food processing:** The government is taking steps to launch a new scheme – SAMPADA or Scheme for Agro-Marine Processing and Development Of Agro-Processing Clusters by 2019-20. The overall mission will involve the launch of three separate schemes – creation and expansion of food processing and preservation capacities, new agro-processing clusters, and establishing backward and forward linkages. SAMPADA will have an outlay of US$935 million (Rs 6000 crores).

4. **Emerging Technologies and Trends**

Use of technology helps to make the processing efficient and economical. It takes years of research and study to implement breakthrough innovations in the food industry. New technological approaches for food preservation have been developed for energy efficiency, water savings and reduced emissions, while ensuring food safety and quality. Some of the major technologies developed are:

- Addition of Heat: Canning (thermal processing)
- Removal of Heat: Refrigeration, Freezing
- Removal of Moisture: Drying, Frying, Extrusion
- Use of Radiation: Irradiation, UV, Pulsed Light
- Addition of preservatives
- Addition of salt and sugar
- Fermentation
- Alternative Heating Media: Microwave, Ohmic
- Non-Thermal Processing: HPP, PEF, Ozone, etc.
- Biodegradable & Edible Films or shelf life extension of fresh and cut fruits and vegetables

The major objectives of these technologies is to help in preservation from undesirable changes by

- Eliminating or disabling Pathogens, Spoilage Organism, etc.
- Deactivating enzymes and suppress chemical reactions
- Product Diversification
- Value addition
- Convenience Foods
- Marketing Needs
- Ingredients Isolation/ Synthesis
- Non-conventional Foods

Some of the emerging trends in TOP (Tomato, Onion and Potato) crops are illustrated as below:

#### A. Tomato:

- Around 80% of the tomatoes produced worldwide are consumed fresh, whereas the remaining 20% are utilized in the tomato processing industry.
- As an important flavoring ingredient, processed tomato products are extensively used in the food processing industry, fast food joints, hotels, restaurants and households.
- Most forms of processed tomatoes are: Peeled tomato, partially dehydrated tomato, diced tomato, tomato snacks, tomato paste, ketchup, soup, juice, sauce, powder and concentrate.
- A number of factors are currently driving the growth of this market. These include changing food habits, rising incomes, urbanization, emerging markets, growing consumption of fast foods especially by youngsters, etc.
The United States currently represents the world's biggest tomato processor accounting for more than one third of the total global tomatoes processed. Other major countries include - Italy, China, Turkey, Iran, Spain and Brazil.


B. Onion:

- Onion powder is a dehydrated form of white, yellow or red onions which can be prepared commercially by dehydrating vacuum-shelf drying, freeze-drying and flow drying.
- Onion is a seasonal and perishable product while onion powder is available all through the year and has longer shelf life. Moreover, onion powder is easy to store, light in weight, smaller in bulk and cheap to pack as compared to raw onions.
- During 2009-2016, the production of onion powder has witnessed a significant growth. In line with the hectic lifestyles, a shift towards ready-to-eat food products has been witnessed. In addition, onion powder offers convenience as it is easy to handle, available during off seasons and saves cooking time as it does not require chopping. This has significantly increased the global demand for onion powder in the past several years which is not limited to only urban households but can also be seen in the food processing industry.
- Region-wise, Asia-Pacific dominated the market with a share of more than two-fifths of the total global production in 2016. It was followed by North America, Europe, and Middle East and Africa.
- Being fragmented in nature, the global onion powder market is surrounded by a number of players. Some of these players include Sensient, Vegenat, STL, JISL and Sodeleg. China, India, US and Iran are some of the major producing countries.

Cross Reference: (EMR), n.d.)

C. Potato:

- Global Frozen Potato Market was valued at $50,755 million in 2016, and is projected to reach at $66,597 million by 2023, growing at a CAGR of 3.9% from 2017 to 2023.
- The main product types of frozen potato include French fries, hash brown, shapes, mashed, sweet potatoes/yam, battered/cooked, twice baked, topped/stuffed etc.
- The global frozen potato market is mainly driven by the expanding business of quick service restaurants (QSRs) in the developing and the developed nations. Some of the highest QSRs contributing to the growth of frozen potato market include McDonald's, Burger King, Dunkin' Donuts, Subway, and more.
- Other factors driving the market are rise in disposable income of people in the emerging countries and increase in urbanization.
- French fries are the most widely consumed frozen potato product globally followed by hash brown.
- Frozen French fries occupy the highest share in the global market. Potatoes from warehouses or directly from the fields are processed via high-tech machinery to manufacture different varieties of the frozen potato.
- Asia-Pacific is the leading region, registering highest CAGR of around 4.5% in the global frozen potato market, which accounted for more than one-third of the total market share in terms of value in 2016.

Cross Reference: (Prasannan, n.d.)

5. Conclusions and Recommendations

- Looking at the current processing capacity figures of the 3 vegetables, we find that the food processing units are negligible with respect to the available production post consumption.
- The processing potential figures indicate the earnest requirement of food processing units in Madhya Pradesh.
- Looking at the processing potential figures, we see that it is nearly 50% of the total production. If this amount of the vegetables is not used in consumption nor food processing then this implies that a huge amount of vegetables gets wasted as all these vegetables are perishable.
- Due to abundant production in last 2-3 years, the onion prices have fallen to bare minimum Rs. 2 / kg resulting in farmer’s distress across the state. Since there is no technique of preserving onions, the
bumper crop is getting rotten. If we would have had food processing units catering to onions then scams like 2017 onion procurement scam will not happen.

► Government should create awareness towards application of latest technology such as Canning (thermal processing), Refrigeration, Freezing, Drying, Frying, Extrusion, Irradiation, UV, Pulsed Light, etc. among entrepreneurs and industry people to promote food processing sector in the state.

► This will help farmers from distress sale during glut situation specially in crops like Onion, Tomato and Potato.

5.1 Global Best Practices in Food Processing Sector

Food Safety and Security Standards

► Adhering to Global food safety and regulatory standards is crucial. A key aspect is adaptation of global food safety standards such as the codex Alimentarius, HACCP, ISO etc. FSSAI in India has implemented these standards in India.

► Food supply chains now cross multiple national borders. Good collaboration between governments, producers and consumers helps ensure food safety.

Policy-makers can:

► Build and maintain adequate food systems and infrastructures (e.g. laboratories) to manage and respond during emergencies

► Enhance multi-sector collaboration among public health, agriculture, horticulture and other sectors to act and respond jointly.

► Increasing focus on nutrition among consumers and focus on safe consumption.

► Think globally and act locally to ensure the food produce domestically is safe for consumption in other nations.

Food handlers and consumers can:

► Know the food they use (read labels on food package, make an informed choice etc.)

► Become familiar with common food hazards and their remedies.

► Increase the focus on nutrition and make smart choices

► Remain updated on information on food allergen groups and nutrients used in food products

Food processing companies can:

► Ensure adherence to safety measures in:

  ➢ Supply chain integration

  ➢ Accurate labeling

  ➢ GMO certifications (if necessary)

  ➢ Ensure methodical technology interventions in food testing, packaging and processing

  ➢ Capitalizing on latest cold chain technologies to preserve quality and shelf life of products

  ➢ Create an effective and timely recall strategy in an event of food safety hazard

  ➢ Build effective systems for faster and efficient procurement

  ➢ Creating additional sampling tests for raw material along the lines of global standards of food safety

  ➢ Seeking independent scientific assessments on microbiological and chemical hazards that form the basis for international food standards, guidelines and recommendations, known as the Codex Alimentarius, to ensure food is safe wherever it originates;

  ➢ Assessing the safety of new technologies used in food production, such as genetic modification and nanotechnology;

  ➢ Ensuring transparency and accountability in ingredients used in the food products for consumers and their awareness

  ➢ Improving the plant and operations conditions and leveraging automation to ensure: Maximize performance, Enhance work quality, Minimize the physical demands of the work, Prevent worker fatigue.

  ➢ Leveraging Industrial Internet of Things (IoT) to generate smart insights and develop an analytics based approach for optimization of work space and operations management.

  ➢ Managing advanced ergonomic challenges on the factory floor