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CHALLENGES AND OPPORTUNITIES: SUSTAINABLE SUPPLY CHAIN MANAGEMENT IN THE FOOD PROCESSING INDUSTRY IN INDIA

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Abstract

Aim: *this research study was aimed at investigating sustainable supply chain management issues in food processing industries and the influence of these factors on business challenges and opportunities. Despite its continued growth and importance to the economy, the food processing industry in the country remains vulnerable to these problems, which threaten its viability.*

Methods: *a sample of 470 supply chain employees in india's food processing sector received a questionnaire. Descriptive statistics mean and standard deviation and cross-tabulation were used to examine the gathered data. Online social media sites were used to gather research data from respondents, and the statistical package for social sciences (SPSS) was used to evaluate the information.*

Results: *research findings indicated that factors include improving supply chain resiliency and visibility, rising raw materials costs, investment in research and development, collaboration with suppliers and partners, the rise of plant-based foods, and immunity-boosting food products. To boost corporate performance in the food processing sector's sustainable supply chain.*

Conclusion: *findings also reflect that human resource management issues represent a significant driver for improving the performance of the food industries. This investigation provides an understanding of challenges and opportunities influencing the operations of food processing industries and what measures should be taken accordingly.*

Key words: Food Processing, Food Industry, Sustainable, Supply Chain.

Introduction and background of the study

Soysal et al (2012) intend to pinpoint the main logistical objectives in these three phases and highlight modelling issues in sustainable food logistics management by analyzing the quantitative models that are currently available. The discoveries demonstrate how research on sustainable food logistics management has evolved in response to industry demands. Nevertheless, the highlighted addressed the inherent qualities of food products and procedures. With a few notable exceptions, most of the examined works have not addressed sustainability issues.

Singh et al (2012) in global commerce, processed food exports have stayed at roughly 1.5%, or $3.2 billion. This essay looks at the state and developments of the food processing sector and identifies and addresses subjects that are hindering its expansion obstacles to growth if some promising characteristics are not handled sooner.

Rais et al (2013) study offers a thorough examination of india's food processing sector, including its s&t capacity, workforce, and job prospects. One of the key sectors of our economy is gradually emerging as the food processing business.

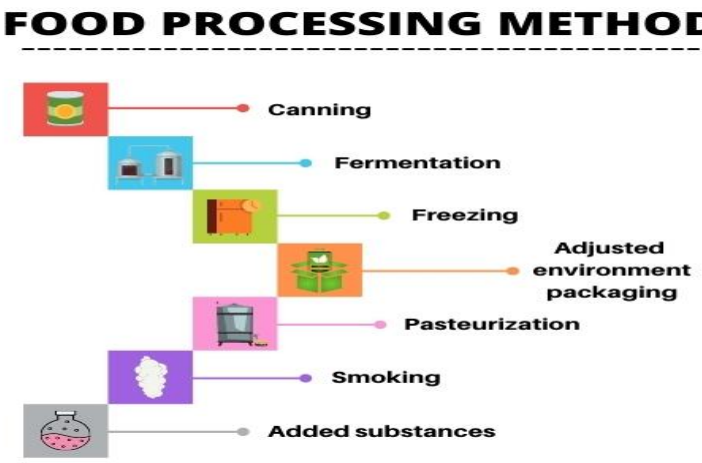
Beske et al (2014) supply chain sustainability practices and DCS are utilized to improve traceability and tracking and satisfy consumer requests. To expand on the operationalization of the current conceptual frameworks, more investigation is required.

Dharni & sharma (2015) the goal of this study is to investigate the state of supply chain management in punjab's food manufacturing sector. Palanivelu & and apdhulkathar (2016) examine the current state and trends in the food processing business and note any barriers hindering its expansion.

Hyder & bhargava (2016) food processing industry holds a special place in the indian economy. Inclusive growth of the rural economy by emphasizing adding value to agricultural products. This industry generates employment opportunities, promotes diversification and commercialization of agriculture by increasing the demand for raw materials, and boosts the income of farmers while creating a surplus for exporting agricultural products. The overall development of the food processing industry will enhance the social and bodily organization of rural india.

Nguegan nguegan & mafini (2017) professionals in the food processing industry's supply chain can gain insights into the root causes of issues and leverage this knowledge to devise effective solutions for enhancing business performance challenges in the food processing industry to streamline supply chain management.

Zhong et al (2017) fscm in the light of data-centric it environments. Attia & salama (2018) in addition to looking at how knowledge management capabilities impact organizational performance (op), this paper also looks at how supply chain management impacts op. Because of the unique characteristics of this sample, the results of this paper apply only to the food industry. Gunarathne et al (2018) global food issues, sustainable development, and food supply chain management are crucial. Additionally, it offers a synopsis of the theoretical foundations of sustainable food supply networks.



Source: https://foodresearchlab.com/

Zhanguo zhu et al (2018) identify the essential components of environmental and social issues in SFSC that could be good subjects for more research. Proposed that techniques are encouraged by certifications and industry standards, as businesses that are certified are more likely to adopt these practices saeed & kersten (2019).

Affia et al (2019) aim of this research was to investigate and identify the different factors that impact the adoption of IoT as a disruptive technology in supply chain management. Perceived benefits, price, data complexity, compatibility, technological know-how, hardware and infrastructure, peer and government support, security and privacy issues, and adoption readiness are some of these considerations.

Sakina (2019) article examines the present condition and advancements in explores the government's efforts to support the sector, identifies and discusses the challenges hindering its growth, and provides possible answers for overwhelming these obstacles.

Khan et al (2020) findings have numerous implications. It highlights the importance of supply chain management, which directly affects how efficiently companies in the food processing industry operate. The fundamental idea of this study is that companies in the food industry can perform better overall by reducing supply chain management problems.

Jagtap et al (2020) article explores the essential technologies in food logistics 4.0 and the associated opportunities and challenges. It primarily emphasizes food logistics, encompassing resource planning, warehouse management, transportation management, predictive maintenance, and data security. The technologies discussed include the internet of things, block chain, robotics and automation, and artificial intelligence.

Wamba and queiroz (2020) conducted block chain evolution, aiming to establish a solid foundation for readers. In augusto's (2020) research paper, an in-depth exploration of the historical, current, and forthcoming obstacles encountered in food processing was undertaken. To tackle these emerging challenges, novel methodologies must be embraced, opening up fresh prospects for the food processing industry. The recognized tests were considered into various domains, including safety, preservation, nutrition, sensory aspects, well-being, environmental concerns, and future possibilities.

Yadav et al (2020) present a study that highlights both the advancements in technology within the internet of things field and the ten significant challenges associated with IoT adoption. The research emphasizes that the development of an IoT-based infrastructure for the asc domain stands as the most crucial challenge, while IoT-based cloud systems pose the greatest difficulty. Moreover, the paper provides valuable managerial insights for organizations aiming to enhance their competitiveness by embracing IoT in the asc.

Aamer et al. (2021) state that the adoption of IoT in the fscm, this research adds value by filling the gap in existing studies and documentation regarding the extent of IoT implementation in the fscm. Assist organizations in understanding how to effectively adopt and oversee IoT applications, while also addressing the factors and challenges highlighted in this research.

Paciarotti and torregiani (2021) have identified a gap in the existing literature reviews on short food supply chains categorizing different types of supply chains and analyzing the pros and cons of SFSCS However, the main objective of their research is to provide a deeper comprehension for researchers and practitioners regarding the importance and potential of logistics in improving the effectiveness and sustainability of SFSCS Their study specifically focuses on this critical aspect of sfscs and highlights its potential impact on the growth and advancement of SFSCS

In the current era of industry 4.0, fsc has encountered the challenge of insufficient technological capability while striving to implement ce practices. To ensure the successful adoption of ce in fsc,

establishing an efficient traceability system becomes imperative to monitor and track the waste generated, as highlighted by nandi et al. (2021).

Mastos and gotzamani (2022) conducted a study involving two prominent figures in the greek food supply chain to explore the three key constructs of sustainable supply chain management. The outcome of their research presents a model that can be tested, providing valuable insights model is built upon a series of propositions.

De boni et al (2022) conducted a comprehensive analysis that examines the environmental, economic, and social aspects of food loss waste. Their review serves as a valuable resource for policymakers seeking to implement effective measures to prevent, reduce, and assess the value of food waste.

Chenxin et al (2022) examined the impact of environmental uncertainties and ict resources on supply chain partners. The significance of competitive pressure does not have a significant influence on both research and practice in the field of sustainable supply chain management.

Erhan (2023) research reveals the possible catalysts for the circular economy in digital transformation within food supply chains. Additionally, this study highlights the advantages that consultants can gain from implementing digital technologies to enhance operational efficiencies in food supply chains.

Mwenda et al (2023) study seeks to gain a thorough comprehension of how SSCMPS impact the financial sustainability of small and medium-sized enterprises in the food processing industry. The outcomes of this research can be utilized to formulate supportive policies and programs that encourage and improve financial sustainability within the food processing sector.

Nsowah and phir (2023) adoption of sscm practices by firms in ghana was found to be influenced by various factors, including instrumental, relational, moral, and knowledge aspects, as indicated by a recent study.

Kumar et al (2023) propose that tackling the obstacles of the circular economy can enable companies to fulfill their corporate social responsibility. Their research offers suggestions for practitioners to embrace ce to achieve sustainable development goals.

Soria-lopez et al (2023) globalization of the food supply chain brings numerous benefits to producers and consumers. However, both long and short-food supply chains need to adapt to meet the demands of the environment and consumers. While the sustainability of short food supply chains in terms of environmental, economic, and social aspects is still being evaluated, it is crucial to ensure efficient food systems that can respond to these demands.

Minardi et al (2023) article delve into the impact of sustainable practices on food supply chains. Through extensive research, we have identified these practices and evaluated their level of implementation by companies. By conducting a comprehensive review of existing literature, we have determined the most effective sustainable applies for managing supply chains in the food industry.

Research gap

Nsowah and phiri (2023) recommend that upcoming investigations focus on examining sustainable supply chain management practices in different industries and developing nations. Soysal et al. (2012) provide support for business decisions and analyze the dynamics of food supply chains. Furthermore, soria-lopez et al. (2023) offer valuable insights into the evolution of food supply systems, from the green revolution to establishing food supply chains, which enhances our understanding of

sustainability. Considering nsowah (2023) recommendation to study SSCM practices in other developing countries, india emerges as a potential candidate for investigation.

Research question - 1: what are the factors that influence the adoption of sustainable supply chain management practices in the food industry?

Research question - 2: which type of food processing industry is used in india?

Research question - 3: opportunities and challenges faced in the food processing supply chain industry**?**

Objectives of the study

1. Factors influence the adoption of sustainable supply chain management practices in the food industry
2. Ii) to determine the type of food processing industry
3. Iii) evaluate the opportunities and challenges faced in the food processing supply chain industry

Methodology

The food processing industry in india is primarily concentrated in the northern and western regions of india.

Table 1: sample size

States	Sample
Maharashtra	100
Uttar pradesh	100
Andhra pradesh	100
Tamil nadu	100
Gujarat	100
Total sample	**500**

The sample size is calculated for the present study by using the following formula:

$$\mathbf{N = n / 1 + n(e)^2}$$

N = required sample size

E = margin of error at 5% (standard value of 0.05)

Population	Distributed	Not received	Final sample size
500	500	30	470

Hence, the sample size is 470.

Research approach

This study used a quantitative data collection method to gather data from the study respondents. This comprises measurement and observation, cause and effect thinking, reduction to specific variables and hypotheses and questions, and the test of theories. The quantitative data were collected through an open-ended questionnaire from workers of the various food firms under study.

Sample size and sampling

This study made use of purposive sampling techniques form of non-probability sampling technique in which researchers depend on their judgment to choose respondents from a population to participate in a study.

Data collection methods

Throughout the study, questionnaires were adopted for the data collection. A questionnaire was employed in this study because it reached many study populations. The questionnaires principally consisted of likert scale questions. This research used five categories, e.g., strongly disagree (sd), disagree (d), neutral (n), agree (a), and strongly agree (sa). Five hundred (500) questionnaires were distributed; however, 470 questionnaires were returned.

Analysis and interpretation of data

Table 1: reliability statistics

Variables	Grand mean	Cronbach's alpha	Number of items
Sustainable supply chain management practices	4.36	0.678	9
Challenges sustainable supply chain management in the food processing	4.35	0.778	5
Opportunities for sustainable supply chain management	4.33	0.645	8

Cronbach alpha sustainable supply chain management practices values of 0.678 are acceptable and indicate consistency. The reliability of the grand mean is 4.35. Cronbach alpha challenges sustainable supply chain management values of 0.7 or higher indicate acceptable internal consistency. The reliability of the grand mean is 4.36. Cronbach alpha opportunities for sustainable supply chain management values of 0.6 acceptable indicate consistency. The reliability of the grand mean is 4.33.

Table 2: total reliability statistics

Cronbach's alpha	Number of items
0.722	28

Cronbach alpha values of 0.700 are higher indicating acceptable internal consistency.

Table 3: percentage analysis of gender

Gender	Frequency	Percent
Male	316	67.2
Female	154	32.8

Table 3 indicates the gender of the respondents; percentile values appear in the statistics table. The value of the 67.2 percentile is male and the value of the 32.8 percentile is female.

Table 4: age

Age	Frequency	Percent
18-24 years	51	10.9
25-35 years	62	13.2
36-45 years	232	49.4
46-55 years	116	24.7
Above 55 years	9	1.9

Table 4 designated the age of the defendants; percentile values appear in the statistics value for the 49.4 percentile is 36-45 years and the low percentile value of the 1.9 percentile is above 55 years.

Table 5: employment period

Employment period	Frequency	Percent
Under 2 years	143	30.4
2-5 years	70	14.9
6-10 years	218	46.4
Above 10 years	39	8.3

Table 5 indicates the employment period, the highest 46.4% is 6-10 years of working period of the defendants. The second highest percentage of worker experience is 30.4 is under 2 years. Remaining 2-5 years is 14.9%, and above 10 years is 8.3%.

Table 6: occupational position

Occupational position	Frequency	Percent
Supervisor	147	31.3
Manager	72	15.3
Junior manager	215	45.7
Operator	36	7.7

Occupational position is junior manager percentile 45.7%, supervisor is 31.3%, manager is 15.3%, operator is 7.7%.

Table 7: type of food processing industry

Type of food processing industry	Frequency	Percent
Primary food processing	171	36.4
Secondary food processing	145	30.9
Tertiary food processing	154	32.8

The types of food processing industries are primary food processing, secondary food processing, and tertiary food processing. Primary food processing is 171(36.4%), secondary food processing is 145 (30.9%), tertiary food processing is 154 (32.8%).

Table 8: mean and standard deviation of SSCM practices

Sscm practices	Mean	Standard deviation
Strategic orientation	4.38	.571
Continuity	3.96	.818
Collaboration	4.06	.663
Risk management	4.59	.772
Pro -activity	4.25	.794
Moral factors	4.54	.692
Instrumental factors	4.43	.735
Relational factors	4.42	1.097
Knowledge factors	4.58	.621
Mean score	**4.36**	**0.751**

The relational factors influencing the adoption of SSCM practices recorded mean scores ranging from 3.96 to 4.59, with an average score of 4.36, which shows that the food processing firms strongly agreed that they had adopted SSCM practices. From the study, sustainability regulation recorded the highest mean score (mean score = 4.59, sd = 1.097), and sustainability supply chain initiatives recorded the lowest mean score (mean score = 3.96, sd = .571).

H0: there is no momentous difference between the challenges of a sustainable supply chain and the types of food processing industry

Table 9: chi-square tests- challenges of sustainable supply chain

Challenges of sustainable supply chain	Pearson chi-square value	Asymptotic significance (2-sided)	Significant / not significant
Reducing waste and operationalizing sustainability	16.245	0.012	Significant
Improving supply chain resiliency and visibility	9.552	0.145	Not significant
Rising raw materials costs	10.830	0.212	Not significant
Managing complexities during disruptive times	15.818	0.045	Significant
Managing human capital	13.141	0.011	Significant

The value of the chi-square statistic is 16.245. The p-value (0.012) appears in the same row in the "asymptotic significance (2-sided)" column. The consequence is important and rejects the null hypothesis. The data suggests that the variables reducing waste and operationalizing sustainability and types of food processing corporations are related to each other.

The value of the chi-square statistic is 9.552. The p-value (0.145) appears in the same row in the "asymptotic significance (2-sided)" column. The outcome is not significant and accepts the null hypothesis. The data suggests that the variables improving supply chain resiliency and visibility and types of food processing industry are not related to each other.

The value of the chi-square statistic is 10.830. The p-value (0.212) appears in the same row in the "asymptotic significance (2-sided)" column. The effect is not momentous and accepts the null hypothesis. The data suggests that the variables of rising raw materials costs and types of food processing commerce are not associated with each other.

The value of the chi-square statistic is 15.818. The p-value (0.045) appears in the same row in the "asymptotic significance (2-sided)" column. The consequence is substantial and rejects the null hypothesis. The data suggests that the variables managing complexities during disruptive times and types of food processing industry are associated with each other.

The value of the chi-square statistic is 13.141. The p-value (0.011) appears in the same row in the "asymptotic significance (2-sided)" column. The result is significant and rejects the null hypothesis. The data suggests that the variables managing human capital and types of food processing manufacturing are associated with each other.

H0: there is no substantial difference between the opportunities of a sustainable supply chain and the types of food processing industry

Table 10: chi-square tests- opportunities of sustainable supply chain

Opportunities for a sustainable supply chain	Pearson chi-square value	Asymptotic significance (2-sided)	Significant / not significant
Block chain	11.021	0.026	Significant
Vertical farming	14.723	0.005	Significant
Automation	15.520	0.050	Significant
Investment in research and development	3.853	0.870	Not significant
Collaboration with suppliers and partners	6.162	0.187	Not significant
Fortification of foods	12.915	0.044	Significant
The rise of plant-based foods	14.767	0.064	Not significant
Immunity boosting food products	7.799	0.453	Not significant

The value of the chi-square statistic is 11.021. The p-value (0.026) appears in the same row in the "asymptotic significance (2-sided)" column. The result is significant and rejects the null hypothesis. The data suggests that the variables block chain and types of food processing corporations are associated with each other.

The value of the chi-square statistic is 14.723. The p-value (0.005) appears in the same row in the "asymptotic significance (2-sided)" column. The upshot is momentous and rejects the null hypothesis. The data suggests that the variables of vertical farming and the types of food processing trade are associated with each other.

The value of the chi-square statistic is 15.520. The p-value (0.050) appears in the same row in the "asymptotic significance (2-sided)" column. The result is significant and rejects the null hypothesis. The data suggests that the variables automation and types of food processing business are related to each other.

The value of the chi-square statistic is 15.520. The p-value (0.050) appears in the same row in the "asymptotic significance (2-sided)" column. The result is not significant and accepts the null hypothesis. The data suggests that the variables investment in research and development and types of food processing trade is associated with each other.

The value of the chi-square statistic is 6.162. The p-value (0.187) appears in the same row in the "asymptotic significance (2-sided)" column. The result is not significant and accepts the null hypothesis. The data suggests that the variables of collaboration with suppliers and partners and types of food processing businesses are not related to each other.

The value of the chi-square statistic is 12.915. The p-value (0.044) appears in the same row in the "asymptotic significance (2-sided)" column. The result is significant and rejects the null hypothesis. The data suggests that the variables fortification of foods and types of food processing trades have ties to one another.

The value of the chi-square statistic is 14.767. The p-value (0.064) appears in the same row in the "asymptotic significance (2-sided)" column. The result is not significant and accepts the null hypothesis. The data suggests that the variables of the rise of plant-based foods and the types of food processing professionals are not linked with each other.

The value of the chi-square statistic is 7.799. The p-value (0.453) appears in the same row in the "asymptotic significance (2-sided)" column. The result is not significant and accepts the null hypothesis. The data suggests that the variables of immunity boosting food products and types of food processing markets are not interrelated to each other.

Recommendations and conclusion

Block chain technology allows for secure and transparent tracking of food production and distribution. Block chain can help solve some of the world's most critical challenges related to agriculture, including tackling issues like agricultural fraud, supply chain inefficiency, and global hunger. Robots are becoming more common in the manufacturing industry, including in the production of food. This model can help improve employee health, lower costs, and boost productivity and performance. Supply chain management can improve financial performance; lead to satisfied customers; reduce delivery times; and build trust, confidence, and commitment among suppliers. The quality in a supply chain can be improved by enhancing the customer value of the end product or by reducing the total cost of the product. Improves by bringing in sustainable targets in the procurement process. Setting smart goals is key to establishing sustainability in the supply chain.

Improving transportation systems, including roads, railways, and air networks, is extremely important in maintaining a smooth food supply chain. Additionally, having enough storage space is vital for adjusting to changes in demand and supply, which allows for efficient inventory management. Besides, there are numerous real methods available for preserving or processing food. These all will work only when processing and preserving are done under stringent rules and regulations. Food research explains the basics of food processing techniques in food processing industries.

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