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ORIGINAL RESEARCH

Green, resilient, agile, and sustainable fresh food supply chain enablers: evidence from India

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Abstract

The existing research on fresh food supply chains (FFSC) sustainability consisting of fur fundamental pillars, namely green (G), resilient (R), agile (A), and sustainability (S) (hereafter GRAS), is explored sparsely and needs thorough investigation. Further, conceptualization and mutual interactions among GRAS enablers that can help perpetuate sustainable supply chains (SSC) still need to be addressed. This study proposes a methodological framework to evaluate the SCS from the perspective of GRAS enablers with an application for the Indian FFSC. A mixed-method sequential approach was used with interviews followed by integrated fuzzy interpretive structural modelling—decision-making trial and evaluation laboratory (FISM-DEMATEL) techniques. The study recognizes twenty supply chain sustainability (SCS) enablers through an extensive literature review and discussions with the expert group. The research discloses that the firms' 'organization culture' acts as the most powerful driver in achieving sustainability in FFSC, followed by the firms' 'environmental certification program' and 'financial strength.' This investigation helps the managers/policymakers of the Indian FFSC to ascertain and comprehend the most significant SCS enablers to achieve sustainability in the supply chain (SC). The causation of SCS enablers supports the managers in systematically focusing on the most significant enablers and working towards their successful implementation. According to our knowledge, this is the first scholarly work that establishes hierarchies and interrelationships among GRAS enablers, thereby providing a holistic picture to decision-makers while adapting such practices.

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1 Introduction

With increasing environmental awareness, firms encourage their stakeholders to adopt practices that positively impact the value chain. The lean and complex value chains built and improvised during the last few decades as part of the ever-increasing globalization met their most daunting challenge in the form of the COVID-19 pandemic (Meyer et al., 2021; Upadhyay et al., 2022). Although the supply chains (SC) were prone to regular disruptions due to frequent natural disasters, SC managers rarely faced such a significant impact on their operations when the entire world reached a standstill. All global SCs, including the local SCs in India, have borne the brunt of disruptions caused by natural disasters and the ongoing pandemic. These disruptions have tested the sustainability of the SC tested to the fore. To be better prepared for the future, firms need to continue to learn from their past experiences and identify and build organizational capabilities. A narrow vision would limit the understanding of organizational capabilities, while a broader perspective will aid firms in addressing mutually conflicting demands (Ivanov, 2020; Sá et al., 2020). Disruptions can occur in multiple SC links, and the pandemic has exposed the weak links, so building sustainability across the entire SC is essential for the business's survival (Dias et al., 2021; Sarkis, 2020).

Building a sustainable food supply chain (FSC) is indispensable. Nevertheless, primarily, the failure to design and build a Sustainable Supply Chain (SSC) is due to the inability to understand the impact caused by the identified risk (Rathore et al., 2021), the inability to create contingency rules and procedures, and the lack of a framework for selection of the best strategies while managing risk. Preparedness for a disaster is vital to resiliency in SCs (Ahmadian et al., 2020). Several studies have increasingly paid attention to the firm's capabilities to recover from disruptions (Dubey et al., 2021; Li et al., 2021; Nandi et al., 2020). The COVID-19 pandemic has also made professionals rethink and design an SSC (Gehrlein et al., 2019; Mishra et al., 2021; Schmidt & Wagner, 2019). As food is a basic human need, any disruption in these SCs has immediate impacts on humans; hence designing Fresh Food Supply Chains (FFSCs) becomes demanding. It is also arduous as it involves highly perishable product categories with seasonality. Therefore, for maintaining the product's shelf life and sustainability at large, the careful design of facilities and logistics for the subsistence of the SC is of utmost priority (Mehrjerdi & Shafiee, 2021).

Sustainability focuses on the long-term performance and firm existence (Katiyar et al., 2018), while resilience tests the ability of the SCs to respond to an unprecedented event with the most negligible impact on the resources and recover in the shortest period (Behzadi et al., 2020; Hosseini et al., 2019; Nandi et al., 2020). Resiliency ensures recovery to the initial state and improves conditions after a disruption (Dora et al., 2021). For achieving sustainability, firms seek the optimal utilization of environmental and human resources while achieving cost reduction. In addition, integrating resilience with sustainability creates value in SCs (Al Naimi et al., 2020). To integrate Sustainability (S) and Resiliency (R), considering the Green (G) and Agile (A) enablers, understanding the organization's Resource-Based View (RBV) is unavoidable for exploring and integrating technologies into the organization's systems to facilitate SC capabilities (Nandi et al., 2020).

The present study highlights that all network entities should handle the disruption to design a sustainable and resilient SC. The vertically integrated intertwined SCs, such as the farm-to-fork model, will have a cascading impact on all the networks of SCs, and the ability to sustain the impact is dependent on the SC density, complexity, and criticality (Falaska et al., 2008; Giannoccaro & Iftikha, 2022). This motivates authors to evaluate the enablers of the FFSCs from sourcing to distribution. Existing literature majorly conceptualized the Sustainability (S) and Resiliency (R) enablers while neglecting the Green (G) and Agile (A) components. Very few empirical studies have attempted to investigate the four related enablers (GRAS) and their implications in a farm-to-fork model for the Fruits and Vegetables (F&V) category (Sharma et al., 2021a, b). The following are the research questions have been addressed in the study:

RQ1: Which are the critical GRAS enablers influencing FFSC sustainability?
RQ2: How are the critical GRAS enablers associated with each other and influence FFSC sustainability?

The paper structure is as follows. The theoretical background is presented in Sect. 2. In Sect. 3, research methods adopted while carrying out the investigation using the hybrid approach of FISM-DEMATEL are detailed. In Sect. 4, the analysis of the results is presented, followed by a discussion and implications in Sect. 5. Section 6 concludes the study by providing future research suggestions.

2 Theoretical background

This section discusses the theory widely applied in the literature to understand the GRAS factors in FFSC. The first section discusses the RBV from the focal lens of SCs' resources and abilities. The next two sections discuss GRAS factors in FFSC.

2.1 Resource-based view (RBV)

In the RBV, strategic resources of the firms, which are rare, inimitable, and valuable, are viewed as an aid to the organizations in exploiting the opportunities, achieving a competitive advantage, and mitigating threats (Barney, 1996; Wernerfelt, 1984). In the context of SCs, RBV aid in collectively analyzing the SC activities and their resources and considering how they contribute to firms' competitiveness (Kozlenkova et al., 2014; Nandi et al., 2020). Prior studies such as those of Lees et al. (2020), Saurabh and Dey (2021), and Ghadge et al. (2020) discussed the food supply chain sustainability (FSCS) under the purview of RBV. It is worth noting that the firm's resources and capabilities define the Supply chain sustainability (SCS) and resilience (Darcy et al., 2014; Rodriguez et al., 2002) and reveal the supplier–buyer relationships. RBV thus plays a vital role in discussing the firm's sustainability and resilience, including selecting suppliers, understanding subsystems, and SC performance (Nandi et al., 2020). The present study thus analyses the SCs' resources and abilities through the theoretical lens of RBV and discusses the SCS in FFSC.

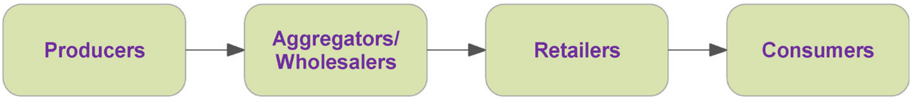

Fig. 1 A typical fresh food supply chain

2.2 Fresh food supply chains (FFSC)

FFSC includes activities from production to distribution of fresh fruits and vegetables that undergo minimal processing (Aramyan et al., 2006; Nobanee et al., 2021). FFSC is a complex decision-making system due to its inelasticity of demand coupled with the tremendous wastages occurring annually along the SC (Bryceson & Smith, 2008). These wastages result from improper handling, poor transportation, and storage facilities (Reddy et al., 2010; Viswanadham, 2006), improper production planning, poor demand forecasting, poor buyer–supplier relationship, improper inventory management and several intermediaries (Shukla & Jharkharia, 2013). Though intermediaries help overcome the lack of infrastructure, but add to the waste and increase the product's per-unit price (De Boer & Pandey, 1997). Figure 1 depicts a typical FFSC.

2.3 Conceptualization of GRAS

The terminology 'GRAS' emphasizes the four crucial elements that impact the FFSC and determine its competency. The GRAS stands for Green, Resilient, Agile, and Sustainability. Now the focus with which the organizations consider such aspects vary. Agile has a customer-centric focus; Resilience has SC as well as a firm-specific focus where both attend to disruptive events. In contrast, sustainability focuses on the triple bottom line consisting of three primary dimensions: social, environmental, and economic. The identified factors under each category have been defined in Appendix Table 1.

2.3.1 Green (G) enablers

Green enablers in fresh foods involve adopting and promoting green practices, which reduce the environmental impacts otherwise caused during operational procedures and the generation of food wastages. The focus of green SCs has been on minimizing the ecological impact and bringing economic performance and competitive advantage (Rao & Holt, 2005; Yang & Liu, 2021). Such environmental consciousness has improved ecological efficiency due to the continuous pressure from environmentally concerned consumers (Azevedo et al., 2011). Managing such SCs, demands collaboration across the partners from sourcing to distribution, enhancing the whole SC gamete (Dora, 2019; Green et al., 2012; Sharma et al., 2021b). Involvement of all SC's stakeholders, such as the donor community, public–private partnerships (PPP), governments, the scientific community, non-governmental organizations, the private sector, cooperatives, community groups, academic institutions, and other relevant actors are considered central (Li et al., 2020).

FFSC requires innovation and technology transfer for food security (Chege & Wang, 2021). In such a context, where firms go for vertical integration, attention is essential toward green supplier development practices (GSDP). Lo et al. (2018) emphasized supplier development (SD) as an enabler for attaining green SC integration. These practices could be direct

SD practices, including training and collaboration, whereas indirect SD practices include audits and standard operating procedures (SOPs) (Zhang et al., 2017).

Luthra et al. (2019) argued that the role of innovation, such as industry 4.0, enabled scalability and flexibility, improved productivity in SC processes, reduced food waste (RFW), and achieved sustainable growth (Kumar et al., 2022a; Sharma et al., 2023). However, bringing green innovation is much more challenging that requires Public Private Partnership (PPP) (Fei et al., 2020; Gabler et al., 2017) in fresh foods. PPP helps solve glitches such as food loss, labor shortage, and last-mile delivery difficulties. Green Supply Chain Practices (GSCP) and Eco-friendly customer practices (EFCP) ensure green practices in supply chains.

2.3.2 Resilience (R) enablers

Resilience is the firm/s ability to design for, retort to, and recuperate from unprecedented events in a cost-effective way and within a time period, returning to its original and better state than earlier (Dubey et al., 2020; Hosseini et al., 2019; Xu et al., 2020). There are two aspects to understand: how resilience works in a firm and SC (Kumar et al., 2022b). As these connect different firms, compatibility is essential (Sá et al., 2020) that could be handled through information sharing (IS) that influence the *Supply Chain Resilience* (SCR) level (Appiah et al., 2020; Duchek et al., 2020). Such a situation calls for vertical integration as arms-length and transactional relationships do not support IS among partners (Wan & Sanders, 2017; Wan, 2019; Eyers et al., 2021). Long-term relationships help firms develop SC capability and respond to disruptions more effectively (Sabahi & Parast, 2020; Um & Han, 2020).

A PPP in technology transfer in warehouse management, processing, and distribution could play a central role in revolutionizing the FFSC in India. Dubey et al. (2019, 2021) and Behl (2020) conducted an exciting study to understand the effect of organizational culture (OC) to instigate trust and thus achieve coordination among distant partners influencing the resilience of SC (Dubey et al., 2017). The firms' capabilities to collect and use the accurate data and comprehend its information are essential to quickly and efficiently overcome disruptions. Moreover, uncertainties in SCs could be handled through analytics-generated insights. However, organizations sign contracts to avoid any security breach due to security reasons, as information acts as both risk and opportunity (Colicchia et al., 2019). IS is inevitable for supply and demand visibility, essential for designing a resilient SC. Moreover, curbing information during a disaster could hamper resiliency (Hosseini & Ivanov, 2019; Razak et al., 2021). IS enhances a firm's dependability and helps overcome disruptions, the prevailing bullwhip effect, and respond to dynamic market needs (Viet et al., 2018). Local and regional food sourcing in fresh foods supports the design of a resilient SC (MacFall et al., 2015). The partners in supply networks should collaborate and engage in transparent transactions in all their activities to maintain a long-term association (Behnke & Janssen, 2020). Maintaining transparency in the transactions between the seller and the buyer could be achieved through several applications, and one among these is Blockchain technology (BT).

2.3.3 Agility (A) enablers

Agile SCs respond to changes quickly and recover fast, smoothly, and efficiently to the turbulences in supply and demand (Lohmer et al., 2020; Stone & Rahimifard, 2018; Wiedmer et al., 2021). Agility and flexibility are considered SC's reactive and responsive abilities (Hyun et al., 2020); though tightly twined, these are two different aspects of the SC.

Chenarides et al. (2021) and Hobbs (2021) argued that embedding flexibility is mandatory for developing a resilient FSC. Flexibility is the capability of SC to retort to the disruption so that the entire system's functioning is unaffected (Chenarides et al., 2021). However, building organizational capabilities such as data analytics, especially blockchain-driven digitalization, along with flexibility, complements SC resilience (Dubey et al., 2021). Data analytics delivers discernments on specific aspects of processes and product changes (Srinivasan & Swink, 2018) to counter disruptions. Supply chain /organizational flexibility allows firms to think of "how to change" products/processes to match environmental ambiguity. Several authors agreed with this argument and focused on ensuring robust linkages between supply and demand visibility to enhance the analytics capability for initiating and organizing information acumens in highly uncertain environments (Saberi et al., 2019; Srinivasan & Swink, 2018).

Velocity in the SC often referred to as speed, is associated with agility in the fresh food space. Speed decides when the food reaches its destination, which impacts the shelf life of the food immensely (Fikar et al., 2019). Delays in transporting the F&V category accumulate food wastage at the SC's intermediate stages (Antony et al., 2018). The delay in the inventory receiving at the stores also reduces the inventory replenishment rate; hence, the fresh foods remain unsold, having inferior to no salvage value. Thus, food traceability ensures tracing back the components of a particular product from retailers to suppliers, down to the farm level, providing the timely updates for all the transactions (Tsang et al., 2019). In sensitive sectors such as food, avoiding counterfeiting of products and assuring quality is of prime importance. Traceability in FFSC has become supreme, where markets become heterogeneous, global, and complex, and consumers anticipate premium food quality (Behnke & Janssen, 2020). Visibility clarifies the inventory and details regarding the consumables used and intricate in sustaining FFSC. Supply chain visibility (SCV) through data analytics capability is thus vital for bringing sustainable operations in food abetting better decisions (Kazancoglu et al., 2021; Khanna, 2020).

2.3.4 Sustainability

FFSC faces food loss and wastage along the supply chain while requiring high energy consumption during processing and warehouse operations (Quentin et al., 2020). Reducing food loss and energy consumption significantly lowers the environmental impact (Quentin et al., 2020; Jouzdani & Govindan, 2021). As F&V category has a limited shelf life, the quality of the fresh produce deteriorates when they spend a long time in transit. Longer lead time thus results in resource wastage and overuse of energy, creating unwanted environmental impacts.

Sustainability initiatives of the organization are inbuilt into the organization's culture (OC). All the practices, from design thinking tools to OC, are knit together (Elsbach & Stigliani, 2018). Felipe et al. (2017) determined the effect of OC typologies on organizational agility comprised of Cameron and Quinn's Competing Values Framework. Though neglected for so long, OC has proven to be the key decision-maker in the firms' strategic choices (Liu et al., 2021). The only reason for BMW's survival in an ambidextrous environment was its culture and, of course, its financial strength (FS) (Raisch et al., 2009). Insurance, Portfolio diversification, price margin, financial reserves, and liquidity decide the firms' economic stability to handle disruptions. It also implies the capacity of firms to invest in certification programs.

Environmental certification programs (ECP) are effective in ensuring global food security (Schleifera & Sun, 2020). An active certification program reduces the exploitation of farmers by providing the proper land use, land rights, and gender equality (Schleifer & Sun, 2018). ECP has become essential for overcoming environmental and social sustainability issues

(Schleifer & Sun, 2018; Schleifer et al., 2019). In the FFSC, where the size of "sustainable markets" has grown steadily in recent years, market-driven instruments are now being deployed most frequently (Lernoud et al., 2018; Garrett et al., 2016).

Industry practitioners appreciate the importance of designing SSC in fresh food. However, academicians must pay more attention to the investigations in the direction of GRAS enablers for a long time. Only a handful of the studies have collectively conducted in-depth studies involving GRAS enablers (Dubey et al., 2021; Hart & Dowell, 2011). Nevertheless, the primary focus in most of these studies has been on non-food categories (Sá et al., 2020). Moreover, according to the authors, studies on GRAS enablers in a farm-to-fork model are non-existent. Investigations on FFSC shocks are also in an early stage. Very few papers have gathered thoughts from food and fresh food studies, signifying the need to enlarge examination into the entire fresh food basket.

3 Research methodology

The data for this research has been collected from December 2020 to September 2021. Eighteen experts from three fresh food retail companies in India have been contacted. The criteria for their selection lie primarily on two conditions, i.e., (a) they should have a minimum of five years of experience with fresh food SC and have been actively handling SC during the COVID-19 pandemic; (b) in-depth knowledge about Green (G), Resilience (R), Agility (A), and Sustainability (S) short term as GRAS practices. These experts were interviewed to confirm which GRAS enablers are critical in the context of the Indian SC and can help in improving the overall sustainability practices. It is worth noting that low number of experts (i.e. 2–3) hamper the generalisation of the result while the large number of experts (20–30) have the complexity of developing the consensus and it may further lead to a high degree of inconsistency (Khan et al., 2021). Therefore, this study recruited an optimal number of eighteen experts that is sufficient to draw robust conclusions (Sharma et al., 2022a).

The authors have used an integrated ISM-DEMATEL approach to find the system actuator and influencing enablers. Various previous works have used integrated methods ISM -DEMATEL in the context of SC (Kamble et al., 2020) as well as in exploring other emerging technologies (Sharma et al., 2021c, 2022b). ISM is to find hierarchical relationships between the identified enablers. Further, to identify which enablers are influencing other enablers and categorize them under cause-and-effect groups DEMATEL technique has been used. The following two subsections explain these methodologies in detail.

3.1 Fuzzy interpretive structural modeling (FISM)

The fuzzy Interpretive Structural Modeling (FISM) method acts as an interactive tool to handle intricate circumstances. The FISM method aids in discovering the relationships between the factors under study. The method utilizes two critical phases: FISM model development (Phase I) and Model validation (Phase II).

3.1.1 FISM model development (phase I)

The detailed steps involved in defining the relationships among the factors are presented as follows:

i. Defining the problem and identifying the relevant factors through a literature review with discussion with the expert's knowledge and users' viewpoint.
ii. Settlement of the factors and the determination of the interrelationships using the following procedures:

   a. The structural self-interaction matrix (SSIM) mapping is done, where the pairwise interactions among the relevant factors are determined through the four symbols viz., V, A, X, and O.
   where V refers to the factor in a row that leads to a factor in the column,
   A refers to the factor in the column that influence an factor in the row,
   X refers that both the element in the row as well as column are related to each other,
   O implies that there is no relationship between the two elements.
   b. The reachability matrix (RM) matrix is formed from SSIM, where SSIM is transformed into the Initial RM (IRM). In the IRM, the four SSIM symbols, V, A, X, or O, are substituted by 1 or 0. That is, 'V' is replaced with '1' while its mirror image is '0'; A is replaced with '0' and its mirror image as '1'; 'O' is replaced with '0' in both the cells while 'X' is replaced with '1' in both the cells.
   c. After developing the IRM, a transitivity check is carried out. In transitivity check, all the indirect relationships among the factors are identified, and the changes are incorporated. These changes are represented with 1*. This step is repeated until all the relationships from the source to the destinations are identified.
   d. The direct relationships, along with the transitive relationships, aid in determining the reachability set, the antecedent sets and the intersection set, to determine the level within the identified criteria.
   e. The levels identified in step (ii.a.) help in developing the ISM. All the transitory links are deleted in this step to present only the direct relationships between the factors.
   f. The conical matrix is developed using the levels obtained in step (ii.d.) This step is an important one for identifying the relationships amongst the factors after placing them w.r.t their levels.
   g. The direct relationships among the factors are replaced with fuzzy numbers depicting the possibility of interaction on a 0–1 scale viz., 0 (No), 0.1 (very low), 0.3 (low), 0.5 (medium), 0.7 (high), 0.9 (very high) and 1 (complete). For this, the opinion of the same academician and industry expert is considered for rating the relationship between the two elements. The final table obtained is called the Fuzzy Direct Relationship Matrix (FDRM).
   h. The structure obtained in step (ii.e) is converted into FISM by considering the relative strength of influence using the scale described in step (ii.g.)
   i. Finally, conceptual inconsistencies in the FISM model are discussed with the expert groups (explained in Phase II) to identify any discrepancies.
   j. Fuzzy MICMAC (FMICMAC) analysis: FMICMAC classifies the factors by ranking them based on driving and dependence power. The final driving and dependence power for each factor is attained by repeatedly multiplying the FDRM to attain the fuzzy stabilized matrix (FSM) according to the multiplication rule:

$$\mathrm{C} = \mathrm{A},\ \mathrm{B} = \ \max \mathrm{k}\ [(\min\ ({}^{a}ik, {}^{b}kj)]$$

The driving and dependence power of each of the factors is observed using the FSM. The factors are then categorized into four clusters, namely the driver factor, autonomous factor, dependent factor, and linkage factor.

3.1.2 Validation of the model (phase II)

Model validation is done through industry and academic experts having experience in the fresh food sector. The final FISM model is discussed with the expert group based on the inputs sought during the meetings, and post several discussions; the final relationships are analyzed and cross-checked with actual practices followed by managers in a typical FFSC. The relationships are again re-evaluated for any inconsistencies observed, and the whole process is followed.

3.2 The decision-making trial and evaluation laboratory (DEMATEL)

The researchers have used the following five steps to translate the pairwise comparisons and related relations into a structural model.

i. The pairwise comparison using a (0–4) scale (0- ”No influence”, (1)“Low influence”, (2) “Moderate influence”, (3) “High influence”, and (4) “Very high influence”) is done i.e., used to advance towards a pairwise direct relation matrix (DRM).
ii. Z is an n × n, initial DRM, where $z_{ij} z_{ij}$ is the degree to which the enabler “I” influence enabler “j”

$$Z = [z_{ij}]_{n \times n} [z_{ij}]_{n \times n}$$

iii. In order to normalize the DRM Q, i.e., $Q = [a_{ij}]_{n \times n} [a_{ij}]_{n \times n}$ where $0 \leq u \leq 1$ to limit the initial influence matrix.

$$Q = u \times Z.$$

$$u = \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^{n} z_{ij}} \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^{n} z_{ij}}, \quad i, j = 1, 2, \ldots, n$$

iv. Finally, to compute the total relation matrix (TRM) (I—Identity matrix)

$$\text{TRM} = A(I - A)^{-1} A(I - A)^{-1}$$

v. To calculate the sum of Rows (R) and columns (D), respectively

$$\text{TRM} = t_{ij}, i, j = 1, 2, \ldots, n t_{ij}, \quad i, j = 1, 2, \ldots, n$$

$$D = \sum_{j=1}^{n} t_{ij}, \sum_{j=1}^{n} t_{ij},$$

$$R = \sum_{i=1}^{n} t_{ij}, \sum_{i=1}^{n} t_{ij}.$$

3.3 Data collection

A total of 21 enablers for FFSC in the Indian context were identified from the literature review and confirmed with experts during face to face and telephone interviews. The pairwise comparisons from ISM and DEMATEL were sent to eighteen interviewees (Table S.1 in Supplementary Material) whose demographic information has been presented in (Table S.2 in Supplementary Material).

4 Data analysis and results

This work sheds light on the GRAS enablers of sustainability in Indian FFSC and their associations. In this regard, the appropriate drivers are determined and ranked using FISM. The intermediate steps followed to determine the driving and dependence powers for all the variables are provided in Tables S.3-S.8 in the Supplementary Material. Later, cause and effect groups are identified using DEMATEL. The results were conferred with the industry experts for their practical relevance in fresh food and helped them make sound decisions and lay the foundations for designing strategies for SSC, especially considering the current pandemic.

4.1 Analysis of GRAS enablers

ISM analysis has helped to find relationships between GRAS factors and found that 'sustainability' factors are the system actuators (refer to Fig. 2). DEMATEL analysis has classified "Resilience" and "Green" Categories as causal factors; "Agility" and "Sustainability" as effect factors (Refer to Table S.9 and Figure S.1 in Supplementary material).

The detailed investigation using the FISM approach reveals that *'Organization Culture'* holds the highest driving power of '14' and the least dependence power of '0' (See Fig. 3). It also belongs to the first quadrant named the driver factors (Fig. 2) in FMICMAC analysis. In the FISM-based model, it is placed at the lowest Level i.e., Level XII (Fig. 2). The DEMATEL analysis has classified it as a "cause" group enabler that can influence other enablers to achieve the aim, i.e., to achieve sustainability (see Table S.13 and Fig. 4d).

'*Environmental Certification Program'* possesses the second highest driving power of '13.4' and dependence power of '0' (Fig. 3). In the FISM structure, it is also placed at the lowest level, i.e., level XII like the 'Organization Culture' (Fig. 2). It also belongs to the first quadrant named as the driver factors in FMICMAC analysis (Fig. 3) and is a "cause" factor (Refer Table S.13, Fig. 4d). Driver factors always lie at the bottom of the FISM model, and the study observed the same.

The factor 'FS', another important driver variable, is found to lie at the same level as those of '*OC'* and '*ECP'*. The driver variable *'FS'* possess a driving power of '12.8' while still holding a dependence power of '0' (Fig. 3). The level at which this is placed is Level XII (bottommost level) in the hierarchical digraph (Fig. 2) and falls in the first quadrant (upper left) of the FMICMAC analysis (Fig. 3), signifying its driving role. The DEMATEL analysis also reveals that it is a "cause" group factor (see Table S.13 and Fig. 4d). The driver enablers actuate the system and possess a higher driving power with a lower dependence power.

Three crucial variables are observed at level XI of the hierarchical structure, viz., *'GSDP*,' *'IS,'* and *'SCT'* with driving power of '8.7', '3.2', and '3.3', respectively (Fig. 3). It is also interesting to note that all these three fall in the linkage cluster in the FMICMAC analysis (Fig. 3). Also, the dependence power of '*GSDP*', *'IS'* and *'SCT' is '3', '1.6', and '3.4'* respectively (Suppl. Table 8). All these enablers are *"cause"* group enablers (see Tables S.10, S.11, and Fig. 4a, d).

The important variables at level X (Fig. 2) include *'PPP'* and *'SCV*.' With driver and dependence power of '2.8, 1.2' and '5.1, 1.6', respectively (see Fig. 3 and Table S.7). The variables fall in the fourth quadrant named as the linkage cluster (Fig. 3) also the former is an "effect" (see Table S.10 and Fig. 4a) while latter is "cause" group enabler (see Table S.12 and Fig. 4c).

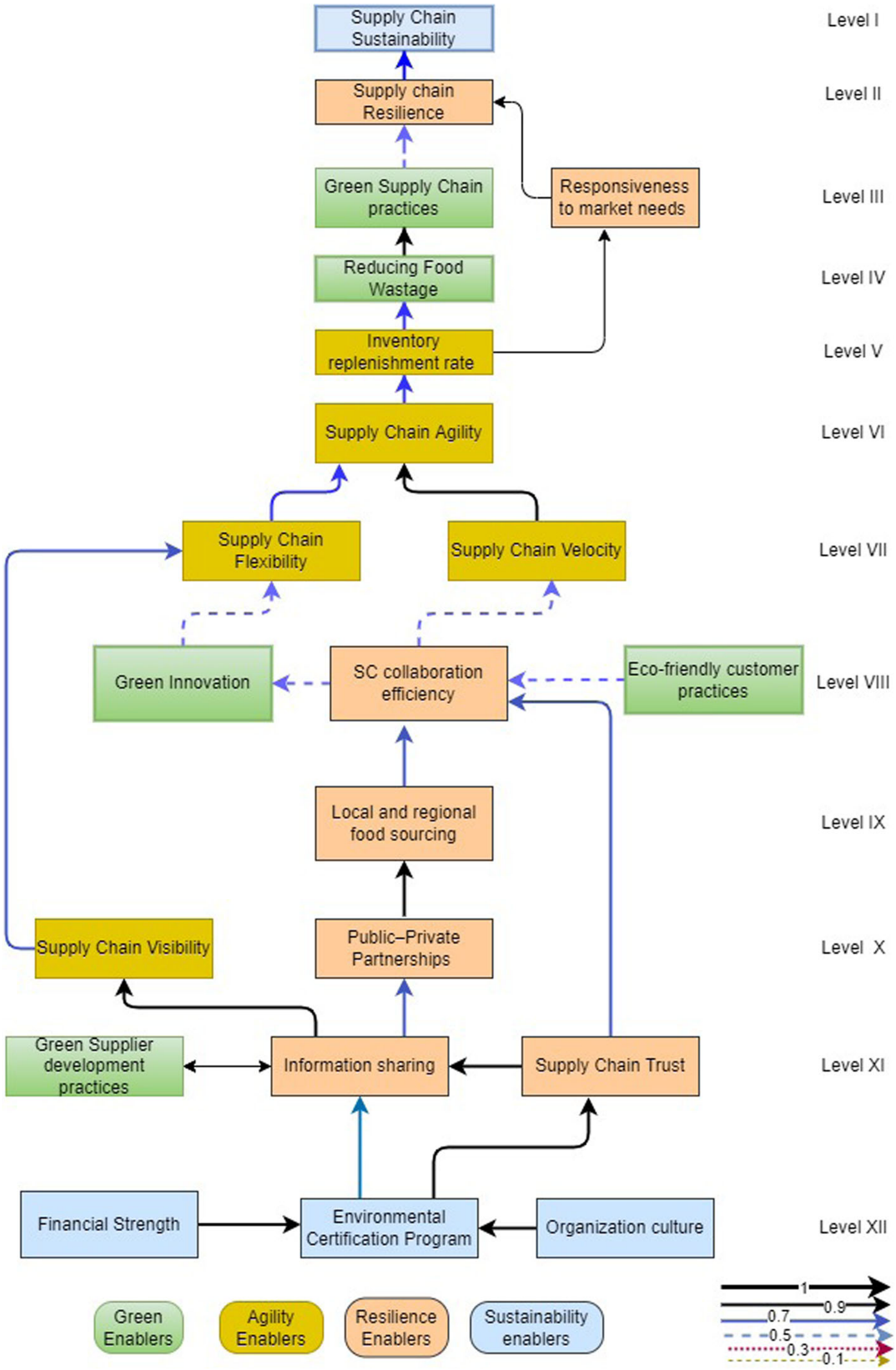

Fig. 2 FISM-based model for GRAS enablers in FFSC

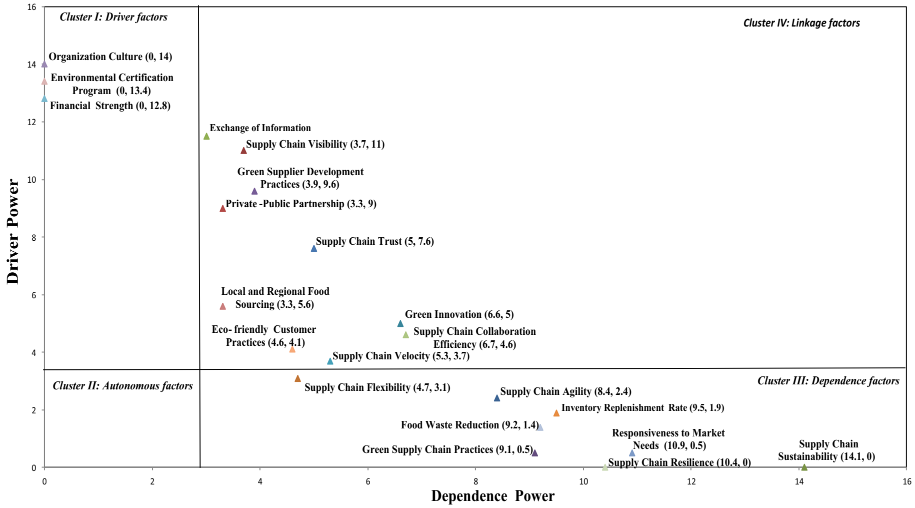

Fig. 3 FMICMAC analysis of GRAS enablers in the fresh food supply chain

The hierarchical structure obtained in Fig. 2 depicts a single variable at level X viz., '*LRFS*'. It possesses a driver power of '5.6' and dependence power of '3.3' (Refer Table S.7). The variable belongs to the linkage cluster (fourth quadrant) of the FMICMAC analysis (Refer Fig. 3) and is an "effect" group enabler (see Table S.11 and Fig. 4a).

At level VIII of the hierarchical structure, the enablers observed are *'GI*,' *'SCCEff'* and '*EFCP'* (Refer Fig. 2) with driver and dependence power as '5, 6.6', '4.6, 6.7' and '4.1, 4.6' respectively (Refer Fig. 3). In the FMICMAC analysis, these enablers are found in the fourth quadrant (linkage factors). The former is "cause" while the latter two are" effect" group enablers (see Tables S.10, S.11; and Fig. 4a, b).

The drivers at level VII in the hierarchical structure are *'SCF'* and *'SCV' (*Refer to Fig. 2*)*. 'SCF' has a driving power of '3.1' and dependence power of '4.7' while '*SCV'* has a driving power and dependence power of '3.7, 5.3' (Refer Fig. 3). The comparatively higher driving power of '*SCV'* made it qualify for the linkage factor (fourth quadrant) (Refer to Fig. 3). However, *'SCF'* is found in the third quadrant portraying a comparatively higher dependence power than SCV. Both these enablers are *"cause"* group enablers (see Table S.13 and Fig. 4b).

The rest of the enablers of SCS are placed from Level I to Level VI. The enablers such as '*SCA'* and '*IRR'* are "effect" group enablers (Refer Table S.12, Fig. 4b) and lie at level VI and Level V, respectively of hierarchical structure (Refer Fig. 2) with driving and dependence power of '8.4, 2.4' and '9.5,1.9'. Both fall in cluster III, i.e., the dependence cluster (lower right in Fig. 3).

The enabler '*FWR*' is placed at level IV and possesses a driving power of '9.2' and dependence power of '1.4' (Refer Fig. 3). Further, it falls in the group of dependence factors, i.e., Cluster III. *'GSCP'* and *'RMN'* are placed at levels III. These enablers' driving power and dependence powers are found to be '9.1, 0.5' and '10.9, 0.5'. They also belong to the third cluster and act as dependent factors. Up in the hierarchy is 'SCR' (Refer to Fig. 2) portraying a driver power of '0' with a dependence power of '10.4'. Due to its nature of higher dependence power, it falls in cluster III in FMICMAC analysis (Refer to Fig. 3). Finally, *'SCS'* is placed at level I of the hierarchical structure, which is the outcome variable. It possesses a dependence

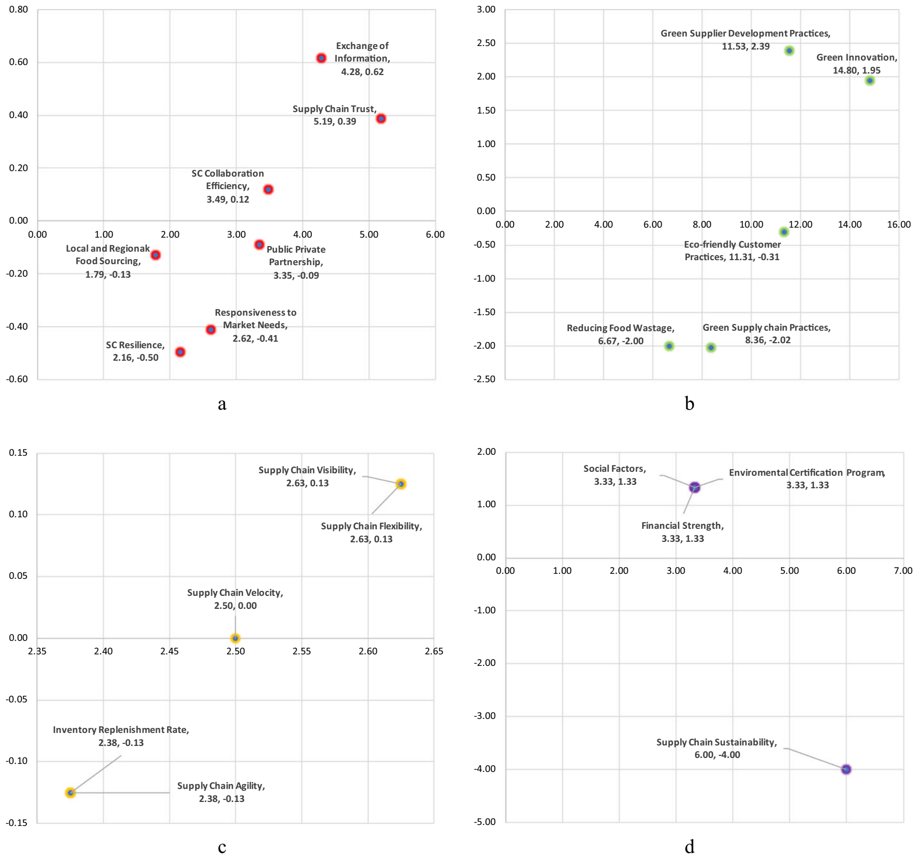

Fig. 4 DEMATEL analysis representation: **a** resilience enablers, **b** green enablers, **c** agility enablers, **d** sustainability enablers

power of '14.1', the highest among all the enablers under study, implying a driver power of '0'. '*SCS' thus* falls in the dependence cluster, which is the outcome variable in the study. All these enablers lie under the "effect" group (see Tables S.9 to S.13, and Fig. 4a–d).

5 Discussions

The current pandemic has forced managers to integrate resiliency while designing FFSC for achieving long-term sustainability. There are essential enablers that have been the focus of the study in recent years. The critical factors and their contribution towards achieving FFSC sustainability are discussed in this section.

'OC' lies in the cause group and hence acts as a universal facilitator in decision-making in every organization. The findings are in line with the contribution of Felipe et al. (2017). The author emphasized that cultural influence significantly contributes to the organization's agility. Though these were confirmed in medium and high-tech firms, the relationships are also found relevant to the FFSC milieu. Moreover, culture shapes the employee's attitude and capacity to tackle and respond to situations. Thus, the like-mindedness of employees contributes to the firm's success (Balaji et al., 2020). It also helps set the behavior of the employees toward handling uncertain situations with a proper approach.

'FS' of the firm also lies in the cause group and is another potential enabler of SCS since it assures the firm's economic viability. Achieving economic stability from farms to retail stores has been an unending concern of FFSC managers. Lack of the right seed, storage facilities, and logistic services, to mention a few, may delay the availability of fresh food on the shelf and, thus, lose customers. The unavailability of cash will put the firms at risk as they fail to absorb any fluctuations during disruptions resulting in non-resiliency. The firms will only be able to invest in training programs and will be able to sustain the employees for a short time.

The 'ECP' is also an influencing factor as it lies in the "cause" group and is considered mainstream due to globalization (Lernoud et al., 2018), playing a crucial role in gaining trust and avoiding exploitation among SC partners. Indian organization for standardization (ISO) 14001 certification wins recognition, new business opportunities, and brands businesses as environmentally responsible. A producer can charge a premium pricing for his products as the certification adds credibility for following environmentally-friendly farming techniques. Certification programs such as hazard Analysis and critical control points (HACCP) and ISO 14001 have now been a prerequisite for Indian firms handling fresh fruits and vegetables to ensure food safety and the continued flow of cash. They have also been portrayed as a double-edged sword towards reducing the carbon footprint and providing healthy food.

All three triple-bottom-line factors, viz., social (OC), economic (FS), and environmental (ECP) factors, are found to the crucial actuators. They lie in the "cause" group emphasizing their role in achieving FFSC sustainability. Laying at level XII of the hierarchical structure, these factors indicate their prominent role in enhancing the SC capability towards developing resilience and achieving SC sustainability.

Attaining sustainability is a collaborative approach, and trust is an essential medium. 'SCT' which also falls in the "cause" group plays an important role in enhancing cooperation among the partners and influences network resilience (Dubey et al., 2017). These, in the context of sustainability, are in line with the studies of Dubey et al. (2019, 2021) and Behl (2020). The transaction cost economics theory (TCE) emphasizes the necessity of contracts to overcome information asymmetry (Joakim et al., 2014) among partners and instigate trust. It is also considered a key for sharing information. As already ascertained, trust is built up among partners when they are engaged in certification programs.

'IS' among the partners helps improve the 'SCV' during any disruption in a supply chain. The DEMATEL analysis also categorized both these enablers under the "cause" group, which indicates their role in achieving FFSC sustainability. The knowledge of any significant events happening in the chain help create necessary buffers in the chain and reduce food wastage. Findings suggest the IS ensures visibility in SCs and building trust among the supply partners is similar to the studies of Zelbst et al. (2020) in the US manufacturing context. Extending the visibility boundaries in fresh food help identify the potential supply chain risk. SC players share information after developing trust among themselves and the driver to initiate any conversation is the partners' certification program. Due to customer and supplier requirements, environmental management systems (EMS) are adapted in firms, creating a snowball impact in the chain.

'GSDP' has been found as an essential enabler that falls in the "cause" group influencing the green supply chain practices in the fresh food context. This finding is in line with previous studies such as Lo et al. (2018) and Liu et al. (2018). Incorporating environmentally conscious practices such as green procurement provide competitive parity for suppliers. Such practices require advanced capability; therefore, it is challenging for all firms to pursue them to the same extent. Our finding also corroborates the studies of Zhang et al. (2017) conducted in the pharmaceutical industry, implying the critical role of SDP in fresh food.

As far as PPP is concerned, it has been so far discussed in a project context (Kumaraswamy et al., 2015), water management (Oliver et al., 2018), and the water-energy-food nexus (Matthews & McCartney, 2018) but rarely discussed in FFSC literature. The findings suggest that our study reinforces the relevance of PPP towards enhancing collaboration among FFSC partners to build a resilient supply chain. Though PPP falls in the "effect" group yet, it has a critical role to play in developing local networks of suppliers. Through **'LRS',** resilient food systems could be designed to secure food for citizens (MacFall et al., 2015).

'SCCEff' is an "effect" group enabler that creates an environment for building resilient SC. Where firms in a supply chain plan and execute initiatives toward common goals. Lack of such cooperation increases the likelihood of propagation of disruptions throughout the supply chain. Substantial wastages across the FFSC could be controlled mainly through supply chain collaboration and shared responsibility essential for a sustainable future (Al Naimi et al., 2020).

The Green enablers at Level VIII are 'GI' and 'EFCP' that fall in the linkage cluster (Refer Fig. 3) where the former is a "cause" group enabler, while the latter is an" effect" group enabler. As asserted in the studies of Hahn (2020) and Singh et al. (2019), GI fosters flexibility in the supply chains. Similar findings are suggested in the current study. Innovation in hybrid varieties of crops and recyclable packaging from the source to the destination can bring breakthroughs in FFSC. Also, to become an asset-light firm, innovative solutions could be a better approach in FFSC considering the food wastage happening along the stages of the SC. Partnering with customers to boost environmental-related concerns could achieve sustainability. Thus, 'GSCP,' an "effect" group enabler, helps to reduce carbon footprints by partnering with each SC player at every stage of the supply chain. Each player has a significant role to play, as acclaimed in the studies of Sabahi and Parast (2020), where the driving power of innovation toward knowledge-sharing capability, agility, and flexibility are well appreciated.

'SCF' is a "cause" group enabler and has been found as an effective activator in developing FFSC Sustainability. These are in line with the studies of Chenarides et al. (2021). The combined effect of SCF and data analytics on SCR corroborates the study of Srinivasan and Swink (2018) carried out in the context of volatile markets that best fits FFSC also. Flexibility allows the FFSC players to respond to the customers' changing requirements. Flexibility among farmers could be brought through introducing new hybrid varieties and making farmers self-sufficient through proper training programs. Flexibility in logistics could be obtained through investing in relevant infrastructure like Reefer technologies. In retail, flexibility is ensured through local and regional sourcing of products.

'SCV,' 'SCA,' and 'IRR' all lie under the "effect" group yet are tightly intertwined in the fresh food context. Where velocity determines the speed of the supply chain, which along with flexibility, helps achieve SC agility. Velocity and agility influence the frequency of replenishment of the fresh food categories at respective supply chain stages. And decisions on inventory replenishment policies, product assortment, shelf space allocation, and display area maximize the retailer's profit (Sharma et al., 2022c; Ozdemir et al., 2022) . These practices also help in 'RFW', which is an "effect" group enabler and is considered necessary in FFSC due to the product nature. Fresh fruits and vegetables require frequent replenishments to make fresh products on the shelf for the customers. For assuring SCS, inventory policies need to be designed to reduce CO_2 emissions, which are very high during storing, transporting, ordering, and other operations. Robust and optimized inventory policies should be considered for SCS as they not only reduce the cost of the SC but are essential under unforeseen circumstances (Gholami-Zanjani et al., 2021).

With the customer's consciousness towards green products, fulfilling their requirements with environmentally safe products ensures 'RMN' not only in terms of the product availability on the shelf but also the availability of environmentally safe products. Moreover, suppliers fulfilling such needs provide environmentally safe products; a symbiotic relationship can bring a sense of consciousness to all the supplier-customer (Dyadic) relationships. 'GSCP' of the whole chain, in general, is the outcome of the consistent efforts on the practices mentioned above, which range from green to sustainable to agile to resilient practices. The hierarchical structure explains the directional relationships between the factors and the subfactors. In fresh foods, consumables (packaging materials) comprise almost 2–5% of the total cost, which involves the cost related to the packaging and associated activities that varies with the product categories handled. Here, products like mushrooms and lettuce require perforated material and antifog films, and products like onion and potato require material such as net mesh/crates. While apples, oranges, etc., require perforated cardboard cases. The product perishability rate decides the consumables required and hence influences the cost. Hence, for handling and transporting fresh food produce, environmentally friendly packaging materials in the fresh food category are required to achieve sustainability in the chain.

'SCR' and 'SCS' are determined as the top-level variables in the study with the highest dependence powers SCR influences SCS. These enablers lie under the "effect" group. FFSC faces challenges in terms of designing SSC. When elements of resilience are embedded into the supply chain structures and processes, considering the risk and economic efficiency are claimed to achieve sustainability in the SC. These imply the long-term impact suggesting a focus on the four GRAS enablers. The clustering of the GRAS enablers (drivers, linkage, autonomous, and dependence factors) is presented in Fig. 5. Sustainability factors are found to actuate the system, while Resilience and Green enablers act as facilitators. Agility factors are necessary enablers for the F&V category as they reduce food waste along the supply chain by considering the perishability nature of the product and assuring minimum time fresh fruits and vegetables spend in the supply chain.

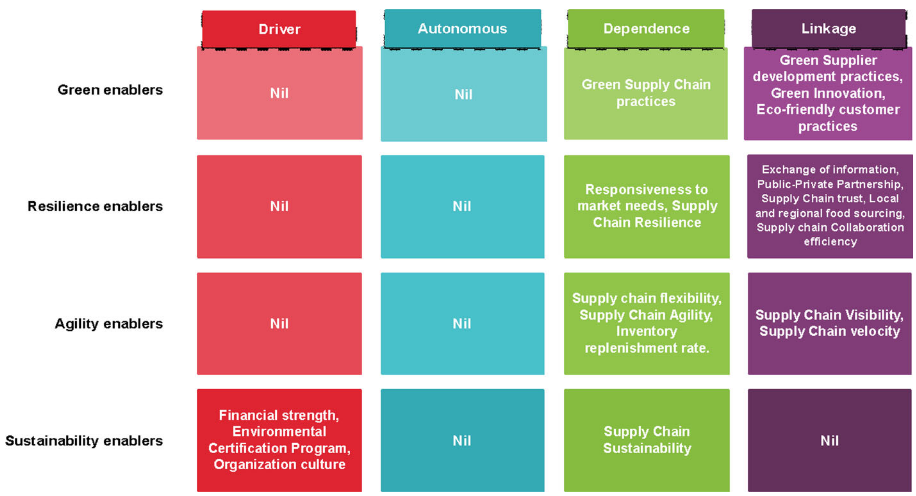

Fig. 5 Clustering of GRAS enablers

The sustainability enablers (drivers) act as the actuators of the whole system to achieve FFSC. Among the sustainability enablers, all belong to the driver cluster. The drivers include financial strength, environmental certification programs, and organization culture. The other activators in the system are Green (G), Agile (A), and Resilience (R) enablers playing different roles. One (GSCP) Green enablers fall in the dependence cluster, while three (GSDP, GI, EFCP) fall in the linkage cluster. Concerning the agility enablers, two (SCF, SCA, IRR) belong to the dependence cluster and two agile enablers (SCV, SCVc) pertain to the linkage cluster. Five (IS, PPP, SCT, LRFS, SCCEff) resilience enablers fall in the linkage cluster. In contrast, one resilience enabler (RMN) falls in the dependence cluster. The analysis implies that the linkage factors are primarily green, agile, and resilience enablers, focusing on such variables to achieve the outcome, i.e., sustainability. Enablers falling in the linkage cluster also highlight that these enablers are very complicated, i.e., any changes in one create a churning impact on others.

6 Conclusions

GRAS enablers in a comprehensive manner have yet to be studied in developing countries like India to design a sustainable FFSC. This work acknowledges the drivers that help achieve sustainability in FFSC. It also establishes the cause-and-effect relationships to orient the firms towards sustainable practices. The industry analysis of the GRAS enablers in the Indian FFSC sheds light upon the consideration of each enabler for designing a long-term sustainable plan for SC meant to handle fresh foods.

6.1 Theoretical implications

The study presents a holistic view of the GRAS enablers in fresh food and their interplay to achieve sustainability through a mixed-method approach comprising a qualitative study followed by a hybrid method by integrating FISM and DEMATEL. These paved the way to rank and determine the interrelationships and define causal relationships among the factors. The contribution of the study is multiple. The design is different from the prior studies, which focused on fresh foods involving the MCDM techniques with minimal application. The model has excellent contributions, such as (i) The study provides a ranking of the GRAS enablers through the MCDM approach. (ii) The hierarchical relationships provide a contextual relationship among the factors providing a guide towards enhancing sustainability in fresh foods considering its specific features. The interplay among the context-specific enablers could help accelerate the adoption of sustainability practices in the firms. (iii) The present work provides a theoretical framework that will guide researchers and practitioners in integrating firms' resources to build capabilities that address sustainability issues and help deliver efficient values to the supply chain. The managers could propose guidelines and design strategies in fresh foods towards attaining sustainability.

6.2 Practical implications

The current work has five significant implications for fresh food suppliers, policymakers, and Quick Service Restaurants. First, the FFSC is a less lucrative field, due to which firms end up in losses rather than making a profit. This creates a cash crunch in the supply chain; hence, the adoption of sustainable practices in fresh foods is limited to non-expensive procedures. Thus, establishing the FS for the firms is inescapable.

Second, the challenges that managers face are also associated with the dynamics of structures and processes of the supply chain. The design part is the most challenging once decided upon, and it involves a lot of rework, cost, and effort. Gradual capacity ramp-up before the rise in demand will be an effective strategy for disruption tail control.

Third, the sensitivity of fresh food towards varying temperatures could be resolved through initiatives such as intelligent and vacuum packaging. Moreover, PPP could be thought of as a source of bringing several important initiatives toward enhancing the shelf life of food products. One such would be the adoption of Artificial Intelligence in FFSC, which will reduce food wastage and enhance its operations (Dora et al., 2021).

Fourth, practices such as inventory replenishment are intricate to maintaining freshness in fruits and vegetables as fresh foods are prone to deterioration quickly due to which players invest in preservation technologies for these categories of products. Reducing emissions due to transporting, material handling, and product characteristics should focus on FFSC players to achieve sustainability. Designing energy-efficient technology in the transportation and preservation of fresh foods will also stimulate customer demands.

Fifth, government policies promoting fresh food supply chain partners to invest in energy-efficient and green technology and customers' green practices together build SCS. The present findings also suggest the role of green practices in achieving sustainability. In the long run, these practices will reduce carbon footprints and improve people's health.

In a nutshell, this study's contributions are essential: (1) The work is a novel and, according to our knowledge, first of its kind with empirical evidence on GRAS enablers of FFSC. (2) The work is also comprehensive, discussing all the GRAS enablers in detail, and portraying the primary and secondary relations with the variables that make up the whole system. The lack of any unknown variable also infers that the variables are sufficient to design a sustainable FFSC. (3) The study has employed a Sequential Exploratory Strategy, where we explore the primary variables relevant to designing a sustainable FFSC validated by academic and industry experts. (4) It is the pioneer in integrating the techniques of FISM-DEMATEL while proposing a framework for FFSC players as a guide to understanding the adoption of sustainability in the context studied. (5) The hierarchical structure provides a path towards adopting sustainable practices in fresh food and ranks the enablers based on their relative importance.

6.3 Limitations and suggestions for future research

This work is the outcome of the adopted integrated approach that aided in ranking and determining the cause-and-effect relationships amongst the enablers, which was very cautiously identified and defined. There is a total of twenty-one enablers identified under GRAS. However, the relationships and the cause and effect identified rely on the expert's judgment, drawing a significant study limitation. The literature analysis and the expert's evaluation of the variables helped conclude that the final framework presented is limited to the context of FSC in general and FFSC in specific. The framework needs to be evaluated for non-perishable SC. Thus, findings lay a foundation for identifying variables in other sectors.

The outcomes of the present work can provide further follow up directions to the managers and practitioners of fresh food to distinguish critical and non-critical GRAS enablers to devise strategies for building SSC. Future studies could investigate non-food-related variables and test their applicability in other sectors. Also, scope exists to study the framework in other developing countries, and comparisons and common learnings could be drawn. Furthermore, due to the methodological advantage of this approach, a similar hybrid method could be applied to other sectors.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10479-023-05176-x.

Appendix

See Table 1.

Table 1 Studies on sustainable supply chain management

Factors	Annotations	References	Definition
Green supplier development practices	GSDP	Singla and Singh (2011), Zhang et al. (2017), Liu et al. (2018) and Lo et al. (2018)	GSDP refers to working with certain suppliers on a one-to-one basis to improve their performance and capabilities for the benefit of the buying organization considering the green practices and most negligible impact on the environment
Green innovation	GI	Chege and Wang (2021), Hahn (2020) and Luthra et al. (2019)	To facilitate green innovation in fresh food, an eco-friendly facility design is required to ensure a closed-loop SC. Also, eco-friendly packaging, processing, and developing new hybrid varieties of crops and practices
Green supply chain practices	GSCP	Azevedo et al. (2011), Green et al. (2012), Sharma et al. (2021b) and Rao and Holt (2005)	Green Supply Chain Practices (GSCP) encompass inter-organizational activities from green sourcing to green logistics and green distribution to reduce environmental impact
Reducing food waste	RFW	De Boer and Pandey (1997), Shukla and Jharkharia (2013), Aldaco et al. (2020) and Dhir et al. (2020)	Reduction of fresh food wastages or losses along the supply chain

Table 1 (continued)

Factors	Annotations	References	Definition
Eco-friendly customer practices	EFCP	Zhu et al. (2008) and Gelderman et al. (2021)	Eco-friendly customer practices (EFCP) are the specific practices that collaborate with customers in ensuring green practices, making them environmental partners
Public private partnership	PPP	Singh et al. (2019), Kumaraswamy et al. (2015), Oliver et al. (2018) and Matthews and McCartney (2018)	Teaming up of private and public entities where they pool skills, knowledge, and resources over a period
Responsiveness to market needs	RMN	Lăzăroiu et al. (2020) and Harris et al. (2020)	Responding to sudden and abrupt market changes
Supply chain trust	SCT	Dubey et al., (2019, 2021) and Behl (2020)	Trust among the partners in the supply chain
Local and regional food sourcing	LRFS	MacFall et al. (2015) and Macfadyen et al. (2015)	Procurement of fresh fruits and vegetables from the nearby places/ market
SC collaboration efficiency	SCCEff	Lohmer et al. (2020) and Dubey et al. (2020)	Collaboration among SC partners through the effective and productive use of IS
Information sharing	IS	Viet et al. (2018), Colicchia et al. (2019), Wan and Sanders (2017), Wan (2019), Eyers et al. (2021), Duchek et al. (2020) and Appiah et al. (2020)	Sharing of the internal and external data for better communication and planning
Supply chain resilience	SCR	Hosseini et al. (2019), Dubey et al. (2020), Xu et al. (2020), Jain et al. (2017) and Zhao et al. (2018)	Supply Chain Resilience (SCR) is a collaborative approach to contain disruptions within a SC without impacting its core functions
Supply chain flexibility	SCF	Dubey et al. (2019), Aramyan et al. (2006) and Gerwin (1987)	Ability of SC partners to change the process or product of the SC using the existing systems
Supply chain visibility	SCV	Khanna (2020), Kazancoglu et al. (2021), Behnke and Janssen (2020) and Tsang et al. (2019)	The transparency in the supply chain regarding the status of fresh fruits and vegetables in the supply chain

Table 1 (continued)

Factors	Annotations	References	Definition
Inventory replenishment rate	IRR	Van Donselaar et al. (2006)	Rate at which fresh fruits and vegetables are sold at the store
Supply chain velocity	SCVc	Fikar et al. (2019)	The speed with which the fresh fruits and vegetables move in the supply chain
Supply chain agility	SCA	Stone and Rahimifard (2018), Lohmer et al. (2020), Wiedmer et al.(2021) and McGaughey (1999)	Agility extends the concept of flexibility, adding the dimension of quickness to the flexibility aspect. Agility explains "how fast to change"
Organizational culture	OC	Balaji et al. (2020), Felipe et al. (2017), Elsbach and Stigliani (2018) and Liu et al. (2021)	OC is the values and norms carried by each individual in an organization that reflect the way to behave in an organization
Financial strength	FS	Béné (2020) and Birkinshaw et al. (2016)	FS is the capacity of organizations to absorb fluctuations in cash flow and remains the penultimate capacity for achieving resilience
Environmental certification program	ECP	Demirel et al. (2019) and Wijethilake and Upadhaya (2020)	Programs emphasize that companies follow environmental regulations and ecolabel their products and services to reduce harmful environmental impacts
Supply chain sustainability	SCS	Capone et al. (2014) and Pérez-Gladish et al. (2021)	A firm ensuring sustainability in its practices focuses on optimal resource use while serving the customers safe and healthy food and ensuring it for future generations

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