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Antecedents of agriculture supply chain performance during COVID-19: an emerging economy perspective

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Abstract

COVID-19 led to several complications like labor shortage, inadequate availability of supply chain facilities, price fluctuation, panic behavior, and uncertainty. Despite the challenges, the farmers and stakeholders adopted different strategies for sustaining the agricultural supply chain performance. Hence, the study proposes to explore the antecedents that led to the ASC performance and their linkages. The study combines literature review and qualitative methods to understand and recognize antecedents that impact ASC performance in developing countries. The conceptual model is built with the underpinning theory (the theory of commitment and organization). A quantitative survey follows the study to validate the theoretical model empirically using covariance-based structure equation modeling (AMOS). The ASC performance in the earlier phase of COVID-19 was disrupted. With time, ASC performance was managed by linking different antecedents. The findings reveal the application and linkage of organization theory and theory of commitment which led to ASC performance. The study finds a unique contribution among academia and practitioners by paving directions to manage the uncertainty during COVID-19 and any such risk triggers in the future. The study offers essential insights for practitioners and policymakers to develop a road map for ASC during the calamities.

Keywords Agriculture supply chain · COVID-19 · Commitment · Complexity · Size · Operational adjustment agility · Uncertainty · Collectives

1 Introduction

Agriculture firms have experienced a significant impact during COVID-19 (Zhang et al. 2020). The disruptions have been different from other recent global incidents. On 11th March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic disease (Ghosh et al. 2020). Since then, the world has faced problems in all sectors. Nevertheless, the agriculture supply chain was also disrupted as the situation worsened, and the countries closed their cross borders to export or import farm produce and commodities (Kumari et al. 2021). Access to raw materials was also limited except for essential commodities. Agriculture productivity has increased with the rise in population, yet the agriculture supply chain (ASC) has faced many issues such as poor traceability, inadequate management, lack of industrialization, and information asymmetry. To overcome the challenges, enablers such as technology, skills, information, and attitude of the supply chain partners are researched extensively (Sharma et al. 2020a, b). Data-driven decision-making is an imperative component of any ASC

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that facilitates close data monitoring for product quality and safety (Kumar et al. 2019). Alignment of ICT in ASC has improved performance and risk management (Kamble et al. 2020a). Therefore, ASC performance depends on data analytics capability for better transparency and integration of resources (Kamble et al. 2020b). The ASC performance was highly researched before, and with the onset of COVID-19, the complex problems added unprecedented challenges. The ASC risks increased as the closure of cross borders led to inadequate management of agricultural produce, especially perishable commodities. Lockdowns, in general, caused a sales decline in the produce (Magzter 2020). The ICT and advanced analytics could not support the ASC for a while as the sector was not prepared. However, with time agriculture firms endeavored to mitigate the disruptions by having cross-functional teams to manage risks and challenges (Zhang et al. 2021). From the Buyers' perspective, there have been limited production and delays in procurement (Butt 2021a, b). From the suppliers' perspective, the significant impact of COVID-19 was an increase in the delivery time (Butt 2021a, b). The distributors claim delays and inventory shortages. The reverse migration of the poor segment led to the shortage of laborers. The pandemic underwent a shortage of truck drivers and distributors (Kumar et al. 2021a, b). The multiple impacts on ASC resulted in building a competitive pressure. The factors such as business uncertainty, size, and complex behavior influenced the firms to revisit their supply chain strategies (Butt 2021a, b). The uncertain supply and demand suggested a need to understand the situations better and manage the disruptions. The ASC in the emerging economy focused on countermeasures to increase the ASC performance during the pandemic. As a countermeasure, the firms refined the production schedules (here in ASC, farm-level could not be rescheduled but may be processed to intermediate / final produce), increased visibility, and alternate inbound outbound routes. They focused on suppliers' risk and supplier relation management (Kumari et al. 2021). The shift towards the online system also acted as a support for the ASC performance. The firms were able to do so because of a team effort and a strong leadership commitment.

Considering the research onion framework (Saunders et al. 2007), we have examined the situation and ASC performance during COVID-19. There have been firms that survived in the ASC while a number of firms were shut down, disrupting the ASC performance. Firms have posed different strategies and factors limited to a trial and error approach to surviving disruptions. Developed countries were dependent upon the resources from the developing countries for further processing and value addition, and the disruption in the ASC created an imbalance in the firms. The ASC research has been challenged due to the multiple impacts of the COVID-19. The fact may not be denied that the pandemic led to an extensive wastage of perishable agricultural produce (Kumar et al. 2021a, b).

Although the studies have focused on enabling factors of ASC performance, there has hardly been a study on preparing ASC for such unprecedented challenges. The extant studies have focused on digitalization, IoT, and advanced analytics in ASC performance (Kamble et al. 2020b). These researches are not contextualised in developing countries as they are not prepared for the digitalization of the agriculture sector. There is a need to explore the time of adversity, stakeholders' dynamics, and sustaining the agriculture supply chain and business during such disasters. Despite the challenge, ASC tried to perform by focusing on different functions of its web. The concerning issue in practice is enormously complex as it influences the stakeholders at different supply chain webs. On that background, many countries face difficulty in managing ASCs due to demand and supply imbalance and heterogeneity in the supply chains. On the one hand, when developed countries were struggling with ASC performance, it was disastrous for the developing countries. Extant reports lack comprehensive deliberations on ASC performance and the antecedents required to cope with disruptions. This scarcity has driven us to a research gap that there is a need for study on highlighting the antecedents for developing countries to sustain the ASC performance during calamities like COVID-19. Therefore, the central problem is to study the antecedents that impact the ASC performance in developing countries where technology is scarce and managing calamities is a challenge. The extant literature and research gaps helped to design the following study objectives.

- To determine the antecedents and their linkage with the ASC performance
- To propose and empirically validate the linkages of the antecedents impacting the ASC performance.

By examining the antecedents for ASC performance during COVID-19, this study offers several contributions to the ASC literature for the emerging economies concerning the pandemic. The research problem is relevant to countries with particular reference to the emerging economies that were also affected by challenges apart from the pandemic. Firstly, and distinct from earlier studies on ASC and COVID-19, we identified the antecedents that led the ASC to perform and revealed the cause and effect relationship. Secondly, to the best of our knowledge, this is a unique contribution focused on the challenges of COVID-19 on ASC. Thirdly, the study recommends the need to work on the antecedents for future calamities in ASC. Finally, this study has managerial, theoretical, and policy implications for developing a strategic roadmap for sustaining ASC performance. The study

explores the different stakeholder measures to sustain the ASC performance.

The remainder of the paper is organized into nine sections. Section 2 reviewed the literature, followed by Sect. 3, exploring the underpinning theory. Section 4 discusses the theoretical framework, followed by Sect. 5 on research methodology. Sections 6 and 7 document the data analysis and findings, further presenting the discussions. Section 8 presents the implications of the study. The final section concludes the research by presenting the future research directions.

2 Literature review

The primary purpose of this section is to understand how the pandemic situation impacted the performance of the ASC. The section carried out a detailed review of the literature (as shown in Fig. 1) published in reputable journals like International Journal of Logistics Management (IJLM), Benchmarking, Annals of Operations Research (ANOR), International Journal of Operations and Production Management (IJOPM), and other key outlets to understand the performance of the ASC during COVID-19. We conducted a keyword search on the renowned journals in the supply chain to have a holistic coverage of all the possible agriculture supply chain practices during COVID-19. The essential search criteria included papers that were published from 2020 to 2021. The keywords for the search included "agriculture supply chain" AND "COVID-19", "performance of agriculture supply chain" AND "COVID-19", "agriculture" AND "COVID-19". We received 93 research manuscripts at the first level, which focused on the theme of our study. In the second round, we reviewed the abstracts of the selected papers and narrowed our study to 77 pieces of research limited to the scope of our study. We scrutinized the papers to 57, which focused only on ASC during the COVID scenario. We prepared a database of all the 57 research studies focusing on the scope of our study. In the second stage, we underwent different seminal articles on theory building and agriculture supply chain. We used reputable journals to dig out the research manuscripts, which could help us in theory building and extracting the constructs for the study. Our results for the second stage showed an initial 113 pieces of research focusing on the theoretical frameworks. We prepared a separate database and scrutinized the result of 43 types of research that were limited to our study's scope. This way, we prepared two databases for the extensive literature review of the study.

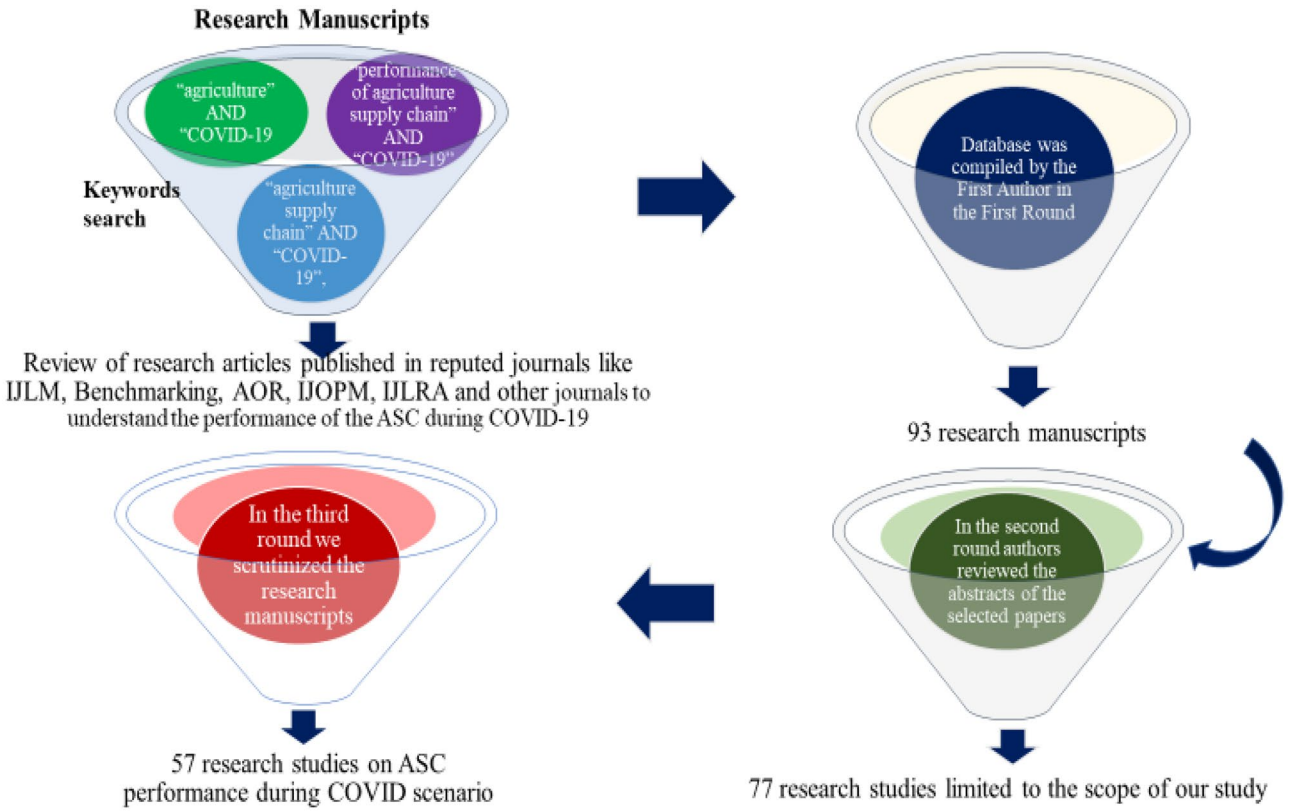

Fig. 1 Literature Review carried out by the authors

2.1 Supply chain management

Supply chain management refers to a system of various stakeholders involved in delivering customer requests (Chopra and Meindl 2007). Stakeholders include the focal firm, distributors, logistics partners, and an information system that facilitates the flow of material, finance, and information. It even includes customers. Mentzer et al. (2001) define it as a set of companies (a company, its suppliers, customer, etc.) that have a direct link and are responsible for the flow of products, finance, or information across upstream or downstream processes. Supply chain management is the synchronization of various business functions within the company and its business partners across the supply chain with the common goal of long-term sustenance and improving the overall market performance of the chain (Sillanpää 2015; Mentzer et al. 2001). The supply chain comprises direct suppliers of a large focal firm, a chain of suppliers involved in converting raw material into a finished product, and logistics services. Thus, it is an ecosystem that consists of entities involved in converting raw material into finished products and making products or services available to end customers. Proper information systems are designed to manage inter-firm business transactions such as ordering, inventory management, transportation, or tracking of materials. Information is shared among various business partners in the supply chain (Annosi et al. 2021). All the stakeholders in the business supply chain are aligned towards creating value for the customer and economic benefit for all stakeholders. The end customer is the source of funds for the supply chain (da Costa et al. 2012). SCM includes marketing of products, new product development, supply chain design, logistics management, inventory management, sourcing, transport and distribution management, warehouse management, and information system (Latte and Javalagi 2021). SCs nhare characterized by a high level of trust among different members, alignment of goals, visibility (Barratt and Oke 2007), agility, and information systems for interlinking of processes across business partners.

2.2 Agriculture supply chain

The Agriculture Supply Chain (ASC) is a complex web of functions wherein agricultural produce flows from production to consumption (Sharma et al. 2020a, b). The ASC includes the farmers as the producers, intermediaries, and consumers. The market channel in ASC is broad, which leads to price discrimination. There is a constant effort to establish a direct linkage between the farmers and the market to control the number of intermediaries. The ASC is different from other supply chains as they produce depending on the farmers' agriculture practices, and animals and humans consume the final product (Kamble et al. 2020a, b). ASC demands knowledge of the proper functioning of the chain. Therefore, farmers of developing nations need knowledge and awareness of quality products for the supply chain (Despoudi 2021). ASC undergoes different functions wherein the agriculture commodities need special care and handling. Technology and digitalization have supported the ASC to perform each function efficiently (Dutta et al. 2020). ASC is mainly dependent upon climate change, technology, quality produce, sorting, grading, handling, processing, and perishable characteristic of the agricultural produce. The performance of ASC is dependent upon the proper linkage among the factors driving the ASC. The primary element for ASC is the agricultural produce from the farmers. The agriculture produce quality is assured and checked. The produce undergoes sorting, grading, and handling. The stakeholders do the primary processing following the packaging and selling in the market (Kumari et al. 2021).

2.3 Performance measurement of supply chain

Supply chain management (SCM) manages all interlinked processes required for fulfilling customer requests. Gunasekaran and Kobu (2007) reviewed several logistics and supply chain performance measurement categories. The supply chain performance matrix has also been discussed by Chithambaranathan et al. (213). Supply Chain Performance is dependent upon supply chain integration. Supply chain Integration is controlled by information quality, risk sharing, information sharing, customer relation, agreed vision and goals, and supplier strategic partnership (Sundram et al. 2016). For business supply chains, demand fluctuations are seasonal and are relatively easy to manage using the forecasting method. Even when a product gets an upgrade or gets replaced with a new one, members of the supply chain are more or less the same. Performance measurement is generally oriented towards measuring actual cost, quality, time, and revenue. This gives a sense of whether an organization is performing according to expectations. For commercial supply chains, several indicators are defined for measuring performance (Abidi et al. 2014) at each stage of the supply chain, such as planning, sourcing, or delivery. Haavisto and Kovács (2014) classify them into financial, time, and volume-related performance. Several other indicators measure performance, such as output, resources, flexibility (Beamon and Balcik 2008), customer service, financial control, and process adherence (Schulz and Heigh 2009). Several metrics (e.g., lead time of delivery, logistics cost, profitability, percentage on-time delivery, percentage of goods delivered as per order) are being used to measure the performance of individual members and the overall supply chain.

2.4 Performance of agriculture supply chain during COVID-19

COVID-19 has left an adverse impact on all sections of society. Nevertheless, the ASC has also seen disruptions during the lockdown phase. The pandemic scenario made it difficult for the ASC to sustain (Udmale et al. 2020). There had been problems at every function of ASC, which led to an unprecedented loss. COVID-19 handled the major issues on the producers and stakeholders of the supply chain (Sharma et al. 2021). The sudden lockdown and closure of the cross borders during the early phase of COVID-19 led to panic among the stakeholders. The agricultural produce, especially perishables, was wasted. The closure of bulk buyers in industries, companies, schools, and restaurants led to a loss of demand for the produce (Hald and Coslugeanu 2021). Many processing industries were shut down, which led the migrant laborers to move to their native places. As a result, due to a shortage of workforce, the performance of the ASC was disrupted. The outbreak interrupted the consumption pattern and preferences for agricultural produce (Aday and Aday 2020). The farmers had to shift their production pattern to food, with high demand and increased immunity. To overcome the challenges of COVID, the ASC focused on different strategies like demand-driven produce, online delivery, and shifting towards collective centers to sustain the supply chain. Improved storage structures and improved technology led to a better performance of the ASC. The countries realized the severity of the situation and took measures to improve the ASC's performance.

The ASC is topical in the current pandemic period to ensure the smooth flow of agricultural produce across different layers. Supply chain managers, practitioners, farmer collectives, and leaders focus on designing optimum supply chains with contingency built into the system. Literature suggests that efforts were made to streamline the flow of material, information, and fund across the supply chain. The approaches from all the stakeholders endeavored to design and manage robust and agile supply chains to minimize the effect of the disruption. Technology is a significant support element in ensuring efficiency. A few studies on ASC have discussed the challenges faced by the sector during COVID (Luckstead et al. 2021; Aday and Aday 2020). Some reports document and deliberate the risk-mitigating strategies in the ASC during the COVID phase (Sharma et al. 2021; Ker 2020). The majority of the studies have documented the disruptions caused in the ASC (Maan et al. 2021) and the impact of COVID-19 on ASC (Gray 2020; Poudel et al. 2020; Siche 2020). There is a need to understand the factors which led the ASC to perform during uncertainty. The literature has focused on digitalization and technology in the ASC (Dutta and Mitra 2021; Nayal et al. 2021; Naz et al. 2021; Tasnim 2020). The studies reflect different elements for ASC during COVID-19. However, the review observed that the literature on antecedents that promoted ASC performance during a pandemic is missing. To address this gap, we have undergone extensive literature to understand the impact of COVID on ASC. The extensive review recognizes the scope to study antecedents through a theoretically underpinned conceptual model for the ASC performance during COVID-19. Thus, the study sets the question—*What antecedents led to the ASC performance during COVID-19?* The study aimed to identify the key antecedents linking the theory and empirically validate the causal impact of the antecedents.

3 Underpinning theory

The lack of substantive literature on performance measures of ASC led us to rely on the theory-building approach for the study. The study combined the perspectives of organizational and collective action theories to finalize the model. It proposes the antecedents based on the organizational and collective action theory to examine the effects on the performance measures. The research adopted an appreciative inquiry model to understand the organizational changes during the pandemic period (Saunders et al. 2007). This was appropriate to explore the social paradigms of organizational changes and it has specifically followed interpretive approach to provide the operational insights by considering the stakeholders ' feedback on complexities and challenges faced by ASCs. Organizational and collective action theories were further used to ground our research to support this paradigm to leverage the rational explanations and offer suitable/optimal solutions to the study questions.

3.1 Organization theory

In general, ASC uses various management tools for its supply chain activities. The decision-making during COVID-19 has been dependent upon internal and external situational factors. The organizational size, environmental uncertainty, and operational scope influence the complexity of the ASC. In emerging economies, ASC is driven by small and marginal farmers. The farmers have formed collectives and networks with the stakeholders to sustain the ASC. Therefore, the supply chain performance is primarily driven by operations, resources, and traditional risk elements like monsoon failure and crop failure. Organizational factors determine the managerial decisions in an organization (Burrell and Morgan 1979). The organized approach made by the leaders in the ASC results in access to resources. The organizational environment impacts the performance metrics as resource scarcity and abundance affect the supply chain. On the other side, complexity is the key feature during the

pandemic situation. Overall, a stable environment provides an organization a high control over the supply chain.

3.2 Collective action theory

Collective Action Theory refers to the collaboration of individuals as a group commonly used for social sciences research (DeMarrais and Earle 2017). Reasons that led us to use collective action theory as a lens for developing a model for the emerging economy are to understand the performance of the supply chain during COVID -19. First, ASC involves different stakeholders who perform functions at each stage. There is a need to make the stakeholders work together for better coordination. Second, the stakeholders in emerging economies are small and marginal, especially the producers. Therefore, the performance of ASC is mainly dependent upon collective action (Kumari et al. 2021). Third, the collective approach by the stakeholders can be an answer to the resilient measures in the ASC. We have attempted our study to expand the understanding of the performance measures, focusing on agriculture collectives in the form of cooperatives, farmer producer companies, non-government organizations (NGOs), and self-help groups (SHGs). The size of the collectives, operational scope, organization culture, and leadership have highly influenced the ASC during the pandemic.

4 Theoretical framework and hypothesis development

Studies have examined the challenges of COVID-19 on ASC performance (Luckstead et al. 2021; Aday and Aday 2020). Most of the studies during the pandemic period focused on the disruptions and complexity in the ASC (Maan et al. 2021; Gray 2020; Poudel et al. 2020; Siche 2020). Therefore, the dire need for the research is to integrate the theory viz. organizational theory, commitment, and collective action theory. This study integrates the three perspectives to explain how ASC can perform during risk and uncertainty like COVID-19. The paper follows a qualitative study and an extensive literature survey to understand the antecedents of the ASC performance during the pandemic. We have adopted a focused group discussion with academicians, practitioners, and supply chain experts. The antecedents were developed using underpinning theory and linking it with the ASC. An FGD with 8 participants was conducted in July 2021 to finalize the antecedents undertaken for the study. The discussion was for 27 min. The discussion involved experts from diverse organizations to comprehend pertinent antecedents for the theoretical framework. The approach resulted in pretesting the theoretical framework developed from the literature. The questions posed with context to supply chain performance during COVID-19 were: What were the challenges in ASC performance during the pandemic? How was the ASC performance managed during the pandemic? What were the factors that enabled the ASC's performance during the pandemic? The panel members then approved the indicators and framed them in the theoretical framework. Table 1 presents the experts' profiles.

The answers and discussions in the FGD led us to finalize the antecedents and our theoretical framework. The theoretical framework was developed using extensive literature and focus group discussion, as shown in Fig. 2.

4.1 Linkage between collective action with organizational size and complexity

The pandemic has made the stakeholders realize the importance of collectives, but it is also essential to link the collective actions with the organizational size and complexity. The flexibility to expand and alter the scope depends on size and

Table 1 Details of the Experts in the focused-group discussions (FGD)

Code	Profession	Designation	Experience (Years)
A1	Academician	Professor	25
SCE1	Supply Chain Expert	Expert Consultant	17
R1	Researcher	Researcher	13
C1	Collectives working in the supply chain – Farmer Producer Organization, Self Help Group, Farmer Producer Company	Board of Director	9
C2	Collectives working in the supply chain – Farmer Producer Organization, Self Help Group, Farmer Producer Company	Member	8
C3	Collectives working in the supply chain – Farmer Producer Organization, Self Help Group, Farmer Producer Company	Chairman	7
PF1	Progressive Farmer	Progressive Farmer	11
D1	Distributor	Distributor	9

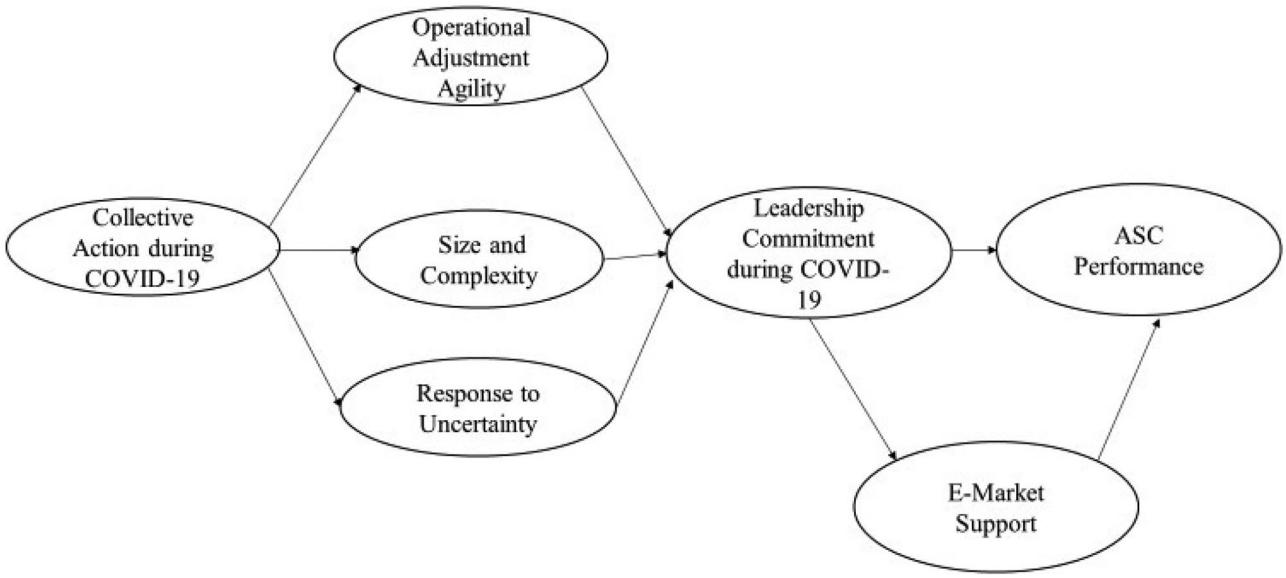

Fig. 2 Antecedents for Performance Measurement of ASC during COVID-19

complexity (Benaroch et al. 2006). The size refers to how big the work is being involved. Size and complexity are why many people who work on the same task do not achieve the expected performance. Size is likely to produce a better economy of scale. The collective approach in agriculture is essential to link the stakeholders in the supply chain (DeMarrais and Earle 2017). The collective action of the farmers may result in increasing the size and complex behavior for handling the bulk agriculture produces. We hypothesize that collective action increases the size, complex behavior, and dependence on individuals and suppliers. Hence, we posit that:

H1: Collective action during COVID-19 has a significant impact on organization size and complexity.

4.2 Linkage between collective action and operational adjustment agility

Operational Adjustment Agility refers to the ability of a firm to cope with the change in market or demand (Lu and Ramamurthy 2011). Agility refers to the flexible and rapid response to accepting a change. COVID-19 led to a shift in the supply chain behavior wherein it was expected by all firms to adapt to the changing environment. The management and agility were complex for the farmers and stakeholders with an individual approach. The collective action approach adopted the change and adjustments to the pandemic scenario. During COVID-19, collectives shifted towards IT capability and technology adoption for better ASC performance. This dynamic approach in operations resulting from the organizational theory can be linked to collective action. Collective action like this may lead to a flexible approach in any operation. Hence, we argue that collective action significantly influences operational adjustment agility. Hence we posit,

H2: Collective action during COVID-19 has a significant impact on operational adjustment agility.

4.3 Linkage between collective action and response to uncertainty

Uncertainty exists in every supply chain function (Lee and Billington 1995). COVID-19 led to upstream and downstream uncertainty. Upstream uncertainty resulted in late deliveries in the supply chain and poor quality of the agriculture commodities. Due to the closure of industries and pandemic scenarios, the supply chain was disrupted. The produce in the emerging economy found no place for storage which impacted the quality of the produce. Agriculture commodities having a short shelf life were wasted. Downstream uncertainty resulted in demand variability, disturbing the planning and performance of the supply chain. Since bulk buyers' closure, there has been a shift in the consumption pattern. This resulted in an imbalance in the performance of ASC. The collective approach is critical to managing both upstream and downstream uncertainty. Some collectives linked to farmers, distributors, and processing industries can reduce the impact of uncertainties and effectively manage the ASC performance. The response to uncertainty is an essential element of the organizational theory linked to collective action. Hence, we argue that collective action has a significant impact on the response towards uncertainty and posit the below hypothesis:

H3: Collective action during COVID-19 has a significant impact on responding toward uncertainty, thereby managing the uncertainty.

4.4 Linkage between size and complexity and leadership commitment during COVID-19:

The ASC is a decentralized system, and many challenges influence the leadership behavior in larger organizations. In the pandemic situation, the ASC, managed by collective leaders, was influenced by the challenges from the producers to the distributors. The leaders' performance measures in large organizations were complex due to external and internal constraints during the pandemic. Organizational factor involving people influences leadership commitment. COVID-19 led to the involvement and commitment of people towards ASC. Amid the pandemic, the farmers and stakeholders looked for opportunities to work together to manage the uncertainty. However, the leadership commitment has a critical influence on managing the complex behavior of the collectives and the size. The leadership belief and participation in the supply chain process in ASC increased the performance. The ASC imposes quality produce and competitive advantage (Thomas and Griffin 1996). This drives the trust and commitment to the stakeholders' relationship (Sarpong 2014). The COVID-19 raised questions about the complexity of the ASC, which led to the leadership commitment toward ASC performance. The organizational size and complexity can significantly influence the leadership commitment. A large firm poses a higher leadership commitment for better performance. Thus, we posit:

H4: Size and complexity have a significant impact on the organizational and leadership commitment during the management of COVID-19.

4.5 Linkage between response to uncertainty and leadership commitment during COVID-19

The response to uncertain demand and supply led to the leadership commitment during COVID-19. There was a need for a leader of the collectives who could make decisions and guide the stakeholders. The uncertain behavior during COVID-19 led to leadership commitment. The supply chain disruptions led to losses and wastages (McEwan et al. 2020), which required necessary actions by the leader. COVID-19 led to uncertain price fluctuations and demand and supply imbalance. Amid the uncertainty, there was a need for leadership commitment to control and balance the demand and supply. (Jia et al. 2019). Leadership is vital to winning a competitive advantage. Leadership Theories, including trait theory, behavior theory, situational theory, contingency theory, multifactor leadership theory, and leader-member exchange theory, discuss different leadership traits. The study is limited to explaining leadership commitment during uncertain situations. Top management commitment can better manage the response toward risk and uncertainty. Thus, we hypothesize as,

H5: Uncertainty in pandemic situations has a significant impact on leadership commitment.

4.6 Linkage between operational adjustment agility and leadership commitment during COVID-19

The requirement of agile functions and decisions was required during the pandemic, which led to the leadership commitment. The challenges like food safety, food waste, growing population, and climate change were a concern for the ASC (FAO 2020). Agriculture and food items are essential; therefore, they need to be managed during COVID-19. The concerns for food security resulted in operational adjustments during the pandemic. Losses of food were found due to lack of storage, demand and supply uncertainty, inefficient strategy, the shutdown of the processing plants, shortage of labor, and export–import disruptions. The disruptions in the supply chain led to immense instability in the ASC (Ivanov and Das 2020). Managing the unpredictable scenario was essential for the adjustment agility, leading to the leadership commitment (Weersink et al. 2020). Therefore, we argue that the operational adjustment agility will significantly influence the leadership commitment.

H6: Operational Adjustment Agility has a significant impact on Leadership Commitment during COVID-19.

4.7 Linkage between leadership commitment during COVID-19 and ASC performance

Commitment to organizations, organizational change, policy, and occupations have captured the attention of researchers and academicians. Commitment is the state of involvement and actions bound by the individuals (Salancik 1977). A leader's commitment has an impact on the organizational response to the diverse workplace (Ng and Wyrick 2011). Leadership commitment to the supply chain drives to achieve an efficient performance. Leadership commitment determines customer satisfaction (Ahire and Ravichandran 2001). Supplier quality is also counted by leadership commitment. The performance measures identified by Siddh et al. 2018 are Customer satisfaction, Supplier relationship, Sustainable performance, Innovative activities, Strategy and policy formulation, and Employee satisfaction. The researchers have studied the impact of leadership commitment on the overall performance matrix. The leadership commitment in different collectives resulted in profitability in the ASC

(Richards and Vassalos 2020). Agriculture leaders have invested in technology to connect the supply chain linkages digitally. The digital transformation by the leaders has led to the ASC's performance. Research has studied that the commitment from top management has resulted in better performance (Mukhsin and Suryanto 2021). ASC is a collective approach wherein leadership commitment is very imperative for the ASC performance. COVID-19 led to several experiments by the leaders who played a significant role in digital transformation for improving ASC during COVID-19.

H7: Leadership Commitment during COVID-19 has a significant impact on ASC Performance.

4.8 Mediating linkage of e- market support to leadership commitment and ASC performance

The initial failures of the supply chain during the pandemic remind us that besides all efforts, there was a need for a change in the supply chain practice. Hence the producers, distributors, and consumers took the assistance of the internet and the web (Nayal et al. 2021). There was a dire need felt to link the technology capability and interrelationship for supply chain performance. It was found through the FGD that E-Market Support mediated the linkage between the leadership commitment and ASC performance. Collaborative public e-market transformed the supply chain performance. The e-market is suitable for reducing risks (Starr et al. 2000). The use of electronic means for supporting the supply chain was required. Technologies like Artificial Intelligence, BlockChain, Big Data, Cloud Computing, Machine Learning, and the *Internet of Things* supported the ASC during COVID times (Gammelgaard et al. 2020). COVID-19 has led to the usage of online market platforms. Thus, we argue that e-market support significantly impacts ASC performance and posit:

H8: E-Market mediates the linkage between ASC performance and Leadership Commitment.

5 Research methodology

The study is an empirical research-based quantitative and qualitative approach, and the study adopts a deductive approach. The study was initiated with a systematic literature review and qualitative study leading to the formulation and validation of ASC performance antecedents.

5.1 Research framework

A quantitative survey further followed the study to validate the model (Fig. 3) empirically. An emerging economy like India was chosen for the study as the ASC performance was the most challenging due to dominant small and marginal farmers. The pandemic hit hard the emerging economy like India, where the country suffered from reverse migration, scattered supply chains, and wastage of agricultural produce. The study has undergone a survey for the ASC, which sustained their performance.

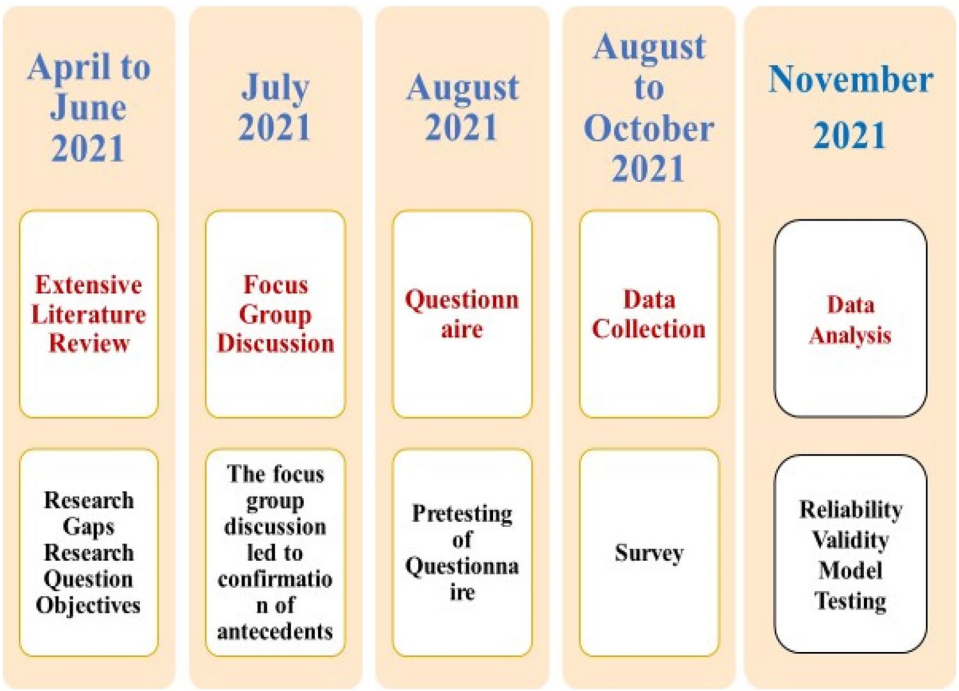

Fig. 3 Conceptual Framework

We performed focus group discussions and extensive literature to finalize the antecedents for ASC performance during COVID-19. Once the model was finalized, we empirically validated surveying respondents. We used a 5-point Likert scale, with 1 = strongly disagree, 5 = strongly agree. The qualitative analysis involved extensive literature and focused group discussion (FGD), which finalized antecedents and items. The theoretical framework finalized has been further validated using Covariance Based Structure Equation Modeling. Covariance Based Structure Equation Model (CBSEM) provides a robust result in parameter consistency, accuracy, and violation of assumptions (Reinartz et al. 2009). Nevertheless, Partial Least Square Structure Equation Modeling (PLS-SEM) may be preferred for prediction and theory development. The present model has been tested for robustness and comprehensiveness, and therefore CBSEM has been used.

5.2 Questionnaire development, data collection, and analysis

The questionnaire finalized was pretested by five experts (two academic experts, a government employee, and a progressive farmer)—the experts' have experience of more than seven years. Appendix-I present the constructs and their indicators used in the study, and Table 2 shows the revised items after the pretesting of the questionnaire.

In the first step, the questionnaires were distributed to the stakeholders involved in the ASC. The study used purposive sampling for selecting the respondents. The database for the stakeholders involved in the ASC has been prepared from the ASC seminars and agriculture trade exhibitions where in the stakeholders across the country. These stakeholders include progressive farmers, board of director members of farmer producer companies, and wholesalers engaged in the supply chain. These stakeholders were in the ASC for more than five years. The survey is limited to the supply chain of agricultural commodities. The final questionnaire was sent to 500 stakeholders involved in the ASC. We sent an email to all the stakeholders in the first week of August. We received a reply from 83 respondents by the 12th of September. A reminder email was sent to the stakeholders on 13th October 2021. We received a response of 103 respondents by 1st November 2021. We sent a reminder email again on 3rd November 2021, which led to 176 respondents by 5th November 2021. A sample size of 176 has been taken for the study. The study has used Covariance based Structure Equation Modeling (SEM) for empirically validating the data. The dependent and independent linkages with latent constructs have been incorporated. The endogenous and exogenous constructs have been identified. SEM has been found appropriate for analysis as it is a relevant statistics tool in social and behavioral science studies (MacCallum and Austin 2000). Therefore, we used the software package of AMOS for good quality path diagrams and reading SPSS files. The data obtained from 176 respondents have been cleaned for the missing data. The reliability of the data has been checked through Cronbach alpha (Table 3). The *Cronbach* alpha was greater than 0.7, which was found reliable (Gaur and Gaur 2009). The normality of the data set has been confirmed through skewness and kurtosis. The skewness value was found in the range ± 2 and kurtosis ± 7 (Curran et al. 1996). The non-response biasness has been checked with the data set before analysis (Lambert and Harrington 1990).

Table 2 Pretesting Result of the Questionnaire

Construct	Number Items	Pretesting Results
Collective Action during COVID-19	6	The final questionnaire dropped one item Our organization is more flexible than our competitors in changing our organizational structure. (CA6)
Size and Complexity	3	No Change
Operational Adjustment Agility	3	No Change
Response to Uncertainty	4	two indicator questions were reframed
Leadership Commitment during COVID-19	4	One indicator was removed Senior management periodically reviewed the activities and effectiveness of the supply chain. (LC5)
ASC Performance	3	No Change
E-Market Support	8	Four Indicators were removed as they were redundant Our organization used e-market support (online, website, internet) for Supplier search. (EM1) Our organization used e-market support for Pricing and negotiation. (EM2) Our organization used e-market support for Shipping/logistics management. ((EM7) Our organization used e-market support for Payment. (EM8)

Table 3 Reliability of all the constructs used in the model

Constructs	Reliability Statistics	
	Cronbach's Alpha	N of Items
Collective Action during COVID-19	.86	5
Size and Complexity	.72	3
Operational Adjustment Agility	.74	3
Response to Uncertainty	.79	4
Leadership Commitment during COVID-19	.78	4
ASC Performance	.70	3
E-Market Support	.87	4

6 Data analysis and findings

To proceed with the Data analysis, we checked the data for the Common method biasness. We performed Exploratory Data Analysis to confirm the variance of a single factor to be 50%. This method extracts the variance of a single factor solution by using exploratory factor analysis (EFA). The method is considered acceptable if the extracted variance is less than 50%. EFA uses IBM SPSS statistical software to extract a single factor in this study. The single factor variance extracted is 41 percent, below 50 percent; hence the constructs are acceptable (Aguirre-Urreta and Hu 2019; Jakobsen and Jensen 2015). Once the Common Method Biasness was confirmed, as shown in appendix-II, the data was used for further analysis.

6.1 Construct validity

The constructs have been checked for validity (Table 4).

6.1.1 Convergent validity

Convergent validity of the constructs has been confirmed using the scale composite reliability (SCR) and Average Variance Error (AVE). The results show that the factor loadings (λ) of the items were above 0.5, SCR ($SCR = \frac{\sum \lambda^2}{\sum \lambda^2 + \sum E}$) for each construct was > 0.7, and AVE ($Error = 1 - \lambda^2$) was > or equal to 0.5 (Campbell and Fiske 1959; Fornell and Larcker 1981) as shown in Fig. 4.

The factor loadings of the individual items were obtained from Covariance based Structure Equation Model. Figure 4 shows the output of the confirmatory factor analysis run through AMOS.

6.1.2 Discriminant validity

After confirming the convergent validity, we checked the constructs for discriminant validity through inter factor correlation matrix (Table 5). The diagonal elements, viz the square root of AVE, is greater than the correlation coefficients, indicating that the constructs possess discriminant validity (Fornell and Larcker 1981).

Table 4 Construct Validity

Construct	Number of Items	Factor Loadings	SCR	AVE
Collective Action during COVID-19	5	0.68	0.87	0.57
		0.71		
		0.67		
		0.81		
		0.87		
Size and Complexity	3	0.97	0.71	0.50
		0.44		
		0.53		
Operational Adjustment Agility	3	0.78	0.75	0.51
		0.50		
		0.82		
Response to Uncertainty	4	0.79	0.79	0.50
		0.63		
		0.56		
		0.78		
Leadership Commitment during COVID-19	4	0.69	0.77	0.50
		0.85		
		0.61		
		0.54		
ASC Performance	3	0.84	0.89	0.73
		0.83		
		0.89		
E-Market Support	3	0.61	0.88	0.64
		0.84		
		0.83		
		0.89		

6.1.3 Nomological validity

The nomological network idea was developed based on a philosophical foundation for construct validity. Nomological validity has been performed to test the actual construct relationships with theoretical relationships (Table 6). Nomological validity is tested for a series of construct correlations and compared with theoretical design. The correlations between the construct are positive, thus indicating good (Hair et al. 2010).

6.2 Model identification and degrees of freedom

The model was validated using Covariance-based Structure Equation Modelling using AMOS. The model has 39 fixed regression weights marked 1 for identification. There are

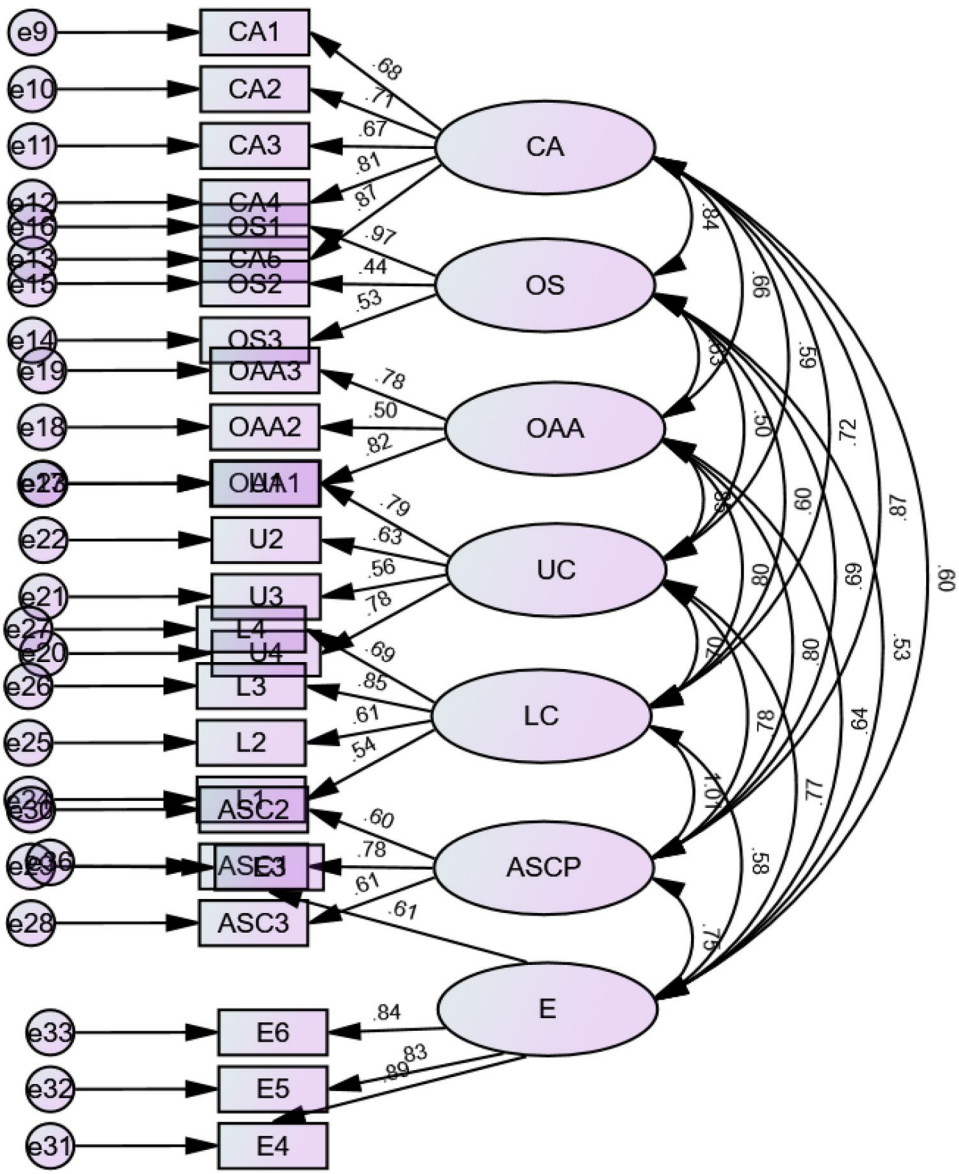

Fig. 4 Confirmatory Factor Analysis

28 regression weights to be estimated, and seven constructs have 33 variances from each other (Table 7). Thus, there are a total of 165 parameters, and 87 are to be estimated. The degrees of freedom are tabulated in Table 8.

6.3 Hypothesis testing

After confirming the reliability and validity, the model was run in AMOS. The results show that the model is recursive

Table 5 Discriminant Validity

	Collective Action during COVID-19	Size and Complexity	Operational Adjustment Agility	Response to Uncertainty	Leadership Commitment during COVID-19	ASC Performance	E-Market Support
Collective Action during COVID-19	0.75						
Size and Complexity	0.57	0.71					
Operational Adjustment Agility	0.54	0.57	0.71				
Response to Uncertainty	0.48	0.48	0.58	0.71			
Leadership Commitment during COVID-19	0.60	0.54	0.60	0.58	0.71		
ASC Performance	0.70	0.56	0.64	0.57	0.75	0.85	
E-Market Support	0.57	0.54	0.47	0.59	0.56	0.58	0.80

Table 6 Nomological Validity

	Collective Action during COVID-19	Size and Complexity	Operational Adjustment Agility	Uncertainty	Leadership Commitment during COVID-19	ASC Performance	E-Market Support
Collective Action during COVID-19	1						
Size and Complexity	0.57	1					
Operational Adjustment Agility	0.54	0.57	1				
Uncertainty	0.48	0.48	0.58	1			
Leadership Commitment during COVID-19	0.60	0.54	0.60	0.58	1		
ASC Performance	0.70	0.56	0.64	0.57	0.75	1	
E-Market Support	0.57	0.54	0.47	0.59	0.56	0.58	1

with a sample size of 176. The details of the model are shown in Table 9. It was observed that there were 65 variables in the model, with 26 observed variables and 39 unobserved variables.

Table 10 below represents the standardized regression weights of the variables. The standardized coefficients have been measured in standard deviation.

6.4 Model validation and path coefficients through SEM

Table 11 shows the path coefficient and hypothesis testing. Out of eight hypotheses, seven hypotheses were accepted based on the significant p-value. One hypothesis was rejected. The path analysis was done after obtaining the CFA model. Path analysis model analyses the fitness of the model. The result shows that the model fitness indicators are under acceptable limits. Figure 5 shows the empirical validation of the model.

7 Discussion

The spread of the COVID-19 has disrupted the ASC and has been given attention by scholars (Chowdhury et al. 2021; Farooq et al. 2021; Junior et al. 2021; Kumar and Kumar Singh 2021; Nasereldin et al. 2021; Perrin and Martin 2021; Sid et al. 2021; Timilsina et al. 2020; Yu et al. 2021; Ivanov 2020; Montoya-Torres et al. 2021). ASCs differ from other supply chains. The other supply chains were disrupted but faced a different constraint. The other supply chains did not have perishable commodities. Therefore, handling the product in other supply chains was not as complex as ASCs. In general, ASCs are labour intensive, especially for fisheries, animal products, and high-value crops.

Table 7 Parameter Summary: CFA

	Weights	Variances	Means	Intercepts	Total
Fixed	39	0	33	6	78
Labeled	0	0	0	0	0
Unlabeled	28	33	0	26	87
Total	67	33	33	32	165

The lockdown led to reverse migration leading to a shortage of labors and truck drivers. ASCs were prone to higher risks as compared to other supply chains. The other supply chains were disrupted due to the closure of cross borders. The lack of efficiency and expertise disrupted the ASC to a great extent (Stephens et al. 2020). Also, the pandemic has witnessed the migration of employees and workers, leading to a shortage of employees and farm workers. Other factors apart from COVID-19 increased the risk in ASC. Agriculture Farming activities depend on the season and climate. The emerging economies are also impacted by climatic and other local-issues such as floods and suffering from the severe locust attack, multiplication of locust eggs, and regions adversely affected by the floods. Social distancing and isolation norms restricted the stakeholders, which led to a delay in the SC activities. Maintenance of hygiene was the priority in ASC. The stakeholders took all possible safety and preventive measures to increase the performance of the ASC (Barman et al. 2021). The result also depicts that the operational adjustment agility was a significant factor for ASC performance. On the whole, it supports that ASC performance has been of strategic importance during COVID-19 (Chowdhury et al. 2020). The study also provides an in-depth understanding of the antecedents that led to ASC performance during COVID-19.

The causal effect analysis informs the linkages between the different antecedents and the way ASC managed to sustain its performance after many disruptions. Deliberating the relationship between the antecedents through the lens of the stakeholders develops a road map for the ASC during such disasters. The study has tried to pen the organization theory with the theme of our study. While the ASC has undergone severe disruptions, drivers have led the ASC to sustain during the pandemic. ASC is already a complex web, and the pandemic increased the complexity (Poudel et al. 2020). During the pandemic, a complex situation was generated, which posed challenges to ASC firms in

Table 8 Degrees of the freedom

The number of distinct sample moments:	377
Number of distinct parameters to be estimated:	87
Degrees of freedom (377—87):	29

Table 9 Model Description

Label	Number
Number of variables in the model	65
Number of observed variables	26
Number of unobserved variables	39
Number of exogenous variables	33
Number of endogenous variables	32

Table 10 Standardized Regression Weights of Latent Variables and Items

Standardized Regression Weights			Estimate
OS	<---	CA	.88
OAA	<---	CA	.74
UC	<---	CA	.59
LC	<---	OS	.24
LC	<---	OAA	.45
LC	<---	UC	.39
E	<---	LC	.72
ASCP	<---	LC	1.04
ASCP	<---	E	.04
CA1	<---	CA	.67
CA2	<---	CA	.72
CA3	<---	CA	.68
CA4	<---	CA	.79
CA5	<---	CA	.86
OS2	<---	OS	.44
OAA2	<---	OAA	.56
L3	<---	LC	.78
ASC3	<---	ASCP	.62
ASC1	<---	ASCP	.77
ASC2	<---	ASCP	.57
E6	<---	E	.86
E5	<---	E	.82
E4	<---	E	86
E3	<---	E	62
OS3	<---	OS	.55
OS1	<---	OS	.93
U2	<---	UC	.74
U1	<---	UC	.65
U3	<---	UC	.69
U4	<---	UC	.77
OAA3	<---	OAA	.78
OAA1	<---	OAA	.77
L4	<---	LC	.65
L2	<---	LC	.61
L1	<---	LC	.57

controlling the external elements. Our findings confirm that the size and complexity of supply chain firms led to extreme variations in the ASC performance (Roh et al. 2014). The measures for dealing with uncertainty also resulted in ASC performance. Public policy (Dyer 1983) and government regulations impact supply chain activities. During the pandemic, the policy significantly impacted the performance to a great extent. Apart from all the measures, leadership commitment was the prime factor for AS performance. A leader's role, function, and power determine the stage of an organization in terms of the culture, norms, stakeholders' behaviors, and decisions. The leadership commitment dealt with flexible and operational adjustments in the supply chain. The operational adjustment agility shown by the stakeholders resulted in a flexible approach to the ASC performance. While there was a change in the ASC structure, it was observed that the organizations tried to adapt to the new system by taking precautions. Measures to deal with Uncertain demand and supply also compelled the stakeholders to rethink the ASC practices (Kumari et al. 2021). The findings show that the size and complexity, operational adjustment agility, and uncertainty have led to the leadership commitment. The leaders associated with the ASC were compelled to rejuvenate the ASC. The farmers could not find a place for the agricultural produce and had to think of a strategy to sustain the supply chain. The leader influenced the attitude of collectives. Through their dedication, some leaders found that they made ASC more robust.

The producers, mainly small and marginal, could not find a good market for their produce. Amidst the collective action approach, the farmers accumulated together to form collectives, cooperatives, farmer producer organizations, self-help groups, non-government organizations, and farmer producer companies and managed to control the ASC performance. The farmers understood the role of collectives in the pandemic. Moreover, the agriculture sector is driven by the characteristic of perishability, and collectives can manage the product's short shelf life. Some collectives linked farmers, distributors, and processing industries to manage the ASC performance and deal with higher uncertainty, adjustments, and complex behavior (Barichello 2020). The farmer collectives adjusted their cropping cultivation to demand-driven crops. The collectives generated excellent revenue from the supply chain of the immunity generating crops like dragon fruits, tulsi, lemon, ginger, turmeric, and others.

The study findings indicate that leadership commitment was a significant factor during the pandemic. The respondents also highlighted that the leadership commitment varied from organization to organization. The farmers observed that the leaders of collectives created a new paradigm to adjust to the pandemic (Kumari et al. 2021). There was a leadership commitment in a firm towards technology adoption in supply chains; it seems to have resulted in improved efficiency. The study provides empirical support for the leadership commitment toward ASC performance. The commitment of the farmer leaders and collective leaders in the form of the *Chief Executive Officer* (CEO) and *Board of Directors* resulted in finding out alternate pathways for ASC performance. The survey analysis proves that leadership commitment leads to ASC performance (Norwood and Peel 2021). It has been observed that the pandemic led to online delivery and digital transformation. The e-market

Table 11 Path Coefficients and Hypothesis Testing

Unstandardized Regression Weights			Estimate	S.E.	C.R.	P-value	Result
OS	<---	CA	.67	.11	6.07	***	The result shows a significant impact of collective action on size and complexity. There will be a 0.67 unit change in size and complexity for every unit change in collective action
OAA	<---	CA	.90	.13	7.07	***	There is a significant impact of collective action on operational adjustment agility. There will be a change in operational adjustment agility for every unit rise in collective action by 0.90
UC	<---	CA	.75	.12	6.05	***	There is a significant impact of collective action on dealing with uncertainty. For every 1 unit change in collective action, there will be a 0.75 unit change in understanding and dealing with uncertainty
LC	<---	OS	.24	.096	2.52	0.012	There is a significant impact of size and complexity on leadership commitment. For every 1 unit change in size and complexity, there will be 0.24 unit changes in leadership commitment
LC	<---	OAA	.29	.07	4.33	***	There is a significant impact of operational adjustment agility on leadership commitment. For every 1 unit change in operational adjustment agility, there will be 0.29 unit changes in leadership commitment
LC	<---	UC	.24	.05	4.59	***	There is a significant impact of uncertainty on leadership commitment. For every 1 unit change in uncertainty, there will be 0.24 unit changes in leadership commitment
ASCP	<---	LC	1.32	.22	5.98	***	There is a significant impact of leadership commitment on agriculture supply chain performance. For every 1 unit change in leadership commitment, there will be 1.44 unit changes in ASC Performance
E	<---	LC	1.44	.22	6.64	***	E- Market Support does not have a significant relation with ASC performance, and this may be because developing countries' agriculture sector is not prone to digitalization and advanced technology that leads to the e-market. However, leadership commitment shows a significant impact on E-market support
ASCP	<---	E	.003	.06	.05	.964	

The p-value indicates that the direct relation between ASCP and E is insignificant. Therefore, there is no mediating role of E-market support in linking leadership commitment and ASC performance. The p-value for the remaining constructs is found significant

support in the ASC led to an increase in the market share and profitability in the supply chain (Hald and Coslugeanu 2021).

Like the Indian agriculture sector, the domain in emerging economies has also suffered from many disruptions during the pandemic. Our findings confirm that E-market is a critical variable for ASC performance that helped reduce the negative impact of those disruptions (Alkahtani et al. 2021). However, the respondents do not feel that e-market support is a mediator. They are of the view that it was already a mandatory initiative for operational adjustment agility, where all supply firms shifted their supply to online mode. The e-platform was chosen to promote and market the product (Chaudhary and Suri 2021). We observed that farmers are fragmented, unorganized, and technologically illiterate. During the pandemic, E-market support has been the need of the ASC. However, accepting the e-platform has been a

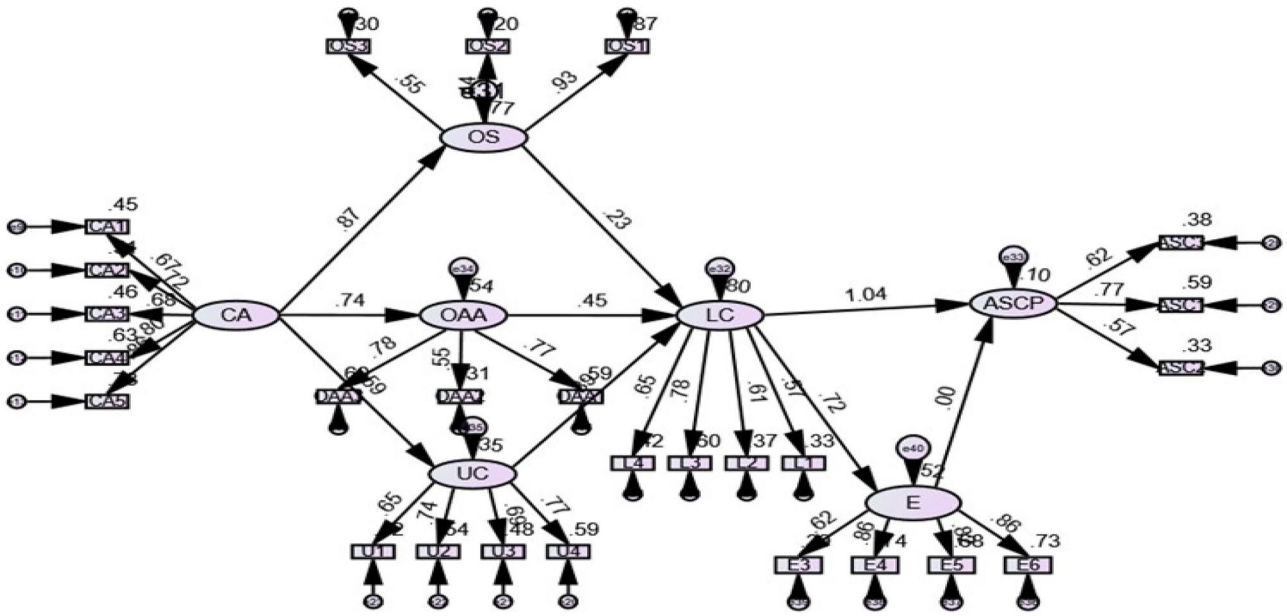

Fig. 5 Model Validation using AMOS

challenge for the farmers. This has been one of the reasons for the overall distress in the ASC. However, e-market support was not a new concept in agriculture. In 2016, the Government of India launched an online market platform named *National Agriculture Market* (eNAM) to bring together the stakeholders in an online p1latform (Behera 2021).

The online platform helps in getting a better price for the farmers. The reason behind the slow integration of the online system is attributed to the high resistance from the stakeholders (Kumari et al. 2022). During the pandemic, the stakeholders realized that the online platform was the only way to stop physical movement and the spread of the virus. The operational adjustments led to the shifting from the offline mode to the online system of ASC. Undoubtedly, the intermediaries in the chain were reduced, and the ASC has performed well with an increase in the producers' revenue. It also led to saving the cost and making prompt payments in the entire chain. The e-market apps were generated by many farmer collectives like Abhinav Farms, VAPCOL, Sahyadri Farmer producer Company, and others (Kumari et al. 2021). The extraordinary efforts made by the leaders in the collectives led the ASC performance to increase. The application of the online market system could be seen before the pandemic. The regions which were limited with digitalization techniques spent more on labor. The study highlighted the complexity of the ASC and the adjustments made by the producers and stakeholders to sustain the ASC performance. The ASC performance was increased following the extra precautions and social distancing. The study has highlighted the difficulties faced by the stakeholders during the pandemic and how the complex, uncertain and agile adjustments led to leadership commitment in the collectives and other ASC firms to sustain the ASC performance.

The findings can be integrated into the advanced theoretical debates. The studies focusing on IoT, machine learning, digitalization, and technology adoption in ASC need to highlight the antecedents for the ASC performance. The technology alone cannot result in ASC performance, and it needs to be led by integrating theories like organizational and collective action theory. Researches need to shift from solely focusing on the online platforms and technology to integrating the factors like operational adjustment agility, leadership commitment, and collective actions, which can add to the theoretical knowledge for ASC performance. The deliberations around organization size, collective action, adjustment agility, and leadership commitment warrant a need to focus on the antecedents in theory for ASC performance.

8 Implications

The study contributes significantly to theoretical, policy, and managerial implications. The study provides valuable insights to the ASC researchers and practitioners, and it highlights the prompt actions carried out by the stakeholders of ASC. The study has a role in academic, policy, and managerial recommendations to deal with disasters in the coming future.

8.1 Managerial implications

First, this study extends existing research on ASC performance concerning the practices in COVID-19. The ASC is one of the important sectors of the economy. COVID-19 has disrupted the ASC. In light of the challenges in the ASC, the study has shown considerable concern about the functions of the supply chain. The study is not a duplicate record of the challenges faced by the stakeholders during the pandemic. Instead, the study has tried to understand the antecedents better to sustain the ASC performance. Second, we found some interesting insights regarding the relationship management between the stakeholders, resulting in better ASC performance. COVID-19 resulted in restrictions that changed the working conditions. It provides a platform to schedule a better performance transparently to all the stakeholders. It releases a better commitment seen from the stakeholders' leadership's dedication drove their commitment to sustain the performance. Third, the study provides insights into organizational complexity and operational adjustment agility. The ASC shifted to technology adoption and digitalization of their work. The offline market system shifted to online and social distancing mode. The institutional role of governments also acted as a support for sustaining the ASC performance. Lastly, ASC performance is influenced by the commitment and trust the leaders have made during COVID-19. It has been observed during COVID-19 that the collective that performed well was because of strong and committed leadership behavior. Collectives and farmer leaders set an example by making extraordinary efforts to sustain the ASC performance. The collectives can undertake different approaches by the successful collectives.

8.2 Theoretical implications

The study offers valuable contributions to the literature. First, leadership commitment theory is essential and emerging in supply chain management research. There have been studies that have focused on different styles of functioning towards leadership commitment. Our study supports that leadership commitment has been the key factor in ASC performance during COVID-19. Second, collective action theory finds a unique contribution toward ASC performance in an emerging economy. The farmers in developing countries are small and marginal, and they cannot perform efficiently in the supply chain at an individual level. Therefore, they look for integrated opportunities. There is a challenge in focusing on sustaining such collectives. Third, a collective approach leads to better supply chain performance. The study is grounded on organization theory as a relatively important theory for ASC performance during pandemics. It highlights the essential parameters of organization theory essential for ASC performance and find the application of organization theory and explore complex behaviors in an

organization. The challenge faced by the size and complexity of the agriculture system in the ASC performance is highlighted in the study. The information deliberated in the paper will help the researchers to understand the performance of AVC during uncertainty. The decision-making during risk and uncertainty can be very well understood through the linkages of the constructs in the study. The readers will get a comprehensive practical knowledge of the disruptions and remedial measures adopted by the industries. The data collection and model validation offers a theoretical contribution toward methodology. The results have built up a robust theoretical debate for better ASC performance during COVID-19. Lastly, the extant literature remains far from linking these three critical theoretical perspectives to analyzing performance. The pioneering study links leadership, collective, and organization theory for ASC performance. Thus, the study offers key inputs for future academicians and researchers to understand how the farmers and stakeholders managed to sustain the ASC performance during uncertain conditions like COVID-19.

8.3 Policy implications

The study has some policy implications. First, The ASC strategy needs to be centralized, focusing on the farmers. The study supports the need for stakeholder awareness on the e-market support to all the stakeholders. Besides, there is a need to conduct training for bringing together the farmers in the form of collectives. Farmers may be encouraged to understand the significance of collectives and be encouraged to be collective leaders. Some countries, such as India, designed financial and institutional support for the farmers to form collectives. Second, the price fluctuation issues should be focused on gaining a competitive advantage by the ASC stakeholders. The knowledge about the policies and schemes designed for the ASC should be spread at the ground level. There is implication to the policy designed by bureaucrats. The deliberations can help formulate the training need assessment of the stakeholders for a better ASC performance. Third, there is a need to recognize and award the successful collectives in the ASC. Farmers need to be aware of the key performing indicators of a collective that help design their strategies. The ASC suffers from quality, storage, and long-chain issue. There is also a need to develop a strategic roadmap for making the farmers aware of the upcoming good agriculture practices and the quality of the agriculture produce. Lastly, a developing country such as India launched an online trading platform (eNAM) in 2016. Such projects are yet to be recognized by the stakeholders. They force policymakers to revise and propose the integrated policy frameworks with attractive incentives and promote digital transformation initiatives. It also warrants ground-level training to promote and website for marketing cultural products.

9 Conclusion

The ASC issues had caused the problems offered by the demand shock. Stakeholders have adopted the situation to improve the performance. The performance of the ASC measured by different metrics has shown a decline. The parameters of ASC have performed differently during the pandemic situation. Our study aims to identify the primary indicators to assess the performance of ASC during the pandemic (Kusrini and Maswadi 2021). We have identified different performance measurement metrics to assess the ASC. The findings of the study indicate the antecedents for performance assessment in ASC. Many global stakeholders said that the ASC has been complex and challenging to manage during uncertain times. Hence, this research contributes to sustaining ASC performance during the pandemic. The study contributes to narrowing the knowledge gap in the ASC performance during COVID-19 by focusing on the prime antecedents which led to proper management. The study also contributes to the ASC performance literature by pioneering the literature survey. It also helps to finalize the empirically validated antecedents using the structural equation modeling technique; the study theorizes the commitment and organization theory to address the priority antecedents for the ASC performance. Finally, The COVID-19 has been the driving factor for the digital transformation (Gupta and Badal 2018) and triggered e-market support for SCs.

Though the study is relevant to the current situation, yet has a few limitations. The findings are established on the industry, which has focussed on primary processing and fresh agriculture produce. The study has not touched on the concerned sectors' processed produce and cold chains. This drives the study for future research directions. Firstly, it prompts a study of the processed produce supply chain. It is essential to understand the recovery measures for the agriculture value chain. The agriculture value chain is more complex and needs a framework for improving performance. Secondly, it motivates studying the cold agriculture chain. The cold chain is an emerging concept and plays a vital role in sustaining the perishable agriculture produce. A lot more complexities and challenges again drive the application of the cold chain. The agriculture cold chain performance needs to be studied during COVID-19. The linkage of theory for sustainable food supply chain performance during such a disaster is an area that needs to be looked into. The food supply chain was also a significant problem during the pandemic. Finally, the global supply chain performance is a concern that needs to be integrated into strategic frameworks.

Appendices

Appendix-I Constructs and Definitions

Constructs	Definition	Indicators	Reference
Collective Action	Collective Action is the collaborative effort of the individuals	In our organization, stakeholders discussed important issues in the ASC during COVID-19. (CA1) In our organization, stakeholders coordinate their efforts harmoniously. (CA2) In our organization, information is widely shared between stakeholders so that those who make decisions or perform jobs have access to all available know-how. (CA3) We share every update with the stakeholders. (CA4) Our organization work in collaboration and coordination with the stakeholders. (CA5) Our organization is more flexible than our competitors in changing our organizational structure. (CA6)	Kumari et al. (2021a, b); Schulz and Blecken (2010); DeMarrais and Earle (2017); Benaroch et al. (2006)
Size and Complexity	Size and complexity refer to the variation in the scope of the organization	The organization size is big for handling the supply chain operations. (SC1) The ASC had been very complex relative to other supply chains during COVID. (SC2) The completion of work on the skills and experience depends on the organization's team members. (SC3)	Sarpong (2014); Benaroch et al. (2006); Thomas and Griffin (1996)
Operational Adjustment Agility	A firm can cope with the market or demand change	We fulfilled demands for rapid-response special requests of our customers whenever such demands arose; our customers had confidence in our ability. (OAA1) We quickly scaled up or scaled down our production/service levels to support fluctuations in demand from the market during COVID. (OAA2) Whenever there was a disruption in supply from our suppliers during COVID, we quickly made necessary alternative arrangements and internal adjustments. (OAA3)	Lu and Ramamurthy (2011); Sambamurthy et al. (2003); Tsourveloudis et al. (1999)
Response to Uncertainty	Uncertainty refers to the inability to predict changes and asymmetric information	It was easy for me to get relevant quantitative information through the internet during the pandemic. (UC1) I believe that the firm could evaluate the various alternatives. (UC2) The store's Web site provided adequate information. (UC3) The online site provided sufficient information about the product. (UC4)	McEwan et al. (2020); Jia et al. (2019); Devaraj et al. (2002)
Leadership Commitment during COVID-19	It is the commitment to knowledge management by understanding the goals and business strategy	There is a general understanding at the top levels of management about how supply chain knowledge is applied during the pandemic. (LC1) There is a board-level (or equivalent) representation for the supply chain. (LC2) Senior management demonstrated response to policy, guidelines, and activities. (LC3) Senior management demonstrated commitment and action during the pandemic. (LC4) Senior management periodically reviewed the activities and effectiveness of the supply chain. (LC5)	Siddh et al. (2018); Richards and Vassalos (2020); Kulkarni et al. (2006); Ahire and Ravichandran (2001)
ASC Performance	Supply Chain Performance refers to increased market share, profit, and customer satisfaction. (maybe limited to cost management and responsiveness. Though the stated performance measures are acceptable, they are more firm centric rather than supply network)	Customers were satisfied with our delivery and supply chain. (ASCP1) Our organization managed to sustain its Market Share during the pandemic. (ASCP2) The profitability of the organization's supply chain showed an increasing trend. (ASCP3)	Kumar et al. (2020); Chithambaranathan et al. (2015); Dubey et al. (2013); Raghavendran et al. (2012)

Constructs	Definition	Indicators	Reference
e-Market Support	E-Market Support is the use of web, online, and digitalization for marketing	Our organization used e-market support (online, website, internet) for Supplier search. (EM1) Our organization used e-market support for Pricing and negotiation. (EM2) Our organization used e-market support for the Purchase order. (EM3) Our organization used e-market support for Demand forecast. (EM4) Our organization used e-market support for the Delivery schedule. (EM5) Our organization used e-market support for Inventory management. (EM6) Our organization used e-market support for Shipping/logistics management. ((EM7) Our organization used e-market support for Payment. (EM8)	Nayal et al. (2021); Gammelgaard et al. (2020); Premkumar et al. (2005); Starr et al. (2000)

Appendix-II Common Method Bias Test using Single Factor Herman's Test

Total Variance Explained (Principal Component Analysis)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.871	41.811	41.811	10.871	41.811	41.811
2	2.145	8.251	50.062			
3	1.887	7.256	57.318			
4	1.724	6.629	63.947			
5	1.330	5.114	69.061			
6	1.221	4.698	73.758			
7	.971	3.733	77.491			
8	.917	3.528	81.019			
9	.685	2.633	83.653			
10	.565	2.174	85.826			
11	.470	1.810	87.636			
12	.445	1.712	89.348			
13	.409	1.574	90.922			
14	.351	1.351	92.273			
15	.308	1.186	93.458			
16	.252	.971	94.429			
17	.249	.957	95.386			
18	.239	.919	96.304			
19	.205	.790	97.094			
20	.164	.631	97.725			
21	.136	.523	98.249			
22	.133	.510	98.758			
23	.108	.414	99.172			
24	.085	.328	99.500			
25	.081	.311	99.811			
26	0.049	.189	100.000			

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Declarations

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