**Cost-Benefit Ratio and Constraint Analysis of Supply Chain for Fresh Fruits and Vegetables in Lucknow District, Uttar Pradesh, India**

**ABSTRACT**

This research provides insights in the supply chain of fresh fruits and vegetables in Lucknow district of Uttar Pradesh. Multistage purposively-cum-random sampling was used to select 120 random respondents. Cost-Benefit ratio was used to determine the profitability of different stakeholders in supply chain. The overall CBR was 1.47 highlighting economic feasibility of supply chain. Respondents incorporating modern technologies like cold storage, standardization etc had a higher CBR ratio compared to traditional approach. Involvement of middlemen and lack of direct market access were the major challenges faced by respondents. Fruits and vegetables supply chain is overall a profitable business for all the stakeholders and government supports and training programmes for awareness and adoption of modern practices will help improve the situation of farmers drastically for the marketing of fresh fruits and vegetables.

***Keywords:*** *Stakeholders, FFV, Cost-Benefit Ratio, Supply chain, Garrett ranking*

**INTRODUCTION**

The fresh fruits and vegetables (FFV) supply chain is a critical component of India's agricultural economy. It ensures the timely distribution of highly perishable commodities from farm to consumers. This supply chain not only supports food and nutritional security but also sustains the livelihoods of millions of farmers, traders, wholesalers, and retailers across the country (Imtiyaz & Soni, 2014; Chand et al., 2021). Among Indian states, Uttar Pradesh stands out due to its large population, agricultural diversity and significant market for horticultural products (Singh, 2008). The Lucknow district, being both the capital and a major consumption hub, serves as a vital node in the state’s FFV network.

In recent years, supermarkets and organized retail formats have gained momentum in India’s agri-food system, responding to rising urban incomes and consumer preferences for clean, graded, and fresh produce. This transition from traditional to modern supply chains brings forth numerous advantages, such as improved storage, streamlined procurement, and better price realization for certain actors (Arumugam et al., 2010). However, it also introduces several challenges, including uneven benefit distribution, infrastructure gaps, and market inefficiencies (Fundira, 2004; Kumari & Ratan, 2019).

In the context of the Gosaiganj block of Lucknow district, which is a prominent fruit and vegetable cluster, this study aims to analyse the economic viability of stakeholders engaged in the supermarket supply chain and compare it with traditional channels. The study also identifies and ranks the major constraints affecting efficiency using Garrett ranking technique, thereby providing actionable insights for improving supply chain performance and farmer welfare. As previous research has emphasized (Kumari & Panda, 2020; Hart et al., 2007), there is a pressing need to strengthen linkages, reduce transaction costs, and enhance institutional support to maximize gains in perishable Agri-supply chains.

**MATERIAL AND METHODS**

**Sampling Technique**

A multi-stage purposive-cum-random sampling technique was used for the collection of primary data. The Lucknow district and Gosaiganj block were selected purposively because of high concentration of fresh fruits and vegetables supply chains. For an unbiased representation 120 stakeholders were selected randomly from among farmers, retailers, traders, wholesalers, and supermarket managers involved in the supply chain. This sampling method was found most suitable for the for the collection of primary data in urban areas of Gosaiganj block.

**Table 1: Stakeholders and commodity classification of respondentss of Lucknow district, Uttar Pradesh**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Stakeholder Category** | **Total number** | **Fruits** | **Vegetables** | **Both** | **Grand Total** |
| Farmer | 23 (19.16) | 5 | 8 | 10 | 23 |
| Retailer | 27 (22.5) | 13 | 6 | 8 | 27 |
| Supermarket Manager | 20 (16.66) | 9 | 6 | 5 | 20 |
| Trader | 36 (30) | 8 | 19 | 9 | 36 |
| Wholesaler | 14 (11.66) | 7 | 4 | 3 | 14 |
| **Grand Total** | **120 (100)** | **42 (35)** | **43 (35.83)** | **35 (29.16)** | **120 (100)** |

**\*Note: Percentage values are presented in parentheses**

**Figure 1: Stakeholders classification of respondents of Lucknow district, Uttar Pradesh**

**Descriptive Statistics**

It is used to simplify and present the data. Percentage method was utilized for finding the proportional contribution of different stakeholders in the respondent (Omar et al., 2025). The formula used:

$$Percentage= \left(\frac{Component Value}{Total Value}\right) X 100$$

**Cost-Benefit Analysis**

It is used to determine the economic gain or net profit. It checks the profitability of the supply chain. If the CBR is more than 1 then the operation is economically feasible,if the CBR is less than 1 then the operation is not feasible and the it should be discontinued and if the CBR = 1 that means break event point which means no ptrofit and no loss condition.The formula used:

Net Benefit (Profit) = Total Revenue – Total Cost

Cost-Benefit Ratio (CBR) =$\frac{Net Benefit}{Total Cost}$

**Garrett Ranking Technique for Constraint Analysis**

It is one of the best and effective method to analyse major constraints experience by the stakeholders in supply chain of fresh fruits and vegetables. Individual Respondent was asked to rank the constraints on the basis of severity from 1 to 10. 1st rank was given for the most severe problem and 10th rank for the least (Gupta et al., 2025). The rank was converted to score and mean was taken for analysis of the rank. The formula used:

$$Percent Position = \left(\frac{R\_{ij}- 0.5}{N\_{j}}\right) X 100$$

Where,

$$R\_{ij}= rank of the i^{th} constraint by the j^{th} respondent$$

$$N\_{j}= total number of constraints ranked by the j^{th} respondent$$

**RESULTS AND DISCUSSION**

The cost-benefit analysis of the supermarket supply chain for fresh fruits and vegetables reveals that traders contribute the highest share of total cost (29.09) and also gain the highest net benefit of ₹89.73 lakh (26.39) with a cost-benefit ratio (CBR) of 1.34. Wholesalers, despite accounting for only 10.32% of the total cost, achieve the highest CBR of 2.87, indicating exceptional efficiency. Supermarket managers follow with a CBR of 1.52, contributing 17.54% to the cost and earning 18.13% of the net benefit. Retailers and farmers, though significant in the supply chain, exhibit relatively lower CBRs of 1.14 and 1.29 respectively. Overall, the entire supply chain yields a total monthly cost of ₹2.31 crore against a revenue of ₹5.71 crore, resulting in a net benefit of ₹3.40 crore and an average cost-benefit ratio of 1.47, highlighting a profitable and economically viable system.

**Table 2: Cost-Benefit analysis for different stakeholder in the supply chain management of fruits and vegetables in Lucknow district of Uttar Pradesh**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Stakeholder category** | **Total Monthly Cost** | **Total Monthly Revenue** | **Net Benefit** | **Cost-Benefit Ratio** |
| **Farmer** | 4563583(19.77) | 1043744218.28 | 5873859(17.27) | 1:1.29 |
| **Retailer** | 5374466(23.28) | 1152673920.19 | 6152273(18.09) | 1:1.14 |
| **Supermarket Manager** | 4049099(17.54) | 10212684(17.89) | 6163585(18.13) | 1:1.52 |
| **Trader** | 6715697(29.09) | 15688869(27.48) | 8973172(26.39) | 1:1.34 |
| **Wholesaler** | 2383144(10.32) | 9224139(16.16) | 6840995(20.12) | 1:2.87 |
| **Grand Total** | 23085989(100) | 57089873(100) | 34003884(100) | **1:1.47** |

The comparison of modern and traditional supply chains in the Lucknow district reveals that the modern supply chain is more efficient and profitable, with a higher overall cost-benefit ratio of 1.42 compared to 1.16 in the traditional system. In the modern model, traders and farmers benefit the most, each with a high cost-benefit ratio of 1.43, contributing 29.03% and 19.06% of the total net benefit, respectively. Supermarket managers also perform well with a CBR of 1.35, while retailers and wholesalers show moderate profitability. In contrast, the traditional system yields lower returns across all stakeholders, with farmers earning a CBR of just 1.15 and traders at 1.24. The supermarket managers in the traditional chain show minimal profitability with a CBR of 1.03, and the overall distribution of net benefits is skewed in favour of intermediaries. Overall, the modern supply chain offers better returns for all stakeholders, especially producers and traders, indicating a more balanced and efficient system for fruit and vegetable distribution.

**Table 3: comparison between modern and tradition supply chain management practices.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Modern** | **Stakeholder category** | **Total Monthly Cost** | **Total Monthly Revenue** | **Net Benefit** | **Cost Befit Ratio** |
| **Farmer** | 2271620(17.57) | 5515227(18.42) | 3243607(19.06) | 1:1.43 |
| **Retailer** | 3375985(26.11) | 7390290(24.68) | 4014305(23.58) | 1:1.19 |
| **Supermarket Manager** | 2436371(18.85) | 5721124(19.10) | 3284753(19.30) | 1:1.35 |
| **Trader** | 3453080(26.71) | 8394173(28.03) | 4941093(29.03) | 1:1.47 |
| **Wholesaler** | 1390688(10.76) | 2927714(9.78) | 1537026(9.03) | 1:1.11 |
| **Overall Total** | 12927744(100) | 29948528(100) | 17020784(100) | **1:1.42** |
| **Traditional** | **Stakeholder category** | **Total Monthly Cost** | **Total Monthly Revenue** | **Net Benefit** | **Cost-Benefit ratio** |
| **Farmer** | 2291963(22.56) | 4922215(22.44) | 2630252(22.34) | 1:1.15 |
| **Retailer** | 1998481(19.67) | 4136449(18.86) | 2137968(18.16) | 1:1.07 |
| **Supermarket Manager** | 1612728(15.88) | 3281560(14.96) | 1668832(14.17) | 1:1.03 |
| **Trader** | 3262617(32.12) | 7294696(33.26) | 4032079(34.25) | 1:1.24 |
| **Wholesaler** | 4992456(33.26) | 2296425(10.47) | 1303969(11.08) | 1:1.31 |
| **Overall Total** | 10158245(100) | 21931345(100) | 11773100(100) | **1:1.16** |

The table 4, ranks various constraints faced by stakeholders in the agricultural supply chain based on Garrett’s mean scores. The highest-ranked constraint is the involvement of middlemen with a score of 58.82, indicating it as the most significant challenge. This is followed by lack of direct market access (55.85) and unpredictable market demand (51.81) as the second and third most critical issues. Other notable constraints include the high cost of packaging (51.34) and lack of training/awareness (49.19). Lesser-ranked challenges include inadequate government support (49.04), lack of cold storage (48.84), transport delay (44.91), spoilage during transit (42.15), and poor price realization (40.42). This ranking highlights the key barriers to efficiency and profitability in the supply chain, emphasizing the need for interventions to reduce middlemen involvement and improve market access.

**Table 4: Constraint analysis of supply chain management of fruit and vegetable in Lucknow district of Uttar Pradesh**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr No.** | **Constraints** | **Percent Position** | **Garrett’s mean Score** | **Rank** |
| 1 | Lack of cold storage | 42 | 48.84 | **VII** |
| 2 | Transport delay | 36 | 44.91 | **VIII** |
| 3 | Poor price realization | 18 | 40.42 | **X** |
| 4 | Involvement of middlemen | 81 | 58.82 | **I** |
| 5 | Lack of direct market access | 70 | 55.85 | **II** |
| 6 | High cost of packaging | 57 | 51.34 | **IV** |
| 7 | Inadequate government support | 47 | 49.04 | **VI** |
| 8 | Spoilage during transit | 29 | 42.15 | **IX** |
| 9 | Unpredictable market demand | 63 | 51.81 | **III** |
| 10 | Lack of training/awareness | 52 | 49.19 | **V** |

**CONCLUSION**

The study highlights the critical economic relationships and constraints in the fresh fruits and vegetables supply chain in Lucknow district, Uttar Pradesh. Cost-benefit analysis revealed that the modern supply chain system provides significantly higher economic returns for stakeholders, particularly traders (1.47) and farmers (1.43), when compared to the traditional model. Wholesalers in the supermarket-driven system achieved the highest cost-benefit efficiency. Meanwhile, constraint analysis through the Garrett ranking technique identified the involvement of middlemen, lack of direct market access, and unpredictable demand as the most pressing issues affecting stakeholder profitability and efficiency. These findings underscore the need for targeted policy interventions such as reducing intermediaries, strengthening direct marketing channels, improving storage infrastructure, and increasing stakeholder awareness to enhance the economic viability and sustainability of the fresh produce supply chain.

**AUTHORS’ CONTRIBUTIONS**

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**REFERNCES**

Arumugam, N., Fatimah, M. A., Chiew, E. F., & Zainalabidin, M. (2010). Supply chain analysis of fresh fruits and vegetables (FFV): Prospects of contract farming. *Agricultural economics*, *56*(9), 435-442.

Chand, K., Suresh, A., Dastagiri, M. B., Kumar, S., & Mandal, S. (2021). Fruit marketing, its efficiency and supply chain constraints in India: A case study. *Indian Journal of Agricultural Sciences (TSI)*, *91*(8), 1146-1150.

Fundira, T. (2004). *A transaction cost analysis of the fruit supply chain in South Africa: A case study approach* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Gupta, S., Omar, I., Yadav, D. N., & Yadav, U. (2025). Growth and Performance of Kisan Credit Card Scheme in Sultanpur District of Uttar Pradesh, India. *Journal of Experimental Agriculture International*, *47*(6), 420-431.

Hart, V., Kavallari, A., Schmitz, P. M., & Wronka, T. C. (2007). *Supply chain analysis of fresh fruit and vegetables in Germany* (No. 36). Discussion Paper.

Omar I., Supriya, Kumar P., Gupta S.,T S., Yadav U. (2025). Growth prospects of India’s plantation crops: Insights from simple growth rate analysis. Int J Agric Extension Social Dev 2025;8(5):563-567.

Imtiyaz, H., & Soni, P. (2014). Evaluation of marketing supply chain performance of fresh vegetables in Allahabad district, India. *International Journal of Management Sciences and Business Research*, *3*(1).

Kumari, K., & Ratan, R. P. (2019). Constraints Analysis in Vegetable Supply Chain Management in Small Production System. *Indian Journal of Extension Education*, *55*(3), 150-153.

Kumari, M., & Panda, C. K. (2020). Analysis of demand supply and production constraints in major fruits & vegetables in Bihar. *Economic Affairs*, *65*(2), 225-232.

Singh, S. (2008). Supply Chain Management for Fruits and Vegetables in Uttar Pradesh. *Study submitted to Uttar Pradesh Council of*.