

## Safety in Agriculture Supplychain Using Meta Regression Analysis

**Dr. R.N.V. Jagan Mohan**  
**SRKR Engineering College,**  
**Bhimavaram**

**Abstract:** *India considers agriculture as a crucial sector since it provides livelihood for approximately 70% of households and 10% of urban inhabitants on average. In order to reach the end consumer, agricultural commodities undergo several stages in the supply chain. These stages involve harvesting, processing, storage, transportation, and marketing. Each stage is crucial for the successful delivery of high-quality products to the market. Due to the involvement of middlemen, farmers in India often struggle to cover their basic expenses and may not receive fair prices for their products. This can result in significant financial losses, leaving farmers unable to repay loans and leading to severe economic distress, sometimes resulting in suicide. Recent research has indicated that farmer suicides make up a significant proportion of all suicides in India, accounting for 11.2% of cases. To address these challenges faced by farmers in India, a website has been developed with the aim of establishing a direct link between farmers and consumers. By facilitating direct transactions, the website seeks to mitigate the issues caused by middlemen and provide greater financial stability to farmers while also ensuring consumers receive high-quality, locally sourced agricultural products. Supply chain management refers to the coordination and oversight of the various processes involved in the movement of goods and services, from the sourcing of raw materials to the production of finished products. These processes involve a range of activities such as transportation, storage, and transformation, all of which are essential in delivering high-quality products to the end consumer. In general, the supply chain for agriculture can be divided into three main stages: first, the movement of crops from farms to intermediate storage facilities; second, the transportation of these crops from storage facilities to processing plants for transformation into finished products; and finally, the distribution of these products from processing plants to clients and end consumers. The experimental results estimate plant cost using least square estimation and supply chain process of goods price estimation on various with the help of MetaAnalysis.*

### **1. Introduction:**

A supply chain refers to the complex network of individuals and organizations involved in the creation and delivery of a product to the end consumer. It typically begins with the producers of raw materials and ends with the delivery of the finished product to the customer. Effective supply chain management is crucial as it can result in lower costs and a more efficient production cycle, helping businesses to

remain competitive in the market. The process of a supply chain typically involves several stages, starting with the sourcing of raw materials, whether it is mining diamonds, curing leather, or manufacturing sheet metal. The raw materials are then transported to a wholesaler who sells them in batches to manufacturers. The manufacturer then uses these materials to create a finished product, which is then delivered to a retailer for sale to the end consumer. At each stage, the product needs to be prepared, packaged,

shipped, and unpacked, making the process complex and intricate. Earlier works on these lines by various authors are as follows:

Kamble SS (2020), *Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications*. The primary purpose of the review was to understand the level of analytics used (descriptive, predictive and prescriptive), sustainable agriculture supply chain objectives attained (social, environmental and economic), the supply chain processes from where the data is collected, and the supply chain resources deployed for the same.

Magesa MM (2020), *Access and use of agricultural market information by smallholder farmers*, Good access to markets and market information may help farmers bypass middlemen while selling crops and thus benefit more. Thus, it is best to improve the informational capabilities (ICs) of farmers in agricultural marketing.

Mérel PR (2019): *Middlemen Market Power*, This article develops a multistage spatial model to determine impacts on marketing costs and competition.

Murudi AS (2019): *Farm produce delivery management*, The farmers are completely dependent upon local traders and middlemen for disposal of their farm produce. This is due to the lack of good marketing facilities. Hence, the products are sold at a throwaway price.

Badar HA [5] (2018): *The role of middlemen in agricultural marketing*, Many marketing inefficiencies like lack of market intelligence, insufficient infrastructure, exaggerated role of middlemen, adulteration, hoarding and profiteering, excessive rates of various services, collusion amongst traders to suppress prices, and mismanagement of input and output markets are some of the main

problems which leave a small amount of marketable surplus.

Ranjan R. (2017): *A model of bargaining between farmers and middlemen*, We present a model of bargaining between farmers and middlemen in which long-term risk considerations by farmers constrain their ability to engage in hard bargaining. In order to avoid the risk of middlemen exiting their region in the future due to hard bargaining, farmers settle for lower prices for their produce. The risks of prolonged drought-induced decline in produce quality and future oversupply of the perishable agricultural commodity also result in lower price outcomes under bargaining. If farmers join a collective that enhances their bargaining power, they tend to be better off when the group is homogeneous.

Heang JF (2015): *The role of internet marketing in the development of agricultural industry*, Agricultural producers in China encounters many issues in marketing their products to end customers. As a result, many have ended up selling their produce to middlemen, but many middlemen manipulate the situation and squeeze producers so that it has become difficult to realize profits. With the proliferation of Internet access and increasing computer literacy rates, this research seeks to understand if Internet marketing could play an important role in helping these agricultural producers.

Iyer RS[8] (2021): *A Portal for Connecting Farmers and End Users*: The aim is to give the farming community a fair and consistent price for their products and the farmers can overcome the problem of facing the middlemen. The farmers can directly connect with the wholesalers, retailers or the end-users and supply the product directly to them. This will ensure that there is an increase in the profit of the farmers.

Watanabe M (2021):The value chain of locally grown japonica rice in Mewa, Kenya:The net profits for locally grown japonica rice in Kenya were higher than those of conventional rice at the production, processing, and distribution stages, which is an advantage for producers and demonstrates that the elimination of middlemen is effective and highly profitable for each stakeholder.

Vasileiou and Morris (2020),conducted descriptive research based on primary data collected through exploratory interviews of 240 potato cultivators, 17 potato merchants and 4 potato retailers and analyzed the data using non-parametric statistical tools. Results reveal that all participants of the supply chain were immensely concerned about sustaining their respective businesses and gaining comparative advantages and economic, market, social and environmental factors have great bearing on these endeavours.

Frick, et al. (2019), studied issues pertinent to supply chain of potatoes, lambs by interviewing cultivators and supply chain intermediaries. They found that entrepreneurship prospects were bright in supply chain of these commodities. However, they have cautioned that such prospects are highly dependent on efficient utilization of fuel and relationships between the components of the supply chain. Taylor (2020) - conducted action research and used value stream analysis (VCA) involving farmers and a key processor and retailer and unearthed through a close scrutiny of lean supply chain mechanism that supply chain performance, efficiency, profitability and relationship between components of supply chain have got immense scope for improvement.

Minten, et al. (2018) surveyed branding of agriculture commodities and SCM issues in Bihar. They found that brand materialization in agriculture commodities results in

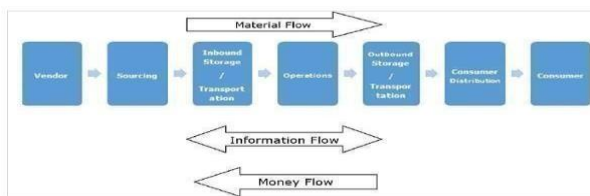
enhanced delineation in retailing segments. The authors have revealed shocking information for consumers that quality of branded commodities sold in packed materials are inferior when compared with those available in the market in loose lots.

Punjabi (2020) studied problems confronting SCM practices of fresh food and vegetable items in India by obtaining responses from corporate managers involved in the process. Her study exposed issues like insufficient refrigerated warehousing facilities, excessive competition among traders in conventional markets, contractual obligations of agriculturists and agro-business firms, dearth of standardization in agricultural commodities, non-compliance with APMC Act while procuring agricultural produce from agriculturists and improper handling of the postharvest produce due to lack of training.

**1.1. Understanding a Supply Chain:** A supply chain encompasses every stage involved in delivering a finished product or service to the end customer, from sourcing raw materials and production to transportation and distribution. The key entities involved in the supply chain include producers, vendors, warehouses, transportation companies, distribution centers, and retailers. The supply chain is activated when a business receives an order from a customer and involves functions such as product development, marketing, operations, distribution networks, finance, and customer service. Effective supply chain management can help lower overall costs and improve profitability, but any disruptions in the chain can prove costly. Supply chain management refers to the organized flow of goods, materials, and relevant information among suppliers, companies, retailers, and consumers. There are three distinct flows in supply chain

management, which include the physical flow of products and materials, the information flow that involves communication among entities involved in the supply chain, and the financial flow that tracks payments and transactions between entities. Each of these flows is critical in ensuring a seamless and efficient supply chain.

There are three different types of flow in supply chain management namely as **Material flow**, **Information/Data flow**, **Money flow** are as follows:



**1.1.1. Material Flow:** A critical component of supply chain management is ensuring the smooth flow of materials from producers to consumers. This involves the use of warehouses and other distribution points that serve as intermediaries between distributors, dealers, and retailers. A major challenge is to ensure that the movement of materials remains uninterrupted at each point in the chain, as this helps to minimize the cash cycle for the enterprise. Additionally, completed goods may flow from customers to their end consumers through various channels. It's also possible for items to flow from consumers to producers for repairs, exchanges, or recycling of end-of-life materials. Maintaining a quick and efficient material flow is key to a successful supply chain.

**1.1.2. Information Flow:** The flow of information or data in supply chain management involves the exchange of various documents between the customer and supplier. This may include requests for quotations, purchase orders, monthly schedules, engineering change requests, quality complaints, and reports on supplier

performance. On the producer's side, the information flow may include company presentations, offers, purchase order confirmations, dispatch details, reports on inventory, invoices, and more. Communication and collaboration between the producer and consumer are essential for an efficient and effective supply chain. Often, other partners such as distributors, dealers, retailers, and logistic service providers are also involved in the information network. Various departments within the producer and consumer's organization are also part of the information loop. It is important to note that the internal information flow for in-house manufacture may differ from this process.

**1.1.3. Money Flow:** The clients review the order to verify its accuracy based on the producer's invoice. If the information is accurate, payment is made from the client to the producer. The producer to transfer money to the client uses debit notes. To achieve a productive and streamlined supply chain, it is necessary to manage all three flows - material, information, and money - with minimal effort. Supply chain managers face the challenge of determining which information is essential for effective decision-making. Therefore, having access to all three flows with just a click of a button is preferred.

### **Fig-1: Supplychain Management**

**2. Related Work:** The food and agriculture sector faces significant challenges when it comes to supply chain risks. One of the primary challenges is transportation expenses for farmers when trying to sell their products. Many farmers rely on intermediaries to sell their products, which often results in them receiving lower prices than their products are worth. These middlemen then sell the same products at much higher prices, leading to a lack of fairness and equity in the supply chain. The

lack of direct access to consumers puts farmers in a vulnerable position, as they have to rely on middlemen to sell their produce. The middlemen occupy the entire space between production and final sale, giving them significant power in the supply chain. This power dynamic often disadvantages the farmers, who despite being the producers, are left at the mercy of the middlemen.



**Fig-2: Process of Supplychain**

The Indian government passed the Agricultural Produce Market Committee (APMC) Act in 1963 to prevent farmers from being exploited by middlemen. However, despite efforts to increase farmers' income, middlemen continue to capture a significant portion of the profits, hindering the government's ability to deliver benefits to farmers. Between 2018 and 2020, more than 17,000 farmers from various regions in the country have reportedly taken their own lives. According to the ADSI report, in 2018, 5,763 farmers or cultivators committed suicide, while 5,957 took their lives in 2019. The report also revealed that 5,579 farmers or cultivators committed suicide in 2020.

### 2.1. Safety in Agriculture Supply Chain:

Supply chain safety is a crucial component of supply chain management that focuses on the management of risks arising from external suppliers, logistics, transportation and vendors. Its primary objective is to identify, assess and mitigate potential risks involved in collaborating with other organizations within the supply chain. Supply chain security encompasses physical security measures for products as

well as cybersecurity measures for software and services. Due to the diverse nature of supply chains and the involvement of numerous organizations, there are no established guidelines or best practices for supply chain security. Therefore, a comprehensive supply chain security strategy requires adherence to risk management principles and a robust cyber defense system.

### 2.2. Agriculture Supply Chain:

Agriculture is an important part of India's economy and at present, it is among the top two farm producers in the world. This sector provides approximately 52 percent of the total number of jobs available in India and contributes around 18.1 percent to the GDP. Agriculture is the only means of living for almost two-thirds of the employed class in India. Agriculture plays a vital role in the Indian economy. Over 70 per cent of the rural households depend on agriculture. Agriculture is an important sector of Indian economy as it contributes about 17% to the total GDP and provides employment to over 60% of the population. From farm to fork, the agri-foods supply chain is typically a long journey with multiple touchpoints. Once harvested in a farmer's barn, the produce is first sent to primary processors, who clean, cut, package, and sort the crops into appropriate sizes for sale. From the processor, it then moves to wholesalers who distribute the produce to retail stores or fresh foods markets in cities and towns. From the market/retail outlet, it finally reaches the customer for consumption.

### 2.3. Contribution of Work:

- The primary objective is to maintain a healthy relationship between farmers and customers based on the selling of the crops.
- The objective of is to maintain a

web portal which manages the transactions of products which were bought by the customers.

- The farmers to sell it to the customer also use the web portal to add new products.

**3. Proposed work:** The predicament of farmers is that they cannot sell their products directly to consumers, and as a result, they depend on intermediaries who take advantage of their situation by offering low prices for the farmers' goods and then selling them for a much higher price. This unfair system can lead to farmers accumulating significant debts and, in the worst-case scenario, even committing suicide. To avoid this, it is essential to enable farmers to directly communicate with consumers and sell their products. By doing so, they can bypass the intermediaries and receive fair compensation for their hard work. However, it is crucial to ensure that the details of the farmers and their transactions with consumers are kept confidential and secure.

**3.1. Meta Analysis of Safety in Agriculture Supplychain:** Before conducting a meta-analysis, it is common to conduct a systematic review to ensure that all relevant data is identified and evaluated, minimizing the risk of bias in the overall analysis. The typical process involves several steps:

1. To initiate a systematic review, researchers typically start by creating a study question using the PICO method, which involves identifying the Population, Intervention, Comparison, and Outcome of interest.
2. Conducting a comprehensive literature search using various databases, such as PubMed, Scopus, and Web of Science, to find relevant studies and articles that meet the inclusion criteria for the review.

### 3. Study selection

3.1. Incorporating quality standards such as the need for particular crops to meet consumer demands.

3.2. Narrowing down the selection of crops based on overly specific criteria.

3.3. In order to prevent biases, it is necessary to determine whether the study has been considered for inclusion.

4. When conducting a meta-analysis on a specific crop, it is important to carefully consider the dependent variables or summary measures that will be included. Some factors to keep in mind include the crop yield, nutritional value, disease resistance, and marketability. It is important to select variables that are relevant to the research question and that have been consistently reported across studies to ensure the accuracy and reliability of the meta-analysis. Difference between discrete trial data.

4.1. Mean of Continuous data.

4.2. Hedge's  $g$  is a widely used summary measure for continuous data, which is standardized to remove any scale differences and incorporates a measure of variation between groups. It is calculated using the formula:  $\delta = (\mu_t - \mu_c) / \sigma$ , where  $\mu_t$  represents the mean of the treatment group,  $\mu_c$  represents the mean of the control group, and  $\sigma$  represents the pooled variance. Select a model for the meta-analysis, such as a fixed effect or random effects model.

4.3. Use meta-regression or subgroup analysis, for example, to look into the reasons for study heterogeneity.

**4. Methodology:** Our solution is to maintain a web portal like Secure Supply Chain Operation on Agriculture to maintain the supply chain management system on agriculture. The portal can be used to establish direct communication between the producers and consumers without the involvement of third parties. Thereby assuring fair business. The farmers are

provided to login into the portal using their login credentials. After successful login, they are redirected to the Home Page. The details of the farmer include information such as passbook number, number of acres in which they farm, previous transactions, bank account details etc. To avoid the risk of unauthorized logins, the details are secured using cryptography algorithms. Farmers can browse through the available suppliers to get their requirements to farm. This includes suppliers' details and can easily transact with them. Without the involvement of third parties, one can easily go through the receiver section and supply their products. The previous and updated transaction details are available in the form of a report. Farmers can easily track their transactions, and details of their suppliers and consumers. The details of the farmers remain secured. Unauthorized access to the accounts can be prevented by using cryptographic algorithms. The communication between the producer and consumer is secured and encrypted. Whenever there is an increase or decrease in crop production, the farmer can edit the data by entering into the 'my profile' page. The data of the product, which has to be sold by the farmer, lies on the supply page. The blogs page is used to get information about the pricing policies set up by the government.

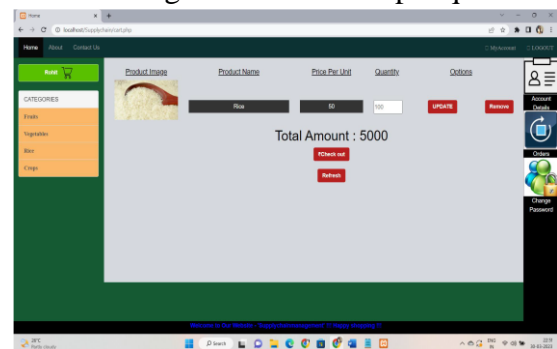
**5. Experimental Result:** The result can be compared by taking the data from various farmers basing on the details given by them and comparing with the prices approved by them. We can make a case study by considering all the previous sales by them to the market.

Farmers were compelled to sell their produce below the Minimum Support Price (MSP), which was prevalent for major crops such as wheat, rice, etc. The government

releases the MSP for the crops every year. The MSP details can be found on the official website

<https://farmer.gov.in/mspstatements.aspx>.

This issue was also witnessed in some parts of Uttar Pradesh, where union leaders forced the farmers to sell their crops below MSP due to the decline in market rates. The implementation of the new farm laws in Uttar Pradesh has led to a significant drop in crop prices, with some crops being purchased at prices that are below the minimum support price (MSP). For example, paddy is currently being sold at Rs 800 per quintal, which translates to Rs 8 per kg. This price is much lower than the usual rate of Rs 25 per kg for paddy, which has been the standard market price. The following image shows that the Rice is being sold at Rs 5000 per quintal:



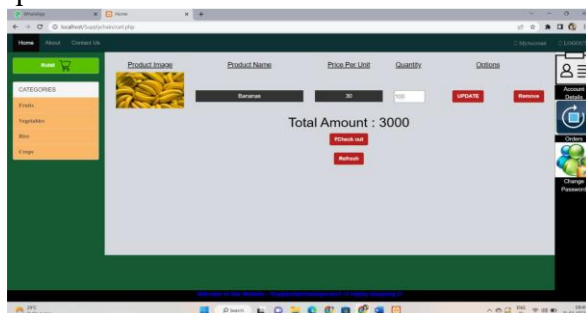
**Fig-4: Minimum Support Price**

Supply chain management can facilitate direct delivery of goods from the farmer to the customer, enabling the customer to receive the products without any intermediaries involved in the process.

Gaon Connection, a media outlet, conducted a survey across 19 states in India, seeking the opinions of 18,267 respondents on the major issues faced by farmers in the country. The survey results revealed that 43.6% of the respondents, or 4,649 individuals, believe that the lack of fair prices for farmers' produce is a significant issue that needs to be addressed. Furthermore, 19.8% of respondents stated that they are experiencing various challenges due to the changing



climate, while 17% reported that the increasing input costs are causing farmers considerable distress. The experts consulted on this matter have cited the lack of minimum support price for farmers as the primary reason for their inability to receive a fair price for their products. Additionally, as per a report by OECD-ICAI, farmers suffered a loss of Rs 45 lakh crore between 2000 and 2017, owing to their failure to obtain fair prices for their produce. Patidar, a resident of Harsola village located in Mahu block, Madhya Pradesh, expressed his concerns about the profitability of growing bananas. He stated that at a wholesale market in Indore, bananas were being sold for Rs 5-6 per kilo, or Rs 500-600 per quintal, which is lower than their input costs. He further added that in such a situation, he and other farmers often question the rationale behind growing bananas. The following image shows that the bananas were being sold at Rs 3000 per quintal:



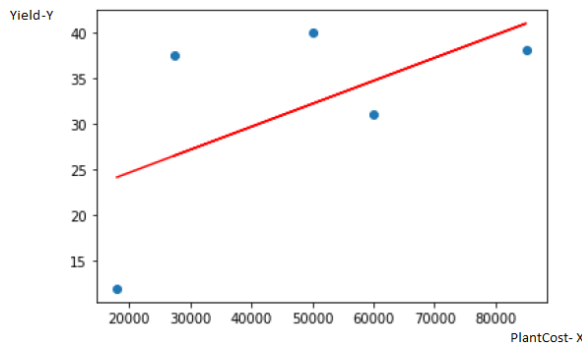
**Fig-5: Banana Crop Price**



**Fig-6: Individual Crop Growth and Rate in Year wise**

The experimental outcome is on crop farming in agriculture calculated or projected per acre yield cost. Let us acknowledge that in real life, there is not always such a perfect match between data inputs and predictions, which is why machine-learning algorithms are required. The equation for a straight line is  $y = mx + c$ , where  $m$  is the slope (slope) and  $c$  is the y-intercept, where  $m$  is the slope (slope) and  $c$  is the y-intercept (where the line crosses the y-axis). After equating a straight line from two points in the formula  $y = mx + b$ , we may apply the same equation to estimate places with different values of  $x$  leading to a straight line.





**Figure-6: Not Perfectly straight line**

The relationship between the variables in Least Square Regression is linear and is represented by a straight line, also called as a regression line, line of average relationship, or prediction equation. If Y is reliant on X in the examination of a relationship between two variables X and Y, then a simple linear relationship exists.

$Y = a_0 + a_1X$ . is known as the Y on X regression line. Similarly, if X is dependent on Y,  $X = b_0 + b_1Y$ .

We assume that the least squares straight line of Y on X is  $Y = a_0 + a_1X$ .

It is normal equations are

$$\sum Y = Na_0 + a_1 \sum X$$

$$\sum XY = a_0 \sum X + a_1 \sum X^2$$

Substituting the values

$$158.5 = 5a_0 + 240400a_1$$

$$8333500 = 240400a_0 + 14399760000a_1$$

Solving  $a_0 = 0.0029273971$ ,  
 $a_1 = 1.6794218742$

Thus the least square straight line Y on X is  $Y = a_0 + a_1X$ .

To replace the values are above equation, so that

$$Y = 0.0029273971 - 1.794218742X$$

$$Y_{\text{estimate}} = Y(\text{at } X=4) = 1.7912913771(4) = 7.174$$

**5. Conclusion:** Secure Supply Chain Management is the way in which both the farmers and the customers will benefit as the intermediaries takes no role in the process of delivering the products from the farmers to the customer. On successful management of this Supply Chain, the farmers will be paid more amounts to their crop compared to the amount offered by the intermediaries. The middlemen costs included such as Transportation cost, Pricing policies, Commission agent cost, Wholesaler cost, Where as the customers will also be benefited as the products received by them will be directly sent by the farmers without the defective ones. The future perceptive of this work is applied on Artificial Intelligence and others.

## 6. References:

1. Kamble SS, Gunasekaran A, Gawankar SA: Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications, International Journal of Production Economics, 219:179-94, 2020.
2. CMagesa MM, Michael K, Ko J: Access and use of agricultural market information by smallholder farmers: Measuring informational capabilities, The Electronic Journal of Information Systems in Developing Countries, 86(6):e12134, 2020
3. Mérel PR, Sexton RJ, Suzuki A: Middlemen have market power: A developing-country analysis, American Journal of Agricultural Economics, 91(2):462-76, 2019.
4. Murudi AS, Keerthana K, Likith SR, Reddy MV, and Shashikanth

- TS: Farm produces delivery management, 2019.
5. Badar HA, Mustafa K: The role of middlemen in agricultural marketing: Myths and reality. Retrieved on 12 March 2018:E548, 2018.
  6. Ranjan R: Challenges to farm produce marketing: a model of bargaining between farmers and middlemen under risk, *Journal of Agricultural and Resource Economics*, 386-405, 2017.
  7. Heang JF, Khan HU: The role of internet marketing in the development of agricultural industry: a case study of China, *Journal of Internet Commerce*, 65-113, and 2015.
  8. Iyer RS, Shruthi R, Shruthi K, Madhumathi R. Spry Farm: A Portal for Connecting Farmers and End Users, In 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS) 2021 Mar 19 (Vol. 1, pp. 429-433), IEEE, 2021.
  9. Watanabe M, Sumita Y, Azechi I, Ito K, Noda K: The value chain of locally grown japonica rice in western Kenya. *Agriculture*, 2021 Oct 8;11(1nb0):974, 2021.
  10. Vasileiou, K. and Morris, J: The Sustainability of the Supply Chain for Fresh Potatoes in Britain Supply Chain Management: An International Journal, 11, 317-327, 2020.
  11. Frick, B., Vitins, G., Eisen, R., Oleschuk, M., Lipton, B. and Consulting, R.S: Local Food Supply Chains in Alberta: Case Studies from the Saskatoon, Potato and Lamb Sectors, 2019.
  12. Taylor, D.H: Value Chain Analysis: An Approach to Supply Chain Improvement in Agri-Food Chains, *International Journal of Physical Distribution & Logistics Management*, 35, 744-761, 2020.
  13. Minten, B., Singh, K.M. and Sutradhar, R: Branding and Agricultural Value Chains in Developing Countries: Insights from Bihar (India), *Food Policy*, 38, 23-34, 2018.
  14. Punjabi, M: Initiatives and Issues in Fresh Fruit and Vegetable Supply Chains in India, 2020.