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Supply Chain Management: For the Indian Agri- Food Sector

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ABSTRACT: *The present research work reflects the existing supply chain architecture of the Indian Agri-food sector and provides areas where concentration is needed for its improvement. The research work is followed by designing an avant-garde sustainable supply chain model named as "Project Samridh Bharat" for Indian Agri-food sector. The present study also highlights the impact of FDI in Indian scenario and is followed by developing a performance measurement framework for the Agri-food supply chain network by an analytical decision making tool named analytical hierarchy process (AHP).*
Indian village life, agriculture cannot be just viewed as an economic sector; rather it is a "way of life" for the millions of Indians. In India agriculture predominantly determines about the culture, traditions and the socio-economic patterns of the society. Therefore the agriculture and the related activities should not be brought directly under the commercial economic system, otherwise due to the centralization and power grip (whether it be at the level of the state, or a person or be any business group) the exploitation of the masses will take place for the production and distribution of the resources essential for sustenance of the

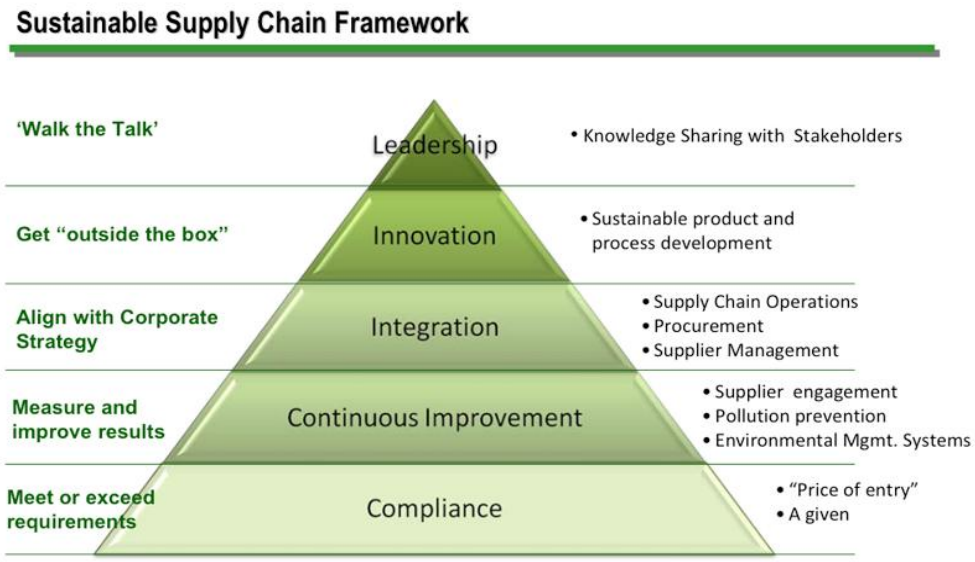
I. INTRODUCTION

Every human being has certain desire (needs and wants). Needs being the basic state of human desire that is needed for survival such as air, water, food, cloth, shelter and Wants being the secondary desire for living satisfaction such as cars, processed food, etc. In economic terms these needs and wants creates demands and hence to fulfill these demands someone has to supply the desired things. These creates a never ending process of demand and supply and takes a form of chain known as supply demand chain commonly known as supply chain.

What is supply chain?
A supply chain is an integration of:-

All facilities, functions, activities, associated with the flow and transformation of goods and services from backend (production house) to front end (customer base).

An integrated group of processes to "source," "make," and "deliver" products.
All process which involves the flow of information from backend to frontend and vice versa.



According to Cooper et al. (1) Supply chains are the conduits through which:

1. Products move from producers to consumers.
2. Payments, credit and working capital move from consumers to producers.
3. Technology and advanced techniques are disseminated among producers, packagers and processors.
4. Ownership rights pass from producers to processors and ultimately to marketers.
5. Information on current customer demand and on retail level product preferences pass back from retailers to producers.

Supply Chain Management: In present times, Supply chain management (SCM) has received a great deal of attention from worldwide practitioners and researchers both from academic and industrial background. Due to the emerging trends of globalization and the increasing saturation of markets, competition has become more intense in recent years. These competitive environments have forced companies to collaborate more closely using the concept of supply chain management. Supply chain management is an approach to design value chains or marketing chains by optimizing the inter-organizational flow of material, information and capital in order to reduce the system wide costs and enhance customer value.

A. supply chain management is:-

A set of approaches used to efficiently integrate :

– Suppliers
– Manufacturers/producers
– Warehouses
– Distribution centers
– Consumer base

So that the product is produced and distributed :

– In the right quantities
– To the right locations
– At the right time

System-wide costs are minimized and

Indian Agri-food sector: Agriculture was and is one of the largest employment sectors in the world and for India it's the major or the primary source of employment. More than half of Indian population depends on agriculture as their primary source of livelihood (24). Agriculture is the backbone of Indian Economy. The occupational structure of Indian workforce can be divided into three classes as shown in Fig (2.1). Agri-food sector constitute the primary sector of the occupational structure. India is the fruit and vegetable basket of the world. India being a home of wide variety of fruits and vegetables holds a unique position in production figures among other countries. Estimates currently suggest that India ranks second in terms of farm output, first being china (25).

Although there have been a large number of people involved in agriculture in India, still there is a food crisis. In India, agriculture got its dimension during green revolution. This introduced several new scientific methods, which increased the food productivity. But still, In India, 37 % live below poverty line and several hundred die due to malnutrition (26). Although the green revolution in India led to sizeable increase in terms of productivity that too in certain crops but the overall growth in terms of farmers economic status is unremarkable.

Agriculture derives its importance from the fact that it has vital supply and demand links with the manufacturing sector. The basic characteristic which is common in agriculture and manufacturing sector is: "Production"

Challenges in Indian Agri-food Sector

According to Hon'ble Union Minister SharadPawar, "Agriculture sector is witnessing radical changes and challenges at national and global level. The demand for agricultural commodities is steeply rising; food preferences of the next-generation consumers are changing; and agriculture sector is struggling with decelerating profitability which is dragging its performance. The emerging challenges and opportunities call for a paradigm shift in the innovation driven agricultural research system to connect inventions with all the stakeholders in the entire food supply chain".

Two different types of contrasting trends have been noticed in present times with respect to present Indian scenario:

1. India is being recognized as the global power in the key economic sectors with consistent high economic growth and
2. Its slow growth observed in the agriculture sector is causing concerns for the future food and nutritional security of the country.

Review on Existing Traditional Indian Agri-food Supply Chain Network

In the case of the agricultural sector, India's supply chain is one of the most fragmented and inefficient ones in the world resulting in wastage of large quantities of food grains, vegetables and fruits. About 25-30 percent of vegetables and fruits are destroyed before they come to the market. Apart from this, output is procured through unhygienic practices. This means farmers and consumers bear the costs of the wastage. The agricultural markets are not functioning in a proficient manner. Apart from inefficiencies in distribution, including wastage of agricultural produce, the farmers suffer due to exploitation by traders.

Problem Analysis Methodology

The present research work is based on a real world problem and then it is modelled in the ideal world with certain assumption in order to meet with the desired criteria. A real world problem is taken, in the present case the traditional Indian Agri-food supply chain network. It is then modelled in the ideal world with certain assumptions and after then it is analyzed with respect to different criteria's (in the present case wastages and supply chain cost). The results obtained are discussed and concluded by providing a better design for a sustainable supply chain network in chapter 4 under the title "Project Samridh Bharat".

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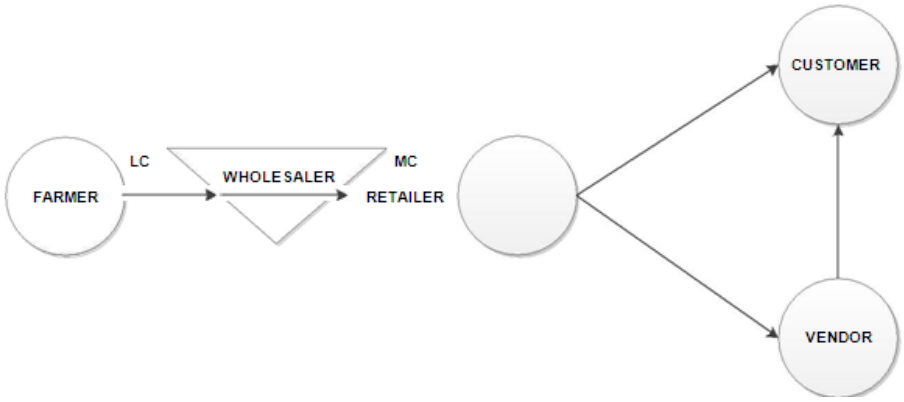


Disadvantages associated with the Existing model

From the results of the past researches and along with the data provided by planning commission of India, it seems that there are lot of drawbacks associated with the present supply chain model. It was rightly said in the starting of this chapter that, the present supply chain model creates nothing except a poverty trap for the small and marginal farmers.

The disadvantages associated with different elements along the traditional supply chain model can be summarized in the following way:-

At farmer's side:-

1. Low return on investments.
2. Prices delinked from the market.
3. Unavailability of adequate infrastructure.
4. High Credits leading to debt trap or poverty trap.
5. High commission charges.
6. High transportation cost.
7. Lack of marketing option at farm gate.
8. Distress selling.

At commission agent's side:-

1. Non value adding player.
2. Unscientific handling.
3. Quality deterioration.
4. Risk free income.

Charges huge commissions from farmers. At trader's side:-

1. No infrastructure for grading
2. Unhygienic means of handling.

Large wastages due to ineffective transportation facilities.

Motivation for bringing the change

There are various factors that motivated the author to work in this sector despite of being from engineering background. Some of the reasons are:-

1. Why the farmers are doing suicides?
2. Unlike other industrial sector, farmers (the producers) know nothing about market status.
3. Agri-food products are the natural resources of any country and are the primary needs for sustaining life, hence localization i.e., fulfillment of the local demands should be the first objective.
4. Proper flow of money in market should be justified when it comes to the basic and foremost necessity (food).
5. Efficient supply chain management framework can be developed for sustainable growth of the Indian Agri-food sector.
6. Sustainable supply chain management in Agri-food sector can cater bread and butter to a large number of people along with sustaining the existing employment opportunities.
7. Being an Indian citizen it is the duty of an Indian to think upon the existing problems of the country and search for its solution.

Features of the Proposed Model

1. No commission agents involved.
2. Cost effective.
3. Complete supply demand management with software support.
4. Every farmer members are the shareholders.
5. Less handling so less wastages.
6. Proper food grading according to food safety measures.
7. Retail counters at village and city for BPL card holders and NGOs.
8. Proper financial and technical support to farmers.
9. Proper waste management system for entire food wastages.
10. Seed bank support.
11. Proper warehousing and inventory management.

A combination of modern retail and cooperative framework with Government support. Hence, can be called as a "GPC" model.

Feature and benefits associated with the Proposed model

The salient features of the proposed model are:-

1. Transportation facilities for farmers.
2. Crop Insurance facilities for farmers.
3. Education and training.
4. Medical facilities.
5. Seed bank support.
6. Technical support.

Table No. 4.1 Functions associated with the proposed model

Functions	Traditional model	Proposed model
Transportation facilities	×	□
Storage facilities	×	□
Automated weighing machine	×	□
Trainings	×	□
Profit sharing	×	□
High ROI	×	□

The benefits associated with the proposed model are:-

1. Optimization in resource use and output management.
2. Increase in farm income
3. Shares on the profit.
4. Reduced storage losses

Cost Benefit Analysis

This section evaluates the performance of the existing model, Modern retail model and the proposed model on the basis of cost-benefit ratio (CBR). A cost-benefit analysis helps in determining the profitability of farmers. The cost-benefit ratio is computed as an indicator of economics of investment criterion. This ratio helps in judging the feasibility of investing in the proposal. The cost-benefit ratio is a simple calculation that depicts the total financial return for each rupee invested in cultivation. If the cost-benefit ratio is 1.50, it means that for every rupee invested in one hectare of land under cultivation for a given produce, the return is about Rs. 1.50 per hectare after the sale of the produce.

The cost-benefit ratio is defined as:

$$\text{Cost-benefit ratio (CBR)} = \frac{\text{Gross Returns}}{\text{Cost of Cultivation}}$$

Where: Gross Returns = Yields * Selling Price

Description of the Models

The models used for the cost benefit analysis are described below:-

MODEL-1

Farmer → Local Commission Agent (Village Level)→ **Trader** (Mandi)→ **Commission Agent** (Mandi Level)→ **Wholesaler → Retailers→ Consumers**

MODEL-2*

***Retail Chain Market

Farmer → Trader → Retail Chain → Consumers

MODEL-3 (Proposed Model)
X*= Farmer Owned Co-Operatives with Government-Private Partnership

Farmers → X*→ Local **Vendors/Retailers → Consumers**
Cost Benefit Table

The cost benefit ratios for the above three models are calculated in the tabular form and is shown in Table No.4.2.

Assumptions:-

Product = Tomato

Quantity Handled= 2600kg

Cost of Cultivation is assumed by consulting with farmers of Raipur (C.G).

Factors affecting Supply Chain Efficiency

Modeling of Supply chain efficiency can be done by following way:-

$Z = f(X_1, X_2 \ldots X_N)$

Where,

Z = Supply Chain Efficiency (%) X_1 = Price received by farmers (Rs.) X_2 = Price paid by consumer (Rs.)

X_3 = Wastages in monetary term along the supply chain (Rs.) X_4 = Marketing cost (Rs.)

X_5 = Marketing margin (Rs.) X_6 = Transport cost (Rs.)
X_7 = Wages (Rs.)

X_8 = Volume of produce handled (kg)

X_9 = Length of the market channel (No. of market intermediaries) X_{10} =Nature of produce

Modeling of Supply chain efficiency can be done by the following formula:-

$$\text{Supply Chain Efficiency} = \frac{\text{Desired output}}{\text{Investments}}$$

Desired outputs include multi objective functions with conflicting objective. Desired output includes High profit on farmer side with Low cost price on customer side.

Investments include total supply chain cost along the chain.

Introduction to Supply Chain Performance Measurement

Supply chain performance measurement is a management strategy that helps companies to enhance their performance levels in all the desired areas of the supply chain network. The idea behind the performance measurement technique is to first optimize the desired goal then to prosper, to get high operational excellence. Proper measurement leads to high market share and correspondingly continuous improvement of the organization. The variables to be measured are known as performance indicators. The choice of variables depends upon the supply chain network under consideration. The performance indicators can be qualitative (customer satisfaction, producer satisfaction etc) and quantitative (total supply chain cost, profit etc). The tools or the models used for performance measurement also vary according to the data available and the goals to be evaluated.

Performance measurement is critical for companies to improve supply chain effectiveness and efficiency. Adequate performance measurement indicators must be identified for the supplychain network under study and a proper methodology is to be developed for better result. The main purpose for developing this framework is to obtain feedback relative to the desired set of goals and once loopholes are evaluated, the

company can change its strategy for getting higher shares from market. Performance measurement affects the decision making through the evaluation of past trends and benchmarking techniques. The choice of appropriate supply chain performance indicators is rather complicated due to the presence of multiple inputs and multiple outputs in the system. This issue becomes even more problematic in the field of food and agribusiness due to specific characteristics of Agri-food supply chains. So before arriving at any conclusion a thorough study is to be done considering the supply chain system as a whole because performance measurement depicts the scenario by which a company can assess whether its supply chain has improved or degraded.

Tools used for Supply Chain Performance Measurement

A wide number of tools and models are available for measuring the supply chain performance of any network. These consist of both qualitative and quantitative tools. Some times for taking simple managerial decisions based on performances of the variable under consideration, qualitative models are preferred. But for taking complex decision, relying completely on qualitative model can be a serious mistake. Therefore, quantitative models are developed to validate the decisions mathematically. Generally, for better results both the models are used together to obtain an optimized value.

An AHP approach for Developing the Indian Agri-food Performance

Measurement Framework

The analytic hierarchy process (AHP) is a quantitative tool for making decisions with multi-criteria developed by Saaty (91) and has been applied to a wide variety of managerial decisions and socio-economic judgment process. The AHP is a commonly used tool because it can solve unstructured problems in different areas of human needs and interests, such as political, economic, social and management sciences (92).

The AHP is acclaimed by many researchers because it leads to accurate decisions. It involves the subjective decisions to be taken and is broken down into hierarchy structure. The consistency of the decision judgment ensures that the problem can be divided into sub-problems that are easier to understand. The comparison may be made by experts or an iterative process until an agreement is reached by the team members.

The Analytic Hierarchy Process (AHP) involves pair wise comparisons of criteria's. The weightage is given according to nine point priority scales (93). The comparisons are made using priority scale of absolute judgements that represents how much more one element dominates another with respect to a given attribute. The judgements may be inconsistent, and how to measure inconsistency and improve the judgements, when possible to obtain better consistency is a concern of the AHP.

Marketing Agent Selection by AHP

This portion is related with the selection of a marketing agent from farmer's point of view. The analytical tool used for making the decision is AHP. The objective is to select the marketing agent from three alternatives available on the basis following criteria.

The various criteria are:-

1. **Price-** Farmers want high price for their products.
2. **Credits-** Sometimes farmers need credits to purchase farm equipments and other farming needs.
3. **Trainings-** Trainings are given by certain Governmental bodies or NGOs with respect to farming and cultivation techniques in order to raise the productivity and other measures.

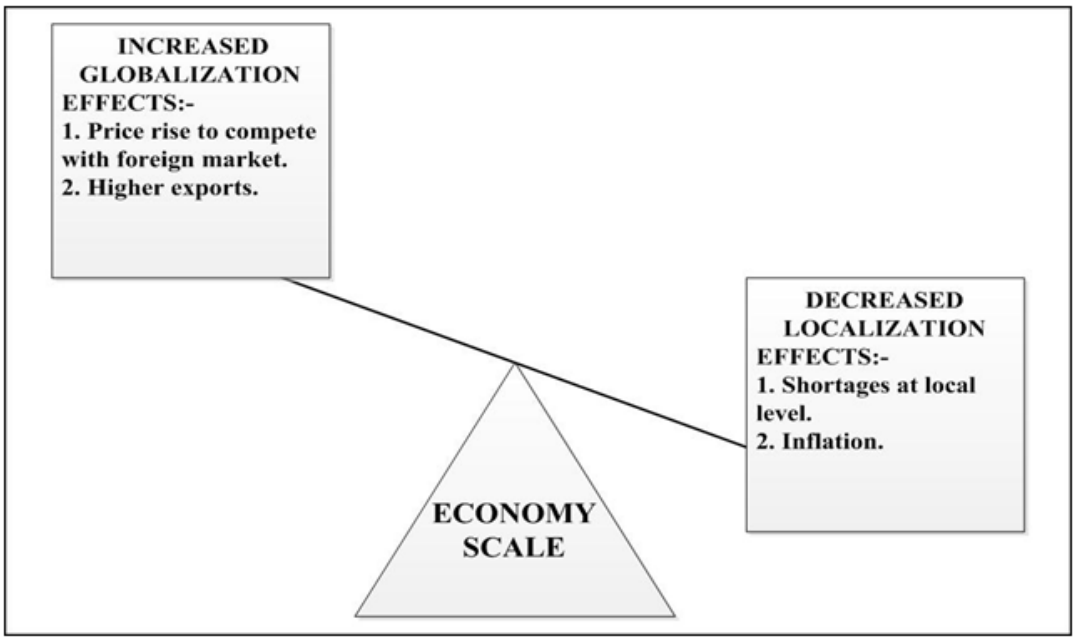
II. SUMMARY

The topic of performance measurement is encountering increasing interest in both the academic and managerial areas. Also, there is a need of real time research work in those sectors of the Indian scenario which directly affects the economy of the country

III. DISCUSSION

As the population increases, the demand for Agri-food products also increases exponentially. In order to have smooth facilitation of demand fulfilment, an efficient supply chain management framework is of utmost important. The role of marketing channel in the supply chain network is to move products from the point of production (farm) to the point of consumption. effective supply chain management should act as a communication medium between the producers and consumers. One of the conventional features of economic development is by raising the amount of marketing services associated with agriculture commodities to meet the consumer demand. But presently, in the name of economic development it acts as a curse for farmer because it has invariably reduced the farmer's share of the consumer rupee. The present scenario is that, for every rupee spent by the consumer, farmer is getting only 28 paisa, the retailers is getting 22 paisa, the wholesaler is getting 15 paisa and rest of the amount 35 paisa is going to commission agents and traders i.e., Indianfarmers receive

only 1/3rd of the total price paid by the final consumer, as against 2/3rd byfarmers in nations with a higher share of organized supply chain network in retail sector.



IV. RESULT

The industrial engineering and management concepts can play an important role in designing and developing a sustainable supply chain network. Following are the list of objectives that can be suitably evaluated and attained by effectively applying the industrial engineering and management concepts in the domain of Agri-food supply chains:-

- Efficient Agri-food supply chain network design.
- Effective planning of food distribution system.
- Handling logistics issues.
- Development of performance measurement system for Agri-food supply chain.
- Integration of IT support for developing effective planning strategy.
- Quality control along the chain.
- Design of distribution networks.
- Marketing agent selection.
- Food Supplier selection.
- Warehouse management.
- Vehicle routing along the chain.
- Warehouse location problem.
- Production system design.
- Customize the chain according to customer requirement by supply chain function deployment using QFD.
- Effective supply chain Cost accounting using ABC including time constraint.
- Optimization of production system.
- Logistic network design and planning.
- Designing cold storage infrastructure.
- Enhanced packaging and grading techniques.
- Cost benefits analysis using RFID technique for Indian agri-food supply chain network.
- Simulation tools for real time modeling.
- Design of effective management information system and decision support system.
- Effective post harvest management by local warehousing.

The Thesis SWOT analysis has been provided by the author in order to have a glimpse of the strength and weakness of the present research work along with the threats and opportunities. Future scope of the present work can be extracted from the opportunities of the present work.

There is a vast area for research to be carried out with reference to Indian scenario. Various

multidisciplinary approaches can be applied to a common problem for obtaining sustainable results. This research also highlighted the field of Indian Agri-food sector and discussed how IEM and economics both can be used together for optimizing the objective function of sustainable Agri-food sector growth. This research work also provided some case studies related to the Agri-food supply chain which can be further studied explicitly The dream of every Indian to be at the top can only be transformed into reality when science, technology, economics and sociology are merged to one discipline and develop strategies for creating a sustainable India. Hence the day has come when Indian engineers should realize that India needs them for developing strategies which can be suitably molded into reality for attaining growth in terms of sustainable living.

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