

**MEASURES TO ACHIEVE BUSINESS SUSTAINABILITY OF
CLUSTER BASED FOOD PROCESSING UNITS IN THE STATE
OF UTTARAKHAND**

A thesis submitted to the
University of Petroleum and Energy Studies

For the award of
Doctor of Philosophy

In

Management

By

Shantanu Trivedi

October 2022

SUPERVISOR

Dr Neeraj Anand
Ex Prof. School of Business - UPES
Professor & Dean (Supply Chain and General Management)
Chitkara Business School

School of Business



University of Petroleum and Energy Studies Dehradun – 248007
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*With the blessings of the Almighty,
I dedicate this thesis to my parents and my family
for their endless love, immense support, and encouragement*

October 2022

DECLARATION

I declare that the thesis entitled “**MEASURES TO ACHIEVE BUSINESS SUSTAINABILITY OF CLUSTER BASED FOOD PROCESSING UNITS IN THE STATE OF UTTARAKHAND**” has been prepared by me under the guidance of Dr. Neeraj Anand, Professor & Dean (Supply Chain Management), Chitkara Business School, Chitkara University. No part of this thesis has formed the basis for the award of any degree or fellowship previously.



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CERTIFICATE

I certify that (Shantanu Trivedi) has prepared his thesis entitled “(Measures to achieve business sustainability of Cluster Based Food Processing Units in the State of Uttarakhand)”, for the award of PhD degree of the University of Petroleum & Energy Studies, under my guidance. He has carried out the work at the School of Business, University of Petroleum & Energy Studies.

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ABSTRACT

The Quantum of Post-harvest losses in India are growing at an alarming speed and the situation is no different for the state of Uttarakhand. In terms of its role in controlling large post-harvest food wastage the MSME industry in the food processing sector has a greater role compared to the organized sector. The government at both the center and state level with their various schemes are working towards making the MSME food processing more vibrant.

One such initiative was to develop farmer interest groups or farmer producer organizations and identifying agriculture cluster-based food processing units.

These clusters are initially provided support by the government to reduce farm losses and distress sales. But over the period, these units or centers are turning out to be non-functional and unsustainable. The food processing sector is a sunrise sector in India and hence there are few research studies on the business sustainability of relatively newer concept. There are more studies focusing on agricultural products and few on other industrial sectors. The ones that exist on processed food products deal with a few specific issues or with a specific technological solution. There exists no study that proposes a model exhibiting sustainable solution synergistic whole and suggests strategies and solutions to either overcome or mitigate the influence of the issues on supply chain and overall business performance. This leads to a prominent research gap.

The current research has further funneled down to Agri-cluster based food processing units in Uttarakhand region of India. First, supply chain performance of agri-cluster based food processing units developed by Government of Uttarakhand was measured. The financial and nonfinancial measures of supply chain performance was measured with the help of Data Envelopment analysis. Subsequently, the best and the worst case were identified with the help of DEA.

In the second stage, a business sustainability model was developed for the agri-cluster based food processing units in Uttarakhand. To develop the Business Sustainability model case study methodology was applied. Using the Atlasti software the qualitative data was analyzed, and model was developed based on triple layered business model canvas. Also, solutions were recommended to be implemented to overcome these issues or reduce their impact on the supply chain's performance. The contribution to the theory

of triple bottom line was done with the findings of the study. Thus, the present study offers an effective environment for the purpose of taking successful decisions and implementing/executing strategies and solutions with the aim of enhancing the effectiveness of the agri-cluster based food processing unit's performance while also leading to reduced food losses, reverse migration and enhancing farmer income.

Keywords: Supply Chain Performance Measurement; DEA; Case study; Agri-cluster based Food Processing; Business Sustainability; Triple Bottom Line; Uttarakhand; India

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Dated: October 2022

Shantanu Trivedi

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List of Abbreviations

Sr. No.	Abbreviations	Full Form
1	ACBFP	Agri-Cluster Based Food Processing
2	ACBFPS	Agri-Cluster Based Food Processing Supply Chain
3	AFSC	Agri-Food Supply Chain
4	AI	Artificial Intelligence
5	APEDA	Agricultural & Processed Food Products Export Development Authority
6	ASSOCHAM	Associated Chambers of Commerce and Industry of India
7	ATLAS.TI	(Archive for Technology, Lifeworld and Everyday Language)
8	B2B	Business to Business
9	BPR	Business Process Reengineering
10	CAGR	Compounded Annual Growth Rate
11	CIPHET	Central Institute of Post-Harvest Engineering & Technology
12	COVID-19	Corona Virus Disease-2019
13	CSR	Corporate Social Responsibility
14	DEA	Data Envelopment Analysis
15	ECR	Efficient Consumer Response
16	EDI	Electronic Data Interchange
17	FAO	Food Agriculture Organization
18	FPO	Farmer Producer Organization
19	FSC	Food Supply Chain
20	F&V	Fruits and Vegetables
21	GDP	Gross Domestic Product
22	GIS	Geographic Information System
23	GOI	Government of India
24	GoU	Government of Uttarakhand
25	GPRS	General Packet Radio Services
26	GPS	Global Positioning System
27	GSCM	Green Supply Chain Management
28	GSI	Global Standards Initiative
29	HACCP	Hazard Analysis Critical Control Point
30	HMNEH	Horticulture Mission on Northeast and Himalayan States
31	ICAR	Indian Council of Agricultural Research
32	ICT	Information and Communication Technology
33	IPCC	Inter-governmental Panel on Climate Change

34	IQF	Individual Quick Freezing
35	ISO	International Standards Organization
36	ISM	Interpretive Structural Modelling
37	IT	Information Technology
38	KBV	Knowledge Based View
39	KPI	Key Performance Indicators
40	LR	Literature Review
41	MADM	Multi Attribute Decision Methods
42	MAS	Modified Atmosphere Storage
43	MCDA	Multi Criteria Decision Analysis
44	MCDM	Multi Criteria Decision Methods
45	MIDH	Mission for Integrated Development of Horticulture
46	ML	Machine Learning
47	MOFPI	Ministry of Food Processing Industries
48	MT	Metric Tonne
49	NCCD	National Centre for Cold Chain Development
50	NGO	Non-Government Organizations
51	NHB	National Horticulture Board
52	NHM	National Horticulture Mission
53	PFP	Perishable Food Product
54	PI	Performance Indicators
55	QAN	Qualitative Associative Network
56	RBV	Resource Based View
57	RFID	Radio Frequency Identification
58	SHG	Self Help Group
59	SC	Supply Chain
60	SCOR	Supply Chain Operations Reference
61	SCQM	Supply Chain Quality Management
62	SEM	Structural Equation Modelling
63	SPSS	Statistical Package for Social Sciences
64	SSCM	Sustainable Supply Chain Management
65	STATA	Statistical Software
66	TBL	Triple Bottom Line
67	USDA	U.S. Department of Agriculture
68	WMD	Watershed Management Directorate

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Chapter 1

Introduction

1.1 Introduction:

This chapter starts with a brief overview of India's food processing industry, a sector whose significance has grown in recent decades. The chapter also highlights the significance of this sector as a connection between the agricultural and industrial sectors. This chapter looks at the state of the food processing business in India, which has the potential to be a major economic engine in rural areas due to the synergy it creates between the consumer, the industrial sector, and the agricultural sector. A developed food processing sector increases farm gate prices, decreases food waste, provides value addition, generates employment opportunities and export income, and promotes crop variety. It also plays a unique function in India's economy by increasing the rural population's income. Also, the study highlights the significance of agricultural cluster-based food processing units and the accompanying business sustainability challenges. The problem formulation for this research study is then offered. This chapter also explores the potential significance of this research. In the last section, the deposition of the thesis is mentioned to explain the entire thesis chapters of the research report.

1.1.2 Food Processing Industry in India – Background and an Overview

India produces more than one billion tons of agricultural produce with food grains output at 284.83 million tons, pulses at a record 25.23 million tons and cereals (rice, wheat, maize, millets, etc.) at 259.60 million tons. Oilseeds production is estimated at 31.31 million tons and in horticulture, the production has reached 311 million tons. Sugarcane, cotton, jute, tea, coffee, tobacco, etc. add more than 400 million tons to the agricultural production of the country.

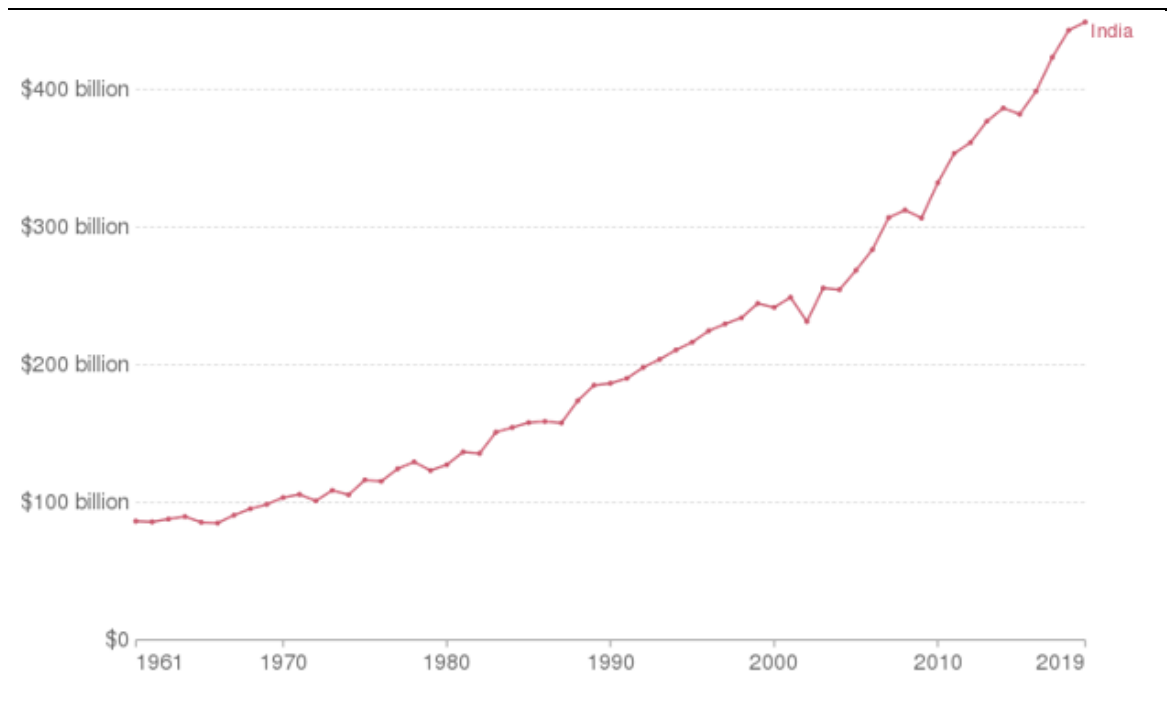


Figure 1.1 Agricultural Production in India from 1961 -2019

As is evident from the graph, Indian agriculture has grown significantly during the past few decades. Agriculture and the associated industry shown the greatest resilience to the Covid-19 shock, registering a 3.6% increase in 2020-21 and a 3.9% increase in 2021-22. (Business Standard, 2022)

Food wastage remains a concern as nearly 40% of perishables goes waste in India. The national-level study conducted by CIPHET estimated that nearly 4.65-5.99% of cereals are wasted, and nearly 4.58-15.88% of fruits and vegetables are wasted. Among pulses, the losses increased from an earlier estimate of 4.3-6.1% in 2010 to 6.36-8.41% in 2015. Overall losses also increased in milk, meat, poultry and marine fisheries. The study also estimated that the value of the post-harvest losses is at Rs 92,651 crores.

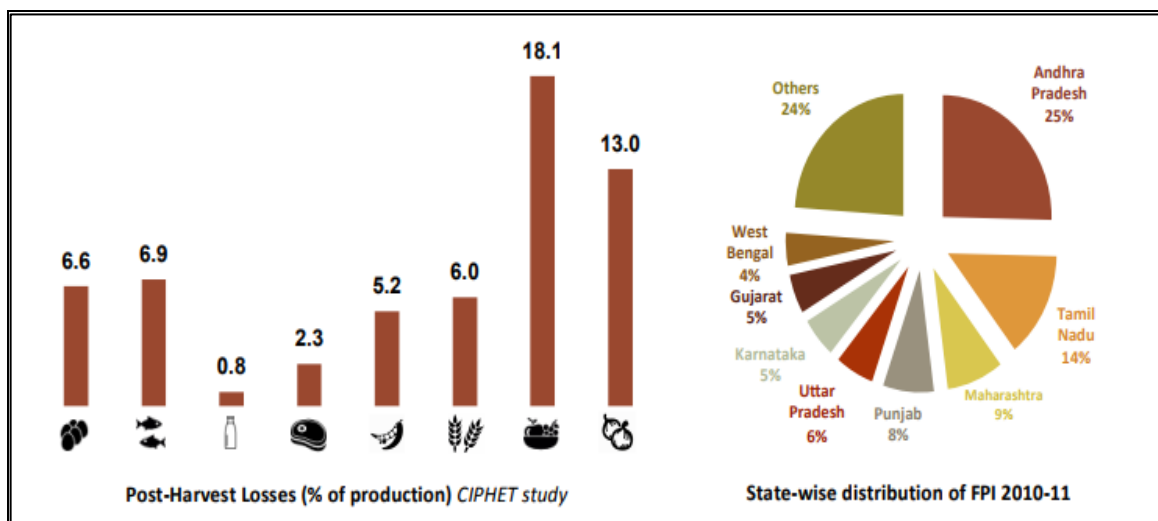


Figure 1.2: Post harvest Losses and State-wise distribution of post-harvest losses

Source: CIPHET

	As per CIPHET Report 2010	As per CIPHET Report 2015
Cereals	3.9 – 6.0	4.65 – 5.99
Pulses	4.3 – 6.1	6.36 – 8.41
Oil seeds	2.8 – 10.1	3.08 – 9.96
Fruits & Vegetables	5.8 – 18.0	4.58 – 15.88
Milk	0.8	0.92
Fisheries (Inland)	6.9	5.23
Fisheries (Marine)	2.9	10.52
Meat	2.3	2.71
Poultry	3.7	6.74
Horticultural Crops		
Guava	18.0	15.9
Mango	12.7	9.2
Apple	12.3	10.4
Grapes	8.3	8.6
Papaya	7.4	6.7
Banana	6.6	7.8
Cereal Crops		
Wheat	6.0	4.9
Paddy	5.2	5.5
Bajra	4.8	5.2
Maize	4.1	4.7

Table 1.1 Wastage of fruits and vegetables - Concern for India

Source: MoFPI Annual report 2017

Given the significance of agriculture to the Indian economy, the government of India has been implementing a variety of reforms via its Central Sector and Centrally Sponsored Schemes to promote environmentally friendly output and increase the income of farmers. Through value addition and promotion of the country's food processing sector, the government is encouraging processing and post-harvest technology for reducing post-harvest losses, enhancing shelf-life, and enabling higher price realization for farmers.

In terms of production, consumption, and exports, the Food Processing Industry (FPI) is one of India's most lucrative manufacturing sectors, ranking sixth. In terms of food production, the nation ranks second in the world behind China. FPIs supported the Indian economy in maintaining GDP growth and providing new employment opportunities despite the global slump. (Das & Biswas, 2021)

India's food processing industry accounts for 32% of the country's total food sales. Given the significance of agriculture to the Indian economy, the government has been implementing several reforms via its Central Sector and Centrally Sponsored Schemes to promote sustainable output and increase farmers' incomes. Currently valued at \$1.3 billion, the Indian gourmet food business is expanding at a CAGR of 20% to \$2.5 billion in the next few years. (IBEF, 2020).

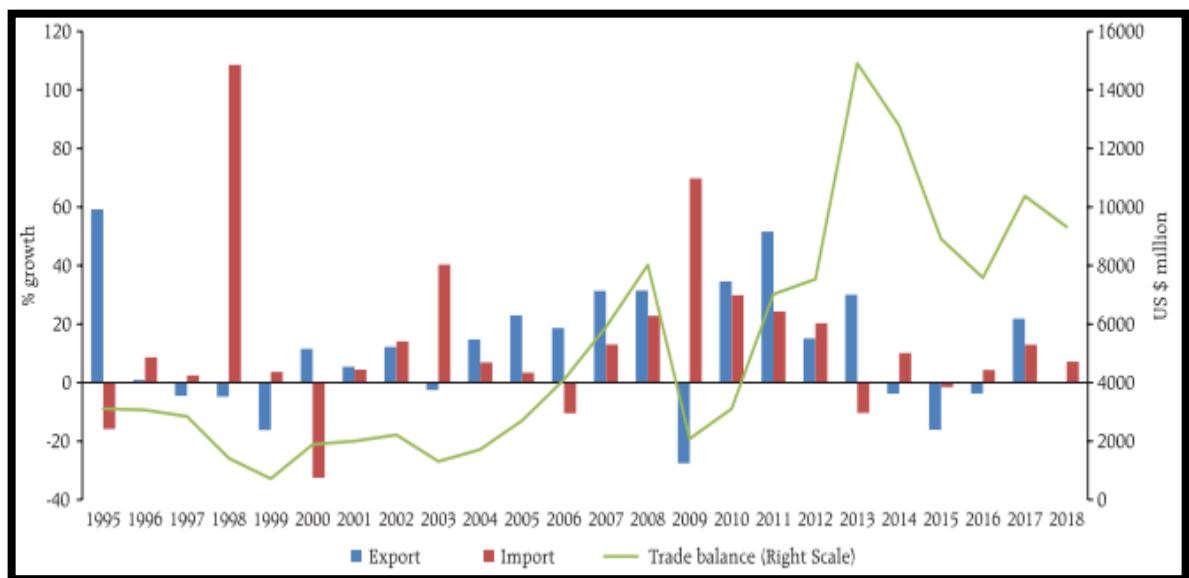


Figure 1.3: Processed Food Products Trade in India

Source: WITS

While processing fruit and vegetables creates many jobs and increases farmers' incomes on both the top and bottom lines, only 6 percent of these crops are processed in India, whereas the figure is between 60 and 70 percent in developing countries and more than 30 percent in the majority of Asian, Latin American, and developing nations. It is visible from the figure 1.1.3 that even developing countries like Philippines is doing great in terms of food processing. The substantial post-harvest waste, very poor value addition in F&V goods and processing account for just 2.2% of India's total production, resulting in lost commercial possibilities and agricultural revenue. Figure 1.1.4 depicts the processing level of various goods. Figure 4 demonstrates that milk and meat products have the highest amount of processing since they are the major FPI organization sectors. Every one percent decrease in F&V waste would result in savings of \$0.13 billion. Therefore, cultivating crops without processing and value addition is pointless, especially since our farmers are striving to discover ways to enhance farm revenue. As per the article by (Pande, 2022) markets need to be studied, mapped, and tagged to the rural production clusters having special advantages. Also important is a plan to impart specific skills, infuse technologies, develop value-added products, strengthen infra-logistics, provide finance and government incentives, etc., for developing a specific value chain in a given rural cluster and it is also it imperative that they operate collectively, through producer-companies or cooperatives, to take care of their needs such as inputs, finance, technology, processing, logistics, marketing, etc, on an aggregate basis (Pande, 2022).

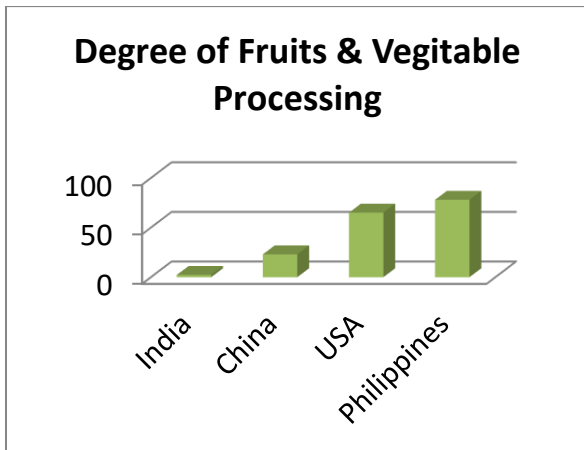


Figure 1.4.1 Degree of Fruits and Vegetable Processing

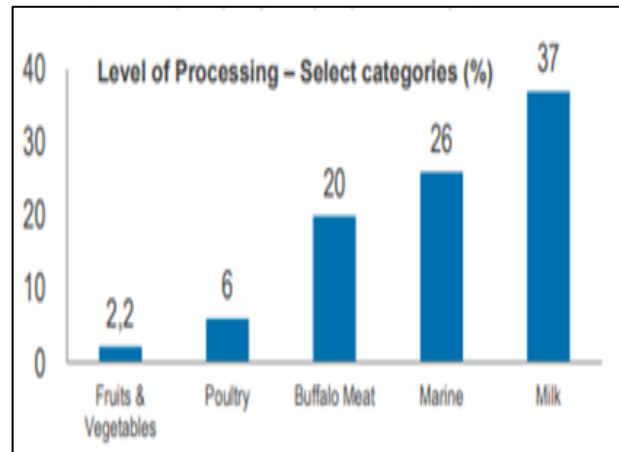


Figure 1.4.2 Level of Agri Processing – India

1.1.3 Food Processing & Its Types

The industry of food processing in India is receiving more attention from the Indian government. The industry plays a crucial part in establishing connections between Indian farmers and markets both inside the country and beyond the world. In spite of the economic difficulties brought on by COVID-19, the industry continues to expand, and there is substantial growth potential for processed goods, particularly in Tier II and Tier III cities, as well as in rural regions. (US Department of Agriculture, 2022).

Food processing is defined as "one or more of a variety of operations such as washing, grinding, mixing, cooling, storing, heating, freezing, filtering, fermenting, extracting, extruding, centrifuging, frying, drying, concentrating, pressurizing, irradiating, microwaving, and packaging" by food scientists (J D, Newsome, Barbosa, & Chen H) . Nutritionists and dietitians define processed foods as "any food other than a raw agricultural commodity, including any raw agricultural commodity that has been washed, cleaned, milled, cut, chopped, heated, pasteurized, blanched, cooked, canned, frozen, dried, dehydrated, mixed, packaged, or otherwise altered from its natural state."(Fox, 2012).

Different types of foods undergo varying degrees of preparation. "Minimally processed" foods are those that have been washed and dried, smoked, or salted to

extend their shelf life. Wheat, barley, and rice may be fermented into bread and beer. The fermentation process, which created alcohol, avoided bacterial contamination, and allowed beer to be kept for later consumption. (MacDonald & Reitmeier, 2017).

1.1.3 a) Types of food processing

Food processing encompasses a vast array of structures. Some foods require almost little preparation, such as apples, which may be plucked off the tree and consumed immediately. Others are unappetizing unless they are prepared according to established recipes. There are three categories of food processing techniques: primary, secondary, and tertiary.

The act of adding value to items derived from agriculture or horticulture is referred to as the food processing process. The food processing sector is substantially more important in India than it is in the West. This position may be divided into the following basic responsibilities:

Primitive processing includes slicing, cleaning, sorting, classifying, and chilling. Secondary processing such as grain milling, fruit pulp production, frozen meat and poultry, and milk packaging. Tertiary processing operations such as the production of fruit preserves and juices, cookies, milk products, ready-to-eat meals, protein supplements, and confections.

	Primary processing	Secondary processing	Tertiary processing
Fruit and vegetable	Cleaning, cutting, sorting	Pulps, pastes, slices	Jams, juices, pickles
Grains and cereals	Sorting and grading	Flour, malt & milling	Biscuits, noodles, cakes
Dairy products	Grading and refrigeration	Cottage cheese, cream, dried milk	Yoghurts, spreadable fats
Meat and poultry	Sorting and refrigeration	Cut, fried, frozen	Ready-to-eat
Marine products	Chilling and freezing	Cut, fried, frozen	Ready-to-eat
Edible oil	Sorting and grading	Refined oils	Fortified oils

Figure 1.5.1: Processing in different food categories

These efforts (shown in figure 1.2.1 for several food categories) contribute to the preservation of food nutrients, the extension of food shelf life, the improvement of nutrition levels through fortification, and the expansion of consumer options.

1.1.4. Food Processing Sector - Issues & Challenges

Challenges in the food processing industry include a lack of focus on quality and safety standards, a deficiency of product development and innovation, and gaps in supply chain infrastructure like inadequate primary processing, storage, and distribution facilities, the insufficient connection between production and processing, seasonality of operations, and low-capacity utilization. There is a lot of room for growth in this sector due to retailer demand, rising interest in convenience and ready to eat meals, and a shift away from a diet heavy in cereals.

Since processed food has a lot of potential to be sold abroad and is also in high demand at home, promoting it with good marketing, the latest technology, and a steady flow of raw materials from farmers that meet certain quality standards at stable prices helps the agriculture sector grow. Linking farm production to the market by bringing together farmers, processors, and retailers would help farmers make a lot more money. (Pracin Jain Academy, 2021)

Developed and developing countries have had different ideas about how to implement quality standards. Because of old problems and problems with infrastructure, the Indian states have different levels of putting food quality standards and procedures into place. (RBI, 2020)



Figure 1.5.3 Challenges in Food Processing Sector

Source: Annual Report MoFPI 2016-17

The food processing industry is currently confronted by a number of obstacles, including gaps in the supply chain infrastructure, a lack of primary processing

storage and distribution facilities, an insufficient link between production and processing, a lack of processing-friendly varieties, seasonality of operations and low-capacity utilization, an insufficient emphasis on quality and safety standards, a lack of product development and innovation, and supplanting technologies. The issue of logistics expenses is one of the most difficult and complex due to their extensive and convoluted structure and the challenges connected with identification. (Dharni & Sharma, 2015).

1.2 Supply Chain of Food Processing Industry

The expansion of the company has been aided by the availability of raw materials, a change in customer tastes, and prudent fiscal measures. Government is also expanding processing and storage facilities and giving money to ease food processing bottlenecks (Damabhai, 2013)

In food supply chain, the processing and manufacturing stage includes all the steps that are meant to turn raw food materials into things that can be eaten, cooked, or sold. In the processing step of the supply chain, raw agricultural products are turned into goods that can be sold. These products are frequently sent to retail stores, wholesale markets, distribution centers, and food service establishments. In addition to that, it encompasses the packaging of products that have been manufactured (CEC, 2019).

The raw materials are the initial link in the food processing industry's supply chain. Included in the category of raw materials are silo materials, raw ingredients, processing aids, and packaging materials. Raw materials also comprise such things. Unprocessed agricultural goods such as wheat, rice, and other grains may be stored in silos for later use. Bags, cartons, and totes are the most common packaging options for purchasing raw ingredients such as colorants, emulsifiers, salt, spices, sugar, and vitamins. Transport options for processing aids and packaging materials include transfer on pallets, transport in boxes, or transport in totes. Materials are maintained in a warehouse after being examined for quality assurance and other record-keeping procedures, and then they are produced in accordance with either the FIFO or FEFO system.

When production begins, the preparation area or kitchen places orders for the necessary ingredients based on the recipes and formulations that are being used, and then the raw materials are sent to the production floor in proportions that have been previously decided. After the product has been processed, which may include pre-mixing, emulsifying, heating, or chilling, it is then packed utilizing the required packing and delivered for either internal or exterior storage. Transportation to a warehouse, store, food service location, school, restaurant, vending machine, or other commercial activity may be a distribution channel for processed foods (Zhang & Bhatt, 2020).

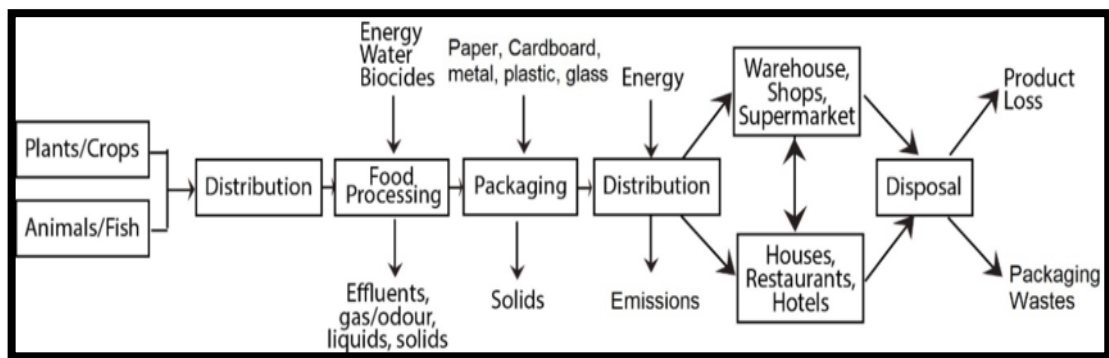


Figure 1.6.1: Processed food Supply Chain

Source: (Cimini & Moresi, 2019)

Figure 1.4.1 illustrates the complexity of the whole supply chain of the food business, from the manufacturing of raw materials through food processing to the consumption and disposal by the customer.

1.3 State Profile: Uttarakhand

Much of the Uttarakhand state is hilly, and it has international boundaries with China (Tibet) and Nepal in the north and east, respectively. It is located at the foothills of the Himalayas. Himachal Pradesh is in the northwest corner, whereas Uttar Pradesh is in the south. All its glaciers, rivers, dense forests, and snow-capped mountain peaks contribute to its richness of natural resources, especially water and forests. The Char-dhams, which are the four most important and renowned Hindu temples, can be found tucked away in the majestic highlands. These temples are Badrinath, Kedarnath, Gangotri, and Yamunotri. It is endowed with a great biodiversity, including 175 kinds of aromatic and medicinal plants that are

extremely rare. With greater levels of literacy than the national average, the state has adequate quality human resources available. Within a short period of time, Uttarakhand has become an important location for manufacturing industry, tourism, and infrastructural development. The focus is on maximizing the potential of all three economic sectors (agricultural, industry, and services) in accordance with the state's geographical character.

The state's entire geographical area is 5.35 million hectares, of which 4.6 million hectares (or 86% of the total) are hilly terrain and 0.74 million hectares (or 14% of the total) are plain region. The geography of the state is primarily responsible for the fact that only around 14% of the total land area is suitable for agricultural purposes. Due to its location and climate diversity, the state provides unique advantages for the development of horticulture, agro processing enterprises, organic farming, off-season vegetable production, and medicinal and aromatic plant cultivation that may be used profitably. Similarly, the service industry, notably tourism, has a substantial capacity to generate employment in both urban and rural regions. Forests cover around 61.1% of the state's land area. Compared to the national average of 43.37 percent, the portion of net-sown area is just approximately 14 percent. The proportion of arable wasteland is around 7%, which offers a tremendous opportunity for fodder trees and other plantation crops, including fruits.

Agriculture dominates the state economy, contributing around 23.4% to the Gross State Product (GDP). The average size of land holdings in the state is 0.95 hectares, compared to the national average of 1.57 ha (Marginal: 0.39 ha, Small: 1.38 ha, Medium: 3.33 ha, and Large: 36.00 ha). Uttarakhand has a higher share of small and marginal holdings than the national average. Agriculture in the state is heavily reliant on precipitation. The net irrigated area of the state is 3.45 million hectares. The terrain is composed of 85.83 percent plains and 14.17 percent hills. The irrigation intensity in the state is 159%, ranging from 155% in the plains to 184% in the mountains (State Horticulture Mission, 2020).

1.3.1 Major Crops - Uttarakhand

- a) The most pears (1.02 lakh MT), peaches (0.48 lakh MT), and plums are grown here than anywhere else in the country (0.38 lakh MT)

- b) The highest productivity of spices in the country at 7.2 metric tons per hectare. The national average yield is 1.80 MT per hectare. When it comes to walnut production, J&K ranks second in the country behind only Himachal Pradesh, which has a total of 0.21 lakh MT (2.61 lakh MT)
- c) Third in apple production (0.91 lakh MT). J&K and HP were the top two producers with 13.48 lakh MT apiece (4.12 lakh MT)
- d) In terms of cut flower output, it ranks eighth in the nation (14.70 crore spikes)

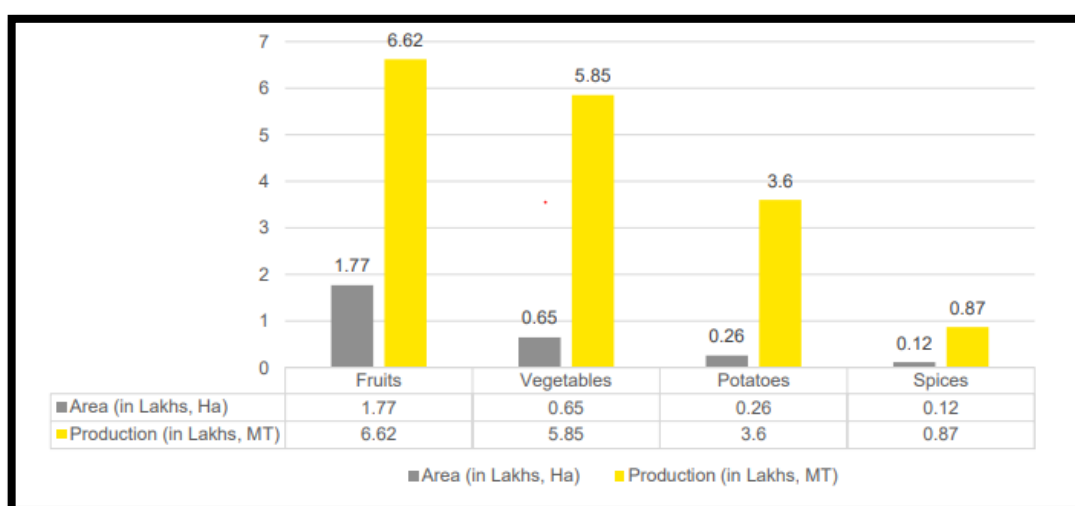


Figure 1.7.1: Area and Production figures of Uttarakhand,

Source: Horticulture and Food Processing Department, Govt. of Uttarakhand, 2017-2018

To develop cluster-based agriculture in the state, the government has created a provision for the 30-year lease of agricultural land for agriculture, horticulture, and other associated businesses. (IBEF, 2020)

The state offers good agroclimatic conditions, with four agroclimatic zones that allow for year-round production of a variety of crops, vegetables, and fruits. The state provides agricultural and agribusiness with a variety of financial incentives, financial support, subsidies, and tax breaks.

1.3.2 Challenges in Agri-Supply Chain in Uttarakhand

In the past 15 years, Uttarakhand has not been able to increase its agricultural growth, even though the majority of its population and land area are still categorized as rural and the state government has a history of spending virtually all of its financial allocations. The growth of large-scale industries and the service sector is hampered by the hills. Therefore, agriculture sector growth remains the state's economic linchpin (Singh, 2016).

Farmers must accept whatever price is quoted for the fruits by the traders in the mandis. There is no way to verify the price and even if it is done, farmers are bound to the traders by informal contracts in lieu of the credit. The findings have significant policy ramifications, including the urgent need to construct storage and food-processing infrastructure that is equally beneficial to farmers as the highways that increase market accessibility. Also, if credit lending and agricultural marketing institutions are not improved in tandem with the deployment of ICT tools such as mobile phones, their ability to boost farmers' earnings is limited (Sah, 2021).

Due to a lack of understanding of the nature and usage of nutrient-rich indigenous and traditional food resources over the years, these foods have been excluded from most nutritional strategies designed to address food security and nutrition issues among the local people. This agricultural agroecosystem would become a highly sustainable production system in the future if more people were aware of the benefits of incorporating natural variety into daily meals as "functional foods" and if additional localized marketing strategies were explored.

The quantity of land available for each person is decreasing, there is insufficient infrastructure for irrigation, animals such as wild boars and monkeys are destroying crops, and fewer young people are interested in farming. These are only some of the existing issues facing agriculture. These issues in hill-based agriculture are made worse by the effects of climate change (Das K. , 2021).

Considering the difficult terrain in the hill area, transportation connectivity is a critical factor for apple marketing in the region. Due to lack of suitable infrastructure, farmers are unable to properly store the produce. Temporary raised shed structures and other facilities for storage may be set-up at common identified assembling points in the sub-

region for safe storage of the produce at the time of harvesting and minimizing the transportation related issues to an extent. Farmers are either dependent fellow farmers or private input suppliers for immediate advice on production related issues, which may be misleading or biased in their own favor (Yadav & Shailendra, 2018).

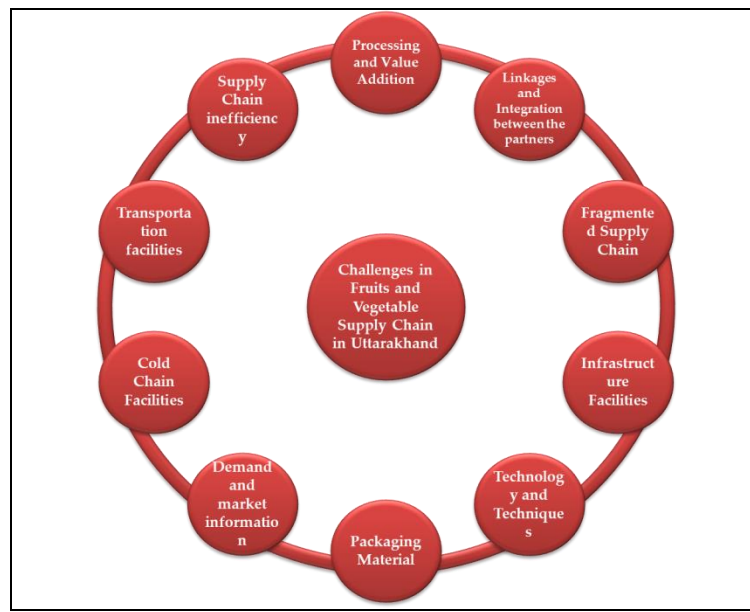


Figure1.7.2: Fruits and Vegetable Supply Chain Challenges in Uttarakhand

Source: (Negi & Anand, 2016)

As can be seen in the graphic mentioned above, the supply chain for fruits and vegetables faces a few important challenges, the most significant of which are a lack of primary processing, poor logistical infrastructure, and inefficiency. According to the same body of data, the largest amount of food waste in the supply chain for fruits and vegetables occurs at the farm level and during transit.

1.4 Food Processing in Uttarakhand

The state government of Uttarakhand has placed a strong emphasis on business facilitation through fostering the formation and operation of enterprises in the state. The government has established a total of 125 big food processing facilities (encompassing all food segments), 52 of which are horticulture-based and sponsored under the MIDH Scheme.

In addition to the 49 Government Food Preservation cum Training Centers that are located around the state, there is also a Bee Keeping Training Centre located in Jeolikote, Nainital (District), and a Mushroom Training Centre located in Jeolikote (District). With the assistance of the Skill Development Mission of Government of Uttarakhand, students may get the training necessary to obtain employment in Uttarakhand's expanding food industry. Uttarakhand's infrastructure is well developed, with two Mega Food Parks & six Industrial Parks/Growth Centers (IBEF, 2019).

1.5. Cluster Based Agriculture and Food Processing in Uttarakhand

The Quantum of Post-harvest losses in India are growing at an alarming speed and the situation is not different for the state of Uttarakhand. Almost 45% of fruits and vegetables that are grown rot away in warehouses. The establishment of small food processing plants will not only minimize post-harvest losses, but migrations from high hills and the income of farmers can be improved in the region. The micro, small, and medium-sized enterprise (MSME) firm in the food processing sector has a bigger role in minimizing post-harvest food waste. This is in comparison to the organized sector, which plays a smaller part. The government at both the center and state level with their various schemes is working towards making the MSME food processing more vibrant.

One such initiative was to identify farmer interest groups or Farmer Producer Organizations (FPOs) and develop agriculture cluster-based food processing units in the rural areas of Uttarakhand. These clusters are initially provided support by the government to reduce farm losses and distress sales. But over the period, these units or centers are turning out to be non-functional and unsustainable due to the discontinuation of several centrally funded schemes and high migration and poor vegetable and crop production (Azad, 2016). The direct farm procurement and creation of value addition at the farm gate are aligned to the policy focus on FPOs and agri-clusters and the learnings can be leveraged to identify structural transformation, collaborative actions, market integration and technology innovations needed for linking clusters to organized supply chains. The existing partnerships can also be leveraged to identify farm gate infrastructure gaps in the clusters and handholding for bridging these gaps. The model also provides the benefit of value creation at the farm level in terms of sorting, grading, and packaging thus helping reduced human contact across the supply chain. The formation of FPO will also align with the agri-cluster approach of 'one district, one crop'

aimed at encouraging farmers to adopt the most suitable crop in their district that will help them realize better prices with increased scale. The cluster approach will also help enhance export competitiveness (Confederation of Indian Industry, 2020). Even after three years, many Farmer Producer Organizations fail to establish themselves. As a result, the majority of FPOs struggle with a frail balance sheet, are unable to raise their capital, and face numerous difficulties in the growth and administration of FPOs owing to a lack of a business strategy. Producer Organizations have a significant role in improving the farmers' way of life. Long-term viability of these firms is crucial for the farmers' continued existence. All the firms' short-term liquidity positions are strong, but their long-term solvency positions are weak. Overall, the data indicates that Producers' Organization is working hard to establish a market presence that will help farmers. The availability and administration of finances pose significant issues for these organizations. The study is beneficial to nonprofit organizations for self-evaluation, the government for policy formulation, and donors for ongoing support. As FPOs are the focal point of the supply chain in agribusinesses, FPOs must be strengthened for company stability and growth. (Chaudhary, Kaur, Neema, & Srivastav, 2021).

1.5.1 Agri-Cluster Based food Processing Unit in Uttarakhand – Sample Case (Gairsain Krishi Phal Utpadak Sangh)

Cluster: Ministry of Micro, Small, and Medium Companies (MSME), Government of India defines cluster as a group of firms situated within a designated and, wherever possible, contiguous region and producing the same or similar goods or services. a) Similarities or complementarities in manufacturing, quality control and testing, energy usage, pollution management, etc. are among the core features of the enterprises that comprise a cluster; and (b) similarity or complementarity in energy consumption, pollution control, etc. (b) comparable technological sophistication and marketing strategies/practices (c) communication mechanisms between cluster members (d) similar issues and opportunities.

Agri-Cluster Based food Processing: Agri-cluster based food processing is the process in which cluster-based agriculture is done, farmers are promoted to produce agri-commodities as per soil, climatic condition, market requirements etc in a region. Then the produce from the farmer is purchased directly from farm or farmer to its nearby

food processing unit brings the produce, which not reduces his time and efforts but, reduces the wastage of produce while taking the same produce to urban market or mandi. At Agri-cluster based food processing unit the primary, secondary and tertiary level processing is done, which adds value the produce and enhances shelf life of the produce. Then the products are sold from the same unit and given to nearby retailers and other villagers. The Cluster based food processing units not only act as a central collection and processing unit but also as a place for disseminating agri-inputs, information and training of new agri-practices as well.

Operations: The food processing unit collects agri-produce from nearby villages, farmers can come to unit and give their produce directly at the food processing unit, and unit has machinery for processing, packaging of products. The unit records maintain the records of the payments and also makes farmers as members of the unit. These food processing units also support farmers with agri-inputs and provide trainings on the agriculture and food processing.

Structure: The structure of the organization comprises of small holding farmers, 1 member from vulnerable group (member from scheduled tribe community), 1 women member as their board member, then there are villagers who are working as committee members, who are handling separate functions at the unit such as, treasury, procurement, billing, processing and operations, community mobilization etc.

Products manufactured were- Squash – Citrus, rhododendron, Local stone fruit, Malta, Gooseberry Pickles – Mango, Ginger, Mix. Jam- Apple Jam, Citrus etc.

Main market- Local market, Yatra Route Tourist places of Uttarakhand – Karnprayag, Gairsain, Gopeshwar, Gaucher and other parts of Uttarakhand

Cluster based food processing and Example of Opportunity Loss

Sr. No.	Estimated Cost of Equipping a Cluster	
	Advisory Services	Cost in Lakhs (INR)
1.	Soil Testing Services	1.5
	Paravet Services	0.5
	Computer With Net	0.5
2.	Collection & Grading of Produce	
	Grain Bin & Crates	1.5
	Canvas/Plastic Sheets	0.3
	Table for Grading	0.2
3.	Packaging/Showcasing/Sale	
	Weighing Balance	0.5
	Sealer/Sewer	0.5
	Vaccum Packing	1
	Sale Counter & Showcase	0.5
	Packaging Material	2
	Milling/Grinding/Oil Extraction	
4.	Milling of Grain/Coarse Millet (Chakki) oil Cold Press(Kachi Ghani)	2
	Grinder of Spices(masala chakki)	1
	Distillation Assembly for aeromatic oil extraction	2
	Training Hall	
5.	Furniture & Other Accessories	2
	Total Cost	17

Table 1.6.1 Estimated Cost of Equipping a Cluster

Area and Estimated Construction Cost		
Particulars	Size Approx ft.	Area(Sqft)
Input Storage (Seed, Fertilizer, Pesticide, Machinery)	15*18	270
Collection and Grading of Farmers's Produce and Storage	15*20	300
Weighing/Packaging/Showcasing/Sale	12*15	180
Drying Space	12*12	144
Processing Area (Spices, Grains, Coarse Millets, Oils)	20*20	400
Advisory Services (Agriclinic/Soil Testing/Paravet/Agromet/Kishan Call Centre/Crop/Insurance)	12*15	180
Training Hall	20*25	180
Toilet Room	6*6	36
Total Area		2010
Estimated Cost@ 1200/Sqft = 25,00,000		
Including Accessories Fitting (Electricity, Water Supply, Etc)		
Approximate Land Required = 3500 Sqft		

Table 1.6.2 Area and Estimated construction Cost

Source: Watershed Management Directorate, Gramya Project, 2017

As mentioned in the table below is a reference from one of the projects in which farmers started farm level processing. The firm started its operations in 2010 by the name of Gairsain Krishi Utpadak Samiti

This federation spent around 5 lac rupees to build additional building for production and marketing display resulted in very high counter selling (average 28-32 thousand per day in the month of June and July)

Average turn over – Rs.12-16 lakh /year Since 2012. World bank sponsored project claiming reduction in local horticulture produce loss and doubling the income of farmer.

The above figures also highlight that there is an opportunity in establishing this food processing units and making them sustainable.

1.6.3 Cluster MAP of Uttarakhand

The map mentioned below shows various agro processing clusters in Uttarakhand, currently there are more than 17 agri processing clusters in Uttarakhand.

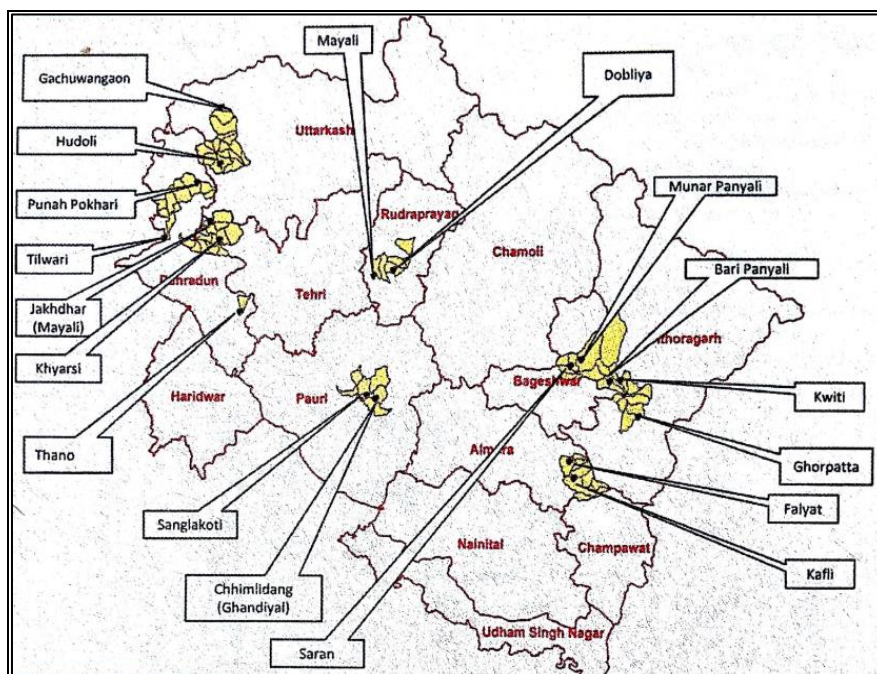


Figure 1.8.1 Uttarakhand's Agri cluster-based Processing Units MAP
 Source: Watershed Management Directorate, Gramya Project, 2017

Table 1.6.3 Status of Agriculture cluster-based food processing units in Uttarakhand

S. No	Division	Name of Federation	Financial Data (Expenditure, Income, assets liabilities) Funding & Initial Investment	Status	
			Funding (Rs. In Lakh)	Turnover (Rs. In Lakh)	In
1	Pithoragarh	Kalika Devi Swayatt Sehkarita (gangolihat	5.25	3.27	Functional

2	Bageshwar	Gomti Ghati Swayatt Sehkarita, Pinglo (Garur)	5.14	0.36	Functional but struggling to sustain
3	Almora	Paharpani Utpadak Evam Vipran Self Reliant Cooperative	4.85	15.17	Functional & Doing Well
4	Chamoli	Gairsan Fal Evam Masala Utpadak Swayatt Shekarita	5.18	6.07	Functional & Doing Well
5	Chamoli	Nanda Devi Kisan Swayatt Sehkarita	4.90	9.45	Functional & Doing Well
6	Pauri	Gramya Kisan Bahudeshiya Swayatt Sehkarita Samiti, Ghandalu (Kotdwar)	5.20	2.35	Functional
7	Rudraprayag*	Shiv Shakti Swayatt Sehkarita, Chopta	-	-	Non-Functional
8	Rudraprayag*	Agastya Krishi Swayatt Sehkarita, Banyarigarh (Rudraparyag)	-	-	Non-Functional
9	Vikasnagar	Tamsa Ghati Phal Evam Sabzi Utpadak Swayatt Sehkarita	4.65	1.30	Functional but struggling
10	Vikasnagar	Dev Bhoomi Phal Evam Sabzi Utpadak Swayatt Sehkarita	4.20	1.10	Functional but struggling to sustain
11	Bageshwar	Danpur Kisaan Ekta Swayatt Sehkarita, Shama	31.06	19.08	Functional
12	Almora	Dhauladevi Gramyashree Swayatt Sehkarita (Falyat)	33.09	133.44	Functional & Doing Well

13	Vikasnagar	Athgaon Phal Evam Sabzi Utpadak Swayatt Sehkarita (Punah Pokhri)	32.17	21.75	Functional
14	Thatyur	Gramya Krashak Swayatt Sehkarita (Khyarsi)	19.07	92.56	Functional & Doing Well
15	Pauri	Chaundkot Navjyoti Swayatt Sehkarita, Simar	22.39	9.98	Functional
16	Pauri	Teelu Rauteli Swayatt Sehkarita (Amotha)	24.42	10.95	Functional
17	PMU, Thano, Raipur	Malkoti Swayatt Sehkarita (Kaknava Maychak Talai, Thano)	26.98	23.75	Functional

As it is clearly visible from the table 3 mentioned above that out of the 17 Food Processing Units developed 2 Units have become non-functional, 2 are struggling to sustain. The 10 Units out of 17 which are function might become non-functional as the project is getting completed in 2022 and funding is being stopped. Also, the article published by (Pande, 2022) explained that the rural farm and off-farm producers do not seem to be fully geared to seize momentous opportunity. There are numerous challenges associated with their informal and decentralized nature, the ultra-tiny scale of their operations and the imperfect rural markets that restrict their competitive abilities.

1.6. Business Problem

A problem statement adequately established by the facts and figures discussed in introduction.

“Business Sustainability Issues of Cluster Based Food Processing Units in Uttarakhand is leading to opportunity loss”

The above business problem motivates the researcher to perform this study. With this background, this research study undertakes study of measures to achieve

business sustainability of agriculture cluster-based food processing units of Uttarakhand, focusing on the business management and supply chain management selection processes in detail with the objective of having thick descriptions of business sustainability related measures at an organization level.

1.7 Topic and Purpose (Aim)

A detailed literature review was done to learn more about the business problem. This section provides an overview of the current state of knowledge regarding supply chain management, business sustainability, and related agribusiness management concepts, such as small and medium-sized enterprises (SMEs) in food processing, strategic alignment with business sustainability, and enterprise-wide integration of business sustainability measures. In Chapter 2, a detailed literature review is offered.

Literature could not explain about what measures can be adopted for improving business sustainability of agri-cluster based food processing units in Uttarakhand. Further, no literature could be found that can measure the supply chain performance of agriculture cluster-based food processing units in Uttarakhand. Therefore, a study of business sustainability-related processes must be conducted to combine an organization's existing business best practices so that business strategy and business sustainability may be defined holistically.

It is evident from the literature review that the business sustainability related frameworks established relationship between business process and business sustainability in an organization with reference to the theory of triple bottom line, but they failed to explain how the components of triple bottom line interact with each other. As explanation is essential for building theory and for improving practice, there is need for a study of business sustainability with reference to business and supply chain operations at an organization level. In addition, an exhaustive literature search for a business sustainability and supply chain performance study employing quantitative and qualitative research methods at the organization level in an operations-intensive industry such as the food processing industry in the Indian context yielded no results. Databases such as EBSCO (Business Source Premier and Business Source Elite+), Emerald, Elsevier's

Business Collection, Elsevier's Business Management & Accounting Collection (Science Direct), Blackwell's HSS Collection, IEEE Online, ACM Digital Library, and others will need to incorporate the following keywords by May 2, 2022, for the literature to be considered relevant. This deadline has been set. The research problem outlined below was identified by a literature review of relevant topics (including but not limited to supply chain operation of MSME, Supply Chain performance, business sustainability, agribusiness management, study of best practices).

1.8 Potential Significance

Due to the paucity of literature on the topic and the absence of research specific to Uttarakhand, it is essential that the business sustainability model of a cluster-based food processing organization in an Indian environment be described. The Agri-cluster based food processing facilities in Uttarakhand need to know if and how the triple-layered business model canvas is employed in practical sense in the Indian industrial environment.

The policymakers, scholars, and practitioners would profit from this study. This research would offer academics new insights regarding its contribution to theory of TBL-(triple bottom line) and its application in the context of agri-cluster-based food processing units in Uttarakhand, its mixed method research methodology, its supply chain performance measurement using data envelopment analysis, and its rich description of cases from multi case cross case analysis. The Study will be helpful in motivating practitioners, farmers Producer organizations and self-help groups in adopting new management techniques and tools to provide safety to its workers and farming community, efficiently using natural resources, optimizing use of inputs for agriculture and processing and using business ethics and morality as their best practices of their agribusiness enterprise. The study can help policy makers in framing farmer centric policies, schemes to reduce post-harvest losses, improve yield, strengthen farmer producer organization, enhancing farmer income, and stopping migration which is still a cause of concern for the high hill regions of Uttarakhand.

1.9 Thesis Disposition

The sections of this research paper are Introduction, Literature Review, and Research Design and Methodology. The supply chain performance measurement cross-case analysis and conclusions then follow.

This chapter detailed the research study's backdrop and background. The subsequent chapter presents a full evaluation of the pertinent literature and conceptual framework utilized in this research and comparable publications. In Chapter 2, the theoretical underpinnings of business sustainability, a literature review on the theory of triple bottom line, categorization and presentation of key challenges based on agri cluster-based food processing facilities in Uttarakhand are thoroughly explored.

Overall, Chapter 2 shows the existing research done till date in the area of agri-cluster based food processing and business sustainability also by methodically categorizing the literature and subsequently evaluating and synthesizing it in order to identify literature gaps.

The third chapter examines the study's research strategy and research methodology. It will have sections on research objectives and questions, general research methodology and justification, quantitative data collecting and analysis, case study design, data gathering method, data analysis strategy, and empirical research quality. The chapter concludes with an outline of Case Study Protocol's construction (CSP), and chapter 3 provides a complete documentation of the Case Study Protocol for simple reference.

In Chapters 4 and 5, solve the objective of the study that are related to developing the business sustainability model and measuring supply chain performance of agri-cluster-based food processing facilities in Uttarakhand (Case Study 1 and 2 – Best Case & Case Study 3 & 4 – Worst Case) are explored in depth. These chapters include the following sections: quantitative data collecting, application of data envelopment analysis, case introduction, data collection, data analysis, findings of data analysis, discussion of the results of data analysis, and conclusions.

The fifth chapter discusses case study analysis, major findings and proposes a model for business sustainability. This chapter examines the parallels and distinctions

between types of conditions. The contrast between cases is then investigated in depth. The outcomes of the cross-case analysis and the business sustainability model are presented. In addition, propositions have been derived from the cross-case analysis, and each of these statements is presented and thoroughly explored.

In the last chapter (Chapter 6), an examination and explanation of the limitation of the research, as well as a discussion of the importance of the outcomes of the study, is presented. On the basis of data analysis, a model for business sustainability based on a triple-layer business model canvas has been established. This model is provided and thoroughly discussed. In addition, the potential for future study in the field of cluster-based food processing is outlined in the last chapter.

The flow Diagram of the thesis is mentioned for the reference:



Figure 1.9. Flow Diagram of the Study

Source: Author

1.10 Concluding remarks

This chapter discussed the context and background. Food processing in core operations intensive industry and requires uninterrupted continuous flow of resources and this many at times becomes the business sustainability challenge at an organization level. As indicated in the introduction, food processing plays a significant role in attaining improved productivity and profitability, and this will not only assist farmers in extending the shelf life of their produce but may also assist in raising farmers' revenue. Many similar funded projects face a major challenge of un-sustainability due to several issues. Based on this background, business problem has been developed and presented in this chapter.

This business problem leads further exploration on literature. According to a comprehensive literature assessment, there is published material on a variety of topics related to the state of Uttarakhand in the Himalayas, including the performance of supply chains, the viability of businesses, the development of mathematical models, and the economic, social, and environmental impact of agribusiness regulations. In addition, this part presents business strategies-related models and frameworks that examine company sustainability selection and supply chain performance.

Dearth of literature on study of sustainability related processes at an organization level in context of Uttarakhand, a Himalayan state of Uttarakhand to understand on how self-help groups and policy makers formulate the business sustainability and why they select specific strategies for a particular unit and process. Problem statement for this research study has been formulated based on literature gap and business problem & presented in this chapter.

In this chapter, potential implications of this research study and thesis disposition are also discussed. Following that, the chapter provides a comprehensive literature review, known and unknown in agri-cluster based food processing units supply chain and business sustainability. Also, theoretical underpinning is also highlighted and discussed in detail.

CHAPTER 2

Literature Review

2.1 INTRODUCTION

A “literature review” is a complete overview of prior research conducted on a particular issue. A thorough grasp of a topic may be facilitated by doing a literature review. This rigorous, categorized, and repeatable approach to locating, evaluating, and combining the relevant data on completed tasks recorded by Researchers and academics will not simply estimate the quantity of work needed but also aid in understanding what research

has previously been done and what needs to be restricted research by providing insightful information about techniques that are not satisfactory for inquiry. In this study, the initial document collection was carried out based on the focused areas suggested by the business problem.

"Pearl growing", also known as the Snowball approach, was utilized for the addition of new materials, in which documents were chosen from the reference lists of the cited publications. 'Pearl growing' (also known as 'Citation mining' or 'Snowballing') is an efficient method of systematic literature search that ensures all relevant material has been found. Snowballing has been found to identify up to 51% of references in a systematic review. However, even though seasoned researchers frequently employ the snowballing method while doing a systematic review, it is rarely mentioned in the methods section. In circumstances where references were unavailable, reports from peers were gathered. The collecting of documents proceeded until no fresh items with a meaningful relevance to the business problem could be identified.

In this study, the mixed technique, which combines the funnel and theme approaches, was used to conduct a literature review. In order to give information that may be used to influence decision-making, a mixed-methods review utilizes the principles of mixed-methods research and applies them to the review process by mixing articles from several different research traditions (but on the same problem) (Pearson, Salmond, Apostolo, & Kirkpatrick, 2015). Mixed methods systematic reviews give a more comprehensive basis for complicated decision-making than single-method reviews, hence enhancing their use for policymakers. (Stern, et al., 2020). At the conclusion of the mixed method review procedure, it is anticipated that business problem solutions would be established.

A comprehensive literature assessment was conducted to assess the business sustainability of agri-cluster-based food processing facilities in Uttarakhand, supply chain practices, performance measurement and strategies for business sustainability of SMEs and models for business sustainability of agri-cluster based food processing units. Based on literature review, definition of cluster and its role in rural livelihood development is highlighted.

In section 2.7, the theoretical foundations of corporate sustainability, the theory of the triple bottom line, and sustainability ideas are examined.

In Section 2.4, food processing-related literature has been evaluated, analyzed, synthesized, and presented. These works are further classified according to their major topics, which include Supply Chain of Food Processing, Business Sustainability, Agriculture Supply Chain, Supply Chain Performance Metrics and Logistical and Supply Chain Infrastructure.

In section 2.5, the essential ideas are presented alongside relevant literature. This broad literature analysis yields preliminary conceptualizations. Benefits of agri-cluster based food processing units, facilitators of business sustainability, Performance Measures, stakeholders, implementation mechanism, hurdles and prerequisites for business sustainability are envisioned from the review of literature.

Review of the pertinent literature comprised a variety of different types of material, such as research papers, published reports, manuscripts, and reports. The information is broken down into categories in the table that follows:

Table 2.1 Keywords, Report and Databases referred for the Study

Keywords used	Reports Published by	Databases
1. Food processing Industry	1. Ministry of Food Processing Industry, India	1. Elsevier
2. Food Supply Chain	2. McKinsey	2. Taylor & Francis
3. Supply chain of Processed Food	3. Watershed management Directorate	3. Google-scholar
4. Supply Chain Performance management	4. Deloitte	4. EBSCO
5. Business Sustainability	5. Gartner	5. JSTOR
6. Supply Chain management	6. Ministry of Agriculture	6. Emerald
7. Technologies in food Processing Supply Chain	7. Department of Food Processing, Uttarakhand	
	8. Ernst & Young	
	9. PWC	
	10. AT Kerney	

8. Theories in Supply Chain	11. Food Processing Industry Association	
9. Post-harvest management	12. Horticulture Board reports	
10. Cluster Based food processing	13. IBEF	
11. Supply Chain Infrastructure	14. Reports of MoFPI, World Bank, Associations	
12. Agriculture Supply Chain	15. Agriculture and food processing policy of Govt. of India and Uttarakhand	

Table 2.1 Keywords, Reports and Databases referred in the Study

2.2 Themes for Literature Review:

The following eight themes emerged from the Literature Review, pointing to Research Gaps, and indicating the need for Research:

The literature review contributes to the formulation of research objectives, the formulation of a study design, the selection of variables, and the creation of a questionnaire. An exhaustive literature review was conducted under the following nine categories in accordance with the study's business challenge.

Theme 1: Supply Chain Management and its significance for MSMEs

Theme 2: Agriculture Supply Chain Management and its Issues

Theme 3: Food Processing Supply Chain and its Challenges

Theme 4: Agri-Cluster Based Food Processing Supply Chain

Theme 5: Supply Chain Infrastructure and its role in Agrifood supply chain

Theme 6: Supply Chain Performance Measurement

Theme 7: Business Sustainability and its importance for MSMEs

Theme 8: Theories in Supply Chain Management and Business Sustainability

The literature review above mentioned themes were done to understand the existing knowledge and to identify the known and unknown from the studies done yet in the area. The table mentioned below highlighted the justification of themes identified and the search outlook used for the study.

	Themes	Justification of the theme	Search outlook
Business Problem	Supply Chain Management and its significance in MSMEs	Theme addressed the importance and relevance of supply chain and its applicability for MSME sector	The research tried to look for classical, contemporary, and recent papers, articles with reference to evolution of supply chain and its applicability in Micro small and medium enterprises
	Agriculture Supply Chain Management and its issues	Theme was related to one preliminary investigation of the area of the study and the probable issues	Search outlook of this theme included researching contemporary and recent paper and articles in relation with agriculture supply chain, its issues challenges in Indian context
	Food Processing Supply Chain and its Challenges	The theme is researched to identify and explore the development of Food processing supply chain and its challenges	The theme focused on supply chain of food processing industry and to do so research papers, book chapters and articles to identify the prevailing challenges with reference to food processing supply chain
	Agri-Cluster Based Food Processing Supply Chain	The business problem was inclined towards the theme, this theme was researched to understand agri-cluster based food processing supply chain and its challenges	The search outlook for this theme tried to find the existing knowledge using research papers and articles in Supply chain of Agri-Cluster Based Food Processing

Supply Chain Infrastructure and its role in Agrifood supply chain	As, background of study highlighted the logistical infrastructural issues and business problem was focusing.	Search outlook of this theme focused on identifying existing bottlenecks in supply chain infrastructure through research paper and articles published in agri-food sector
Supply chain Performance Measurement	Introduction of research highlighted the inefficiency in agri-supply chain, hence this theme focused on identifying variables for supply chain performance,	The research outlook for this subject comprised reviewing supply chain performance assessment research papers, journals, and book chapters.
Business Sustainability and Importance of Business Sustainability in MSMEs	As the title and business problem were inclined towards the business sustainability, theme tried to identify the concept and its relevance for MSMEs around it.	The search outlook for this theme tried to understand existing knowledge in business sustainability literature through research papers and articles
Theories in Business Sustainability Supply Chain Management	The theme aimed to discover theories oriented toward business problems, such as supply chain and corporate sustainability.	Search outlook of the theme tried identifying the theories using contemporary and recent research papers, book chapters and articles.

Table 2.2 Themes, Justification of themes and search outlook for Literature review

Literature identifies many models/frameworks on business sustainability, supply chain performance, and food processing business model, and section 2.7 explains the inferences from these models/frameworks as well as the gaps. It may be utilized as a

basis of knowledge in the field of agri-cluster-based food processing supply chain to construct a comprehensive and integrated model for business sustainability.

Section 2.8 details about major gaps identified through literature review.

There is a well-established relationship between an organization's supply chain and its performance. The first theme of the literature survey focuses on the different studies conducted on this theme in various sectors.

2.2.1 Supply Chain Management and its significance for MSMEs

The study of relevant material that was carried out in this part sheds insight on the history of the supply chain idea as well as its definition. This article places a strong emphasis on the importance of supply chain management in MSEs (micro, small, and medium-sized businesses). In the early 1980s, management consultants invented the term "supply chain management" or SCM (Oliver & Webber, 2012) and it first appeared in scholarly literature in 1985 (Luque, 2009), used by John Houlihan (Houlihan, 1985). Over the past three decades, several definitions of SCM have been established and revised.

The council of supply chain management professionals (CSCMP, 2019) is the biggest practitioner association for supply chain management in the world, with over 10,000 members, and hence their definition for this issue has currency among practitioners. The CSCMP defines supply chain management as "the planning and administration of all sourcing and procurement, conversion, and other logistics management procedures." Channel partners, who may be suppliers, intermediates, third-party service providers, or consumers, must also be coordinated with. Supply chain management integrates supply and demand management across organizations. Also, the supply chain management has been described by (Al-Odeh & Smallwood, 2012) as supply chain management as the process of controlling supply chain operations with environmental, economic, and social matters in mind to advance the long-term financial goals of both individual enterprises & supply networks.

Supply chain management provides an overarching perspective and establishes connections between all relevant parties, from the supplier's supplier to the customer of

the customer. In the following table, we can see the many links in the supply chain, their functions, and their significance. The goal of this tabulated literature analysis was to illustrate the gaps in understanding of supply chain along with the information that has previously been uncovered by previous research.

Tabulated Review of Literature: Supply Chain Management & its significance for MSMEs

Theme	Author	Known	Unknown
Supply Chain Management and its significance for MSMEs	(Chen & Paulraj, 2003);	In the supply chain, structures and ways to measure performance have been found. Because organizations and their supply chains depend on each other, it could be the supply chain that puts the business at risk or the other way around. There are risks to business continuity in the supply chain as a whole. There is a new way of thinking about supply chain management that includes three parts: 1. the business process, 2. the management part, and 3. the structure of the chain.	Service oriented constructs need to be identified.

	(Christopher & Peck, 2004);	Accomplishing increased levels of competitiveness and profitability call for the integration of company operations with key members of the supply chain. The structure of activities and processes both inside and across businesses is critical to achieving these goals.	It is necessary to investigate if companies are willing to forego short-term cost minimization in exchange for enhanced sustainable supply chain resilience.
	(Cooper, Lambert, & Pagh, 1997);	Customer value and satisfaction play a crucial role in achieving competitive advantage and profitability for individual supply chain enterprises and the supply chain.	For business processes to be integrated across the supply chain, more research needs to be done.
	(Mentzer, DeWitt, Min, & Smith, 2001)	Clusters of businesses also use supply chain management to improve customer service, lower total costs, and gain a competitive edge by focusing first on local resources when choosing supply chain partners.	The role of each business function and how it works with the other functions and companies should be looked at.

	(Kouvelis, Chambers, & Wang, 2009)	Scholars of SCM have advised academics to expand the setting of SCM study beyond a single organization to dyads or networks of enterprises. Supply chain administration	The significance of each SCM method in explaining product development remains undetermined.
	Gilal & Jian, 2017)	The responsiveness of an organization's supply chain will be higher the more they use SCM, and a higher level of responsiveness in the supply chain will help companies make new products.	The cluster and its supply chain must be assessed for its long-term business viability.
	(Chebokchinova & Kapsargina, 2020);	More attention should be paid to consumers' sentiments about the service level, and service level evaluation should also be based on customer satisfaction.	Supply chain quality management should be addressed more often.
	(Lee, 2021)	Combining SCM strategies and organizational competencies will enhance operational and financial performance among MSME firms.	Efforts are required to discover efficiency and strengthening by improving existing supply chains in the short term, and

			new opportunities by exploring and developing new supply chains in the long term.
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Table 2.2.1 Tabulated Literature Review: Supply Chain Management and its significance for MSMEs

The above-mentioned tabulated literature review highlighted the concept, application and importance of supply chain for MSME sector, also a robust supply chain become a competitive advantage which also explained by (Su & Gargeya, 2012) the authors of the study suggested that one of the best ways to effectively compete in the market is to reduce the cost of producing an item to the bare minimum required to meet consumer needs, and that this can be achieved through effective supply chain management, which is crucial to the performance of a business organization. One of the greatest methods to successfully compete in the market, according to the study's authors, is to cut the cost of creating an item to the absolute minimum required to suit customers' wants. The tabulated literature review also discusses the unknown aspect, which is specifically that research is necessary for the integration of business processes across the supply chain, that additional research is necessary to understand the role of individual business functions, and that the use of supply chain as a key component to improve sustainability across the industry must be investigated. Specifically, research is necessary for the integration of business processes across the supply chain. Additional research is also necessary to understand the role of individual business functions.

After reviewing the theme titled ‘Supply Chain Management and its significance for MSMEs’ the consolidated research gap for this theme can be to that further studies are required to understand the role of supply chain as an integrator of various business function across industry.

The next theme discusses about agriculture and how its supply chain is managed, as well as how important a good supply chain is in agriculture. The study also tries to find

out what is known and what isn't known about the management of the agriculture supply chain in India.

2.2.2 Agriculture Supply Chain Management and its issues

Investing in agriculture is one of the most efficient strategies to bring an end to extreme poverty, increase shared prosperity, and provide food for 9.7 billion people by the year 2050. While agriculture only accounted for 4% of global GDP, it accounted for almost 25% of GDP in some of the world's poorest nations. Current food systems not only threaten human and environmental health, but also generate excessive quantities of waste and pollution. It is estimated that one-third of the world's food supply is wasted every year. Improving food and nutrition security, meeting climate goals, and lowering environmental stress all require that we do more to prevent food from being wasted (World Bank, 2022).

World Bank research reveals that there are positive social, economic, and environmental spillover effects from focusing on improving supply chains rather than simply the business sector (employment generation, added value, decreases of product losses, etc.). The study also highlights a lack of technology integration and infrastructure as significant obstacles in the agriculture supply chain in emerging nations (Roekel, Willems, & Boselie, 2002).

India's economy has traditionally been based on agriculture, and now it is world's second largest gross producer of agricultural goods. Despite employing 60% of the population, the sector's contribution to GDP is just about 17%. Due to poor logistics and supply chain constraints, India loses 20% of its agricultural output. There are many linking points from farm to fork, and every point witnesses some leakage.

The data mentioned above highlights the criticality of the agriculture supply chain in the national economy. It also mentions the role supply chain in post-harvest management of fresh produce. The table below highlights the importance of logistics and supply chain in agriculture, and how technology and logistical infrastructure are now playing a key role in agricultural supply chain performance. The tabulated literature study also tackles previously unknown areas of agri-supply chain management, such as methods for determining how much of an influence automation has on the supply chain of farm products.

Tabulated Literature Review: Agri-Supply Chain Management and its issues

Theme	Author	Known	Unknown
Agri-Supply Chain Management & Its Issues	(Negi & Anand, 2016)	Since several authors have placed varying values on post-harvest loss, post-harvest loss research sometimes leads to confusion amongst scholars. Post-harvest loss studies need to be conducted with precision, and their results presented alongside relevant contextual information such study location, agricultural production details, research period, state of logistical infrastructure, etc.	The report does reveal the extent of post-harvest losses as well as a plan for reducing post-harvest losses.
	(Routroy & Behera, 2017)	Smart Farming and Organic Agriculture are the future of agriculture supply chain management.	The does not explain any mechanism how small and marginal farmers will implement smart farming practices and enhance farm income.
	(Vishwakarma et, al, 2020);	In low-income countries, there isn't enough or any pre-harvest management,	The study does not explain anything about any model or

		<p>processing, storage, or market infrastructure. Agricultural mechanization is thus an important factor for farm operations to prevent post-harvest losses and improve storage infrastructure, skill development, and entrepreneurship development programs for proper use of machinery, and awareness to farmers, traders, and processors about scientific management of Agri products.</p>	<p>framework to implement mechanization. Also, the study does not mention how the mechanization can improve the agri-supply chain performance.</p>
	(Sachan, et al, 2020)	<p>The findings were mostly about three things: "lack of suitable packing facilities," "lack of proper storage facilities," and "lack of suitable storage facilities." "Inadequate processing and storage infrastructure" was the most important one, and policymakers and decision-makers paid the most attention to it and gave it the most weight.</p>	<p>The study does not emphasize the methods that may be taken to eliminate the inefficiencies in the supply chain.</p>
	(Anand & Barua, 2022);	<p>It was found that losses were greatest on farms, in</p>	<p>The study does not suggest any model</p>

		storage facilities, and during processing. High agri- fresh produce waste in the Supply chain is caused by poor communication between producers in the catchment region (Uttarakhand, Chhattisgarh, Jharkhand, and Himachal Pradesh) and those in charge of logistics and packing.	to reduce post-harvest losses and improving processing efficiency.
	(Khandelwal, et, al, 2021)	The Internet of Things and information and communication technology play critical roles in addressing food security, traceability, and food quality, all of which contribute to the achievement of sustainable development goals.	The study does not highlight the implementation plan for small and marginal farmers.
	(Khandelwal, Singhal, Gaurav, Dangayach, & Meena, 2021)	Small food value chains are also in the process of evolving and may eventually replace the conventional approaches to the management of agricultural supply networks.	Incorporating a variety of supply chain actors and stages that are often absent in the already operating agri-supply chain in particular and in Asian nations such as India.

	(Kamble, Gunasekaran, & Gawankar, 2020)	The objective of the data-driven Agri-food Supply chain is to attain social, environmental, and economic sustainable performance results.	For data-driven involvement in AFSC, research should also focus on establishing new business models and technologies to successfully connect governments, farmers, banks, insurance firms, market intermediaries, cooperatives, etc.
	(Kumar, et al., 2021);	Environmental and sustainability issues are becoming more important to consumers, which is pushing the players in the agriculture supply chain to use new technologies and circular economy practices.	There is a need of extensive study identifying barriers of sustainability implementation in agriculture sector in India. To take into account the many unknowns in agriculture, we need effective and efficient models of the agri-supply chain.
	(De & Singh, 2021)	Lack of skills and motivation, lack of practices that can last, and lack of acceptance all	There aren't many knowledge-based models that work well and are

		showed strong dependencies.	efficient in the business of managing agricultural supply chains.
	(Anand & Barua, 2022);	It was found that losses were greatest on farms, in storage facilities, and during processing. High agri- fresh produce waste in the Supply chain is caused by poor communication between producers in the catchment region (Uttarakhand, Chhattisgarh, Jharkhand, and Himachal Pradesh) and those in charge of logistics and packing.	The study does not suggest any model to reduce post-harvest losses and improving processing efficiency.

Table 2.2.2 Tabulated Literature Review: Agri-Supply Chain Management & its issues

The tabular literature review presents the known and unknown aspects of agriculture supply chain research. It underlines that a lack of competence and desire, a lack of methods that are sustainable, and a lack of acceptance were important factors to the inefficiencies of the agriculture supply chain. The review also suggests that smart and sustainable farming will be the future of agriculture. The table also displays the unknown part which explains that there is a need of extensive study identifying barriers of sustainability implementation in agriculture sector in India. In addition, in order to accurately reflect the high levels of agricultural uncertainty, strong and effective models of the agricultural supply chain are necessary.

This section examined the agriculture supply chain and its potential for improvement. The sections elaborate on the gaps in the prior research. Studies should also focus on

building new business models and technologies to successfully connect governments, farmers, banks, and insurers, if this section is to be considered complete.

The next section discusses the food processing supply chain and challenges related to its findings and its gap.

2.2.3 Food Processing Supply Chain and its Challenges

In the field of managing agricultural supply chains, there are not a lot of knowledge-based models that are effective and efficient enough to be considered widespread (Stevenson, 2018). The (Essila, 2019) says that organizations are made up of different facilities, functions, or units that are responsible for carrying out production or service supply activities in order to fulfil their purposes. As a result of this, the establishments, functions, and activities that are engaged in the manufacturing of products or the provision of services that they are responsible for are essential components of supply chains. Since information is manipulated to trigger, transfer, and monitor goods and services across and across the supply chain, facilities might comprise operational units such as factories, storage facilities such as warehouses, processing centers, distribution centers, and even offices.

The Indian Food Processing Supply chain (FPSC) is lengthy and fragmented. Integration and consolidation are at an extremely low degree. Within the Indian FPSC, the most important actors are the processors. Indian researchers have conducted research on a wide variety of topics, including climate change and its effects on farmers, capacity development, productivity growth, regulatory compliance, competitiveness, consumer demand, performance measurement, food insecurity, determinants of fast-food choice, consumer perception of fast food, green purchasing behavior, consumer behavior, risk propagation, and inhibitors in cold chains, to name a few.

The diagram 2.2.3 below illustrates the food processing supply chain and its components. The agri-food processing supply chain begins with food grain production and ends with numerous intermediates involved in processing and distribution; the chain also includes clients such as retail stores, small shops, and so on. The figure mentioned below also suggests that food processing supply chain is highly fragmented and has an impact of climate change as well.

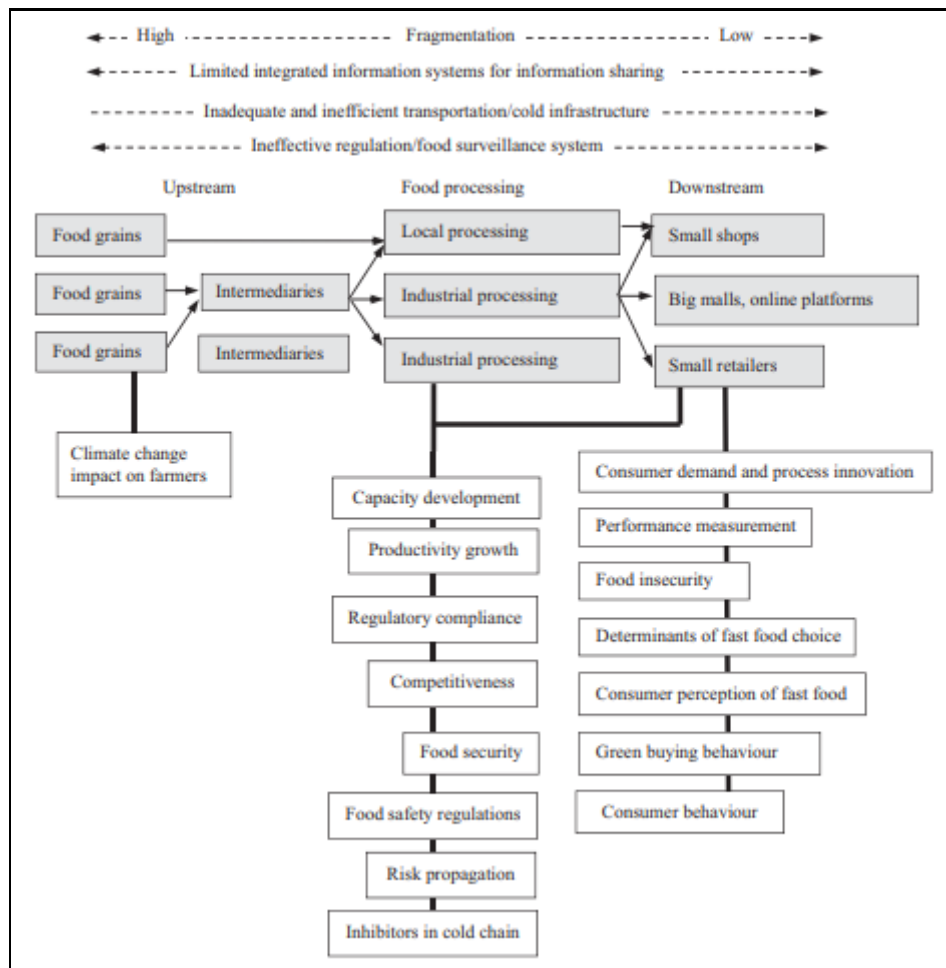


Figure 2.2.3: Agri-food processing supply chain

The challenges that arise in the upstream supply chain of food processing in India are characterized by a high degree of fragmentation, large harvests, and postharvest losses. inadequate number of agriculturalists Farm production is about on par with other industries. Components of the supply chain that are located in the middle of the process, also known as the processing level, comprise a low level of food processing organization and a low degree of vertical integration with players further upstream and further downstream in the process. This level of the supply chain is also referred to as the processing level. There is a limited degree of visibility, and most forms of collaboration revolve around links that are at a distance. There is a major need for upgrades to the supporting infrastructure, and the cold chain is not yet finished. Most products are distributed to ultimate clients through conventional channels such as retail

shops, corner markets, and major shopping centers. Distribution channel players collaborate with processing actors, although their level of integration and cooperation is minimal.

Overall, the supply chain orientation of distributors needs significant improvement.

Tabulated literature review on Agri-cluster based food processing units and its supply chain

Theme	Author	Known	Unknown
Food Processing Supply Chain	(Nobis, 1993)	The study emphasizes the significance of changing customer behavior and trend as well as complete quality management in the food processing business.	Study does not discuss about the theory used and the producer's perspective and consumers of FSCM
	(Devi, 2014)	Policy issues, inadequacy of infrastructure and identification of value addition for processed food export	Study does not discuss anything about logistical infrastructure issues and supply chain
	(Turi, 2014)	To address global food and nutrition insecurity, a comprehensive multisectoral strategy along the whole food supply chain is needed.	empirical evidence from other perspectives is needed

	(Dharni & Sharma, 2015)	According to the survey, the logistics and supply chain management practices used in the food processing industry are still in their infancy stage. There is a requirement for improvements to be made to the methods of managing supply chains, particularly about data quality and latency.	Study is required to improve business performance in accordance with supply chain performance
	(Behzadi, 2017)	Green measures, Resource Utilization, reverse logistics, energy consumption can be used for measuring performance of FSCM.	There is a need to analyze the processes of frugal innovations utilizing analytical techniques and empirical instances in both informal and formal regions of discourse in the subject of frugal innovations.
	(Rahul, 2017)	The study reveals that BFPIs required a steady supply of raw materials to operate their processing operations. The analysis focuses on two distinct	Climate change risks and problems have been exacerbated by a lack of study on

		supply-side disruption concerns to achieve appropriate depth.	sustainable supply chain in food processing, particularly in emerging nations.
	(Ojo, Shah, & Coutroubis, 2017)	According to the findings of the study, the logistics and supply chain management industries in the food processing sector are still in their developmental years. It is necessary to develop new strategies for managing supply chains, particularly with regard to the latency and quality of the data.	It is necessary to do research to discover, develop, and validate the most effective strategies for incorporating sustainable practices into food sector supply chain management.
	(Prakash, 2018); (Gyan, 2022)	The processing and upstream phases of FSCs must be designed with the dual goals of enhancing the capabilities of small farmers and constructing robust supply chain operations.	Included in the needed research are network design for milk procurement, the identification and prioritization of sustainability aspects, and the development of a distributed information

			system for linking diverse players.
	(Maaz, Ahmad, & Abad, 2021)	Green SCM methods enhance economic and operational performance, hence enhancing organizational performance. Additionally, the paper proposes a framework for GSCM implementation in the food processing sector.	After implementing green SCM, the study provides no foundation for making the food processing supply chain sustainable.

Table 2.2.3 Tabulated literature review on Agri-cluster based food processing units and its supply chain

The tabulated literature review displayed the above explains the known and the unknown in the food processing supply chain literature, the known part mentions that green supply chain practices, role of training in economic and environmental

According to the findings of the study, the logistics and supply chain management industries in the food processing sector are still in their developmental years. It is necessary to develop new strategies for managing supply chains, particularly regarding the latency and quality of the data. The study elaborates on the gaps in previous research. The aggregated gap for this area may be the requirement to build sustainable business models that incorporate several supply chain participants.

The next section discusses the Agri- Cluster Based food processing its findings and its gap.

2.2.4 Agri- Cluster Based food processing unit

The growth of the MSMEs industry can be impacted by supply chain and performance. In a well-integrated and fully integrated supply chain, it is possible to fulfil customer demand and become a competitive advantage for the firm, as demonstrated by reduced pricing and higher quality, so that the company may grow its competitive edge over its rivals.

For the average Indian farmer with a small landholding, clustering is a wonderful strategy. It can provide several benefits. The Gujarat Cooperative Milk Marketing Federation (Amul) is India's best-known cluster example. The grape cluster in the Pune district is a less well-known Maharashtra triumph. To reduce transaction costs and enhance income for marginal farmers, Mahagrapes were developed. It achieved this by providing shared facilities for pre-cooling, chilling, and storing grapes, and by reducing the cost of market linkage for all cooperative members. Importantly, a mutually operated insurance system mitigates liability for all participants by using transparent quality standards (Ramachandran, 2019).

In their research, the authors investigated fundamental theoretical and methodological issues of building agricultural clusters in the mainstream of their classical interpretation, while taking into consideration the particular of agricultural sectors (Tsathlanova, Idzhilova, & Erdnieva, 2015) and in both economic development theory and practice, clusters and cluster policy have emerged as a dominating paradigm. Cluster theory posits that enterprises that are a member of a geographically defined cluster profit from being a part of that cluster, and that these advantages contribute to the expansion of economic activity and production in the region. From this, it is a simple step to argue that economic development practitioners may design policies to support cluster growth using a variety of intervention strategies (Wolman & Hincapie, 2015).

Study conducted by (Kapaya, 2019) found that clustering promotes industrial growth. The study further calls for policy dressing and specific research in the areas of clustering properties and financial inclusion and their effects on industrial growth.

Agricultural entities, such as households, agricultural organizations, peasant (farmer) households, and related local authorities, are grouped together in the settlement's territory to form a cluster structure. These entities are all part of the grain legume crops market structure and work together to produce and distribute grain legume products, increasing efficiency and strengthening competition (OVCHINNIKOV, IVANOVA, & BALASHOVA, 2018).

(Chebokchinova & Kapsargina, 2020) Based on agricultural production and including many areas that make up the technological value chain, the agro-industrial complex is a cluster, innovation-oriented, localized, geographically linked structure with components of a network organization.

Three variables can influence the activities of agro-industrial clusters:

- a) geolocation.
- b) connections between industrial firms.
- a) technical integration in the manufacture of final goods across industries.

(Pogodaeva, 2009) Strategic cooperation agreements can connect agricultural producers and infrastructural groups around a processing firm at the core of the cluster.

Table 2.2.4 Tabulated Literature Review on Cluster Based food Processing Supply Chain

Theme	Author	Known	Unknown
Cluster Based food Processing Supply Chain	(Beckeman & Skjöldebrand, 2007)	A cluster was a "bottom-up" venture involving many entrepreneurs. On the basis of Porter's ideas from 1990, food processing clusters in regions/countries are considered as a means of boosting the likelihood of competing. Also, Clusters/networks in their former forms may not be	There is dearth of study which can suggest the replication and customization model for cluster sustainability and innovation.

		immediately replicable today, but diverse players might take the initiative and develop methods to interact, much as they did in the past for frozen food.	
	(Najib, 2010)	Adopting innovative methods is often associated with the generation of competitive advantages and the improvement of SME company performance.	Study does not suggest any model or framework to improve innovation and business sustainability
	(Vinodh, 2018)	In the context of micro, small and medium-sized firms (SMEs), which often lack the resources essential for innovation, cooperation with other parties may encourage innovative activities.	Study do not discuss anything about, how to how to develop innovation sustainable, implement innovative practices.
	(Allaoui, 2016)	Make it easier for the food processing units to implement lean ideas in a methodical manner so that they can ensure long-term advantages. Validation of the study is not currently being carried out; nevertheless, SEM may be utilized to validate the study. Based on research, a two-stage integrated hybrid	There is lack of study that can create a single integrated approach to make agri-cluster more sustainable.

		strategy was offered as a method for designing a sustainable agro-food supply chain network.	
	(Viscusi, Cabitza, Maurino, & Stella, 2013)	Further study can be done on accessing impact of cluster-based agriculture policies, and the adoption of ICT, further investigating the generational changeover in the ownership of MSMEs is missing.	Study should also be done on cluster based MSME and role of ICT intervention.
	(Kozenko, Kozenko, Rogoleva, & Zemlyanitsina, 2017)	The failure to consider a sufficiently comprehensive range of ecological risk factors during the establishment and growth of agricultural clusters is the root cause of many economic difficulties, the majority of which are attributable to a decline in soil fertility.	It is necessary to conduct research into the qualitative evaluation of the economic efficiency of the cluster-based agricultural project as well as the extent of the costs associated with the construction of the project.
	(Silfia, Helmi, Noer, & Henmaid, 2021)	The study empirically shown the connection between CE and the competitiveness and sustainability of SME-based agri-cluster growth.	Government policy is one of the criteria for strengthening agricultural cluster regions' competitiveness and sustainability for

			regional economic growth.
	(Otsuka & Ali, 2020)	Community social businesses in agri-clusters are superior at managing synergies including collaborative action components for innovation, SCM, accessibility, profitability, and benefit-sharing.	For the creation of a SME-based agri-cluster, it is required to investigate the relevant knowledge, implementation, and policies to foster the growth of community social enterprises.
	(Helmi, Azhari, Henmaidi, & Riyadhie, 2019)	The creation of an Agro-based cluster requires collaboration among numerous stakeholders. Improving the role of government, which was minimal in terms of price stabilization; (2) bolstering market institutions for a more equitable interaction between farmer producers and traders; (3) enhancing the financial literacy of farmers; (4) enhancing agriculture extension, particularly in terms of red onion horticulture farming management and the wise and appropriate use of chemical inputs; and (5)	Unseen is a sustainability model for agri-cluster-based food processing plants. Farmers were in a precarious position, and the ecology for an integrated and sustainable horticulture cluster region had not yet been established.

		fostering social capital development in relation to strengthening farmers' organizations.	
	(Sumule, Angkasa, Retno, & Andiewati, 2021)	Innovation cluster is a type of innovation network that acts as a vehicle to develop a process of interaction, links, and partnerships amongst invention players and to accelerate the flow of knowledge, innovation, dissemination, and learning as part of strategic efforts to strengthen innovation.	The validity of innovation model needs to do and study on how innovation model can lead to business sustainability of the cluster can be studied.

Table 2.2.4 Tabulated Literature Review on Cluster Based food Processing Supply Chain

The table mentioned above focuses on the cluster and its supply chain, the finding of the table mentioned above suggests that the cluster-based approach improves competitiveness, innovation and training and infrastructural development can improve economic conditions of a cluster. The area to be researched in this theme includes requirement of policy level interventions, qualitative and quantitative assessment of the cluster development programs and impact of cluster development on ecological changes in the region.

This section also, discussed about the agri-cluster based food processing, the existing status of agri-cluster based food processing, its issues challenges and what can be done to further enhance its performance and sustainability. The consolidated gap for this section can be that there is a need to develop policies, model and framework to assess cluster performance study ecological impact of cluster development for sustain agri-cluster based food processing.

The next section discusses the supply chain infrastructure and its role in agri-food supply chain findings and its gap.

2.2.5 Supply Chain Infrastructure and its role in Agrifood supply chain

Connectivity, which may be described in terms of the quality of the infrastructure that is accessible on the territory as well as the number of connected nodes, is one of the key variables that contribute to a country's or firm's operational level competitive advantage in the field of logistics (maritime, air and intermodal services). This applies to both the tangible network and node infrastructure as well as the physical infrastructure, and it is for the purpose of increasing efficiency while also enhancing safety and sustainability (Remondino & Zanin, 2022).

Despite significant food production, India was unable to feed its population of more than a billion and attain food security. India's lack of well-developed food processing infrastructure is one of the factors contributing to this condition. Currently, India processes barely 10 percent of its food, resulting in an annual food waste of roughly 40 percent of all food produced (Chittawadagi, 2019).

In order to make benefits in this industry, investments need to be made in cold chain infrastructure, applied research in post-harvest technology, the expansion of food processing facilities in diverse sectors, and the growth of the food retailing sector. Roads and power are examples of necessary physical infrastructure elements that connect rural areas to regional wholesale and terminal markets and, ultimately, to international shipping ports. The building of cold storage facilities is not encouraged, and there is a severe shortage of warehouse space. Transport infrastructure, such as refrigerated carriers, is required for the safe and timely delivery of perishable agricultural goods. Not enough effort is put into establishing commodity-specific packaging facilities and encouraging technological advances in agricultural commodity packaging (Sazzad, 2014).

A program has been developed by the government with the intention of developing modern infrastructure and common facilities with the goal of encouraging groups of entrepreneurs to establish units for food processing using cluster approach. A supply chain that is updated with contemporary infrastructure will be used to attain this goal

by linking groups of producers or farmers to processors and marketplaces. Each agricultural processing cluster is required to have two primary components in order to qualify for the scheme. These components are as follows: basic enabling infrastructure (roads, water supply, power supply, drainage, etc.); core infrastructure/common facilities (warehouses, cold storages, IQF, tetra pack, sorting, grading, etc.); and at least five food processing units with a minimum investment of Rs. 25 crores. Each of these components must be in place for the cluster to be considered a success. The apartments are constructed concurrently with the development of a shared infrastructure (MOFPI, 2019).

Below is a tabulated literature evaluation that illustrates the current understanding and knowledge gaps about Supply Chain Infrastructure and its significance in the Agrifood supply chain.

Tabulated Literature Review of Supply Chain Infrastructure and its role in Agrifood supply chain

Theme	Author	Known	Unknown
Supply Chain Infrastructure & Its role in Agrifood supply chain	(Lau, Wong, Pun, & Chin, 2003)	Infrastructure enables supply chain members to interact through the Internet and share information in real time.	To utilize the intelligence level of the virtual agents, infrastructure framework, particularly linked to the technologies' synergistic coupling, is necessary.
	(Kogan & Tapiero, 2011)	Cooperation, sharing and sustainability” provides additional opportunities for extensions in supply	Further studies can be done to identify supply chain infrastructure to improve traceability control.

		chain infrastructure research	
	Ross, Parker, Espinosa, & Droge, 2012)	To enhance the infrastructures and internal communication systems of supply chains, it is essential to build collaboration capacities and institutional agreements. Infrastructure enhancements must be matched with the development of competences, particularly those pertaining to human resources.	Study to propose a sustainable infrastructure for agri-supply chain is scarce.
	(Sharma, 2013)	The wild apricot fruit bar packaged in aluminum laminated pouches suffered the least quality loss compared to those packaged in plastic pouches.	Study does not identify on sales and distribution issues and challenges of wild apricot fruit/flower.
	(Gupta, 2018)	There is a need for more research that addresses infrastructure concerns throughout the retail	No method or model of how cold chain infrastructure to supply and store products

		phase of the cold chain, i.e., from manufacturing to retail display.	throughout the year and end to end supply chain
	(Mercier, 2018); (Hill, 2018); (Garg, 2018)	To take advantage of some of the potential benefits of the new information layers that extend beyond basic legal requirements and could involve improvements in food quality infrastructure, tracking and tracing infrastructure, and chain efficiency infrastructure, solutions will need to be based on a network of limited enterprise clusters that are easier to coordinate.	Further studies can be done to identify supply chain infrastructure to improve traceability control.
	(Babacan & McHugh, 2020)	A vision with focused agricultural production and priority areas such as, integrated supply chain plans, investment and subsidies in supply chains, multi-sectoral coordination and collaboration mechanisms, development of multi-	The study does not identify hard and soft infrastructure required to improve agri-supply chain plans.

		modal east-west supply chain routes, a focus on Asia, addressing workforce challenges, and rethinking infrastructure planning, assessment, and decision-making.	
	(Bhattacharya, Nand, & Prajogo, 2021)	Research shows that poor planning and management lead to significant amounts of food being wasted at every step of the food chain. At the level of consuming, questions of behavior and demographics become important.	Future scholars can conduct more thorough study with the help of the conceptual model and recommendations by adding new search criteria and delving into under-explored topics.

Table 2.2.5 Supply Chain Infrastructure and its role in Agrifood supply chain

The tabulated literature review cited above demonstrates the importance of supply chain infrastructure in the agrifood supply chain through findings like the fact that cold chain and processing infrastructure can lead to reduction in post-harvest losses and improvement in farm income, and the fact that studies infrastructure and management decision-making cause major food waste at all stages of the supply chain, from production to consumption. The table also displays the unknown or unexplored area such as study on supply chain infrastructure to improve traceability reducing climate change impact and sustainability of the agriculture and food processing sector.

This section discussed about the supply chain infrastructure, the present status of infrastructure related to supply chain, role supply chain infrastructure plays in agri-

supply chain & what can be done to improve supply chain infrastructure. The study further explains the gaps in the studies done in supply chain infrastructure so far. The consolidated gap for this section can be that although the importance of supply chain infrastructure is known, model for supply chain infrastructure for agri-supply chain and how to integrate technology infrastructure for improving performance of agri-supply chain is scarce.

The following section discusses the theme, performance measurement of supply chain performance measurement, findings of reviews done and major gaps identified.

2.2.6 Supply Chain Performance Measurement

Supply chain management's major objective is the improvement of organizational productivity and financial performance (SCM). When it comes to supply chain management (SCM), there is a plethora of resources at your disposal. Measuring and tracking organizational performance has received a lot of focus from academics and professionals in recent years. For a firm to maintain a competitive edge over the long term, effective SCM is crucial (Hernandez, Lyons, Zarate, & Dargam, 2014).

The Performance measurement system plays an vital part in the management of organizations, and Supply chains are a key component of the Performance measurement system. (Kaplan & Norton, 1992) assert, "Without metrics, progress is impossible." To make prompt judgments in Supply Chains, it is crucial to measure the correct item at the appropriate time.

To formulate strategies, communicate them effectively, and establish diagnostic control systems based on real outcomes, performance assessment is essential (Wouters, 2009). Each of the three categories of resource measures, output measures, and flexibility measures is essential to the supply chain's overall performance and must be measured

by the supply chain performance measurement system. With this system in place, we can guarantee at least a base level of performance across the board, or at the very least, investigate the interplay between the various metrics (Beamon, Measuring supply chain performance, 1999).

These measurements and indicators are essential to an organization's success because they influence strategic, tactical, and operational planning and management. Metrics and performance metrics play a crucial role in establishing goals, assessing performance, and determining future actions. Scholars and practitioners have not paid adequate attention to SCM-related performance measurement and metrics; thus, new research and practitioner-driven efforts are necessary in the field of SCM-related performance measurement (Gunasekarana, Patel, & EMcGaughey, A framework for supply chain performance measurement, 2004).

Measuring the effectiveness of agrifood supply networks is challenging due to the unique characteristics that distinguish them from other supply chain types. Examples are:

- a) limitations placed on the amount of time that raw materials can be stored, as well as the amount of time that things can be perishable.
- b) a lengthy manufacturing throughput time
- c) a seasonality in production
- d) the presence of sensory qualities in the product such as its flavor, odor, look, color, size, and image
- g) natural circumstances impact the quantity and quality of agricultural goods
- e) needs conditioned transportation and storage
- f) worries about product safety and
- g) requires conditioned transportation and storage

In addition, current socioeconomic developments have altered the performance standards for food supply chains as a whole and at every level of the supply chain.

The tabular assessment of present and recent works on supply chain performance measurement contains implications and gaps.

Tabulated Literature Review on Performance Measurement of Supply Chain

Theme	Author	Known	Unknown
Supply Chain-Performance Measurement	(Beamon, Measuring supply chain performance, 1999);	Any system that evaluates the performance of a supply chain must have at least one measurement for each of these three forms of performance: resource, flexibility and productivity.	Due to the difficulty of selecting relevant supply chain performance metrics due to the complexity of systems, systems-based performance assessment was not prioritized.
	(Gunasekarana, Patel, & EMcGaughey, A framework for supply chain performance measurement, 2004)	Measures may be useful and should be established by enterprises and supply chain players in accordance with their specific requirements.	SCM performance measurement calls for further research and practitioner-driven activities.
	(Galankashi & Rafiei, Financial performance measurement of supply chains: a review, 2022)	The availability of several financial performance measurements has complicated the process of adopting suitable measures. In this respect, it is essential to analyze existing measurements, identify their frequency, and build a framework for measuring what needs to	There is a need for a model with which the performance of a supply chain can be evaluated and improvement opportunities may be discovered.

		be assessed in terms of financial performance.	
	(Ramos, Coles, Chavez, & Hazen, 2022)	Optimizing the operational performance of the supply chain by primarily managing its demand and customer service, among other aspects.	Studies can be applied to accesses the supply chain performance including the financial measures.
	(Jamal, El-Khodary, & Ali, 2022)	The performance of whole supply chain will be efficient if and only if all its parts are efficient.	Studies can be applied to accesses the supply chain performance including the financial as well as non-financial measures.
	(Mastos, Gotzamani, & Kafetzopoulos, 2022)	Sustainable Supply chain management (SSCM) essential aspects include firm-level and supply chain sustainability considerations. SSCM includes supply chain collaboration and strategic direction. SSCM performance factors include economic, social, and environmental.	Both demand management and customer service may benefit from more integration and collaboration in the food supply chain. Multiple empirical and analytic approaches might be used to sustainably manage the agri-food supply chain.
	(Maaz & Ahmad, 2022)	Risk, coordination, integration, collaboration,	In the future, researchers may use

		quality management, etc. may impact supply chain performance. Future study may include supply chain antecedents into the model.	more nuanced models that integrate a wider range of performance metrics as moderators of their primary interest.
	(Jha, Sharma, Kumar, & Verma, 2022)	Strategic supply/distribution network, customer connection, internal operations, information interchange, and social/environmental responsiveness are supply chain pillars. The empirical data show how company strategy is incorporated into the modern supply chain's design and performance evaluation system. Key performance indicators vary by strategy and circumstance.	The influence of supply chain performance metrics on company sustainability must be investigated.
	(Abdullah, Saraswat, & Talib, 2023)	DEA is the most appropriate method for analyzing the efficiency of SMEs due to the nature of the problem and the characteristics of the criteria for the suggested framework of evaluation	Future studies may compare various regions and economies in terms of evaluating their SMEs' performance based on Smart, Green, Resilient,

		(e.g., the AHP, ANP, Fuzzy, etc.) The DEA model assists in differentiating between efficient and inefficient SMEs.	and Lean implementation
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Table 2.2.6 Tabulated Literature Review on Measurement of Supply Chain Performance

Tabulated literature review mentioned above shows the evolution and application of supply chain performance measures. The tabulated results show that supply chain performance may be impacted by risk, coordination, integration, collaboration, overall quality management, etc. When analyzing the success of the cluster's supply chain, the gaps shown by the tabulation indicate the adoption of both financial and non-financial metrics.

Also, the study conducted by (Aramyan, Lansink, Vorst, & Kooten, 2007) Costs, profits, customer happiness, lead time, and most product quality indicators were recognized as additional significant indicators for monitoring the performance of the complete supply chain. Some seemingly important variables are not measured by supply chain participants (e.g., delivery flexibility, and marketing indicators).

Further the review done by (Mohan, Neelakanteswara, & Krishnanand, 2019) Research is required in supply chain performance modelling employing simulation methods like system dynamics and discrete event simulation, which are better suited to assessing supply chain performance in an uncertain environment.

The literature review conducted above on supply chain performance measurement highlighted on including risk, volatility and financial and nonfinancial measures in supply chain performance. A review of the relevant literature reveals a lack of models that take into account operating performance, economic performance, social and environmental supply chain performance, and so on; this suggests that future research should take business sustainability into account when developing a performance measurement system.

The next section discusses the Business Sustainability and its importance for MSMEs its findings and its gaps.

2.2.7 Business Sustainability and its importance for MSMEs

Business sustainability refers to a company's capacity to fulfil its short-term financial obligations without jeopardizing its or anyone else's ability to fulfil its long-term duties. This capacity is essential for any company that wishes to be profitable in the long run. (Bansal & DesJardine, Business sustainability: It is about time, 2014).

Additionally, the concept of business sustainability refers to the process of running a firm while considering three distinct factors: the economy, society, and the environment (Mahajan & Bose, 2018).

Business sustainability, defined by (Touche & Deloitte, 1992) as "the adoption of corporate strategies and activities that satisfy the current needs of the organization and its stakeholders while preserving, maintaining, and developing the human and natural resources that will be necessary in the future," business sustainability can be defined as "the adoption of corporate strategies and activities that satisfy the current needs of the organization and its stakeholders."

Early sustainability programs focused primarily on environmental issues, but now they incorporate environmental, economic, and social considerations. "Business sustainability" refers to the capacity of firms to endure internal and external shocks by being intimately related to healthy environmental, economic, and social systems. This type of resilience allows for businesses to be more successful in the long run. Considering this fact, businesses are giving increased consideration to how the life cycle will be affected by the decisions they make (Ahi & Searcy, 2013).

The maintenance of a viable firm has evolved into an essential necessity for micro, small, and medium-sized companies (SMEs). When it comes to being competitive and thriving in the market, sustainable innovation is very necessary. Nonetheless, small and medium-sized businesses (SMEs) in developing markets, notably in the food processing industry, continue to lack the resources necessary to become more inventive (Najib, Rahman, Abror, & Rachmawati, 2021).

The study done by (Mosteanu, Faccia, Ansari, Shamout, & Capitanio, 2020) Among all management activities, corporate sustainability is strongly reliant on good supply chain and logistics integration.

The tabulated literature review mentioned below highlights the concept and application of business sustainability. The review also mentions the importance of business sustainability measures in agrifood processing sector. The review also mentions the gap in the existing literature.

Business Sustainability and its importance for MSMEs

Theme	Author	Known	Unknown
Business Sustainability	(Daniel, 2005), (Christopher, 2009), (Sisco, 2011)	As a result, the Business sustainability framework provides an initial integration and growth of all these perspectives into a conceptualization that is both managerially useful and theoretically created.	Implementation and testing to the framework developed is required and no specific framework for Food processing supply chain.
	(Slaper & Hall, 2011)	Business sustainability refers to the practice of implementing sustainable development goals into a company's operational operations. Some examples of these goals include social equity, economic efficiency, and environmental performance.	In order to incorporate the findings of sustainability assessments into decision-making processes, additional evaluation of a combination of monetary value and MCDM procedures is being carried out.

	(Høgevold & Svensson, 2012)	The term "business sustainability" refers not only to a company's internal business operations but also to the company's whole demand and supply chain networks, all of which need to be incorporated and considered.	Further research can be done to incorporate supply chain and climate change in developing a business sustainability model.
	(Carter, 2008)	Reports include some recommended practices and benchmarks for assessing sustainability performance. demonstrating how the organization impacts and is impacted by sustainable development aspirations; and comparing performance inside a company and across companies over time The triple bottom line is the dominating corporate rationale.	The study does not address operational sustainability of organizations. The study does not mention any business sustainability framework
	(Sambhanthan & Potdar, 2016)	Conservation of scarce resources, optimization of production processes, identification of product innovations, cost efficiency and	There is a need for specific tools for measuring the sustainability of ICT enterprises, as well as methodologies for

		effectiveness, increased productivity, and promotion of corporate reputation can all be aided by supply chain sustainability performance in the financial, environmental, social, ethical, and governance dimensions. For a country as a whole, it is extremely important that its micro, small, and medium-sized enterprises (MSME) be successful.	assessing organizational influence on sustainability. There is also a gap in evaluating corporate competitiveness in terms of implementing sustainability measures.
	(Dyllick & Muff, 2015)	To analyze, compare, and improve corporate contributions to overcoming sustainability concerns, organizations must be transparent about their decisions and activities.	The research investigated the role of ICT in absorbing the economic and environmental sustainability of nations, but they lacked a commercial viewpoint.
	(Bansal & DesJardine, Business sustainability: It is about time, 2014)	Business Sustainability knows the future isn't always predictable and controlled, but that uncertainty is manageable with resilient processes.	Literature suggests that a successful evaluation of the contributions of businesses to sustainability challenges

		Profitability measures a company's overall performance, but it's extremely variable and not predictive of long-term survival.	necessitates the use of proper metrics and measures to analyze and compare their effects.
	(Chatterjee, DuttaGupta, & Upadhyay, 2018)	There are two ways in which small firms may work together to gain knowledge: through shared experiences or through the development of strategic partnerships.	Most strategic management theories concentrate on a single level of analysis, obscuring system dynamics throughout time, which is critical for understanding firm and system sustainability and organizational strategy effectiveness.
	(Chopra, et al., 2021)	Nine fundamental clusters of new knowledge are produced through knowledge management for sustainability research (informed sustainability practice, social network, firm performance, knowledge sharing culture, green innovation, sustainability assessment framework, global warming,	There are no ideal blueprints, and policy choices will be influenced by a variety of circumstances, including the underlying sustainability conditions of MSMEs and SHGs. Application of technology and knowledge management on

		knowledge management, and innovative performance).	business sustainability need to be researched.
	(Kusumastuti, Silalahi, Asmara, & Juwono, 2022)	Innovations in indigenous food production, local ownership (market and property), land, public services (housing, healthcare, retirement), economic policy, micro-credit, pollution control, employment, local business sustainability, electricity, women (gender) and household income, management, and public policy all fall under the umbrella of “innovative economics and public services”.	Conservation of forests and other natural areas, as well as measures to reduce global warming, should be part of any research on village entrepreneurship.

Table 2.2.7 Tabulated literature review of Business Sustainability and its importance for MSMEs

The tabulated literature review summary underlined the importance of business sustainability and how knowledge and innovation can help with company sustainability. The gap in the tabulated literature study showed that establishing an appropriate evaluation of the company contributions to sustainability challenges required suitable metrics and measurements to analyze and compare their effects.

The study done by (Muafi & Roostika, 2022) suggested that the MSMEs business sustainability model allows efficient, proactive, and creative MSMEs to adopt green

business practices like the circular economic system, which promotes zero-waste production and a greater quality of life. According to the survey, small businesses' ability to design and execute strategies affects their success. Green HRM, personal values, a green business culture, and a competitive strategy cannot be implemented. Another Study done by (Sofyan, Suprijatna, Santosa, & Setiadi, 2019) Variables relating to society, the economy, institutions, and income all have a substantial and favorably influencing role on the sustainability of businesses. (Doroteja, Marjeta, & Andreja, 2021) Evidently, unsustainable BM, motivated only by commercial profit, has already caused environmental and social harm. Currently, the overall performance of businesses is assessed from a sustainability viewpoint, which encompasses not only economic but also social and environmental aspects, at least for major businesses.

This theme reaffirmed the significance of corporate sustainability approaches for both large and small businesses. In the current scenario as the MSME's are facing sustainability issue specially in case of agri-cluster based food processing units in Uttarakhand, and the government has plan to lift the subsidy entirely in the coming days making there MSMEs self-sustainable. The consolidated research gap of this comes out to be that literature is scars on availability of business sustainability model for agri-food processing MSMEs in India. The mixed method of literature review helped to identify theories on contemporary supply chain management, business sustainability, strategic management, and community development to narrow down to the underpinning theory for this study, which is discussed in the subsequent section.

2.3 Theoretical Premise

Development of theory depends on research and research counts on theory. Theories play a significant role in research to understand, explain, and predict various concepts. During many occasions, theories are challenged and extended to increase the knowledge base within their boundary assumptions.

The theoretical premise presents and clarifies the theory that elucidates the research topic within the study domain. All research projects require a theoretical foundation for analysis and interpretation. Moreover, theories must be regularly evaluated through

research investigations. The study results add not just to the literature section but also to the theory upon which the research is based.

Review of theories pertaining to four dimensions of supply chain management, corporate sustainability, Strategic Management, and community management. For this study's theoretical assumption, theories such as resource-based perspective, theory of constraints, agency theory, network theory, transaction cost theory, Triple bottom line, theory of agglomeration, Systems theory, and Basic need theory were evaluated. This study utilized John Elkington's "Triple Bottom Line" theory for business sustainability to construct a business sustainability model for cluster-based food processing supply chain.

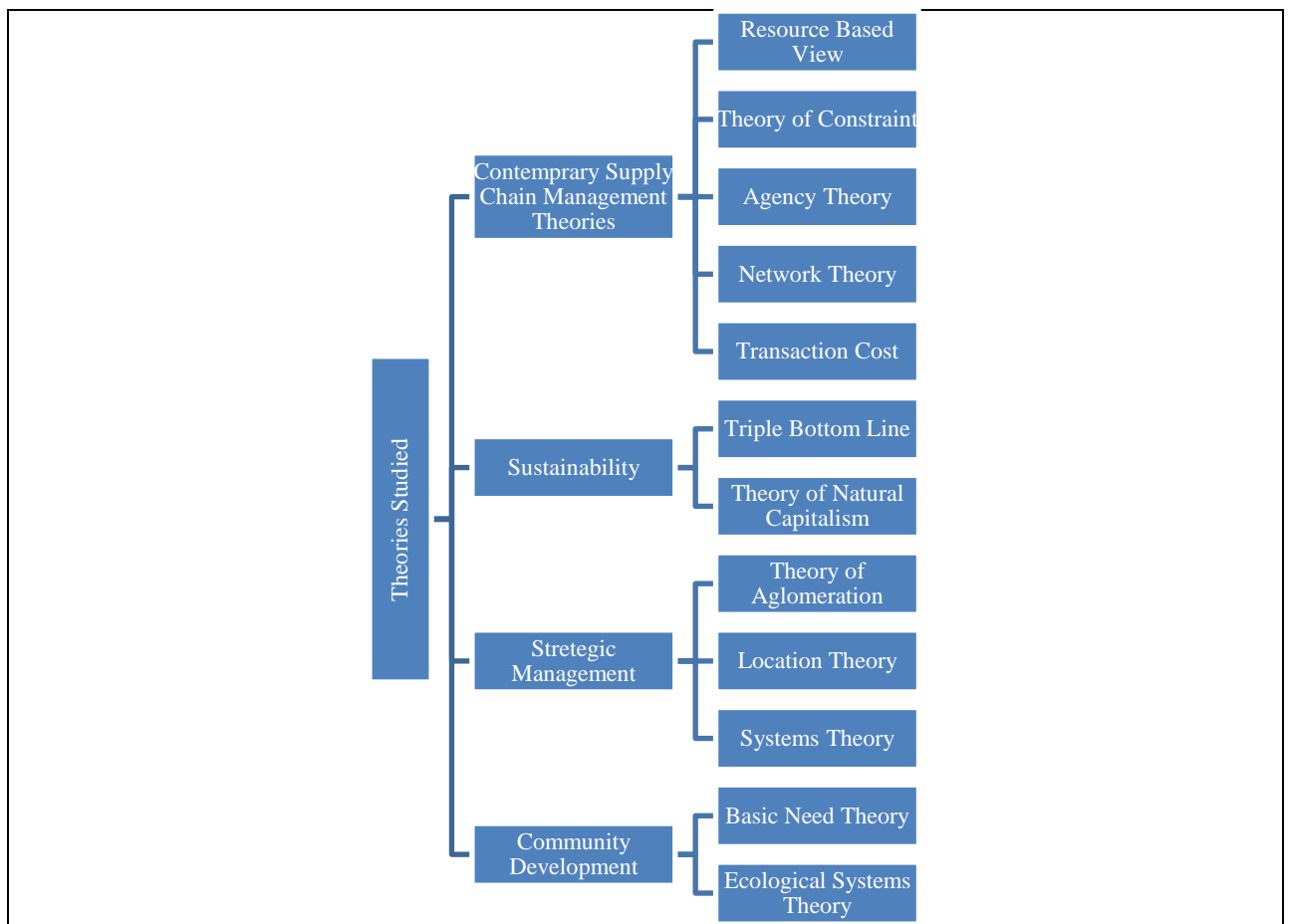


Figure 2.3: Theories studied for this study
Source: Authors

Over the years, many theorists worked on the business sustainability aspect and developed several theories. Theory of triple bottom line is one of the widely followed theories among them. As this proposed study aimed to develop a business sustainability model for agri-cluster based food processing units in Uttarakhand, theory of triple bottom line is found to be an appropriate base theory.

2.4 Triple Bottom Line Theory

In recent years, an increasing number of national and international organizations, special interest groups, and multinational businesses have taken an interest in sustainability. Sustainable business practices and sustainable supply chain procedures, as detailed in this report, are becoming a global corporate need. Multiple groups have articulated in detail a few of the most important sustainability needs. A often cited definition of sustainability is credited to the Brundtland Commission of the United Nations: "filling existing demands without sacrificing future generations' ability to fulfil their own needs" (WCED, 1987) (Christopher, 2011). As study primarily talks about the business sustainability the definition for this, have considered is the definition proposed by (Sevensson, 2016) which is Business Sustainability refers to a company's attempts to manage its environmental, social, and larger economic effect on the marketplace and society, in addition to its profitability.

In the 1990s, a management consultant by the name of John Elkington came up with the term "triple bottom line" to represent the economic, environmental, and social advantages of investing beyond a company's financial bottom line (Elkington, 2004)

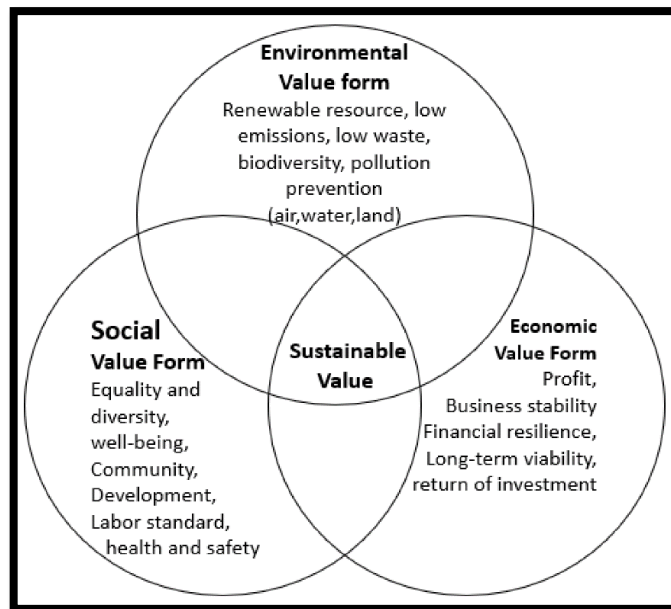


Figure 2.4.1 TBL-Triple Bottom line Venn Diagram

The goal of TBL is to get a more accurate valuation of assets and to leverage resources so that money may be spent effectively. "the 3Ps," which stands for "people, planet, and profit," "triple value addition," which was developed by Roberts and Cohen (2002), and "blended value" (Emerson, 2003). In disciplines associated with economic growth, such as business, planning, and finance, the triple bottom line and sustainability principles have gained acceptance. The figure below illustrates how triple bottom line has combined people, profit, and the environment for the organization's holistic sustainable growth. The term "triple bottom line" (TBL) describes the sum of an investment's monetary, ecological, and social returns. As it pertains to the expansion of the economy, the theory is gaining popularity in a variety of fields, including, but not limited to, finance, business management, and planning, as well as real estate. In the literature on economic development, the TBL notion is discussed, although no precise definition of TBL economic development has yet been established. Even less is known about how those who work in economic development think about and use the idea. TBL methods of development and evaluation have a full research agenda. Building a record of previous outcomes and lessons learned, as well as extending and improving previous research on collaborative governance, adaptive management, social capital, equitable development, routes to opportunity, and sustainability evaluation, are all possible ways to accomplish this goal. Several reasons, such as the lack of TBL-related topics in formal education, training, and certification programs and the existence of

disincentives, contribute to this disparity. The TBL is not typically emphasized in professional development or evaluations. It is argued that a TBL strategy is crucial to the achievement of economic growth, and specific steps are given that can progress theory and practice in this area through training, incentives, assessment, and research.

2.4.1 Literature Review on Theoretical Premise:

The concept of a "triple bottom line" in business encourages companies to evaluate not just their financial success but also the effects they have on society and the environment. Profit, people, and the environment are referred to as the "three Ps." (Miller, 2020). (Elkington, Cannibals with Forks - The Triple Bottom Line of 21st Century Business, 1997) defines as the Triple-Bottom-Line as (Economic, Environmental, and Social). The below mention tabular literature review highlights the existing knowledge and area where study is required in the aspect of theory of triple bottom line.

Tabulated Literature Review on Triple Bottom line

Theme	Sources	Known	Unknown
Triple Bottom Line	(Elkington, Partnerships from cannibals with forks: The triple bottom line of 21st-century business, 1998)	Business and sustainability experts have praised The Triple Bottom Line of the 21st Century as a "practical, empathetic, and highly knowledgeable, magnificent distillation of his gift for cutting through the tangle." Moreover, businesses attempting to shift to sustainability will benefit greatly from strong, long-term collaborations.	There must be research done to figure out how the many parts of triple bottom line work together.

	<p>Sustainable agriculture, backed by a sustainable agricultural supply chain, has been shown to provide healthier and safer products while also helping to preserve the environment and biodiversity compared to conventional agricultural practices. This finding has policy implications for establishing a more effective framework for achieving sustainable agricultural supply chains.</p>	<p>Though 3BL is gaining popularity, its integration isn't perfect. The literature lacks discussion on the triple bottom line's three components, showing that research is still dominated by green issues.</p>
<p>Syahrudin(2014) Monore(2013),</p>	<p>The three distinct goals of the triple bottom line should be unbundled and rephrased as part of future research in order to broaden the scope of the study to include the social and economic components of the triple bottom line. This will allow for the broadening of the scope of the study.</p>	<p>There is no one method that can offer a complete analysis of the supply chain's potential to be sustainable that is presently being used. It is necessary to do research on the social and economic elements of TBL.</p>
	<p>Through the lens of corporate social responsibility, the study of sustainable supply chains has developed from an initial focus on and analysis of independent research in social and environmental concerns.</p>	<p>Researchers now have more tools at their disposal to proactively carry out future sustainable supply chain research, which would be of tremendous assistance to both</p>

		businesses and society.	
		<p>About a quarter of agricultural supply chain firms issued non-financial reporting. Even though voluntary sustainability reporting has grown in popularity in recent years. According to the findings of the study, the agriculture sector appears to be tardy in its reporting efforts. Companies in the agri-food supply chain have not adopted a comprehensive approach.</p>	<p>Not all firms within the agri-food supply chain evaluated in this study provide data on all three parts of the triple bottom line model of sustainability.</p>
		<p>Solutions will need to be based on a network of limited enterprise clusters that are easier to coordinate to take advantage of some of the potential benefits of the new information layers that extend beyond basic legal requirements and may include improvements in food quality, in tracking and tracing, and in chain efficiency.</p>	<p>A sector-wide network of clusters, a less-than-ideal but workable option for satisfying the sector's future information management requirements.</p>
Triple Bottom Line	(Yen Hsu, 2014)	<p>Environmental concern has a tremendous impact on customers' attitudes and inclinations to purchase.</p>	<p>There is no qualitative confirmation of the findings indicating the triple bottom line (TBL) influences customers' attitudes and purchasing intentions toward</p>

		organic and conventional food.
(Göransson, 2017)	The triple bottom line, which takes society, the planet, and business into account, "provides a suitably robust general empirical frame of reference," as the authors put it. It also delves into what economic sustainability is and why businesses today need to transform into learning organizations to survive.	The Study does not define how to develop models for measuring supply chain sustainability.
(Garg, 2018)	Future analysis may include channel coordination contracts like revenue sharing and cost sharing agreements. issue may be studied in a variety of conditions, including multi-period, non-linear deterministic demand, and stochastic demand.	The Study does not suggest any model for measuring effect of triple bottom line sustainability
(Monore, 2013); (AuYong, 2017)	The firm was able to boost its long-term earnings and strategic objectives, such supply security, thanks to the contracts, which also benefited the farmers' incomes and the environment.	As the literature on socially responsible operations emphasizes, such supply chain contracts may be useful for developing countries like India that are facing significant agri-food environmental concerns. Our studies must include modelling and quantitative work,

		such as that seen in the finance literature on commodities. It may also be helpful to explore mixed-methods techniques that take the recommendations into account.
(Mercier, 2018); (Becker, 2017)	Adapting existing research to the varying sustainability enablers and obstacles faced by various supply chain organizations is a key area for future study.	More study is required to determine which indicators may be used to evaluate supply chain sustainability.
(Biswas, 2018) (Formentini, 2016)	This research helps verify and expand the TBL dominating logic essential for business sustainability.	Maintain ongoing re-testing and validation of the BS framework based on the TBL approach in other country types that are more varied than Norway and Sweden. In further research, we are planning to analyze and assess more components of the BS framework in order to broaden the scope of its usefulness.

	(Gu, Pan, Hu, & Liu, 2022)	Economic and political instability can help to promote the triple bottom line of sustainability, but it can also hinder the promotion of innovation and entrepreneurship for social progress. The government should promote the economic idea of green and sustainable development, which is not only beneficial to environmental protection but also tremendously beneficial to long-term social and economic growth.	Further Study is required to develop a model integrating triple bottom line components to make small agribusiness sustainable and promote innovative entrepreneurship for social development.
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Table 2.2.8 Literature Review of Theory of Triple Bottom Line

However, each study in the tabulated literature review describes the economic or environmental aspect of the theory of the triple bottom line of business sustainability, and no study has been found that can suggest a holistic model and interaction among the triple bottom line's components in a combined manner. On the basis of these findings, it is necessary to develop a model that integrates supply chain-related processes such as procurement, storage, packaging, and transportation strategies into a holistic model of business sustainability using the triple bottom line theory and a triple-layered business model canvas.

The above extensive literature review's inferences can be summarized as follows: -

The detailed literature review reveals that the most of existing literature have discussed performance measurement and business sustainability in agri-cluster based supply chain management, across various industries such as automobile, electronics, agriculture etc. but no study has been found that can measure the supply chain performance of agri-cluster based food processing industry nor any business sustainability model has been found for the same. Based on these inferences, it is evident that there is a need to develop a holistic business sustainability model which combines the human resource, communication and supply chain strategy related processes in a model.

2.5 Gap Analysis:

To the best of the researcher's knowledge, no references were found in the literature that provided a rich description based on tacit and implicit knowledge available with managers at the organization level in operations-intensive industries like the agri-food processing industry in an Indian context regarding the agri-food supply chain, the supply chain infrastructure, the supply chain performance measurement, or the business sustainability model.

(As of May 10, 2022, literature containing the following key terms can be found in databases including EBSCO (Business Source Premier & Business Source Elite+), Emerald insights, Elsevier's Business Management & Accounting Collection (Science Direct), Taylor & Francis, Blackwell's HSS Collection, IEEE Online, ACM Digital, Web of Science, and Scopus Library: "Food Processing Supply Chain," "Supply Chain Performance Measurement," and "Agri-food Supply Chain."

Following completion of the topic literature assessment, the most significant omissions were identified and discussed. The gaps in knowledge that have been identified from the sources are as follows: -

- a) In an operations-intensive business like the agri-food processing industry in Uttarakhand, no literature references were discovered for research on the supply chain performance assessment of an agri-cluster-based food processing sector at the organizational level.
- b) There isn't enough material in the business sustainability literature to construct a full-fledged business sustainability model.
- c) There is no established model for business sustainability that fully articulates the connections between the various elements of the triple bottom line theory.

2.6 Research Problem

How the components of social, economic and environmental sustainability in triple bottom line theory interact with each other to achieve business sustainability?

2.7 Concluding Remarks

This chapter concludes the discussion on literature available in the domain of supply chain relating agri-cluster based food processing units and their business sustainability. Extensive literature review has been conducted under different themes to identify the research gap in the past available literature.

The literature study used a bottom-up and top-down, mixed-method approach, emphasizing the significance of supply chain and its performance monitoring for agri-food processing facilities. While studying the different sustenance programs and business sustainability, introducing business sustainability for agri-food processing units, as a solution to the business problem, was found to be appropriate but not addressed in any of the earlier studies. Among the different theories of business sustainability, TBL is getting widely accepted among researchers in the recent years. The learnings from TBL are used in formulating different applications such as environment sustainability, business, education, corporate social responsibility, etc. However, no comprehensive study is found that utilizes TBL in business sustainability of agri-cluster based food processing units. Through this study, the identified research gaps will be filled by defining the role of TBL in a business sustainability paradigm. Each research problem will be different and needs to be solved according to the nature of it. Detailed review of theory of triple bottom line identified from literature is also presented in this chapter. Research methodology is an organized way of resolving a research problem. Finally, literature gaps are arrived from this detailed literature review and presented. The next part will focus on the research strategy and methods used in this investigation.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

In this chapter, research methodologies and strategies were described. A study's research design describes the logical relationship between its data, research questions, and its findings (Yin R. K., *Case Study Research: Design and Method*, 2003).

Numerous scientific paradigms, methodologies, techniques, methods, research strategy, data collection strategy, and analytical strategy are all directly addressed. The focus, questions, aims, and nature of the questions central to the study are presented in the part that follows. To assess supply chain performance and build a commercial sustainability model for agri-cluster-based food processing facilities in Uttarakhand, we will use a mixed-methods research approach, which is described in detail in Section 3.3. In addition, it covers the specific research methods employed and their relevance to the study.

Section 3.4 examines data envelopment analysis, unit selection, unit study design structure, and sampling.

Section 3.5 examines case study design elements such as the number of cases, case selection, case study design structure, and sampling.

The data collection procedures for this study are outlined in Section 3.6. Section 3.6 describes the data analysis strategy, which includes data analysis and cross-case analysis (Miles & Huberman, 1994)

Additional assessments of construct validity, internal validity, external validity, and dependability, all pertinent to qualitative research methods, are discussed in section 3.7. (Yin, 2003). Section 3.8 concludes by discussing the implementation of the Case Study

Protocol (CSP) and providing a complete presentation of the protocol document used to this study.

3.2 Rationale of the Study

The Quantum of Post-harvest losses in India are growing at an alarming speed and the situation is not different for the state of Uttarakhand. Almost 45% of fruits and vegetables that are grown rot away in warehouses. The establishment of small food processing plants will not minimize post-harvest losses, but migrations from high hills and the income of farmers can be improved in the region. Compared to the organized sector, the micro, small, and medium-sized enterprise (MSME) business in the food processing sector has a higher role in reducing post-harvest food waste. The government at both the center and state level with their various schemes is working towards making the MSME food processing more vibrant.

One such initiative was to identify farmer interest groups or Farmer Producer Organizations (FPOs) and develop agriculture cluster-based food processing units in the rural areas of Uttarakhand. These clusters are initially provided support by the government to reduce farm losses and distress sales. But over the period, these units or centers are turning out to be non-functional and unsustainable due to the discontinuation of several centrally funded schemes and high migration and poor vegetable and crop production (Azad, 2016). The direct farm procurement and creation of value addition at the farm gate are aligned to the policy focus on FPOs and agro clusters and the learnings can be leveraged to identify structural transformation, collaborative actions, market integration and technology innovations needed for linking clusters to organized supply chains. The existing partnerships can also be leveraged to identify farm gate infrastructure gaps in the clusters and handholding for bridging these gaps. The model also provides the benefit of value creation at the farm level in terms of sorting, grading, and packaging thus helping reduced human contact across the supply chain. The formation of FPO will also align with the agri-cluster approach of 'one district, one crop' aimed at encouraging farmers to adopt the most suitable crop in their district that will help them realize better prices with increased scale. The cluster approach will also help enhance export competitiveness (Confederation of Indian Industry, 2020). Even after three years, many Farmer Producer Organizations fail to establish themselves. As a result, the majority of FPOs struggle with a frail balance sheet, are unable to raise their

capital, and face numerous difficulties in the growth and administration of FPOs owing to a lack of a business strategy. Producer Organizations have a significant role in improving the farmers' way of life. Long-term viability of these firms is crucial for the farmers' continued existence. All the firms' short-term liquidity positions are strong, but their long-term solvency positions are weak. Overall, the data indicates that Producers' Organization is working hard to establish a market presence that will help farmers. The availability and administration of finances pose significant issues for these organizations. The study is beneficial to nonprofit organizations for self-evaluation, the government for policy formulation, and donors for ongoing support. As FPOs are the focal point of the supply chain in agribusinesses, FPOs must be strengthened for company stability and growth. (Chaudhary, Kaur, Neema, & Srivastav, 2021)

Based on these identified processes, activities and factors, supply chain performance has been measured and based on that a model has been developed for business sustainability of agri-cluster based food processing units in Uttarakhand.

3.3 Research Focus:

This research aims to comprehend and characterize the supply chain performance of agri-cluster-based food processing facilities in Uttarakhand. It is also to understand why the specific business unit fails to sustain and what the elements that make an organization sustainable. Since the case study method description states, "Mixed methods design refers to the use of two (or more) research techniques in a single study, when one (or more) of the methods is incomplete," a mixed-methods research design was used for this study. The term "mixed methods" refers to a research strategy in which two or more distinct research approaches are combined into a single study to get insight into a phenomenon that would be inaccessible using only one approach. The use of mixed method design makes the study more comprehensive or complete than if a single method was used (Morse & Niehaus, 2016). Additionally, qualitative research methodologies such as case studies and action research have been used by European researchers for a considerable amount of time and have garnered a lot of attention as of late (Craighead, Hanna, Gibson, & Meredith, 2007) (Taylor & Taylor, 2009). In spite of this, research that utilizes mixed methodologies, or a combination of qualitative and quantitative techniques, is not very popular in the subject of supply chain and corporate sustainability.

3.3.1 Problem Statement

Business Problem

A problem statement adequately established by the facts and figures discussed in introduction:

“Business Sustainability Issues of Cluster Based Food Processing Units in Uttarakhand is leading to opportunity loss”

3.4.1 Theoretical Premise Gap

The notion of the "triple bottom line," in which the financial, ecological, and social returns of a company action are evaluated, addresses this issue and provides more explanation. Despite its links to economic growth, the theory does not address a number of topics, including business, finance, planning, and real estate, to name just a few of them. The term "TBL economic development" has not been defined clearly. In addition, there has been no study done to yet on the interplay between the triple bottom line's constituent parts and the business sustainability it aims to promote.

3.4.2 Research Problem

How the components of social, economic and environmental sustainability in triple bottom line theory interact with each other to achieve business sustainability?

3.4.3 Research Objective and Research Question

3.4.3.1 Statement of Research Question/s

- a) What is the measure of supply chain performance of agriculture cluster-based food processing units in Uttarakhand?
- b) What are the business sustainability solutions is available for agriculture-cluster based food processing units in Uttarakhand?

3.4.3.2 Statement of Research Objective/s

1. To measure Supply chain performance of agriculture-cluster based food processing units in Uttarakhand

2. To develop and propose business sustainability solutions for agri-cluster-based food processing in units in Uttarakhand

3.5 Research Design

Quantitative, qualitative, and mixed methodologies research designs all exist to provide more granular guidance for study operations (Creswell J. W., 2014). As a result, the term "research design" refers to the strategy that a researcher used when conducting a study. According to (Creswell J. W., 2014), Approaches to research are the plans and procedures used to conduct studies, and their results inform everything from broad assumptions to specific techniques for acquiring data and drawing conclusions. It is the combination of theoretical presumptions, practical tactics, and concrete operational procedures. Quantitative research, qualitative research, and a mixed technique approach are the three varieties of research methodologies that are available (Creswell J. W., 2014). A mixed method technique, which combines quantitative and qualitative research approaches, was used to collect data (Greene, Caracelli, & Graham, 1989). The results of mixed-method studies are “more comprehensive since they draw together information from several types of data or sources.” (Denscombe, 2008). Research and data collection from both quantitative and qualitative techniques are required for the mixed method approach, which may involve logical or theoretical underpinnings (Creswell, 2014).

The combination of qualitative and quantitative research yields greater insight than the use of either method alone. Their joint usage enhances our comprehension of research issues.

There are around forty recognized mixed-methods study designs in the literature (Tashakkori A. &, 2003). (Creswell, Plano Clark, Gutmann, & Hanson, 2003) found the six most prevalent designs, including three concurrent and three sequential designs. One of these designs is the mixed-methods sequential explanatory design, which is quite widespread among researchers. In the context of a single research, this design entails the gathering and analysis of quantitative and qualitative data in two successive stages. The literature has a lot to say about its qualities and characteristics (Tashakkori & Teddlie, 1998); (Creswell J. W., Research design: Qualitative, quantitative, and

mixed methods approaches, 2003)), and the design has found application in both social and behavioral sciences research (Ceci, 1991). In the first stage of this approach, a researcher acquires and examines quantitative data, also known as numerical data. The quantitative (numerical) data are acquired and reviewed first, and then the qualitative (text) data are gathered and evaluated after that. The purpose of the qualitative data is to explain or expound on the first quantitative findings. The qualitative phase builds on the quantitative phase as the research progresses into the intermediate stage, and the two phases are connected. The use of quantitative data and subsequent analysis of those data provides a thorough understanding of the topic under investigation, which is the reason for this technique.

The qualitative data and their analysis deepen and clarify these statistical findings by delving further into the participants' perspectives (Rossman & Wilson, 1985); (Tashakkori & Teddlie, 1998); (Creswell J. W., *Research design: Qualitative, quantitative, and mixed methods approaches*, 2003). Typically, a sequential explanatory design is used to explain and comprehend quantitative outcomes through the collection and analysis of following qualitative data. It is particularly useful when quantitative research produces unexpected results (Morse, 1991). The following gathering of qualitative data might then be utilized to evaluate these unexpected outcomes in greater depth. This method may or may not be founded on a particular theoretical framework. Its design's simplicity is one of its key characteristics. It is simple to implement since the processes are clearly separated. Additionally, this design element makes it simple to define and report. For both the first and second objectives, the research strategy employed in this study falls within the category of explanatory research as suggested by (Creswell, 2009) which is depicted through figure 3.5.

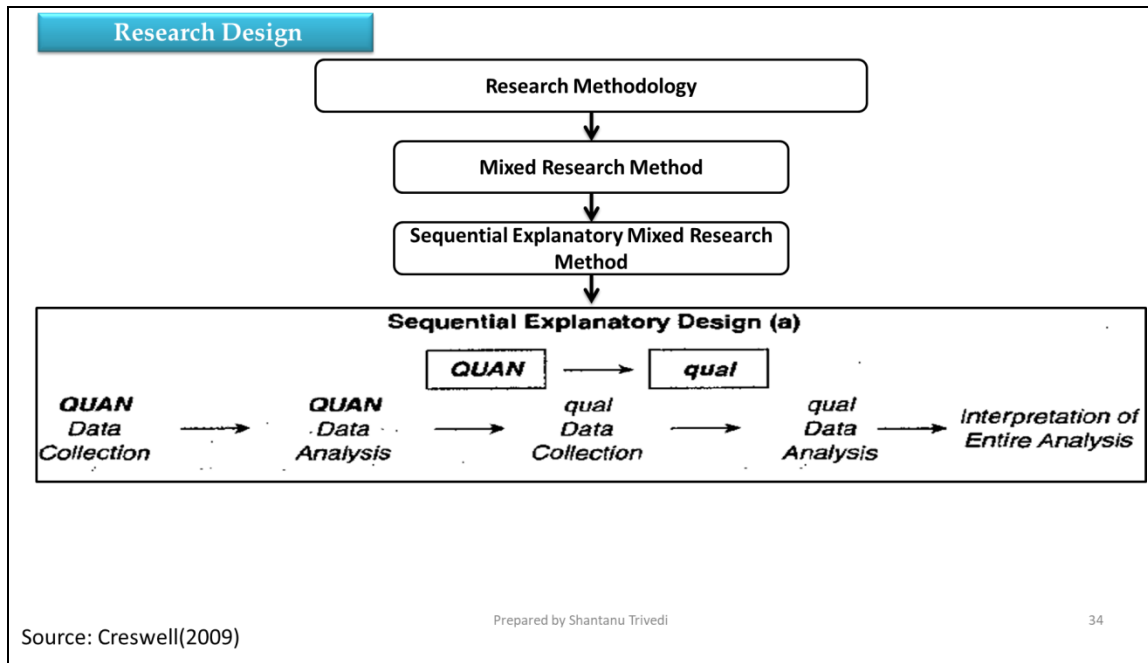


Figure 3.5 Research Design of the study

Source: Creswell (2009)

The research design and necessary steps followed to accomplish Research objective 1, and 2 have been shown separately.

3.6 Philosophical Assumptions

On several factors, such as reliable research procedures, research components, and assumptions about the nature of reality, the research study relies (Myers, 2013). Possibly it is now commonly known that a researcher's philosophical ideas shape every choice they make. The researcher's position on the nature and proper construction of reality (ontology), the researcher's position on how and why he or she knows about reality (epistemology), the researcher's position on what values is incorporated into the research (axiology), the researcher's position on how and why he or she writes about it (rhetoric), and the researcher's position on the methods used in the research all constitute philosophical assumptions (methodology). This is described by (Creswell, 2007). The assumptions and their consequences for this study are summarized in Table 3.6 below.

Table 3.6 Philosophical Assumptions and Implications for the Present Study

Assumptions	Question	Characteristics	Implication in this research study
Ontological	What is the nature of reality and how it should be constructed?	As described by participants in the research study, reality is subjective and multiple in nature. The nature of the world and what we can know about it.	Processes, Practices and Concepts are described in words of participants and evidence have been provided to explain different perspectives.
Epistemological	What is the nature of knowledge and the relationship between the knower and the would-be known?	Researcher attempts to understand thoroughly and be in continuous touch with subjects being studied in this research work.	Researcher spent time of 40 days at various food processing units' company and observed the business and supply chain practices and processes, planning and implementation of processing and overall business strategies
Axiological	What values go into research?	Researcher acknowledges the value addition in this research study	Inferences and interpretations of researcher are validated with the interpretations and of interview participants.
Rhetorical	How the researchers write about his/her research study?	The writing style adopted in this research study is of literary and informal style using the personal voice. It also uses qualitative terms and limited definitions.	First person pronoun is used in the research; Provided rich description of the problem
Methodological	What is the process of research? (or) How can the knower go about obtaining the desire knowledge & understandings?	To study the topic within its context inductive and deductive logic with good design is used.	Research has measured the supply chain performance and business sustainability practices at an organization level. Conceptual lens has been revisited based on the findings from case studies.

Source: (Creswell, 2007)

When selecting mixed method research, researchers make these assumptions, which reflect a particular perspective. A paradigm is "a comprehensive or expansive view of something." (Taylor, Kermode, & Roberts, 2006). A design for a scientifically rigorous research methodology that includes a qualitative or quantitative core component that drives the theoretical impulse and qualitative or quantitative supplemental components. These study components may be completed concurrently or sequentially and are meant to improve description and comprehension. A paradigm has the capacity to affect and drive research, and it may be defined as "belief patterns that control inquiry within a

field by offering lenses, frames, and procedures for conducting study." (Weaver & Olson, 2006)". Before discussing the precise procedures employed in this study, it is necessary to first describe the paradigm that was selected for this research. This is because describing the paradigm clarifies the framework of the inquiry and the researcher's methodological decisions. This inquiry utilized the realism paradigm since the realist strategy has been presented as an alternative single paradigm for mixed method approaches. Further information regarding these mixed method methodologies can be found in the following section.

3.7 Scientific Paradigms

Appropriate paradigm selection is seen as a prerequisite for justifying the use of mixed approaches. Mixed method research designs feature three paradigm selection strategies: a-paradigmatic, numerous, and single. The single paradigm stance is reportedly unassailable. Pragmatism can't justify mixed tactics without a clear understanding of 'what works.' The transformative-emancipatory paradigm is limited to social research and is not a mixed-methods paradigm. Alternative paradigms include realism. This strategy is used in program assessment and social research (Hall, 2013). A study conducted by (Allmark & Machaczek, 2018) It was discovered that realism may serve as the foundation for mixed methods research and that doing so has advantages over pragmatism. The realist asserts that scientific ideas try to depict a mind-independent universe. Understanding the tacit and implicit information available with the farmers is the focus of this study, which aims to measures supply chain performance and offer a business sustainability model at the organizational level, FPO's and the government officials implementing the project; it is not possible measure the efficiency and develop a model. Thus, the positivist or pragmatist paradigm is inappropriate for this investigation.

3.8 Scientific Approach

Researchers are now employing three separate types of research procedures to build linkages between previously established hypotheses and real facts. Research approaches include deductive reasoning, inductive reasoning, and abductive reasoning. Each of the three subsequent paragraphs will offer a detailed description of one of these three research approaches.

The deductive strategy begins with an examination of the already established hypotheses in a certain study field. These hypotheses, along with the research questions that were developed for the research study, are used to examine the validity of the various ideas. In order to make a comparison between previously established theories and the acquired empirical data, the hypotheses and research questions are used to guide the collection of the empirical data. An analytical procedure was followed in order to get the conclusion. (Bell & Bryman, 2007).

The inductive methodology revolves around the collection and analysis of empirical data. To begin with, empirical data collecting is the initial phase in this methodology. A notion is developed by the researcher using the facts from the empirical studies. In addition, the concepts are what give the theories their structure. The distinction between the inductive and the deductive method is that the deductive method examines previously established theory, while the inductive method develops brand new theory (Gummesson, 2000).

3.9 Research Flow:

A research flow is a diagram depicting the operations and motions inside a complex system. Research flowcharts serve as a road map from the beginning of an investigation to its conclusion. The research flow mentions that the overall process of conducting the study. It starts from reviewing the literature, collecting the data, analyzing it, interpreting it and finally concluding the study. The research flow diagram of the study is mentioned below.

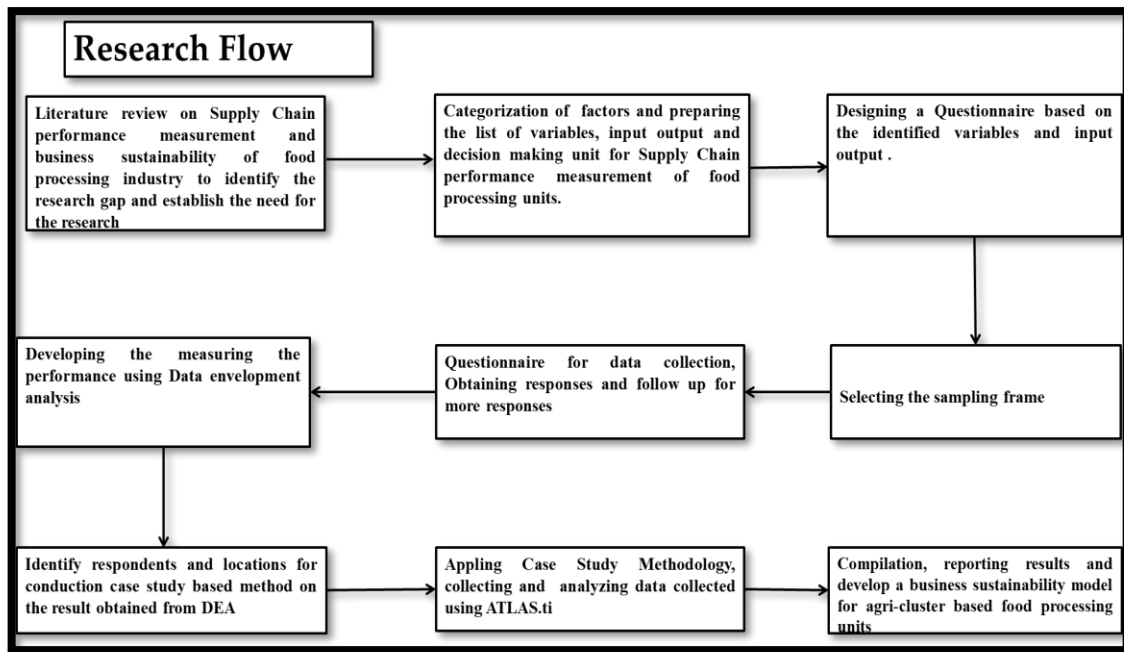


Figure 3.9 Study's Research Flow Diagram

3.10 Research Methodology for RO1:

Research Objective: To measure supply chain performance of agri-cluster based food processing units in Uttarakhand.

A well-stated research question is vital for guiding the thesis since it specifies what is to be discovered via the study and gives the inquiry a defined focus and objective; this will be attained through a well-formulated research question (Quashie, 2022). Quantitative data give preliminary assessments of relationships that, when effectively used, can improve both insight and rigor (Molina-Azorin, Bergh, Corley, & Ketchen, 2017).

There is a growing need for quantitative methods of evaluating agricultural output (Dalsgaard J. P., 1995). Using these indicators in the context of the proposed framework will allow the researchers to approach the problem of ecological sustainability in agriculture in a methodical, systematic, and quantitative fashion (Dalsgaard & Oficial, 1997).

To achieve study objective 1, a quantitative strategy comprising a questionnaire-based survey and Data envelopment analysis will be utilized to evaluate supply chain performance.

Since the first objective of the study was to measure the supply chain performance of agri-cluster-based food processing units, which was not available, a quantitative approach was deemed appropriate as it is an excellent method for addressing comparative research questions and determining the differences between two or more research subjects across variables. These sorts of inquiries assist the researcher in identifying distinguishing characteristics that distinguish one study topic from another while highlighting existing commonalities. This sort of research inquiry can shed light on how your product or service compares to the competition and uncover the product's strengths and flaws for a greater competitive edge (Formplus, 2021).

DEA is an approach which helps the researcher see how the different data can be combined and analyzed to create a performance graph. As the primary methodology is mixed method for the study the quantitative research is being used as the research design is Sequential explanatory research design, quantitative data collected will be analyzed with the data envelopment analysis to create an efficiency graph of agri-cluster based food processing units and to identify the best and worst performing units.

3.10.1. Sequential explanatory design starting with quantitative data analysis using DEA

There are different methodologies used for qualitative data analysis, which follow various approaches. In supply chain management, all feasible efficiency techniques are crucial to attaining the twin objectives of lowering costs and increasing profits. The Data Envelopment Analysis (DEA) has been more popular as a method for assessing the efficiency of supply chains, and DEA models may be used to investigate the competitive relationships that exist between various supply chain components (Tavana, Kaviani, Caprio, & Rahpeyma, 2016). Furthermore, (Weber, Current, & Desai, 1998), use of DEA technique for supply chain performance evaluation (khamseh & Zahmatkesh, 2015).

DEA has extensive applications in agriculture, industry, healthcare, transportation, education, energy, and the environment, in addition to banks, government

organizations, and their supported projects. With the development of the computer-assisted data analysis tools, a lot of researchers conducted the entire framework analysis with the help of software. The software packages included a variety of the most modern DEA models for application in science and technology (ILIYASU, MOHAMED, & TERANO, 2015).

As part of this study's first objective, quantitative data acquired from various reports, interviews, and government documents were analyzed using data envelopment analysis. Famous quantitative analysis software STATA was used for generating supply chain performance graph of agri-cluster based food processing units.

3.10.2 Steps in research methodology for objective 1

The methodology adopted to meet the research question of Objective 1 has several steps that are mentioned in the diagram 3.5.2 below. In the first, supply chain performance measurement variables application in this study were identified. Then data was collected with the help of a survey questionnaire, financial statements, report and government records etc. Input, Output and Decision-making units were defined, then DEA was applied on the data entered in the system. DEA efficiency graph was generated. Based on the performance measures of supply chain, the two best cases and worst cases were identified. The findings related to the supply chain performance of agri-cluster based food processing units were used to strengthen the theoretical premise.

The data provided by DEA models can aid in identifying inefficient units and implementing corrective measures for continual improvement. The results were also used to prepare the business sustainability model for agri-cluster based food processing using in using case study methodology. The details of all steps in the research methodology are provided subsequently.

Fig 3.10.2 Steps for Research Objective 1

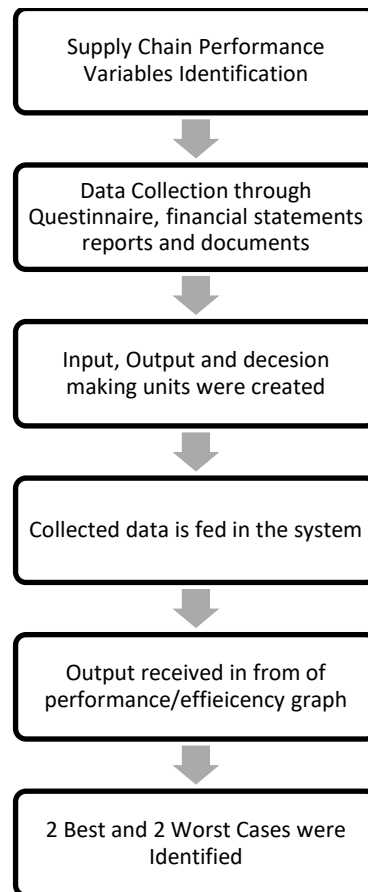


Figure 3.10.2 Application of DEA for Supply chain Performance measurement of ACBFPU

3.10.3 Data Envelopment Analysis

The first purpose of the research was accomplished by applying a method of quantitative data analysis known as data envelopment analysis. This was done to get accurate results. The DEA is a nonparametric method based on linear programming used to evaluate the efficiency of the examined units. The capacity of DEA to monitor diverse inputs and outputs and to quantitatively and qualitatively evaluate these metrics helps managers to make reliable conclusions regarding the efficiency of the researched units (Wong & Wong, 2007). Charnes and Cooper (1978) created DEA as a linear programming (LP)-based technique for assessing a corporation's operational efficiency. It identifies the analyzed units with the abbreviation "DMU," which stands for decision-making units. The decision-making units (DMU) are discrete observational units positioned near or piecewise along the border. Each DMU's performance is evaluated using a virtual input–virtual output algorithm. DEA can measure several inputs and outputs; hence, it may be utilized in multi-criteria decision-making (MCDM) (Wong &

Wong, Supply chain performance measurement system using DEA modeling, 2007). Analyzing the efficacy of DMUs in the same cohort may be done with the use of the robust non-parametric approach known as data envelopment analysis (DEA). It accomplishes this by facilitating comparisons between individuals and between groups of individuals based on a wide variety of input and output characteristics, using a wide variety of models, and utilizing a wide variety of application software. The DEA's broad popularity and applicability, which comes from the simplicity with which it may be used as well as the many different variants on its fundamental model that are accessible, is one of its most notable characteristics.

(Li, Yang, & Liu, 2019) The Data Envelopment Analysis (DEA) takes the data from several different samples, encloses them, and then seeks to determine the link between those samples and the benefits that are necessary for an effective efficiency assessment model. This kind of strategy employs linear planning, considers the characteristics that may be used to evaluate the performance of different DMUs, and analyses the performance of different units that have features that are comparable to one another.

In using data envelopment analysis there is no need to assign weights to criteria. Data envelopment analysis automatically makes the related weights for analyzing. Also, despite parametric methods which need a mathematical function and based on it by using independent variables, the dependent variable has been estimated, data envelopment analysis doesn't need estimating the production function and its accompanied assumptions. Data envelopment analysis is a simple and easy approach and to its special capabilities, this method can lead to making a proper decision based on reliance. Even though famous methods like Logistic regression analysis, Neural Networks and multiple audit analysis which needs predicted data for ranking, this approach (data envelopment analysis) uses real and practical data sets of decision maker units (Rezaei & Adressi, 2015)

The study conducted by (Soheilrad, et al., 2018) Data envelopment analysis was confirmed as a promising evaluative method for future supply chain management evaluations when the production function between inputs and outputs was either almost nonexistent or very difficult to obtain. This suggested that data envelopment analysis has significant potential as a useful assessment technique in the future.

To start the process of data collection and analysis using data envelopment analysis, literature review was conducted on the supply chain performance measurement theme to identify the input and output variables followed by a preliminary survey questionnaire which was created, considering the analytical, perspective, and methodological purposes of the study. The data collected with the help of questionnaire was triangulated with the help of financial reports, government records and other documents. Some of the questions include, “what is amount of money invested in the cluster”, “What was the revenue and profits in the last financial year”, “What is raw material cost incurred during last financial year”, “what the amount of ” etc.

To find the answers to these questions and collect data with reference to supply chain performance questionnaire was prepared which is attached in the annexures, also a lot of data was collected with the help of experts from the agribusiness sector and reports published by government.

Based on the questionnaires the data was collected from 16 agri-cluster based food processing units by site visits and further triangulation done with the help of data collected from experts.

3.10.4 Preparation of the questionnaire, sampling and statistical tool & Schedules

This study's needed data collection was conducted using a survey, which consisted of a planned questionnaire administered to respondents to elicit the information necessary for reaching a satisfying result. To obtain the necessary data, a comprehensive questionnaire was designed and organized according to financial and non-financial facts. The data was collected from 16 agri-cluster based food processing units by site visits and further triangulation done with the help of data collected from experts working the agri-cluster based food processing units. The 16 units selected were the units that were developed by watershed management directorate of government of Uttarakhand under gramya 1 and gramya 2 schemes.

Different administration techniques might be utilized to gather data from the units; however, due to poor internet penetration and education level, the survey was administered by visiting all 16 units to collect data.

After gathering data, it was cross-referenced with financial reports, yearly plans, and other government documents. After data collection, data were synthesized and put into

the STATA program. Stata's DEA application will enable users to execute typical optimization procedures as well as more extensive managerial analyses. (Ji & Lee, 2018).

3.10.5 Sequential explanatory design concluding with qualitative research methodology using Case study method

The second objective of the research was to develop a commercially sustainable model for food processing facilities in Uttarakhand based on agri-clusters. This information was gathered from a mixture of primary and secondary sources. To attain this objective, qualitative research and case studies were adopted as a research technique. This section describes the reasoning for using this research approach.

3.11.1 Research Methodology for RO2:

RO2: To develop business sustainability model for cluster-based food processing units in Uttarakhand.

A qualitative research method was selected for this objective. Since the nature of the research questions are exploratory (Creswell J. W., 2003), For this specific study, the qualitative research method has been chosen as the most suitable research methodology. These are more questions of the "how" and "what" variety than they are of the "how many" or "how much" variety. In addition, the quantitative method begins with a test of a theory; next, the researcher discovers the relationship between variables; and, ultimately, this information is offered as questions or hypotheses. In the realm of natural science, this method uses techniques like as surveys and experiments to get a knowledge of natural phenomena. The social sciences pioneered the qualitative research method to better comprehend social and cultural phenomena. A few examples of qualitative research methods are the case study, action, and ethnographic approaches (Ritchie & Lewis, 2003). Qualifications for qualitative researchers include knowledge of the study problem's context and the participants' environment. This makes it easy for researchers to personally collect data by travelling to the problem's location. Second, the study's ultimate objective is to provide commercial sustainability strategies for agri-cluster-based food processing facilities in Uttarakhand. Without direct involvement, it can be challenging to gain a full grasp of the agriculture strategy and supply chain procedures

involved. Because of this, semi-structured interviews and secondary data were also utilized in order to accomplish this goal. Observation of both the process and the participants was another method that was utilized for the purpose of gathering data and performing data triangulation for this objective. The researcher was able to gain a deeper comprehension of the tacit and implicit parts of the design of business sustainability plans and business sustainability practices already in place inside the organization because of this. Lastly, the development and execution of corporate sustainability must be researched in natural contexts, as opposed to controlled experimental settings. This is due to the fact that natural surroundings provide a more realistic reflection of real-world situations.

3.11.2 Research Strategy – Case study

Sustainable innovation is a developing and inventive issue in business and society, and the case study technique is a good choice for analyzing it. The technique permits the development of current notions and theories as well as the introduction of innovative areas of investigation. Since the objective is to comprehend the event as it occurs in the local context and as it is experienced by people involved, the case study technique permits interpretative sense making and contextualized explanation (Welch, Piekkari, Plakoyiannaki, & Paavilainen-Mäntymäki, 2011). Quantitative research approaches, including surveys, experiments, and mathematical models, have traditionally been widely utilized in the field of supply chain management study (Boyer & Swink, 2008). Since there is a wide variety of qualitative research methods available, the researcher can choose a specific type of qualitative research method that is appropriate for the research project. Techniques such as action research, case study analysis, and ethnography are examples of qualitative methodologies (Ritchie & Lewis, 2003). In consideration of the following factors, every approach has several benefits in addition to certain drawbacks:

a) the nature of the study question being addressed; b) the extent to which the researcher exerts influence on the specific behavioral events being researched; and c) the decision to focus on recent rather than past occurrences (Yin R. K., Case Study Research: Design and Method, 2003)

Today's economic, technical, social, and ecological settings are all taken into account when investigators delve into the case (Eriksson & Kovalainen, 2015). Through abstraction, the objective is to transcend the factual setting to a larger theoretical understanding. (Yin R. K., 2018).

The primary focus of the case study methodology is on the evaluation of a contemporary phenomenon in the context of its real-life setting, where the boundaries between the context and the phenomenon are not readily apparent. This evaluation is done with the intention of drawing conclusions about the relationship between the two. [Method of case studies] Case study research draws on a wide variety of different lines of evidence to accomplish the goal of data triangulation (Yin R. K., 2018). To this research study, need to understand the current organizational practices and business procedures, both from the perspective of the policy implementation level. Employed self-help groups, farmers, and villagers must have their tacit and explicit knowledge recorded as part of the organization's supply chain and operations function in order to obtain an understanding of the ways that are currently being utilized in the development of business models.

Research flow for Research Objective 2

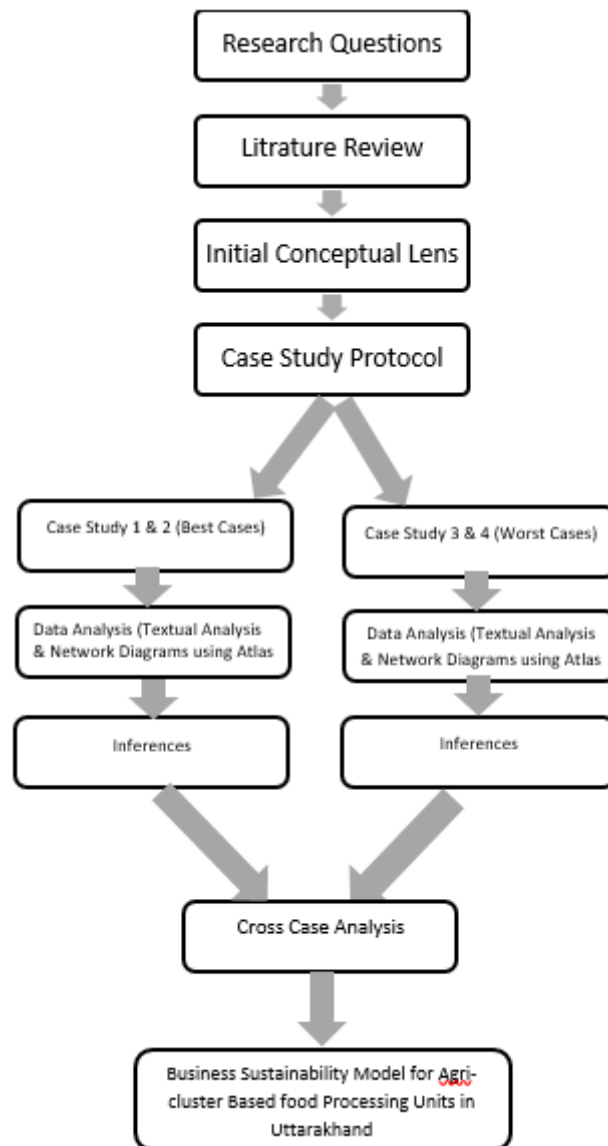


Figure 3.11.2: Case Study Research Design - Flow Chart for Research Objective 2

The following table lists the various research approaches employed and explains why the case study method was chosen for the study.

3.11.3 Number and classification of the cases

For the case study approach to be successful, it is essential to pick the appropriate kind of case, such as a design for a single case study or a design for several case studies. If the case is supposed to shed light on a previously uncovered phenomenon, if the case is uncommon or one of a kind, or if the purpose of the case is to test an established hypothesis, then the single case study design is a suitable approach for the case study

(Yin R. K., 2018). Neither of these conditions holds true for the investigation under consideration here. As a result, a design including many cases was selected. After that, it was important to determine the minimum and maximum numbers of cases that were required. According to (Creswell J. W., *Qualitative inquiry and research design: Choosing among five approaches*, 2013) A multiple-case design investigates an actual multiple-bounded system by collecting extensive, in-depth data from different information sources. By employing a multiple-case approach, the researcher will be able to comprehend the differences and similarities between the best and worst performing agri-cluster-based food processing units through a more thorough examination of the research issue and theoretical development (Eisenhardt & Graebner, 2007). Multiple case studies have the potential to serve a replication logic, which means that the findings may have significance beyond the examples that are currently being investigated (Ridder, 2017). The use of replication logic is essential for conducting many case studies, and it also contributes to an increase in the overall external validity of research (Yin R. K., *Case Study Research: Design and Method*, 2003).

Food processing may promote the commercialization and value addition of agricultural goods, as well as minimize waste, create jobs, and improve the rural economy. To boost the food processing business, it is necessary to establish a robust and efficient supply chain network. Due to a lack of suitable warehouses, cold storages, transport, and handling facilities, food is spoiled before it can be processed and distributed due to the vagaries of nature and the perishable nature of the crop (SANGURI & SANGURI, 2015).

The Agri-Cluster based food processing units and growth centers were set up to improve the agri-processing performance and generate employment, enhance the rural economy and reduce land degradation. The value addition and processing is being done by processing units established by watershed management directorate of government of Uttarakhand under gramya I and II project. Therefore, the units established under both the projects were taken in consideration. There was a total of 16 units established from the year 2009 to 2021. To comparing the findings from many examples, the selection of case studies should follow the logic of "replication." The scenarios with the best and worst supply chain performance were selected. The logic of replication indicates that a sequence of cases should be viewed as a series of experiments. Each new case contributes to the validation or refutation of the conceptual lens developed

throughout the study. The objective of replication logic is to demonstrate or anticipate comparable discoveries and to explain dissimilar outcomes by offering predicted arguments for why they happened (Yin R. K., 2018). Because of this, the method of doing case study research that has been decided upon for the completion of this project is referred to as a multi-case holistic design (Yin, Case Study Research: Design and Method, 2003).

It has been taken into consideration to utilize a multiple-case design since the data that is accumulated from a greater number of examples tends to be more convincing, providing weight to the opinion that the entire study is more trustworthy. (Yin, Case study research: Design and methods, 2013).

3.11.4 Selection of Cases

The selection of four situations (two of the best and two of the worst) was based on theoretical and practical factors. Agri-cluster based processing facilities were built to enhance rural living conditions, increase agriculture, decrease post-harvest losses and soil degradation, and control migration. In objective 1, the best and worst units are chosen based on the output given by the supply chain performance study conducted using data envelopment analysis. Therefore, these four units were selected for the company sustainability analysis.

3.11.5. Structure of case study design

The plan for a case study may be broken down into the following categories:

a.) Best Cases

Case 1: Dhauladevi Gram Swayitya Sehkarita

Unit of analysis: Agri-cluster based food processing Unit

Level of Analysis:

- a) Beneficiary (Farmer Member at Village Level)
- b) Cooperative level (Head Processing Unit/Growth Centre)
- c) Policy and Strategic Level (Agribusiness Expert)

Case 2: Danpur Gramya Krashak Swayatt Sehkarita

Unit of analysis: Agri-cluster based food processing Unit

Level of Analysis:

- d) Beneficiary (Farmer Member at Village Level)
- e) Cooperative level (Head Processing Unit/Growth Centre)
- f) Policy and Strategic Level (Agribusiness Expert)

b.) Worst Case

Case 3: Agastya Krishi Swayatt Sehkarita, Banyarigarh

Unit of analysis: Agri-cluster based food processing Unit

Level of Analysis:

- a) Beneficiary (Farmer Member at Village Level)
- b) Cooperative level (Head Processing Unit/Growth Centre)
- c) Policy and Strategic Level (Agribusiness Expert)

Case 4: Shiv Shakti Swayatt Sehkarita, Chopta

Unit of analysis: Agri-cluster based food processing Unit

Level of Analysis:

- a) Beneficiary (Farmer Member at Village Level)
- b) Cooperative level (Head Processing Unit/Growth Centre)
- c) Policy and Strategic Level (Agribusiness Expert)

The Above 4 cases have been done separately and then cross case analysis of business sustainability measure including supply chain practices and strategies are conducted. Three levels are selected to cover respondents' levels exists in the company i.e., farmer level (individual); Head of SHG/FPO (unit level/department level); implementation agency level, agribusiness expert.

The above-mentioned four business units of India's Agri cluster-based food processing units each have their own unique set of applicable business strategies and practices, in addition to those that are common to all of them. The business sustainability model for

Agri cluster-based food processing units is built based on the examination of the four scenarios that were presented above: Case 1, Case 2, Case 3, and Case 4.

3.11.6 Sampling

For this study, the theoretical sampling method was used. As In qualitative research, one type of sampling known as theoretical sampling is one in which the researcher is not constrained by the boundaries of a priori selection. Instead, theoretical sampling involves simultaneously gathering and evaluating data in order to select what data to collect next and where to locate it so that theory may be developed (Glaser & Strauss, 1970). For data sample, Agri-cluster based food processing unit's head, farmer member and agribusiness experts who are working at the field level were considered. The Units/Growth Centers were selected using the database maintained by the department of watershed management. The locals who work in these units were interviewed either at their places of employment, at the units or back in their villages, depending on their availability.

The names & contact details of the head field officers/experts etc. were obtained from the watershed management directorate head office records available. Among the Unit Heads/ farmers and agribusiness experts identified, based on the unit of analysis & level of analysis, 12 heads/farmers and agri-business experts related agri-cluster based food processing units were chosen. Finally, interviews were conducted from more than 12 farmers/experts/agribusiness experts including both the case studies Case Study 1, 2, 3 and Case study 4.

3.11.7 Methods of Qualitative Data Collection:

Rather than testing theoretically constructed hypotheses, "deep dives" into the data are used to explore open problems (Patton, 2002). Because of this, inductive reasoning has been used to examine and understand the data collected. Qualitative data is distinguished by its " detailed, dense description," " in-depth inquiry," and " direct quotations reflecting people's distinct opinions and experiences," among other defining qualities (Patton, 2002).

Case study research is advantageous because (i) Research design involves gathering evidence for data collection from various sources like documents, archival records, questionnaires, interviews, and observation, (ii) allowing interviewees to share their

experiences in their native language rather than the researchers' (iii) and allowing for in-depth information above each case under study. Case study site visits and pre- and post-visit data gathering are the most prominent forms of data collection activities. This study's empirical investigation involved collecting data from agri-cluster-based food processing units/growth centers, as well as the watershed management directorate and agribusiness experts of the government of Uttarakhand, Government of India.

Participant observation, interviews, informal chats, and historical documents were used to collect data on the food processing unit based on an agri-cluster. The observations concentrated on many aspects of the process, such as the context, the actors, and the acts (Pettigrew, 1997). When appropriate, the researcher also took thorough field notes and recorded the interactions between farmer members and other respondents at the unit.

Using the case study method, information was gathered from farmer members, agribusiness professionals, and food processing facility managers. A protocol is a document that comprises the questionnaire (instrument) for data collection as well as the techniques and general principles that are to be followed throughout the process of putting the protocol into action. This document is called a protocol for a case study. During the stage of data collection, construct validity was established using numerous sources of evidence (document analysis), and reliability was proven using the case study technique. Both steps took place during the phase of the research referred to as "collecting data" (Yin R. K., 2018). The interview data collecting procedure utilized in this study is detailed in depth in Section 3.6. Before data collection and semi-structured interviews with Unit heads, Farmers, and agribusiness experts were done, a comprehensive case study procedure was designed.

3.11.8 Prepration of the interview protocol

To obtain the necessary data, a thorough interview procedure was developed and organized into three major categories, including the present process, difficulties or obstacles, and measurements. Table 3.11.8 provides specifics for each group.

Table 3.11.8 Details of the protocol

Sr. No.	Heading	Contents	Number of Questions
1	Existing Process	A full discussion of the context, goal, and so on is provided here. Different sorts of process and product information, such as types of processing or value addition done, methods of adding new members, training, and development, and so on, were requested. Data types include dichotomous and open-ended, multiple-choice questions.	19
2	Issues and challenges	After discussing the processes, concerns, and challenges associated with the present procedure, interviews were conducted. Data types include dichotomous and open-ended, multiple-choice questions.	20
3	Measures	Along with the issues and challenges, probable measures to solve existing sustainability issues were also asked. Data format: dichotomous, and open-ended, multiple-choice	29

Table 3.11.8 Details of the protocol

19 questions in the protocol were intended to collect the description, background, aim and significance of agri-cluster based food processing units and its supply chain and business processes. Different issues and challenges related to the agri-cluster based food processing units' business were collected through 20 questions. And finally, 29 questions were used to collect the probable measures to not only solve the prevailing issues but to make the business sustainable. Given the nature of the participants, the questions were provided in both English and Hindi. The finalized questionnaire (Appendix A1) along with explanation is presented in the results and discussion section.

3.12 Initial Conceptual Lens

(Erickson H. L., 2002) defined a conceptual lens as a tool that "supersedes the specific topic and time" to build a metacognitive approach to learning by compulsion of a broader and more integrated scale of thought. The rationale behind the development of initial conceptual lens was to understand and develop knowledge about cluster, stakeholders involved in cluster, its impact, barriers and enablers of the agri-cluster based food processing in the state of Uttarakhand. An initial conceptual lens was prepared with the analysis of literature review and a semi structure interview conducted of agri-business experts heading agri-cluster based food processing and livelihood development projects and working at watershed management directorate, Uttarakhand. The data was analyzed with the help of NVivo software.

The initial conceptual lens diagram is mentioned in the chapter 5 of the study.

The initial conceptual lens recommended considering the enablers and advantages of the agri-cluster based food processing unit from the standpoint of the triple bottom line. The initial conceptual lens also highlighted the importance of strong implementation and monitoring mechanism and it also to find the barriers, requisites and key stakeholders of the agri-cluster based food processing unit.

3.13 Data Collection

Professionals in the agricultural sector were interviewed using a semi-structured format. and implementing agency was conducted, also the data from the related texts was collected from different sources was combined and brought under the most appropriate questions and sub questions. As an example, under the first theme "Process", there are three categories, namely, "farmers members", "unit owners", "and "government/implementation agency officials". All of these categories were converted into separate questions such as "What is a cluster-based agri-food processing unit and what are its benefits for the village?", "What is a cluster-based agri-food processing unit and the benefits marginal farmers as well as for people working in the unit?", "What are the environmental and social benefits from this project?", "How the agri-cluster based food processing unit will economically benefit the farmers?". By following the same pattern, a total of 68 questions were formed as part of indexing.

After formulating these questions, the answers related to all these questions were put together to create separate sheets in an Excel file. To reduce the size and repeatability of the collected data, inferences of the collected texts under different categories were prepared as transcriptions. Extreme care was taken to avoid researcher's bias while preparing these documents. Illustration of a transcript is presented in Appendix A4.

The arrangement and labelling of data may be made more appealing to the reader using coding, which facilitates this process. It is possible to regard as a code in a document all ideas, topics, and concepts that are pertinent and linked to the research being conducted. Researchers can conduct analyses and formulate hypotheses based on the codes since they are connected to the whole documents. ATLAS.ti, a widely used software for qualitative data analysis, was used for the coding purpose (Ronzani, Costa, Silva, Pigola, & Paiva, 2020). With the help of ATLAS.ti software, grounded theory-based coding of all the 35 documents was carried out. The flowchart of coding process is presented in Fig. 3.13.

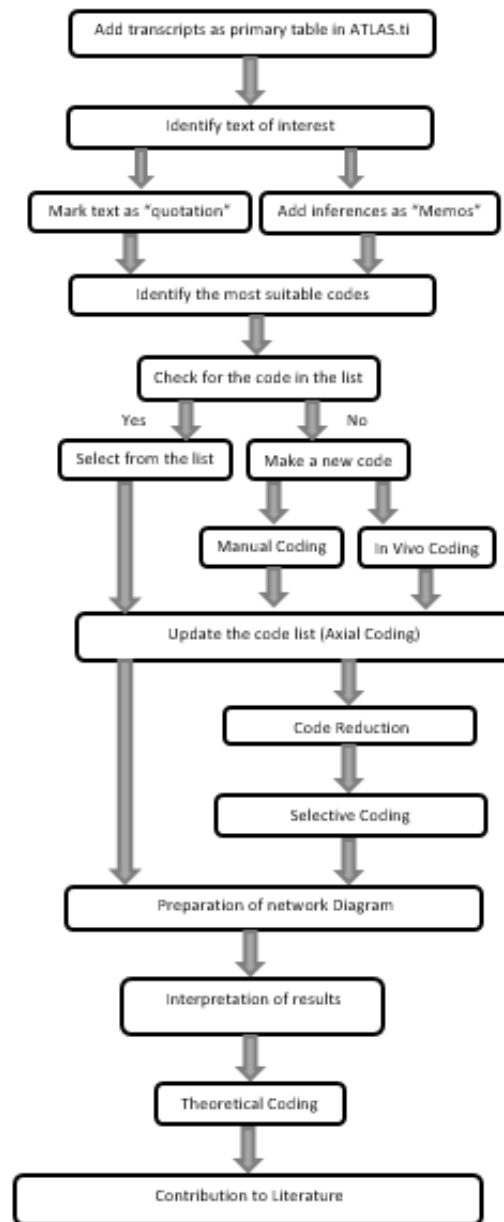


Figure 3.13 The process of coding in Atlas.ti

After adding the documents to the primary document table, the researcher had to read all documents in detail to find the text of interest. The initial phase in the coding process consisted of extracting interesting bits of the texts and preparing quotes and notes from those parts. Quotations are sections of data that have clearly delineated beginning and ending points, whereas memoranda are written by analysts based on their comprehension of the document after they have read a specific section of the text that is contained within it.

3.14. Scope of the Study

Study's scope is limited to business sustainability of agri-cluster based food processing units in Uttarakhand with specific reference to units developed by watershed management directorate, Government of Uttarakhand under Gramya I and Gramya II Project, as the highest amount of business units were developed under this scheme funded by World Bank. A cross case analysis was done to develop a business sustainability model, and the supply chain that goes from the farm to the retailer was chosen because this is where the greatest amount of inefficiency can be found. Additionally, these units were chosen based on how well their supply chain performed.

3.15 Concluding Remarks

This chapter concludes the discussion on research methodology adopted by the researcher to attain the objectives. In this study, both exploratory and conclusive research methods were employed. The researcher collected and analyzed the data by combining quantitative and qualitative research techniques. In addition, this chapter outlines the study's rationale and scope. Next chapter discusses the data analysis and measures the supply chain performance of agri-cluster based food processing units and findings of the study in detail.

Chapter 4

Measuring Supply chain Performance of Agri-cluster based food processing units in Uttarakhand

4.1. Introduction

This chapter discusses the analysis and outcomes gained by data envelopment analysis. In the first portion, the context, issues, and significance of assessing supply chain

performance are examined. In the second section, data envelopment analysis, its application, and the analysis and interpretation of the results are presented.

4.1.1 Background

The global Agriculture sector as food is transported from field to plate, with global food waste is estimated at around 1.3 billion tonnes, or 1/3 of the total food production. Indian agriculture contributes 276 billion US dollars to the national economy, and the food and grocery sector in India is the sixth biggest in the world. Because of limited storage and processing facilities, farmers are unable to sell around 40 percent of the total fruits and vegetables after harvest (Indo-German Chamber of Commerce, 2022). Post-harvest food supply chain is one of the many direct ways in which consumer and producer value distribution is influenced. This is described as the measurable quantitative (lower weight or volume) and qualitative (unwanted changes in the aesthetic aspects of food and decreased nutritious content) losses along the supply chain that can occur at any point between harvest and final usage (Boss & Pradhan, 2020). The basic objective of supply chain is to optimize total value, and it entails managing connections with suppliers and consumers to give the highest customer value at the lowest possible cost (Stevens, 1989). The evaluation of supply chain performance is extremely important for the company's operations, as the supply chain's major objective is to maximize the overall value created (Chithambaranathan, Subramanian, & Palaniappan, 2015). First, the efficiency and efficacy of a supply chain network provides sustainability, followed by profitability, expansion, and competitiveness. (Chen, Paulraj, & Lado, 2004); (Tracey, Lim, & Vonderembse, 2005) (Li, Rangunathan, Rangunathan, & Subba Rao, 2006). In their study (Santos & Leite, 2018) Suggested that future study in supply chain performance measurement be reproduced in real-world supply chain instances so that differences, similarities, and particularities of each application can be identified and the proposed PMS may be tailored to other scenarios.

The study also found that (Steering Committee for the Review of Commonwealth/State Service Provision, 1997) governments can use performance measures to:

a) promote policy formulation by stressing the impact on performance of government-determined components of the operational environment (such as client choice and the level of competition);

b) assess the effectiveness of public sector management and enhance government accountability.

c) encourage "yardstick competition" by offering a way for comparing the performances of individuals accountable for comparable components of service supply in circumstances when direct competition in input and/or output markets is limited.

d) aid the resource allocation/budgeting process by offering a method for distributing funds based on accepted plans for improved performance, as opposed to the presumption that performance levels should remain the same as in the past.

e) Analyze the interdependencies between agencies and programs so that governments can coordinate policies across agencies (for example, the interrelationships between policing, courts, and correctional services).

f) Assist the resource allocation/budgeting process by offering a method for allocating funds based on resource allocation.

Also, in the study done by (Chithambaranathan, Subramanian, & Palaniappan, 2015) suggested that for the objective of assessing the performance of supply chains, it is necessary to investigate the applicability of applying various new MCDM approaches such as PROMETHEE, ELECTRE, data envelopment analysis, and goal programming. It is possible to restructure a supply chain with less resources while meeting current demand, but such short-term evaluations do not account for the changing nature of demand. Thus, resources are directly linked to the output and flexibility performance of the system.

Return on sales and return on investment are two examples of financial ratios that measure the effectiveness of an organization's output relative to its input, although they may not be representative of supply chain performance. Consequently, typical approaches presented in past research that do not consider numerous components would not be able to offer a reliable assessment of supply chain performance. The development of a multi-factor performance measure is important because it allows policymakers to gain a better understanding of how much a specific industry or company can be expected to increase its multiple outputs and reduce the level of inputs it requires to achieve the same level of efficiency gains. This metric would represent how functional units and technologies have been integrated into a supply chain's operations in terms of

their efficiency (Wong & Wong, Supply chain performance measurement system using DEA modeling, 2007). Since supply chains function in a dynamic setting, the authors also proposed future study may look at the possibilities of modelling DEA in a stochastic supply chain context.

The following is a sample of resource performance indicators that may be used in a supply chain:

- (1) Total cost: Sum of all cost of resources used.
- (2) Supply Chain Cost: Total Cost of Information Flow, Product flow and The Financial Flow.
- (3) Cost of Distribution: Total distribution cost, including transportation and materials handling costs.
- (4) Cost of Manufacturing: Total cost of manufacturing, including labor, maintenance, and re-work costs.
- (5) Inventory: Costs related with inventory held:
 - a) Inventory investment: Investment value of held inventory.
 - b) Inventory obsolescence: Costs linked with obsolete inventory; sometimes includes spoilage.
 - c) Work-in-process: Expenses connected with the storage of work-in-progress inventories.
 - d) Finished goods: Expenses incurred because of completed items being retained in inventory.
- (6) Return on investment (ROI). determines how successful a company has been financially. The rate of return on capital is often expressed as a percentage of net profit relative to the asset base (Beamon, Measuring supply chain performance, 1999).

4.1.2. Agri-Processing Supply chain Performance

Agriculture FSC plays a key role in ensuring farmers have access to the market. This has the impact on rural farmers' social, environment and economical sustainability (Naik & Suresh, 2018). Food wastage and inefficiency in India's agri-food supply chain are caused, in part, by the country's poor post-harvest management and a lack of cold chain and processing facilities (IBEF, 2021).

The effectiveness of the agri-food supply chain is measured by how well it is able to respond to market demands, ensure that products are always readily available for purchase, reliably deliver goods to retailers, and keep the manufacturing company's minimum and maximum stock levels under tight control (Bowersox, Closs, & Cooper, 2007).

Each step of an agri-food supply chain might have a different realization based on how much less or how much better it performs in comparison to the identical activity being performed by current rivals in the market (Dinu, 2016). Thus, it is feasible to state that there is no rivalry between firms, but there is competition among the purchasing and retail supply chains, as well as logistic activities and operations, of the companies (Shin, Collier, & Wilson, 2000). It is possible to attain chain efficiency and performance throughout the whole chain and with each component.

4.1.3 Agri-cluster based food processing Units

Post-harvest loss hampered the supply chain business, and it was distressing that significant food was lost every year. Agriculture and food processing businesses should collaborate to reduce agricultural product waste and consequently enhance farmers' incomes (The Hindu, 2021).

The cluster-based development method is among the most promising solutions. Clusters are "groups of industries that are closely connected by expertise, technology, supply, demand, and/or other ties" (Delgado, Porter, & Stern, 2015)

(Wardhana, Ihle, & Heijman, 2017) Regional concentrations and specialties in agricultural production, processing, or marketing are proposed as agri-clusters. Agri-clusters have several benefits for enhancing agricultural output and lowering poverty (Kiminami & Kiminami, 2009); These clusters produce economic opportunities for farmers and job opportunities for other rural residents. Infrastructure upgrades should also be a top priority for policymakers to promote connection across nearby areas. Cluster initiatives are also regarded as efficient policy tools since they permit the concentration of resources and money in regions with a strong growth and development potential that might extend beyond the target locations. Clusters are spatial clusters of related businesses and organizations in a certain industry (Potter, 1998)

A study done by (Joffre, Poortvliet, & Klerkx, 2019) argued that if the cluster method is to be implemented effectively, policy and practice must take into account local peculiarities characterized by social interactions, risk perception, and geographical dimensions. This is required to promote local connections between farms (horizontal coordination) and a better integration into the value chain (vertical coordination).

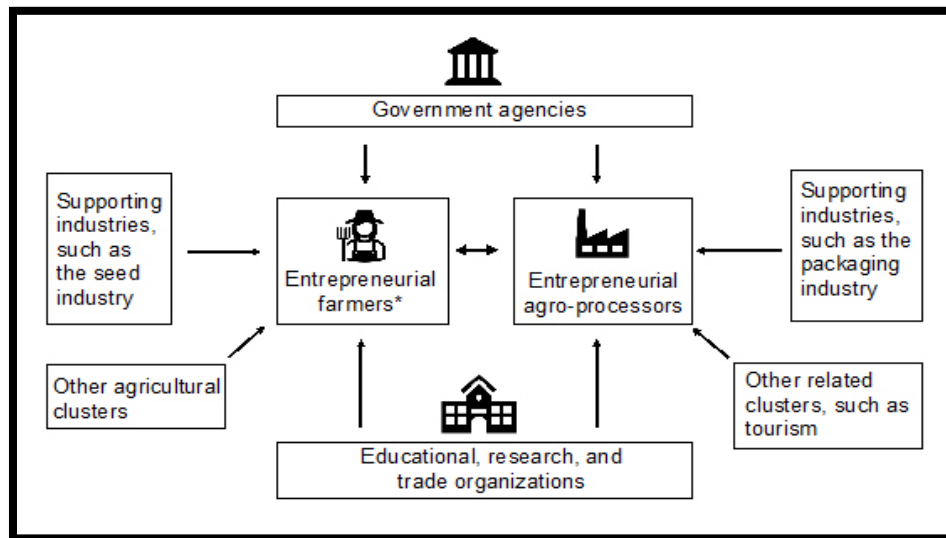


Fig 4.1.3 Structure of an Agro-Based Cluster

Source: (Kumse, Sonobe, & Rahut, 2021)

An agriculture-based cluster is a concentration of agricultural producers, agribusinesses, and educational institutions that are all active in the same agricultural or agro-industrial subsector. This subsector may be focused on production, processing, or distribution of agricultural goods. These entities engage in conversation with one another and construct value networks in the process of addressing and pursuing opportunities and problems that they share. Increased productivity may be stimulated by specialized inputs, access to knowledge, synergies, and access to public goods. A well-developed concentration of linked industries can also facilitate more fast innovation via joint research and competitive striving. Participation in agriculture-based clusters may be beneficial to both individual farmers and to small and medium-sized agribusinesses. In addition to this, clusters can contribute toward the formation of a national or regional brand identity. In addition, the establishment of agriculture-based clusters appears to have favorable spillover effects on the development of local communities and rural areas (Sharma & Anupam, 2014).

4.1.4 Issues and challenges in clusters

Cluster expansion is constrained by many internal factors. (1) There is no purpose or need to unite; (2) there is a lack of mutual trust; (3) there are conflicts between groups; (4) there is a lack of developed inner communication and cooperation between cluster members; (5) clusters lack critical mass; (6) clusters have limited financial capacity/resources; and (7) clusters have limited production, export, and innovation capacity. External impediments can hinder cluster formation. (1) disincentive measures in agriculture policy; (2) an undeveloped business environment for agribusiness enterprises and family farms; (3) unsuccessful privatisation of agribusiness firms and unresolved land property and legal concerns; (4) an inadequate legislative and judicial framework; etc. (Paraušić, Cvijanović, & Mihailović, 2013) Numerous domestic-oriented nascent clusters (e.g., Central American dairy clusters) do not appear to have a bright future since many supply chain connections, which are required for endogenous growth, are not being strengthened.

4.1.5 Agri-Cluster based food Processing Supply Chain

The use of cluster tactics recognizes that all stakeholders in the agricultural value chain are often more inventive and effective when they connect with supporting institutions and other supply chain partners. Cluster strategies encourage the utilization and development of substantial local externalities by encouraging vertical and horizontal linkages between local agricultural firms and supporting their partnerships with organizations that assist them (such as local governments, research institutes, and universities).

In the figure 2, supply chain diagram of agri-cluster based food processing unit is displayed with supply chain flow, enabler and barrier is mentioned. The agri-cluster based food processing unit of Uttarakhand starts from procurement of seeds and other agri-inputs then the agri-production, harvesting, storage, processing, packaging, distribution and sale.

4.2. Agri cluster Based supply chain performance measurement

The supply chain performance of a cluster-based food processing unit may be assessed using financial and non-financial metrics such as return on investment/return on capital employed, inventory turnover ratio, supply chain cost, etc.

Using data envelopment analysis, agri-cluster-based food processing units' supply chain efficiency is measured. Once the context, goals, methods, and outcomes of a Cluster initiative study have been established, researchers may conduct causal analyses to determine the relative importance of the many factors that contributed to the study's findings (Kiminami & Kiminami, 2009).

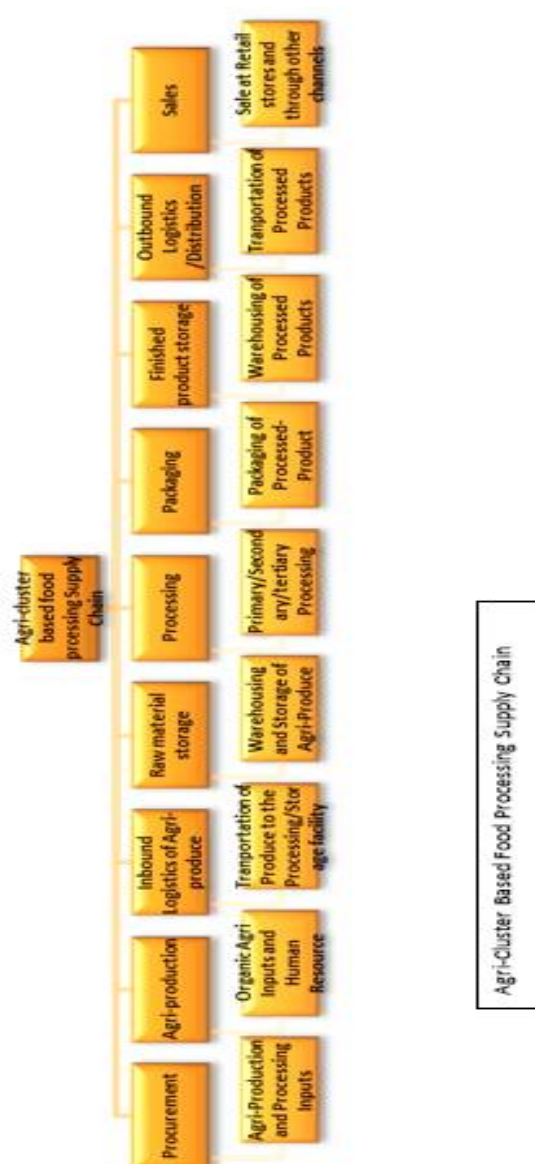


Figure 4.2 Cluster Based Agri-Supply Chain

Source: Authors

The above-mentioned diagram of Cluster Based Agri-Supply Chain mentions the business. An absence of pan-chain performance assessments and the information and organizational structures that underpin them is a major barrier to the widespread adoption of sustainability throughout supply chains and business.

4.3 Methods

An Envelopment Analysis focused on Outcomes (DEA) The purpose of this study is to evaluate the effectiveness of Uttarakhand's agri-cluster-based food processing facilities. Analysis of food processing units in an agri-cluster was performed using data obtained from the cluster's processing units and shared with the nodal department. From October 2020 to July 15 of 2021, data were gathered. The survey relied on a pre-made questionnaire covering all the bases necessary to assess cluster supply chain performance: (1) the supply chain operations and various costs associated to supply chain operations of clusters; (2) the amount of investment done; (3) revenue and profit generated.

A total of 16 Agri-cluster based food processing units were selected for data collection, which were develop under gramya I and II project of by watershed management directorate of government of Uttarakhand. List of units covered in this study is attached below.

4.3.2 Data envelopment analysis

Using linear programming techniques, DEA is used to determine the efficiency frontier and the distance of each DMU from it using a non-parametric approach. Both DEA and Stochastic Frontier Analysis may be used to learn about efficiency. There are two type of DEA Models which are used by various researchers in their empirical study [Insert citation]. Charnes, Cooper, and Rhodes (CCR) established the first type of model; it is based on the assumption of continuous returns to scale (CRS). The CRS method presupposes that if you alter one variable, the other will adjust accordingly. Banker, Charnes, and Cooper's (BCC) alternative model assumes variable returns to scale and is therefore (VRS). If you raise the input, the output might go up or down according to the variable response scaling (VRS) model. Since our research is focused on the

efficiency of Agri-cluster based food processing units, which employ a wide variety of inputs to generate a single output, the VRS approach is well suited to this endeavor. The purpose of the BCC model is to optimize the output in relation to the inputs. As the DMUs in this study included various input factors (such as "Supply chain cost," "Manpower," and investment"), the most appropriate DEA model was one that focused on the output variables (which in this case were inventory turnover ratio and return on investment). Technical efficiency is equivalent to scale efficiency if a Decision-Making Unit runs at CRS. Technical efficiency as calculated by the CCR model may be affected by scale efficiency if the units are not running at optimal scale. As the BCC model characterizes production via VRS, it is able to include the effect of scale efficiency into the evaluation of technical efficiency. In this study we have calculated VRS technical efficiency scores.

Within the framework of data envelopment analysis (DEA), the present investigation has adopted the homogeneous bootstrap approach proposed by Simar and Wilson (1998, 2000). Since traditional DEA models don't account for these statistical features, the resulting efficiency estimates might be inaccurate. The efficiency estimates with the bias adjusted for are more accurate. Furthermore, even with a small sample size, bootstrap DEA models give valid and trustworthy efficiency. As a result, in this research, we employed a bootstrap DEA model to estimate the bias-corrected financial and social efficiency scores of individual MFIs, with a focus on output variables.

4.3.3 Output-oriented (BCC) model

The goal of the output-oriented technical efficiency model is to maximize output with a constant level of inputs. In order to get the highest possible efficiency score, the model's goal for solving every given DMU (agri processing units) is to minimize the number of resources (denoted θ). The efficiency score implies the amount by which all outputs can be improved for each agri processing unit holding the input variables constant. The output-oriented BCC model can be shown as below:

$$\begin{aligned}
& \text{Maximize } \theta^A \\
& \text{subject to} \\
& \sum_{i=A}^E \lambda_i y_{mi} \geq \theta^A y_{mA}; m = 1, 2 \text{ outputs} \\
& \sum_{i=A}^E \lambda_i x_{ni} \leq x_{nA}; n = 1, 2, 3 \text{ inputs} \\
& \sum_{i=A}^E \lambda_i = 1 \\
& \lambda_i \geq 0; i = A, B, C, D, E \text{ DMUs}
\end{aligned}$$

Where y_{mi} = amount of output m from each processing unit i.

x_{ni} = amount of input m to each processing unit i

λ_i = weight given to input i

m = no of outputs

n = no of inputs

$\lambda_i > 0$ shows increasing returns to scale $\lambda_i = 0$ is CRS, and $\lambda_i < 0$ shows decreasing returns to scale. The technical efficiency scores are defined by θ^A , and their values vary from 0.00 to 1.00. If the score is 1.00, then the production from the DMU is efficient; if the score is less than 1.00, then the DMU is inefficient.

4.3.4 Bootstrap DEA procedure for the supply chain performance measurement

The recommended method to address these weaknesses and evaluate the sensitivity of the measured DEA scores to sample fluctuations is to bootstrap the DEA estimators (7). The fundamental idea behind bootstrapping is to resample from the original data to build replication datasets that, in effect, imitate the original unknown sampling distribution of the estimates of interest. This imitates the sampling distribution that was used to generate the estimates in the first place. The process of bootstrapping index scores, which are used to summaries results, is illustrated in the flowchart below.

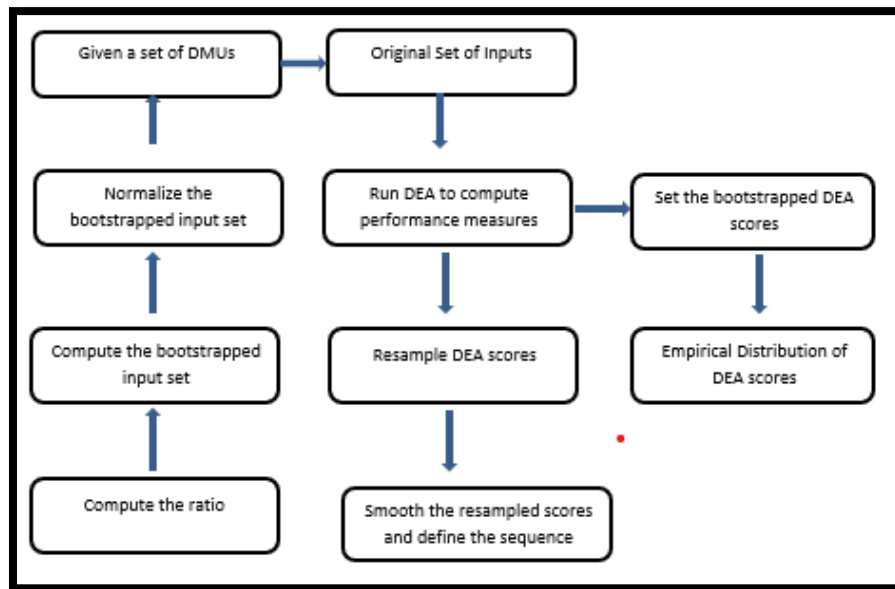


Figure 4.3 Steps for bootstrapping in DEA

4.4.1 Quantitative Data collection

For this study, the agri-cluster based food processing units developed under gramya I and II project executed by watershed management directorate, were selected. The firms are involved in agri-cluster based food processing and process food to prepare products such as jam, pickle, squash, essential and cooking oil, flour, etc. Data was collected from units by personal visits to each of the units and observing and enquiring the stakeholders present at every unit. Also, the data was collected using a schedule questionnaire and triangulated with the data received from the implementing agency, in this case, which is watershed management directorate, the implementing body shared some documents such as annual plan, achieved targets and financial documents such as balance sheets. These variables come straight from the literature review and reports. balance sheet and income statement at the conclusion of each company's fiscal year. Despite a number of uncertainties, there is a wealth of DEA literature that makes use of accounting data. A wide range of input and output variables are used in the experiments, and it is not clear which combinations are optimal. (Hill & Kalirajan, 1993) For instance, work with three inputs: personnel cost, material cost, and investment value, while (Thore et al.1994). Consider the operational expenditures, fixed

assets, and employee count. This research bases its analysis on such studies and given the scarcity of relevant data, it considers the production.

4.5 Data Envelopment Analysis for Measuring Supply Chain Performance

To better understand how agri-cluster based food processing facilities in Uttarakhand might benefit from Data Envelopment Analysis, this section describes the methodology behind DEA and its most recent advancement in the form of bootstrapping approaches. DEA is a nonparametric methodology that presents a linear programming-based method for evaluating the relative efficiency of a collection of manufacturing processes, or DMUs, relative to one another. These DMUs may involve multiple inputs and outputs across multiple stages, and the method may produce a single relative efficiency measure (Chaowarat, Piboonrunroj, & Shi, 2013).

Because of this, it is unlike models like financial ratio analysis in that it considers a broader range of factors related to an organization's success. However, unlike DEA, which provides a clear picture of performance, ratio models can be misleading since each ratio often represents a distinct degree of performance. Better agreement with DEA findings can be achieved only by combining numerous financial and non-financial ratios into a single summary measure of performance.

Hence, both techniques are usually regarded as complementing each other.

The capacity of DEA to identify potential peers or role models, in addition to basic efficiency ratings, offers it an advantage over other metrics such as total factor productivity indices (Steering Committee for the Review of Commonwealth/State Service Provision, 1997). DEA includes the application of linear programming methods to businesses' inputs and outputs. Next, the DEA develops a production frontier based on the most effective methods. The efficiency of each company is then assessed compared to this frontier. In recent years, the DEA's methodological progress has been substantial, resulting in the creation of several models*. Regarding the technology, DEA designs imply various returns to scale assumptions. Returns to scale quantify the change in output levels resulting from changes in input levels.

Increases in input lead to commensurate increases in output, as stated by the concept of constant returns to scale (CRS).

Input and output variables are generated by SME actor brainstorming, and then the SCOR indicator is applied.

The collected the data through schedule questionnaire had variable such as

4.5.1 Variable Input.

1. Investment is the amount of money invested in the unit for procurement, processing, distributing the cluster based agri products.
2. Manpower is the human resource involved in the procurement, processing, distribution and sale of agri-products
3. Supply chain cost is the summation of all costs associated from procurement to distribution including warehousing, packaging and information cost.

4.5.2 Variable Output.

1. Inventory turnover ratio: The inventory turnover ratio measures how rapidly a company replaces and transforms its present inventory into revenue. A higher ratio indicates that the company's product is in high demand and sells quickly, resulting in reduced inventory management expenses and more earnings.
2. Return on investment: Return on investment (ROI) is a financial ratio used to evaluate the profit an investor would get in comparison to the cost of the investment. It is most frequently calculated as net income divided by the initial investment cost. The bigger the ratio, the greater the earned advantage.

Table 4.1: Descriptive statistics of input output variables					
Particulars	SCM Cost	Manpower	Investment	Inventory Turnover Ratio	Return on Investment
Mean	218764.267	5.600	15.237	5.979	1.324
Standard Error	43053.894	0.214	3.083	1.687	0.385
Standard Deviation	166747.013	0.828	11.941	6.533	1.491
Minimum	52931.000	4.000	4.200	1.987	0.070
Maximum	562922.000	7.000	33.090	20.529	4.854

Table 4.1. The basic descriptive statistics of data

Note: All variables, except for number of employees, are expressed in lakhs of rupees (INR).

We can observe that the mean agri-cluster based food processing unit in our sample has 5.6 employees and almost 15 lakh INR as investment. Hence, it belongs to the category of micro and small enterprise.

4.6 Results

The bootstrap algorithm of (Simar & Wilson, 2007) mentioned before in this investigation was carried out using the DEA software package with B equaling 2000 bootstrap replications. The following metrics' means are broken down and summarized in Table 4.6: scores of efficiencies, scores of efficiencies after bias correction, and confidence intervals for scores of actual efficiencies are all included in the VRS standard.

Table: 4.6 Original and Bias-corrected efficiency scores and ranks of DMUs				
Sr. No	DMU Name	Original Efficiency Scores	Bias-Corrected Efficiency Scores	Ranks
1	Gomti Ghati Swayatt Sehkarita, Pinglo (Garur)	0.103	0.069	15
2	Athgaon Phal Evam Sabzi Utpadak Swayatt Sehkarita (Punah Pokhri)	0.168	0.137	14
3	Gramya Kisan Bahudeshiya Swayatt Sehkarita Samiti, Ghandalu (Kotdwar)	0.220	0.175	13
4	Kalika Devi Swayatt Sehkarita (gangolihat)	0.389	0.264	12

5	Danpur Kisaan Ekta Swayatt Sehkarita, Shama	0.428	0.368	11
6	Chaundkot Navjyoti Swayatt Sehkarita, Simar	0.487	0.462	10
7	Paharpani Utpadak Evam Vipran Self Reliant Cooperative	1.000	0.539	9
8	Teelu Rauteli Swayatt Sehkarita (Amohta)	0.605	0.540	8
9	Gairsan Fal Evam Masala Utpadak Swayatt Shekarita	1.000	0.550	7
10	Malkoti Swayatt Sehkarita (Kaknava Maychak Talai, Thano)	0.672	0.629	6
11	Nanda Devi Kisan Swayatt Sehkarita	1.000	0.667	5
12	Gramya Krashak Swayatt Sehkarita (Khyarsi)	1.000	0.678	4
13	Dhauladevi Gramyashree Swayatt Sehkarita (Falyat)	1.000	0.732	3
14	Dev Bhoomi Phal Evam Sabzi Utpadak Swayatt Sehkarita	1.000	0.880	2
15	Tamsa Ghati Phal Evam Sabzi Utpadak Swayatt Sehkarita	1.000	0.894	1
<p>Note: The authors have used bootstrap DEA method to estimate bias-corrected DEA scores by using 2000 iterations as suggested by (Simar & Wilson, 2007)</p>				

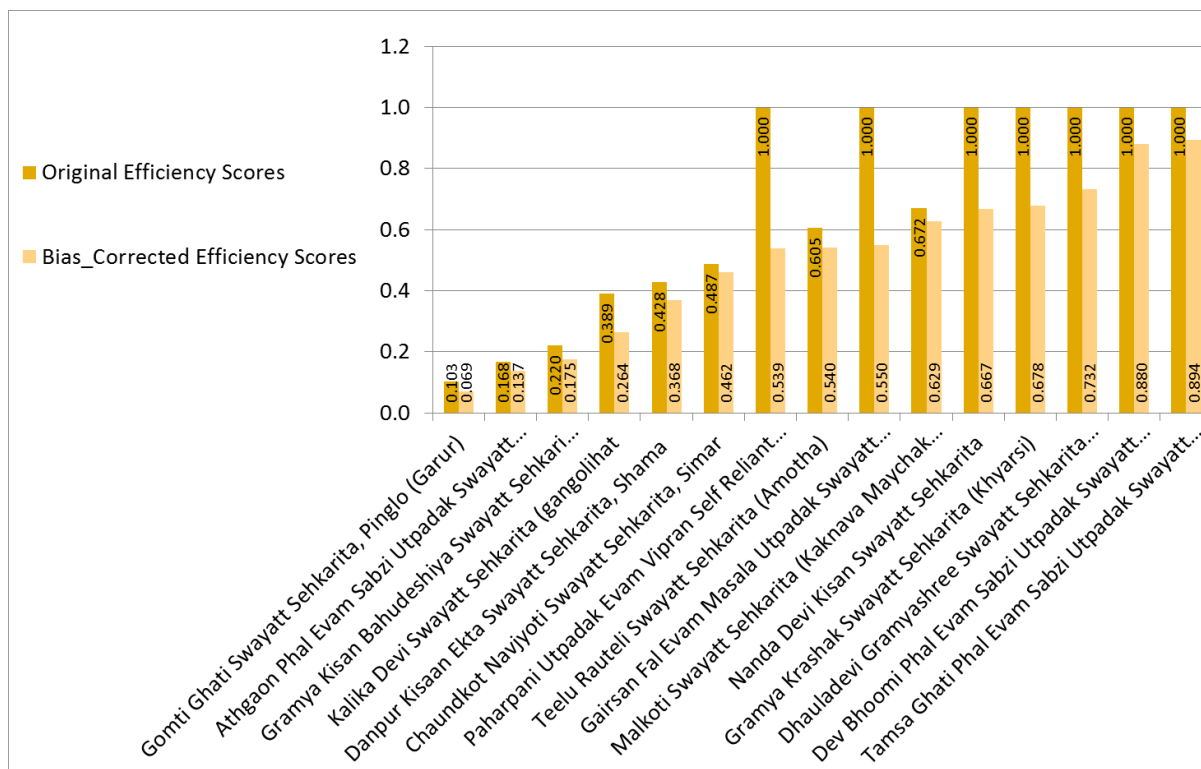


Figure: 4.6.2 Graphical Representation of Supply chain Performance of Agri-Cluster based food processing units.

As it is clearly visible from the table and graph mentioned above the supply chain performance of two units Dev Bhoomi Phal Evam Sabzi Utpadak Swayatt Sehkarita with corrected efficiency score of **0.880** and Tamsa Ghati Phal Evam Sabzi Utpadak Swayatt Sehkarita with bias corrected efficiency score of **0.894** better performer than other units and hence are at the rank 1 and 2 respectively. While Gomti Ghati Swayatt Sehkarita, Pinglo (Garur) with bias corrected efficiency score of **0.069** and Athgaon Phal Evam Sabzi Utpadak Swayatt Sehkarita (Punah Pokhri) are 0.137 the laggards.

4.7 Findings & Inferences

This analysis aimed to evaluate the effectiveness of Uttarakhand's agri-cluster-based food processing facilities in 2020. In the empirical investigations, an input-oriented DEA model and assessed the statistical significance of generated indices using the bootstrap technique was utilized. As shown by an efficiency score of 0.881 or 0.817 when the bias-corrected score is included, the textile enterprises in our sample are, on average, quite efficient in their production process. The efficiency indices exhibited very modest fluctuations; hence, the impact of greater rivalry in the industry cannot be

discerned from the enhanced efficiencies. Probably, firms focused mainly on the investment in technological development. In addition, when performing the test of stochastic dominance, it was found that these Dev Bhoomi Phal Evam Sabzi Utpadak Swayatt Sehkarita, Tamsa Ghati Phal Evam Sabzi Utpadak Swayatt Sehkarita units are highly efficient than Gombi Ghati Swayatt Sehkarita, Pinglo (Garur), Athgaon Phal Evam Sabzi Utpadak Swayatt Sehkarita (Punah Pokhri). The following are the conclusions drawn from the inefficiencies noticed in the sample. First, there is space for input reduction in agri-cluster-based food processing facilities. Businesses should be able to retain the same level of output, as measured by sales revenues, while reducing the number of workers, fixed assets, and material costs utilized in production. As a consequence of picking the incorrect scale of inputs for output level, the sample firms have some small problems with scale efficiency.

The limitations of the reported empirical inquiry provide potential for further study. The estimated efficiency indices do not differentiate between the impact of companies approaching the benchmark frontier and the effect of the benchmark frontier's movement over time (technological development). Future study must utilize the Malmquist index to distinguish between the two shifts and more precisely evaluate the impact of greater competition in the textile industry. In addition, future study might compare the DEA approach with financial ratio analysis to determine, for instance, if and to what degree the two models agree or differ with the performance of businesses.

4.8 Concluding Remarks

This chapter concludes the discussion on first objective that was to measure the supply chain performance of agri-cluster based food processing units in Uttarakhand. To analyze the data, the researcher used data envelopment analysis. Based on analysis conducted performance efficiency scores were calculated. Also, based on performance efficiency score the best and worst performing units were identified. Next chapter discusses the data analysis and findings of the qualitative data analysis done in the study in detail.

Chapter 5

Developing a business sustainability model for agri-cluster based food processing units in Uttarakhand.

5.1 Introduction

The Pervious chapter measured the supply chain performance of Agri cluster-based food processing units. The two best and worst performing units were identified from the above analysis, which will be used in this chapter to be analyzed using case study methodology to develop a business sustainability model for agri-cluster based food processing units.

In this chapter, qualitative data collected from Farmer member, Govt-Agribusiness Expert, and Agri-food processing Unit head of the four agri-cluster based food processing units were analyzed from the perspective of supply chain and business sustainability in accordance with the data analysis strategy outlined in Chapter 3 (Section 3.6) This section develops and proposes a business sustainability model for agri-cluster based food processing unit in Uttarakhand contributing to the supply chain and business sustainability strategy of the food processing units and related rural livelihood. The extensive data analysis based on the detected and conceived initial conceptual structures and sub-constructs from the literature review (Section 2.6) such as Barriers and enablers of sustainability, economic social and environmental sustainability, Supply Chain, Risk Assessment, Planning & Monitoring, Value addition, food processing, Training and capacity development, rural empowerment, agri-cluster based food processing, and Agribusiness Polices/Budget is presented below.

5.1.1 Agri-cluster based food processing - An overview

The agriculture sector is vital to India's economy, accounting for 15% of GDP and employing half of the nation's workforce. Even with a drop in GDP due to Covid-19 in April to June quarter, the agriculture sector grew by 3.4 percent during the same time, as output persisted with much less interruption than in many other sectors. In addition, between April and September of 2020, exports of essential agri-products climbed considerably compared to the same period in 2019. However, the industry continues to encounter significant obstacles that have damaged farmland and farmer earnings. Although some of the difficulties are structural in origin, the most majority are the

outcome of the pandemic and involve the agriculture supply chain to varied degrees of difficulty. Unexpected challenges faced by stakeholders around the value chain included a severe labor shortage, reverse migration, and the lack of transportation and logistics infrastructure. Due to the lockdown caused by the epidemic, the Rabi crop harvest was delayed because to a lack of labor, agricultural equipment (harvesters, threshers, etc.), transportation facilities, and movement restrictions. Despite a good environment and a bountiful harvest, crop damage caused by the supply chain interruption led to agricultural losses. This, in turn, affected the working capital needs and profitability of farmers, which carried over into the Kharif season. In addition, the agriculture supply chain was plagued by long-standing structural issues rife with inefficiencies that had negatively affected production output, productivity, and product quality. Therefore, for large or small-to-medium-sized agri-business businesses in agriculture-based emerging countries, enhancing supply chain performance in the direction of greater efficiency is an absolute necessity (Negi and Trivedi, 2021; Battese et al., 2017; Odongo et al., 2017; Routroy and Behera, 2017; Bhattarai et al., 2013). Given that agriculture is rural India's mainstay and that a significant percentage of small and marginal farmers and MSMEs are involved in the agribusiness value chain, the Indian government has placed a strong emphasis on revitalizing the sector as part of its Atma Nirbhar Bharat Abhiyan (Self-reliant India initiative), as evidenced by several announcements aimed at strengthening farm gate infrastructure (Ramanathan, 2021).

Food loss and waste are a big problem in most developing countries around the world. It is driven in India by a lag in several stages of the country's supply chain (Negi and Anand, 2019). The government has failed to perform in areas such as cold chain and proper storage, exports, transportation, sufficient processing facilities, and marketing, resulting in food waste (Sharma, 2019; Negi and Anand, 2018). Most post-harvest losses in various agricultural products are in fruits and vegetables in India (Negi and Anand, 2016) and the concentration of almost 76% of the food processing units are in 8 states of India. In India, the problem of post-harvest losses can range anywhere from 0.8% to 18% for different types of food items. In India, the levels of food processing are extremely low, and the Ministry of Food Processing Industries (MOFPI) estimates that the overall level of processing is less than 10%; one example of this is the processing level of 2.2% for fruits and vegetables, which is significantly lower than the

processing levels of 23% in China, 65% in the United States, and 78% in the Philippines (ResearchAndMarkets, 2019).

In terms of output, consumption, and exports, the food processing industry in India is ranked fifth, making it one of the country's most lucrative businesses. The food processing sector was valued at USD258 billion in FY15, according to estimates. Food processing accounted for 14% of India's GDP through manufacturing in FY15. India's food processing enterprise USD 258 billion, in 2015, and is anticipated to be USD 482 billion. Food processing marketplace bills for 32 % of the entire grocery store in India 13 % of Indian exports. In India, the food processing industry is a monolithic ecosystem that is suitable for technological and social transformation. Supply chains have been criticized for their resilience and efficiency because of the global epidemic of a novel coronavirus, and consumer behavior has shifted dramatically to adopt modern social standards such as social distancing behaviors and lockdowns. In the post-COVID scenario, for example, the food and farming sector is expected to attract premium investor interest to encourage organically grown food for the masses while also implementing the “delivery at home” model (Bhatia et al., 2020).

Increasing the value of agricultural or horticultural goods is accomplished through a process called food processing. There are two distinct sub-industries within the food processing sector: the primary sector, which includes packaged fruits and vegetables, milk, and other dairy products; it is responsible for around 62% of the industry's overall value; and the value-added sector (processed fruits and vegetables, juices, jam & jelly, etc. comprising around 38 percent share in the total processed food). Since they are the third and fifth biggest sectors, respectively, the output and gross cost introduced of food goods are unaffected by the low capital intensity. According to the registered factory, the total fixed capital in the food processing sector is 4.27 crore, which suggests that most of the factories in this field are micro and small companies. In India's food processing business, the unorganized sector is responsible for 42 percent of total revenue. The full-size involvement of small-scale businesses indicates the sector's contribution to employment generation. Only 30% of the food processing sector is organized, while 70% is unorganized.

The objective of the study is to develop and provide business sustainability solutions for cluster-based food processing facilities in the North India region, with a particular

emphasis on the state of Uttarakhand as the primary area of concentration. Also, the proposed study will try to show that clusters enable Micro, Small and Medium Enterprises (MSMEs) to build cooperation and reduce food loss and increase farmer's income.

The Quantum of Post-harvest losses in India are growing at an alarming speed and the situation is not different for the state of Uttarakhand. Almost 45% of fruits and vegetables that are grown rot away in warehouses. The creation of several small food processing plants will not only help to minimize post-harvest losses; nevertheless, the problems of migrations from high hills and the enhancement of farmer incomes are also things that may be improved in the region. The micro, small, and medium enterprise (MSME) business in the food processing sector has a higher role than the organized sector does in terms of its involvement in regulating huge amounts of post-harvest food waste. With their many different programs, the central and state governments are working toward the goal of making the micro, small, and medium-sized enterprise (MSME) food processing sector more dynamic.

One such initiative was to identify farmer interest groups or Farmer Producer Organizations (FPOs) and develop agriculture cluster-based food processing units in the rural areas of Uttarakhand. These clusters are initially provided support by the government to reduce farm losses and distress sales. But over the period, these units or centers are turning out to be non-functional and unsustainable due to the discontinuation of several centrally funded schemes and high migration and poor vegetable and crop production (Azad, 2016). The direct farm procurement and creation of value addition at the farm gate are aligned to the policy focus on FPOs and agri-clusters and the learnings can be leveraged to identify structural transformation, collaborative actions, market integration and technology innovations needed for linking clusters to organized supply chains. The existing partnerships can also be leveraged to identify farm gate infrastructure gaps in the clusters and handholding for bridging these gaps. The model also provides the benefit of value creation at the farm level in terms of sorting, grading, and packaging thus helping reduced human contact across the supply chain. The formation of FPO will also align with the agri-cluster approach of 'one district, one crop' aimed at encouraging farmers to adopt the most suitable crop in their district that will

help them realize better prices with increased scale. The cluster approach will also help enhance export competitiveness (Confederation of Indian Industry, 2020).

As a result, the purpose of the proposed research is to devise an economically viable business model for the cluster-based food processing facilities in the rural areas of India, with a particular emphasis on the state of Uttarakhand.

The remaining parts of this research may be broken down into the following categories: The literature review is discussed in part 2, the third section goes over the methodology, and section 4 goes over the findings of the study. In the end, the conclusion of the study, as well as any limits and potential future applications, may be found in section 5.

5.2 Data Collection

Using case study technique, semi-structured interviews were performed with the following agribusiness persons in the region associated to an Agri cluster-based food processing unit: farmers/villagers/experts of cluster-based agriculture and food processing in Uttarakhand.

The methodology is based on qualitative study which involved review of literature review followed by case study methodology. Case studies are particularly effective when researchers seek to examine how a phenomenon has evolved through a "current series of events over which the researcher has little or no influence" (Yin, 2018). It is acceptable to utilize qualitative methods such as case studies, ethnographies, event histories, etc., to observe the influence of otherwise unobservable impacts in a business context (Godfrey & Hill, 1995). Case studies were chosen as a qualitative holistic strategy that facilitates deeper discovery and allows researchers to study participants' life experiences in depth (Creswell, 2003). Also, to bridge the gap between academia and practice, case studies are more understandable by practitioners, allowing thus easier replicability of results and lessons learned (Dal Mas, Massaro, Lombardi, & Garlatti, 2019). Furthermore, multiple case studies here facilitated cross case analysis, comparison and generalization of findings (Noor, 2008). In addition, case study is a research method applicable to the majority of agricultural and extension programs, which takes place in real-world settings, necessitates an interdisciplinary approach, and necessitates a properly portrayed context to enable readers to draw parallels between

the study and their own experiences (Leite & Marks, 2005). We selected two units in agri-cluster based food processing and farmer federation in Uttarakhand, namely “Danpur Swaytya Sehkarita” and “Maa Kalika Krishi Utpadan Samooh”, to illustrate the challenges faced by farmers, federation owners and government in developing and sustaining and these food processing units and how a synergy among above mentioned stakeholders can improve the existing situation and make the federations more profitable and sustainable. These instances were chosen for theoretical, not statistical, considerations. The two scenarios include comparable geographical characteristics, corporate characteristics, distribution systems, and possible environmental enhancements, as well as obvious distinctions in terms of social inclusion policies and business sustainability issues (Eisenhardt, 1989).

The development of a case study procedure for data collection is one of the challenges. In this study, a protocol was designed in an effort to comprehend how economic, social, and environmental measurements, as well as supply chain practices, might be modelled in an agri-cluster-based food processing federation in order to promote business sustainability. To ensure construct validity, (Yin, 1994) recommends the use of numerous sources of evidence (triangulation), the establishment of a chain of evidence, and the provision of draught case study reports evaluated by key informants. A rich and varied data to discover the business sustainability and cluster-based agriculture, first, secondary data was accumulated from a series of sources including research papers, articles, and government and industry reports. Secondly, interviews were administered with agribusinesses that operating agri-cluster based food processing units in the study region, which extended and facilitated to validate the data gathered through secondary sources, enhancing the author's support in the findings. The research team, which included members with extensive knowledge of the local rural region, designed and tested interview questions. Along with the interview, research evidence was also collected in the form of audit reports, photographs, leaflets, etc. from the concerned stakeholders. The interviews were conducted with the farmers, FPO workers, villagers, and government employees from the cluster-based agri-processing units in Uttarakhand to understand the current scenario and present operations. In the interviews conducted, information such as the current state of business, issues, and challenges faced, and what can be done to improve the situation were inquired off. Hence, thereby develop a business sustainability solution for cluster-based food processing units in Uttarakhand.

Based on the detailed discussion through interviews, different codes were inculcated to develop a model.

The data came from academic, policy, and technical sources, as well as semi-structured interviews with members of the supply chain and other stakeholders performed between 2018 and 2020. In-person interviews were done in 4 units of Uttarakhand, and further interviews were held in Dehradun, Uttarakhand, India, with policymakers and other relevant authorities. After identifying the codes, open coding, axial coding, and selective coding were carried out. The identified codes were then converted to create triple layered business model for the agriculture cluster-based food processing units in Uttarakhand.

Based on existing relevant literature and preliminary discussion with the experts, an initial conceptual lens for agri-cluster based food processing units of Uttarakhand. The initial conceptual lens tries to identify the barriers, enablers, requisites, stakeholders, implementation or operational mechanism and benefits of creating an agri-cluster based food processing unit in Uttarakhand. The discussion questions of that resulted into making an initial conceptual lens is mentioned below:

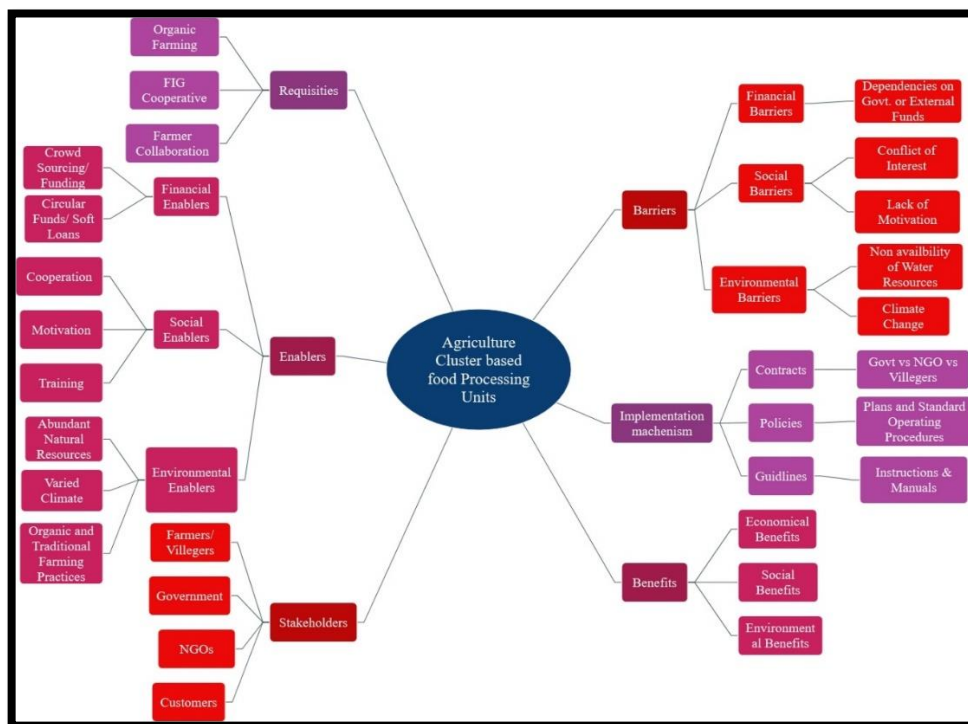


Figure 5.1 Initial Conceptual Lens

The initial conceptual lens mentioned above then helped to create a revised interview protocol for collecting data from various stakeholders. (Erickson H. L., 2002) A conceptual lens is defined as a device used to "supersede the specific issue and moment" in order to build a metacognitive approach to a topic by driving cognition on a wider and more integrated scale. The conceptual lens was made with an idea to understand more about the various dimensions and key concerns about the cluster development its operations, enablers and barriers to cluster development.

Table 5.1: Initial Protocol for developing conceptual lens

1.	What is a Agri-cluster based food processing and how a cluster is developed?
2.	What are the characteristics for implementing the above said program?
3.	What are the prerequisites required to implement the above said program?
4.	What are the barriers in agriculture cluster-based food processing unit's business sustainability?
5.	What are the enablers in agriculture cluster-based food processing unit's business sustainability?
6.	How much financial cost will be involved and how the revenue is generated?
7.	What is the communication strategy for this program?
8.	What benefits are expected while implementing this program?
9.	What time do you think most suitable timing to implement the above said programs?
10.	How can we implement agriculture cluster-based food processing units in Uttarakhand and make it sustainable?
11.	How can we make very effective contracts and who should be the other party to engage?
12.	Who should take the responsibility to make the business sustainable?
13.	What type of manpower development is required to implement these types of strategies?

14.	What type of benefit stakeholders can get by doing agriculture cluster-based food processing and how stakeholder engagement is ensured?
15.	What is the local and regional level benefit for the above said program?
16.	Other than FIGs, who are the other responsible people to take the lead in the implementation program?

A revised protocol was developed based on conceptual lens developed which is mentioned in the annexure B.

Based on the above revised conceptual lens the data was collected from the units and transcripts were prepared. Keeping in mind the study topics, cross-case data analysis was conducted using interview data. This resulted in the identification of different aspects and components that constituted the foundation of a business sustainability model for agri-cluster-based food processing facilities in Uttarakhand. In addition, the components of the triple bottom line and the supply chain component of the business sustainability model were identified. Then, the relationship between the components of the triple bottom line was investigated. The next section covers the thorough data analysis and conclusions of the cluster-based food processing units agri-cluster case study. The transcripts were then uploaded in AtlasTi software to generate the codes.

5.2.1 Case Study Protocol

The case study procedure and the survey questionnaire are both meant to gather data from a single respondent or case study at a time. For example, a single respondent to the survey may represent a single case study. But there is a big difference between the case study protocol and the survey questionnaire. It's a lot more than a questionnaire or instrument, and it has instructions and general rules for how to use it (Yin, 2003). It is written for the researcher, not the people being studied, and Yin (2003) suggests that for multiple case study research, it is recommended to use a case study protocol. The case study protocol makes sure that the investigation is done the same way every time. Important documents may contain a summary of the project, instructions for the field, leading questions, and a report outline.

Objective

To develop a business sustainability model for agriculture cluster-based food processing units in Uttarakhand

Research Model

According to the research findings from the literature analysis and case studies, as well as following the business model canvas offered by (Joyce & Paquin, 2016).

Field Procedures

a) Interviews with Food processing Unit Head

Within the firm, interviews were held with the heads/managers of the Uttarakhand-based units to assess the company's overall supply chain effectiveness and commercial viability. After that, interviews were performed with additional team members that interact directly with farmers and perform various tasks inside the unit.

b) Interviews with Farmers Members

Farmers and villagers were also questioned to eliminate responder bias and provide diverse opinions. In addition, attempts will be made to acquire data through observation and triangulate the information from numerous sources.

c) Interviews/Conversations with Government/NGO officials

Government officials were also interviewed. This provided a comprehensive picture of the situation and helped us grasp the concerns, requirements, and expectations of Farmers, villages, and FPOs, FIGs, as well as the government.

A case study methodology was created using Yin's conceptual framework and recommendations. Following is a comprehensive explanation of the process that will be followed in the case study. The draught case study technique was previewed for agribusiness professionals, namely those working with and monitoring an agri-cluster-based food processing facility.

The team's input on these elements was considered when finalizing the case study procedure.

5.3.1 Agri-cluster based Food Processing and its Existing Process

Literature-identified sub-concepts for business sustainability, such as existing processes, efficiency program, organizational support, footprint and the natural environment, key enablers, training and capacity development, are also practiced in agri-cluster-based food processing units, according to interviewee data. The following are a few selected excerpts from the interviews: -

A cluster is a place where organic farming is done and collective farming, food processing and other value addition is performed. Cluster based food processing increases productivity and farmer income as well. (Head of Unit)

A cluster is a place where similar crops can be grown and brought at central place for processing or value addition and sale. (Government/agribusiness expert)

Government WMD has created Agribusiness Support Centre which has a cold storage warehouse, processing center and machinery, packaging machinery and other training support etc are also being created. (Government/agribusiness expert)

Training and Certification are being provided by government support and watershed management department; exposure visits are also provided by the government department. (Farmer Member)

It is evident from the quotations that the agri-cluster and growth center where the processing and training and development activities are conducted are only used for benchmarking agri-production and value addition practices in the food processing unit of the agri-cluster-based farming organizations as conceived by the farmer members and growth center expert. Further, agri-processing cluster promoted organic farming and used methods to increase production of high value cash crops. The watershed management directorate helped identifying and developing cluster and provided support from initiation to execution and monitoring of the agri-cluster based food processing units.

As indicated above by farmers/unit heads/agribusiness experts, focus is being placed on the food processing and training function. From the unit and project reports, further as explained by the the farmers/unit heads/agribusiness experts, there is a structured

process to develop cluster and processing unit. Organic farming, training, and collective farming and value addition being the major components of the agri-cluster based food processing units. However, cluster heads have emphasized on agri-produce value addition, smooth flow of funds for sale and procurement of agri-commodities function.

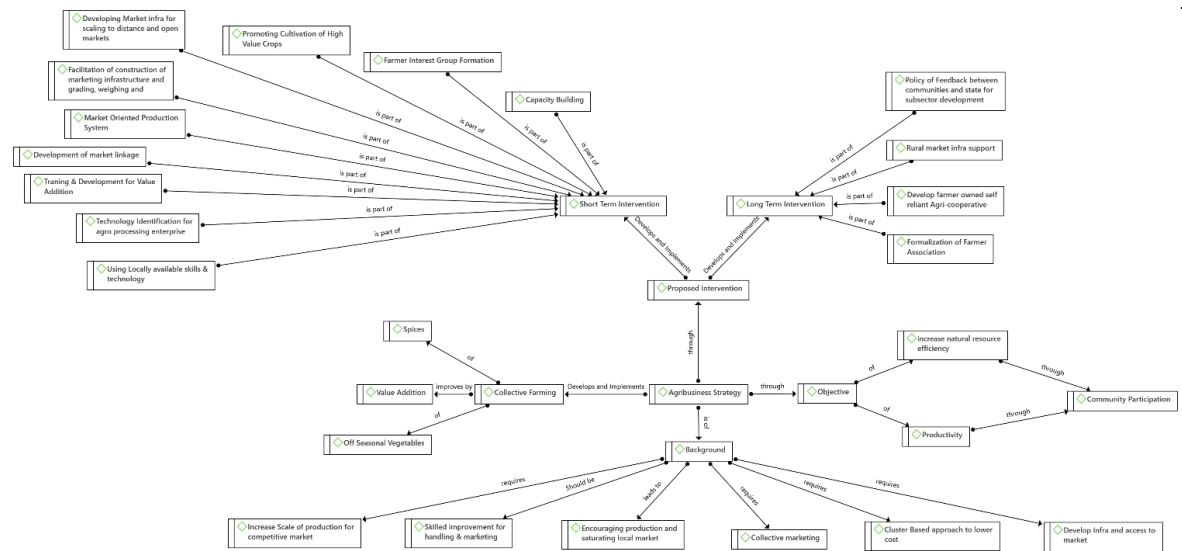


Figure 5.3.1: Qualitative Associative Networks for agri-cluster based food processing business and its strategy

The above-mentioned diagram mentions agri-cluster based food processing business and its business strategy, the background of starting this business involves collective farming, marketing, encouraging production and processing of organic agriculture products, training, skilling and cost minimization. Objective of agri-cluster based food processing business is to increase natural resource efficiency and productivity with the help of community participation. The agribusiness approach consists of both short- and long-term measures. The short-term interventions included capacity building, marketing linkage development, market-oriented production, value addition, and skill development, among others. Whereas the long-term interventions included formalization of farmer associations, development of rural market support infrastructure, policy on feedback mechanism for community and subsector for development and developing farmer owned self-reliant agri-cooperative.

Procurement of produce in bulk is sometimes an issue due to lack of funds, machinery for processing comes late which sometimes delays the processing, majority of produce is off seasonal so processing (Unit Head)

Packaging material should be lost cost and easily available, packaging material should be eco-friendly and easy to carry (Unit Head)

Procurement should be in timely manner and payment for procured item and for processing done need to be cleared. (Farmer Member)

Packaging material needs to be low cost and easy to carry all types of products and it should be made available to farmers from the center in advance. (Farmer Member)

The design could be made more attractive to get customer attention, but it is with the project after project completion farmers have to manage and maintain on quality of packaging on their own. (Agribusiness Expert)

The procurement process needs to be transparent and as per the procurement procedure and guidelines and audit and monitoring should be done as well (Agribusiness Expert)

As described by the farmers and agribusiness experts packaging and procurement of raw material/ input and machinery for processing. Monitoring and audit of packaging material and procurement processes need to be done to identify the gaps best practices and should be reported for further recommendations. These planning and monitoring of processes improves the procurement and overall business performance as explained by the unit head.

Figure 5.3.2 depicts the qualitative association network connected with the original conceptual construct "Planning & Monitoring."

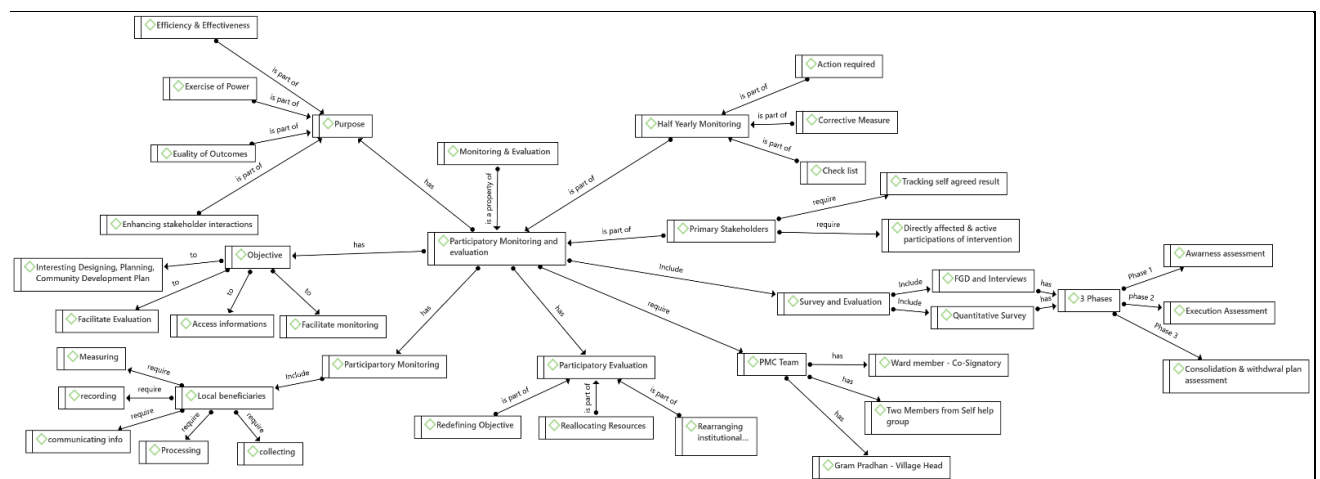


Figure 5.3.2 Qualitative Associative Network for Planning & Monitoring

The monitoring and evaluation in the cluster-based food processing units are participatory and it is done by members of cluster. As displayed in the above diagram the primary stakeholders such as people who are directly benefitting from the project or actively participating in the project are involved. The participatory evaluation redefines or aligns objectives, reallocates resources and rearranges institutional support. The objective of the participatory monitoring and evaluation is to access information facilitative monitoring, evaluation and redesigning community development plan. The monitoring is done semi-annually and includes focused group discussion, interviews and quantitative surveys as a medium of data collection.

5.4 Business Sustainability model based on Triple layered Business Model Canvas

It has been found that sustainable business models provide options, such as the construction of a market-oriented business model, which can deliver win-win solutions for a variety of stakeholders. It is recommended that future research concentrate on the social and environmental performance of the organization (Nosratabadi, et al., 2019). The TLBMC contributes to this special issue on organizational creativity and sustainability by presenting a user-friendly tool to aid in the development of business models that prioritize sustainability. The three levels of the business model specify how a company creates economic, environmental, and social value.

Triple Layered business model canvas for business sustainability

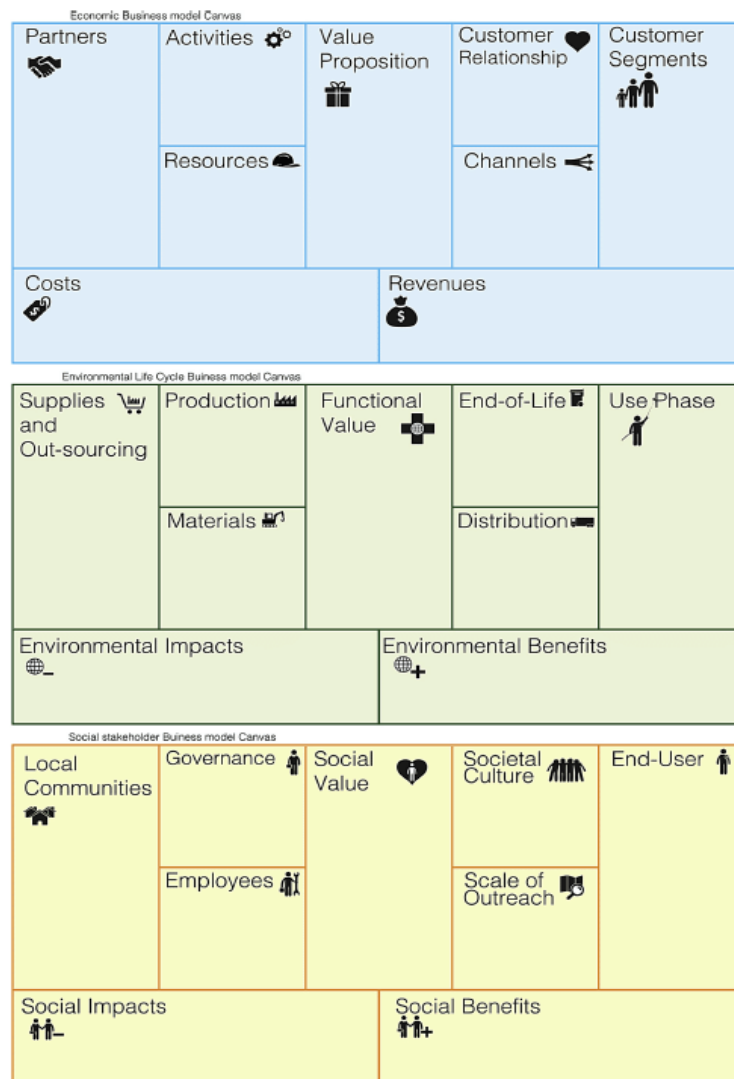


Figure 5.4 Triple Layered business model canvas for business sustainability

Source: (Joyce & Paquin, 2016)

This is an expanded version of the Business Model Canvas created by Alex Osterwalder. This model demonstrates how important it is for an organization to be sustainable on all fronts—economically, environmentally, and socially. In addition, the Triple Layered Company Model Canvas is a tool that may be used to investigate different company models that are centered on sustainability.

Using this canvas tool to create a visual representation of a business model enables not only the facilitation of the creation and transmission of a more comprehensive and integrated image of a business model, but also the inventive development of business models that are more sustainable. (Joyce & Paquin, 2016).

The triple-layered Canvas paradigm presents an all-inclusive strategy that involves all stakeholders. The social level of the model encompasses the social effect of the organization and identifies the sources that cause that influence (Diana, 2020). Its nine components for the agri-cluster based food processing units have been described below.

5.4.1 Suppliers Partners & Communities

Interviews indicated that the Suppliers, partners and communities play a crucial role in not only developing a business but also sustaining it as well. A qualitative network associated with Suppliers, partners and communities is shown in figure 5.4.1.

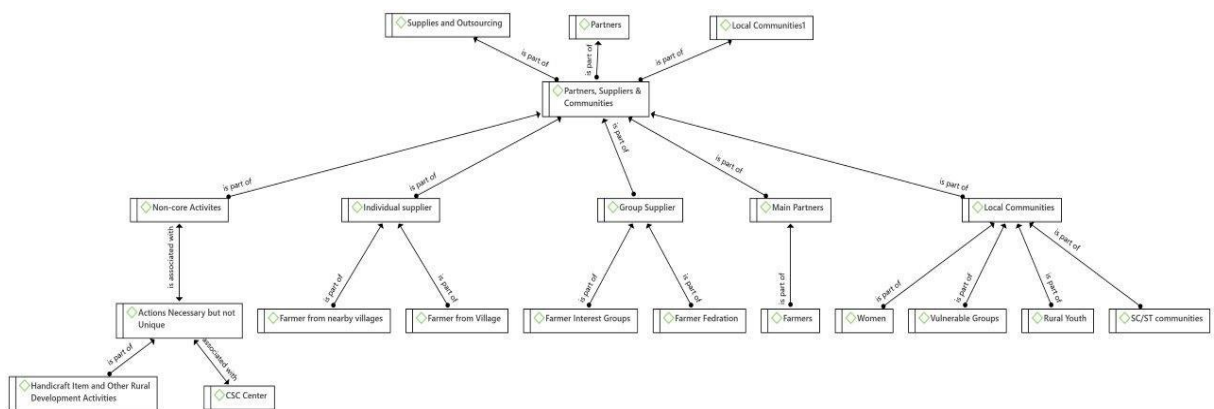


Figure 5.4.1 Qualitative Associative Network for Partners, Suppliers and Communities

The categories that emerged from this qualitative associative network are then explained using evidence and case study descriptions.

Main partners of this type of project are farmers, women and youth are also getting involved in this project (Farmer Member)

The Farmer interest group and farmer federations from nearby villages collect the produce and bring it to the unit for sale, now they don't have to go to mandi. (Farmer Member)

We are involving women, people from vulnerable groups, ST community and rural youth while developing the cluster this would help in checking migration as well. (Unit Head)

The Non-core activities may include developing handicraft items which can be sold at the unit. (Unit Head)

A cluster comprises of farmer interest group and farmer federation where key stakeholders are farmers. (Agri-business Expert)

Farmer from this village as well as farmers from other nearby villages collect their produce and come here for sale. (Agri-business Expert)

As explained by all types of respondents above, the suppliers, partners and communities include farmers are key partner, the suppliers can be farmers form and outside the village and while developing a cluster, member from tribal community and vulnerable groups, small and marginal farmers women and youth are involved as much as possible.

5.4.2 Activities and Production

The first of the nine components of the triple-layered business model canvas highlight the activities and production component. This component includes activities such as decision making policies which included plans and manuals, organizational structure which included the farmer interest group, processing activities which included processing of primary, secondary and tertiary processing of agricultural products, sales which included sale of products in the form of fresh produce and processed products and production which included production of agri-commodities and production of value added products and handicraft items.

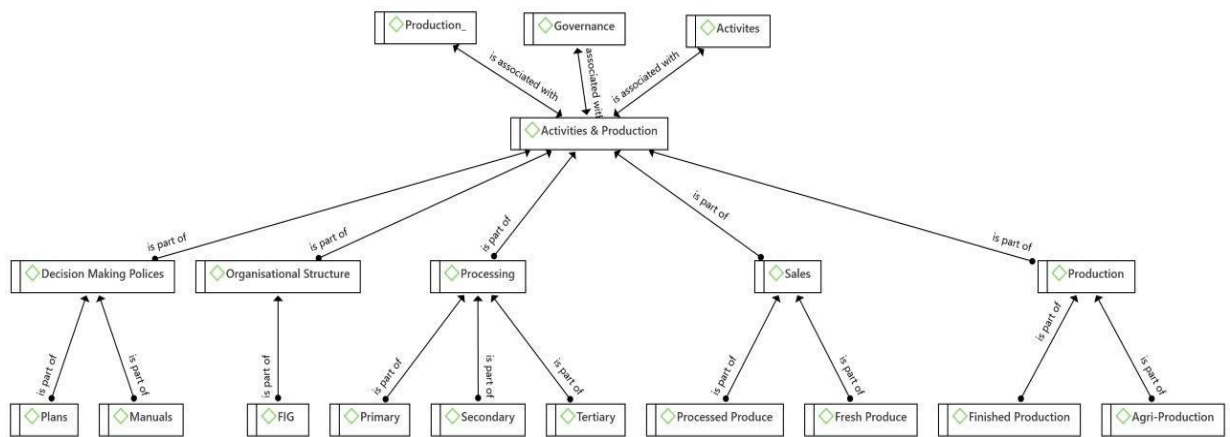


Figure 5.4.2 Qualitative Associative Network for Activities & Production

As this was evident from the discussions and quotations such as

“Yes we do manual processing, majorly sorting grading” and provide the fresh produce for sale as well, we don't need to go to Mandi anymore, we can sell the produce here as well (Farmer Member)

Agriculture Products Sale and, Sale of inputs at low cost can be sold (Farmer Member)

Banking facility can be given from cluster, rural training and entrepreneurship, CSC like facility can be made in the unit. The training provided to farmers should be used for chargeable and can be given handholding to convert agri-produce to processed products (Agri-business Expert)

Manual Processing is also done for some products, sorting grading etc and machinery for processing and inputs for production were initially provided by government to test the production performance of certain inputs and farming practices. (Agri-business Expert)

Activities such as agriculture and processed products ale and sale of inputs at low cost can be done at the cluster-based food processing unit. The structure of the organization is very transparent including FIGs connected well in the network and some villagers are very cooperative and supportive. (Unit Head)

The cooperative team develops plans and procedures in consultation with agribusiness expert involving key stakeholders. (Unit Head)

From the above quotes, it's clear that agri-cluster-based food processing units do things like primary, secondary, and tertiary level processing. The units also sell fresh produce. The unit tries to develop more farmer producer organizations in nearby villages and provide decision making policies, manual and plans.

5.4.3 Material and Resources

Materials and resources are important parts of making a business plan for sustainability. Effective management of raw materials will make it easier to put into action an effective production and value-adding strategy. Figure 5.4.3 shows a qualitative associative network that was made by analyzing the data from the interviews done for the Agri-cluster based food processing units case study.

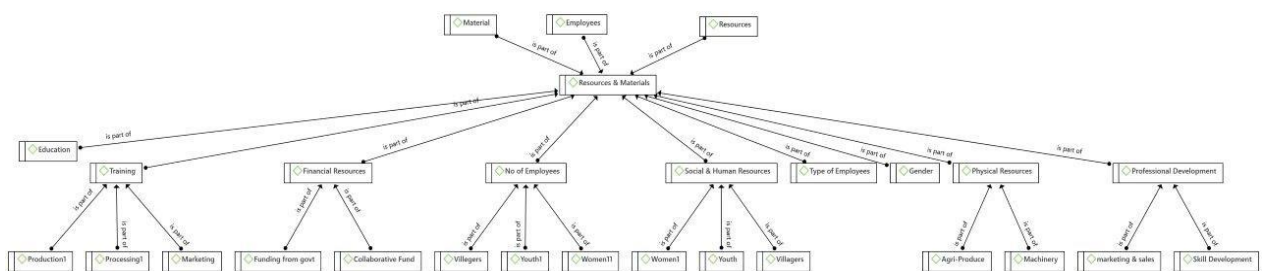


Figure 5.4.3 Qualitative Associative Network Resources and materials

To manage the sudden surge in raw material demand farmers from nearby villages are asked to fulfill our demand. Otherwise, we access the market demand in advance to manage the risk (Unit Head)

More and more FPO linking and farmer collaboration is required. Farmers need to trust and take this initiative forward (Agribusiness Expert)

The governance and human resource in the unit include women, youth and small and marginal farmers. Financial assistance is initially provided by Watershed management directorate to procure machinery and other material and resources (Agribusiness expert)

Farmers were trained in production, processing, new farming practices and marketing of the agri-products. (Farmer Member)

From the above quotes from the interview data and field observations at the food processing units in the agri-cluster, it was clear that

1. Raw material, processing machinery and packaging materials are important component for agri-cluster based food processing units functioning and sustainability.
2. The number and type of employee at an agri-cluster based food processing unit rangers from 6-12 and has women, rural youth and people from vulnerable community as its core team or decision making.
3. Trainings of farmer member are being organized at regular intervals to enhance their skills; exposure visits are also arranged for farmers.

In the food processing unit to do processing, not only raw material but financial and human resources are required. Accordingly, resources are managed by the villagers with help of government at the initial phase of the project. These are established from the above representative quotations.

5.4.4 Value

The value shows what the organization being looked at does best with a service or product. The value weather it is functional, social, environmental, or even the functional value all needs to be improving and innovating so that not only the existing customer base is satisfied but the customer base should expand as well. The value component of the includes the mission, shared value, extra offerings, products and value addition in the products and services offered. Figure 5.4.4 shows the qualitative associative network made with Atlas-Ti software for the value component.

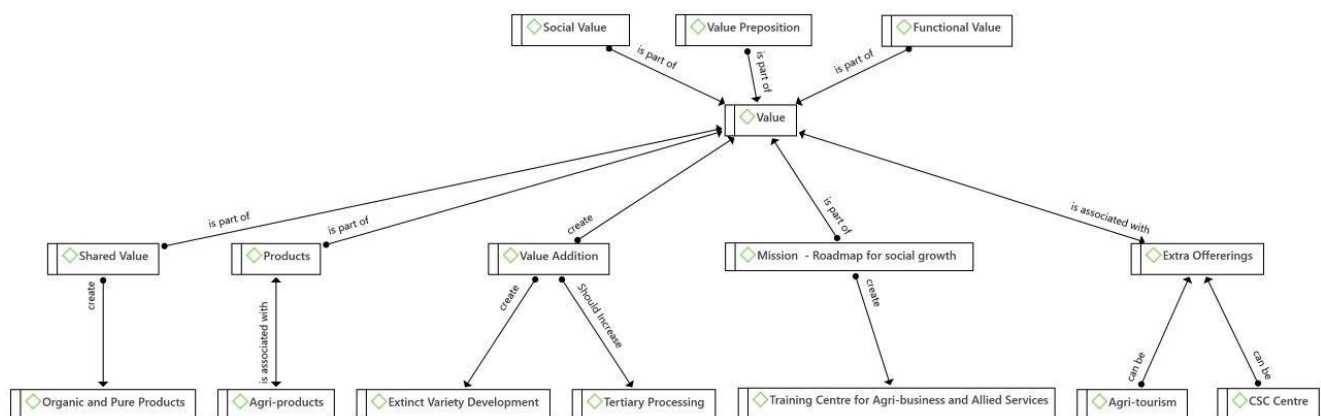


Figure 5.4.4 Qualitative Associative Network for Value

In the cluster we are doing organic Farming, Seed development, Horticulture and Cash Crop development, and value addition like tertiary level Processing, Packaging, Sale of agri-products. (Farmer Member)

Apart from value addition in the agri-products we are making handicraft items and we are also planning to promote agri-processing to the level of extracting oil from turmeric and apricot. (Farmer Member)

From retail shop in nearby villages the processed products are sold, some people at block level also take from shops and some visit our unit to take products in bulk, currently we are selling it in Kapkot, Bageshwar we have tied up with some seller.

We are making annual plans and mission for inclusive growth and work accordingly to collaborate with farmers in the nearby villages. (Unit Head)

We are involved in processing and we are planning to have cold chain warehouse which will also facilitate farmers and helping villagers to improve productivity through trainings. (Unit Head)

The Farmer interest groups and farmer federation can go ahead and plan their production and processing and sales and accordingly start their production and processing. (Agribusiness Expert)

The unit can also work in providing extra offering such as agro-tourism and can utilize the unit as a CSC center to disseminate the government services this will help the units in developing extra earnings and will help farmers and villagers. (Agribusiness Expert)

In the cluster a proper plan and vision mission statement should be formulated that makes the farmer members more motivated. Also, more value creation methods such as opening a common service center can be opened in the unit or agri-tourism can be promote through cluster. These are established from the above representative quotations.

5.4.5 Customer Relationships, Culture and End of Life

The recognition of the organization's potential effect on society is accomplished via the Customer Relationships, Culture, and End of Life component. End-of-life is when a customer decides to stop using a product's functional value, and it frequently involves

material reuse difficulties such as remanufacturing, repurposing, recycling, disassembly, incineration, or disposal. End-of-life occurs when a customer decides to stop using a product's functional value. The interview information has been analyzed using the Atlas-Ti program. As illustrated in Figure 5.4.5, Customer Relationships, Culture, and End of Life have emerged as a category and data analysis has produced a qualitative associative network.

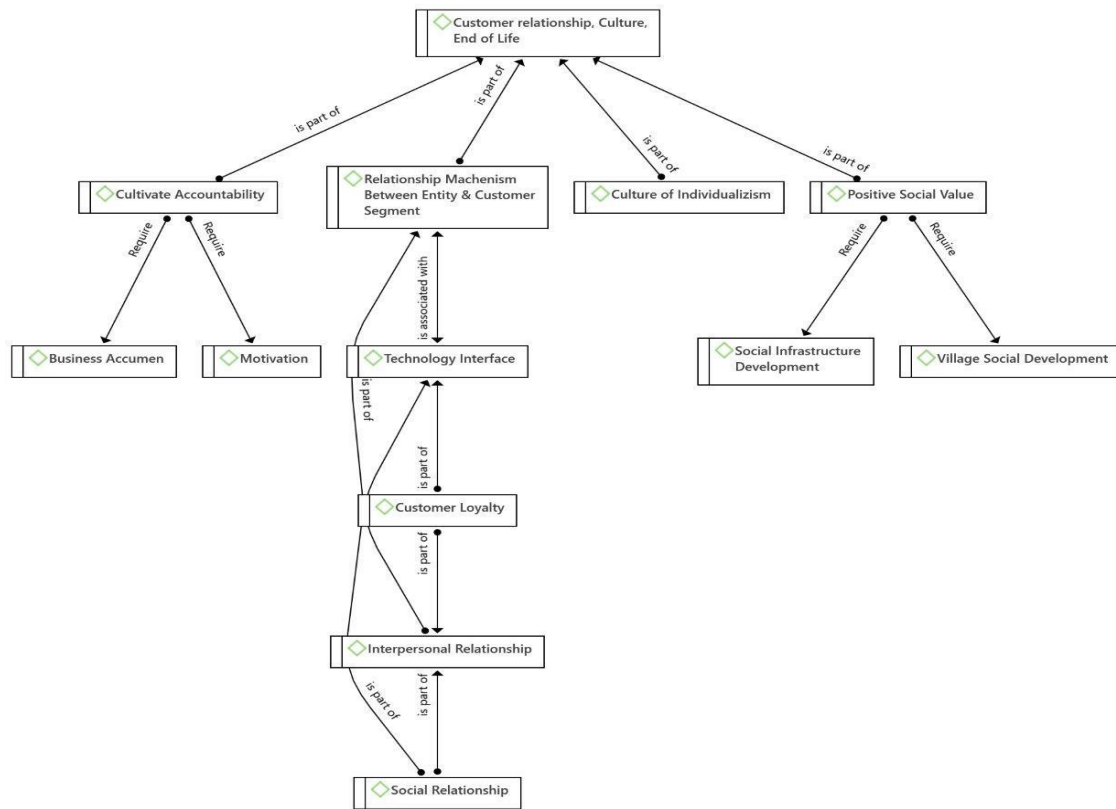


Figure: 5.4.5 Qualitative Associative Networks of Customer Relationships, Culture and End of Life

The Customer Relationships, Culture, and End of Life component acknowledges the organization's potential influence on society. End-of-life occurs when a customer decides to stop using a product's functional value and frequently involves material reuse difficulties such as remanufacturing, repurposing, recycling, disassembly, incineration, or disposal. The interview information has been analyzed using the Atlas-Ti program. As illustrated in Figure 5.4.5, Customer Relationships, Culture, and End of Life have emerged as a category and data analysis has produced a qualitative associative network.

The quotations mentioned below from the interview data show that the culture, customer relationship and end of life has a significant role in business sustainability of agri-cluster based food processing units.

If farmers are motivated for processing and collective farming and all the produce will be sold in nearby fares and if the produce is sold in mandis like, Haldwani and New Delhi it will get us good prices. (Unit Head)

Farmer are using Facebook and other social media platform for sale of products. (Unit Head)

Now even our small amount of produce is being sold and we don't have to go to mandi (Farmer Member)

With this initiative the social interactions and relationships have also improved, we have renovated village school and temple with the collaborative funds received from the sale of the produce. (Farmer Member)

The farmers are being trained and motivated to use technology in not only agriculture and processing but also in selling and creating their products visible as brands. (Agri-business expert)

The villagers are using technologies to enhance customer base and with their interpersonal skills they are getting raw material in time and are tying up with other online sellers as well. (Agri-business expert)

It is evident from above quotations from people involved in agri-cluster based food processing business that trainings and use of technology can increase the revenue but also the overall sustainability of the cluster. Also with the development of agri-cluster based food processing units are the social relationships and cultural ties have strengthened.

5.4.6 Distribution and Channels

The distribution and channel component of the business model canvas is still another component. Figure 5.3.6 demonstrates the qualitative associative network that is connected to distribution and channel, and it may be found below. Interview data from

farmers, unit heads, and agribusiness specialists of agri-cluster based food processing facilities in Uttarakhand was used to inform the development of the same using the Atlas-Ti software.

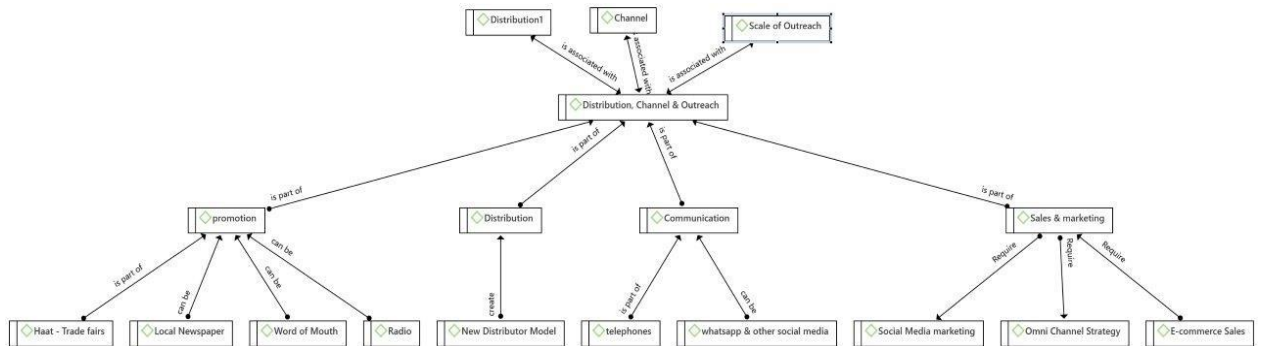


Figure 5.4.6: Qualitative Associative Network of Distribution Channel and Outreach

Few representative quotations from interview data are presented below:

If farmers are motivated for collective farming and all the produce will be sold in nearby fairs and if the produce is sold in mandis like, Haldwani and New Delhi it will get us good prices. We also use phone calls to check prices of products in mandi, usually same price is given for products being sold here. (Farmer Member)

We don't have any idea of selling products online, but we are now getting more channels to sell our produce. (Farmer member)

We can plan online portal for this produce to be sold anywhere, we have tied up with one organization which is selling products on amazon. So they come and collect in bulk and give us orders in advance. (Unit Head)

We are going to trade fairs, haats and now people from nearby regions are getting aware of our efforts. Now even our products are sold in dehli and Dehradun with the retail outlets there. (Unit Head)

We have developed a distribution strategy to bring produce from nearby villages, do primary processing and transport the produce. (Agri-business expert)

We are advertising through radio adds, newspapers, trade fares etc, we are planning to have some tie-up with ecommerce website so that products are sold online and people through social media can come and purchase the products. (Agri-business expert)

It is evident from above quotations from people involved in agri-cluster based food processing business that promotions through newspapers, social media handles, radio and word of mouth the sales can be increased and distribution model of consolidation and selling the produce in bulk can increase the revenue but also the overall sustainability of the cluster. Also, sales and marketing activity need to improve by identifying and developing new markets, using omni-channel strategy and e-commerce and also enhance sales and visibility of products which ultimately improve the business sustainability of the cluster.

5.4.7 Customer Segment, Use Phase and End User

Customer Segment, Use Phase and End User is another component of triple layered business model canvas. The qualitative associative network related to Customer Segment, Use Phase and End User is presented below in Figure 5.4.7. The same has been developed through Atlas- Ti software based on interview data from farmers/unit heads and agribusiness experts involved in agri-cluster based food processing organization in Uttarakhand.

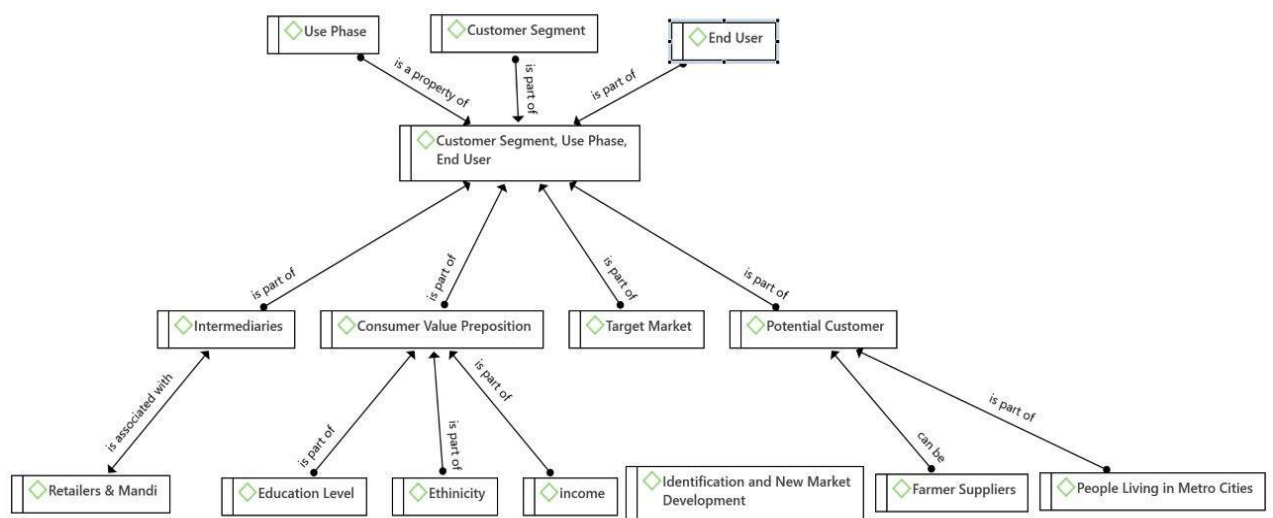


Figure 5.4.7 Qualitative Associative Network of Customer Segment, Use Phase and End User

Few representative quotations from interview data are presented below:

From retail shop here at unit, the products are sold, some people at village block level also take from shops and farmers from nearby villages also supply their agri-produce. (Unit Head)

We are trying to tap the nearby market in villages for our products such as spices, oils and other food grains and pulses. With the training given for biscuit making some farmer federations are selling product in. (Unit Head)

The customer who have settled in cities want to buy same spices, pulses and food grains, and the quality of the product is pure and organic and the prices are not high and thus anyone can buy the products. (Farmer Members)

With this intervention we have almost removed intermediaries' adhatiyas etc, as now farmers can sell the produce directly in the center.

We have planned to sell products that can be purchased by customers not only in villages but also who are living in the cities and want pure, organic and authentic Uttarakhand's taste.

It is evident from above quotations from key stakeholders involved in agri-cluster based food processing business that target market, ethnicity of the customer and supplier base plays a major role in not only selling the products but also in sustaining the products in the market. Also, removing intermediaries from sales channels, identifying and creating the awareness among customers can increase organization and products visibility which ultimately improve the business sustainability of the cluster.

5.4.8 Costs and Impacts

The next component out of the nine component of triple layered business model canvas highlights the costs involved in the project and social and environmental impact. This component includes components such as marketing cost, processing cost, cost of procurement, costs related to packaging, transportation, production and storage. It also included the taxes, cost of machinery, labor cost, impact on health safety, cultural heritage and policy, fair trade and competition. Raw material costs can be bought down by bulk procurement and contract. Impact on environment can be reduced by using biodegradable and multi-use materials for packaging and storage. Also, using

renewable energy can reduce the impact on environment but will also reduce the cost of operations as well in the long run. The qualitative associative network related to costs and impacts is presented below in Figure 5.4.8

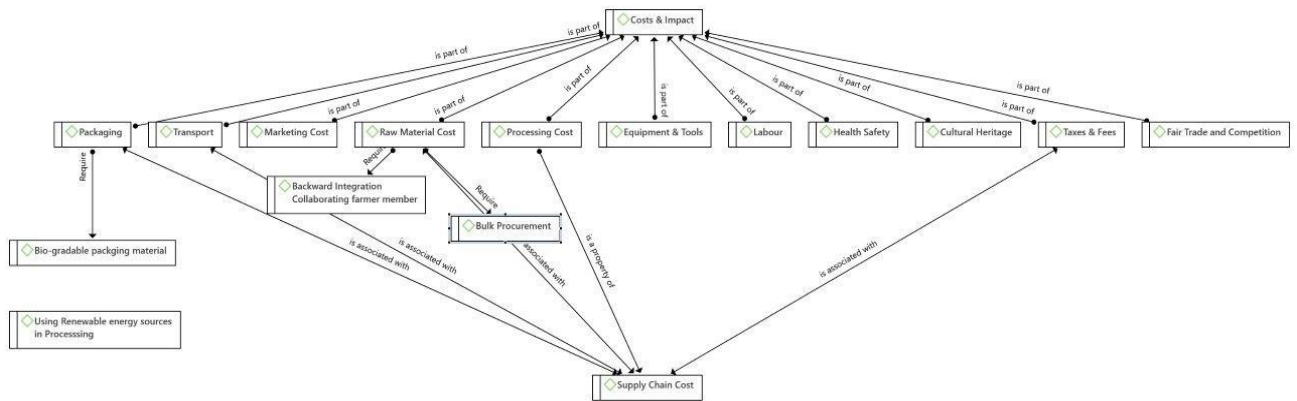


Figure 5.4.8: Qualitative Associative Network for Costs and Impacts

The following are a few typical excerpts from the interviews that were conducted:

We are producing and transporting the products to the unit/center, from there it is further processed and sold. (Farmer Member)

We manage all the transportation cost, if any farmer is bringing his produce, then he manages on its own. (Unit Head)

We are using doing organic farming, the processing done is also manual and minimal amount of wastage is being done, majority is used in making compost or used as fodder for cattle. (Farmer Member)

The fees for certification and license is being handled by us Farmers and farmer interest groups. (Unit Head)

We practice fair trade policy and also advise our farmer members that don't involve in any kind of malpractice. Products should be pure and of quality then it will sustain in this competitive market. (Unit Head)

Health safety of the farmers are taken care of as well, who are involved in the processing units. There are training programs also organized for better health and quality of life for farmers. (Agri-business Expert)

It is apparent from the above quotations that fair trade practices, preserving culture and managing health safety etc can positively impact the sustainability of the cluster-based food processing units. Also, the costs can also be managed by effectively by collaboration and coordination to reduce the expenses and increase bottom line.

5.4.9 Revenue & Benefits

The last component of the nine components of triple layered business model canvas highlights revenue and benefits. The benefits include the community engagement, personals development and value of revenue includes local market, global market and access to regional market. The continuous increase in benefits and revenue will lead to sustainability in business. The qualitative associative network related to costs and impacts is presented below in Figure 5.4.9

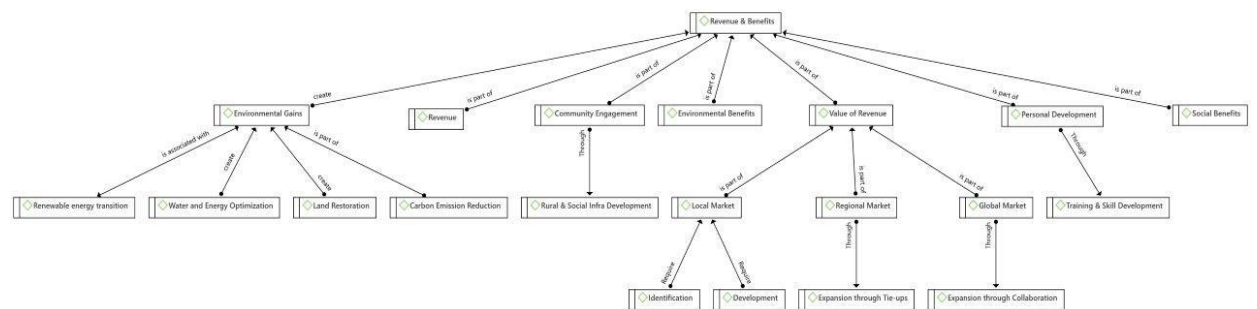


Figure: 5.4.9 Qualitative Associative Network for Revenue and Benefits

Few representative quotations from interview data are presented below:

Organic agriculture, People participation, community engagement, training and personal development, quality product development, near farm collection and processing, faster payment cycle are some components that are benefiting the cluster development. (Unit Heads)

After some time a collaboration with nearby villages and tie-ups govt departments to enhance the coordination, expansion and accessing the technologies for increasing production and sale, plus some social development work. (Unit Head)

We are collaborating with farmers and villagers from nearby regions, we are also sent on exposure visits. (Farmer member)

We are also engaging in community development activities that are also helping in training in skill development. (Farmer member)

The unit is developing training and skill development activities that will improve community engagement and also help farmers to identify and develop new markets. (Agri-business expert)

The revenue of the units will increase with the more and more farmers collaborating and exploring and developing new markets with variety of products. (Agri-business expert)

From the above quotations it is visible that the agri-cluster based food processing units provide benefits such as community and rural development. Expansion through collaboration and further increase in cohesiveness through training and community engagement. The continuous improvement and innovation in processing, market development and farming will strengthen the sustainability measures in the business.

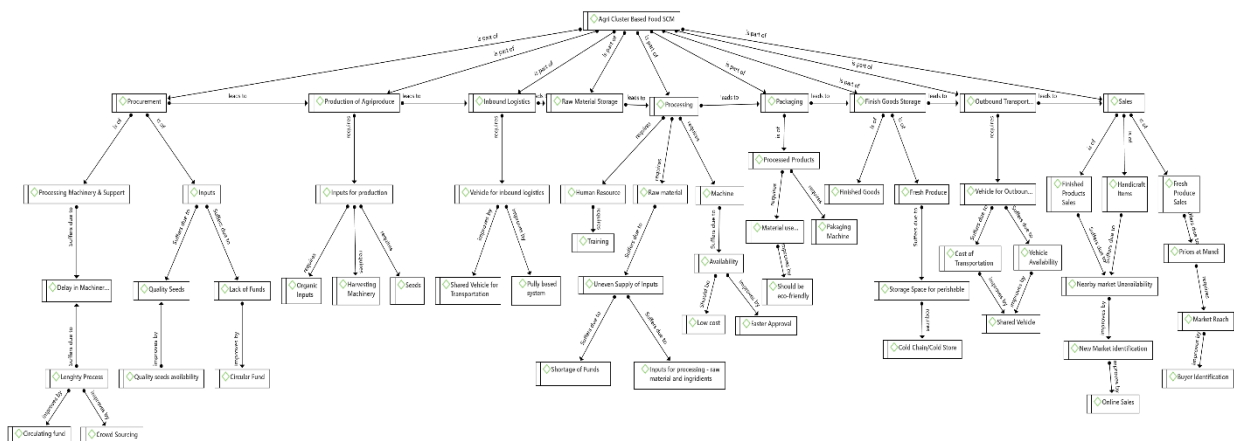
5.5 Supply Chain Model for Agri-cluster Based Food Processing Units

In addition, Supply Chain Management (a component of the entire business model) was investigated with the goal of enhancing the efficiency of the company's operations. It was determined that the management of the supply chain is an area that, in addition to other aspects of the company, must be better if overall performance is to be improved. The supply chain model included subcomponents such as procurement, production, warehousing, transportation, sales and distribution. The lacuna in the existing supply chain components and measures for its improvement were also Identified, which are mentioned in the model, developed from the data analysis done with the AtlasTi software. The qualitative associative network related to supply chain management is presented below in Figure 5.5

Additionally, a few exemplary interview quotes are offered below:

We can procure in bulk at the time of season's harvest but for that if faster and easy bank loan is given that can help. For storage and processing we are developing a processing unit and cold chain warehouse as well.

For transportation we use a shared vehicle, if a dedicated vehicle can be arranged for the unit, faster transportation can be done. (Farmer Member)



5.5 Supply Chain Management Diagram of Agri-cluster Based food Processing Unit

We don't have proper transport and logistical infrastructure due to which our produce was not able to reach the market in time, with agri-cluster based food processing units we can just bring our produce here and we can procure quality seeds and other organic agri-inputs from here as well. (Farmer member)

The packaging material should be environment friendly, low cost and easily available. For transportation we have used pulley-based system at nainbag in the valley region, transportation of fresh produce is now moved with crates to the road with pulley system. This has also increased the production in the valley region as well which was earlier kept barren. (Agri-business Expert)

The Supply chain of the cluster has been improved due to the intervention of food processing unit. Now the Kiwi fruit, apple, litchi buransh etc are being processed, also the spices, oils seeds and food grains are being processed and sold. This has not only increased the income but also has reduced the post-harvest losses. (Unit Head)

We are taking measure to strengthen the villagers to make their logistic and supply chain network resilient by adding better retailers, transportation network, processing automation, improving packaging quality, developing cold-chain warehouses and training them in improving the sales. (Agri-business Expert)

The above-mentioned diagram highlights the supply chain issues and solution for improving supply chain performance and sustainability. In this model issues and its probable solution has been mentioned in the context of cluster-based food processing units. It starts from procurement of agri-produce and production, its processing, inbound logistics, its storage, processing packaging and finished goods storage, outbound transportation and sales have been mentioned. In each process issues with the help of case study methodology were identified and their probable solutions have been also highlighted.

5.6 Business Sustainability Model for Agri-culture Cluster Based food Processing Unit in Uttarakhand

This section discusses the proposed business model for agriculture cluster-based food processing in Uttarakhand state. The present model is developed based on the data collected through interviews from the concerned stakeholders in a rural region in the Uttarakhand state such as farmers, food processing operators, government officials, policymakers, and other stakeholders.

The proposed agriculture cluster-based food processing business model is presented in figure 5.6 which was developed by analyzing data using Atlasti software.

The proposed agriculture cluster-based food processing business model depicts key resources, key processes, and profit formula for the agribusiness. Also, the model explains the interrelationship among the three (key resources, processes, and profit formula) and their association with customer value proposition. It can be established that cluster-based agricultural production, near-farm processing, government support, motivation, collaboration, and cooperation play a key role in business sustainability and development. The positions in the model are not exhaustive, but they do provide a key progress platform for the strategic steps that must be taken to ensure a sustainable agriculture cluster-based food processing sector in rural areas.

The results of previous studies carried out by Nieto and Santamaria (2007) and Doloreux (2004) observed that agribusiness units' cooperation with the stakeholders had a substantial impact on its business sustainability. While the government has launched initiatives aimed at encouraging SMEs to innovate, SMEs see the government

as a source of capital rather than a source of innovation. This notion originated because of the government's tendency to provide financial aid rather than instruments, equipment, or technology.

According to this study, the greatest barrier to innovation for farm cluster-based food processing units is a lack of accessible resources, such as money, technology, and human capital, as well as an insufficient supply chain. Participating in a cluster allows SMEs to establish partnerships with other businesses as well as research institutions. Such collaborative projects would be able to help SMEs overcome their innovation problems. The importance of Business sustainability in Uttarakhand's agri-cluster based food processing units, is highlighted in this study.

The authors also formed a business model of agriculture cluster-based food processing units as depicted in figure 5.6, which will enable the stakeholders, policymakers, and the researchers to understand the agriculture cluster-based food processing and take necessary actions to improve the agri-business performance and sustainability in rural regions. The model is developed based on Osterwalder's Business Model that highlights key partners, key activity, value propositions, client relationship, buyer segment, revenue streams, and cost structure in the business that can make the business sustainable. In practice, it needed a large amount of data input, some of which was repeated regularly (Polakova, et al., 2015).

In accordance with previous research that found a correlation between the triple bottom line and business sustainability, this study concludes that optimization, efficiency, cooperation, and collaboration have a significant impact on business performance in agriculture and food processing industry clusters. Innovation in product, process, marketing, and packaging is required for firms to compete for consumers and market share. Increased innovation increases the likelihood of commercial success for small businesses. Given the obvious association between innovation and business success, SMBs operating in highly competitive and complicated contexts should consider implementing an innovation strategy. Collaboration fosters innovation: thus, it may be important for small and medium-sized enterprises (SMEs) to establish strong collaboration to maintain their inventiveness.

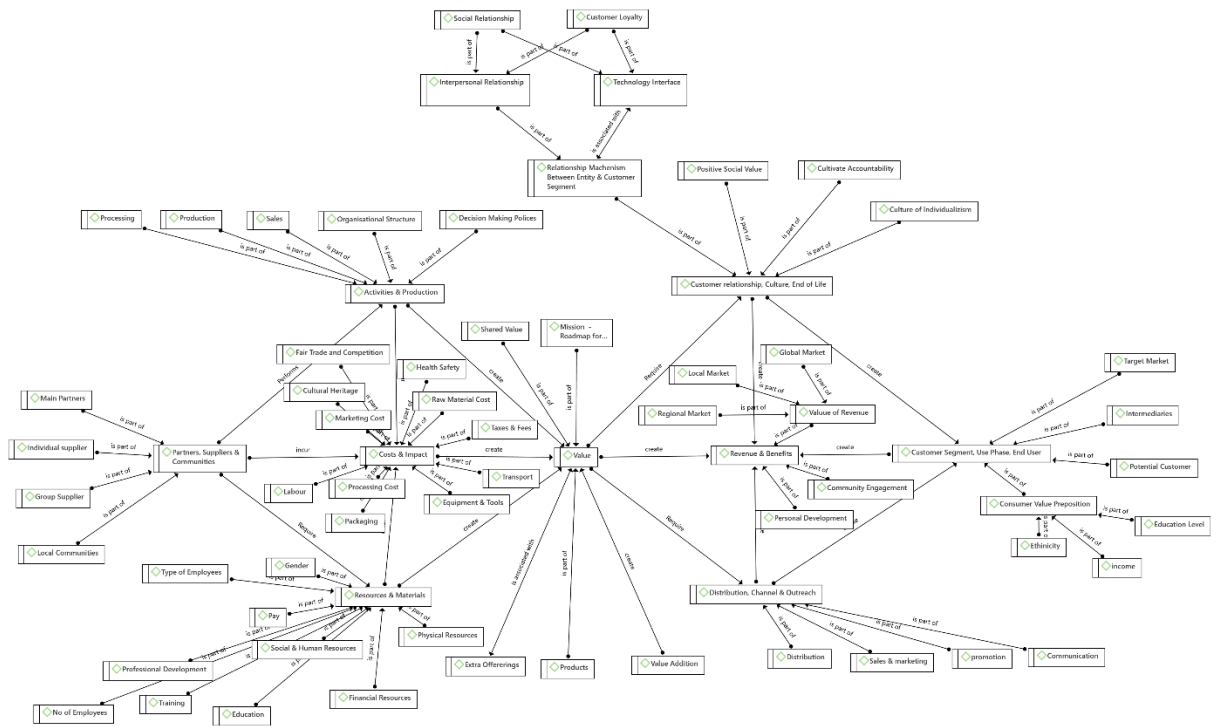


Figure 5.6 Business Sustainability model for Agri-cluster based food processing units in Uttarakhand

Improving the commercial performance of SMEs via innovation requires the participation of research institutions, such as universities, in the collaboration of SMEs within a cluster. To foster innovation, research institutions should share cutting-edge knowledge and technology. Universities may give these clusters with several additional resources, such as technical support, to aid in their innovation. According to a study, the knowledge generated by university research may be leveraged to foster innovation in small and medium-sized enterprises (Acs et al., 1994). In this case, the government will facilitate participation by research institutes by making the necessary resources available to universities.

5.7.1 Validity and reliability

Construct validity, internal validity, external validity, and reliability are four tests relevant to the qualitative research technique that are discussed in section 5.7.1 (Yin, 2003). Finally, section 5.2.1 contains the protocol document for the Case study Protocol (CSP) utilized in this study, and details how it was implemented throughout data collection.

In contrast to what is commonly encouraged, this study is narrowly focused on creating a model of commercial sustainability for agri-cluster based food processing units (Yin, 2003). It could be argued that this method is flawed because it only allows to produce a purely local empirical theory. Potential lack of generalizability. According to Hughes and Jones (2003), the method can still add to what is already known in this area.

Any research work can be judged by the following criteria: Information about the four types of validity (Yin, 2009)—Construct, Internal, External, and Reliability—is provided below.

Case study methods for four design experiments (Yin, 2009)

Test	Tactic	Phase Where it Occurs	Incorporated in the study
Construct Validity	Make use of multiple sources of evidence	Data Collection	✓
	Establish a chain of evidence	Data Collection	✓
	Get the key informants to review draft of case study report	Compilation	✓
Internal Validity	Do a pattern matching	Data Analysis	✓
	Do an explanation building	Data Analysis	✓
	Address rival explanations make use of logic models	Data Analysis	✓
External Validity	Make use of theory in multiple case studies	Research Design	✓
	Make use of replication logic in multiple case studies	Research Design	✓
Reliability	Use of Case Study protocol	Data Collection	✓

Table 5.7.1: Case study tactics for four design tests (Yin, 2009)

The primary objective of the test of dependability is to identify flaws and biases in the research investigation. Using a reliability test, tasks such as data collecting may be

repeated with the same outcome (Yin, 2003). This means that if a second researcher collects data in the same way that the first researcher did in the case study, the second researcher will get the same findings and conclusions.

Several methods are used in this research to make sure that the procedures for collecting and analyzing data are always done the same way. First, the research process has been guided by the Case Study Protocol (CSP). Protocol is one of the most essential approaches to improve the reliability of case study research. CSP tells the investigator how to do the research for the case study (Yin, 2003). The protocol includes interview questions, methods, and general guidelines to be followed during interviews. This ensures that the same topics are addressed in each case.

The interviews are then recorded and transcribed so that all the material may be stored. Thus, other researchers may independently examine the data. Third, using Atlas-Ti software helps researchers analyze qualitative data in a systematic and consistent way (Weitzman, 2000). This makes research more reliable because the same steps can be done repeatedly (Yin, 2003). In the fourth place, the notes that were collected from the files have been taken and are now being transcribed for use in the future. In the following paragraphs, we will go through the Case Study Protocol in further detail.

5.8 Concluding remarks

This chapter concludes the discussion on second objective that to develop business sustainability model for agri-cluster based food processing units in Uttarakhand. To analyze the data, the researcher case study analysis. Based on analysis business sustainability model on triple layered business model canvas was developed for the agri-cluster based food processing units. Also, supply chain performance model was developed which can be integrated in the overall business sustainability model to further enhance the competitiveness of the agri-cluster based food processing units. The last chapter discusses the recommendation, contribution to theoretical premise, implication and limitation of the study.

CHAPTER 6

CONCLUSIONS

6.0 Introduction

This study concludes with a discussion of its significance, findings, and limitations. Here, we take a close look at how the findings of this research might be used in the realms of theory and management. The study's findings are presented first, emphasizing the need to create a commercial sustainability model for Agri cluster-based food processing facilities in Uttarakhand. In the next section the recommendation for business sustainability of agri-cluster based food processing units are mentioned (Section 6.2). The subsequent section explains the significance of study, limitation and future research directions of the study (Section 6.3, 6.4 & 6.5). The last section of the chapter spells out the contribution to the body of knowledge (Section 6.6); hence, this chapter briefly presents the measure to improve the business sustainability of agri-cluster based food processing units in Uttarakhand and further presents the contribution of this study to present literature.

6.1 Conclusion

The present study measures the supply chain performance and develops a business sustainability model for cluster-based food processing units in Uttarakhand to achieve business sustainability. The results of objective 1 of the study suggests the need for a business sustainability model for agriculture-cluster-based food processing units in Uttarakhand. Consequently, it can be determined that implementing innovative methods in business lined with triple bottom line constructs can lead to generating competitive advantages and ultimately tend to sustain the business for these agriculture cluster-based food processing units in Uttarakhand.

The study results reveal that Cluster Based food processing units, people can be motivated by monitoring, training, and skill development. However, there are several obstacles, such as an inefficient supply chain, a lack of willingness, and inadequate supply chain infrastructure. To an extent, this can be overcome by introducing appropriate enablers such as circular funds, quality input, awareness on morality of

business, safety and wellbeing of workers, subsidized input support, handholding, monitoring, continuous feedback, cohesiveness & motivation.

This study's results and suggestions may not be generalizable because it focuses on SMEs in the Uttarakhand food processing sector. Since such tendencies were not examined in this analysis, future studies should address them. Though many studies measure food processing supply chain modeling, the present study attempts to model the business sustainability of cluster-based food processing units for the first time. Secondly, the study adopts a qualitative research approach for providing a supply chain solution for business sustainability, which can be further empirically tested, and the viability can also be checked in other states of India and specific food processing businesses. Finally, based on the developed business model, a detailed framework can be further formed for the agribusiness industry in hilly region.

6.2 Recommendations

As this study has focused on the business sustainability of agri-cluster based food processing units, the recommendations for each component in the form of business model canvas having nine components is mentioned below:

Key Partners	Key Activities	Value Propositions	Customer Relationship	Customer Segments
Enabling women and youth from vulnerable group communities and support related to quality seed and inputs can be given for building trust among them	Emphasis upon preparing decision matrix and decision-making policies for long term plans and auditing team to check the deliverables periodically, the focus should be more on value addition by advance	Emphasis on agri tourism, and offering CSC center services from the units will not only generate revenue but can make the units more sustainable	Should include focus on customer record or data base management to pitch them new offerings which is missing in the existing model, also there should be feedback mechanism which can improve upon product offerings and understanding customer demands.	Internet and Social Media mechanism in identifying potential markets and customer and developing products according to various customer segments

	<p>processing, production and sales through e-commerce portals and social media</p>		<p>The culture in the units should inculcate environment friendly, customer centric approach to generate word of mouth approach</p>	
	<p>Key Resources Machinery having lesser energy impact or low energy requirements. Even looking at the demand of handicraft products can be developed. The training and development component should focus on involving women and youth from the region to upscale the business. A collaborative fund should be utilized among members and an amount of the revenue should be made a part of, circulating funds.</p>		<p>Channels Focus should now be exploiting local as well as far flung markets with the help of tie-ups, distributorship can be developed to strengthen sale and dependency. Also, social media and e-commerce can be utilized for distribution. Omni channel strategy can be taken up to increase sales</p>	

	Units can be further motivated to generate crowd sourcing mechanism for fund generations			
<p>Cost Structure</p> <p>The cost of inputs can be reduced by backward integration of farmer, agri suppliers, the processing cost and impact can be reduced by manual processing, using renewable energy in processing, the marketing cost can be reduced by increasing social media marketing and distributorship mechanism</p>		<p>Revenue Streams</p> <p>Revenue which can be increased by farmer collaboration, agri-tourism, quality product development and tertiary processing such as nutraceutical</p>		

6.3 Significance of the results and findings

The relevance of the research's findings is covered in this section. This study's findings were significant because the study brought out business sustainability solution for the agri-cluster based food processing units in Uttarakhand. These findings will aid those involved in the decision-making process, including think tanks, bureaucrats, farmers, self-help groups, cooperative societies, central and state governments, the Department of food processing and industries, policymakers, and private agri-business firms, in planning and carrying out their operations accordingly. The implication of the findings is given below:

6.3.1 Managerial Implications

The Study will be helpful in motivating Farmers Producer organizations and self-help groups in adopting new management techniques and tools to provide safety to its

workers and farming community, efficiently using natural resources, optimizing use of inputs for agriculture and processing, and using business ethics and morality as their best practices of their agribusiness enterprise. Also, these practices and application of the proposed model will help in cluster-based agribusiness firms to become sustainable in the long run.

6.3.2 Policy Implication

The study can help policy makers in framing farmer centric policies, schemes to improve business performance and sustainability, reducing post-harvest losses, improve yield and income of farmer, strengthen farmer producer organization, self - help groups, and stopping migration which is still a cause of concern for the high hill regions of Uttarakhand.

6.3.3 Practitioner & Researchers implication

The study can be helpful in implementing the model for business sustainability of agri-clusters in other regions. Also, the practitioners can use components of business model and supply chain model of assess the sustainability components of their area of study. The researchers can explore the avenues where the study of other clusters such as electronic manufacturing, automobile and FMCG etc can be studied with the help of this model.

6.4 Limitations

The study has been limited to the supply chain performance measurement and business sustainability of Agri-cluster food processing units in Uttarakhand. With the change in geography, the specific factors may change such as the infrastructure, resources availability, and farmer's knowledge. The severity of impact of one component on another is not discussed. The entire work was done from the perspective of the implementer. Separate research must be conducted to determine the viability of other linked sectors and locations. Even though this model is suitable to implement in any hilly market specific study is always advised prior to the implementation.

6.5 Future Scope of Work

The study conducted has opened promising vistas for future research. The proposed business model proposed shows the direction, analyzing the magnitude of impact is out of scope of work of this study and can be future scope of work. Feasibility of introducing different types of non-monetary incentives is another scope for investigation. Incorporation of renewable energy of energy and transportation for cluster based Agri-processing will be a potential area for further research.

A similar empirical study could be carried out in the future for the business and supply chain sustainability of the related sector, which includes agriculture export units, the beverages industry, the nutraceutical industry, and other business units such as FMCG, FMCD, food ecommerce aggregators, and so on. Finally, an attempt can also be made to develop a framework for the organized/modern food processing supply chain.

6.6 Contribution to Body of knowledge

The purpose of a research such as this is to explicate the ultimate contribution to knowledge. This is unquestionably the case here, as the vast majority of organizational scholars do not develop new theories but rather add to what already existing.

This research will contribute to knowledge in the following manner:

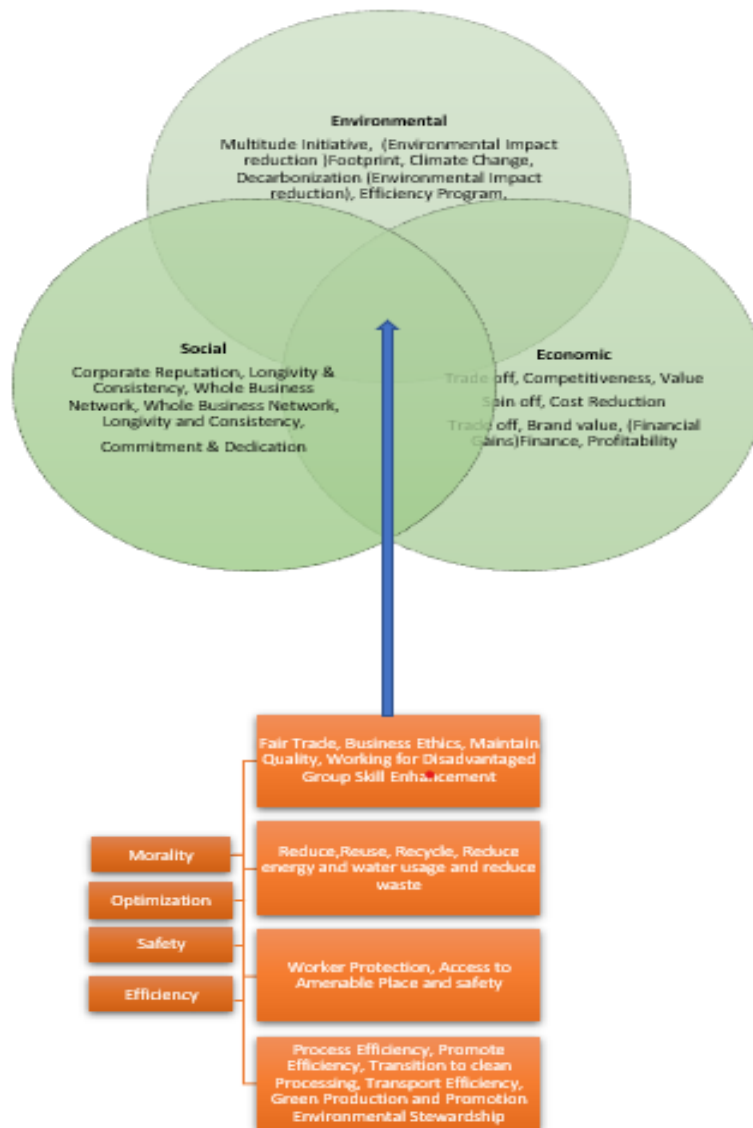


Fig 6.6 Contribution to Theory of Triple Bottom line

In the above-mentioned diagram, the three components of triple bottom line theory have been mentioned with the help of a Venn diagram. The subcomponents of economic, social and environmental components have also been mentioned which are (Multitude

Initiative, Environmental Impact reduction, Footprint, Climate Change, Decarbonization for – Environmental Component), Economic –(Trade off, Competitiveness, Value, Spin off, Cost Reduction, Trade off, Brand value, (Financial Gains)Finance, Profitability) and social components' subcomponents Social, Corporate Culture, Reporting, Organizational Support, Corporate Reputation, Whole Business Network, Longevity and Consistency, Commitment & Dedication. The central point in the diagram where the three circles of the triple bottom line component each other, is the section which is the core of the triple bottom line theory has not been discussed much and the component such as Fair trade, Ethics, Energy & waste reduction, Worker, Protection, Organic production etc. are being highlighted as its core part. These subcomponents in the center of the Venn diagram are interconnected, or the three elements of the theory of triple bottom line, interact with regard to morality, optimization, safety, and efficiency. These are the newly identified components because of the research conducted. The study contributes by highlighting the essential components (morality, optimization, safety, and efficiency) on which the three components of the triple bottom line theory (Social, Environmental, and Economical) interact.

There is a dearth of literature especially on agri-cluster based food processing units in the Indian context. This is since most of the earlier research on triple bottom line focuses on the environmental component of triple bottom line for the sustainability of businesses. This study improved the business sustainability of agri processing units in Uttarakhand by applying the methodology of triple bottom line theory. As a result, it filled a vacuum in the existing literature on the topic of the "Triple bottom line."

The model thus developed will help various stakeholders involved in the chain, i.e., Farmers, self-help groups, cooperative societies, Policymakers, central and state government, Department of food processing and industries, Private agri-business companies in planning and executing their operations accordingly in making agribusiness not only sustainable but more competitive one.

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APPENDICES

Appendix/Annexure A

Schedule Questionnaire

- | | | |
|-----|--|----------------------|
| Q1 | What is the time for which machine can operate/month (Forecasted)? | <input type="text"/> |
| Q2 | What is the time for which machine operates/month (Actual)? | <input type="text"/> |
| Q3 | What is the level of which labor productivity? Total number of goods produced/ month? | <input type="text"/> |
| Q4 | What is the amount of raw material used/month? | <input type="text"/> |
| Q5 | What is the amount of finished goods produced/month? | <input type="text"/> |
| Q6 | What is the total number of Products Manufactured SKU wise? | <input type="text"/> |
| Q7 | What is the total number of products shipped in time? | <input type="text"/> |
| Q8 | What is Total amount Invoiced per year? Total Sales | <input type="text"/> |
| Q9 | What is the total number of products shipped in time per year? | <input type="text"/> |
| Q10 | What is the quantity demanded per year? | <input type="text"/> |
| Q11 | What is the total supply chain cost? (Transportation cost+ Order Processing Cost+ Inventory Carrying cost+ Information Cost) | <input type="text"/> |
| Q12 | What is the Average inventory level per year? | <input type="text"/> |
| Q13 | What is the amount of net profit earned per year? | <input type="text"/> |
| Q14 | What is the amount of investment or cost incurred per year? | <input type="text"/> |
| Q15 | What is the amount of Fixed Assets of the organization? | <input type="text"/> |
| Q16 | What is the amount of Current Assets of the organization? | <input type="text"/> |
| Q17 | What is the amount of Current Liabilities of the organization? | <input type="text"/> |
| Q18 | What is the amount of Total Liabilities of the organization? | <input type="text"/> |
| Q19 | What is earning before interest and tax? | <input type="text"/> |
| Q20 | What is the cost of inbound transportation cost? | <input type="text"/> |
| Q21 | What is the cost of outbound transportation cost? | <input type="text"/> |
| Q22 | What is the total cost incurred in producing per Product? | <input type="text"/> |
| Q23 | What is cost of packaging incurred per year? | <input type="text"/> |

Q24	What is cost of sourcing of raw materials?	<input type="text"/>
Q25	What is the total cost incurred in storing the raw material/finished product/semi-finished products?	<input type="text"/>
Q26	What is the cost of Information? Telephone, Internet, etc.	<input type="text"/>
Q27	What is the amount of money spent on quality assurance/control?	<input type="text"/>
Q28	What is the delivery Lead time?	<input type="text"/>
Q29	What is Price of Products sold by the firm (SKU wise)?	<input type="text"/>

Appendix/Annexure B

Case study Questions and Transcripts Sample from the two clusters

Cluster Development	Questions	Danpur Kisan Ekta Swyawtya Sehkarita Shama Bageshwar	Farmer Member	Head of the Unit	Kalika Devi Swayata Sehkarita	Questions	Farmer Member	Head of Unit
Q1	What is a cluster? How will you define a cluster-based farming and processing center?	A Cluster is a place where similar Corp is grown. Processing center and growth centers are located at the points were nearby villages are connected and produce from all the nearby places come at a point for processing.	A Cluster is a place were similar Corp is grown	A cluster is a place where organic farming is done. And Collective Farming is practiced	Federation started in 2009, In phase 2 also gave so training, seeds etc. Trainings are given for increasing production and	What is a cluster? How will you define a cluster-based farming and processing centre?	region were similar crops are produced as per the conditions in a particular region	Federation started in 2009, In phase 2 also gave so training, seeds etc. Trainings are given for increasing production and similar crops in organic is grown

Q2	What help does the government does in developing the cluster?	Government is giving seeds and farm equipment and other processing machinery, the WMD has created Agribusiness Support Centre which has a cold storage warehouse, processing centre and machinery, packaging machinery and other training support etc are also being created.	Government is giving seeds and others inputs at low cost	Government Provides inputs like seeds machinery infra and funds	In phase 2 also got some machinery more people were also joined and, a lot of people who are doing good work also joined. ABSO people also come for motivating people, in phase 1, FIG were formed initially but were not working properly. Cow shelters etc were also made	What help does the government does in developing the cluster?	In phase 2 also got some machinery more people were also joined and, a lot of people who are doing good work also joined.	ABSO people also come for motivating people, in phase 1, FIG were formed initially but were not working properly. Cow shelters etc were also made
Q3	What issues/Challenges they face in developing in a hill based cluster?	Selection of members is a challenge, identifying market is a challenge	Getting inputs in time, as per the desired quantity	Selection of members is a challenge, identifying market is a challenge	Phase 1 started in 2006-7 but federation was made in the end of phase 1 in 2009 7 members joined initially in the federation but most of them left	What issues/Challenges they face in developing in a hill based cluster?	Initially the farmers collaborate but once the project is completed people start leaving	Initially the farmers collaborate but once the project is completed people start leaving

Q4	What activities are done in cluster and who decides and how they are implemented?	Activities like organic farming, training and new hybrid and cash crop production and processing, the Federation decides in cooperation with experts from Gramya plan how the thing will be implemented on ground	Organic Farming, Seed development, Horticulture and Cash Crop development	Organic Farming, Seed development, Horticulture and Cash Crop development, Processing, Packaging, Sales	Spices are specialty and expertise, earlier also working in spices. Also working in juice, squash, herbal, organic and medicinal plant cultivation . Reviving the extinct and endangered variety of produce.	What activities are done in cluster and who decides and how they are implemented?	herbal, organic cultivation. Reviving the extinct and endangered variety of produce.	Spices are specialty and expertise, earlier also working in spices. Also working in juice, squash, herbal, organic and medicinal plant cultivation. Reviving the extinct and endangered variety of produce.
Q5	What kind of Training and quality certification and other assistance	Training and Certification are being provided by WMD, exposure visits are also provided by WMD	Training is provided	Training and Certification are being provided by WMD, exposure visits are also provided by WMD	Yes FSSAI certification and training were given when project phase 1.	What kind of Training and quality certification and other assistance	We are provided many training	We have taking trainings exposure visits we have also taken FSSAI Certification
Q6	What type of monitoring is done after cluster formation?	Monitoring is done by WMD team and they ask us to create annual plan	Visits to farm to check growth and requirements of Inputs	Monitoring is done of production, processing and field visits to identify problems	The Project management team comes for monitoring they also take inputs for preparing annual plan and ask to submit all the requirement in the form of a plan	What type of monitoring is done after cluster formation?	Monitoring is done by WMD people	We ask govt to monitor our projects and identify what further can be done to make it on a large scale

Q7	What according to you are major issues and challenges in hill based farming and processing?	Wild animals are a challenge, ease of availability of good quality seeds is a challenge	Wild Animals, easy availability of desired quantity of seeds	Wild animals, inputs etc	Involving people sometimes becomes challenging, Wild animals are a issue, getting quality seeds is etc are some of the challenges	What according to you are major issues and challenges in hill based farming and processing?	Wild animals are a issue, getting quality seeds is etc are some of the challenges	Wild animals are a challenge, ease of availability of good quality seeds is a challenge. Involving people sometimes becomes challenging and after the project gets over it becomes more difficult
Supply Chain Management								
Q1.	What are the key components of cluster based food processing supply chain?	Famer collaboration, collective farming, participative agriculture management	Famer collaboration, Food Processing, Organic Farming	FPO's, Processing, Better Production, Horticulture and cash crop production	Organic agriculture, People participation, quality product development, near farm collection and processing, faster payment cycle are some components.	What are the key components of cluster based food processing supply chain?	Organic agriculture, People participation, near farm collection and processing	Famer collaboration, collective farming, participative agriculture management. Organic agriculture, People participation, quality product development, near farm collection and processing, faster payment cycle are some components
							Farmer Member	Owner
Q2.	What are packaging related issues and challenges?	Packaging machine was not available earlier, if all types of packaging material	Packaging material is not given to us it is with the growth Centre	Packaging material is being provided	Single use plastic is now being banned, good quality packaging material	What are packaging related issues and challenges?	Packaging should be good, durable	Packaging machine was not available earlier, if all types of packaging material. Single use

					should be provided to the phase 1 associations.			plastic is now being banned, good quality packaging material should be provided to the phase 1 associations.
a.	What are the issues related to material quality?	Packaging material should be given in advance, packaging should be eco friendly and easy to carry	Yes it should be given in advance	Packaging material should be given in advance, packaging should be eco friendly and easy to carry	Packing material is required, which is compatible with single use plastic bag, paper bag were given but those were not compatible,	What are the issues related to material quality?	Quality is good should be provided in advance'	We should be tying up with the suppliers that can provide the material
b.	Issues related to design of packaging material?	No issues	No issues	No Issues	Packing material should be designed in such a way that it can carry all type and quantity of products	Issues related to design of packaging material?	design is appropriate	Design should be good so that people can procure the product
c.	Issues related to packaging sustainability and ecofriendly ?	Yes, Eco friendly packaging	Yes it should be of Eco friendly material	It should be as per government norms	There is a demand of eco friendly packaging material as government is imposing severe penalty on plastic bags and paper bags are not comfortable to carry products of all types and sizes	Issues related to packaging sustainability and ecofriendly ?	the material should be capable of handling all types of material	There is a demand of eco friendly packaging material as government is imposing severe penalty on plastic bags and paper bags are not comfortable to carry products of all types and sizes

d.	Do you have been given any training in packaging and packaging material develop?	No	No training	No training specific to packaging	No	Do you have been given any training in packaging and packaging material develop?	No training on packing material	No training
e.	Where do you get the cost the cost of packaging material?	Gramya has given us all the material for packaging.	We handle on our own	Gramya is giving but once the project gets over then we have to manage it on our own	The packets were given by WMD, even the stickers and labels are given by WMD. Paper bags are expensive so demand is for eco friendly packaging bag.	Where do you get the cost the cost of packaging material?	we have to manage on our own	The packets were given by WMD, even the stickers and labels are given by WMD. Paper bags are expensive so demand is for eco friendly packaging bag.
f.	What are the issues related to packaging material availability	All the packaging material are send by WMD	Packaging material should be on time	Material is being provided by Gramya	Packing material should be provided to phase 1 organisation also in advance, some times it is provided	What are the issues related to packaging material availability	Packing material should be provided in advance	All the packaging material are send by WMD. Packing material should be provided to phase 1 organisation also in advance, some times it is provided
							Farmer Member	Owner
Q3.	What are the issues related to agri processing?	Procurement of produce in bulk is sometimes an issue due to lack of funds, machinery for processing comes late which sometimes delays the processing, majority of produce is off	If the production is more than the processing will be high as well.	If we are given some funds from the government so that we can purchase products from farmers as early as possible it would be better	new machinery should be provided	What are the issues related to agri processing?	Farmer Collaboration, quality inputs, animals, funds for	Procurement of produce in bulk is sometimes an issue due to lack of funds, machinery for processing comes late which sometimes delays the

		seasonal so processing					inputs etc	processing, majority of produce is off seasonal so processing. Additional Machinery should be given to phase 1 Units as well.
a.	Do you get machinery for processing easily?	We have got some machinery from WMD and training as well	We ask the growth center people on how to increase the productivity, we are provided machinery for processing	we have been given machinery and training on how to use it for processing is also being given	Machinery were given by WMD in phase 1, now some of the machines have become obsolete, new machines as per requirements should be given so that processing can be extended to more crops.	Do you get machinery for processing easily?	No we don't have machinery	We have got some machinery from WMD and training as well. Machinery were given by WMD in phase 1, now some of the machines have become obsolete, new machines as per requirements should be given so that processing can be extended to more crops.
b.	Is there any manual processing done with the product?	Yes some sorting and grading is done manually	Yes we do manual processing, majorly sorting grading	Yes we do both manual processing but now we have got processing machinery	Yes some times	Is there any manual processing done with the product?	Yes manual processing is done, sorting grading	Yes some sorting and grading is done manually
c.	How do you manage the processing waste? What do you do to reduce waste and left over of processing?	Processing waste is used for making compost etc	Waste is used as fodder or in making compost	Waste is used as fodder or in making compost	Processing waste is some times converted in fodder or utilized for making compost	How do you manage the processing waste? What do you do to reduce waste and left over of processing?	We use it as fodder and as compost	Processing waste is some times converted in fodder or utilized for making compost.

d.	Do you use any eco friendly method for processing?	Manual Processing	Manual Processing	Manual Processing	Manually some times no eco friendly methods	Do you use any eco friendly method for processing?	Yes we use manual processing	Manually some times no eco friendly methods
e.	How do you manage you operating cost of processing?	Operating cost is being managed on our own, help is provided by WMD in Processing	We manage it on our own	We manage it on our own	In season we hire one person, for doing some processing job if the tourist season is good cost is managed automatically	How do you manage you operating cost of processing?	manage on our own	Operating cost is being managed on our own, help is provided by WMD in Processing
f.	Do you get any training for food processing and preservation?	Yes	Yes we get training	Yes we get training	Yes many trainings were given in phase 1, some in phase 2 as well	Do you get any training for food processing and preservation?	Yes initially jam squas h making	some training were given
g.	What activities can be done apart from processing in a cluster?	Banking facility can be given from cluster, rural training and entrepreneurship, CSC like facility can be made in the in the unit, The cluster can be used for developing new and extinct varieties of agri produce	Agriculture Products Sale and, Sale of inputs at low cost can be sold	Yes, It can be made as a hub for all nearby villages to sell their produce and if they want to get something to be processed we are their to help them in this.	Developin g new varieties of crops, reviving extinct crops	What activities can be done apart from processing in a cluster?	seed production, animal rearin g	Banking facility can be given from cluster, rural training and entrepreneurship, CSC like facility can be made in the in the unit, The cluster can be used for developing new and extinct varieties of agri produce.
h.	Can a processing plant can be made to run on renewable source/ solar power etc.	Don't Know	Don't know	Don't know	We have not tried, machine requires a lot of power that solar panel operated machines	Can a processing plant can be made to run on renewable source/ solar power etc.	no idea	We have not tried, machine requires a lot of power that solar panel operated machines cannot function

					cannot function			
Q.4	What is the issue related to Transportation?	If vehicle is available then the produce is sent fastly in the market	Transport is not easily accessible	The cargo is more then we hire a vehicle from the village otherwise vehicle going from here can pick up out cagro and move	Charges of vehicle are high, we planned to get one vehicle for the fedration for our operation but was not approved	What is the issue related to Transportation?	not easily available for farmers from upper hilly region	Charges of vehicle are high, we planned to get one vehicle for the fedration for our operation but was not approved. If vehicle is available then the produce is sent faster in the market
a.	What are the issues related to inbound transportation?	No issues	No issues	No Issues	no	What are the issues related to inbound transportation?	No issues	Easy accessibility from farms to mandi
b.	What are issues related to vehicle availability ?	Vehicle is available in time for transportation many times it is arranged from other village	We have manage it on our own	Vehicle is available in time for transportation many times it is arranged from other village	vehicle is easily available or vehicles going to city pick up	What are issues related to vehicle availability ?	vehicle is available but charges are high	At Some places the Vehicle is available at some places the vehicle is not available
c.	Transportation cost is managed by managed by whom?	Transportation cost is being managed by us, it is being paid by organization only	We have manage it on our own	Transportation cost is being managed by us, it is being paid by organization only	we manage all the transportation cost, if any farmer is bringing he manages on its own	Transportation cost is managed by managed by whom?	We oursel ves manage the cost	Transportation cost is being managed by us, it is being paid by organization only and the farmers bringing the crops to the unit handles its cost
d.	Are there any alternate mode of transportation/ eco friendly/	no	No Idea	No idea	No	Are there any alternate mode of transportation/ eco friendly/	No Idea	No idea

e.	Is there any reduction in food loss due to cluster development as less fresh produce and more processed?	Yes, now the production has also increased, we are now growing new varieties and the produce that was being lost due to mis handling is now being processed or being sold at better prices in market	Yes now are able to sell our crops in the market with the tie ups	Yes, now the production has also increased, we are now growing new varieties and the produce that was being lost due to mis handling is now being processed or being sold at better prices in market	Yes we have grown some extinct variety of crops	Is there any reduction in food loss due to cluster development as less fresh produce and more processed?	Yes now even lesser produce has a market, we are also increasing the cropping area and increased the number of crops	Yes, now the production has also increased, we are now growing new varieties and the produce that was being lost due to mis handling is now being processed or being sold at better prices in market
f.	What are the issues related to outbound transportation?	No issues	No Issues	Vehicle availability	No issues	What are the issues related to outbound transportation?	Vehicle availability	No issues some times vehicle is not available and the cost is high
g.	Is there any damage in transit outbound? How do you try to reduce it.	From WMD we have got the crates and corrugated packaging material for keeping all the produce so there is less in damage.	Yes some times earlier we had as we didn't had crates etc	The crates are useful in providing support to the system	Crates are given by gramya loss is less	Is there any damage in transit outbound? How do you try to reduce it.	Yes some time due to roads	From WMD we have got the crates and corrugated packaging material for keeping all the produce so there is less in damage.
h.	What is the ease of availability of vehicle for outbound transportation	Vehicle is available in time for transportation many times it is arranged from other village	We have manage it on our own	Vehicle is available in time for transportation many times it is arranged from other village. Farmers have to manage	vehicle is easily available or vehicles going to city pick up	What is the ease of availability of vehicle for outbound transportation	Yes easily available but cost is high	Vehicle is available in time for transportation many times it is arranged from other village or vehicle going to city picks up

i.	What is amount of transportati on cost as compared to product cost and what od you do to reduce it.	Cant say, we are collaborating with many farmers to get do collective farming and sell that by collecting crops and transporting it in bulk	Can't Say	Cant say, we are collaborating with many farmers to get do collective farming and sell that by collecting crops and transporting it in bulk	No idea, depends on products	What is amount of transportati on cost as compared to product cost and what od you do to reduce it.	no idea but it is high	Cant say, we are collaborating with many farmers to get do collective farming and sell that by collecting crops and transporting it in bulk
j.	Is there any alternate method to use transportati on	No	Don't Know	No Idea	no	Is there any alternate method to use transportati on	No idea	No Idea
							Farm er Mem ber	
Q5.	What are the issues and challenges related to warehousin g?	As of now no issues	We don't have the warehouse	Now we are developing the cold storage with the help of government	Space and size, we plan to build but the cost of land is very high	What are the issues and challenges related to warehousin g?	we don't havet he wareh ouse	Space and size, we plan to build but the cost of land is very high
a.	What type space is for raw material warehouse?	Yes, 10*10	Raw material warehouse is	Yes, 10*10	is but is very small, it used for keeping food grains, raw spices and fruits and veg in season	What type space is for raw material warehouse?	We store in our house	Yes only 10*10. Space is there but is but is very small, it used for keeping food grains, raw spices and fruits and veg in season
b.	Do you have/require raw material warehouse?	Yes If we can have a warehouse we can purchase produce in bulk and store, bring more produce from nearby villages	We don't have that much produce yes but if production increases at least some place should be there near village to store our products	Yes If we can have a warehouse we can purchase produce in bulk and store, bring more produce from nearby villages	Yes	Do you have/require raw material warehouse?	No we don't have that much requirement	Yes If we can have a warehouse we can purchase produce in bulk and store, bring more produce from nearby villages

c.	How the raw material and finished product is stored and who bears the cost of storage?	Products are stored in our unit, he handle the cost of storage.	We store some produce in our homes	Products are stored in our unit, he handle the cost of storage.	We handle the cost of warehousing	How the raw material and finished product is stored and who bears the cost of storage?	We have to bear the cost of storage	Products are stored in our unit, he handle the cost of storage.
d.	What measures you are doing to reduce warehousing cost? What can be solutions for reducing warehousing cost/	We are developing a cold storage with WMD and ABSO people the we will manage it on our own and its cost will be managed with the help of the funds received from sale of products of Unit.	Nothing as of now	We are developing a cold storage with WMD and ABSO people the we will manage it on our own and its cost will be managed with the help of the funds received from sale of products of Unit.	A of now we are keeping everything in own houses in a separate room	What measures you are doing to reduce warehousing cost? What can be solutions for reducing warehousing cost/	Processing and packing and selling directly	We are developing a cold storage with WMD and ABSO people the we will manage it on our own and its cost will be managed with the help of the funds received from sale of products of Unit. In phase one there was no such provision so we have used separate rooms in our houses
e.	How do you get any training for and agriculture warehousing?	Yes we get training for a lot of things, yes we were informed about how to manage the cold store	No training	Not much training	No	How do you get any training for and agriculture warehousing?	No training	Yes we get training for a lot of things, yes we were informed about how to manage the cold store
f.	What methods are you using to reduce the warehousing cost?	Nothing as of now	Nothing as of now	Nothing as of now	As of now nothing	What methods are you using to reduce the warehousing cost?	No Idea	As of now nothing

Q6.	What are the issues related to procurement of product?	Many a times we know that the produce is there if we have some amount we can purchase that in bulk.	We need to buy inputs for the next cycle of production if we are able to get seeds etc in time that would help. The right quantity and quality of seeds are required.	Many a times we know that the produce is there if we have some amount we can purchase that in bulk.	Availability of circulating fund, bank limit should be there to procure in bulk in time of high demand as we know the market with our experience	What are the issues related to procurement of product?	Funds	Many a times we know that the produce is there if we have some amount we can purchase that in bulk. Availability of circulating fund, bank limit should be there to procure in bulk in time of high demand as we know the market with our experience
a.	What is the amount of procurement cost of Raw material in total cost?	Total cost of procurement can be reduce by bulk procurement and initial contract or mutual agreement for purchasing all the produce plus giving most of amount early as possible and involving famers by further giving good quality seeds etc	Don't know but it is high as we are not able to get quality seeds at this price in project we are getting some seeds at low cost	Total cost of procurement can be reduce by bulk procurement and initial contract or mutual agreement for purchasing all the produce plus giving most of amount early as possible and involving famers by further giving good quality seeds etc	Major cost if cost of procurement, it is high	What is the amount of procurement cost of Raw material in total cost?	No Idea	Total cost of procurement can be reduce by bulk procurement and initial contract or mutual agreement for purchasing all the produce plus giving most of amount early as possible and involving famers by further giving good quality seeds etc.
b.	What measures are you taking to reduce the raw material cost?	Yes if we give seeds and give assurance to farmers to purchase all his produce we can be get some material in lower cost	As of Now nothing		We are collaborating with farmers in nearby villages motivating them to join us and give produce	What measures are you taking to reduce the raw material cost?	Go to govt departments to get inputs like horticulture etc.	Yes if we give seeds and give assurance to farmers to purchase all his produce we can be get some material in lower cost. We are collaborating

								with farmers in nearby villages motivating them to join us and give produce
c.	What is the procedure to procure raw material?	We have made farmers as members of the organisation by charging registration amount, then as the seeds come to us we distribute it to respective farmer as per their demand and our availability, then we deposite the amount	We just look for low cost who so ever gives us at less cost we procure from them	We are planning to make procurement smooth by registering farmers with us then as the seeds come to us we distribute it to respective farmer as per their demand and our availability, then we deposite the amount we ask farmers to sell to us	Raw Material is procured direct by us from farmers and sold in nearby market like haldwani	What is the procedure to procure raw material?	To purchase raw material we have to go to market or wait for government supplies	We have made farmers as members of the organisation by charging registration amount, then as the seeds come to us we distribute it to respective farmer as per their demand and our availability, then we deposite the amount Raw Material is procured direct by us from farmers and sold in nearby market like haldwani
d.	What is the procedure to procure machinery and tools for processing?	We are being given all the machinery by WMD	We ask ABSO Govt etc they do the procurement we don't need much machinery	We are being given all the machinery by WMD	We look for machines and for government support	What is the procedure to procure machinery and tools for processing?	No Idea	We are being given all the machinery by WMD. We look for machines and for government support, in phase one some machinery were provided

e.	How do you handle the operating cost of the company?	Currently the operating cost is being handled by us and all the produce that we have sold we are getting the products on is helping us to sustain the business and the profits that we are earning is being transferred in federation's account that will be used after the gramya will go	We manage our production all the cost related to it is being handled by us	Currently the operating cost is being handled by us and all the produce that we have sold we are getting the products on is helping us to sustain the business and the profits that we are earning is being transferred in federation's account that will be used after the gramya will go	We handle all the operating cost, remaining amount is being in saved in the account of federation	How do you handle the operating cost of the company?	we have to manage on our own	Currently the operating cost is being handled by us and all the produce that we have sold we are getting the products on is helping us to sustain the business and the profits that we are earning is being transferred in federation's account that will be used after the gramya will go. We handle all the operating cost, remaining amount is being in saved in the account of federation
f.	What is ease of availability of raw materials for processing?	We get RM for processing easily from nearby villages	Yes we ask farmers nearby also to give some material to us	We get RM for processing easily from nearby villages	Raw material is now easily available	What is ease of availability of raw materials for processing?	We have to look for farmers who can supply in time, otherwise for some item we have to go to nearby market	We get RM for processing easily from nearby villages. We are also growing produce and utilizing land that was left barren.

g.	What are the methods that can be taken to reduce paper work in procurement? Go green initiative?	Currently we are maintaining the record in registers we are not competent in computers we hire some people to do the computer entry work for us. Then paper will be reduced	No Idea	Currently we are maintaining the record in registers we are not competent in computers we hire some people to do the computer entry work for us. Then paper will be reduced	We don't know computer and how to operate as of now we do it manually, purchasing and operating a computer is also expensive	What are the methods that can be taken to reduce paper work in procurement? Go green initiative?	No Idea	Currently we are maintaining the record in registers we are not competent in computers we hire some people to do the computer entry work for us. Then paper work will be reduced. We don't know computer and how to operate as of now we do it manually, purchasing and operating a computer is also expensive
Q6.	How do you sell your product?	currently we are selling it in Kapkot, bageshwar we have tied up with some sellers	We either sell to Unit or sell in nearby Market or wait for the vehicle to pickup our produce while going to mandi	Yes we are currently we are selling it in Kapkot, bageshwar we have tied up with some sellers	From retail shop the products are sold, some people at block level also take from shops, some	How do you sell your product?	We go mandi, market or give our produce to Unit to sell	Currently we are selling it in Kapkot, bageshwar we have tied up with some sellers. From retail shop the products are sold, some people at block level also take from shops, some
a.	How do you manage your sales records?	Currently we are maintaining the record in registers we are not competent in computers we hire some people to do the computer entry work for us	we don't maintain much detailed record but the Unit people manage the records	Currently we are maintaining the record in registers we are not competent in computers we hire some people to do the computer entry work for us	The receipts and lists are created and payment is made accordingly, no use of computer or computer	How do you manage your sales records?	On register	Currently we are maintaining the record in registers we are not competent in computers we hire some people to do the computer entry work for us.

					based technology			Manual receipts and lists are created and payment is made accordingly, no use of computer or computer based technology
b.	What are the new ways that be used to increase sales?	If farmers are motivated for collective farming and all the produce will be sold in nearby fares and if the produce is sold in mandis like, haldwani and New Delhi it will get us good prices	more farmer collaboration to get better price	If farmers are motivated for collective farming and all the produce will be sold in nearby fares and if the produce is sold in mandis like, haldwani and New Delhi it will get us good prices	We are going to local fares and fest and are also tying up with other retailers	What are the new ways that be used to increase sales?	identifying new markets	If farmers are motivated for collective farming and all the produce will be sold in nearby fares and if the produce is sold in mandis like, haldwani and New Delhi it will get us good prices. Collaboration with other nearby retailers should be
c.	What about selling these products online?	we have no idea, if we get some tie up for selling the produce we will try to provide but sometimes it is difficult to provide material on time so we should be given some timeframe	No idea	we have no idea, if we get some tie up for selling the produce we will try to provide but sometimes it is difficult to provide material on time so we should be given some timeframe	No	What about selling these products online?	Farm er Mem ber	we have no idea, if we get some tie up for selling the produce we will try to provide but sometimes it is difficult to provide material on time so we should be given some timeframe

Q7.	What are the infrastructure related issues for procuring/manufacturing and storage of the products?	As of now no issues, once we are ready with our cold store, more motivation to farmers from other villages is required.	No issues	As of now no issues, once we are ready with our cold store, more motivation to farmers from other villages is required.	Registration charges is 50 INR which all the farmers who are joined have to pay 1 time. Then they bring all their produce at one place. List is given and date wise payment is done.	What are the infrastructure related issues for procuring/manufacturing and storage of the products?	We don't have manufacturing setup, neither the storage...	As of now no issues, once we are ready with our cold store, more motivation to farmers from other villages is required. Registration charges is 50 INR which all the farmers who are joined have to pay 1 time. Then they bring all their produce at one place. List is given and date wise payment is done.
a.	What is the issue related to hard infrastructure?	No issues	No issues	No Issues	Cost of land is high, even the rent is very high. Cost of shop for rent is more than 10 thousand	What is the issue related to hard infrastructure?	No issues, sometimes roads in rains get damaged roads are blocked	Cost of land is high, even the rent is very high. Cost of shop for rent is more than 10 thousand
b.	What are the issues related to soft infrastructure?	No issues	No issues	No Issues	Nothing	What are the issues related to soft infrastructure?	No Issues	No issues
Q8.	What are the policy/procedure related to cluster development?	After some time a collaboration with all govt department, plus some social development work.	Government officials need to come and monitor the progress and work on issues and	After some time a collaboration with all govt department, plus some social development work.	Collaborate and motivate farmers and with government help do all the processes	What are the policy/procedure related to cluster development?	policy making should involve farmers and	After some time a collaboration with all govt department, plus some social development work.

			challenges with us				villagers also	
a.	How this cluster has helped the people living here as economically more effective?	Yes even 2 kg crop has market	our crops now can be sold at the unit, even lesser produce now has a market	Yes even 2 kg crop has market. Earlier the land which was kept barren, now the farmers are interested in doing agriculture on that as well	Earlier the people were growing less spices etc because the sale of those by going to market was difficult, but now the farmers can come to federation and can sell the produce. Plus the rate here are fixed and there was distress sale at mandi	How this cluster has helped the people living here as economically more effective?	Cluster has helped the farmers grow cash crops, organic farming	Yes even 2 kg crop has market, small farmers are also getting benefitted. Earlier the people were growing less spices etc because the sale of those by going to market was difficult, but now the farmers can come to federation and can sell the produce. Plus the rate here are fixed and there was distress sale at mandi
b.	How this cluster has helped the people living here as Socially more effective?	Cultivation through collaboration because of intervention has been increase.	We are now discussion agricultural practices, we are getting trainings, we are getting inputs all due to this cluster based agri	Cultivation through collaboration because of intervention has been increase.	Yes, people from outside villages also come in contact and call us for training and for taking there produce for sale and processing	How this cluster has helped the people living here as Socially more effective?	People are now more connected, they call and ask for produce, learn new agriculture practices	Cultivation through collaboration because of intervention has been increase. Yes, people from outside villages also come in contact and call us for training and for taking there produce for sale and processing

c.	How this cluster has helped the people living here as environmentally more effective?	Yes there is keeping village in organic farming plus reduced cutting of trees	In the cluster the farmers are now planting trees orchards, doing organic farming	Organic farming, less cutting of trees	Earlier the farmers kept there land barren but now they are working in there fields	How this cluster has helped the people living here as environmentally more effective?	Farmers are now moving towards organic farming, developing seeds and orchards, developing compost	Yes there is keeping village in organic farming plus reduced cutting of trees. Earlier the farmers kept there land barren but now they are working in there fields
d.	How the cluster can be made more sustainable and more beneficial to reduce migration?	Yes a lot of people are planning to come back seeing this intervention, 11000 bulb of liliun have been planted but now there is a target is of 45000	Better Quality input, proper monitoring and year round support can help this initiative to bring back more people if this is profitable	Yes a lot of people are planning to come back seeing this intervention, 11000 bulb of liliun have been planted but now there is a target is of 45000	Education and health are major causes of migration, if these are addressed there will be less migration	How the cluster can be made more sustainable and more beneficial to reduce migration?	If some collaboration, monitoring and support is done after completion of the project	Yes a lot of people are planning to come back seeing this intervention, 11000 bulb of liliun have been planted but now there is a target is of 45000. Education and health are major causes of migration, if these are addressed there will be less migration

RESEARCH PUBLICATIONS

JOURNAL

- Paper Titled "Developing a Sustainable Supply Chain for Climate Change-Resilient Agriculture in Uttarakhand State of India" in press, International Journal of Social Ecology and Sustainable Development, Scopus indexed, IGI Global Publication, 2021
- Paper titled "Sustainable Packaging" in Fresh Food Supply Chain: Case of Kiwi Fruit Supply Chain in Uttarakhand" article in press in International Journal of Business Excellence, Scopus Indexed, Inderscience Publications, 2021
- Paper titled "Role of Big Data Analytics and the Internet of Things (IoT) in Indian Agricultural Supply Chain" article in press in International Journal of Business Information Systems, Scopus, ABDC, Inderscience Publications, 2021
- Paper Titled "Factors that impact Quality during the Transportation of Tomatoes: Evidence from India" published in Research Anthology on Food Waste Reduction and Alternative Diets for Food, IGI Global, Index in UGC in 2021
- Paper Titled "Factors impacting the quality of fresh produce in transportation and their mitigation strategies: empirical evidence from a developing economy" published in Journal of Agribusiness in Developing and Emerging Economies , Emerald Publishing, indexed in Scopus, ABDC, Web of Science. 2021
- Paper titled "Creating Sustainable Agriculture Supply Chain Ecosystem for Remunerative Markets Under Changing Climate in Uttarakhand" International Journal of Social Ecology and Sustainable Development, IGI Global Publications, Indexed in Scopus; Volume 12 Issue 4, 2021
- Paper Titled "Impact of COVID-19 on agriculture supply chain in India and the proposed solutions" in International Journal of Sustainable Agricultural Management and Informatics, Inderscience publishing, Indexed in Scopus, 2020
- Paper Titled "Role of food safety and quality in Indian food supply chain" published in international journal of logistics economics and globalization, Inderscience Publishing, ABDC "C" UGC, 2019
- Paper Titled "ERP solution for effective supply chain of micro, small and medium-sized enterprises: a case study of customized ERP solution development and deployment for MSMEs in the state of Haryana International Journal of Business Innovation and Research Volume 17 (4), Indexed in Scopus, Web of Science, ABDC, 2018

- Paper on E-waste management titled “Integrating Facilities of Recycling and Collection of E-waste” published in Electronics Industry Association of India (ELCINA) Journal, Vol 17, Issue 3, May-June 2014.

CONFERENCES

- Paper Titled “Developing a business model canvas for agriculture cluster-based food processing in rural regions of Uttarakhand” at International Conference, SUSCON - 2021, IIM Shillong
- Paper Titled “Developing a business sustainability solution for Agri-food Supply chain in Uttarakhand” at International Conference AGBA – 2019, IIT Delhi, India
- Paper Titled “Creating a climate resilient Agri-supply chain for Uttarakhand”, Presented at FRI, Dehradun in 2018
- Paper titled “Creating a sustainable supply chain for Agribusiness in Uttarakhand” at DOON University, Uttarakhand in 2019
- Paper Titled “Impact of Covid-19 On Fresh Food Supply Chain in India and The Proposed Solutions”, CIBMIT - 2020 Amity University
- Paper Titled Paper titled “Creating a Supply Chain for Agriculture and Rural Development in Uttarakhand” received best paper award at sustainability conference at IMT Nagpur, 2018, IMT Nagpur

AWARDS & ACHIEVEMENTS

- Received Best Paper Award for Paper titled “Creating a Supply Chain for Agriculture and Rural Development in Uttarakhand” at IMT Nagpur, 2018
- Received Best Paper Award for Paper titled “Developing a Business Sustainability Model for Agriculture Supply Chain in Uttarakhand” at IMT Nagpur, 2019

PROJECTS

- Project Title: Analysis of Economic Survey – Government of Uttarakhand
- Funding Agency: Department of Planning-Government of Uttarakhand
- Amount: 3 Lakh
- Duration: December 2018 – December 2019
- Project Title: Developing a Business Sustainability Model for Agriculture Cluster Based Food Processing Units in Uttarakhand
- Funding Agency: University of Petroleum & Energy Studies, Dehradun,
- Amount: 1 Lakh
- Duration: May 2020 – June 2021

BRIEF PROFILE

QUALIFICATION:

- Pursuing Ph.D. at School of Business, UPES, Dehradun – India
- Post Graduate Diploma in Multimodal Transportation and Containerization, Institute of Rail Transport, New Delhi - India.
- Master of Business Administration (Logistics & Supply Chain Management) from UPES, Dehradun - India
- Bachelor of Science (Information Technology) from H.N.B. Garhwal Central University, Uttarakhand - India

WORK EXPERIENCE:

- ‘Assistant Professor at Centre for Continuing Education, UPES Dehradun, Dehradun from March 2016 to March 2023.
- Assistant Manager -Training at Safeducate Learnings Private Limited (Sister Concern of - Safexpress Private Limited), New Delhi, August 2015- March 2016
- Senior Executive at CSC E-Governance Services India Limited, August 2014 to August 2015
- Digital India Corporation, Management Trainee-Research, Duration, August 2013 to 2014
- Research Analyst at Center for Transportation and Logistics, New Delhi, Duration: July 2012 to August 2013