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Supply chain linkages and constraints of mulberry silk sector in major sericulture clusters of Karnataka

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Abstract: Mulberry silk is a natural silk produced by the silkworm *Bombyx mori* L. by consumption of the only mulberry host plant Morus spp., *Moraceae*. Mulberry silk is the major producing silk in Karnataka and has huge demand in textile and industries. Karnataka is the leading silk producer accounting of 31 per cent of mulberry silk production in India. The paper is focused on the supply chain linkages and constraints in production and marketing of mulberry silk and silk products. A sample size of 60 of each mulberry cocoon producers, silk reelers and silk weavers were selected by multistage sample sampling and snowball technique were used for the study. The supply chain linkages were continues from production to marketing of mulberry silk. The backward linkage consists of production of mulberry leaves, cocoons and the silk as the same the forward linkage consists of value addition to silk by throwing, dyeing and weaving. Major production problem in mulberry silk were lack of skilled labour, good quality of reeling water and in mulberry silk product were unavailability of good quality silk, rise of price of silk yarn and lack of skilled labours. Major marketing problems in mulberry silk were price fluctuation, lack of regulated or organized market structure and in mulberry silk product were lack of regulated or organized market structure and middleman problems. It is fact that every silk sector has a value added chain from silk worm eggs to fabrics. In this paper an attempt has been made to study every activity in the value chain and the constraints that are being encountered in production and marketing of mulberry silk and their products.

Keywords: Mulberry silk, Cocoon producers, Silk reelers, Silk weavers, Supply chain, Linkages.

I. INTRODUCTION

Sericulture is an agro-based industry, the term which denotes production of silk through silkworm rearing. Sericulture is a labour intensive agro industry which ideally generates employment and improves the economic standards. It is estimated that one acre of mulberry garden with its allied sericulture activates can provided employment to a large number of people. Sericulture provides frequent returns throughout the year with relatively less expenditure. Silk is a natural silk, which is made up of proteins (sericin and fibroin) released in a fluid state by a caterpillar popularly referred a “silkworm”. These silkworms consume a variety of plant leafs and spin cocoons, which act as a ‘protective shell’ to help them to pupate and form cocoon. The silkworm’s life cycle includes four stages: egg, caterpillar, pupa, and moth. Humans intervene with this life cycle in order to obtain silk, a continuous filament and used in production of silk fabrics which has high demand in market. People who have dealt with silk are often charmed with the exquisite appearance, elegance, comfort and durability of silk products. Silk, popularly known as the “Queen of Textiles”, is a lustrous fibre of incomparable grandeur. It possesses unique

characteristics such as a natural sheen, a natural propensity for dyes and vibrant colours, excellent absorbency, light weight, resilience, and a breathtakingly appearance, all of these properties drive people insane. Mulberry, Tasar, Eri, and Muga are the four types of silk that are commercially produced across the world. India is the only country in the world that produces all four types of silk. The focus of this research paper is exclusively on Karnataka's mulberry silk industry. From silkworm eggs to fabrics, every silk enterprise has a value added chain as every activity in this chain has its own significance, and performing each one requires technical knowledge. The supply chain's many activities are spread across the state as mulberry cultivation, cocoon production, silk reeling, spinning, dying, and silk weaving. All of the actions are interdependent on one another. However, certain middlemen or traders establish the link between the chain as players. The objective of the paper is to know the backward and forward linkages in mulberry silk and constraints in production and marketing of mulberry silk and silk products.

II. RESEARCH METHODOLOGY

The study was conducted in Chikkaballapur, Ramanagara and Mandya districts which had immense potential in production and marketing of mulberry cocoons in Karnataka. The study was based on primary data, collected by personal interview through structured survey. Multistage sampling procedure was adopted for sample selection. The study was conducted in Shidlagatta and Chintamani taluks of Chikkaballapur district, Ramanagara and Kanakapura taluks of Ramanagara district and Krishnarajapete and Nagamangala taluks of the Mandya district were selected based on the highest area and production of mulberry, cocoon and silk across the sericulture clusters of traditional districts. The sample size of 60 as each of silk reelers and silk weavers from each district was collected using pre-tested and well-structured schedule. Snowball technique was adopted for selection of sample respondents. Garrett's ranking technique was employed to identify the constraints in the production and marketing sector. The objective of the paper has two sections; first section discusses supply chain links in the mulberry silk industry, while the second section discusses constraints in the production and marketing of silk and silk products in Karnataka.

III. RESULTS AND DISCUSSION

3.1 Supply chain linkages in mulberry silk sector of Karnataka

The bulk of the commercial silk produced in Karnataka comes from mulberry silk. Sericulture is a combination of both art and science of producing the mulberry silk. Sericulture is the production of silk by rearing of silkworms. Mulberry silk comes from the silkworm, *Bombyx mori* L., which solely feeds on the leaves of mulberry (Morus spp., *Moraceae*) and produce mulberry silk.

3.1.1 Backward linkages of mulberry silk

The mulberry silk is obtained through the process of mulberry leaves cultivation, cocoon production and extraction of silk from cocoon. Cultivation of mulberry and production of mulberry leaf is known as Moriculture. Mulberry is the only host plant for the production of mulberry silk and it's grown under varied climatic conditions ranging from temperate to tropical. It is a major economic component in sericulture since it directly attains on quality and quantity of cocoons. Mulberry varieties such as Victory-1, Kanva-1, Kanva-2, S-36, S-34, RFS-135 and RFS-175 are the leading varieties. In backward linkages, one who cultivates and produces mulberry leaf is known as sericulture farmer. For production of mulberry leaf, mulberry saplings were brought from nursery, where proper care is taken for the growth of saplings as initial care results in high yield and quality mulberry leave which implies for quality cocoon production. Others such as irrigation to plants in the form of drip irrigation is very much suitable, growth regulators, plant protection to safeguard the mulberry leaves from pests and diseases and the farm yard manure were required as the inputs in the process of mulberry cultivation. The output obtained, mulberry leaf or shoots were pruned and transported to rearing house for cocoon production (Figure 1).

The silkworm breed used for rearing is *Bombyx mori* L. At first, the female silk moth lays hundreds of eggs and these are stored over a clean paper or piece of cloth. The eggs are kept under the

accurate temperature of 24ºC to 28ºC and humidity at 60 to 80 per cent until hatching. After this process fresh tender mulberry leaves are feed to newly hatched silkworms, popularly known as 'ants'. The larva eats this mulberry leaves day and night and it grows to caterpillar or silkworm. Rearing trays are used to keep these silkworms and freshly chopped mulberry leaves are feed to silkworms. Approximately after 25-30 days, silkworms will stop eating the leaves and then it is transferred to chandrike or mountages for spinning. Then the cocoons are used for production of silk as well as for eggs. In backward linkages, one who rearers silkworm and produces cocoons is known as rearer. The primary input for production of mulberry cocoons is the silkworm eggs (disease free laying's) and chawki silkworms, they were brought from grainages and chawki rearing centers, respectively. Addition to it rearing house and equipments such as sprayers, heater, trays, ant wells, bed cleaning nets, plastic basins and buckets, rearing racks and mountages (chandrike), disinfectants such as bleaching powder, sanitech, decol, slaked lime, astra, vejetha were used, silkworm pest protection and mountages or chandrike were required in the process of mulberry cocoon production. The outputs such as, the by-product rearing waste was transported to manure and the main product mulberry cocoons was transported to cocoon markets (Figure 1).

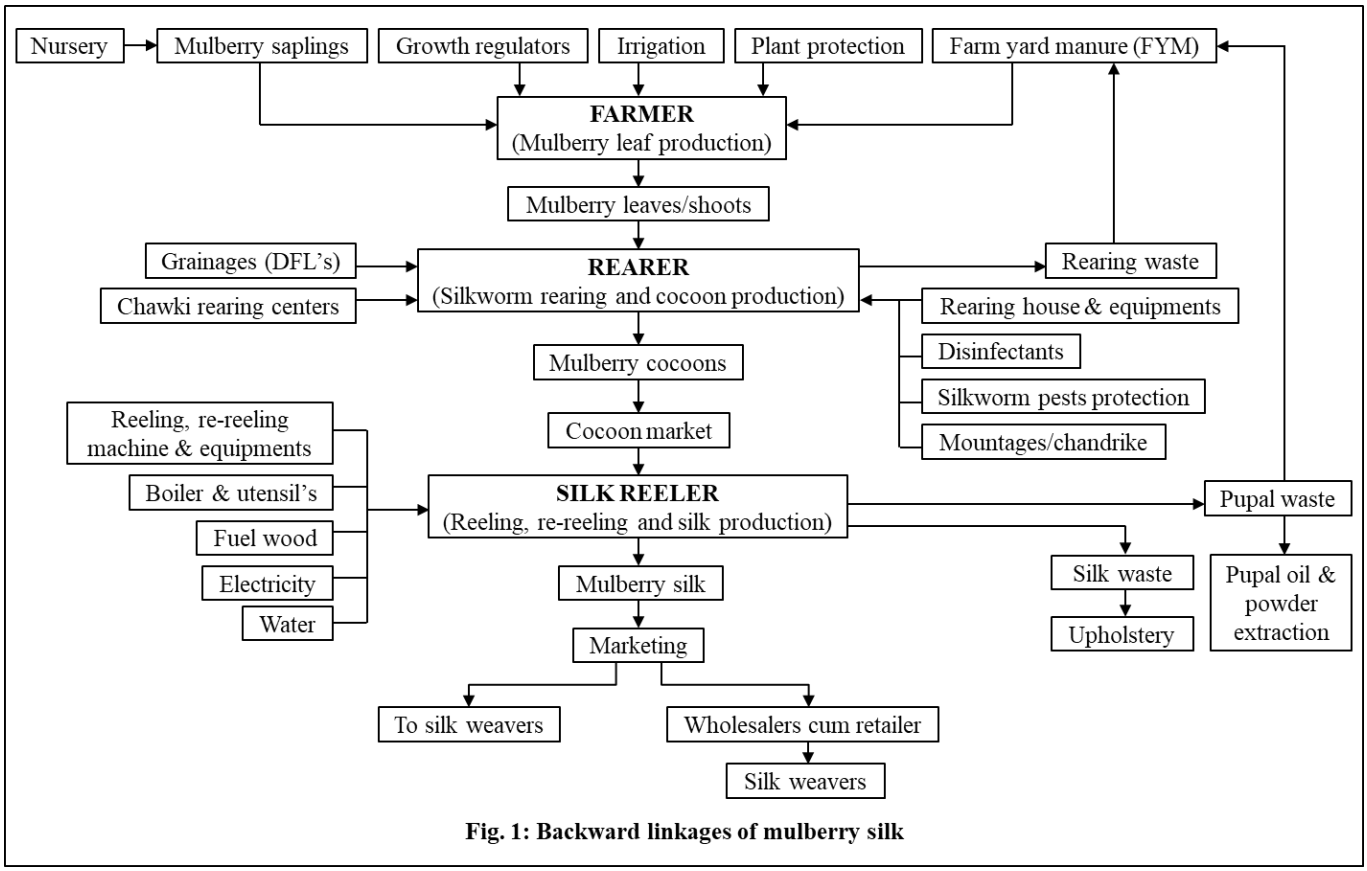

Fig. 1: Backward linkages of mulberry silk

Silk reeling is the process by which a number of cocoon baves (silkworm filament) are reeled together to produce a single yarn. This is achieved by unwinding filaments collectively from a group of cooked cocoons at one end in a warm water bath and winding the resultant thread onto a fast moving reel, it is known as silk reeling. The reeled silk if formed into different size of skeins (small bundles of raw silk). In backward linkages, one who reels the mulberry silk is called as silk reeler. The raw material for silk production was bought from cocoon market to produce raw mulberry silk yarn. Additional things such as multi-end reeling machine is used for reeling, equipment's such as boiler and utensils, fuel wood for steam production, electricity and water were required for extraction of silk filament from cocoons. The outputs obtained were, silk waste, it's sent in making upholstery and pupa waste was sent into oil or powder extraction and also for manure. The main product raw mulberry silk, it was marketed through wholesalers cum retailers and also sold directly to silk weavers (Figure 1).

3.1.2 Forward linkages of mulberry silk production

The forward linkage is the processes of value addition to mulberry silk, which contains the activity of silk throwing, dyeing, and weaving. Silk throwing is the process where silk skeins, it's cleaned, doubled, twisted and the yarn is wound onto bobbins and preparation of weft and warp as requested by silk weaver. Silk dyeing is the process of application of dyes or pigments on silk yarn with the goal of achieving colour with desired colour fastness. Silk weaving is a process of creation of silk fabric. Silk fabric is created by interlacing the warp yarns (length-wise) and the weft yarns (width-wise). Weaving is carried out on looms as it is done by using either handlooms or powerlooms. For production of silk fabric, raw mulberry silk was obtained from silk reelers or through wholesalers cum retailers. In forward linkages, one who converts the raw silk to yarn is known as twister and the activity is called as throwing, twister involves the process of winding, doubling and twisting of silk yarn and making into silk yarn bobbins, waft and warp. The obtained mulberry silk is sent for dyeing and the throwing waste is used in making of upholstery. The one who dye the silk is known as dyer. The dyer colours the mulberry silk as requested by the silk weaver, he adds the pigmentation by degumming (removal of sercine) and bleaching of silk, with addition to do this requires dyes or pigments, utensil's, fuel wood and water. The one who prepares the silk fabric is known as silk weaver. The dyed mulberry silk is weaved by the silk weaver by using loom, equipment's, electricity to produce silk fabric or grey fabric. The produced silk fabric was marketed through silk weaver, wholesalers and retailers to the customer (Figure 2).

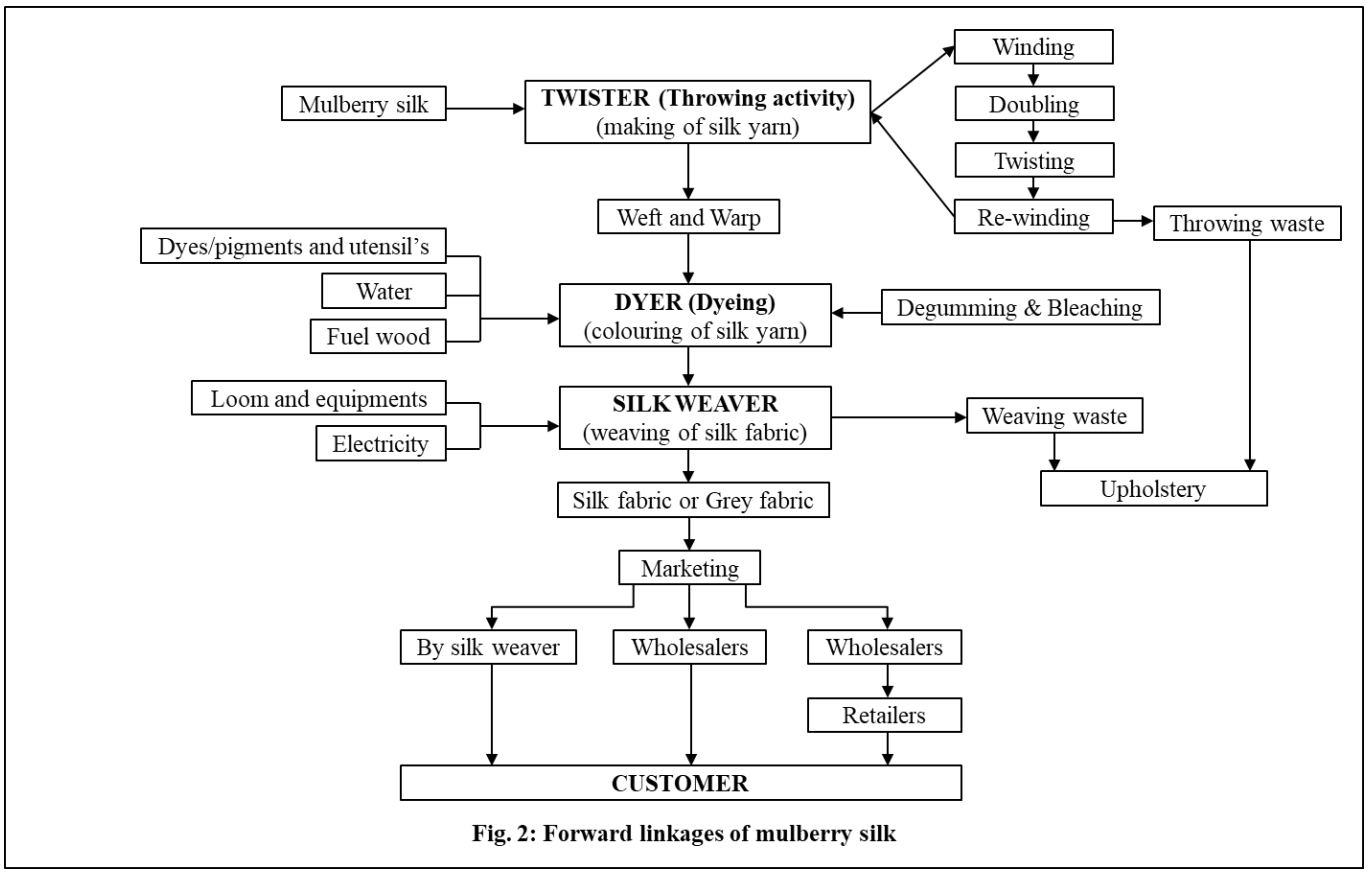

Fig. 2: Forward linkages of mulberry silk

3.2 Constraints faced in mulberry silk and silk products

3.2.1 Constraints faced in mulberry silk

Mulberry silk production is one of the most essential activities in the silk industry's supply chain. The silk reelers are the producers of mulberry silk yarn. The study found that, some of the silk reelers produce silk yarn independently on their own as a venture and some of them produce yarn on behalf of either the silk weavers or the traders. However, following constraints are related to production and marketing of mulberry silk.

3.2.1.1 Production constraints

Lack of skilled labour was the major constraint in mulberry silk production. Another constraint was good quality of reeling water to obtain silk from cocoons, as water is the base for unwinding of silk filament from the cocoons and cooking of the cocoons. Unavailability of good quality of mulberry cocoons was one of the important constraints due to lack of quality diseases free layings. Other major problem was unavailability and high cost of reeling equipment's. Due to low income in the family, most of the respondents were unable to purchase the required equipment's and to avail equipment assistance from the state government. However, there are other constraints related to stable prices for finance and discontinues supply of electricity (Table 1).

3.2.1.2 Marketing constraints

Fluctuation in the pieces was the main constraint of silk reelers. This could be due to quality, quantity and demand of the silk in the market. Lack of regulated or organized market structure was also major constrain. The reasons behind this constraint were mainly due to the scattered production in the state, less Government intervention in setting up of proper market structure of good quality cocoon. Also there was less availability of good quality cocoon throughout the season. Non availability of market information was also important constraint in marketing. This could be due to the absence of lack of regulated or no organized market structure for selling of mulberry silk. The other constraints were delayed payments, inadequate storage facility, less demand in market due to quality standards and less support for export marketing for mulberry silk (Table 1).

Table 1: Constraints of mulberry silk

Sl. No.	Particulars	Chikkaballapur		Ramanagara		Mandya		Overall	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank
	Production constraints								
1.	Lack of skilled labours	76.05	I	56.30	III	56.65	III	63.00	II
2.	Good quality of reeling water	66.95	II	76.70	I	50.35	IV	64.67	I
3.	Unavailability of good quality mulberry cocoon	55.95	III	24.00	VII	77.35	I	52.43	IV
4.	Fluctuation of mulberry cocoon prices	51.05	IV	50.70	IV	65.65	II	55.80	III
5.	Unavailability and high cost of reeling equipment's	40.80	V	66.30	II	33.40	VI	46.83	V
6.	Financial problem	32.20	VI	41.20	V	41.60	V	38.33	VI
7.	Electricity problem	25.00	VII	32.80	VI	23.00	VII	26.93	VII
	Marketing constraints								
1.	Price fluctuation	76.05	I	77.35	I	76.70	I	76.70	I
2.	Lack of regulated or organized market structure	66.95	II	56.65	III	56.30	III	59.97	III
3.	Non availability of market information	55.95	III	65.65	II	66.30	II	62.63	II
4.	Delayed payments	51.05	IV	33.40	VI	32.80	VI	39.08	VI
5.	Inadequate storage facility	40.80	V	41.60	V	50.70	IV	44.37	IV
6.	Less demand in market	32.20	VI	50.35	IV	41.20	V	41.25	V
7.	Less support for export marketing	25.00	VII	23.00	VII	24.00	VII	24.00	VII

3.2.2 Constraints faced in mulberry silk products

Weaving is one of the highly specialized activities in the supply chain linkages of the silk sector. Their weavers produce silk product mainly for two types in the state, one produce for exporting and

another produces for commercial purposes. On the other hand, the commercial weavers can also be divided into two classes, master weavers and general weavers. The master weavers have a good number of looms depending upon their amount of investment and under them a number of general weavers work. The weaving job is mainly done on frame type fly shuttle handlooms i.e. handloom and powerloom, that is suited for production of different silk fabrics.

The silk products produced from the mulberry silk were plain and designer silk saree, dhoti set, silk shirting fabric, silk made-ups such as ties, pouches and bags, upholstery as such bed and pillow covers, sofa covers and curtains and other silk fabrics such as lehenga and kurta pieces, stole and robe. The most expensive silk item was found to be the designer silk saree and most popular item was plain silk saree, it's because of comparatively less price, wider utility and also weaving duration. The products such as silk shirting piece, dhoti sets and silk made-ups were found to be very popular and have good demand. Other silk products were widely used for exports and industrial purposes. The designs were repeated time and again and not at par with the other silk clusters. It is observed that except a few, most of the silk weavers have not been able to expand their business due to the lack of sufficient capital. It is also observed that with some exceptions, the weaving in clusters is done to meet the need of the local customers. The master weavers generally give weaving job for hired weavers as wage earners. Majority of the hired weavers are local men and women and they have very high demand in these clusters. Apart from the problems that have been mentioned above by the fabric sector, the study has also identified the following ones:

3.2.2.1 Production constraints

Unavailability of good quality of mulberry silk was the major constraint. It's due to the lack of good skilled labours in production process of mulberry silk *i.e.*, silk reeler. Other major constraint was rise of price of raw mulberry silk. The reason might be due to change in quality and availability of raw mulberry silk in the market. It was reported that lack of skilled labours was another important constraint. It's because of that process making of mulberry silk cloth or fabric requires high skills and it comes from experience. In recent years the silk weavers are decreasing in weaving, it might be due to reduce in quality and quantity of mulberry silk availability and high price of mulberry silk in the market. Problems such as joblessness, wages variation, lack of co-operation between silk weavers, loom problem and unavailability of its parts and financial problem were found to be less importance as these were individual or cluster wise and time period problems and were sorted based on purchasing of the raw material and the income generated by selling of the silk products (Table 2).

3.2.2.2 Marketing constraints

The major constraint was lack of regulated or organized market structure. This could be due to the absence of market institutions or silk markets. Other major constraint was middleman problems. It may be because of lack of proper organized marketing structure for selling of silk products. It was reported that delayed payments was another constraint. It's due to intervention of marketing intermediaries and lack of timely financial support in process of selling of silk products to the customer. However, there were many other constraints like price fluctuation, change in costumer preference and transportation problems were found to be less importance, as these constrains mainly depends upon the consumer or customers personal tastes or preferences. (Table 2).

Table 2: Constraints of mulberry silk products

Sl. No.	Particulars	Chikkaballapur		Ramanagara		Mandya		Overall	
		Score	Rank	Score	Rank	Score	Rank	Score	Rank
	Production constraints								
1.	Unavailability of good quality mulberry silk	80.40	I	70.20	II	79.20	I	76.60	I

2.	Rise of price of raw mulberry silk	69.60	II	79.80	I	70.80	II	73.40	II
3.	Lack of skilled labours	61.70	III	61.40	III	61.10	III	61.40	III
4.	Joblessness	56.30	IV	50.60	V	49.10	V	52.00	IV
5.	Wages problem	49.70	V	29.80	VIII	56.90	IV	45.47	V
6.	Lack of co-operation between silk weavers	44.30	VI	56.60	IV	29.20	VIII	43.37	VI
7.	Health issues	37.65	VII	37.30	VII	36.95	VII	39.73	VII
8.	Loom problem and unavailability of its parts	30.40	VIII	44.60	VI	44.90	VI	37.53	VIII
9.	Financial problem	19.95	IX	20.90	IX	21.85	IX	20.90	IX
	Marketing constraints								
1.	Lack of regulated or organized market structure	75.60	I	63.70	II	74.90	I	71.40	I
2.	Middleman problems	64.40	II	76.30	I	65.10	II	68.60	II
3.	Delayed payments	53.20	III	53.60	III	52.80	III	53.20	III
4.	Price fluctuation	46.80	IV	46.40	IV	47.20	IV	46.80	IV
5.	Change in costumer preference	34.70	V	35.35	V	34.05	V	34.70	V
6.	Transportation problems	24.30	VI	23.65	VI	24.95	VI	24.30	VI

IV. CONCLUSION

Supply chain linkage is the process of management of the flow of goods and services and includes all processes that transform raw materials into final products. Supply chain management plays an integral role in keeping business costs minimum and profitability as high as possible. Minimizing of cost is done by eradicating unnecessary expenses, movements and efficient handling at various stages of supply chain management. It is observed that, in sericulture sectors such as mulberry leaf production, cocoon production, silk and its products production are interlinked to each other and require proper timely supply of raw materials as such that every output of one sector is the input or raw material for the next sector. The supply chain linkage concludes that Sericulture is mainly based on the supply links of leaf producers, to rearers, to cocoon market, to silk reelers, to silk traders, to twister, to silk weavers, to silk product traders and finally to the consumer, which indicated that the timely disposal and availability of the intermediate products are interrelated and independent process. It is also found that supply of materials is a continuous process and it's a chain linked process, the breakage of the supply chain affects the employment and income generation of sericulture industry. The quality of ultimate products *i.e.* fabrics entirely depends on the performance of each activity in the chain.

Major constraints faced in production and marketing of mulberry silk and silk products were, reeling water, skilled labours and fluctuation of mulberry cocoon prices were the major production constraints for silk reeling sector as the unwinding of silk thread from cocoon depends upon water and skill, which affect the quality of cocoons and influences the price fluctuation in marketing of silk, organized market structure and market information for selling of silk are the marketing problems as there are no particular platform for selling of silk. Unavailability of good quality mulberry silk, rise of price of raw mulberry silk which affect the quality of silk products as there is lack of skilled labours in the field of making of silk products such as plain and designer silk saree, dhoti set, silk shirting fabric, silk made-ups such as ties, pouches and bags, upholstery as such bed and pillow covers, sofa covers and curtains and other silk fabrics such as lehenga and kurta pieces, stole and robe, the marketing of these products lack of regulated or organized market structure and due to presences of middleman selling of products for marginal prices if difficult and leads to delayed payments.

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