Chapter 1
INTRODUCTION
1. INTRODUCTION

Silk is the Queen of Textiles from the time immemorial, so smooth, so elegant, so soothing and so natural. Silk is a marvellous gift of nature for the human and is the royal fabric across the globe. Silk a material of long standing tradition, beautiful and most expensive of all the textile fibres. Even today, no other fabric can match its lustre and elegance. Over the centuries silk has been reined undisputed as the “Queen of Textiles”. Silk is produced from silk cocoons produced by the silkworm. The art and science of rearing silkworm to produce silk cocoons is known as sericulture. Sericulture is an important agro-based activity, involving rearing of silkworm and production of silk cocoons. There are various types of silkworms, but the most popularly and widely domesticated and reared is the mulberry silkworm. Most of the other commercial silkworms are eri, muga, tasar etc. which are wild silkworms. Around 95 per cent of the world silk is produced from mulberry silkworm. Hence, the term sericulture goes with cultivation of mulberry and production of mulberry silk cocoons.

1.1 SILK INDUSTRY IN THE WORLD

The origin of silk is shrouded in the history. There are numerous Chinese legends, those of Chinese Queen Hsi-Ling-Shih (2500 BC) who stumbled upon silk while roaming in imperial garden and Queen Sing-Ling-te (2640 BC) hailed as the ‘Silkworm Goddess’ for her discovery and devotion to silk. Though the history of silk is fascinating, it does not provide any authentic clue to its origin. Some believe that in India, the Himalaya is the home of sericulture. Recent archaeological and historical evidence however supports the theory that mulberry silk definitely originated in China many centuries before Christian era. The footholds of Himalaya in India are however thought to have harboured various kinds of silkworms (4000 BC) and the Aryans learned the secret of silk independently of China.
The earliest textile fibres discovered by man are wool, hemp and linen. This was followed by cotton and silk. The history has recorded the ceremonial linens of Egypt, gorgeous woollens of Mesopotamia and Peru, the ‘bird and flower’ silk of China and the ‘Woven Wind’ muslins of India. Textile fibres including silk played an important role in the economic and cultural development of ancient civilizations. The fabulous silk caravans trudged their way through the famous ancient 4000-mile Silk Road from China and India to Persia and to ancient civilizations in the Middle East and Europe.

A sericulture belt running parallel to the Tropic of Cancer circles the earth. Extending up to 50°N latitude, the temperature zone covers univoltine (one silkworm crop or generation per year) producing countries of Japan, Korea, Northern India, Burma, Iran, Turkey, the Southern Bulgaria, Hungary, Yugoslavia, Spain, Italy and Poland. The tropical zone stretching to 10°S latitude include polyvoltine and the wild silk producing countries like Southern China, Thailand, Central and Southern India, Central Africa, Brazil and Peru. Sericulture and silk weaving are practiced on a large or small scale in some 60 countries of the world.

While several countries in Europe and America produce silk, over 90 per cent of the total production is in Asia. The global production of raw silk was 1,15,092 metric tonnes, with China contributing 93,100 metric tonne (2006). The remaining 21,992 metric tonnes is contributed by India, Japan, Brazil, Uzbekistan, Thailand and other silk producing countries. The other silk producing countries include North Korea, Iran, Turkey, Bulgaria, Romania, Bangladesh and Vietnam which together produce around 2 per cent of the global output. The bulk of silk is obtained from the domesticated silkworm *Bombyx mori* yielding mulberry silk. Less than 10 per cent of the silk comes from wild silkworms producing mainly tasar silk and a very small quantity of eri and muga silk which are mainly restricted to India.
The world silk production has almost doubled over the last two decades with a production of 58,914 MT during 1985 which increased steadily over the years reaching 1,15,092 MT during 2006. Compared to the global textile production, silk production is in negligible quantity accounting for around 0.25 per cent as against cotton accounting for 51 per cent and synthetic fibres accounting for 40 per cent. The world trade in silk had a growth rate of 3-4 per cent per annum. China exports 90 per cent of its raw silk production and controls 75-80 per cent of the world raw silk market. Contrary to this, India has a strong domestic market and consumes almost 85 per cent of its production with limited export surplus. The main components of silk exports of India are its finished goods. USA is the largest importer of silk mainly from China and India.

In recent years, there has been a major shift in Asian silk production. Japan is rapidly giving up sericulture and the production has come down from 9,592 MT during 1985 to merely 150 MT during 2006. China and India are expanding their traditional silk industry. China’s silk production has almost increased by three folds from 32,000 MT during 1985 to 93,100 during 2006 whereas, the Indian silk production has more than doubled (7,029 MT during 1985 to 16,525 MT during 2006) keeping in line with the world’s production. China contributing 80 per cent of the world silk production is the largest exporter, whereas India contributing about 13 per cent of the world silk production is the largest consumer. Some developing countries with tropical climate are also adopting sericulture to better their farm economy. Brazil in Latin America had a steady growth in sericulture during the decade 1985-1995 (from 1,458 MT to 2,468 MT) and later the production started decreasing, touching a lower production 1,285 MT during 2005. Uzbekistan and Thailand took sericulture and production of silk in a bigger way during 1995 producing 1,320 MT and 1,313 MT respectively. Further, the production varied over the decade and during 2006 these two countries produced only 950 MT and 1,080 MT of raw silk respectively.
Turkey is also reviving her ancient silk tapestry tradition by cultivating cocoons from imported eggs. The developing countries - Thailand, Indonesia, Bangladesh, Sri Lanka, Afghanistan, Romania, Bulgaria and many others are adopting sericulture and silk processing which help the rural population to augment their income. The world silk scenario provides much scope for increasing Indian silk production to a still greater height. The climatic conditions literally favour for further expansion. Looking at the world silk scenario, there is demand for sericulture in many developing countries which creates demand for inputs like seed (both mulberry as well as silkworm), production technology, training etc. This gives more scope for involvement in R & D at the international level which needs to be supported by the knowledge and experience based countries like India and China.

Silk industry provides much needed employment in several developing and labour rich countries. Indian silk industry has lot of expansion potential for both exports and domestic consumption. It is observed that there is transfer of income from the rich to the poor when silk is produced and sold domestically.

1.2 SILK INDUSTRY IN INDIA

India is an important sericultural country under the tropical zone holding second position with reference to the world mulberry raw silk production, with a production of 16,525 metric tonnes (2006-07) next only to China. In India, mulberry is being cultivated in an area of 1.92 lakh hectares of land. India has also the unique distinction of producing all the five varieties of silk viz. mulberry, oak tasar, tropical tasar, eri and muga. India produces 1,485 MT of eri silk, 350 MT of tasar silk and 115 MT of muga silk (2006-07). Out of the total of 18,475 MT of silk produced in India mulberry silk accounts for around 90 per cent.
There was steady increase in the India’s silk production from 7,029 MT in 1985 to 13,450 MT during 1994. During 1995 there was sudden fall in the production to 12,884 MT which was mainly due to the outbreak of pebrine disease in silkworm. Later, the production has been fluctuating over the decade with overall increasing trend reaching 16,525 MT during 2006. The growth rate of silk production in the country has been around 8 per cent while the demand for silk is growing at 10 per cent per annum. By the end of XI plan the demand is estimated to cross 33,500 MT. The weaving sector is estimated to consume over 26,000 MT annually.

Under the National Sericulture Project (NSP), the expansion of silk industry in India assumed greater importance from both domestic and export point of view. As per the assessment by UNDP, the demand for silk is likely to increase by 3 percent every year. Over and above the consumption of indigenous yarn, India is also importing substantial quantity of bivoltine raw silk. The export earnings from silk and silk goods during 2006-07 were Rs. 3,338.35 crores. India imported 8,383 MT of raw silk during 2005-06 out of which 8,165 MT was from China (CSB Annual Report, 2007-08). A small portion of its production (15 per cent) is being exported to other countries. The market share of Indian silk export in the global silk trade is only 4-5 per cent. The export of Indian silk commodities has been increasing at the rate of 20 percent by value every year.

The five year NSP (1990-95) aimed at developing 11,200 hectare area under mulberry in the non-traditional areas and 46,950 hectares in the five traditional sericulture states. The objectives of the NSP were to increase the raw silk production and introduce sericulture in new areas of non-traditional states. NSP was initiated with the financial assistance from the World Bank and the Swiss development cooperation (SDC) with an outlay of Rs. 555.3 crores during the year 1989-1990. The project was extended up to 1997.
In India sericulture is mainly grown in Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu & Kashmir states which have been considered as the traditional sericulture states. Under NSP, sericulture was extended to other non-traditional states. Out of the total production of raw silk in India (16,525 MT), contribution of traditional states is around 98% (16,234 MT). Only 2 per cent of the total silk production is contributed by non-traditional states (2006-07).

Within the traditional States, Karnataka produces 7,883 MT of raw silk (2006-07) contributing around 50 per cent of the country’s raw silk production followed by Andhra Pradesh (5,526 MT), West Bengal (1,598 MT) and Tamil Nadu (1,125 MT). Jammu and Kashmir contributes only 102 MT of raw silk.

1.3 SILK INDUSTRY IN KARNATAKA STATE

Sericulture in Karnataka dates back to nearly two centuries. It is the premier mulberry silk producing state accounting for nearly 50 percent of total production in the country. This state has ideal climate for both mulberry cultivation and silkworm rearing. Besides, it has all the infrastructure facilities with the statutes of “Karnataka Silkworm Seed, Cocoon and Silk Yarn (Regulation of Production, Supply, Distribution and Sale) Act, 159 and Rules 1960” in the form of statutory cocoon markets, silk exchanges, seed legislation, etc. For transaction of cocoons, 66 cocoon markets have been established. For transaction of silk, in addition to the main Silk Exchange at Bangalore, 9 sub-units are functioning in the important silk weaving areas like Kollegal, Ramanagaram, Shidlaghatta, Chikkaballapur, Kolar, Kanakapura, Chamarajanagar, Guledgudda and Gadag. Further, in order to control the racial characteristics and hybrid vigour, 91 Silk Farms have been established. These farms maintain and produce P4, P3, P2 and P1 level basic seed cocoons to meet the seed demand of the sericulturists. For production of seed cocoons by the farmers, seed areas have been demarcated. For Pure Mysore which is traditional multivoltine race used for production of
Multivoltine hybrids, Magadi taluk of Ramanagar district, Kunigal taluk and Hebbur hobli of Tumkur taluk have been identified as seed areas. For bivoltine seed cocoons, 31 taluks in the state have been identified. For production of silkworm seeds there are 64 State Government grainages, 6 National Silkworm Seed Organisation (Central Silk Board) grainages and 383 private Licensed Seed Producers (LSPs) are functioning. Karnataka Silk Marketing Board (KSMB) and Karnataka Silk Industries Corporation (KSIC) have been established to procurement of raw silk and production of silk fabric. KSIC has latest machinery for reeling, weaving and making spun silk from silk waste which produces world famous silk sarees and fabric in the brand name of KSIC / Mysore Silk.

In Karnataka alone, out of the total 29,406 inhabited villages, sericulture has been practiced in 13,374 villages (45.48 per cent). About 1,80,353 families are engaged in this occupation. Sericulture is practiced in Karnataka in an area of 97,647 hectare and produce about 58,697 MT cocoons per year. From these cocoons 7,882 MT raw silk is produced per annum (Annual Report of Karnataka, 2006-07). Sericulture enterprise can provide employment up to 13 persons per hectare throughout the year. Out of the total employment in the silk industry, 40 percent of the employed labour is engaged in sericulture (mulberry cultivation and silkworm rearing) and the remaining 60 percent are employed in post cocoon activities like reeling, weaving and dress making.

Development in terms of infrastructure brought up with the introduction of “Karnataka Sericulture Project” which was implemented during June 1980. The outlay for the project was 54 million US$. As a result of the project, the production of mulberry raw silk in the state increased from 2,878 MT during 1980-1981 to 4,970 MT during 1987-1988 (CSB, 1992). It also encouraged the development of sericulture in other neighbouring states like Andhra Pradesh and Tamil Nadu. Further, strengthening of infrastructure was brought about by the implementation of “National Sericulture Project” launched during 1989. As on
1989-90, the production of mulberry raw silk in Karnataka was 6,076 MT. Karnataka being the major producer of mulberry raw silk, much of the efforts have been made in this state for the multidimensional development of sericulture. There was steady growth in the silk production reaching 8,865 MT during 1994-95. Later there was much fluctuation in production with a declining trend. The silk production reached 7,883 MT during 2006-07.

1.4 SERICULTURE

India has unique distinction of producing all the five varieties of silk viz., mulberry, oak tasar, tropical tasar, eri and muga. Among these, the silkworm Bombyx mori feeds on the leaves of Morus sp. and produces mulberry silk. Muga silkworm Antheraea assamensis is endemic to India and confined to Brahmaputra valley of north-eastern states. Muga silkworm feeds on som (Machilus bombycine) and soalu (Litsea polyantha) trees. The tropical tasar silk is the product of Antheraea mylitta which feeds on Terminalia tomentose, T. Arjuna and Shorea robusta grown in the deciduous forests of Jharkhand, Bihar, Madhya Pradesh and Orissa. Oak tasar silk is the product of Antheraea frithii and A. Proylei, A. Roylei and A. Pernyi which feed on several species of oak plants (Quercus spp.). Oak tasar is confined only to sub Himalayan oak-belt, comprising of Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Manipur, Mizoram, Nagaland, Arunachal Pradesh and Meghalaya. Eri silkworm (Philosamia ricini) which feeds on the common castor plant (Ricinus communis) is mainly raised in Assam and Orissa producing eri silk. Mulberry silk production being 90 per cent of the Indian silk and 98 per cent of the total silk production of the world, the term sericulture generally refers to mulberry sericulture.

Sericulture is an agro-based activity includes (i) On farm activity involving cultivation of mulberry and (ii) Off-farm activity involving rearing of silkworm and production of cocoons. The silk cocoons thus produced undergo various stages of
processing (post cocoon activities) like reeling, twisting, dying, degumming, weaving, printing etc. to arrive at the ultimate consumer goods i.e. the fabric.

1.4.1 Mulberry cultivation:

Mulberry silkworm *Bombyx mori* is a monophagous insect feeds only on the mulberry (*Morus sp.*) leaf. Mulberry, though a perennial tree species, is trained and cultivated as a low bush for commercial purpose under tropical and temperate conditions. Mulberry is cultivated mainly through vegetative propagation using stem cuttings. The cuttings with two to three buds are being directly planted in the field during rainy season or raised in a nursery bed and transplanted to the main field during favourable season. Mulberry is generally planted giving a spacing of 3 ft by 3 ft. To help mechanisation using power tiller or tractor wider spacing with paired row system of plantation has been developed and recommended for adoption.

Mulberry is affected by a large number of foliar and root diseases. Among foliar diseases, leaf spot, powdery mildew and bacterial blight are of serious concern which affects the yield and the quality of the leaf. Among root diseases, root rot and root knot are common. A large number of root diseases affect saplings in the nursery. Tukra disease is very much common in mulberry which is due to the attack of insect pest mealy bug. Apart from mealy bug the pests like leaf roller, bihar hairy caterpillar and army worm attack mulberry and cause damage to the leaf yield.

1.4.2 Silkworm Rearing

The silkworm *Bombyx mori* which feeds on mulberry has been cultivated throughout the world. Based on the voltinism (number of generations in a year), the silkworms are classified into univoltine, bivoltine and multivoltine.
Univoltine silkworms (UV): They have one generation in a year and are characterised by large body size with good quality cocoon and filament, but are susceptible to fluctuating environment and poor quality leaf.

Bivoltine silkworms (BV): They have two generations in a year and are characterised by shorter larval duration, comparatively inferior cocoon quality (compared to UV). These are reared during summer and autumn season in temperate countries.

Multivoltine silkworms (MV): They have more than three generations in a year and characterised by non-diapause eggs, small cocoons, short filaments and robust larvae. They can be reared throughout the year under tropical and subtropical conditions. They are relatively resistant to environmental fluctuations, diseases and leaf quality.

India, with tropical and sub-tropical climate harbour mainly multivoltine silkworms. Since, the yield level and the quality of these silkworm races are poor, efforts have been made to obtain superior hybrids by crossing multivoltine with bivoltine breeds. The bivoltine hybrids are also being reared just like multivoltine breeds by breaking the diapause through acid treatment. Life cycle of mulberry silkworm is of 40-50 days with minor variations depending on the climate. The egg stage lasts for 10 days, the larval stage is for 23-28 days and the pupal stage is 10 days. Silkworm rearing is done indoors in suitably designed rearing houses. Earlier the rearing was being done in trays and worms were fed with chopped leaf 5-6 times in a day which required more labour. Over the years due to the efforts of R&D, rearing is undertaken in shelf / racks by feeding the silkworms with the mulberry shoots twice in a day has been practiced to a greater extent which has reduced the labour requirement drastically. The entire process of silkworm rearing from hatching of silkworm eggs to formation of cocoons takes 23-25 days. During this period the silkworm undergoes moulting (shedding of
skin) four times resulting in 5 stages. These stages are technically called as instars. Up to third stage (between 2nd and 3rd moult) say about 10 days, silkworms are considered as young age worms or chawki worms and are reared with utmost care. Thereafter, the worms enter late age and undergo two moults. The matured worms (after 5th stage/instar) start spinning and the cocooning takes about 6 days. After 6 days the cocoons are harvested and marketed. The cocoons are to be processed or reeled before emergence of the moth i.e. within 10 days of spinning.

Mulberry silkworm is threatened by pebrine disease caused by a protozoan *Nosema bombycis* which is mainly transmitted transovarially. There was epidemic outbreak of the disease during 1994-95 especially in southern India causing heavy loss to silkworm crops. With efforts of R&D and the control measures, the disease was brought under control. The main check was laid at the preparation of eggs and only disease free layings were supplied to the farmers. Hence, the silkworm layings are popularly attributed as DFLs (Disease free layings). Other major diseases are grasserie caused by nuclear polyhydral virus, flacherie caused by infectious flacherie virus and muscardine a fungal disease. Use of chemical disinfectants like formalin, chlorine-di-oxide, bleaching powder etc. to clean rearing houses and utensils after every crop and use of bed disinfectants like vijetha, suraksha, sanjeevini, resham Jyothi developed by research institutes on silkworm during rearing will be helpful in preventing these diseases.

The mulberry cultivation, silkworm rearing and silk reeling are restricted to some parts of world or the country. Silk weaving is fairly wide spread. This necessitated transfer of raw silk from one part to the other and even from one country to other countries. Hence, production of international grade raw silk is very much required for the production of superior grade silk fabric for the international market.
Sericulture is basically an agro-based cottage industry, providing employment to the unemployed rural folk. It involves cultivation of mulberry and rearing of silkworm by the farmer. Sericulture is confined to some parts of the world and to some regions within the same country depending on the agro-climatic and socio-economic conditions of the region. The sericulture activity has many economic advantages which are listed below.

a. Higher income turnover with continuous income once in every month / two months for the farmer.

b. It has a very low gestation period of 6 months to one year after plantation.

c. Once planted it survives for many years and has the advantage of plantation crops.

d. Mulberry is a hardy plant and the leaf is the main product. The effect of fluctuation in environmental factors on leaf production is less compared to other fruit/seed bearing crops.

e. It has comparative advantage over other crops in terms of economics like profit and income turnover.

f. It has labour use efficiency as it provides continuous employment especially to the family members throughout the year. Further, family women labour who are confined to household activity, are actively involved in sericulture as the silkworm rearing is the in-house activity.

g. There is assured and good regulated marketing system especially in Karnataka compared to other competitive commercial crops/activities in agriculture.
Further, it has complementary effect on other farm enterprises by adding to FYM (mulberry waste and silkworm litter) and by generating continuous income that provides financial support for other farm enterprises. It is estimated that the indirect contribution of the sericulture to the farm income is about 25 per cent which is next to the animal husbandry (Raveendra Mattigatti, 1995).

The main limitation of sericulture is that it demands lot of labour and needs continuous involvement of the farmer or a responsible person throughout the crop for efficient management of the crop.

Though, there is potentiality of cocoon production of 70-80 kgs per 100 DFLs, in the field, the average cocoon yields are reported to be of 50-55 kgs per 100 DFLs. The low yields of cocoon crops are due to various reasons and one of such important reason is the non-adoption of new technology recommended by the research institutes.

To produce higher quality and quantity of cocoons, proper attention and skill is required in various phases of mulberry cultivation and silkworm rearing. The new technology packages have been developed by the leading research institutes like CSRTI Mysore, which has given a substantial boost to the production of cocoon and associated aspects. In large-scale adoption of silkworm rearing technology in traditional areas, the rearing technology needs attention and improvement over the existing packages. Karnataka is the leading state as far as mulberry sericulture in the country is concerned which is often called a silk state of the country. The development of new technology has contributed to enhance the yield levels and quality of the cocoons over the years. But, much gap always lies between the recommended and the actual.
Silkworm (Bombyx mori) rearing is the integral part of the sericulture. Silkworm is a cold blooded insect and by nature quite delicate and very sensitive to the environmental condition. Silkworm rearing has certain amount of uncertainty and risk which is invariably experienced by sericulturists as it is greatly influenced by the environmental factors, i.e., temperature, humidity, light, and air current from incubation to cocooning.

1.5 NEED FOR THE STUDY

India is the second largest producer of silk in the world next only to China. In India Karnataka is the leading state contributing almost 50 per cent of the total raw silk production of the country. Sericulture in India is almost 200 years old. After independence, sericulture has been given the boost and since 1960s sericulture has been growing steadily.

In Karnataka, sericulture has been practiced on marginal dry lands with less water resources. Over the years, with introduction of new varieties of mulberry and silkworm races, the area under mulberry has been increasing i.e. from 86,800 ha during 1970-71 to 1,67,778 ha during 1994-95. The quality and quantity of production also increased steadily over the years. The percentage area under irrigation has increased from 20 per cent during 1970-71 to almost 90 per cent during 2007-08. Since 1995-96, in spite of improvement in the technology and productivity, the area under mulberry and the cocoon production has been on decline. Further, a wide gap prevails in the yield level of the farmers to that of potential yield level. Sericulture being sensitive to climatic factors suffers from yield and crop uncertainties. With globalisation, the policies have changed, throwing the industry to compete in the global market. Taking all these parameters into consideration, a need was felt to analyse the yield gap and uncertainty in sericulture in Karnataka State with the following specific objectives.
1.6 SPECIFIC OBJECTIVES OF THE STUDY

1. To assess the yield gap in mulberry cultivation and silkworm rearing with the given technology of the sample farmers in the study area.

2. To assess the uncertainty involved in mulberry cultivation, silkworm rearing and marketing of cocoons in the study area.

3. To study the knowledge and adoption of sericulture practices by the sample farmers in the study area.

4. To suggest appropriate policy measures to minimize the yield gap and uncertainty in mulberry sericulture in the study area.

1.7 PRESENTATION OF THE STUDY

The study has been organised and presented in seven chapters. Chapter-I gives the introduction to the area of work, the setting of the problem, the background of the field of study with major problems. The specific objectives of the study along with the limitations and scope of the study have been clearly indicated.

The research works carried over the period of time that are having a greater bearing on the objectives of the study outlined in Chapter-I have been reviewed and presented in Chapter-II in an order.

Chapter-III deals with the explanation of main features of the study area, i.e. Karnataka and the sample districts. Chapter-IV deals with methodology indicating the sampling design, sources and method of data collection, important terms used and the statistical tools and techniques with the help of which the data has been analysed and interpreted.
In Chapter-V, the findings of the analysed data have been compressed and presented in the form of tables and graphs. The findings of the study have been subjected to critical analysis. The discussions of these findings which seek to explain why the variable behaved as they did during the period under study has been set out.

The main findings have been summarised and presented along with conclusions and policy implications in Chapter-VI. In the VII and the last chapter, the references made for the research work are presented systematically. Finally, the supporting information needed for the study has been put as appendices.

1.7 LIMITATIONS OF THE STUDY

The present study is aimed at evaluating the yield gap and uncertainty in sericulture in Karnataka. Taking into consideration the constraints such as availability of data, time and problems involved in conducting the study, the study has following limitations.

1. The study is being conducted only for irrigated mulberry as 90 per cent of the mulberry is grown under irrigated conditions in Karnataka.

2. The study covered both traditional and non-traditional areas of Karnataka State. Only potential areas having higher area under mulberry have been selected looking into the availability of data for the research work.

3. Region specific potential research yields were not available and hence, only the potential yields at the main research station were considered for the study.

4. Demonstration yields were not available for all the sample districts and hence the attainable yields of the farmers were collected and analysed.
1.8 SCOPE OF THE STUDY

Because of time and other resource constraints the study was restricted leaving much scope for further studies.

1. The study of yield gap and uncertainty in alternative crops can also be studied for comparison.

2. The spatial and seasonal yield variation data was restricted and collected for one year. The time series data over the period can be collected and analysed for better generalisation of the results.

3. The anticipated yield which was used to assess the yield uncertainty can be further explored by keeping the crop under observation and recording the anticipated yield of the farmer at each stage of the crop. This provides information on the uncertainties and their magnitude at different stages of the crop.

4. The study can be extended to the rainfed area of Karnataka State taking Mysore and Chamarajnagar districts. Separate study can also be taken up for seed cocoon production in the state.

5. A deeper analysis of the declining trend in mulberry and cocoon production in Karnataka needs to be taken up and strategies for revival and further expansion can be worked out.