

Present status and future strategies of wool production, processing and product manufacture

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1. Introduction

Fibre has been of great importance to man and rank second only to food in their usefulness. Animal fibres are largely those which cover mammals such as sheep, goats and rabbits, but also include cocoon of the silk-worm as well as feather from poultry. Globally natural Fibres contribute about 48% to the fibre basket with 38% from cotton, 8% from bast and allied fibres and 2% from wool and silk fibres. India is a vast country with 44 descript sheep breeds spread over a wide range environmental conditions. The Indian sheep breeds produce wool differing in fineness from 25 to 60 μ . As per economic survey, Government of India, the country produced about 45 m kg of raw wool (2007). Out of the total production of raw wool about 10 % was apparel grade, 70 % carpet grade and 20 % coarse grade. Specialty hair fibres obtained from Angora rabbit, Pashmina and Yak are popular for its superb whiteness, high warmth and softer feel.

Wool is consumed mainly in suiting and knitted garments for men's wears while for women's wear, shawl, coating and dress material are major products. In addition, one of the important end use of non-apparel wool is in hand knotted, tufted and woven carpets. Woollen industry in India is small in size as compared to cotton and synthetic fibre based industry, wool and woollen activities in rural areas are having important position. The woollen industry including carpet sector contributes about Rs. 5000 crore in export earnings. Moreover the industry provides employment and source of sustenance to about one million people mostly belonging to low income group. In addition the expansion of the industry particularly the Khadi, handloom and carpet segments will create more job opportunities in future.

2. Scenario of Wool and Speciality Hair in India

2.1 Wool production

India is a vast country with 44 descript sheep breeds spread over a wide range environmental conditions. The Indian sheep breeds produce wool differing in fineness from 25 to 60 μ . These wools are mainly utilized for the manufacture of hand-knotted, tufted and handloom

woven carpets. As per economic survey, Government of India, the country produced about 45 m kg of raw wool (2007). Out of the total production of raw wool about 10 % was apparel grade, 70 % carpet grade and 20 % coarse grade. The annual growth of wool production is marginal and wool production has remained static for last 10 years. Wool yield per sheep in India is about 800-1000 g/year. The country can be divided into 4 agro climate regions with reference to wool production. The sheep population is more or less equally spread in North Western parts of the country covering the states of Rajasthan, Gujarat, Punjab and Haryana and Southern Peninsular region consisting of State of Andhra Pradesh, Maharashtra, Tamilnadu and Karnataka. However, wool production is more in North western region than Southern Peninsular region. The wool produced in North-Western region finer than Southern Peninsular region.

The production of wool in the country is not satisfactory mainly because of dominance of medium fine wool, carpet wool and coarse wool/hairy sheep breeds. Moreover, for most part of the year the animals are subjected to under feeding mainly due to over stocking far exceeding the carrying capacity of the land and unfavourable agro-climatic conditions. In order to avoid prevailing harsh agro-climatic conditions and loss of production, the sheep farmers resort to short and long distance even inter-state migration with their stock and return back to their native tract in the favourable season. With the onset of summer, the sheep farmers of western India migrate to neighbouring states namely, Uttar Pradesh, Madhya Pradesh, Haryana and Punjab while those from the sub Himalayan region migrate to Alpine meadows. Continuous drought during last decade has changed the breed composition, production response and marketing structure of sheep produce in the dominant sheep producing regions of the country.

2.2 Speciality hair fibres

Angora rabbit hair, Pashmina and yak wool are main important speciality hair fibres are found in our country. The fineness of Angora rabbit hair ranges between 12 -14 micron. In our country, rabbits are reared in Himachal Pradesh. Central Sheep & wool Research Institute also has got its station in Himachal Pradesh at GARSA where different varieties of Rabbits i.e. British, German and Russian are reared. German rabbits are the best. Pashmina or Cashmere is obtained from Changthangi and Chegu breed goats that are famous for their softest, finest and warmest commercial natural animal fiber. The average diameter of pashmina produced in most of the countries is ranging in between 11-18 micron.

Table: 1 Animal Fibres: Production, Quality and Products.

Name of the fibre	Source	Production Lakh kg	Fineness Micron	Product
Wool	Sheep	456	22-60	Carpets, blankets, Felts, shirting, suiting etc.
Pashmina	Cashmere goat	0.4	10-15	Shawls and knitwears
Rabbit hair	Angora Rabbit	0.5	10-14	Shawls and Knitwears
Yak fibre	Yak	0.1	15-25	Shawl and knitwear

2.3 Wool Marketing in India

The single weakest link after production of wool is marketing of wool in the country. Wool marketing in India is essentially in the hands of private wool merchants and traders. The producer of wool rarely takes the wool to the markets. A substantial proportion of wool is purchased by village merchants. The merchants/commission agents in wool market sell wool on behalf of village merchants or purchase the wool for themselves. There is a common practice of wool producers selling their wool per animal basis well before the shearing season by taking money in advance. The reasons for village level selling are ascribed to distant locations of wool mandies causing transportation problem. The unscientific wool marketing practices are completely against the interest of woolgrowers that have stunted production of wool over the years. To ensure remunerative price to woolgrowers, to provide protection to them against exploitation by the middlemen, to make available good quality and well-graded raw material to wool industry, it is imperative that effective market intervention is made by government agencies.

The availability of animal fibres except sheep wool is very meagre and therefore, their marketing is not at all organized. These fibres are sold locally and used locally. However, with the efforts of some developmental agencies, the production of rabbit hair has increased in the states of Himachal Pradesh and Uttarakhand. The price of rabbit hair is also not constant and fluctuates with the price of rabbit hair in international market. Further, with the globalization and open market approach the survival of this species and its products have to face a stiff competition in the times to come. Presently, India produces about 100 tons specialty hair fibres per year (50 ton Angora rabbit hair, 10 ton yak fibre and 40 ton Pashmina wool). The

value of these fibres is approximate Rs. 10 crores which fetch a value of 200 crores after processing and value addition. Among animal hair fibres, the share of speciality hair is very small.

2.4 Wool Utilization

Out of total wool produced in the country about 10 m kg is utilized by Khadi sector and other village based industries for manufacture of different products by hand spinning and weaving. About 8 m kg of raw wool is used by organized sector for the manufacture of shawl and knit wears in Ludhiana and Amritsar. The remaining quantity of 28 m kg is utilized by carpet sector. To make up the shortage of carpet quality wool about 50 m kg of wool is imported from New Zealand, Italy, Turkey, Saudi Arabia, and Argentina etc. Import of wool of 32 μ and above is permitted by government under OGL. The major import is from New Zealand, which supplies wool in scoured stage.

The major carpet yarn production centres are Bikaner (70-80%), Panipat, Bhilwara, Kekri, Beawar and Bhadohi. Carpet yarn is produced on woollen system, semi-worsted and by hand spinning. Most of the yarn produced in different centres is sent in scoured stage to Bhadohi where it is dyed in desired shades. The yarn number generally spun is 2 to 5 Nm and the wool utilized for such spinning varies from 32 to 37 micron.

Indian carpet industry employs 1.5 million workers spread over a number of states. The four major regions making hand-knotted carpets are Jammu and Kashmir, Jaipur-Agra-Gwalior, Bhadohi, Mirzapur and Warangal-Eleru produce super (200 to 400 knots psi), fine (120-200 knots psi), medium (60 to 120 knots psi) and low medium (20-60 knots psi) types of carpets respectively. However, country's major carpet production is at Bhadohi-Mirzapur and Jaipur, amounting to about 80%.

Angora Rabbit hair and Pashmina wool processing and value addition made significant contribution through shawl manufacturing in handloom sector. However, processing of yak needs to be standardized for efficient utilization. Presently, Angora wool, Pashmina and yak fibre processing industry is well recognized for shawl manufacturing. However the growth of this sector is stagnant over last decade. The growth needs to be enhanced by diversified utilization of Angora wool, Pashmina and yak fibres in knitwears and garment sectors.

3. Research and Developmental Activities at Institute

The Central Sheep and Wool Research Institute is conducting basic and applied research in all disciplines related to sheep and rabbit production and is developing technologies for utilization of animal fibre and other products.

3.1 Carpet Wool Production

Avikalin strain was evolved by crossing Rambouillet X Malpura half bred base through inter breeding and selection for enhancing greasy fleece production with target of 1.7 kg greasy wool having 27 μ diameter, 25 % medullation and 4.75 cm staple length. This breed was suitable as a dual-purpose sheep for carpet wool and mutton production. Avikalin sheep produced about 75- 80 % more wool compared to Malpura sheep and wool produced by this strain was of ideal carpet quality. The performance of the evolved breed was up to mark under farm condition while its performance was not encouraging in field adaptation due prevailing agro-meteorological condition. Marwari sheep selected against medullation have shown faster response to selection than those selected for greasy fleece weight at Bikaner. Presently the sheep yields around 1.3 kg GFY with 30 to 35 μ fibre diameter and 40- 55 percent medullation. Emphasis is being given to increase greasy fleece production and develop elite flock with 2 kg annual GFY serve as improver for field population. Magra sheep produces soft and lustrous wool. A project on improvement of Magra sheep under farm and field conditions is in progress at ARC, Bikaner. Sufficiently large number of improved rams has been distributed to the farmers for the breeding purpose. Chokla sheep is another fine carpet wool producing type breed and work on its evaluation and improvement is in progress at Avikanagar. Efforts are being made to increase the annual GFY up to 2.5 kg through selection.

3.2 Fine Wool Production

Avivastra sheep was evolved by crossing Chokla/Nali sheep with Rambouillet/Merino rams and stabilizing at 50 percent exotic inheritance through interbreeding and selection. The target for the genotype was to produce 2 kg greasy wool annually with medullation less than 5 percent and fibre diameter 24- 25 μ . After up gradation, up to 75% exotic inheritance, Avivastra was merged with Bharat Merino flock. Bharat Merino sheep was developed by crossbreeding indigenous Chokla/ Nali sheep with Rambouillet/Merino rams stabilizing at 75 % exotic inheritance with potential to serve as import substitute for exotic fine wool breeds. The genotype has annual greasy wool production of 2.5 kg with fibre diameter of 19- 20 μ , medullation less than one percent. Although the target of fiber diameter, reproductive efficiency and survivability of the genotype was up to mark in semiarid environment, the

adult weight, birth weight, wool yield and staple length reduced over the period indicating the genotype was adapting to prevailing harsh environmental condition but on the cost of the production. The genotype was subsequently shifted to sub temperate condition of Mannavanur where the annual GFY stabilized at 3.5 kg with 20 μ fiber diameter, 0- 5 % medullation and 7 cm staple length to serve as dual purpose breed for fine wool and mutton production.

Nutritional state of animal influences wool growth and production. Wool production and quality traits are largely affected by the dietary protein quality that provides amino acids for incorporation in to the wool. Amino acid nutrition is particularly important for wool/ fiber producing animals in comparison to energy. Since content of sulphur containing amino acids of wool is high, therefore adequate dietary sulphur and nitrogen level of the diet shall improve supply of sulphur amino acids to abomasums by the microbial protein flow to the abomasums. Protein flow of 150 g/day to the abomasum yielded the maximum rate of wool growth. The 2.7 g S/ kg feed DM requires for wool production. The S:N ratio 0.1- 0.4 is essential for higher wool production in sheep. Dietary iodine requirement for optimum wool production is 0.18- 0.27 mg/ kg diet DM. The supplementation of Cu and/ or Se improves wool production under subclinical deficiency conditions and dietary Zn at 15- 20 mg/ kg DM promotes wool growth

3.3 Angora Rabbit Hair Production

The wool yield in German Angora was 900 g in 4 clips; Russian, British & their breed cross yielded 350 to 400 g in three clips. The staple length was 5.0 to 6.0 cm, fibre diameter varied from 12.0- 12.7 μ with guard hair of 2 to 3 %. The objective is to increase the yield to 1000 g and disseminate the breed for development program. One of the major constraints in popularization of the breed in developmental program in target area is serious competition of cheap Angora wool export from China. In Broiler Rabbit Production program the rabbits have achieved target body weight of 1.7 kg at 12 weeks of age in colonies. However, in individual feeding experiments they achieve more than 2 kg with 30 g ADG and 30 % Feed Conversion Efficiency. Efforts are underway to achieve body weight of 2.0 kg at 12 weeks of age in colonies. The Soviet Chinchilla breed of broiler rabbit has been found to be most suitable for all agro-climatic conditions in India.

3.4 Wool Quality Evaluation

The quality of wool available from different indigenous and cross bred sheep has been evaluated with regard to their physical attributes and their physio-mechanical properties.

Suitable blend formulations have been recommended for manufacture of different products. Database on physical parameters of wool from different breeds of sheep has been created. Since carpet industry demands lustrous wool, a method was developed and standardized to screen wool samples from indigenous breeds for lustre parameters. They were evaluated for reflectance and fluorescence, which have been found to relate to the lustrous appearance of wool. Among breeds Magra and Chokla were found to be superior in their lustrous appearance and are at par to the imported New Zealand wool. The commercial Mandi (Market) wools have also been evaluated for their properties and end use suitability. Dying methods are being developed using vegetable dyes.

3.5 Value addition to wool and speciality hair fibres

Value addition of coarse wool by blending has been standardized. Carpets from different types of indigenous and imported wool have been prepared and evaluated for quality. Non woven technology for value added products was also standardized. Natural colour applications on wool and wool blended products is an innovative area which has been made popular recently because of inherent virtues of such colours. Wide range of natural vegetable and animal sources could be used for extracting colours and applying the same with mordants. The colour range could be widened by using different metal mordants in different concentrations. Some natural mordants are also found its acceptance in wool dyeing with natural colours. The natural colour dyed hand-knotted carpets and knitwear helping in higher value realisation.

4. Future of Wool in India

Carpet wool is always in demand. Country imports about 100 m kg of carpet wool from New Zealand and other countries to meet the demand of the carpet yarn producing industry. It is very much desired that country should increase the carpet wool production to fulfil the demand of the industry. Stress should be to increase the fibre production per animal rather than increasing the number of animals. The indigenous Chokla, Nali, Magra and Jaisalmeri sheep wool produce good quality carpets, so production of these wools is to be augmented through selection. The established carpet wool breeds of the country are getting diluted due to intermixing with heavy bodied breeds to meet farmer's requirement of higher body weight and mutton yield which is his major source of earning, therefore, introduction of incentive schemes for higher wool yield should continued to maintain pure breed flocks. In order to enhance the wool production and meet the wool requirement of industry following breeding

strategies i.e. selective breeding; upgrading the inferior breeds by use of native improver breeds and Marker Assisted Selection for enhancing wool yield; may be adopted in region. With the increasing pressure on land for conventional agricultural production to meet the food requirement of growing population and construction of dwellings, the pasture land is shrinking rapidly as a result the stocking density on CPR is increasing progressively leading to ecological consequences. In the existing scenario and land utilization pattern it is envisaged that the country can not support more number of sheep. Hence it is necessary to increase the wool yield per animal which is also not an easy task to be accomplished as development ventures by nutritional manipulation targeted to increase wool production is uneconomical. As it is difficult to increase wool production in present land utilization pattern the thrust should be on improving quality so that the wool can be used for quality carpet and other product manufacture. Since the country has large installed wool processing capacity and growing domestic as well as international market, the wool consumption will be certainly increased in future.

Rabbit hair and Pashmina are utilized by decentralized industry and luxurious shawls and knit wears are produced from these fibres by blending fine merino wool. These products are in high demand. There is a need to augment the production of speciality fibres and to find out suitable utilization techniques, which are internationally competitive. The speciality hair processing with mechanical dehairing technology should get importance. Various product mixes by blending with other natural and synthetic fibres need be standardized.

The carpet sector will have to develop technologies for carpet production by eliminating child labour. The Khadi sector, handloom sector and knitting sectors have to be suitably modernized. The garment manufacturing activities should get boost for expansion in organized sector. Camel hair, equine hair and different type of goat hair can be used in the preparation of floor coverings by weaving and felting methods. Fine goat and camel hair felts can be utilized for outer wear purposes. Commercial transaction of such camel wool is yet to be developed.