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Study on the Possibilities to Produce Sustainable Wool Fibre in Bangladesh

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Abstract**—***Wool is a natural fibre originated from animal origin which comes from sheep hair. Sheep hair is considered as a good source of textile fibre. Commercial sheep farming is very important for producing valuable wool to help develop wool-based textile in the country. Currently, Bangladesh is producing about 3,000 tons of wool from 3.4 million sheep that are being used in producing blanket, shawl, bed-sheet and other winter clothing. Wool fibre has a good moisture content and strength which puts wool fibre ahead of manmade fibre. Wool can be blended with cotton or jute as well to produce blended fibre. Furthermore, it does not feel damp when it is wet due its inherent physical property. It is evident that though Bangladesh does not have significant impact in sheep firming but still there are huge possibilities to produce wool fibres from local sheep. The study analyses the scope that local sheep could be a used as a source of fibre considering the properties of wool fibre.*

Keywords**— Wool Fibre, vegetable fibres, Wool Industry.**

I. INTRODUCTION

Wool fibre is a natural fibre. It is called the protein fibre. Though vegetable fibres were probably the first to be used for spinning and weaving into cloth, animal fibres in the form of skins and furs were undoubtedly the earliest form of clothing used by primitive man.

Britain, therefore, first comes into the story of wool as producer of the raw material which was exported to other lands for manufacture into cloth. The small, wild sheep with black faces and long horns that supplied the wool were probably indigenous to Britain.

The Romans built a weaving factory at Winchester, from which they sent home 'wool so fine it was comparable to a spider's web'. The industry developed under Roman rule, but the coming of the Saxons in the fourth and fifth centuries A.D. put an end to the woollen trade by scattering the flocks and destroying the factories.

Fig.1 – A sheep[4]

British Wool Industry

Throughout the nineteenth century, Yorkshire gradually became established as the centre of the world's wool trade, with other areas in Britain providing tweeds and special weaves. Industrial Britain, thriving in the prosperity that steam had brought, became the greatest textile manufacturing centre of the world.

South Africa

In the dominions the story was different. Two rams and four ewes presented by the King of Spain in 1789 to the Dutch Government became the nucleus of the great dominion flocks. Bred by Colonel Gordon, commander of the Dutch East India Company at the Cape, these merinos flourished in the warm climate of South Africa. The colonization of South Africa during the nineteenth century was largely brought about by farmers seeking fresh pastures for their expanding flocks of sheep. By 1888, Cape Colony alone had 10 million sheep; by 1927, South African flocks amounted to 44 million sheep with an annual wool clip valued at £18 million. During the 1930s, drought and depression reduced the numbers. But South Africa has rebuilt her flocks and produces a wool that is noted for its fineness and softness.

Australia

In Australia, similarly, wool production has become a major factor in the economy of the country. More than 134 million sheep graze on the Australian plains; they are direct descendents of 26 ewes and rams bought in 1795 from Colonel Gordon's merino stud at Cape Town.

Fig.2- Shearing wool fibre[5]

As the number of sheep has increased so has their output of wool been multiplied by selective breeding. Modem merino flock sheep will yield 6.4kg (14 lb) of wool per head compared with 1.8kg (4 lb) of the early Spanish merinos. Over three-quarters of Australia's sheep are merino breeds reared primarily for their wool. The clip is worth hundreds of millions of pounds a year.

New Zealand

New Zealand, the third great sheep farming country, has a climate more closely resembling that of Britain. The sheep are reared to a much greater extent for their mutton and lamb. Cold storage, developed in 1882, paved the way for the rapid growth of New Zealand's meat trade, and on the great Canterbury plains are bred the Southdown-Romney crosses that supply us with our Canterbury lamb.

But New Zealand is not solely concerned with meat. Dual purpose breeds of sheep now provide "Crossbred" wool in addition to meat. With more than 60 million sheep, New Zealand is a major wool producer [1].

Wool fibres grow from small sacs or follicles in the skin of the sheep. The wool fibres grow in groups of 5-80 hairs and there are 1550-3410 per sq cm (10,000-22,000 per sq in). A typical Hampshire sheep will have some 16—40 million fibres in its fleece; a Rambouillet between 29 and 97 million, and an Australian merino may carry as many as 120 million individual wool fibres. These fibres grow on the average at the rate of 2.5cm (1 in) in two months; altogether they represent a considerable drain on the resources of the animal. [1]

Table -1 The World's Top Wool Producing Countries [3]

Rank	Country	Share of World Production (%)
1	Australia	25
2	China	18
3	United States	17
4	New Zealand	11
5	Argentina	3
6	Turkey	2
7	Iran	2
8	United Kingdom	2
9	India	2
10	Sudan	2
11	South Africa	1

Table -2 Worldwide Natural and Manmade Fibre Production [8]

FIBRE PRODUCTION				
in ,000 tonnes	2008	%	2018	%
NATURAL FIBRES				
Coir	1,056	1.4	970	0.9
Cotton Lint	23,584	31.4	26,120	23.5
Flax fibre et al.	533	0.7	310	0.3
Hemp fibre & tow	61	0.1	70	0.1
Jute, Kenaf et al.	2,588	3.4	2,500	2.2
Sisal et al.	295	0.4	210	0.2
Silk, raw	164	0.2	164	0.1
Wool, clean	1,198	1.6	1,080	1.0
Other fibres	1,076	1.4	780	0.7
Total Natural	**29,479**	**40.7**	**32,200**	**28.9**
MANMADE FIBRES				
Cellulosic fibers	3,464	4.6	6,900	6.2
Synthetic filament	25,750	34.3	49,800	44.7
Synthetic staple	15,331	20.4	22,400	20.1
Total Manmade	**44,545**	**59.3**	**79,100**	**71.1**
TOTAL FIBER	**74,024**	**100.0**	**111,300**	**100.0**

Source: DNFI

Chemical Composition of Wool Fibre :

Component	%
Wool Keratin	45
Wool wax	18
Suint	10
Water	12
Debris	15
Total	100%

Properties of wool fibre [2]

Dimensions

The dimensions of wool fibres vary between considerable limits. Fine wools are about 38-125mm ($1^{1/2}$-5 in), medium wools 65-150mm ($2^{1/2}$-6 in) and long wools 125-375mm (5-15 in). The measurement of the actual length of a wool fibre is complicated by its crimp (see below). The stretch length of a fibre may be nearly twice that of its natural length.

The average width of a top quality merino fibre is about 17µ; a medium wool fibre is about 24-34µ, and a long wool about 40µ. The fibres are therefore thicker, on the whole, than cotton fibres. Wool fibres are roughly oval in cross-section.

Crimp

The wool fibre has a natural waviness or crimp, which is unique among natural fibres of major commercial importance. The crimp does not consist of waviness in a single plane, but takes the form of a three-dimensional waviness as shown above. It is related to the spiral form of the two core sections of different constitution, which twist spirally around one another in phase with the twists of the crimp - After the Wool Bureau Inc.

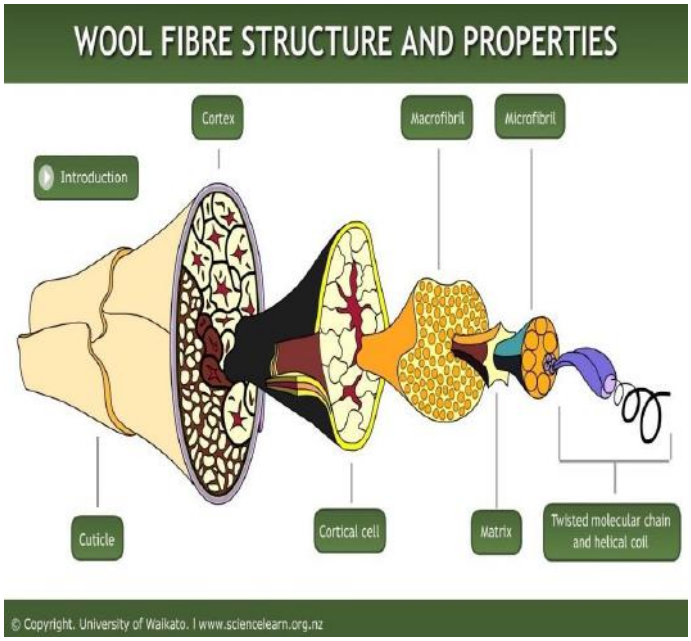


Fig.3 – Physical Structure of wool fibre [6]

Lustre

Wool fibres have a natural lustre which varies in its characteristics, depending on the type of wool.Lustre seems to depend very largely on the nature of the fibre surface. Light is reflected from the fibres in such a way as to create a lustrous appearance. The 'lustre wools' from Lincolns, Leicesters.

Colour

Most of the wool from modern sheep is white or near-white in colour. Some breeds of sheep produce a quantity of brown or black wools, the proportion being highest in the breeds that provide the coarsest wool.

Tensile Strength

Wool has a tenacity of 8.8-15.0 cN/tex (1.0-1.7 g/den) dry, and 7-14 cN/tex (0.8-1.6 g/den) wet. The tensile strength is 1190-2030 kg/cm2 (17,000-29,000 lb/in2).

Elongation

Wool has an elongation at break of 25-35 per cent under standard conditions, and of 25-50 per cent when wet.

Effect of Moisture

Wool absorbs moisture to a greater extent than any other fibre, and yields it up readily to the atmosphere. Under ordinary atmospheric conditions, wool will hold 16—18 per

cent of its weight of moisture. Under suitable circumstances, wool will absorb about a third of its weight of water

Effect of Heat

Wool becomes weak and loses its softness when heated at the temperature of boiling water for long periods of time. At 130°C. it decomposes and turns yellow, and it chars at 300°C. As it decomposes, wool gives off a characteristic smell, similar to that from burning feathers.Wool does not continue to burn when it is removed from a flame. Each fibre forms a charred black knob; this is a test used in the identification of wool.

Effect of Age

Wool shows little deterioration when stored carefully.

Effect of Sunlight

The keratin of wool decomposes under the action of sunlight, a process which begins before the wool has been removed from the sheep. The sulphur in wool is converted into sulphuric acid; the fibre becomes discoloured and develops a harsh feel. It loses strength and the dyeing properties are affected. Wool subjected to strong sunlight is particularly sensitive to

alkalis, including soapy water.

Effect of Acids

Wool is attacked by hot concentrated sulphuric acid and decomposes completely. It is in general resistant to other mineral acids of all strengths, even at high temperature, though nitric acid tends to cause damage by oxidation. Dilute acids are used for removing cotton from mixtures of the two fibres; sulphuric acid is used to remove vegetable matter in the carbonizing process.

Effect of Alkalis

The chemical nature of wool keratin is such that it is particularly sensitive to alkaline substances. Wool will dissolve in caustic soda solutions that would have little, effect on cotton. The scouring and processing of wool is carried out under conditions of low alkalinity.

Even weakly alkaline substances such as soap or soda are used with care. Soda will tender wool and turn it yellow if used in too concentrated a solution, particularly if the solution is too hot. Ammonium carbonate, borax and sodium phosphate are mild alkalis that have a minimum effect on wool. Ammonia, carefully used, will not

cause damage.

Effect of Organic Solvents

Wool has a good resistance to dry-cleaning and other common solvents.

Insects

Wool is attacked by moth-grubs and by other insects. (See 'Wool in Use').

Micro-organisms

Wool has a poor resistance to mildews and bacteria and it is not advisable to leave wool for too long in a damp condition.

Scope for sustainable wool production

Government took a developmental project titled "conservation and improvement of native sheep through community and commercial farming (component A, research -2ndphase) project" at Bangladesh Livestock Research Institute under the Ministry of Fisheries from July 2012 to June 2019.

The project was actually promoted to help the rural farmers of Bangladesh to survive their poverty and to make the sheep farming sustainable.

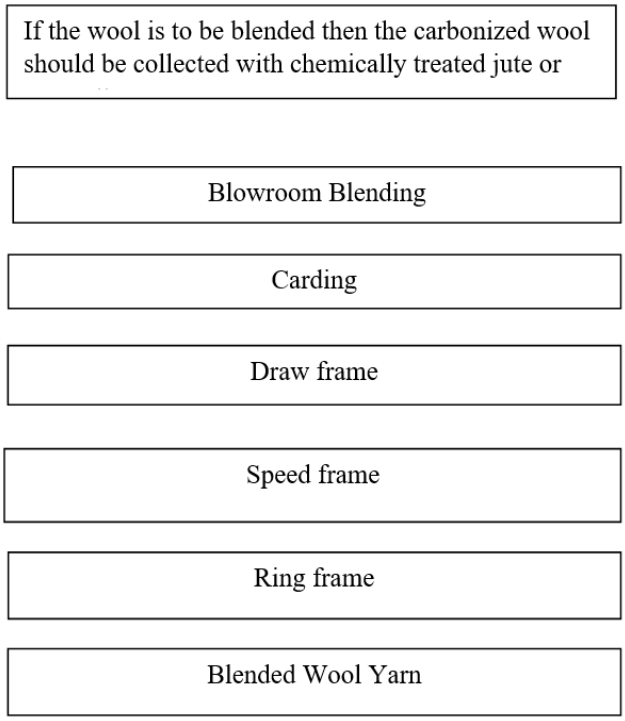
The project highlighted for the production of good quality yarn and fabrics from the combination of wool, jute and cottons.

Furthermore, with the help of this project, three high yielding pure breed namely suffolk, perendale and dorper were imported from Australia on March 2016 and reared them for adaptation and crossing with native sheep through natural service and artificial insemination with frozen semen for upgrading countries native breed.

This type of research activity should continue to get the sustainable outcome. Under this project, sheep was reared in the hilly area of Bangladesh for the first time for observing its feasibility in this area. It gave good results. At present the farmers of hilly area are showing interest in rearing sheep. As this project was undertaken in a small area of Bangladesh it needs to take getting more such project for serving all over the Bangladesh.

For producing wool blended yarn at first have to select the sheeps to be sheered . After shearing the collected sheep wool should be washed with detergent and carbonized with 6% H_2S_04 and then baked for 3 minutes at 150°c. If it is required to be blended with jute or cotton fibre then have to follow the following procedure to poroduce wool yarn.

It is to be mentioned that a sheep may yield 15.2.5 kilograms of wool in a year.



II. CONCLUSION

The possibilities to rear sheep is enormous in Bangladesh. To collect wool fibre from the reared sheep can be done with a proper plan which will definitely need the help or support from the government and private sector. The govern should launch further projects with the country's textile universities. The private sector or textile industries should come forward to build a sustainable research hub to engage the local; wool fibre to create a substitute sustainable source of wool and allied yarn. There is no substitute for research activities in this sector to produce sustainable wool fibre. The farmers should be encouraged to promote sustainable rearing of sheep to provide quality wool fibre. There is surely an opportunity for the local reared sheep to produce wool. Again, the government and the private sector entrepreneurs are the two key entity for this huge prospect.

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