Presentation to EIHA Conference, 2004-10-19

The potential market for Hemp fibre in the Textile Market

Ladies and Gentlemen

Introduction

My objective in making this presentation today is very simply to discuss why hemp has so small a share of the textile fibres market; to examine in a little detail the technological and other reasons which, at present, prevent is from increasing this share; to try and identify the size of the potential market for these fibres should we manage to overcome these problems and finally to assess the possibilities of overcoming these technical and other disadvantages and so putting hemp in a position to increase its penetration of the textile market

Why has Hemp so small a share of the textile market?

Of the world to total consumption of textile fibres of 53 million tonnes last year about cotton supplied a some 19.5 million tonnes or about 36% of the market, and polyester staple fibre 9.25 million tonnes.

These two fibres, together with some other relatively small contribution from other fibres such as hemp and flax constitute what I will call, for the sake of convenience, the 'cotton type market'.

Table 1: The 'Cotton Type Market: Production in 2003

	Tonnes (thousand)	Share %
Cotton	19.529	63,6
PESF	9.241	29,6
Regenerated Cellulose	2.000	6,4
Flax	350	1,1
Hemp	70	0,2
Total	**31.190***	

*56% of world textile fibre production

It is. I think, appropriate to make a short comment at this point on the validity, or otherwise, of textile fibre production statistics. Fibre Organon, and Cotlook produce statistics for synthetic fibres and cotton respectively which are reliable. Other vegetable fibre statistics are often based on statistics produced by the Food and Agricultural Organisation in Rome and these are only as reliable as the figures supplied to them by the countries in which the fibres are produced. Unfortunately some of these countries do not produce reliable figures and in the case of flax and hemp I have used the FAO figures but adjusted them according to information that I have obtained from personal contacts. The regenerated cellulose fibre figure is based on Fibre Organon publications but these do not include Lyocel, presumably because this fibre is now only manufactured by one company and therefore their production statistics could be considered to be confidential. However, based on information which has been published I have made, what I believe to be, is a reasonable estimate and in any event it does not affect the basic issue, which is hemp's negligible proportion of the market.

In have not included in this table fibres such as bulked polyester or nylon filament yarn, and acrylic staple fibre although 'cotton type' fabrics are made from these fibres because the quantities produced that are made into garments, household textiles and furnishing fabrics for this market sector are difficult to quantify from the available statistics and also, in my view, are probably largely compensated for by the fact that not all PESF does go into these markets. Substation tonnages are used in other end-uses such as, for example, geo-textiles and fibrefill

In the textile industry the sensible way to look at a fibre's position in relation to other fibres is not only, or even principally, to look at their prices and technical characteristics. One needs to compare the commercial (including prices) technical and aesthetic qualities (such as handle, drape and appearance) of the finished consumer products made from these fibres

Bearing this in mind it is self-evident that hemp's major end-use is in the 'cotton type textile' market and it is with these other three fibres that it is competing, but why does hemp have such a small share of the market, much less than 1%.

I am sure that most delegates to this conference have a very good idea of the answers to this question but it will clarify our minds, and lead us to possible solutions if we examine them in a little detail.

I suggest that the basic problems are, when compared to other fibres in the 'cotton like textile' group:

Table 2

1)	Relatively higher risk involved in fibre production
2)	Relatively high fibre production and processing costs
3)	Limitations in the fineness of the yarns that can be spun from currently produced fibres
4)	Competition with flax

Relatively higher risk involved in fibre production
As we all know, flax is a bast fibre and the usual way of separating the fibres from the plant is to ret them.

This retting process requires that the stalks to lie on the fields for several weeks and is inherently risky because during this time meteorological conditions may be either too wet or too dry both of which will reduce fibre quality and yield. This is a risk that neither cotton nor PESF have to face (but flax does) and therefore is an added cost.

Not all hemp stalks are ground retted in this way, in some countries water retting is still carried out and whilst this eliminates the extra meteorological risk it entails added labour costs and possibly energy costs' if heated water is used. These are again costs that hemp's fibre competitors do not have to bear

Relatively high fibre production and processing costs
There are several reasons why these are high.

- Even ground retting involves extra labour costs when compared to cotton and PESF because the stalks are harvested and laid out in the field, Ideally they should the be turned, and if the fibres are to be used for textile processing this, in my view, is essential as it is necessary that all parts of all stalks be retted to as much the same degree as is possible. Otherwise fibre yield and quality will suffer. This turning is an extra process, and therefore entails costs.

- One could imagine that just harvesting hemp, without taking into account turning, should not be more expensive that harvesting cotton but it is, because the hemp stalks are cut and laid on the ground, and then a few weeks later they are lifted, cut and baled. The latter operation requires a specific agricultural machine and the whole series of processes take more time than one simple harvesting operation.

- Of course all textile processing carry costs but hemp (and flax are more expensive than cotton or POSF because the technology and machinery used are older and not as efficient. To give an example labour costs in a modern spinning plant come t6o about 5% of total Production costs whilst using the most up to date wet spinning machinery entails labour costs of around 20% to 25% of production costs.

- A further ‘opportunity’, but for all that, real cost is very large ‘wastage due to the somewhat basic technology of scutching. After retting and drying the fibres are relatively brittle and during the beating which they receive during this process a substantial proportion of the fibres originally in the plant stems reduced to either fibres too short to process or to dust. I have been quoted the figure of 70% for the level of this fibre wastage but I have not seen the results of scientific trials to confirm this high figure, but I do believe the loss to be very considerable.

- Another higher cost is due to the normally greater loss of fibre during processing. Again this is due to the older technology of the machinery concerned

It would be reasonable to ask why is hemp (and flax) textile machinery less efficient than that used by other fibres. The answer given by the machinery manufacturers is simple. R & D costs in developing new technologies and their applications are considerable and the size of the hemp and flax markets are too small to warrant such investments. Frankly, bearing in mind that the total annual production of these two fibres is less than half a million tonnes, one can understand their point of view!

Limitations of the fineness to which hemp fibres can be spun

Bearing in mind the thickness of fibres produced by the present dry spinning process and their smooth surfaces, which provide little fibre to fibre friction during yarn preparation and spinning, just about the finest count that can be spun from these fibres is 10s metric (100 tex). For all practical purposes the lightest weight fabrics that can be woven from these yarns is about 350 gr/sq.m. This would qualify as ‘bottom weights, suitable for trousers and skirts, and of course for furnishing fabrics. However it does exclude all middle and light weight apparel, furnishing and household textile fabrics and therefore from a very important sector of the market.

I have heard that here are small quantities of finer count hemp yarns, of up to 35s metric, usually wet spun hemp yarns on the market but the prices seem to be very high and it seems to me that these are only of marginal interest.
Cotton, Flax and PESF have no such limitations and can spin counts of over 100s metric, admittedly using high quality and therefore costly raw materials.

Competition with flax

Flax and hemp are both bast fibres and the fibres are extracted from the plant stalks and spun into yarns using broadly similar technology
As far as consumers (and most people in the textile industry) are concerned it is practically impossible to notice any differences between flax and hemp fabrics of the same weight and construction. Microscopic examination is necessary to identify which is which. Their performances are also very close with hemp possibly having the advantage of slightly greater abrasion resistance. Hemp is also more ‘ecologically sound’ as it requires little to no weed control chemicals and less or no insecticides

But when compared to hemp, flax has a long established and good ‘image’ and has been well promoted. Flax can also be spun to finer counts of up to 35s metric (32 tex) and possibly finer and thus has the entire range of apparel weight fabrics open to it.

A further similarity between the two fibres id that the plants both grow in temperate climates

As far as price is concerned it is difficult to make precise comparisons as the range of hemp fabrics at present available is limited to heavier weights and also because the price of flax can fluctuated between a wide range, and has done so over the past few years. However it would not be an unreasonable assumption to believe that were all thing equal and using present day technology the price ranges of the two fibres would be broadly equivalent.

The size of the potential market

Table 1 showed size of the ‘cotton type’ market in 2003. From this it is obvious that this market is completely dominated by cotton and PESF

Fig. 1: Production of ‘cotton type textile fibres 1990-2004 (Thousand tonnes)

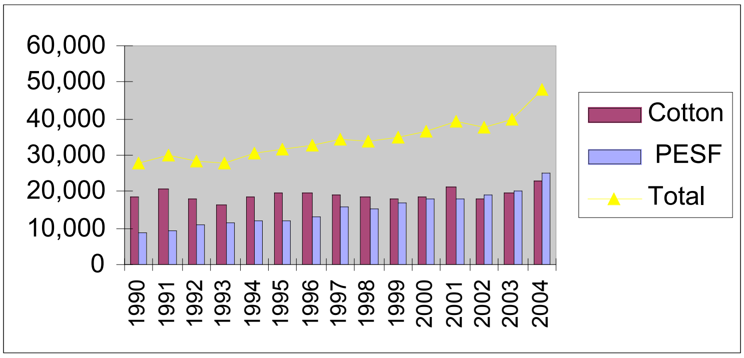
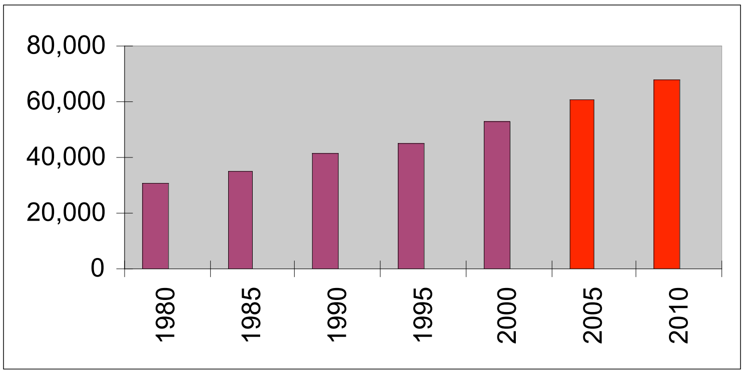


Figure 1, show how the relationship between these two fibres has developed since 1990. It is particularly interesting to note from this that the production of cotton has stayed relatively steady between 17 to 20 million tonnes per year whilst PESF has increased from just over 5 million tonnes to nearly 10 million. What is surprising is that despite the fact that world textile consumption (Fig 2) has increased during that period from 41.2 tonnes in 1990 to 56 million tonnes in 2003, an increase of 36%, cotton has scarcely increased at all and PESF has more than doubled so that the market for ‘cotton type’ fibres as a whole (Ignoring hemp and flax whose inclusion would be so relatively small as not to affect the issue) has increased by 44%.

Fig. 2: Total World Textile Consumption 1980-2010 (Thousand tonnes)



We need to ask ourselves why cotton’s production has remained almost static in comparison to PESF and is this situation likely to continue? One reason is certainly price.

The prices of ‘cotton type’ fibres

All textile fibre prices fluctuate according to supply and demand and the effect of changing monetary exchange rates and this is certainly true of cotton, as the following figures, supplied by Cotlook, show:

Year	**Price** (US$/kg)
1994/5	2,49
2001	0.90

These are, of course, extremes, and I suggest that for our purposes to take $1.70/kg as a reasonable basis for discussion

PESF prices also vary, from around $0.0 to $1.0 but present prices are around $.80. However these might well increase if the price of oil remains as high as it is at the moment, or perhaps even increase

Bearing these prices in mind we can divide those staple fibres which share the apparel, furnishing fabric and household textile markets into 3 groups

i) The ‘main market fibres: Cotton and PESF
Price range from $0,80 to under $2 per kg
ii) Middle priced fibres. Wool, Regenerated Cellulose, Flax, Hemp.
Price range $2 to $5 per kg
iii) Luxury fibres. Silk, Cashmere, etc
Price range $5 per kg upwards

It is clear from these prices that if a fibre is to penetrate the main market it must be priced at under $2 per kg. The most important of the group ii) fibres, each of whose production is in the 2 million tonnes per year range, are wool and regenerated cellulose fibres.

But in our view, and I have discussed this with Cotlook, which is an independent organisation that analyses the world’s cotton industry, the price of cotton is not the only factor that affects the amount of cotton grown in the world.

The successful cultivation of cotton requires well-watered land in Mediterranean or sub-tropical climates; but so do many food crops, such as maize, soya and many others. But practically all such land is already under cultivation and producing either food or cotton, with only one exception of any size, the Mato Grosso province of Brazil. A few years ago Queensland in Australia was the object of great expectations but this has proved to be disappointing and cotton production from that country is now decreasing. This shortage of land has undoubtedly limited cotton production and is, probably, a reason for the relatively high price of the fibre.

However the outlook for cotton production is not entirely negative. This year, again according to Cotlook, the harvest is expected to meet 23 million tonnes, compared to 19.5 million last year. This increase is due partly to unusually favourable meteorological condition over the northern hemisphere countries which produce the fibre and which account for 75% if the world's production of cotton, but also to the increases in yields in certain countries. In turn these yield increases are the result of more efficient farming, including the use of genetically modified cultivars, which, in turn require less pesticides and thus also reduce costs. If such improvements in yields can be maintained, or even spread to other countries, then the world's production of cotton could continue too increase.

To illustrate this point I will give you one example, India. Again quoting Cotlook, average yield over the past three years in the USA and India have been 768 and 311 kg/ha. respectively. Should India close this gap even by half, which would be equivalent to an increase in their yield of nearly 75%, their increase in production would be about 1.5 million tonnes. This is not likely to happen in the immediate future but it does give food for thought.

The future of PESF, on then other hand, is reasonably easy to foresee. It takes one to two years to build a Polyester plant and the required intermediate chemicals facility and it can be assumed that present suppliers, and others who may join them, will build sufficient capacity to supply the market.

But what is this future market of cotton type' fibres likely to be, in terms of millions of tonnes, because this is, after all, what interests us.

We know the present size of the market (fig 1) and so to estimate its future growth let us consider the following:

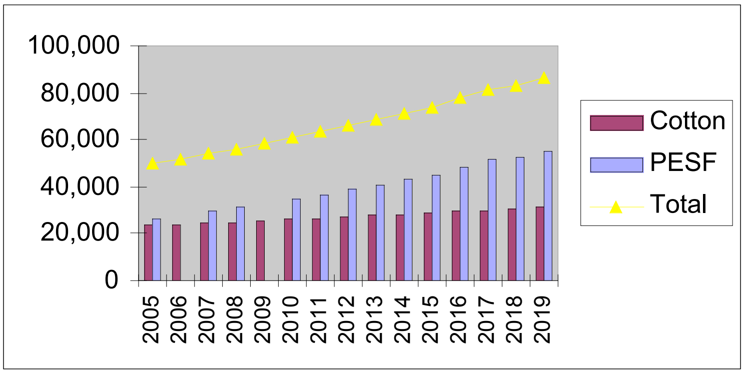
a) World fibre consumption increase at a rate of about 3.4 % per year; due to the increase in world population and the increase in the standard of living of living of a large part of the world's population.

b) Over the past 15 years 'cotton type fibre production has increased at a rate of nearly 5.5% annually (fig 1).
There is, of course, no certainty that this increase of 5.5% will continue in the future, so in my estimates I have taken the more modest rate of 4%.

c) Cotton has increased its production by 1.7% per year (fig 1), but bearing in mind possible increases in yields I am taking 2% per year as the increase in cotton's production

Fig 3 shows the extrapolation of these 3 assumptions

Fig. 3: Forecast 'cotton type' textile fibre production 2005-2030



The difference in the 2% increase for cotton and the 4% increase of the total market will be taken up by PESF, and to a small extent by the possible growth of regenerated cellulose fibres, Flax and hemp scarcely come into the picture.

Naturally these projections must not be taken literally. They are made to illustrate the reasoning behind my colleagues' of the BioRegional Development Group and my decision to examine, seriously, the possibility of producing a hemp fibre which could compete with PESF for a share of this market. We also think that it will be difficult for cotton to double its present production in the next 25 years, bearing in mind their constraints, but this lack of cotton would make PESF's share of the market even larger.

This market will be huge. In 5 years time it could reach 35 million tonnes and even if hemp could take only 10% of this it would come to 3.5 million tonnes. This would require about one million hectares to grow the plants. In 10 years this could more than double and I would add that this development would be specially beneficial to Europe since we have a great deal of land which is either under-used (in Eastern Europe) or used to produce more food than we need (in Western Europe)

But why do I believe that we could obtain even 10% of the market?

Once we have overcome hemp's present disadvantages, and I hope that I have persuaded you that it is worth trying to do so, hemp has certain real advantages over PESF.

- From the consumers' point of view: it is a natural fibre, comfortable to wear and use, and biodegradable. These are qualities that PESF does not have
- From broader economic and ecological viewpoints it would be grown in Europe thus improving the income of farmers by cultivating many millions of hectare, many of which are at present not used to the best advantage of the community, to produce crops which need little or no chemical fertilisers and pest control chemicals.

This may also help us to revive our textile industries because I doubt if it would make economic sense to ship the fibre from Europe to Asia to be spun and woven. I am convinced that this renewal of textile manufacture in Europe will happen, perhaps sooner than many people realise. This is because of such changes as the 'just in time' requirements of retailers and therefore the growing necessity of suppliers moving geographically closer to their customers. These matter will grow in importance as it becomes clear that they affect companies' profits more than reducing labour costs, and especially as these become an ever smaller proportion of total costs now that these have to include significant expenditure in marketing, promotion and R&D. Hemp fibre, grown close to the final user, will help in this renaissance of the industry.

How do we overcome hemp's present problems?
These are listed in table 2

I am sure that many of you will have ideas concerning these problems and indeed, have worked on them but I offer these points that my colleagues and I have developed for what they are worth.

Relatively high risk in fibre production

This is due to the necessity of field retting

In our view the most likely solution is to eliminate field retting and develop an alternative method of separating the fibres from the rest of the plant. This could be done in two ways:

a) By developing more efficient and less costly methods of water retting, probably by using enzymes. But even if successful this would not be ideal because it does not eliminate the need to scutch the stalks which is, as we have seen above, a wasteful process. Labour costs in water retting will also be high unless efficient mechanical handling processes can be developed.
b) By mechanically separating the fibres from the stalks, in other words, ribboning, as is done in the primary processing of some other bast fibres.
c) This would necessitate the subsequent removal of the pectic gums. This is much more difficult than it would seem to be as ideally, it need to be done immediately after ribboning before the gums have dried and hardened. Also the gums must nor be entirely removed as the ultimate fibrils that this would produce would be too small to spin.

   In this last respect some basic scientific research is necessary because it seems that little is known about the chemical and physical characteristics base of these gums and without a sound scientific base technological progress is a hit or miss affair.

   After degumming the fibres in the ribbons would need to be dried, separated and cut or broken to the thickness and length required but it should be possible to adapt known textile process and machinery to this end

   A further problem would be to ensure that the ribbons and subsequent fibres start off and remain parallel during processing. Otherwise, if they become entangled further processing will be required to straighten them and this will cause extra cost and fibre wastage. Here again present textile machinery and processing could perhaps be adapted.

Relatively high fibre production and processing costs

These are due to two causes:

a) High fibre loss and damage during scutching, and hackling (if this is to be done). These two processes would be eliminated if the fibres were ribbonned and degummed, and not retted.
b) The relative inefficiency, both as to labour costs and machine productivity. The suggested answer is to produce a fibre that can be spun by the short staple route, as are cotton and PESF

Limitation as to the fineness of yarns that can be spun from hemp fibres.
This is due to the relative coarseness of present hemp fibres and the solution would be to degum the ribbons than is done at present by field or water retting

Competition with flax
Should it be possible to produce fibres as fine as flax (about 25 microns), the fact that hemp could yield 3 to 4 tonnes per hectare, and flax's maximum is about 2 tonnes/ha should give hemp an immediate price advantage.

Conclusion
Our conclusion is that the market is there, but the product isn't, but could be.

To overcome the scientific and technological barriers would require a great deal of work and a substantial amount of money. It is true tat over the past ten years or so many projects have been funded by different governments and the EU, and a lot of work done. However I suggest that, as far as producing a fibre for the major sections of the textile market, not many results have been achieved

In our opinion this is because the problem has never been attacked in its entirety, as a whole. Individual aspects have been researched but not always to good effect because the results did not fit into the 'jigsaw puzzle' which is the whole chain of plant growing, fibre extraction and textile manufacture, marketing and distribution. These again, in our view, are problems which can only be solved by harnessing all the different skills and experiences required.

This requires a major R&D effort, and a certain amount of scientific research. It would need to cover a whole range of disciplines: agronomy and agricultural engineering, plant biochemistry, enzyme processing, mechanical engineering and textile engineering, economics and marketing.

At BioRegional Development we have already done a certain amount of work which I will briefly describe in a few moments and we are now thinking about our next steps. We would be very pleased to discuss possibilities of working with individuals or organisations that could be interested in joining in a co-operative effort aimed at overcoming the obstacles that are in our path

We would add, and emphasize, that the ideas that I have outlined are ours and we certainly do not claim to be the only peoples with ideas on these subjects. These are big problems, which need all the good ideas and good will that are available and that can be joined together so as to attain the objective of a reasonably priced hemp fibres, that can be spun on the short staple system.

Recent work in the UK

This will be a very brief outline of the work carried out by the Bioregional development group in the UK over the past 18 months or so.

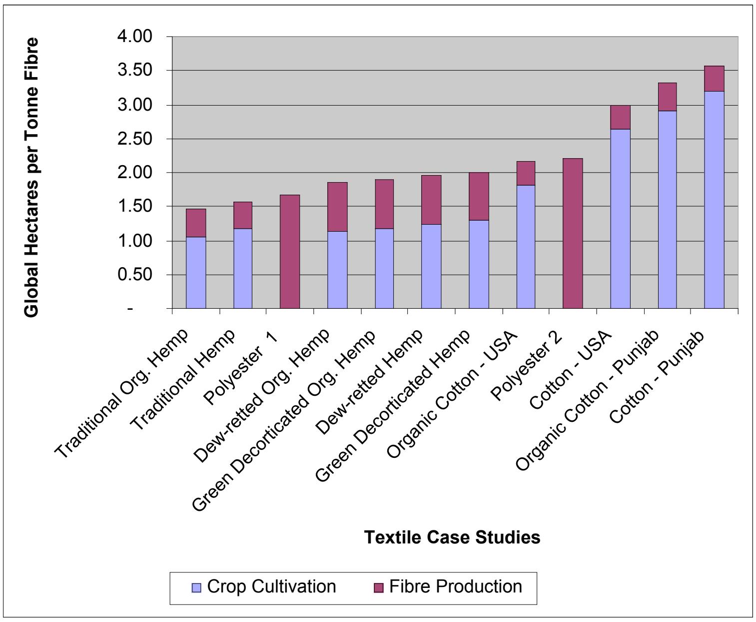
We obtained funding, mainly from the UK ministry of Agriculture but also partly from other organisations, including Marks and Spencer.

BioRegional began a new programme of work in 2003, commissioning agronomic engineers from Cranfield University to assess newly identified technology based on mechanically separating the bast fibre from hemp stalks without the need for retting (green ribboning). This technology had been developed by Fibrenova Pty Ltd and Williames Hi-Tech Pty Ltd, Australian companies, and it was claimed to produce a fine white fibre within days of harvest at comparable prices to cotton and flax.

Fields trials were carried out in the UK during July 2003 and in Australia in January 2004, in which Cranfield University assessed the technical feasibility of the systems presented for use in the UK. An ecological footprinting study was also undertaken by the Stockholm Environment Institute in York to compare the environmental impact of hemp fibre with cotton, organic cotton and polyester. Resulting fibres from the field trials were then processed and assessed by BioRegional for their suitability as textile fibres.

Open day for stakeholders,
Battle UK, July 2003

The fibre produced in UK field trials was chemically cleaned with publicly available methods, and then carded in preparation for spinning on the cotton system. However, the resulting fibre was found to be lacking homogeneity in length and diameter, making spinning difficult. Yarns were produced at a UK ring spinners, but only in blend with viscose. It was concluded that green ribboning had great potential, but that the subsequent stages of storage, mechanical handling and removal of pectins required further refinement to yield a useful textile fibre. BioRegional have formed a consortium of partners along the production chain, and intend to develop a more controlled system suitable for the UK, based on the green ribboning approach, to make sustainable and economic hemp textile production a reality.



The Ecological Footprint represents the amount of land area required to provide all the necessary resources and absorb the waste to produce a given unit of each textile, within the Earths biological capability to regenerate them.

Hemp was found to place significantly lower demands on the earth's available resources than cotton and polyester.