

## **The European Hemp Industry: Cultivation, processing and applications for fibres, shivs and seeds**

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Hemp is a multi-purpose crop delivering fibres, shivs and seed. The fibre is used today for cigarette paper, insulation material and biocomposites. The shivs, the woody inner core of the stem, are used for animal bedding and construction. Hemp seeds, small nuts, have a high nutritional value, Hemp oil has an excellent and unique fatty acid profile. Both seeds and oil are used for human food and animal feed.

Industrial hemp has been grown in Europe for many hundreds of years. Through the Middle Ages and until the end of the sailing ship period Hemp was an important crop in many European countries like The UK, France, The Netherlands, Germany, Spain and Italy. Most important applications for the strong fibre were canvas for sails, sacks, canvas water hoses and fabrics as well as ropes.

Today Hemp is a niche crop, cultivated on 10,000 to 15,000 ha in the European Union. Because of its unique properties, particularly its environmental benefits and the high yield of natural technical fibres, hemp is a valuable crop for the bio-based economy.

The European Industrial Hemp Association (EIHA) conducted in summer 2012 the first comprehensive survey on cultivation, processing and especially applications of hemp fibres, shivs and seeds. It is the most detailed market analysis of European Hemp ever carried out. This reports presents the main results of the survey.

### **Basic data on cultivation and processing**

The survey covers the harvest of 2010, related to a total cultivation area of 10,480 ha and 14 Hemp processing companies, as well as two associations of Hemp processing companies. In the official EU statistics 10,617 ha are shown for the cultivation year 2010 – that would mean that the survey covers 98.7% of the EU cultivation area. The first figure shows the development of the cultivation area since 1993. Between 1993 and 1996 the cultivation of industrial Hemp was legalised in most of the member states, some followed later. In 2011 the cultivation area decreased to its lowest value since 1994 (ca. 8,000 ha), but increased in 2012 again to 14,000 ha. That means that the Hemp cultivation area in the EU over the last ten years was between 10,000 and 15,000 ha, except 2003 (18,000 ha) and 2011 (8,000 ha). The main cultivation member states are France, The UK and The Netherlands. Since 2011 Hemp cultivation in Germany has virtually ceased because the main processor moved to France due to strong land competition from highly supported bioenergy and biofuel crops in Germany.

From the existing processing capacity the cultivation area could be extended to at least 20,000 ha without additional investment. This means that an increasing demand could easily be covered.

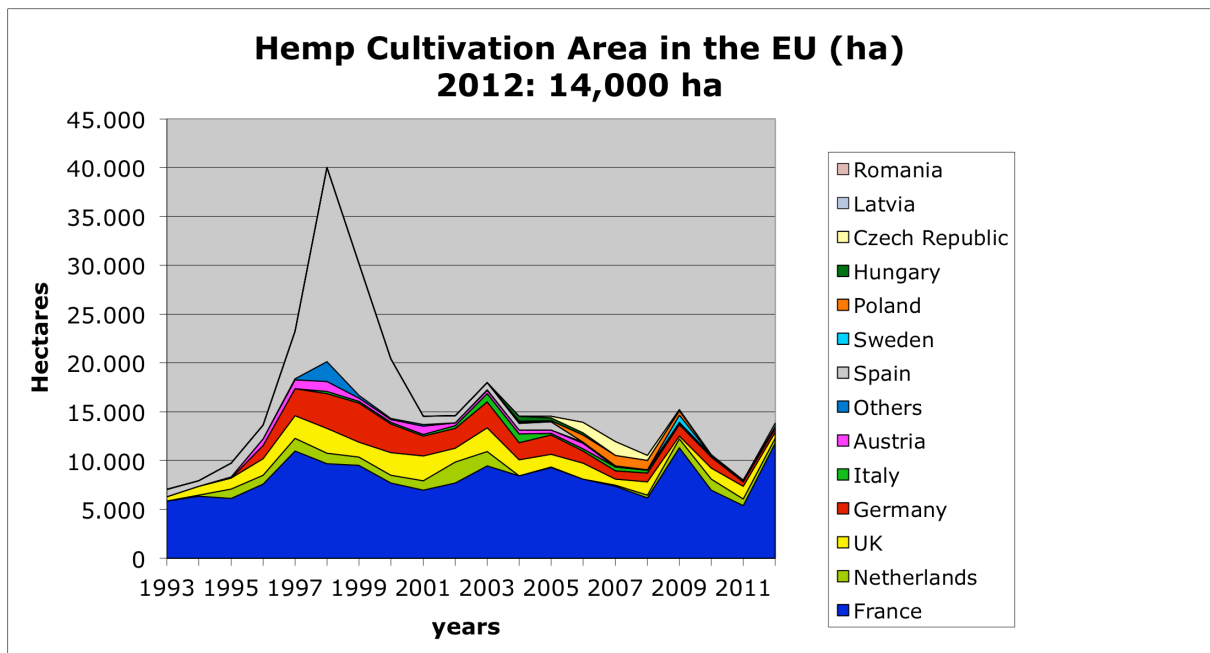


Figure 1: Hemp Cultivation Area in the EU 1993 - 2012, Source: EU Commission 2012 – data for 2012 estimation only

From the 10,480 ha in the year 2010, 76,095 tonnes of Hemp straw were harvested. This means an average straw yield of 7.3 t/ha – greater than the average of 6 t/ha established over many years

The 76,095 tonnes of Hemp straw from harvest 2010 plus additional ca. 5,000 tonnes from stocks were processed into:

- 25,589 metric tonnes fibre (including 2 to 25% shivs, depending on the application)
- 43,621 metric tonnes shivs (woody core of the stem)
- The relation between shivs and fibres (shivs : fibres) is equal to 1.8 to 1
- 11,439 metric tonnes of dust (20% pelletized for incineration, 80% other uses)

Hemp straw in Europe is only processed in a so called total fibre line, producing random non-aligned technical fibre. This is in contrast to Flax, processed in long fibre processing lines, which produces a high value aligned, long textile fibre and a technical short fibre in a similar form to Hemp.

Some processing companies also harvested Hemp seeds and others Hemp flowers:

- 5,991 tonnes seeds / nuts
- 7.5 tonnes of flowers for medical applications and the production of essential oil (for food and beverages)

It should also be mentioned that Hemp is one of the very few crops in Europe, which is cultivated on non-organic farms without the use of any agrochemicals. Strong, fast growing Hemp crops are able to suppress weeds without chemical support and the crop does not suffer from any pests or diseases that would warrant a spray. Hemp also grows well under an organic regime.

## Applications for Hemp Fibres

Hemp fibres have some of the best mechanical properties of all natural fibres. They are mainly used for insulation material and for bio-composites in automotive applications.

Before the rediscovery of industrial Hemp in Europe in the 1990s, Hemp fibres were mainly (> 95%) used for **speciality pulp & paper**. Because of the high price of Hemp pulp – about five times higher than wood pulp – the applications were limited to a very few applications: technical filters, bank notes, bible paper and cigarette paper. The only well established market for Hemp pulp is the cigarette paper market. More than 90% of the Hemp pulp mixed with Flax pulp is going to this market. The Hemp pulp market was a relatively stable market during the last decades, but on the other hand there is no market expansion expected and the market is risky, because from a technical point of view, today Hemp and Flax pulp could be substituted by Kraft wood pulp with specific additives. When the Euro was introduced in 2002 a big opportunity was missed. Instead of using US cotton pulp, European Flax and Hemp pulp for banknotes would have been an environmental friendly and tamper-proofed alternative with benefits for the European economy.

Nevertheless, also in the year 2010, Hemp pulp & paper with a share of 55% is still the most important market for European Hemp Fibres, covered mainly by French producers, see Figure 2 for details.

Due to a lot of research and development in the 1990s financed by the European Commission and the Member States, new applications for Flax and Hemp Fibres could be realised like biocomposites (see blue shares in Figure 2 and 3) and insulation material and other non-woven applications (see green shares in Figure 2 und 3).

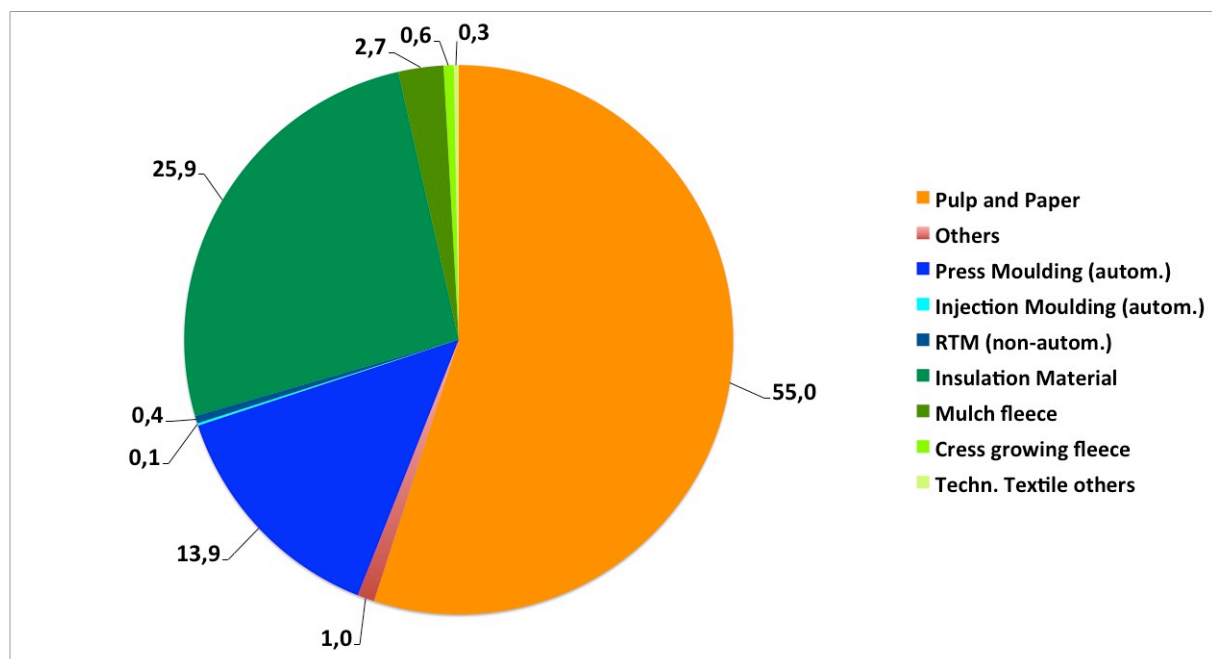


Figure 2: Applications for European Hemp Fibre from harvest 2010, in total 26,000 metric tonnes (EIHA 2012)

Today (early 2013) the price range for Hemp fibres lies from about 50 Eurocent/kg for the cigarette paper industry (ca. 25% shiv content) to around 75 Eurocent/kg for automotive and insulation (2-3% shiv content).

**Insulation material** is the second important application for Hemp fibres today. Insulation material is accounting for 25.9% of the applications (Figure 2) or without pulp & paper 58.5% (Figure 3). Together with other non-woven applications like mulch fleeces which are used in

gardens and agriculture, cress growing fleeces in some European countries are the dominant product for cress cultivation) and other non-wovens such as mats for piglets, the share of this applications group is 29.2% .Without pulp & paper this share is 66.4%.

Non-wovens as a final product or precursor for biocomposites can be produced with different technologies like needle punch or air laid – the latter is increasingly used in modern natural fibre insulation material production.

In all the above mentioned non-woven applications the use of Hemp fibre could still grow significantly. In some applications the natural fibre solutions are price competitive giving extra benefits (cress cultivation, mulch fleeces); in others like insulation Hemp is 2 to 4 times more expensive compared to glass or mineral wool. Therefore although Hemp insulation gives additional benefits regarding health (non-irritant to the handler), moisture flow and heat capacity, only eco minded niche customers tend to choose this option.

**Biocomposites** account for 14.4% of the applications (Figure 2) or without pulp & paper 32.7% (Figure 3). The only really established biocomposite market is press (or compressing) moulding in automotive interior applications with a share of 96% of all biocomposites. That corresponds to more than 3,700 tonnes of Hemp fibre or about 7,500 tonnes of biocomposites (natural fibre content varies between 30 and 70%).

Automotive biocomposites for interior applications are still a growing market and are used for door panels/inserts, trunkliners, spare wheel covers, parcel trays, headliners, A-B-C columns and many more. Biocomposites are mainly used in the German automotive industry, followed by French and Czech Republic industries. Biocomposites show light weight (low density), good accident behaviour (no sharp edges, good energy absorption), have a high bio-based share and are price competitive in high-quality interior concepts.

Hemp Fibres here are in competition with flax, jute, kenaf and sisal fibres, with a recent market share of between 10 to 20%. Therefore we believe the total market and the share of Hemp fibre can further increase. Technical short Hemp fibres could be produced over the last ten years at an attractive and stable price because the production was only for industrial applications (speciality pulp, bio-composites, insulation), and not dependent on other markets like textiles. Compared to almost all other agricultural raw material including other natural fibres, the prices are unusually stable (see Figure 4).

Natural fibres can be processed in many different ways to produce biocomposites. Also only press moulding is well established, different other technologies are used for a wide spectrum of high quality applications. These include Resin-Transfer-Moulding (RTM), which is used for high-performance products like furniture (chairs and tables) and yachts, and injection moulding which is used with natural fibres in different consumer goods, for example trays for grinding discs, urns and also in some automotive interior applications. Due to new developments for feeding and dosing the Hemp fibre in a more suitable way using short cut fibres or soft pellets, it is expected that natural fibre injection moulding will be used in more and more applications.

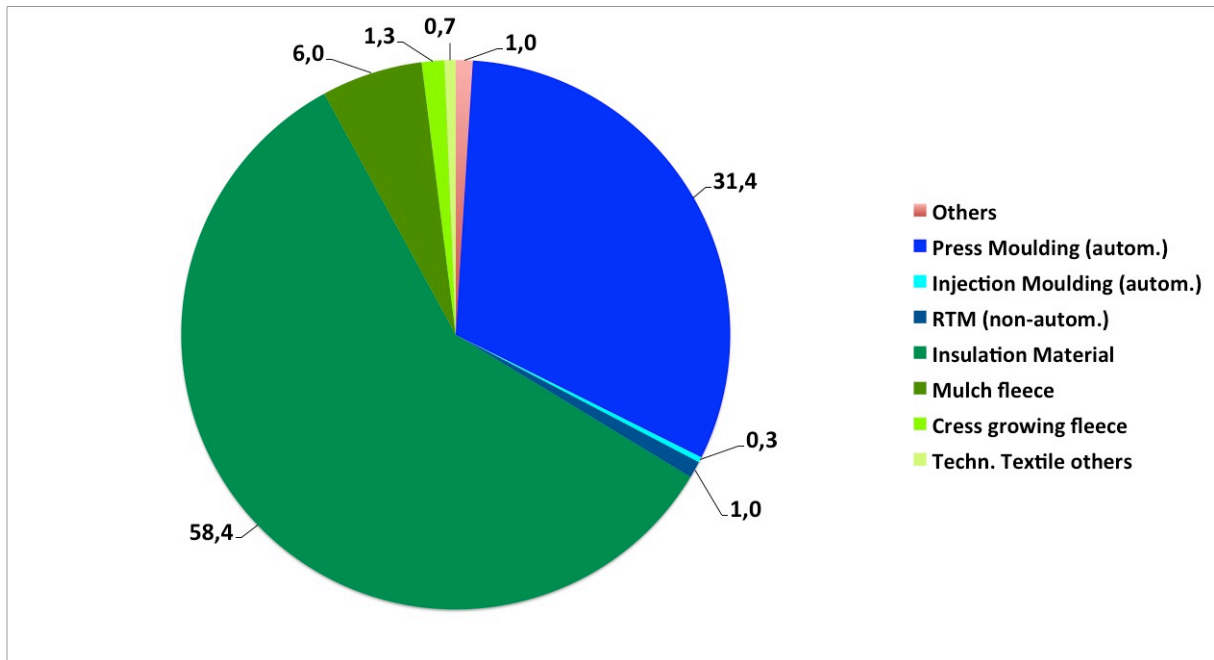


Figure 3: Applications for European Hemp Fibre (without pulp & paper) from harvest 2010 (EIHA 2012)

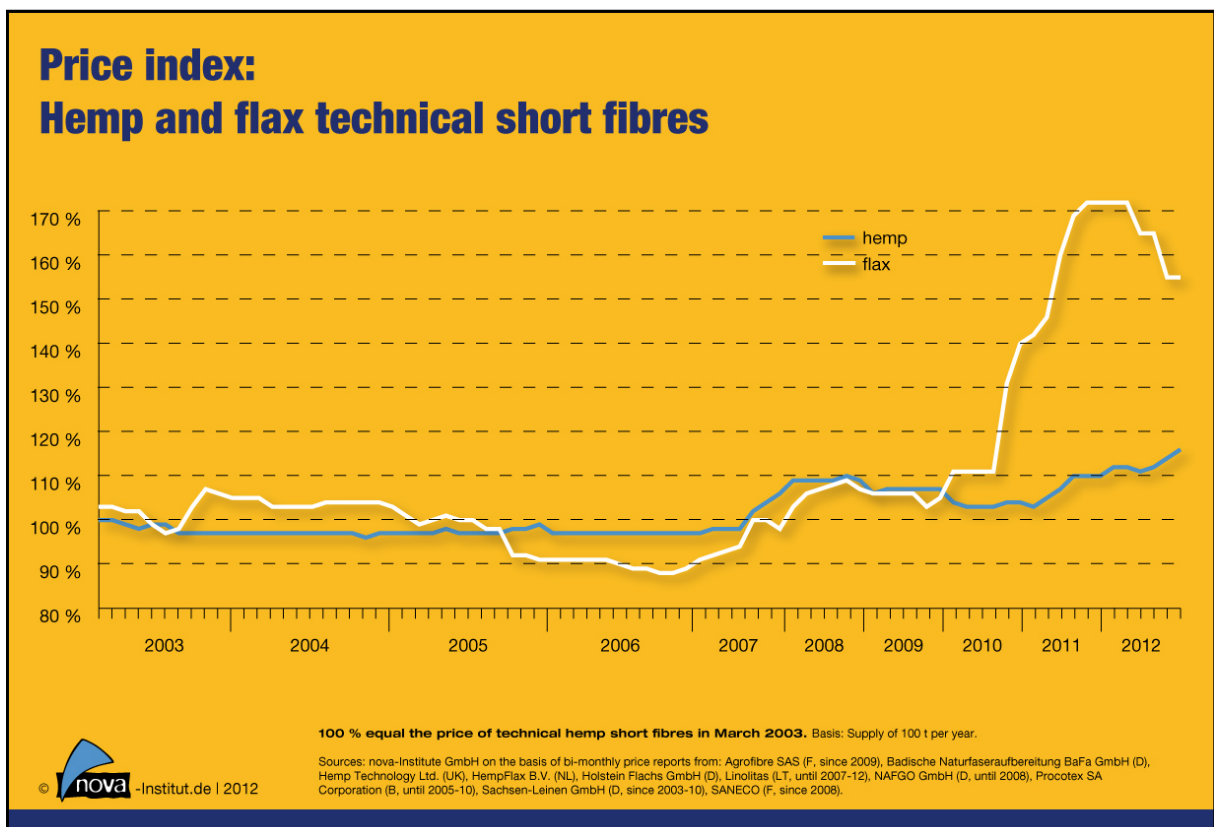


Figure 4: Relative price development for Hemp and Flax technical short fibres from European production 2003 – 2013 (nova 2013)

### Applications for Hemp Shivs

In addition Hemp fibres have a much higher value than Hemp Shivs, about double. For the economy of Hemp fibre producers it is very important to produce clean Hemp shivs and sell

into added value markets: for each produced kilogram of Hemp fibre you get as a by-product 1.7 kg of Hemp shivs.

High performance bedding material for horses and other animals like chickens is today the most important market for Hemp shivs. Hemp shivs can absorb moisture up to 4 times their dry weight. They are effective for much longer in the stable or hen house compared to other materials thus saving working time. After use Hemp bedding rots down quickly into an excellent compost.

Of the total Hemp shiv applications animal bedding has a market share of 45% and other bedding 17%, in total 62% of the total Hemp shiv applications.

An interesting new and increasing market is using Hemp shivs in combination with lime for construction. Here the market share for shivs is 15%. Over the last few years hundreds of private houses have been built in France, UK and Ireland with this new material, which is sprayed into a wooden frame. In the UK this material has already been used for a huge beer distribution warehouse and a Marks & Spencer eco retail store. The material is easy to handle, price competitive, shows good insulation properties for a construction material and it appears to be crack proof, a good attribute for earthquake risk areas. Eco-construction experts especially are seeing a great potential for Hemp-Lime-Construction.

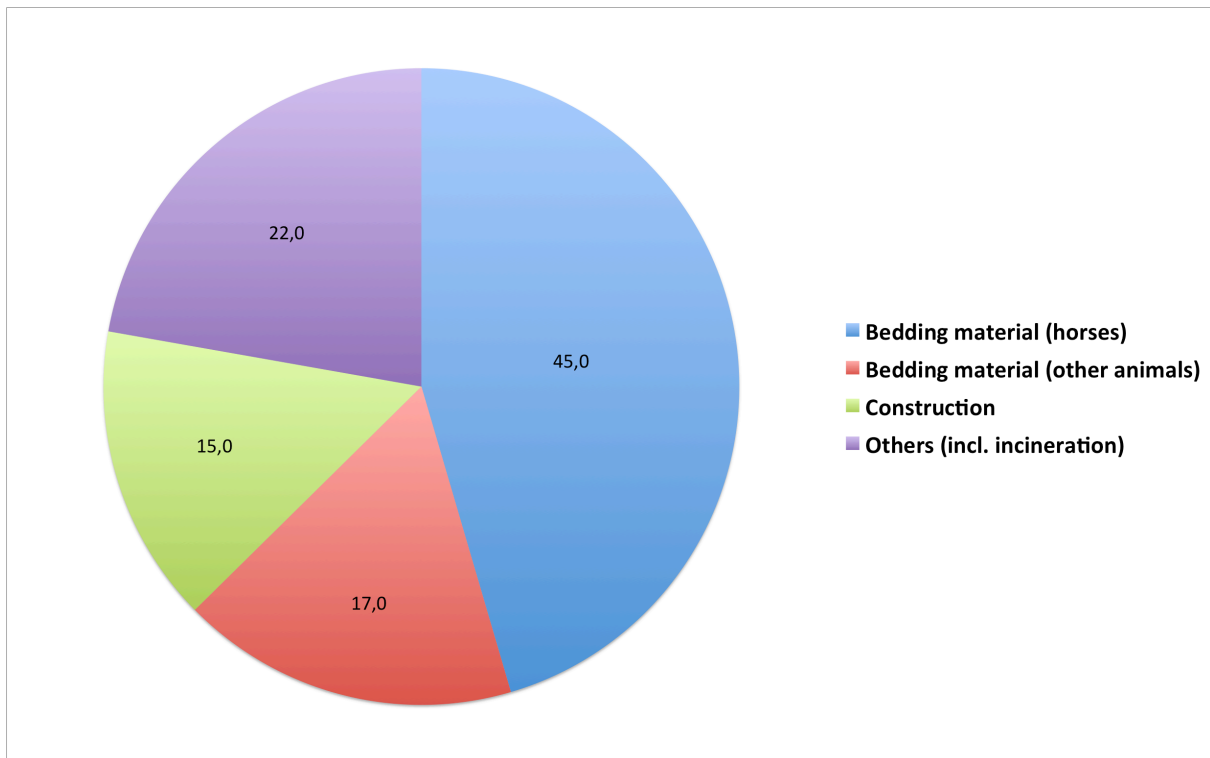


Figure 5: Applications for European Hemp Shives from harvest 2010, in total 44,000 metric tonnes (EIHA 2012)

22% of the shivs are used in “other applications” including incineration for heat and/or electricity. Small amounts also go to the particle board industry. Hemp shivs have been used for decades to produce light particle boards (half density). Because of the higher price for Hemp Shivs compared to wood and the structure of the particle board industry (only huge production sites), Hemp particle boards are only a very small niche market in Europe. This is especially disappointing, because in trucks, caravans, campers and boats, light particle boards would show relevant benefits in fuel demand. Other light particle boards use wood and fossil based foams and are also expensive. In China Hemp shivs are still used for production of particle boards (see for example on [www.alibaba.com](http://www.alibaba.com)).

## Applications for Hemp Seeds and Oil

Hemp seeds are mainly a by-product from Hemp crops grown in middle or south Europe for fibre production. Only small areas are used exclusively for Hemp seed production, in contrast to Canada where almost all Hemp is grown for seeds only.

In Europe there is a total demand for Hemp seed of about 12,000 metric tonnes per year. This is covered ca. 50% by domestic production and ca. 50% by imports from China. Only a small share is cultivated organically, mainly used in the bio-food market.

Most Hemp seeds are used as whole seeds (72.3%), followed by Hemp seeds for oil (15.7%) and dehulled seeds (11.7%). The applications correspond to the price levels of the different materials. The whole seed, the cheapest and less processed product, is mainly used for animal feed (67.2%) and only 5.1% for human food. In contrast the dehulled seed is mainly used for human food (9.5%) and only 2.2% for animal feed. The most expensive product, Hemp oil, is almost entirely used for human food (15.4%), cosmetics (0.3%) and only 0.3% for animal feed.

Birds and fish feed is the main market for Hemp seeds in animal feed. Both need fatty acids with a high share of omega-3 and omega-6 fatty acids for optimum development. The Hemp oil is mainly used to mix with protein feed for Koi Carp.

Hemp seed is an excellent source of several critical mineral nutrients and vitamins. Its oil has an outstanding fatty acid spectrum. It has unusually high 90% unsaturated fatty acids like Linoleic acid (omega 6, essential), Alpha-linoleic acid (omega-3, essential), Gamma-linoleic acid (omega-6). Its protein is balanced and easily digested. Its nutritional composition and culinary versatility is very much in line with several major trends in the science and marketing of food. With the right quality management and marketing, the use of Hemp seeds and oil in healthy human nutrition could be expanded at least 100 times.

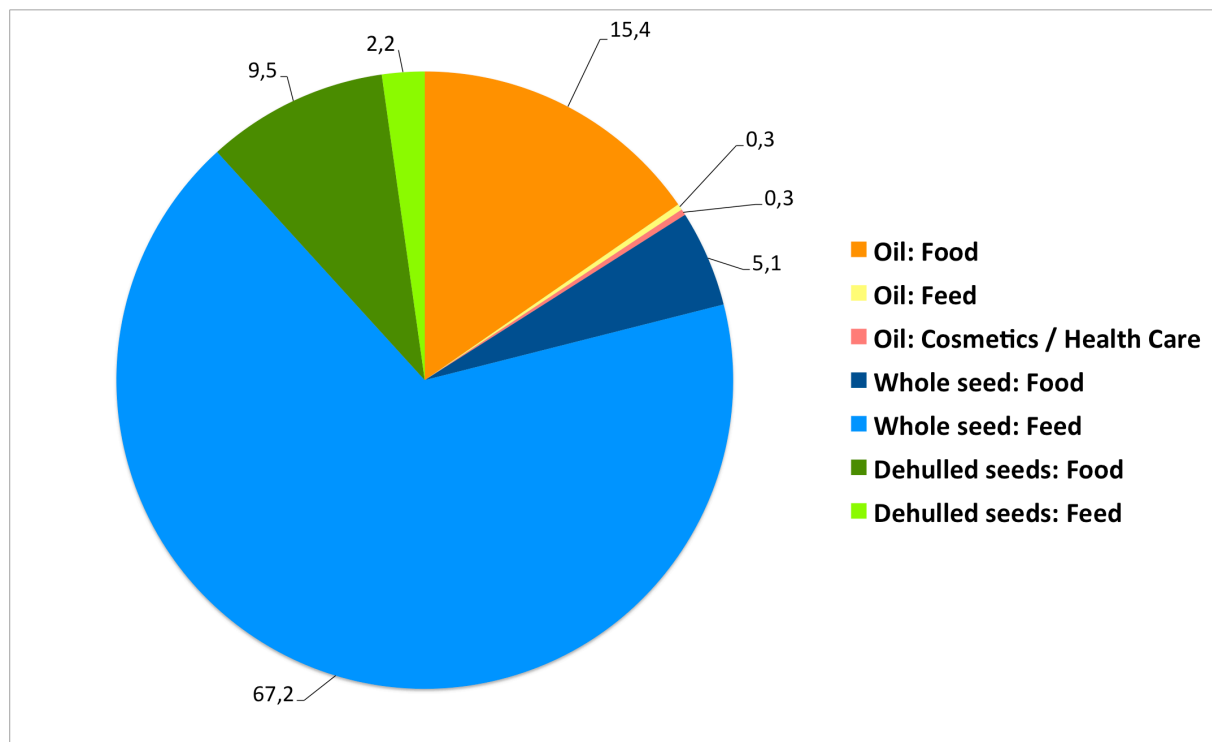


Figure 6: Applications for European Hemp Seeds from harvest 2010, in total 6,000 metric tonnes (EIHA 2012)

## **Future trends**

The survey also asked the Hemp processing companies which market trends they are expecting in the coming years. Three products were named 4 to 6 times as having high growth expectations in the coming years: building material, hemp shivs and lime, was mentioned 6 times) hemp fibre reinforced biocomposites, 4 times and Hemp seeds in the food market 6 times. On the other hand the companies are expecting “low growth” in the bedding material market, 3 times and in Hemp pulp & paper, 2 times.

Whether the European Hemp industry will grow also depends on the political and economic framework in the European Union.

## **Political framework for the European Hemp Industry**

Despite growing demand from automotive and construction industries the Hemp Fibre Sector is suffering from the misguided policy framework. The European Industrial Hemp Association (EIHA) is supporting the “Greening” in Brussels reform proposal for the Common Agricultural Policy (CAP). It is a step in the right direction, but EIHA also sees an urgent need for a level playing field for bio-based materials in relation to bioenergy & biofuels.

During the last five years bio-based plastics and composites have shown a double digit growth per year. Natural fibres are part of this success. Natural fibre reinforced plastics, also called biocomposites, are for example widely used in the European automotive industry. Bio-Composites are the easiest way to go green: they are price competitive to alternatives, light weight (up to 30% lower weight) with very good mechanical properties, high bio-based share up to 80% and proven processing technology. Also the LCA data is excellent due to a recent META-LCA by nova-Institute (Germany): Hemp fibre reinforced plastics show considerable energy and greenhouse gas (GHG) savings in comparison with their fossil-based counterparts. When biogenic carbon storage is taken into account savings between 30 % and even 75% can be reached.

Although today most natural fibres are used to reinforce fossil-based plastics the demand from the bio-based plastic industry is rising due to the increase in mechanical properties at a low price for durable applications. Another increasing application is insulation material where European Hemp fibres substitute glass and mineral wool.

However despite this growing demand and interest, European hemp fibres cannot profit from this development: the whole European Natural Fibre industry is suffering from the wrong policy framework and the cultivation areas of hemp have been decreasing over the last few years.

There are two main reasons for this undesirable development which is in stark contrast to the professed aim of greening European industries:

- The strong ongoing support of bioenergy and biofuels during commercial production (quotas 2020: 10% biofuels & 20% renewables incl. bioenergy, tax incentives, green electricity regulations and more) has been detrimental to the Hemp Industry. Without comparable support bio-based materials will suffer from under investment from the private sector. Recent policy has led to a market distortion regarding feedstock availability and costs: The increasingly high prices for arable land can only be afforded by highly subsidised energy crops. Under the existing policy framework Hemp cannot offer the same profit for farmers; the result is an ever decreasing cultivation area.

Because of this situation EIHA is strongly supporting the Policy paper on Bio-based Economy in the EU: “Level Playing Field for Bio-based Chemistry and Materials”, written by different bio-based experts and supported by many associations, companies and universities involved in the bio-based economy. (see [www.bio-based.eu/policy/en](http://www.bio-based.eu/policy/en))



- In addition European hemp fibres are completely unprotected by the competition from imported exotic fibres like jute, kenaf or sisal, which cannot even show a sustainability certification like imported biofuels. The social and environmental standards of these tropical fibres are often low. EIHA is seeking a binding sustainability certification for all imported (and domestic) natural fibres to guarantee fair competition.

The future policy framework in the EU can be more favourable for Hemp, because on the one hand the support for biofuels has already begun to decrease and on the other hand the new Common Agricultural Policy (CAP) will include “greening” aspects. Hemp as an environmental friendly crop can profit from this “greening”. Also sustainability certifications are more and more in demand for all kinds of biomass. Together with an increasing demand from automotive and construction sectors will all mean an continuous increase in Hemp production during the coming years.

For more information, please go to [www.eiha.org](http://www.eiha.org)

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