Ecological benefits of hemp and flax cultivation and products

By Stephan Piotrowski and Michael Carus

1. Background

According to Regulation (EC) Nr. 73/2009, Article 68 (1), member states may grant direct support to farmers for specific farming practices. Among others, such payments may be granted for

(a)(i) specific types of farming which are important for the protection or enhancement of the environment or

(a)(v) specific agricultural activities entailing additional agri-environment benefits.

According to Art. 69 (1) of this regulation, member states may decide every year to use from the year following that decision up to 10% of their national ceiling for direct payments for the specific support provided for in Art. 68 (1). The next deadline for making a decision on the use of this provision is August 1st 2011.

The following text provides arguments for the support of hemp and flax cultivation under these requirements of Art. 68 (1)(a)(i) and (1)(a)(v) above.

2. Effects on soil and crop rotations

Both hemp and flax are **valuable preceding crops in rotations**. Especially hemp has a deep rooting system, has a **favourable influence on the soil structure** and curtails the presence of nematodes and fungi. After cultivation, the soil is left in optimum conditions (tilth) due to the complete weed suppression following from the high shading capacity of hemp. A study by Bócsa and Karus 1998 reports 10–20 percent higher wheat yields after the cultivation of hemp.

Furthermore, due to its vigorous growth, hemp is known to be a **pioneer plant** that can be used for land reclamation. Also, both hemp and flax have been shown to be suitable to remediate land polluted by heavy metals (**phytoremediation**), using the biomass as industrial raw materials for composites, pulp and paper and chemical industries etc. (Kozlowski et al. 2004).

Different to hemp, flax is **not self-compatible**. According to recommendations, a rotation of five years between cultivation of flax should be complied with. This, however, can also be seen as a positive effect of flax, since it necessitates a **diverse crop rotation** and prevents the monoculture of flax.

3. Pest management

Due to its vigorous growth, shading capacity and disease resistance, hemp can be grown without the use of herbicides, pesticides or fungicides. Hemp therefore easily complies with requirements of organic farming and is suitable for cultivation near surface water. The crop leaves the soil virtually **weed-free**. In practice, **no pesticides** are applied in UK, Germany and

the Netherlands. Only in France, approx. every eight years an application against the hemp flea beetle (*Psylliodes attenuatus*) is common. Moreover, hemp has been shown to be **not resistant to most herbicides** which precludes any use in the first place.

Different to the cultivation of hemp, herbicide applications usually are required in flax cultivation. Due to the low shading capacity, flax is prone to weed infestation. However, this can also be dealt with by multiple treatments with mechanical hoes.

The **quantity of pesticides required in flax cultivation** is still **less than for many other crops**. It is also interesting to note that the majority of these chemicals are returned to the soil during retting, thus reducing the quantities required by subsequent rotation crops.

4. Fertilisation

While both hemp and flax require a certain amount of added plant nutrients, their levels are much lower than for most major crops such as wheat and maize.

Flax requires little fertilising, excess fertilising and especially of nitrogen can lead to lodging of the crop (Heyland et al. 2006). Flax requires only up to a maximum of 60 kg/ha of nitrogen, given before sowing, 30-50 kg/ha of phosphor (P_2O_5) and 70-100 kg/ha of potassium (K_2O), which is much lower than for cotton and many other crops.

Compared to flax, hemp has higher nutrient requirements: Recommended are 80-100 kg nitrogen, 100 kg P_2O_5 and 150 kg K_2O per hectare.

5. Agro-biodiversity

Hemp is one of the oldest and most versatile crops of mankind. Earliest findings of hemp products in Europe date back to the Hallstatt culture (800-400 B.C.). Especially in times of increasing monocultures, hemp is an enrichment to agro-biodiversity. Also flax is a culture with a long tradition in Europe and provides an enrichment of agro-biodiversity. Furthermore, flax as a flowering plant adds to the diversity of agricultural landscapes and provides a valuable habitat for insects.

Biodiversity is a complex issue. A study by Montford and Small (1999) has therefore assessed the biodiversity friendliness of 23 crops along 26 biodiversity parameters. These, which included both hemp for fibre and seeds and flax, were then ranked on a scale according to their biodiversity friendliness. **Hemp for seeds and fibre turned out to be in the top five crops and also flax performed better than all major crops such as wheat, maize or rapeseed** (see Figure 1).

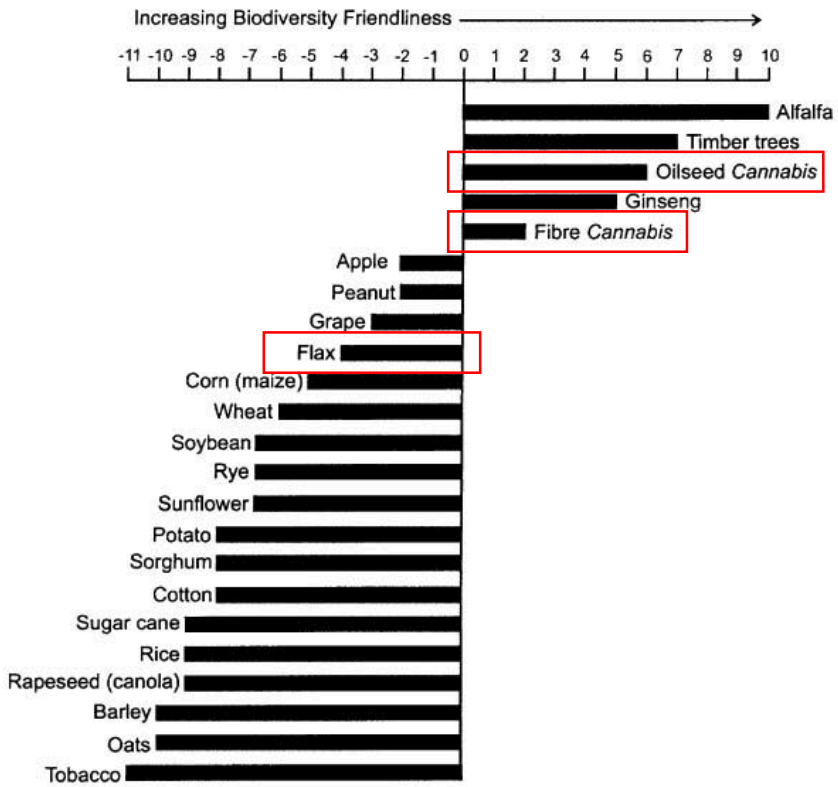

Figure 1: Crude mean evaluation of biodiversity friendliness of selected major crops and fibre and oilseed Cannabis
Source: Montford and Small 1999

6. Comprehensive assessment of environmental effects in cultivation

As a study by the European Environmental Agency (EEA 2007) on the ecological effects of different crops proved, both flax and hemp exhibit excellent ecological credentials in their cultivation.

In the EEA study, crops were evaluated on a scale from A to C, with A indicating the best and C indicating the worst performance on a parameter. Table 1 shows the results for hemp and flax and puts them into perspective to a selection of other crops.

In essence, hemp and flax also performed much better in this study compared to most other major crops.

	Nutrient depletion	Pesticides	Erosion	Soil compaction	Water consumption	Biodiversity	Agro-biodiversity
Permanent pasture	A	A	A	A	A	A	A
Short rotation coppice (poplar, willow)	A	A	A	A	B	A/B	A
Winter grains	A	A	A	A	A	B	B
Linseed	A	B	A/B	A	A	A/B	A
Hemp	A	A	A/B	A	B	B	A
Alfalfa	B	A	A	A/B	A/B	A/B	A
Grass	B	B	B	A/B	A	B/C	A
Switchgrass	?	?	A	A	A	B	A
Mustard	A/B	B	A/B	A	B	B	A
Sorghum	A	B/C	A	A	A/C	B	B
Wheat	A	B	A	A	B	B/C	C
Sunflower	A/B	B	B/C	A	B	A/B	B
Rapeseed	B/C	C	B	A	0	B/C	A/B
Sugarbeet	B/C	B	C	C	A/C	B	B
Maize	C	C	C	B	A/B	C	B/C
Potato	B/C	B	C	C	C	B/C	C

Table 1: Environmental effects of hemp, linseed and different major crops
Source: Adapted from EEA 2007; A = Lowest impact on environment, B = Medium impact, C = Worst impact on environment, 0 = not applicable, ? = insufficient database

7. Product assessment: Example of bio-composites

Not only the cultivation itself, but also the products made of hemp and flax entail significant environmental benefits. In a new study by the nova-Institute, hempbased reinforced plastics are compared to non-renewable materials like acrylonitrile butadiene styrene (ABS) and glass fibre reinforced polypropylene (PP-GF) regarding their environmental impacts on climate change and primary energy use (Haufe and Carus 2011). The analysed products are compared based on their functionality. The assessment encompasses the extraction of raw materials, where applicable the cultivation of crops, the processing of materials and transports. The results are shown in Figure 2. Six of the LCA studies included in the analysis of hemp fibre reinforced plastics are depicted in the chart. All of the hemp fibre reinforced plastics examined show **energy and greenhouse gas (GHG) savings** in comparison with their fossil-based counterparts.

In this respect, flax products are not significantly different from hemp and studies on flax products therefore led to similar results.

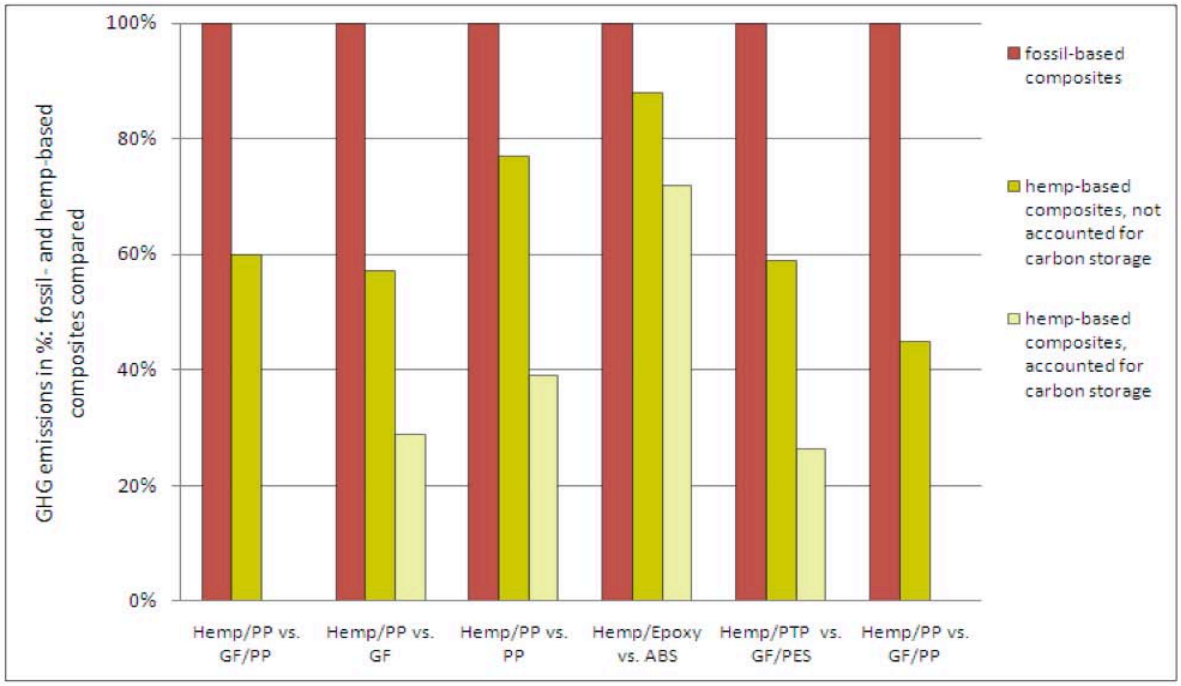

Figure 2: GHG emissions expressed in percent for the production of fossil-based and hemp-based composites for a number of studies – where available showing the effects of biogenic carbon storage
(PTP: Polymer material made of Triglycerides and Polycarbon acid anhydrides, PES: Polyester)
Source: Haufe and Carus 2011

8. Summary

Table 2 summarises the evaluation of both crops on the most important parameters discussed above.

	Hemp	Flax
Crop rotation	**++**	**+**
Effects on soil	**++**	**+**
Pest management	**++**	**+/-**
Fertilisation	**+/-**	**++**
Agro-biodiversity	**++**	**++**
Products/LCA	**++**	**++**

Table 2: Overall ecological assessment of hemp and flax

Finally, the usage of Art. 68 by member states in the past may also give an indication that hemp and flax are good candidates to benefit from this support (see European Commission 2010).

Several member states have already granted support for a **diversification of crop rotations** (France, Italy and Spain) with reference to Art. 68 (1)(a)(v) of Regulation (EC) Nr. 73/2009. Since both hemp and flax provide significant benefits as preceding crops, both are clearly eligible for support, especially if integrated in a proper crop rotation system.

Furthermore, Denmark granted support for **perennial energy crops** and Poland for cultivating **pulses and herbage legumes** under Art. 68 (1)(a)(i).

9. References

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