

## **Environmental impact of products from industrial crops compared to conventional ones – an overview**

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In recent years, biomass utilisation has been re-discovered to be multi-purpose. Not only can crops be used for human nutrition and animal fodder, but also as fuels for transportation, heating and electricity production and on the other hand as raw material for industry.

This paper covers only the use of industrial crops. However, the bandwidth of types, varieties, and applications is nonetheless large. A first classification can be given by the physical condition of the agricultural product: liquid or solid. The liquid biomass products mostly are vegetable oils and utilised for lubrication, in cosmetics industry, or for other uses where normally mineral oils are applied. Several of these products have been in use since many years, such as rapeseed oil or sunflower oil. Nevertheless, also in this sector there have been some developments recently. New varieties of plants now are able to produce oils with a high content of oleic acid (therefore called HO, high oleic), a fatty acid with optimal properties for industrial use. In this paper the use of rapeseed oil as a hydraulic liquid and the use of HO-sunflower oil as a lubricant are investigated.

Also some other industrial crops have already found their niches in the market, such as hemp. Hemp belongs to the plants offering liquid and solid products. Whereas the liquid part – hemp oil – can be used for pharmaceutical purposes, the solid parts are commonly more significant: fibre and shives, the woody part of the stems. The application investigated is a fibre-resin compound used as inner covering in the automotive sector. Other fibre plants have had less success so far. Flax, a very old industrial crop (for textiles), is being discovered only recently. An application analysed is the use of flax fibres as insulating material in housing. Other fibre plants, such as miscanthus or nettle, are still before their market entering. They show however interesting application and cultivation possibilities. Investigated uses are compound material and textiles, respectively. Starch plants such as wheat and corn have become increasingly interesting for replacement of plastics material. This paper studies polylactic acid (PLA) from wheat and corn for packaging.

Most of these industrial crops have not only one product, but several co-products that have themselves different utilisation possibilities. According to standard practice for life cycle analyses (LCAs), as defined by ISO 14040 – 14043, not only the whole life cycle of a particular product has to be accounted for in terms of its ecological implications, but also any co-products arising from its production. The environmental effects of these co-products can under certain circumstances tip the balance with regard to the overall ecological effects of the main product.

For this reason, the environmental implications today and in the future with a potentially increased use of the industrial crops mentioned are worthwhile being examined thoroughly by means of life cycle analyses. Advantages and disadvantages are revealed and analysed under the aspect of their optimisation potential.

In this paper an overview of LCAs of the set of industrial crops mentioned above is given. Comparing the agricultural products to their fossil counterparts and considering different uses of the co-products, a large variety of results and conclusions is compiled.