FIBRA PROJECT

Fibre Crops as Biobased Material source for Industrial Products in Europe and China

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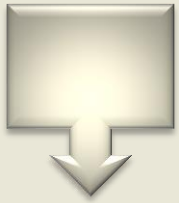
Main objective and expected impact

The FIBRA network has as main target to link the research activities carried out on both EU and China and to provide a long term vision on future common research activities on fibre crops and will improve researchers' training opportunities.

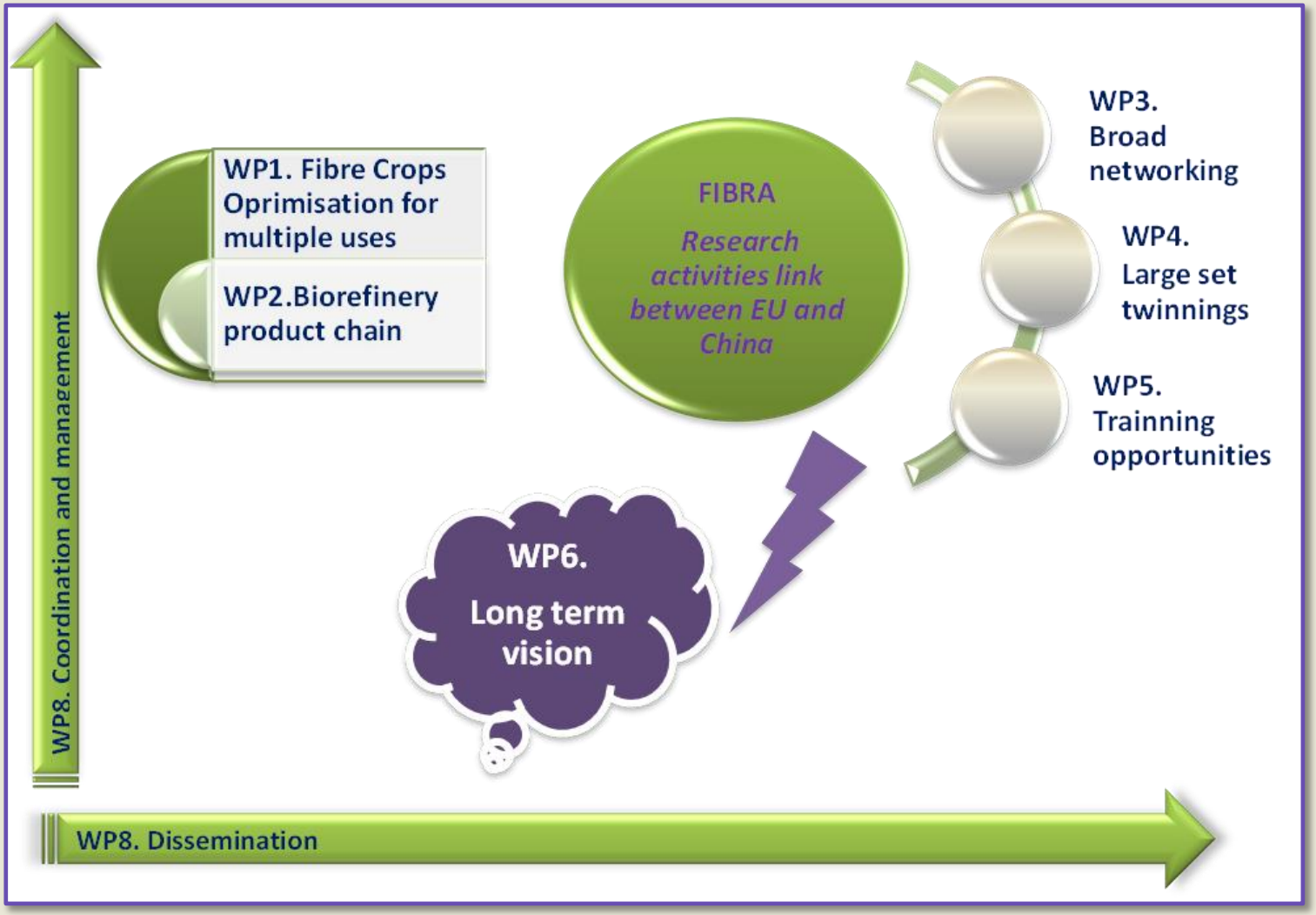


The *expected impact* of FIBRA project is *the establishment of an effective and wide co-ordination of the research activities on fibre crops in Europe and China* thus to stimulate a *broad stakeholders' participation* and generate *common research programmes to fulfil the international EU policy targets*.

Some details about the FIBRA project

- FIBRA project is a **coordination and support action project** funding under the **7th Framework Programme**.
- FIBRA started in **September 2012** and will finish at the end of **November 2015** (39 months).
- A total number of **16 partners** participate in the project (15 from Europe and 1 from China).
- The partners will receive a total finding of **999915** euros.
- A **Chinese Mirror Group** have been established to support the FIBRA project.
- The **Chinese Mirror Group** is receiving additional funding from the **Chinese Academy for Agricultural Sciences** (CAAS).
- The project website is **www.fibrafp7.net**

FIBRA concept



Classification of fibre crops

According to www.fibrecrops.nl a botanic classification can be made for fibres based on the part of the plant from which they can be obtained. The major groups of fibre crops with technical or economic importance are:

- ***Bast fibres*** (flax, hemp, kenaf, jute, nettle, and ramie),
- ***Grass fibres*** (miscanthus, switcgrass, giant reed and bamboo),
- ***Leaf fibres*** (sisal, abaca, banana, and henequen),
- ***Seed hairs*** (cotton, kapok, milk weed),
- ***Palm fibres*** (coconut husk coir) and
- ***Woody fibres***

Bast fibres
(flax, hemp, kenaf, jute, nettle, and ramie)


flax


hemp


kenaf


jute


nettle


ramie

Grass fibres
(miscanthus, bamboo, and reed)

Bast fibres
(flax, hemp, kenaf, jute, nettle, and ramie)

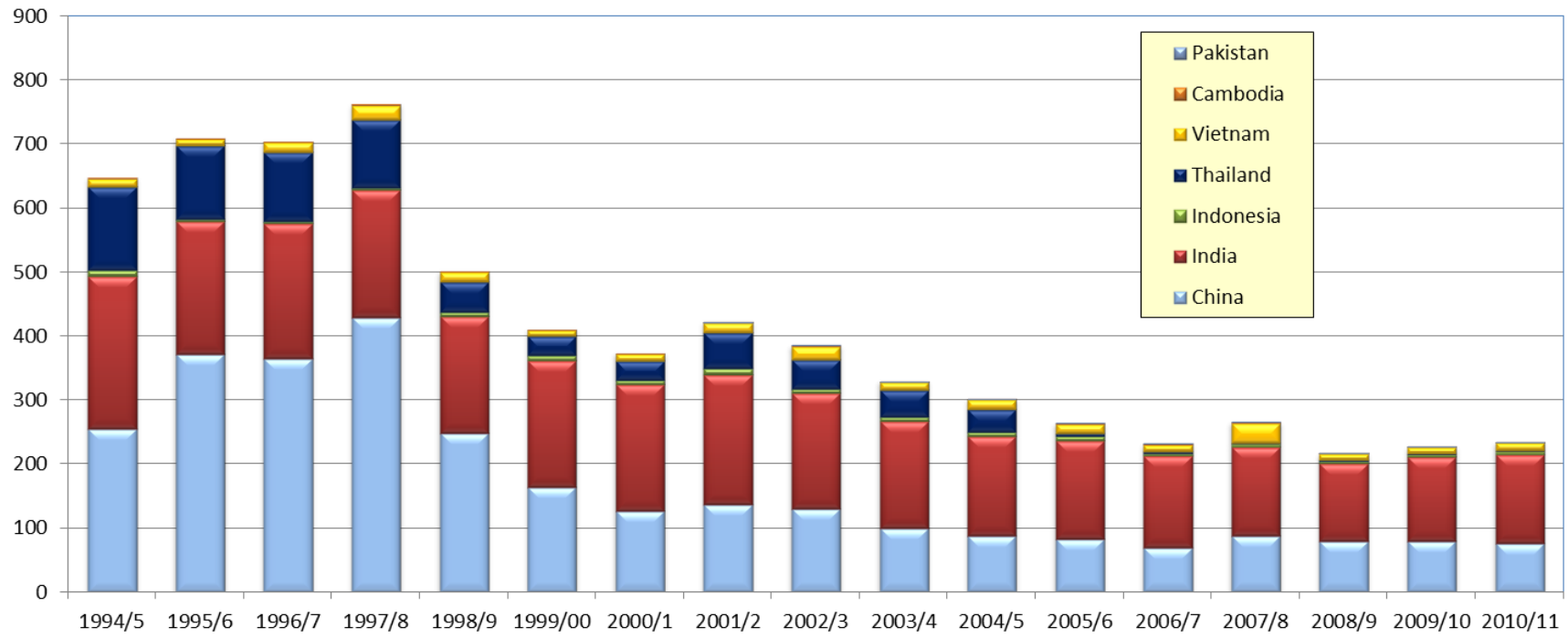
- The ***bast fibre crops*** are considered the most important group worldwide.
- Of the bast fibre crops, ***flax***, ***hemp*** and ***kenaf*** are the most interesting for the European countries, while in China ***jute*** and ***ramie*** are also major crops supported by a significant research activity in breeding and cultivation.

World fibre production, cultivation area and yield (FAO, 2009).

Crops	Production (Mt)	Cultivated area (Mha)	Yield (t/ha)
Flax	458	322	1.4
Hemp	70	49	1.4
Jute	2952	1264	2.3
Ramie	253	125	2.0
Other bast fibres	299	215	1.4

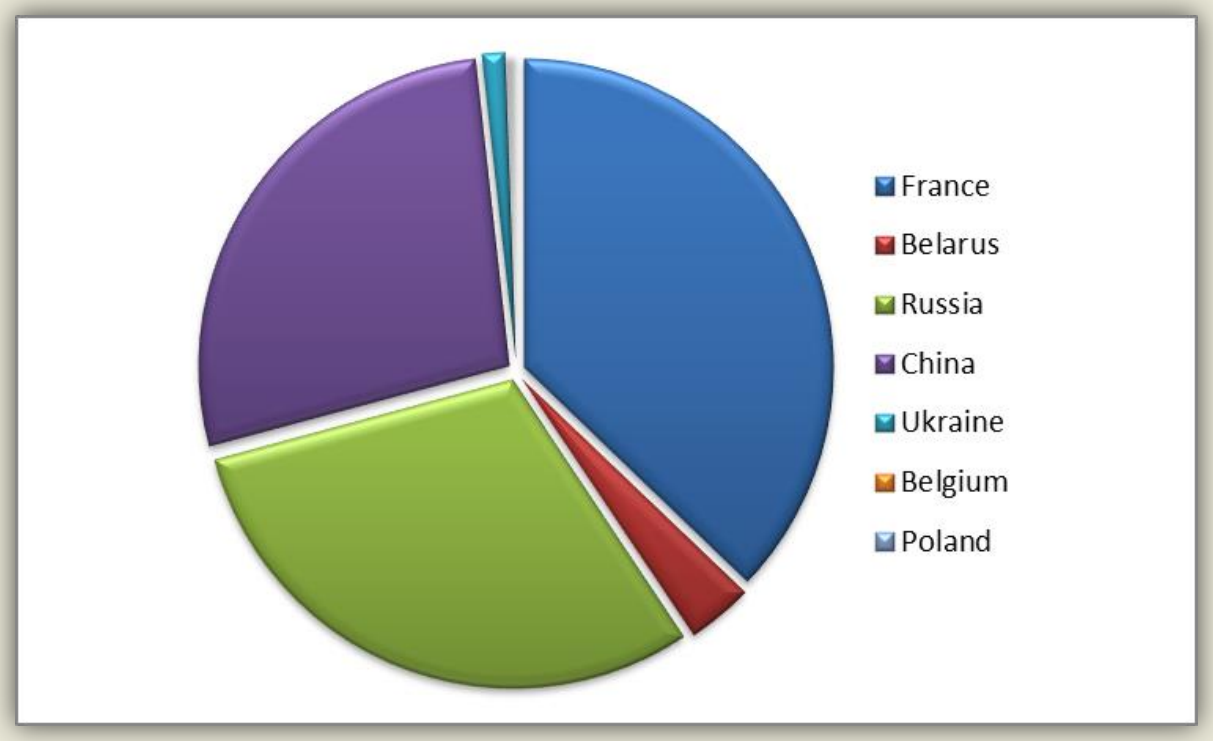
Bast fibres
(flax, hemp, kenaf, jute, nettle, and ramie)

- Over the last 20 years, the total planting area of combined kenaf/jute in China ranks the third in the world next to India and Bangladesh (together representing > 90% of the total kenaf area).
- In China the mean cultivated area was 150,000 to 400,000 ha with a over 900,000 ha in 1985. However, kenaf production has been declining in the last years due to the strong competition by synthetic materials.



Cultivation area of fibre flax in 2012
(source: INF&MP, Poland)

Country	Area (ha)
Belarus	63,000
Russia	55,000
France	67,760
Ukraine	2,184
Belgium	500
Poland	500
China	50,000

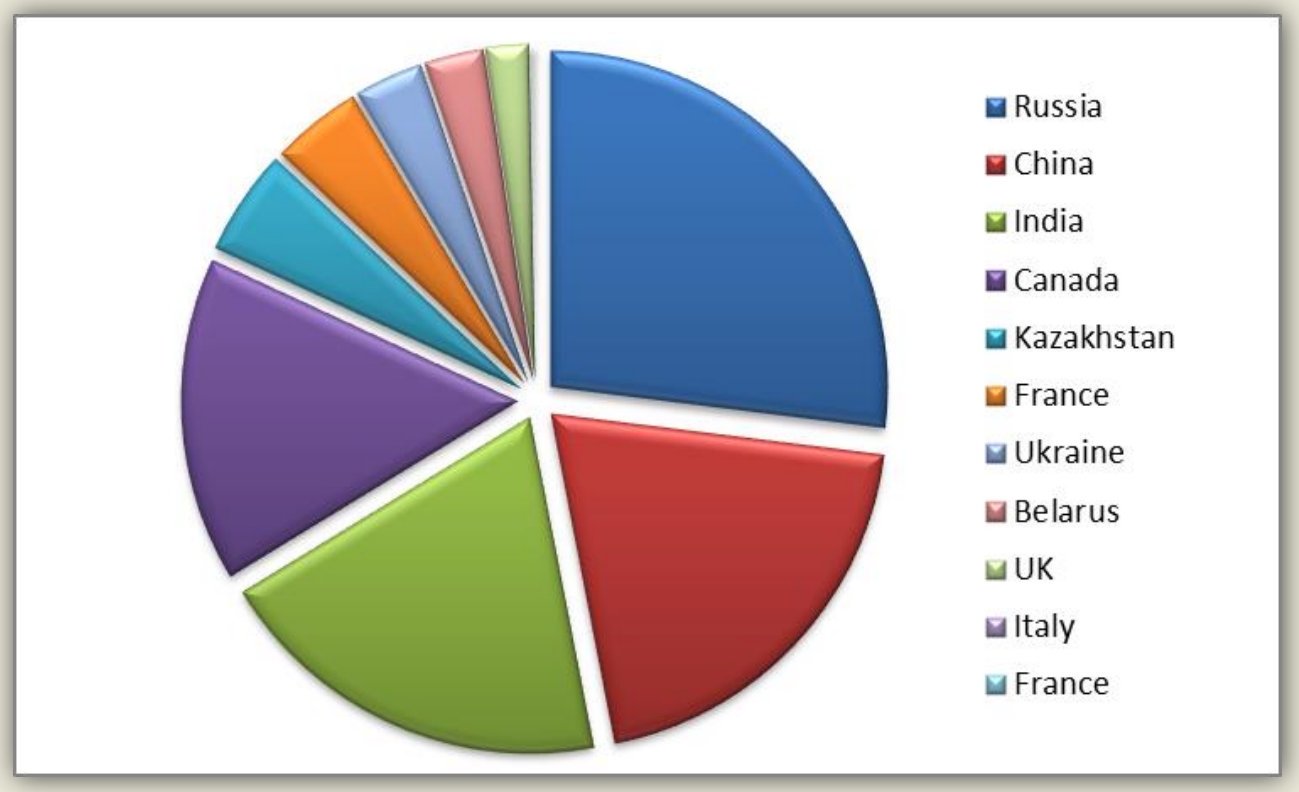


The larger area of fibre flax is in Belarus with 63000 ha, while quite big is also in Russia (55000 ha), in France (67760 ha) and in China (50000 ha).

Cultivation area of linseed in 2011
(source: INF&MP, Poland)

Country	Area (ha)
Russia	472,000
China	350,000
India	338,810
Canada	273,200
Kazakhstan	90,000
France	77,292
Ukraine	58,700
Belarus	49,981
UK	36,000
Italy	3,000
France	2,160

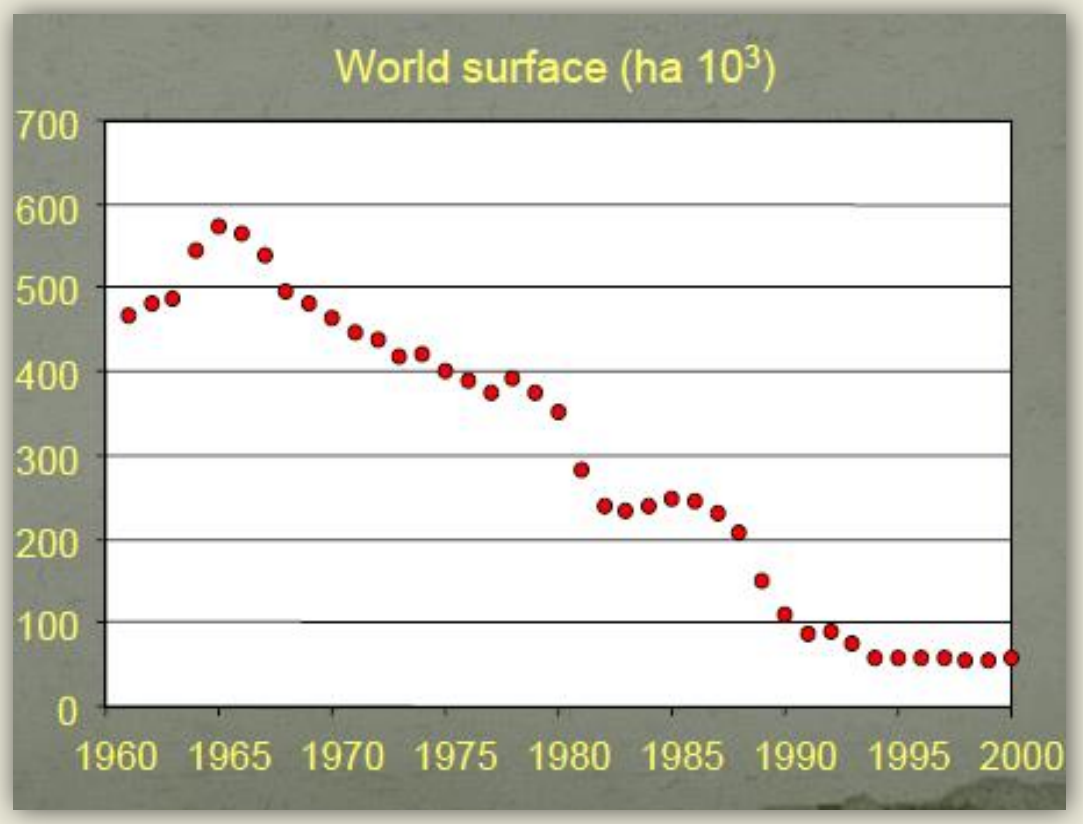
The larger area of linseed cultivation is in Russia, while in China, India and Canada the area of linseed cultivation is quite big.



Decline in the area of cultivation area of hemp *(1960 to 2000)*

Reasons for hemp decline:

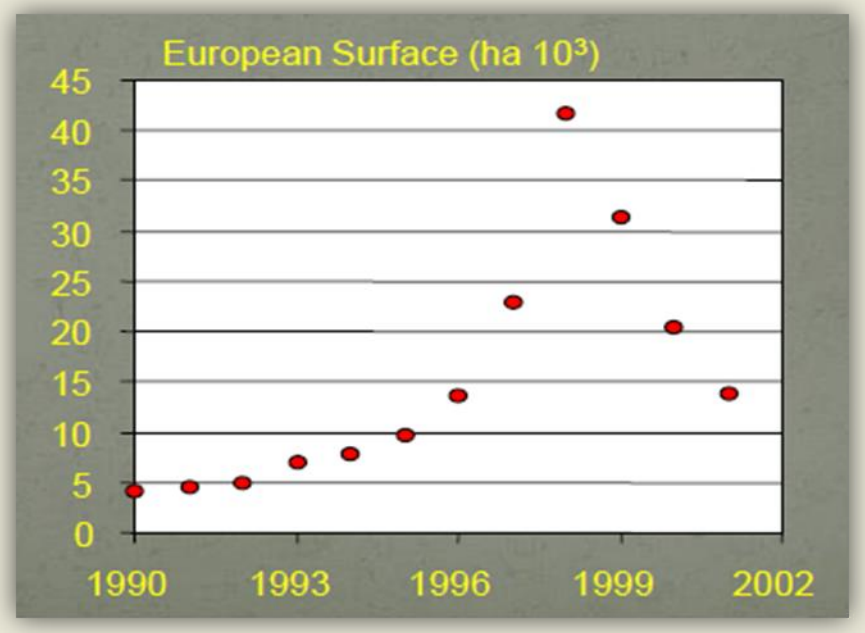
- ***American cotton,***
- ***Competition with synthetic fibers,***
- ***Low income,***
- ***High labour request (1200 h ha^{-1}),***
- ***Difficult working conditions (maceration),***
- ***Low level of mechanization,***
- ***Cannabis legislation***



Increase in the hemp cultivation from early 90's
Cultivation area of hemp in Europe (2012)

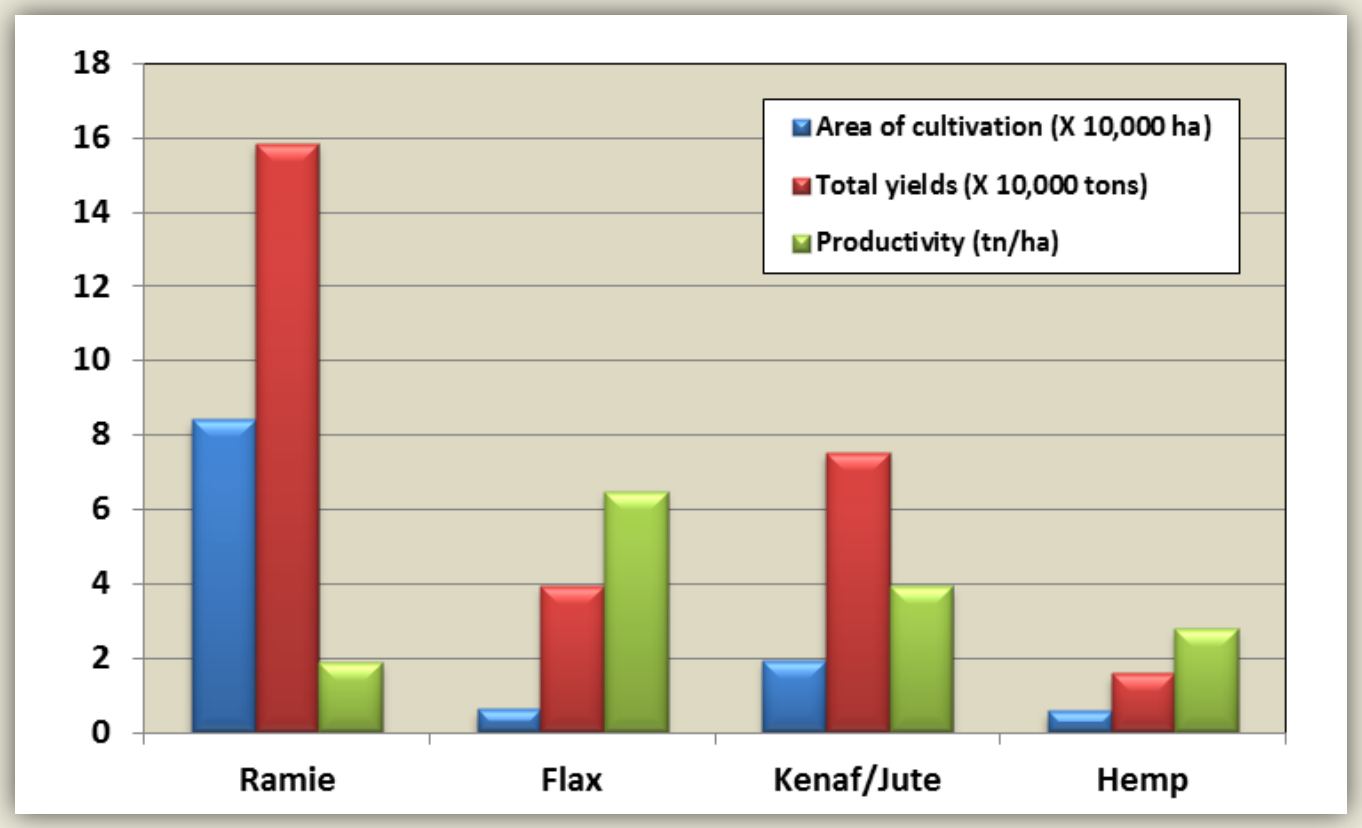
In early 90's a increase in the hemp cultivation area was recorded due to the

- ***Changes in the CAP (exceeding, no food crops,…);***
- ***Environmental awareness;***
- ***Sustainability of agriculture;***
- ***Consumer perceptions.***



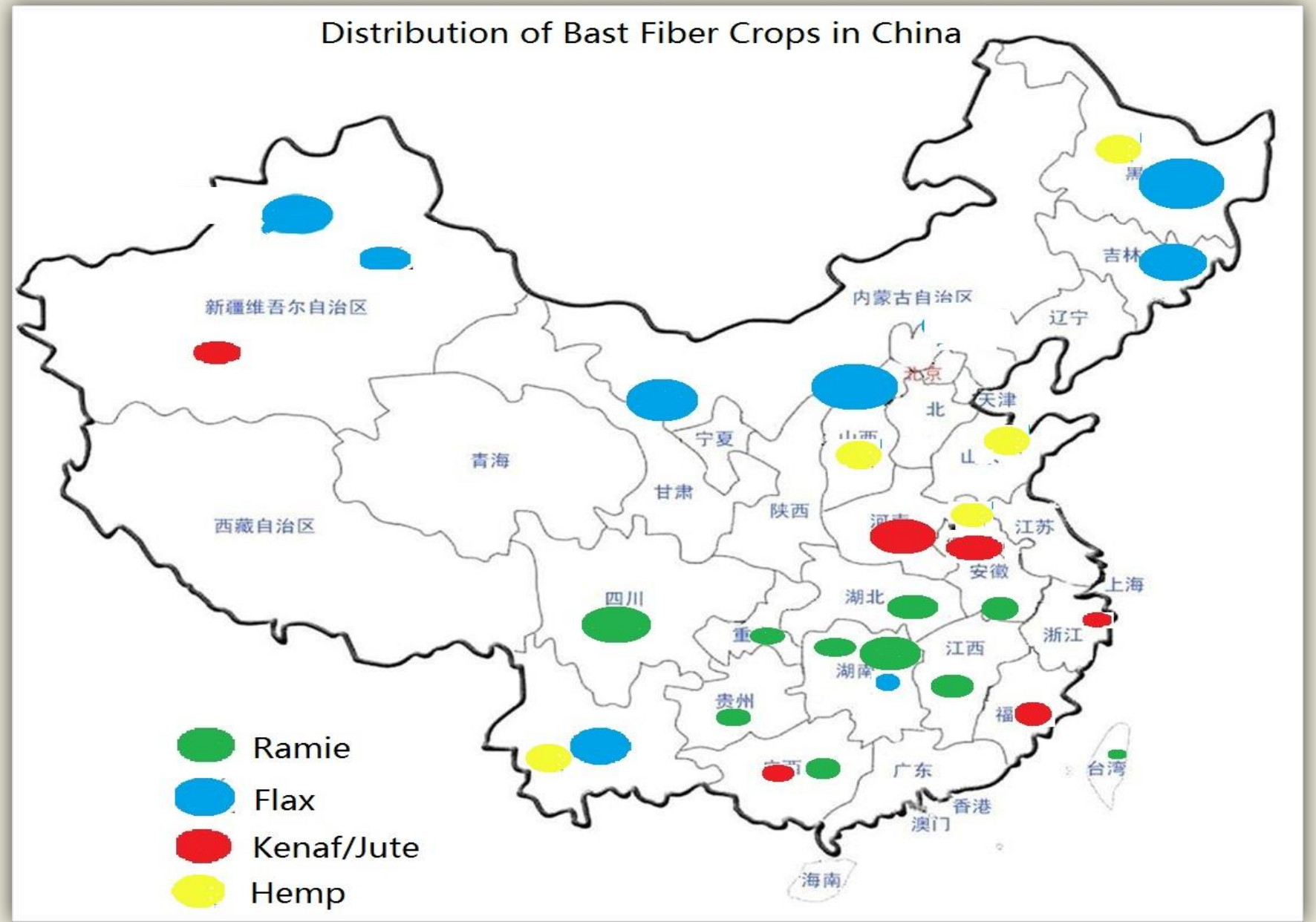
The cultivation area of hemp in Europe (2012) is around 15,000 ha. 11,800 ha are in France that corresponds with the 0.05 % of its total agricultural area.

Cultivation of bast fibre crops in China (cultivation area, total yields and productivity)



- The total cultivation area of bast fiber crops in China is 11.51 X 10^3 ha.
- The highest productivity per ha is being reporting by flax (6.47 t/ha) and the lowest by ramie (1.98 t/ha)

Chinese Ministry of Agriculture (2011)



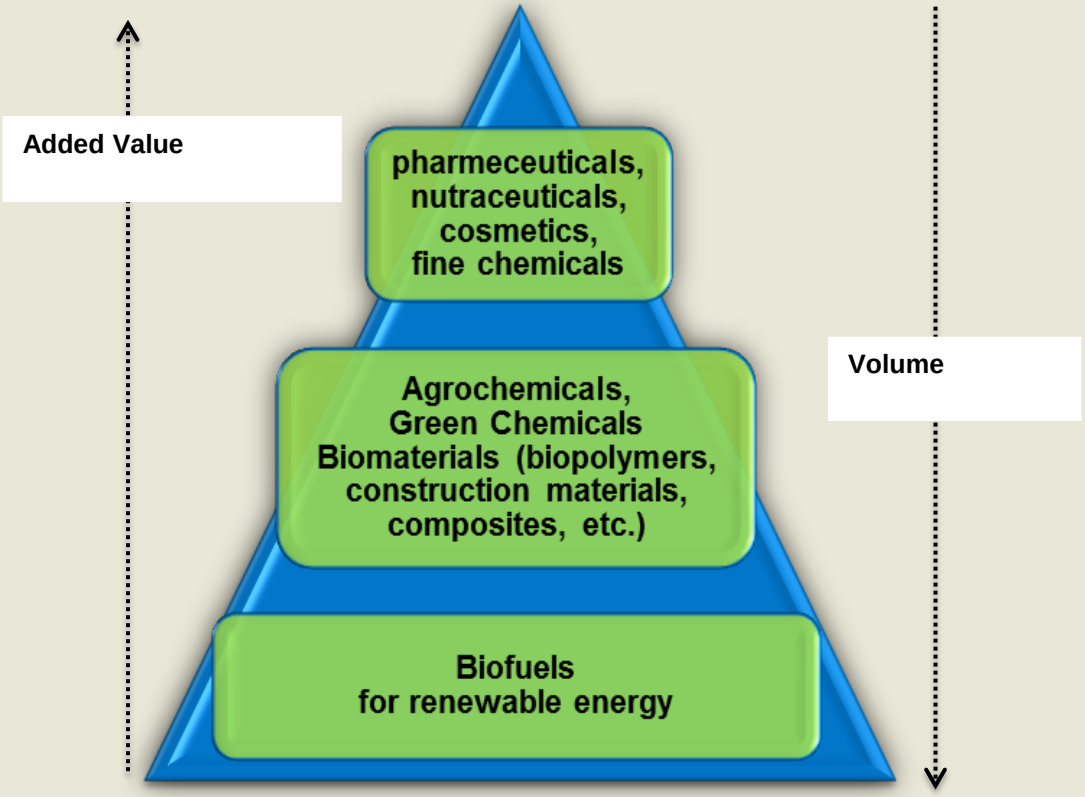
Grass fibre crops

- High yielding crops like **miscanthus**, **giant reed**, **switchgrass**, **reed canary grass, elephant grass, bamboo,** etc. are alternative and innovative fibre crops.
- Whether **their fibres quality is lower than that of bast fibres** (i.e. fibre fineness, length and lignin content), **the high productivity** associated with a **low energy requirement**, could make them interesting feedstocks for papermaking, bio-building or biopolymers, and bioenergy purposes.
- During the last two decades several grass fibres (miscanthus, giant reed, switchgrass, etc.) have been tested as raw material for **solid biofuels**, while recently are being tested as raw material for **biobased materials** as well as for **second generation biofuels**.

Miscanthus

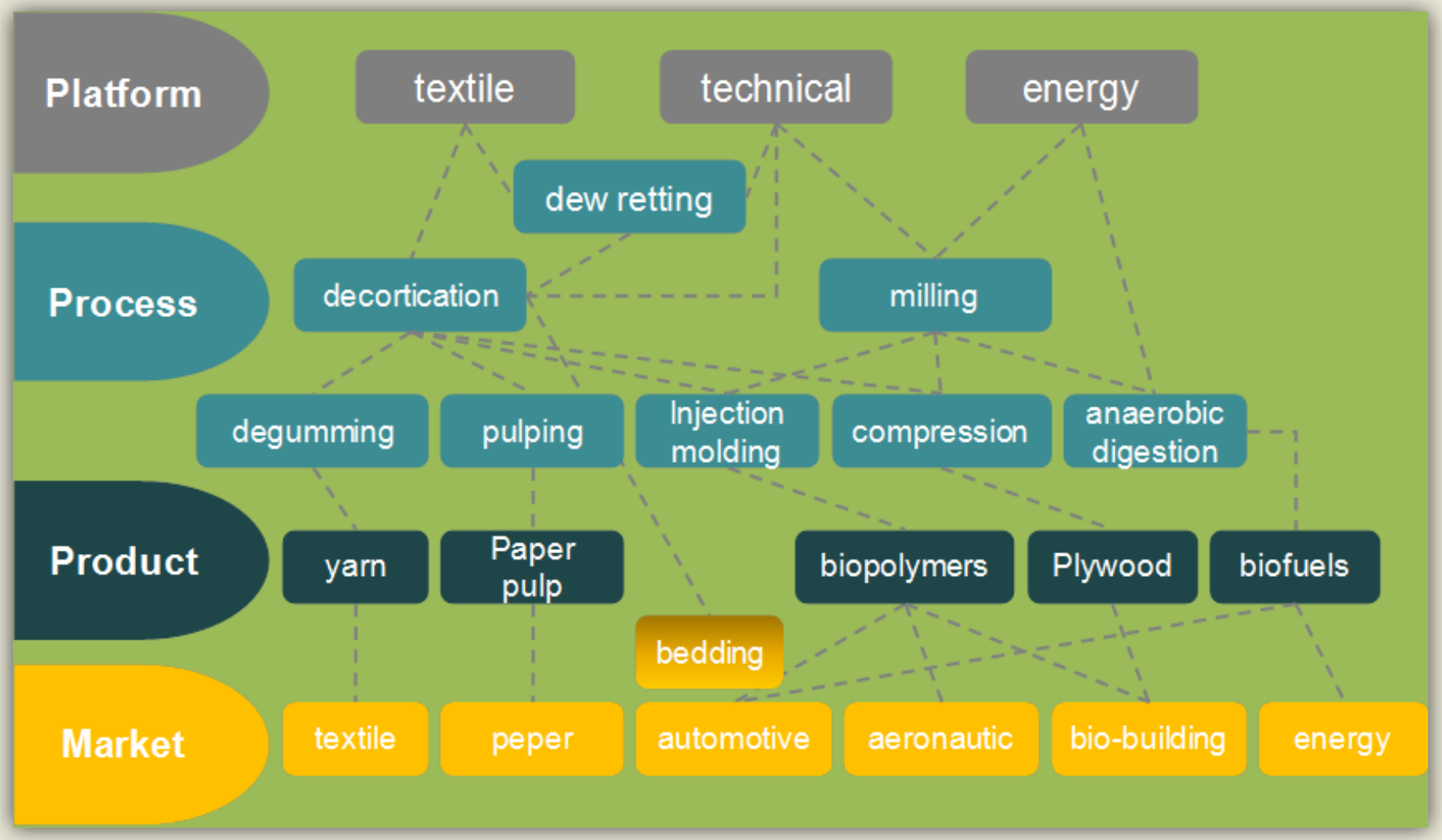
- **Miscanthus** is one of the main raw materials used in the **Republic of China** for paper making, and in several studies undertaking miscanthus for paper pulp production.
- In **Europe** miscanthus is being cultivated in a total area of **3000 ha** (Germany, Poland, Austria and UK) as raw material for **solid biofuels**, while it is considered a valuable alternative to wood fibre both for bio-building and paper pulp purposes in Europe as well as for **second generation biofuels**. Currently, it is investigated in three European projects namely **OPTIMA**, **OPTIMISC** and **GRASS MARGINS** that started in October 2011 and will finish in the beginning of 2016.

Pyramid value of the added economic value of the biomass uses

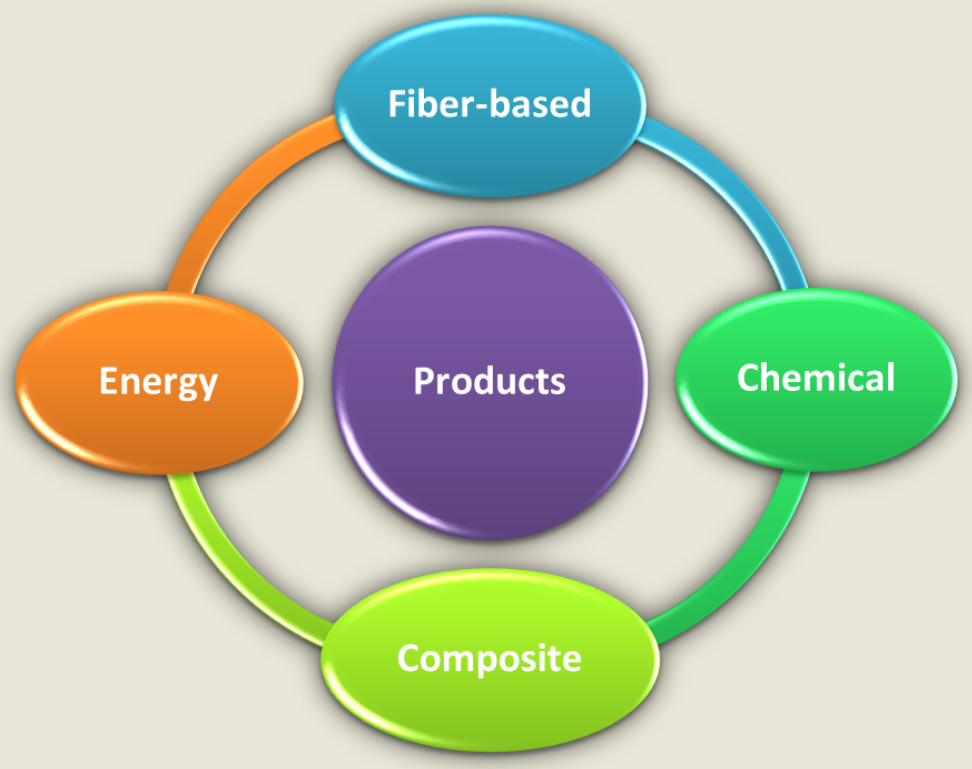


- **The added value is the highest at the top of the pyramid and the lowest at the bottom. On the contrary, the volume of biomass needed for the applications is the lowest at the top of the pyramid and the highest at the bottom of the pyramid (www.bio-basedeconomy.nl).**

The main platforms, process, products and markets in a biorefinery concept of bast fibre crops



Products from fiber crops



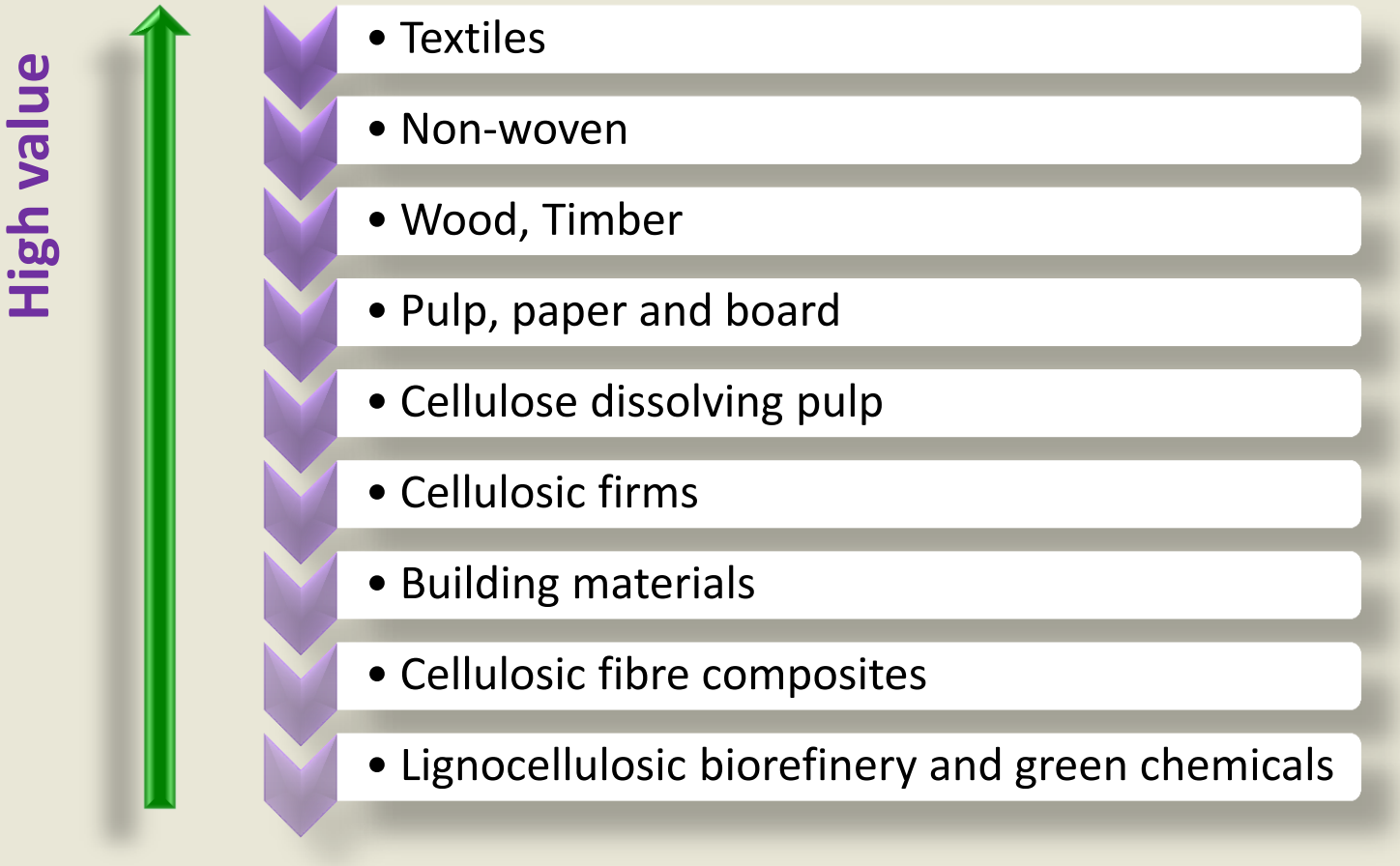
The issues that addressed in FIBRA are:

- ***State-of-the-art for the Main products and the Secondary products***
- ***Anticipated development in short term***
- ***Anticipated development in long term***

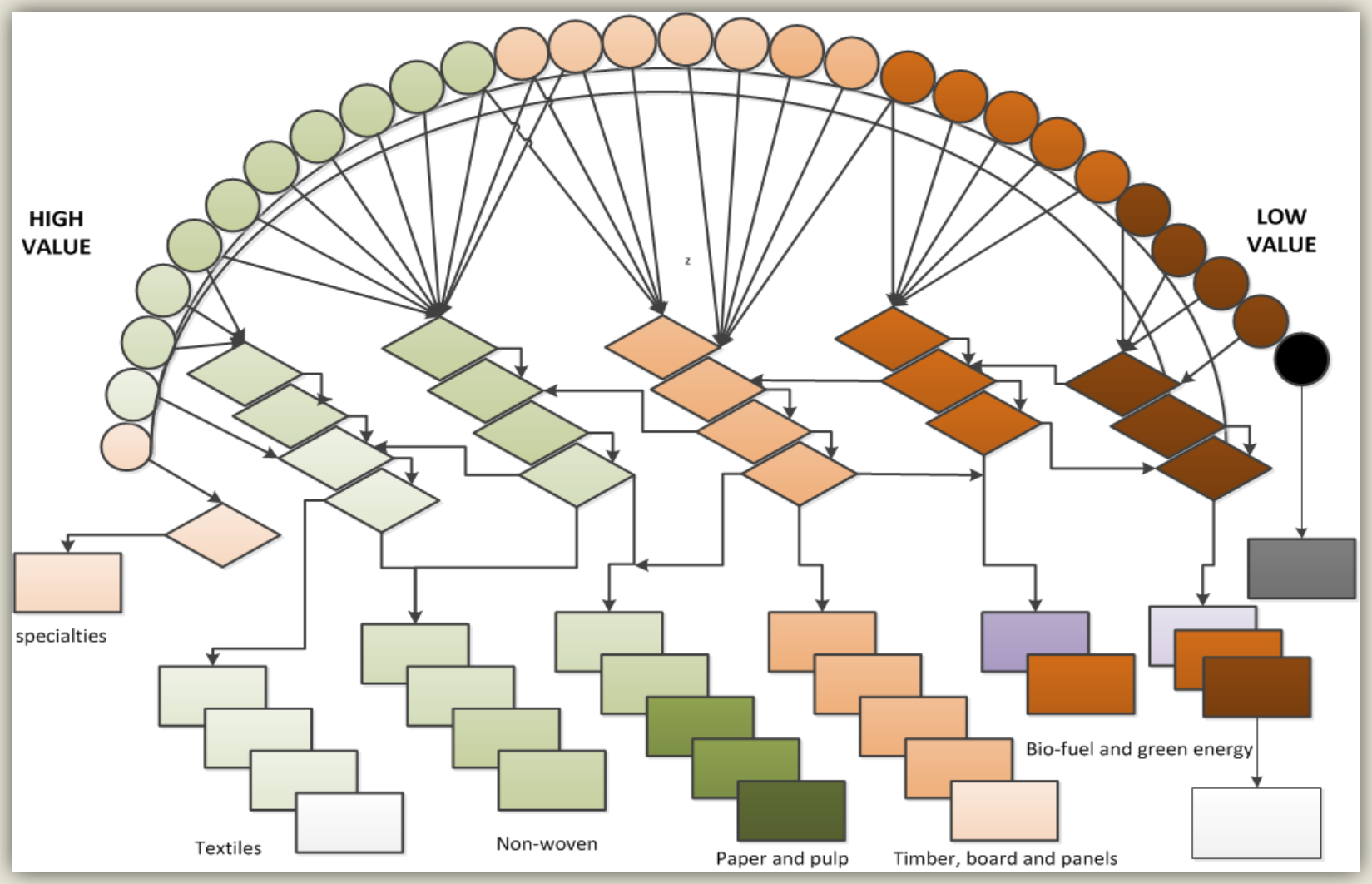
Products from fiber crops

	Main products	Sec. products	Future products
Fiber-based products	Chemical or mechanical pulp Specialty paper Wet-laid non-vowen Textile (natural&regenerated) Garments, bedlinen, technical textiles	Bedding mateial Shives Seeds Specific textiles	Regenerated cellulose Nanofibres, Carbon Moldable webs Foam-formed structures Functional textiles: physical properties, controlled release of substances
Chemical products	Sugars Extractives (talloil) Oil (food&feed?) Pulp	Lignin Press cake Cosmetics Agro-fine Chemicals	Sugar acids Aromatic compmosites, Carbon (Para)pharmaceuticals, agro-chemistry
Composite products	Reinforcement fibres Particle& fibre board Fibre reinforced/filled polyolefin composites (mainly for automotive ind.)	Bark Minor composite products in every day use	Composite foams Biocomposites Foam-formed structures 100% biodegradable fibre reinforced composites, structural biocomposites
Energy products	Black liquor (internal&external?) Biogas Pellets Shive briquettes & pellets	Lignin Bark	Fatty acids Bioethanol Carbon 2nd gen. Biofuel (from high yielding biomass)

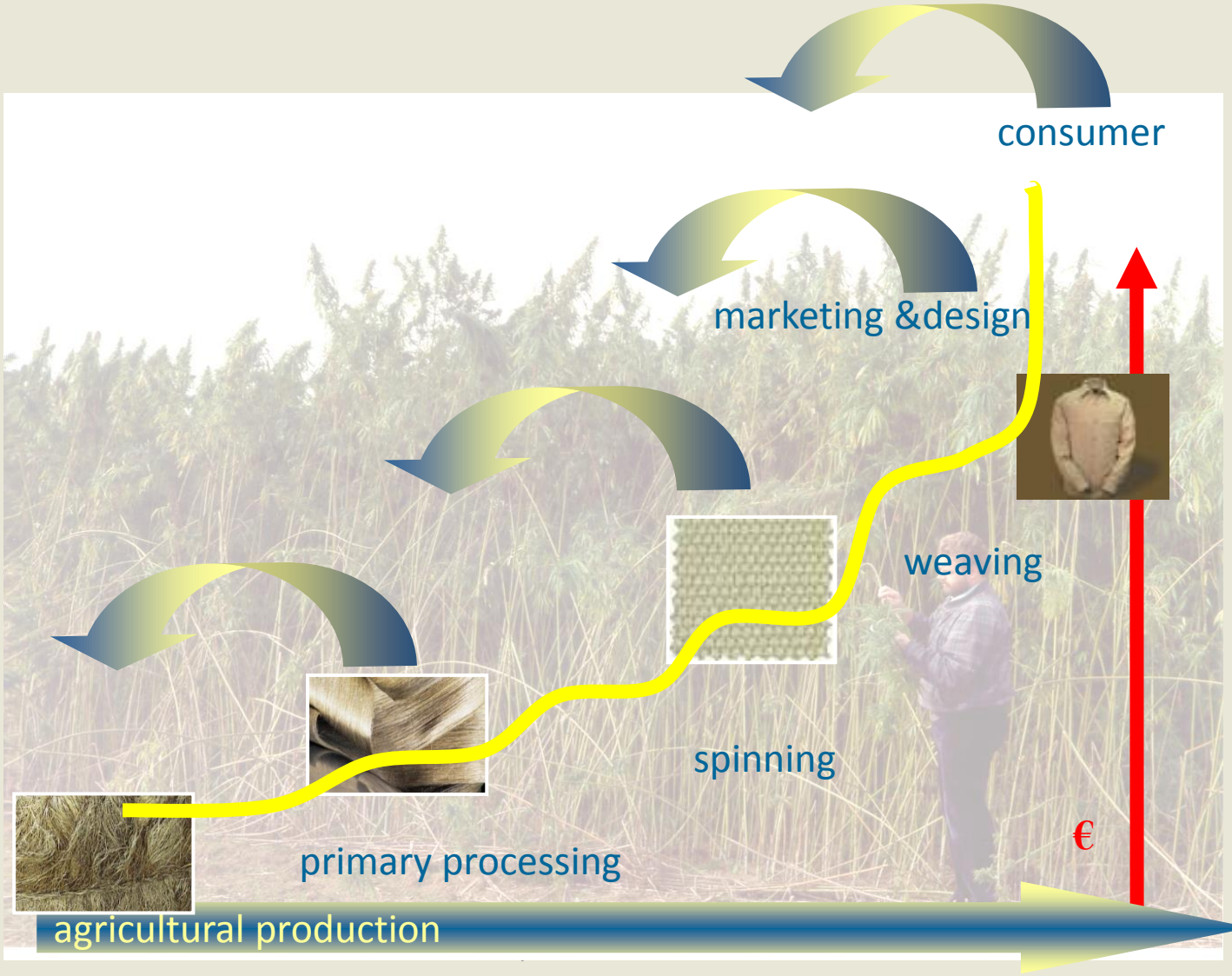
Markets of the fibre crops



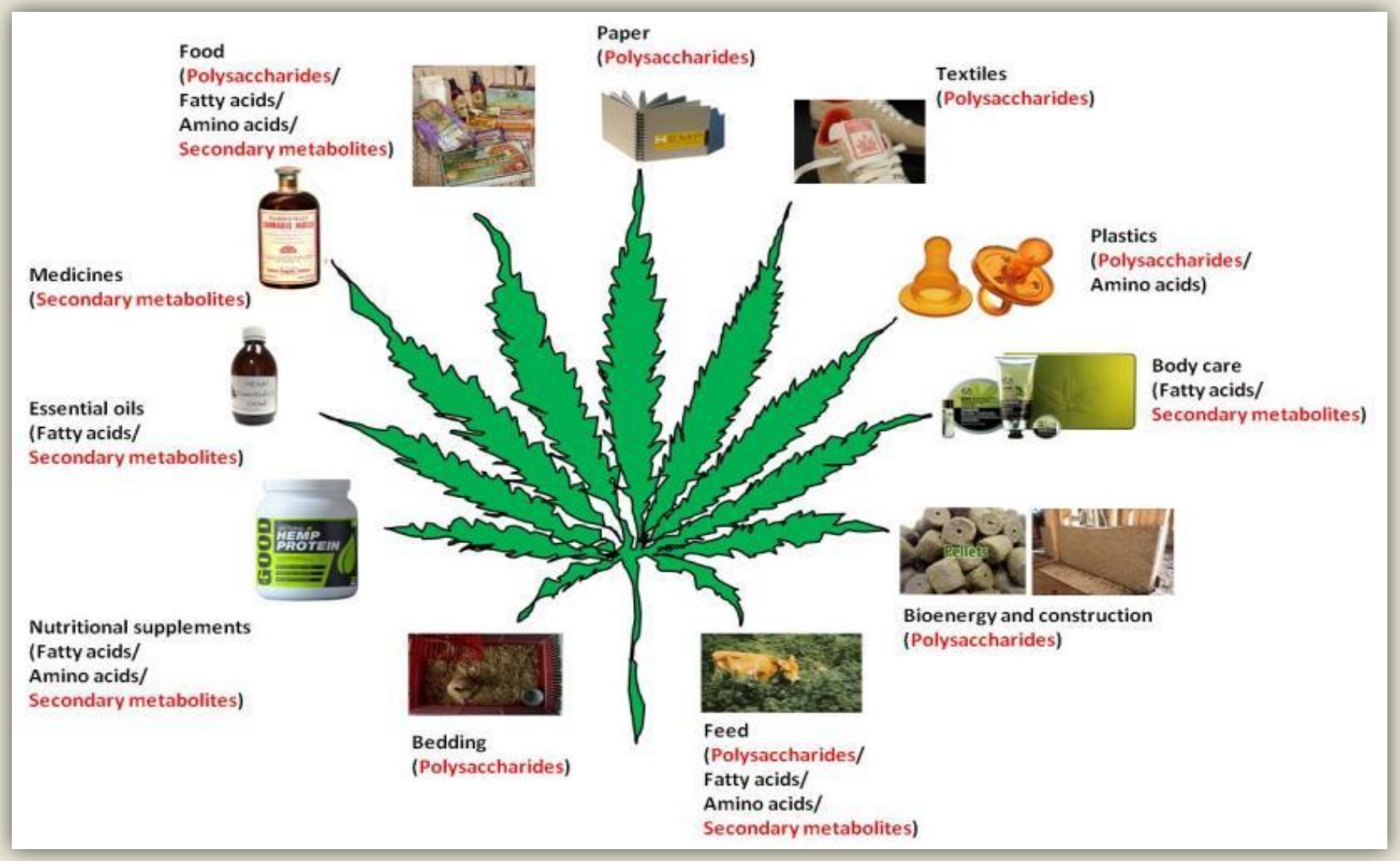
Markets (Cellulose Matrix)



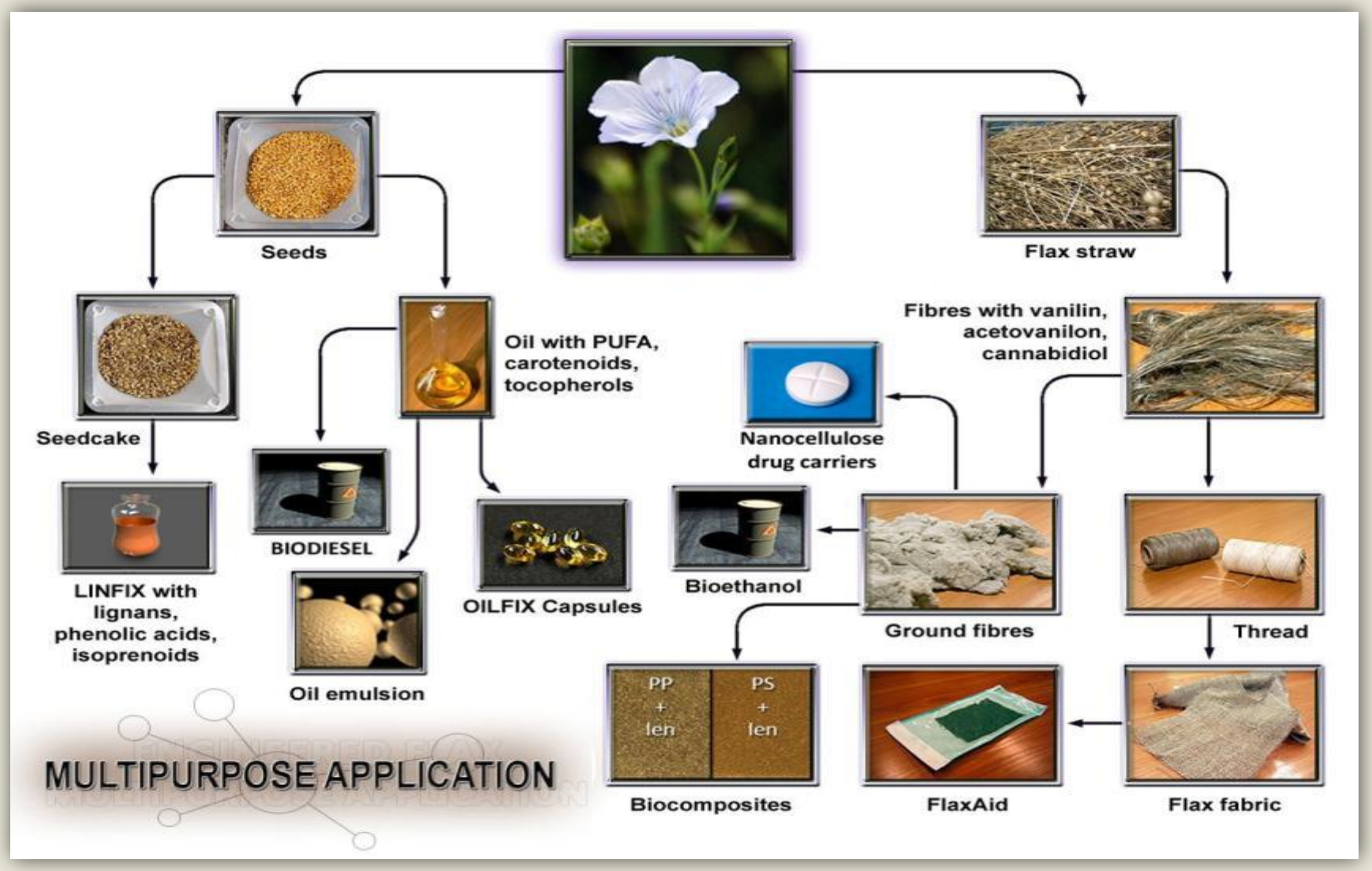
Hemp fibre quality chain



Hemp products
(modified from Small and Marcus, 2002)



Flax products
(source: Prof. Jan Szopa, University of Wroclaw)



Kenaf products

Organic absorbent

Polymer compounds

Insulation material

Insulation mats

bioplastic for

bioplastic for

Integrated assessments of fibre crops: socio-economic and environmental implications

- A **synopsis of the state-of-the-art knowledge** on socio-economic and environmental issues in relation to the production of fibre crops mainly based on literature review and for the situation in Europe and China is on-going and will be completed in month 24 (August 2014) and will be revised in month 36 (August 2015).
- In the **environmental assessment** the *use of water and mineral resources, soil quality and erosion, emission of minerals and pesticides to soil and water, waste generation and utilization, landscape, energy savings, greenhouse effects, acidification issues and biodiversity will be studied.*

What have been done in year 1?

The project started in ***September 2012*** and in the first year ***two workshops*** and ***one summer school*** were organised.

The ***two workshops*** were:

- 20/3/13, Rome entitled **"Agronomy and logistics of fibre crops"**
- 6/6/13, Copenhagen entitled **"Can EU agriculture feed both the energy and bio-based industries of the future in a sustainable way?"**

The ***summer school*** took place in Catania from 21st to 27th of July 2013. The summer school was organised by University of Catania and CRES.

- The title of the summer school was **" FIBRE CROPS: FROM PRODUCTION TO THE END USE"**

What have been scheduled in year 2?

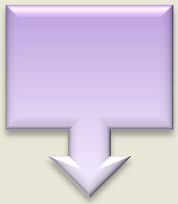
- A **twinning & matchmaking event** will take place in Wageningen (The Netherlands) on 30th and 31st of October 2013.

In this event ***European*** and ***Chinese project coordinators*** will participate as well as representatives from European and Chinese

- The ***summer school*** will take place in Lisbon from 26th to 31st of July 2014. The summer school was organished by University of Lisbon and CRES. The summer school will concentrate on ***bast fibre and grass fibres as ideal crops for future biorefineries***.

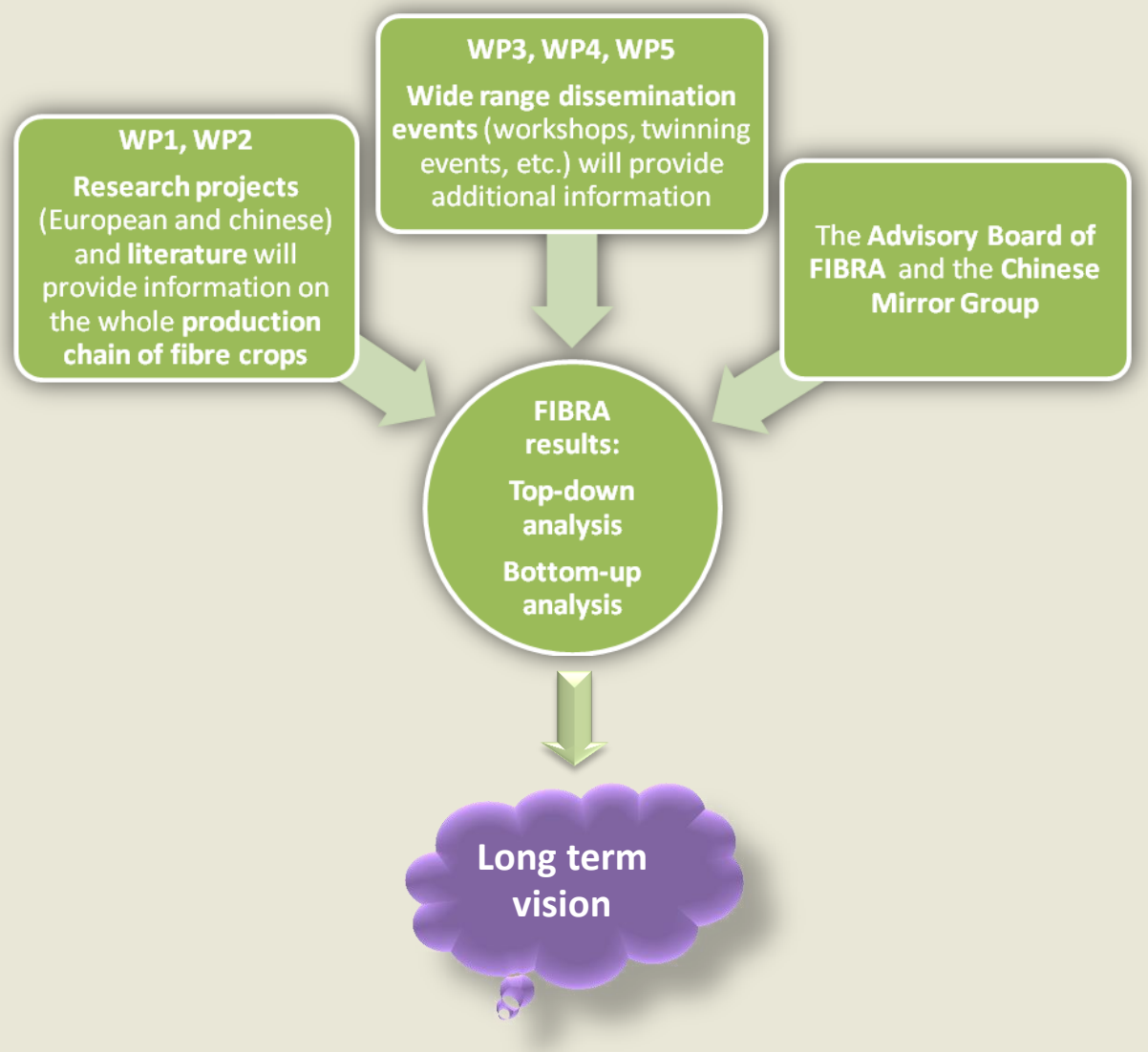
How FIBRA project will create the long term vision on fibre crops in both Europe and China?

- The ***technical information*** that will be collected from the project partners regarding ***genetics, agronomy, logistics, products, markets, environmental issues and social implications*** as well as
- The information that will be collected from the project events namely workshops, summer school, twinning & matchmaking events as well as from the FIBRA conference will contribute on the creation of the



"Long Term VISION on FIBRE CROPS in both EUROPE and CHINA"

Long term vision of FIBRA



The FIBRA Long term vision will include the following chapters:

- **Current situation on fibre crops in EU and China**

  Genetics (breeding and genomics);

  Agronomy (adaptation, cultural practices etc.);

  Logistics (from harvest to processing and transportation);

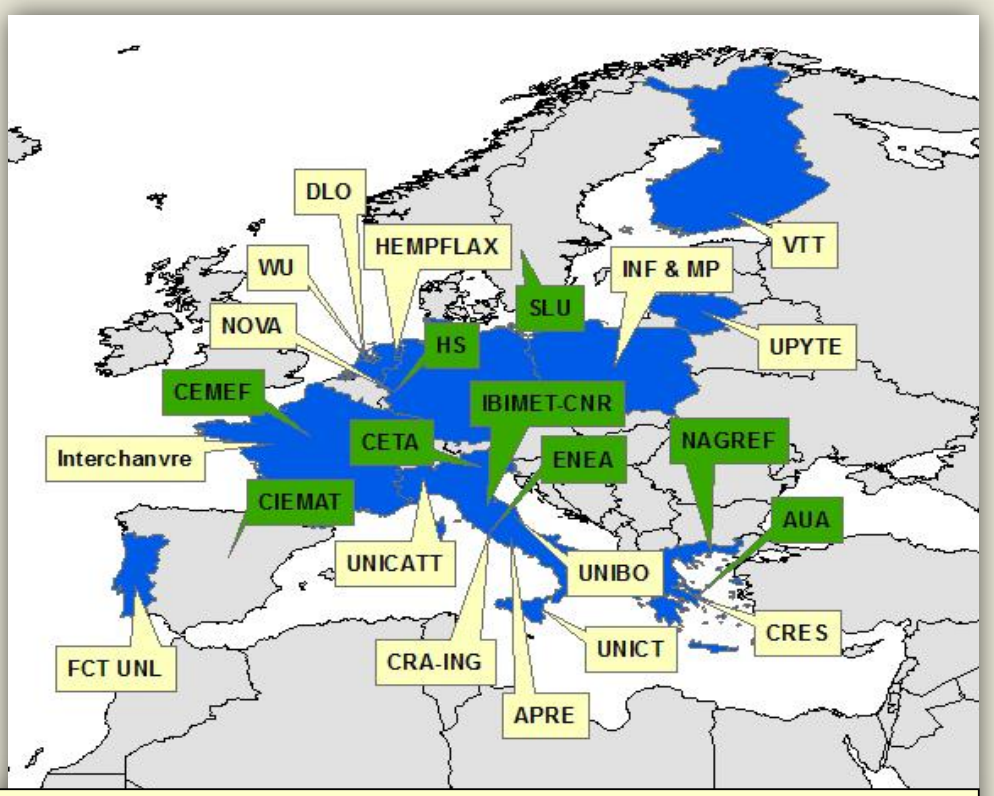
  Products (composite, fibre-based products, bioenergy etc.)

  markets (e.g. textiles, non-woven, paper and pulp, composites, boards and panels);

  sustainability (socio-economic and environmental)

- **Challenges and opportunities for the future in the perspective of common research programmes on fibre crops between EU and China;**
- **Vision for future research activities on fibre crops in EU and China**
- **Recommendations for future research activities**

The consortium



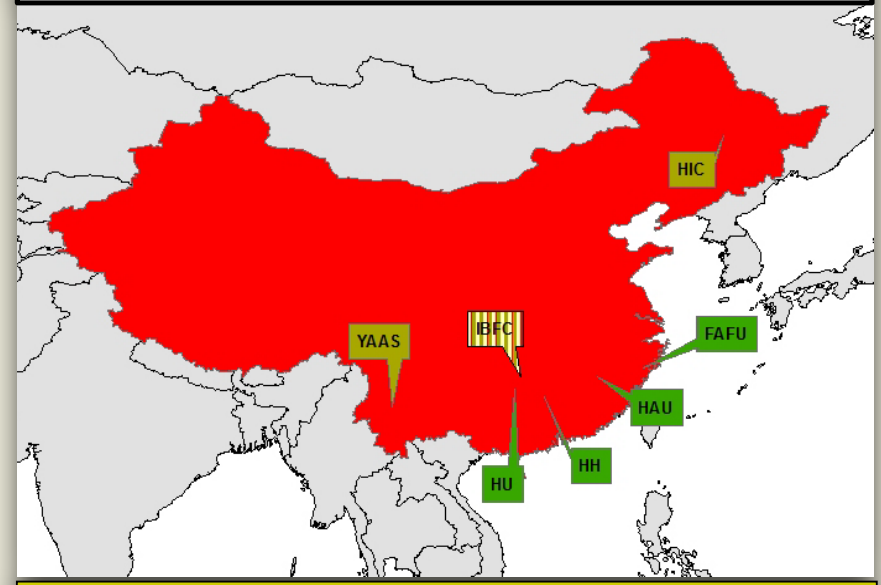
FIBRA consortium

CRES: Center for Renewable Energy Sources, **IBFC:** Institute of Bast Fibre Crops in China, **UNIBO**: University of Bologna, **CRA-ING**: Agricultural Mechanization Research Institute, **WUR-PRI** and **DLO FBR**: University of Wageningen, **Interchanvre**, **FCT UNL**: New University of Lisbon, **INF& MP**: Institute of Bast Fibre Crops, **UPYTE**: Lithuania Research Centre for Agriculture, **UNICT**: University of Catania, **VTT**: Technical Research Centre of Finland, **APRE**: Italian Agency for Research Promotion, **UNICATT**: University Cattolica del Sacro Cuore, **Hempflax BV**, **NOVA**: nova-institut

European Advisory Board

HS - University of Applied Sciences, **SLU** - Swedish University of Agricultural Sciences, **Ifeu -** Institute for Energy and Environmental Research, **CEMEF** Center for Materials Forming, **ENEA -** European Energy Research Alliance, **AUA** - Agricultural University of Athens, **CIEMAT -** Centro de Investgaciones Energeticas, **IBIMET-CNR** Institute of Biometeorology, **C.E.T.A. -** Centro di Ecologia Teorica ed Applicata, **NAGREF**, National Agricultural Research Foundation

Fibre Crops as a sustainable source of biobased material for industrial products in Europe and China



Chinese Mirror Group

IBFC: Institute of Bast Fibre Crops in China, YU: **HIC -** Institute of Industrial Crops, Heilongjiang Academy of Agricultural Sciences, **YAAS** - Yunnan Academy of Agricultural Sciences
Institute of Industrial Crops

Chinese Advisory Board

HAU - Huazhong Agricultural University, **HU** - Hunan University, **FAFU** - Fujian Agriculture and Forestry University, **HH** - Hunan Huasheng company and director of Hunan Huasheng Lt

Harvesting, processing and logistics of the fibre crops

Fibre crops

Longitudinal stems

Disordered stems

By products

Textile fibre

Fiber insulation boards

Technical fibre

Automotive components

Longitudinal stems

- Disordered stems

Flax harvesting

Longitudinal stems

Parallel-stem roto-baler

Ramie Decorticator Model 4BM-260

Longitudinal stems

Jute and Kenaf Decorticator Model 4HB--480

Institute of Bast Fiber Crops, CAAS:
Long Chaohai Dean/Professor

Disordered stems

Disordered stems

- Mowing after start flowering
- July-August
- Cutting device developed and patented by HempFlax!
- GPS Pilot
- Cut on 60 cm
- Left in a swat

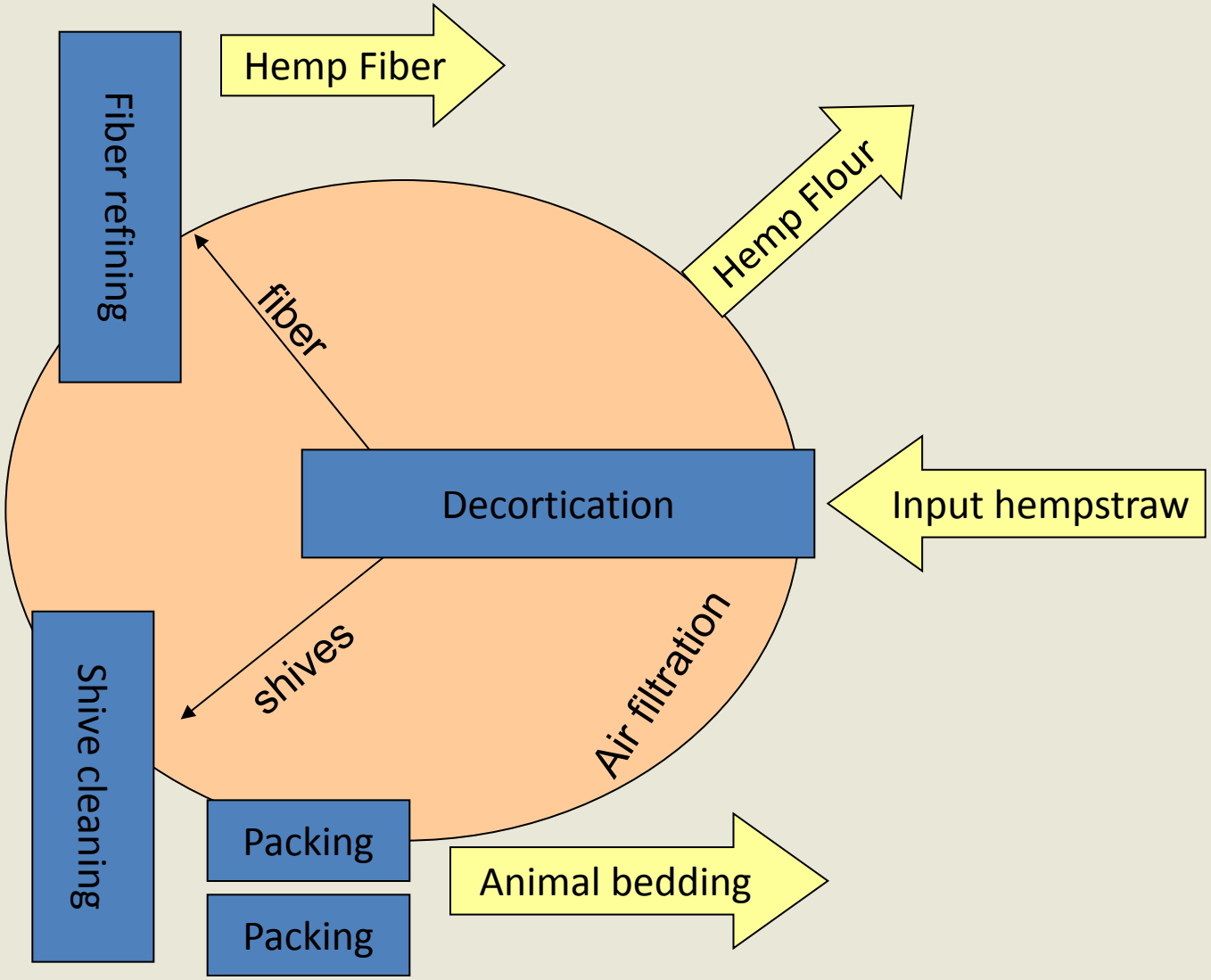
- Turning after one week
- Once or twice, depending on weather
- For retting and drying

- Baling in square bales
- Advantages:
  - Handling
  - Transportation: 11-14 tons a t
  - Quality
- Modified balers

Storage

- Logistics
- Storage: 70.000 m2 storage space

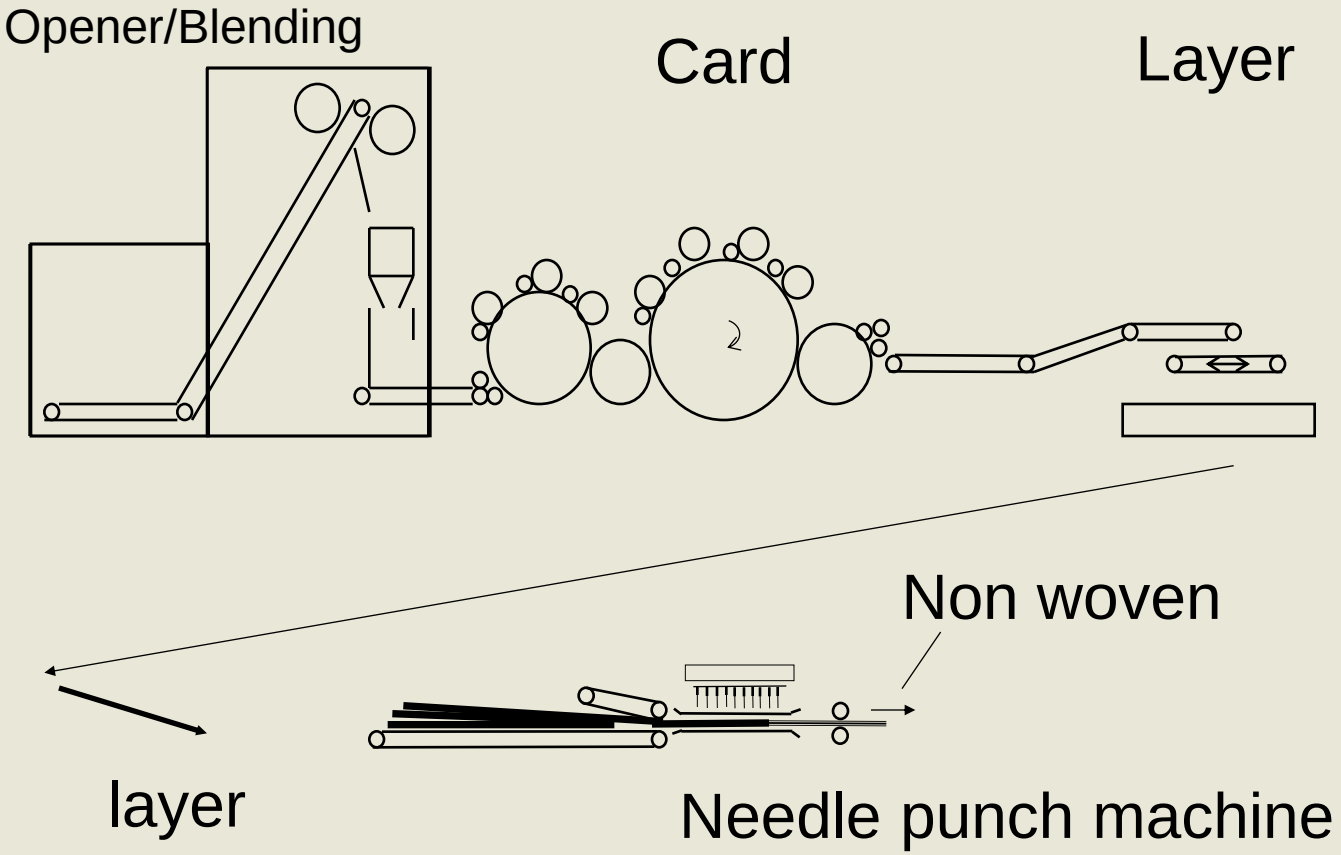
Primary processing



Primary processing

- Real life development
- Input: 3-4 mt/hour
- Output: 700-1000 kg fiber/hour
- Installed power: 600 KW
- Fiber quality:
  - Technical grade: max 2% shives
  - Textile grade: aprox. 0% shives
- 2 staff members operational

Secondary processing



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Thank you for your attention

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