NON-WOOD FIBERS: A GLOBAL AND REGIONAL PERSPECTIVE

March 8, 2019
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Introduction to Pöyry

Non-wood (Alternative) fibers:

- Global overview
  - Production by region
  - Production by fiber type
  - Potential
  - Key properties and pros / cons of each fiber type

- Regional assessments: China / Asia, Latin America, North America, Europe
  - Fiber types most prevalent in each region
  - Non-wood pulp potential
  - Key end uses for each fiber type: demand growth, key drivers, trends
  - Region specific examples

- Summary
WHO IS PÖYRY?
PÖYRY IS AN INTERNATIONAL CONSULTING AND ENGINEERING COMPANY. OUR VISION IS TO BE THE TRUSTED PARTNER, DELIVERING SMART SOLUTIONS THROUGH CONNECTED TEAMS

<table>
<thead>
<tr>
<th>ENERGY</th>
<th>INDUSTRY</th>
<th>INFRASTRUCTURE, WATER &amp; ENVIRONMENT</th>
</tr>
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<tbody>
<tr>
<td>Thermal Power &amp; Renewable Energy, Hydropower, Transmission &amp; Distribution, Nuclear Energy</td>
<td>Forest Industry, Chemicals &amp; Biorefining, Mining &amp; Metals</td>
<td>Rail, roads, traffic planning, tunnels &amp; urban development, Water lifecycle services, Environmental services (strategy to operations)</td>
</tr>
</tbody>
</table>

- **Top 10**
  - Ranked in power generation in the world

- **#1**
  - Ranked in Pulp, Paper & Board

- **#6**
  - Ranked in Industrial Engineering

- **1,000 km**
  - More than the length of transportation tunnels in the last decade

- **25+ countries**
  - 25+ countries rely upon Pöyry’s energy management consulting

- **90%**
  - Delivered projects for 90% of the world’s pulp and paper companies

- **3,000+ due diligence**
  - Environmental due diligence in last decade

- **20M people**
  - Water people benefiting from cleaner water in Europe and Middle East
GLOBAL OVERVIEW: NON-WOOD FIBER USE IN PAPER MAKING

• PRODUCTION BY REGION
• PRODUCTION BY FIBER TYPE
• POTENTIAL BY FIBER TYPE
Average papermaking fiber furnish: global

Non-wood accounts for 2-3% of total fiber furnish globally for papermaking.
Two different ends of the spectrum in fiber consumption, based, to a large extent, on regional availability.
CONSUMPTION OF NON-WOOD PULP IN PAPER AND PACKAGING

China and Rest of Asia account for around 88% of total non-wood pulp in paper and packaging, but their share has been slowly declining.

Total production in 2017 10.4 MM tonnes
- China accounts for over half the production of non-wood pulp
- India accounts for an additional 23%
- Combined, a total of 80% of the total non-wood pulp production
- Latin America accounts for 5%

Renewed interest in non-wood raw materials driven by:
- Good availability
- Increasing environmental consciousness / search for positive environmental image
- Development of new technologies for processing these fibers
PRODUCTION OF NON-WOOD PULP 2000-2030

World production of non-wood pulp for papermaking is expected to decline from 10.4 million tonnes in 2017 to 8.1 million tonnes by 2030

Why the seeming disconnect?

• China accounts for 57% of the world non-wood pulp production
• Production in China forecast to decline: tightening environmental regulations and closing down of old non-wood pulp mills
• Production in Rest of Asia, North America, other regions forecast to grow
NON-WOOD PULP POTENTIAL: CAPACITY CHANGES

Closures continue, but new capacity could eventually tip the balance the other way

- Older non-wood fiber mills are often not environmentally friendly, are small and have inadequate facilities or capital to deal with chemical and energy recovery

- High capital costs required per ton of capacity for building new, medium scale, environmentally friendly wood pulp mills is making non-wood pulp more popular

- New mills using non-wood fibers are generally less capital intensive and more environmentally friendly

<table>
<thead>
<tr>
<th>Year</th>
<th>New capacity</th>
<th>Closures 1,000 t/a</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>0</td>
<td>-259</td>
<td>-259</td>
</tr>
<tr>
<td>2017</td>
<td>410</td>
<td>-321</td>
<td>+89</td>
</tr>
<tr>
<td>2018</td>
<td>200</td>
<td>-118</td>
<td>+82</td>
</tr>
<tr>
<td>2019</td>
<td>140</td>
<td>-90</td>
<td>+50</td>
</tr>
</tbody>
</table>
NON-WOOD FIBER SUPPLY

Non-wood raw materials include a wide range of both long and short fiber raw materials

Short fibers dominate, with 93% of production
- **Short-fiber:** straw (wheat, rice), reed, bagasse, bamboo, esparto grass, oil palm bunch, coconut husks etc.
- **Long-fiber:** abaca (Manila hemp), cotton linters/combers, flax, hemp, jute, kenaf (bast) and sisal

Examples of novel non-wood raw material applications:
- Bamboo in **tissue** and **dissolving pulp**
- Bagasse in **nonwovens** and **food service boards**
- Straw and grass fiber in **tissue**, **packaging** and **molded fiber** products

Orange text denotes short-fiber
*includes cotton
NON-WOOD PULP POTENTIAL

Non-wood pulp is available, especially in Asia, but there is opportunity in other regions

- **Availability** of non-wood fiber raw material is not a major limitation for expanded use

- **Straw** might be the most important source of non-wood fiber for the pulp industry
  - The availability of straw is estimated at 1.3 billion BDMT per year

- The global availability of other non-wood fibers amounts to another 1.3 billion BDMT

<table>
<thead>
<tr>
<th>Fiber</th>
<th>Estimated Production*</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straw</td>
<td>3.6</td>
<td>China, India, Pakistan</td>
</tr>
<tr>
<td>Reed</td>
<td>0.7</td>
<td>China</td>
</tr>
<tr>
<td>Bamboo</td>
<td>2.6</td>
<td>China, India</td>
</tr>
<tr>
<td>Bagasse</td>
<td>2.7</td>
<td>China, India, L. America, Africa</td>
</tr>
<tr>
<td>Cotton linters &amp; combers</td>
<td>0.3</td>
<td>China, Europe, North America</td>
</tr>
<tr>
<td>Flax, hemp</td>
<td>0.1</td>
<td>North America, China, India</td>
</tr>
<tr>
<td>Abaca</td>
<td>&lt;0.1</td>
<td>Philippines</td>
</tr>
</tbody>
</table>

*Millions of tonnes/yr
KEY PROPERTIES BY FIBER TYPE
### FIBER DIMENSIONS

Fiber dimensions of common pulp wood fibers and selected non-wood fibers

<table>
<thead>
<tr>
<th></th>
<th>Norway spruce</th>
<th>Bamboo</th>
<th>Bagasse</th>
<th>Eucalyptus grandis</th>
<th>Wheat straw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber length, mm</td>
<td>2.2</td>
<td>1.7</td>
<td>1.4</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Fiber width, μm</td>
<td>26</td>
<td>14</td>
<td>23</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Aspect ratio</td>
<td>85</td>
<td>89</td>
<td>74</td>
<td>47</td>
<td>44</td>
</tr>
<tr>
<td>Lumen width, μm</td>
<td>18</td>
<td>5</td>
<td>15</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Cell wall, μm</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Wall/cross-section</td>
<td>52 %</td>
<td>93 %</td>
<td>38 %</td>
<td>72 %</td>
<td>86 %</td>
</tr>
</tbody>
</table>

“Optimum fiber for paperboard”

“Optimum fiber for paper”
FIBER PROPERTIES OF THE PREVALENT NON-WOOD FIBERS

Non-wood fibers are a mixed bag. Generally, the yield is low and silica and ash content high compared to wood pulp. Straw, the most common non-wood fiber, is smaller in dimensions to hardwood fibers. However, bamboo has dimensions in the range of softwood fibers. Cotton, the benchmark for security paper, is in its own league in purity, yield and fiber length

<table>
<thead>
<tr>
<th>Item</th>
<th>Fiber length (mm)</th>
<th>Coarseness (mg/mm)</th>
<th>Fiber width (mm)</th>
<th>Yield of unbl. pulp (%)</th>
<th>Alpha cellulose (%)</th>
<th>Lignin (%)</th>
<th>Pentosan (%)</th>
<th>Ash</th>
<th>Silica</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardwood</td>
<td>0.7-1.6</td>
<td>0.07-0.12</td>
<td>16-25</td>
<td>50-57</td>
<td>38-49</td>
<td>17-26</td>
<td>17-26</td>
<td>&lt;1</td>
<td>&lt;.03</td>
</tr>
<tr>
<td>Softwood</td>
<td>2-3.5</td>
<td>0.16-0.34</td>
<td>30-45</td>
<td>50-60</td>
<td>40-45</td>
<td>26-34</td>
<td>7-14</td>
<td>&lt;1</td>
<td>&lt;.03</td>
</tr>
<tr>
<td>Straw-wheat</td>
<td>0.8-0.9</td>
<td>0.09</td>
<td>15</td>
<td>44-49</td>
<td>26-51</td>
<td>16-22</td>
<td>24-32</td>
<td>&gt;6</td>
<td>12-18</td>
</tr>
<tr>
<td>Bagasse</td>
<td>0.8-2.8</td>
<td>N/A</td>
<td>23</td>
<td>50-52</td>
<td>31-34</td>
<td>16-21</td>
<td>26-31</td>
<td>1-5</td>
<td>1-4</td>
</tr>
<tr>
<td>Bamboo</td>
<td>&lt;2.7</td>
<td>N/A</td>
<td>14</td>
<td>46-47</td>
<td>26-43</td>
<td>21-31</td>
<td>15-26</td>
<td>2-5</td>
<td>0.7</td>
</tr>
<tr>
<td>Cotton linters &amp; combers</td>
<td>2-6</td>
<td>0.22</td>
<td>20</td>
<td>70</td>
<td>80-85</td>
<td>0</td>
<td>0</td>
<td>0.8-1.8</td>
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</tr>
</tbody>
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FIBER PROPERTIES OF THE PREVALENT NON-WOOD FIBERS

When considering specific end use products, such as **printing and writing grades**, and the specifications for those products, fiber qualities provide a somewhat different value

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FIBER PROPERTIES OF THE PREVALENT NON-WOOD FIBERS

For use in a product such as containerboard, where high strength is required, the fibers fare differently still

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<td>80-85</td>
<td>0</td>
<td>0</td>
<td>0.8-1.8</td>
<td>N/A</td>
</tr>
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</table>
## NON-WOOD FIBER QUALITIES

The physical properties of the fibers are reflected in the characteristics of various strength or optical properties.

<table>
<thead>
<tr>
<th></th>
<th>Straw</th>
<th>Reed</th>
<th>Bamboo</th>
<th>Bagasse</th>
<th>Cotton</th>
<th>Flax</th>
<th>Abaca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tear</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td></td>
<td>-</td>
<td></td>
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</tr>
<tr>
<td>Strength</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
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<td>+</td>
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<tr>
<td>Formation</td>
<td>+</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Opacity</td>
<td>-</td>
<td>+</td>
<td>+ / -</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brightness</td>
<td>-</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Drainage</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulk</td>
<td>-</td>
<td>-</td>
<td>+ / -</td>
<td></td>
<td>-</td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>
REGIONAL ASSESSMENT
NON-WOOD PULP POTENTIAL: KEY FIBERS BY REGION

China, India and North America have the largest range of non-wood fibers available

- The main future issues of the non-wood pulp industry
  - Poor condition of most existing assets
  - Challenging production economics due to mill scale
- The main problems of straw and bagasse pulps:
  - Seasonal supply
  - Logistics of harvesting, transport, storage
  - Processing challenges
  - Short-fiber non-wood raw materials offer no real quality advantages over wood
- There isn’t necessarily an inherent advantage to non-wood pulps

<table>
<thead>
<tr>
<th>Region</th>
<th>Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>Straw, Reed, Bamboo, Bagasse, Cotton Linters, Flax, Hemp</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Straw</td>
</tr>
<tr>
<td>India</td>
<td>Straw, Bamboo, Bagasse, Flax, Hemp</td>
</tr>
<tr>
<td>Philippines</td>
<td>Abaca</td>
</tr>
<tr>
<td>Latin America</td>
<td>Bagasse</td>
</tr>
<tr>
<td>Africa</td>
<td>Bagasse</td>
</tr>
<tr>
<td>North America</td>
<td>Cotton Linters, Flax, Hemp, Straw, Bagasse</td>
</tr>
<tr>
<td>Europe</td>
<td>Flax, Hemp, Grass</td>
</tr>
</tbody>
</table>
NON-WOOD PULP POTENTIAL: BAMBOO

Bamboo may be the most promising non-wood raw material

• Bamboo is botanically classified as a grass
  – Growing period of about ten years
  – Grows fast
  – Can be harvested in two to three years

• Bamboo is a viable raw material alternative to wood
  – Unrestricted harvesting time
  – Relatively large size of bamboo stems
  – Does not need to be replanted

• Global bamboo resources are estimated at 36 million hectares
  – Asia: 60-65%  India (11 MM ha)  China (5 MM ha)
  – Latin America: 25-30%  Brazil (9 MM ha)
  – Africa: 5-10%.
NON-WOOD PULP POTENTIAL: BAMBOO

Bamboo is already used for various applications, such as building materials, decoratives, fabrics, panels, flooring, plywood, tissue, packaging, etc.

- **Advantages:** *Suitability for papermaking*
  - Strong and long fibers
  - Can be used without the addition of long fibers; tear / physical strength is high
  - Works for non-traditional end uses: sack, wrapping / bag paper, linerboard
  - Good component in tissue paper--almost as good as NBSKP, especially for brown / natural tissue

- **Disadvantages:**
  - Manual harvesting, more difficult to cook and bleach, dealing with silica
  - Higher chemical / energy costs
  - Not good for softness

---

<table>
<thead>
<tr>
<th>Mill</th>
<th>Bamboo pulp capacity (1,000 t/a)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sichuan Yibin Paper Industry, CH</td>
<td>200</td>
<td>New mill, integrated tissue + FBB</td>
</tr>
<tr>
<td>Sichuan Yinge Bamboo P&amp;P, CH</td>
<td>80</td>
<td>Conversion to unblached market pulp</td>
</tr>
<tr>
<td>BILT Graphic Paper, IND</td>
<td>130</td>
<td>Restart, UWF integrated</td>
</tr>
<tr>
<td>Sichuan Yongfeng /Luzhou Yongfeng P&amp;P, CH</td>
<td>200</td>
<td>New unbl. &amp; bl. market pulp mill</td>
</tr>
</tbody>
</table>
## NON-WOOD FIBER END USES

Non-wood is finding a home in several end uses with growth

<table>
<thead>
<tr>
<th></th>
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<th>Bamboo</th>
<th>Bagasse</th>
<th>Cotton</th>
<th>Flax</th>
<th>Abaca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood free P&amp;W</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
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<tr>
<td>Packaging</td>
<td>?</td>
<td></td>
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</tr>
<tr>
<td>Fluting</td>
<td>?</td>
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<td></td>
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<tr>
<td>Tissue</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Dissolving Pulp</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td></td>
<td></td>
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<tr>
<td>Specialty Papers</td>
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<td></td>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Molded Fiber</td>
<td>Y</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LONG-TERM PAPER DEMAND GROWTH BY REGION 2017-2030

Emerging regions provide the best opportunities for paper and paperboard demand growth

Emerging regions are forecast to have the most growth:
• China
• Rest of Asia
• Eastern Europe
• Africa
• Middle East
• Latin America

Developed regions will be flat to declining
• Saved by tissue and packaging

Demand growth, %/a

Share of consumption in 2017, %
LONG-TERM PAPER DEMAND GROWTH BY PRODUCT 2017-2030

Demand for graphic papers will weaken through 2030, while consumption of tissue and packaging papers and boards continues to grow.

Winners:
- Tissue
- Containerboard
- Cartonboard
- Sack paper
- Other
  - Food service packaging
  - Specialties

Challenged end uses:
- Printing and writing grades

Demand growth, %/a

<table>
<thead>
<tr>
<th>Product</th>
<th>2017-2030 Demand Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue</td>
<td>3%</td>
</tr>
<tr>
<td>Containerboard</td>
<td>2%</td>
</tr>
<tr>
<td>Cartonboard</td>
<td>1.5%</td>
</tr>
<tr>
<td>Sack paper</td>
<td>-0.5%</td>
</tr>
<tr>
<td>Other</td>
<td>-1%</td>
</tr>
</tbody>
</table>

Share of consumption in 2017, %

MARCH 8, 2019
IMFA PRESENTATION
REGION SPECIFIC EXAMPLES
NON-WOOD PULP IN EUROPE

Non-wood pulp is marginal in Europe making up only 0.1% of the total papermaking fiber capacity

In the 21st century, non-wood pulp production in Europe has declined by an average of 4.6% per annum

- 120 kt/a of straw pulp capacity shut down between 2000-2015
- Trend is going the other way with the novel grass paper developed by Scheufelen and two announced straw pulp mills
- Cotton has been the most important non-wood fiber in Europe: 55% of the total capacity
  — Security papers, décor and various technical papers in batteries and filters.
- Non-wood fiber market in Europe is fragmented, filled by small specialty paper producers

<table>
<thead>
<tr>
<th>Fiber type</th>
<th>Capacity, kt/a</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>61</td>
<td>Security, decor, technical</td>
</tr>
<tr>
<td>Flax</td>
<td>27</td>
<td>Cigarette, thin paper</td>
</tr>
<tr>
<td>Other agro-fiber</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>111</td>
<td></td>
</tr>
</tbody>
</table>
CASE EXAMPLE: SCHEUFELEN GRASS PAPER

Though Scheufelen filed for insolvency in February 21st, global megatrends favor the development of novel, environmentally sound packaging solutions

Scheufelen grass paper is made of 50% sun-dried grass
• Grass produced locally and processed at an integrated site
• Suitable for bags, pouches and packaging boards
• Holds ISEGA food packaging and FSC-mix certificates in addition to being recyclable and compostable

Benefits of grass paper
• Process water requirements as low as 1 liter / ton of pulp compared to few thousand liters/ ton of wood pulp
• No chemicals needed
• Energy consumption is 80% lower than traditional pulp

Challenges
• Printability was the main challenge
• Using perennial grass instead of agricultural residues, Scheufelen’s solution is competing with food production

Sources: Scheufelen, Packaging Europe, EUWID
NON-WOOD PULP IN NORTH AMERICA

Non-wood pulp is relatively marginal in North America, as well, with only ~300,000 tons of capacity in 2017

Since 2000, non-wood pulp production in North America has declined by an average of 1.5% per annum. But that is changing

Straw pulp:
- Sustainable Fiber Technologies, Columbia Pulp, SustainaPulp Canada, Red Leaf Fiber, etc. and the Phoenix Process, are generating new volumes and renewed interest in non-wood
- With significant acres dedicated to the production of wheat
  - Washington State
  - Canada

Bagasse and other options developing for MF in other regions of NA

Wheat straw pulp generally needs to be utilized with other types of fiber, as it is a short fiber and it doesn’t bleach to the same brightness as wood pulps

- Wheat straw performs most closely to a hardwood fiber
- Generally used as a blend of wheat straw pulp and wood fibers
  - Up to 30% straw
- Derive benefits from the wheat straw, but maintain performance requirements through the blend
ASIA: NON-WOOD PULP

China is ahead of Other Asia, with some non-wood pulp mills producing more than 300,000 tons per year

- **China:**
  - Many non-wood pulp producers are integrated to paper, some MF
  - Large mills produce / sell to Tissue and MF, use mainly bamboo, wheat straw
  - Small-mid use bamboo and wheat straw, plus bagasse and reed
  - Smaller mills produce / sell to P&W and cartonboard

- **Other Asia:**
  - Largest is ~300,000 tpy
  - Use mainly bamboo, bagasse, kenaf.
  - Some smaller ones use wheat straw
  - Some integration to paper, MF
  - Mid-sized mills sell mainly to P&W
  - Smaller ones might sell to MF
ASIA: MOLDED FIBER

China is estimated to account for ~75% of the molded fiber production in Asia.

**Asia Molded Fiber Demand**

- **China:**
  - 10-15 mid-large MF producers; rest, the vast majority, are small.
  - 3 of the largest are **backward integrated** to pulp.
  - End uses served: foodservice, industrial, medical, agricultural.

- **Other Asia:**
  - 3-5 mid-large MF producers; vast majority are small.
  - Minimal **backward integration** to pulp.
  - Main end uses are industrial and agricultural.

**Rest of Asia (mainly India, Malaysia, Thailand):** Utilizes bamboo, bagasse, wheat straw.

**China:** Utilizes reed, bamboo, bagasse, wheat straw.

Total ~3.0 MM tons.

---

MF: Large: >3 locations  Medium – small: < 3 locations
ASIA: TRANLIN GROUP CASE STUDY

Tranlin is the largest straw utilization enterprise in the world

Company Highlights
- Founded in 1976
- Headquarters: Shandong, China
- Largest straw utilization enterprise in the world
- Total assets of $1.1 billion
- Targeting the overall utilization of 50 million tons / year of straw processing by 2020

Non-wood Pulp Production
- 600,000 tons non-wood pulp
- Stores 4 million tons non-wood pulp across 800 collection centers
- The largest integrated molded fiber producer in China
- Also produce tissue

Tranlin Product Portfolio
- Fulvic Acid Fertilizers
- Natural Color Printing Paper
- Natural Color Tissue (100% non-wood pulp)
- Natural Color Food Packaging (100% non-wood pulp molded fiber)

Strengths & Weaknesses
+ Modern storage and transportation system
+ Forward integrated to tissue and molded fiber packaging
- Stagnant development outside China
  $2-billion straw pulp, tissue and fertilizer mill in Chesterfield County, VA indefinitely delayed
Latin American producers are diverse and spread throughout the region.

- **Non-wood pulp:**
  - Large mills mainly use bagasse, others use flax or other locally available fibers
  - Sell to P&W, packaging and tissue
  - Larger mills in Venezuela, Peru, Colombia; mid-small mills in Argentina, Cuba, Ecuador, Bolivia

- **Molded fiber:**
  - Mainly use bagasse
  - Large companies sell to industrial, agriculture and foodservice
  - Mid-smaller ones sell to industrial and agriculture
  - Larger ones in Mexico, Argentina, Brazil; others also in Chile

Pulp mills: Large: >300  Medium: 100-300  Small: <100 k tons
MF: Large: >3 locations  Medium – small: < 3 locations
CERTIFICATIONS
<table>
<thead>
<tr>
<th>Fiber</th>
<th>Certification</th>
<th>In China?</th>
</tr>
</thead>
</table>
| Straw  | • Verified Carbon Standard (VCS) offers verifications and International Sustainability and Carbon Certification (ISCC) offers certifications  
• Approved by the European Commission                                                                                                               | No       |
| Bamboo | • PEFC and FSC have certification for bamboo  
• In 2015 there were allegations regarding the accuracy of the bamboo value chains. Transaction verification is ongoing to determine whether there are mismatching volumes or misleading transactions | ?        |
| Bagasse| • VCS: verifications for energy industries re: GHG emission reductions from fuel consumption if using bagasse instead of non-renewables  
• ISCC: certifications for bagasse upstream supply chain; for food, feed, bio-based products and energy; certifications are stated as fully traceable, deforestation free, covering all feedstocks and markets  
• BonSucro offers certification for sustainable sugarcane production, processing and trade.                                                   | No       | Yes      |
SUMMARY AND CONCLUSIONS
SUMMARY AND CONCLUSIONS

All fibers need to be considered in production of papers and packaging in the future.
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Pöyry Management Consulting