Convergence of the Markets for Food, Feed, Fuel and Fiber: Opportunities or Cause for Concern for Global Forests?

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Outline

- Convergence of the “Four Fs”
- What is Driving it?
  - Fiber (Wood)
  - Fuel (Energy)
  - Food & Feed
- Is There Any Good News?
- So What?
The markets for food, fuel and fiber will converge in the sense that the feedstocks will trade on the basis of their energy equivalency. (eg., The first oil/rapeseed swap deal was recorded in August 2010.)

The price of oil is expected to become a support price for cereals, oilseeds and lower-quality wood.

All these prices spiked in 2007/8, and then fell with the financial crisis. They have since partly rebounded. This is consistent with the convergence thesis, but it doesn’t prove it.
Impact of Biofuels on Food Prices?

• Was increased biofuel production a key reason for the food crisis in 2007/8?

• Many empirical studies have been conducted, but the magnitude of the impact is very sensitive to the models used.
  
  • Models which look at the food and agricultural sector in isolation, find higher impacts on food prices. (i.e., partial equilibrium models)
  
  • Models which account for interactions of various sectors, find the impacts to be relatively small (i.e., general equilibrium models)

• It did have a bigger impact on the prices of specific crops (e.g., corn, soybeans), than on global or aggregated food prices.
Impact of Biofuels on Food Prices?

• What about the future relationship?

• IIASA study in 2009 is amongst the most rigorous:
  
  • Base case assumes biofuel production remains at 2008 level.
  
  • Given the IEA’s World Energy Outlook 2008 projections, price increases for both cereals and other crops in 2020 are ~10% higher.

  • Given the mandates and targets announced by several large countries are implemented, price increases are ~30% higher.

Message? If government’s follow through with their aggressive biofuel targets, we can expect meaningful upward pressure on the prices of key food stuffs, lower quality wood, and shifts in land use.
Implications of the Convergence?

Population growth, rising incomes and urbanization will continue to drive demand growth for food, fuel and fiber.

The common denominator in these markets is the underlying land.

- Given the scarcity of arable non-cultivated land, expect greater land-use pressure in many regions.
- Given technological and market developments, it is becoming relatively more attractive for larger enterprises to use the land.
- Pressure is expected to rise the most in emerging tropical/semi-tropical countries markets, and to manifest itself in a number of ways (including higher land prices).
Increasing demand and rising land prices: S. American Case Study

In Brazil, a key country for new forest plantations:
• Land in Mata Grosso suitable for eucalyptus is selling at USD 3,000/ha and for teak at USD 6,000/ha.
• Land prices in Parana and Santa Catarina, the two main pine states, has grown 22% and 33% pa, respectively, since records started in 2003.

- **Uruguay** is the most recent country to develop a large scale forestry industry. The first pulp mill (at USD 1.2bn, 1.2mn ton/yr) started in 2008. The marginal cost of pulp wood in Uruguay (when including land value) is already at parity with the Scandinavia marginal cost.
- Land prices in Uruguay increased by 5x during the last 10 years.
- Good quality forest land with deep soil sold for USD 500/ha in 2000 and similar land with shallower soils are now selling for USD 2,500 to USD 3,000/ha in Eastern Uruguay.

![Uruguayan land prices (unplanted)](chart.png)

Source: Uruguay Ministry of Agriculture, CIBC World Markets Inc.
FIBER (WOOD) PERSPECTIVE
Wood Prices

Average Delivered Non-conifer (Hardwood) Pulpwood Prices
(Q2/2010)

- Log prices vary significantly across regions – the highest ~ 4x the lowest. This implies a steep cost curve for the global forestry industry.
- Given growing demand and a steep cost curve, there may be significant upward pressure on log prices going forward.

Source: Wood Resources International, CIBC World Markets Inc.
After weakening in 2008 with the recession, global wood fiber prices have resumed their upward trend.

1 Source: Wood Resources International.
China’s fibre supply deficit was ~105 million m3 (roundwood equivalent) in 2009, and is projected to reach ~150 million m3 by 2015, and 200 million m3 by 2020.

India’s timber supply deficit was just over 9 million m3 in 2009, and is projected to approach 15 million m3 by 2015 (the majority of which is expected to be obtained from off-shore plantations.)

Given India’s per capita consumption of paper and paperboard is less than 1/6th of China’s, the growth rate in India’s fiber needs is expected to exceed that of China over the next 10 years.
Strong Fundamentals in Global Fiber Market

Growth of the Bio-Energy Sector

▲ The EU, United States and China are all providing strong government support to their domestic bio-energy sectors
▲ If the EU enforces its target of sourcing 20% of its energy needs from renewable sources by 2020, it is estimated the EU will need to import over 200 million m3/year of biomass
▲ China’s NDRC has announced a rise in its national pellet target from 2 million tpy in 2009 to 50 million tpy in 2020. Even if successful, this is not sufficient to reach the bio-energy target (5.5GW in 2010 to 30 GW by 2020)

Constraints on Russian log exports

▲ In 2007 Russia raised its export tax on logs from 6.5% to 20%, and then to 25% in 2008 where it currently remains. The Russian government has postponed a further increase to 80% through 2011, but insists this additional increase has not been abandoned
  ➢ As a result, the traditional importers of Russian logs continue to seek alternative sources of supply

Reduction in Illegal Logging

▲ It is estimated that ~10% of the world’s annual harvest of timber has historically been illegal. However, we are witnessing declines in illegal harvesting due to:
  ➢ Stronger legislation (e.g. U.S. Lacey Act)
  ➢ Stronger enforcement (e.g. China, Indonesia)
  ➢ Shortage of accessible stands (e.g. Russian Far East, Myanmar, Suriname)

Insect Infestation in Western North America and Russia

▲ Significant insect infestations in both Western North America and Russia
▲ Up to 1 billion m3 of biomass has been killed in British Columbia by the Mountain Pine Beetle
▲ The expected declines in sustainable harvests in both N.W. Russia and the Russian Far East/Siberia due to insect infestations are reportedly significant, but not yet quantified

Competing Land Use

▲ Greater land-use pressure in many regions due to rising demand for land relative to potential supply is resulting in higher land prices
▲ Uruguay has experienced land price increases of 500% over the past decade
▲ In Brazil, land prices in Parana and Santa Catarina, the two main pine states, have grown 22% and 33% per annum, respectively, since 2003
▲ Expect the pressure to convert to agriculture to be greatest on the land which is most productive for forest plantations.
Bio-Energy in the Overall Energy Mix

Today’s biomass supplies ~50 EJ globally, which is ~10% of global annual primary energy consumption. This is mostly used for cooking and heating.

Source: based on IEA, 2006; and IPCC, 2007.

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Fuelwood is the main source of bio-energy, and is used for cooking and heating. It is typically >20% of the total primary energy mix in developing countries.

In industrialized countries, modern bio-energy is typically <5% of the mix, and is mostly for heat-only and heat & power applications.

Energy Outlook

- Globally, even under a “business-as-usual” scenario.
  - The use of biomass in heat industrial energy applications is expected to double by 2050.
  - Electricity production from biomass is expected to grow 5-6%/year by 2030.
  - Transport fuels are currently the fastest growing bioenergy sector, and biofuel production is expected to increase by 10 to 20 fold by 2030.

- Numerous countries have announced targets meant to result in “lower carbon” scenarios, and they entail an even greater use of bio-energy.
The economic crisis had a major impact on the level of investment in the global bioenergy sector. After exceeding $12 billion in 2008, it fell by ~25% in 2009. It is now rebounding.

Biofuels have historically accounted for the bulk of the global investment in bioenergy, but biomass-based energy has been more important since 2009.
- U.S. and Brazil have dominated the global investment in biofuels (liquid), almost all of which is either corn or sugar-based ethanol

- Europe and China have dominated the investment in biomass-based (solid and gas) energy.
Global Trade in Bio-Energy is Growing Rapidly

Main International Biomass for Energy Trade Routes

Biggest growth in the future? Likely torrefied pellets from L. America, Russia, Africa and Australia; and palm oil from Africa.

Source: Junginger and Faaij, 2008. Intra-European trade is not displayed for clarity.
Is it Better to Produce Traditional Forest Products, Bio-energy, or Both?

ROCE Traditional + Emerging Technologies
Earning Their Cost of Capital

BC Central Interior

Cost of Capital = 11%

OSB medium
Ethanol via Syngas (E)
LVL small
Pellets West medium
Lignol Commercial
OSB large
SPF West Large + Pellets Large
Lignol Commercial Brownfield
LVL large
SPF West large
Pellets West small
SPF West small
Lignol Commercial
OSB large
SPF West Large + Pellets small
CHP via Pyrolysis
CHP (17.8 MW)
Nexterra CHP small (<10Mw)
Acetate via Syngas (E)
CHP Direct
SPF West Large + Pyrolysis
Nexterra Syngas dryer
Pyrolysis Stand-alone
Torrefied Pellets West
There is an increasing number of players interested in competing for fiber..... And their ability to pay for it varies widely. MDF (the traditional winner for residues) is expected to lose the auction to a wide range of bio-energy technologies (eg., pellets, pyrolysis oil, gasification). Torrefied pellets had a high ROCE (helped by using a small amount of capital), but couldn’t win the auction because it does not create enough value.
Is There a Trade-off Between Financial Returns and Employment?

---Top 5 Employment---

--------Top 5 ROCE------
Employment Conclusions

- There is a general trade-off between the financial returns and Employment Generated per 100,000 ODT of fiber.
  - The top 5 products in terms of ROCE generate an average ROCE of 21% and average employment multiplier of 131.
  - The top 5 products in terms of Employment Multiplier generate an average ROCE of only 1%, but an average Employment Multiplier of 599.

- The traditional forest products tend to generate far higher employment multipliers than do the bio-energy products. Per unit of fiber consumed, it is estimated that the pulp & paper segment generates:
  - 3x more total employment than does the bulk production of energy; and,
  - Almost 5x more when just the direct employment is considered.
Conclusions? Include Bioenergy

• Many of the bio-products produced with traditional technologies do not generate an adequate return on capital. However, the three best are all related to bio-energy.

• Many of the bio-products produced with emerging technologies still do not generate an adequate return on capital. While some are quite attractive, you have to be careful what you choose.

• If we look at the “best” of both the traditional and emerging technologies in terms of ROCE, all of the top ten produce some form of bio-energy/bio-chemicals as part of the complex.

• If you want to get both a high economic return and employment, add bio-energy onto traditional processing plants (those that are already economic, or close to it – don’t put good $ after bad.)

Bottom-line?
At least in the Canadian case study, if you are in the forest industry and you are not involved in the production of bio-energy, you are not maximizing the sustainability of your operations.
Land for Bio-energy

- Where will the land for additional biofuel production come from? Likely at the expense of pasture land and natural forest (if not regulated).

- One approach to counteracting the growing scarcity of arable land would be to bring abandoned agricultural land back into production.
  
  - Field et al (2008, World Bank report) estimate that between 475 to 580 million ha could be brought back into biofuel cultivation.
  
  - (FAO, 2009) Permanent pastures cover an area of 3.4 million ha worldwide, and although some proportion of that is unsuitable for cropping, it is still far larger than the current arable area of 1.5 Million ha.
Food & Feed Outlook

FAO Report – How to Feed the World in 2050?

- To feed a population which is roughly 1/3\textsuperscript{rd} larger, and more urban and richer than today, food production (net of food used for biofuels) must increase by 70 percent)
  - Cereal production needs to rise from 2.1 B. tonnes today to \( \sim \) 3 billion
  - Meat production needs to rise by over 200 million tonnes to reach 470 million tonnes.

- \( \geq 80\% \) of the increased food must come from improved yields since possible expansion of area is limited and only found in a few countries.
Where (and How Much) Farmland is Available?

Potential Availability of Uncultivated Land in Different Regions

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Area ('000 ha)</th>
<th>Share of Land with Travel Time to Market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(&lt;6 hours)</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>201,761</td>
<td>47%</td>
</tr>
<tr>
<td>Latin America</td>
<td>123,342</td>
<td>76%</td>
</tr>
<tr>
<td>Eastern Europe &amp; Central Asia</td>
<td>51,136</td>
<td>86%</td>
</tr>
<tr>
<td>East and South Asia</td>
<td>14,769</td>
<td>22%</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>2,716</td>
<td>97%</td>
</tr>
<tr>
<td>Rest of the World</td>
<td>52,134</td>
<td>47%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>445,858</strong></td>
<td><strong>59%</strong></td>
</tr>
</tbody>
</table>

Note: Data identify uncultivated land with high agroecological potential in areas with population density of less than 25 persons/km².
Source: Fischer and Shah 2010.

The currently non-cultivated area suitable for cropping that is non-forested, non-protected, and populated with less than 25 persons/km² (or 20 ha/household) is estimated to be 445 million ha.

This is ~ 1/3 of globally cropped land (1.5 billion ha).

Potential to bring new land into agricultural production is limited to only a few countries: Brazil, Savannah Africa, Ukraine, Russia and not many more.
The Demand for Farmland is Rising

### Large Land Acquisitions in Select Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Projects</th>
<th>Area ('000 ha)</th>
<th>Median Size (ha)</th>
<th>Domestic Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambodia</td>
<td>61</td>
<td>958</td>
<td>8,958</td>
<td>70%</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>406</td>
<td>1,190</td>
<td>700</td>
<td>49%</td>
</tr>
<tr>
<td>Liberia</td>
<td>17</td>
<td>1,602</td>
<td>59,374</td>
<td>7%</td>
</tr>
<tr>
<td>Mozambique</td>
<td>405</td>
<td>2,670</td>
<td>2,225</td>
<td>53%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>115</td>
<td>793</td>
<td>1,500</td>
<td>97%</td>
</tr>
<tr>
<td>Sudan</td>
<td>132</td>
<td>3,965</td>
<td>7,980</td>
<td>78%</td>
</tr>
</tbody>
</table>

Note: Data are for the 2004-2009 period except for Cambodia and Nigeria where they cover 1990-2006. Liberian figures refer to renegotiation of concessions that had been awarded much earlier.

1 Domestic share is the proportion of the total transferred area allocated to domestic investors (vs. foreign investors) rather than the share of the number of investments.


Compared to an average annual expansion of 4 million ha before 2008, 45 million ha worth of large scale farmland deals were announced before the end of 2009.

More than 70% of such demand has been in Africa.
The increased demand for agricultural commodities over the next decade could likely be met by increasing farmland productivity and farmland expansion in non-forested areas. Clearing natural forests is not required.

In particular, none of the African countries of recent interest to investors are achieving more than 30% of the potential yield on currently cultivated areas. This reflects constraints related to infrastructure and institutions and technology.
Ensyn Case Study

- Canadian bio-technology company that produces “pyrolysis oil” from biomass
- In the process of transforming from a bio-technology company to a bio-energy/chemical operating company.
- Sold the rights to Ivanhoe Energy to use the technology to upgrade oil sands to light oil
- Sold the rights to Red Arrow to use the technology to produce food chemicals
- JV with Honeywell to fine-tune and scale the technology
- JV with Tolko to produce power and chemicals from forest biomass in Canada
- JV with Premium Renewable Energy to produce power and transport fuels from oil palm biomass in Malaysia

Any Good News?
Any Good News?

- Roughly 60 million tonnes of biomass is produced yearly by the Malaysian palm oil industry:
  - 32 million tonnes is in the form of empty fruit bunches and fiber:
    - This could produce 11 million tonnes of pyrolysis oil/year;
    - Equivalent of 41 million barrels of crude oil;
    - Annual revenue of ~$3 billion at today’s prices.
Implications of Large-Scale Investments for Local Communities – So What?

Potential concerns:

- Weak land governance and a failure to recognize, protect, or - if a voluntary transfer can be agreed upon - properly compensate local communities’ land rights;
- Lack of country capacity to process and manage large investments, including inclusive and participatory consultations that result in clear and enforceable agreements.
- Investor proposals that are insufficiently elaborated, non-viable technically, or inconsistent with local visions and national plans for development.
- Resource conflicts with negative distributional effects.
Implications of Large-Scale Investments for Local Communities – So What?

Potential benefits:

- Generating employment
- Provide access to markets and technology for local producers
- Support social infrastructure, often through community development funds using land compensation
- Higher local or national tax revenue.

Assertion:

Beyond a subsistence level, natural forest harvesting operations are not sustainable in the tropics.
Toward a Country Typology

Potential Land Availability vs. Potential for Increasing Yields

Meaningful Differences in the Cost of Tree-Planting

• Cost of establishing new plantations in Brazil, Australia and Uruguay, the main countries for establishing new plantations, is in the USD$3,500-$4,000 range.

• Marginal cost of establishing new plantations in East Africa is USD 800-1,000 per ha. Primarily due to significantly lower land costs. (mainly on grass land or degraded forest land)

• High-cost, slow growth regions (North America and Europe/Russia) currently account for >80% of the world’s wood supply.
  • This ensures a steep cost supply for wood
  • Provides a high margin for low-cost areas, which is capitalized into the value of bare land over time.

Cost of eucalyptus plantation establishment

Source: Green Resources review 2010

Cost of pine plantation establishment

Source: Green Resources review 2010, Pine