ARTEMisinin production and pricing

WHO/MMV Artemisinin Conference
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Market situation for ACT producers

- Global forecasts of needs overestimated in the past
- Increased competition between ACT producers with prices decreases
- Increased uncertainties concerning the quantities of ACT to be produced for each producer.
Market situation for ACT producers

- Pressure on prices of API and artemisinin to stay competitive.
- No long term binding contracts but mainly rolling forecasts of needs or spot purchases as until now there were inventories of artemisinin. Opportunistic purchases.
Market situation for extractors

- Big pressure on prices: selling price below cost price.
- Numerous extractors needing to sell at any price.
- Incertainties about quantities as orders do not cover a campaign or are spot orders.
- Main financial risks put on them and to the farmers.
Market situation for extractors (2)

- Relationship with farmers:
  - History: confidence no more there
  - Competition from other crops
  - Competition between extractors
  - Collect from the wild
- Control of plantations limited to some extractors.
Artemisinin production

- Inventories of leaves of former campaigns have been used.
- Deliveries in 2008-2009 based mainly on former inventories.
- Production in 2009 based on new crop or collect from the wild.
- Crop in 2009 below former expectations due to difficulties with farmers, climate.
Artemisinin production (2)

- Collect from the wild with low content giving an average content in the range of 0.5 – 0.6% in China.

- Forecasted production ex 2009 crop + collect from the wild reduced from a former 70-80 T to a maximum of 50 – 60 T.
Artemisinin: production/demand

Assumptions:
- Plantations: average extraction: much less than 4.5kg/ha, closer to 4 kg/ha
  - China: 4,000 ha max
  - Africa+Madagascar: 1,500 ha
  - Vietnam+India+ROW: 1,000 ha
- Collect from the wild: 5,000 T of wild leaves giving a maximum of 20 T artemisinin.
Artemisinin production (4)

Trends:

- more integration of the supply chain: API producers becoming artemisinin producers or signing JV.
- Willingness of artemisinin extractors to go downstream to API production.
- Some still looking to withdraw from the extraction as they lose money.
Artemisinin: production/demand (1)
Artemisinin: production/demand (2)

- Balance production/forecasted demand shows a shortage in 2010 but
- Gap will be at least partially covered by using safety stocks in the supply chain from some ACT producers.
Artemisinin: production/demand (3)

- The main problem will be to have a strong increase in the plantations in 2010 to cover the needs of 2011.
- For 260 million treatments, needs of artemisinin in the range of 130 T corresponding to 23,000 to 28,000 ha to be planted!
- Needs for inventories?
Artemisin production cost

- As explained in Guilin, production costs linked to:
  - Total cost of leaves and content
  - Type of technology for purification:
    - Chromatography: higher cost but good efficiency
    - Cristallisations: lower cost but low efficiency and lower quality
  - Cost for extraction and purification, efficiency
Artemisin production cost (2)

- Cost of leaves: from 400 $/T for wild to 800 $/T.
- Extraction cost: about 200 $/T of leaves
- Purification cost: about 600 $/T of leaves for chromatography.
- Efficiency 70% in that case.
- Content in the leaves is the key point.
### Artemisinin production costs (3)

<table>
<thead>
<tr>
<th></th>
<th>Leaves $/T</th>
<th>Ext. cost $/T</th>
<th>Purif. Cost $/t</th>
<th>Total cost $/T</th>
<th>Content %</th>
<th>Kg artem. (70% eff)</th>
<th>Prod. Cost $/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>400</td>
<td>200</td>
<td>600</td>
<td>1,200</td>
<td>0.35</td>
<td>2.5</td>
<td>480</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>200</td>
<td>600</td>
<td>1,400</td>
<td>0.6</td>
<td>4.2</td>
<td>333</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>200</td>
<td>600</td>
<td>1,400</td>
<td>0.8</td>
<td>5.6</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>200</td>
<td>600</td>
<td>1,600</td>
<td>0.6</td>
<td>4.2</td>
<td>380</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>200</td>
<td>600</td>
<td>1,600</td>
<td>0.8</td>
<td>5.6</td>
<td>285</td>
</tr>
</tbody>
</table>

- **Prod. Cost**: $/kg
- **Ext. cost**: $/T leaves
- **Purif. Cost**: $/t
- **Total cost**: $/T
- **Content %**: 
- **Kg artem. (70% eff)**:
Artemisinin price evolution

Artemisinin indicative spot price Price ($/kg)

$/kg

Years

2002 2003 2004 2005 2006 2007 2008 2009

240 300 750 1100 700 170 260 290
Artemisinin price evolution (2)

- Market prices still in the range of 280-315 $/kg for good quality product in June 2009.
- Tendancy to increase to 300-350 $/kg
- This prices do not encourage farmers and extractors to plant more.
Artemisinin price evolution (3)

- Proposed fair price of 350±30 $/kg still acceptable by Asian extractors to have a normal supply.
- To reach the quantities needed in 2011 and after, prices will have to increase to a range 350 – 400 $/kg to encourage farmers.
Artemisinin market future

- Necessity to increase production in avoiding speculation.
- To increase firm contracts between ACT producers and artemisinin extractors at fair prices for all the supply chain.
- This needs stable relations with farmers.
Artemisinin: market future

- Artemisinin hemi-synthetic expected to be available in 2012.
- Another mechanism is A2S2.

- Thank you
## API production and price

### Main APIs

<table>
<thead>
<tr>
<th>API</th>
<th>Artemisinin need per kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHA</td>
<td>1.24 kg if API</td>
</tr>
<tr>
<td></td>
<td>1.12 kg if interm.</td>
</tr>
<tr>
<td>Artesunate</td>
<td>0.98 kg</td>
</tr>
<tr>
<td>Artemether</td>
<td>1.67 kg</td>
</tr>
</tbody>
</table>
API production and price (2)

- Numerous ACT producers control the API production.
- More integration of the supply chain due to quality, specs, guaranty of supply, better prices
- Prices on the market are only spot prices and quality is different.
API production and price (3)

- Some prices indication:
  - DHA: no real market for the moment
  - Artesunate: 300 to 350 $/kg
  - Artemether: around 500 $/kg.
Thank you