Unlocking Practical Cold Chain Solutions in Africa – Lessons from India

Anurag Agarwal – Founder, New Leaf Dynamic Technologies (P) Ltd
Farmers Moving to Horticulture

- Moving to growing Fruits & vegetables can triple incomes*.
- India is now the 2\textsuperscript{nd} largest grower of fruits and vegetables in the world

* Niti Policy Paper 1/2017, Planning Commission of India. Average productivity from Fruits & Vegetables (HVC) is Rs 1.42 Lacs per Hectare as compared to Rs 0.41 Lacs from staples.
“The lack of an adequate and efficient cold chain infrastructure leads to massive post-harvest losses, estimated at **USD 13 Billion** annually. Perishables account for the bulk of post-harvest losses”

“Inadequate cold-chain infrastructure hampers India’s food exports as well”

*Niti Aayog, New Strategy for India @75, Dec 2018, chapter 7, page 36*
Predictable Profits by Storing

- Seasonal predictable price variations, so assured income
- Most perishables are easy to store
- Some of them can be stored for many months

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Feb, 20</th>
<th>Mar, 20</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemon</td>
<td>2210</td>
<td>5430</td>
<td>145%</td>
</tr>
<tr>
<td>Tomato</td>
<td>1064</td>
<td>1643</td>
<td>55%</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>433</td>
<td>1750</td>
<td>300%</td>
</tr>
<tr>
<td>Cabbage</td>
<td>390</td>
<td>710</td>
<td>82%</td>
</tr>
</tbody>
</table>

Prices/quintal at Fruit/Vegetable Wholesale Market, New Delhi, 2019
Predictable Profits by Storing

Monthly Price Index of Tomatoes for last 4 Years in New Delhi Fruit/Vegetable Wholesale Market

Monthly Price Index of Papaya for last 4 Years in New Delhi Fruit/Vegetable Wholesale Market
Use Grid Power?

- Horticulture needs cold storage else loss due to market glut
- Need cooling for 500 million tons/year now
- 2X increase in consumption If additional cooling is grid powered (base load)

Electricity consumption in Maharashtra
Data from Economic Survey of Maharashtra 2017-18
GreenCHILL™ Can Solve this Problem

- 15 Ton Cold storage, ripening chamber & pre-cooler for on farm usage
- Powered by farm waste, no fossil fuels
- Cools down to 0°C
- Biomass consumption of 70 Kg/day
- Green Refrigerant (GWP=0)
- Two Patents Published /Applied & Paper Published in Elsevier Energy Journal
How Does GreenCHILL Work?

Biomass gasification generates producer gas without smoke & ash

Producer Gas heats water

Hot water provides energy for refrigeration to GreenCHILL™

GreenCHILL cools stored fruits & vegetables down to 0°C
Bhim Bhai: Farmer in Junagadh using GreenCHILL™

- Lemon storage
- Prices vary from 12 Rs/kg Mid January to 70 Rs/Kg March/April
- 2 to 3 harvests/year
- Profit of 6 lacs/harvest
- Financed by Axis Bank. Financed 5 installations in 6 months
Bhim Bhai
Marigold Flowers
Custard Apple
Potato
Sorting & Storing Peas
Banana
Mango
Milk Chillers at Village Milk Collection Centers
# GreenCHILL™ Storage Costs Comparison

Use case: Store 15 tons of vegetable at 8°C for 90 days, 3 RT refrigeration system

<table>
<thead>
<tr>
<th></th>
<th>GreenCHILL™</th>
<th>Grid</th>
<th>Diesel</th>
<th>Solar PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit cost of fuel (Rs)</td>
<td>1.50/Kg*</td>
<td>Rs 8/unit</td>
<td>70/liter**</td>
<td></td>
</tr>
<tr>
<td>Energy cost of storage (Rs)</td>
<td>5,920</td>
<td>23,400</td>
<td>70,000</td>
<td></td>
</tr>
<tr>
<td>Carbon Emission</td>
<td>Carbon Neutral</td>
<td>2.4 Tons***</td>
<td>3.0 Tons +</td>
<td></td>
</tr>
</tbody>
</table>

*Mustard husk was purchased by at Rs 0.75/Kg in Mandsor, MP
** Rs 72/liter + transport 20 times in 90 days, 50 liters/transport
***http://www.cea.nic.in/reports/others/thermal/pece/cdm_co2user_guide_ver13.pdf
Carbon Emission in India= 0.82 Kg/Unit
Diesel consumption = 0.309 Kg/unit
Diesel density = 0.83
Comparison with Solar PV

- Solar PV + PCM and others provide a 5 Ton storage systems
- GreenCHILL provides 3X cooling capacity at the same price
- Requires grid or diesel backup if loading capacity is more then 1 Tons
GreenCHILL™ Implementation
GreenCHILL: Use Precooling to reach Markets Further Away to Earn More

- Precooling removes field heat increasing shelf life
- Cooled produce can reach markets 500 Km further away
- Farmers can exploit price differentials to earn more

Wholesale Tomato Price in Mumbai 50% higher than Jalgaon where tomatoes are grown*

* www.MandiGuru.co.in
99% shortage of on farm cold storages (NCCD + NABARD 2016 study, referred to as modern pack houses))

- Production of perishables increasing so, cooling requirement will increase
- Hot climate in India, so, perishables spoil fast, can't survive without cooling
- 123 million farmers in India, 13.2% hold 5 Acres or more (2011 census), these farmers will need cooling
- Predictable price variations every season to earn from, so easy to get financial viability
- Farm is the start of the cold chain, so if cooled at the start energy requirements reduce to 10% in the rest of the chain
- Precooling: The faster the produce is pre-cooled, the longer the shelf-life. As retail chains come-up they will value this improvement in quality for procurement

### All India Gap Assessment

<table>
<thead>
<tr>
<th>Type of Infrastructure</th>
<th>Total Requirement (A)</th>
<th>All India Created (B)</th>
<th>All India Gap (A-B)</th>
<th>% share of Gap to Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Pack-house</td>
<td>70080 units</td>
<td>249 units</td>
<td>69831 units</td>
<td>99%</td>
</tr>
<tr>
<td>Reefer Transport</td>
<td>61826 units</td>
<td>9000 units</td>
<td>52826 units</td>
<td>85%</td>
</tr>
<tr>
<td>Ripening Chamber</td>
<td>9131 units</td>
<td>812 units</td>
<td>8319 units</td>
<td>91%</td>
</tr>
<tr>
<td>Cold Storage (Bulk)</td>
<td>34164411 MT</td>
<td>31823700 MT</td>
<td>3276962 MT</td>
<td>10%</td>
</tr>
<tr>
<td>Cold Storage (Hub)</td>
<td>936251 MT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Not considering the cold storage capacity found non-functional or missing.
There may be capacity-off records in case of transport, reefer, ripening rooms.

- The gap is large in case of pre-cooling/pack-houses, reefer transport and ripening units.
Other Products to Enhance Shelf Life

• Post-harvest Coatings for various fruits and vegetables to prolong shelf life – Partnership with KN Biosciences Ltd

• Nano dehumidification membrane based Specialized Fruit and vegetables drying systems at 30 to 40°C to maintain nutrition and color – Partnership with Dou Ys' Chem Co. Ltd., South Korea
Conclusion

“Farmers get too small a share of eventual price of what they produce. They cannot access local, nationwide or international markets”

Farm or village level cold storage solutions can make them part of supply chains integrating then with the local, nationwide or international markets

“1/6 of India’s energy imports are used to power diesel generators, the energy imports could reach 640 Billion USD per year by 2040”

25% additional grid capacity or diesel is required to power cooling capacity, farm waste usage can provide this in a sustainable manner
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