Cold Chain Reaction
How effective and climate-friendly cold chains can contribute to a better world

Side Event at the 31st Meeting of the Parties to the Montreal Protocol
4 November 2019
Rome, Italy
## Agenda

| 1. Welcome Remarks | Mrs. Ulrike Haupt  
(Federal Ministry for Economic Cooperation and Development, BMZ)  
Mr. Christian Meineke  
(Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, BMU) |
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
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Importance and Challenges of Cold Chain Development for Food

Rosa S. Rolle, Ph.D
Senior Enterprise Development Officer
Team Leader, Food Loss and Waste Nutrition and Food Systems Division
Population Growth is Taking Place Across All Regions of the Globe

Source: UN, 2011
Rapid Urbanization

Source: UN, 2011
High Levels of Food Loss From Post-harvest To Distribution

NOTE: Percentage of food loss refers to the physical quantity lost for different commodities divided by the amount produced. An economic weight is used to aggregate percentages at regional or commodity group levels, so that higher-value commodities carry more weight in loss estimation than lower-value ones.

SOURCE: FAO, 2019
Food loss and waste (FLW) is the decrease in quantity or quality of food along the food supply chain.

- Food loss occurs along the food supply chain from harvest up to, but not including, the retail level.
- Food waste occurs at the retail and consumption levels.
Highest Level of Loss - Occurs in Perishables

PERCENTAGE OF FOOD LOSS

NOTE: Percentage of food loss refers to the physical quantity lost for different commodities divided by the amount produced. An economic weight is used to aggregate percentages at regional or commodity group levels, so that higher-value commodities carry more weight in loss estimation than lower-value ones.

SOURCE: FAO 2019. The State of Food and Agriculture
Increasing Consumption of Perishables in All Developing Regions

In Urban Centers, linked to:

- Increasing incomes.
- Changing lifestyles
  - Demand for food that is safe and of good quality;
  - Demand for convenience
- Emphasis on environmental sustainability

Source: UN, 2011
Perishables in Developing Countries are Handled Under Ambient Conditions

Improper handling, transport and temperature management contribute to quality loss and compromises safety

Source, Yahia, 2016
Contribution of Cold Chain Systems:

- Maintain the quality and safety of food.
- Ensure the health security of populations.
- Improve supply chain efficiency.
- Reduce food losses.
- Create added value.
Changing Retail Landscape in Urban Centers of Developing Countries
Cold Chain Systems Create Added Value

Cold Chain Systems: Generate Economic Development

Connect farmers to higher value market options (urban and export).

Contribute positively to income growth in rural areas.
Small farmer groups organized and capacitated to produce certified (GAP and organic) high value produce.

Land donated by the Government for construction of a (project-funded) GMP compliant pack-house facility.

- Equipment and installation of electricity undertaken by the project.
Reduced post-harvest losses, reduced transport and logistic costs and improved quality.

Improved market access for farmers (EU and middle East).

New employment opportunities were created in a very rural location.
  # A majority of new employees are women.

Logistics cost reduced to 1/3
Major Challenges of Cold Chain Systems:

1. Access to sustainable and affordable infrastructure
2. Skilled Manpower
3. Monitoring performance
4. GHG emissions

REFRIGERATION

Direct emissions from refrigerant leakage
30%

Indirect Emissions
generated from fossil fuels or grid electricity used to generate power.
Coolant leakage
70%
Optimizing Refrigeration Systems

- Redesign systems to reduce leakages, e.g. insulation.
- Renewable energy applications for generating cooling power - solar, wind, water, biogas, geothermal energy.
- Combination of cooling with other technologies, e.g. vacuum (costly)
FAO’s Initiatives - Using Renewable Resources

Pre cooling Technology

Dairy industry

Milk can be cooled in two steps: precooling, followed by refrigerated cooling by ITC. Precooling can be reduced by precooling the fresh warm milk using water from the mains supply, surface, well or groundwater. Precooling reduces the refrigeration load, thereby reducing costs and energy needs. When the temperature difference between the mains water and the fresh raw milk is significant, refrigeration costs can be reduced by up to 70 percent.

https://3dwarehouse.sketchup.com/by/unfao?tab=collections

Used in FAO projects in India, Eritrea, Sudan, Afghanistan

CONTAINERIZED MILK COOLING CENTER

Dairy industry

Mobile, stand-alone unit for remote locations with limited resources to support rural dairy production and improve sustainability. The system uses green technologies such as solar energy, thermal energy, and electrical energy to maintain the quality of milk for long time.

Design fabricated by private sector to support developing countries

https://3dwarehouse.sketchup.com/by/unfao?tab=collections
Thank You

Rosa.Rolle@fao.org
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Cold Chains in Health Care

Bernhard Siegele, GIZ Proklima
The Importance of Vaccines

- Immunization is one of the most successful and cost-effective public health interventions in history, saving 2-3 million lives every year.

- Cold chain systems are struggling to efficiently support immunization programs.
The Challenge

1 in 5 infants misses out on basic vaccines

WHY?

Challenge: Keeping vaccines between 2 – 8 °C
Keeping Medicine Cool

1. Manufacturer
2. International Transport
3. National Storage Centre
4. Storage in Health Centres
5. National Transport
6. Immunization
Weak Cold Chains lead to...

- Risk of spoiled vaccines
- Poor availability of immunization supplies
- Inefficient use of limited financial and human resources

→ Weak cold chain systems are struggling to efficiently support immunization programs
Key Procedures

In order to maintain a reliable vaccine cold chain, monitoring of key procedures is essential:

- **Storage** of vaccines within required temperatures
- **Packaging and Transport** to and from outreach sites
- Keep vaccines within recommended cold chain conditions **during immunization**
Example I: SolarChill

Facts

- Solar direct drive units, without batteries
- Independence of electric power supply
- Environmentally friendly
- Temperature autonomy of 5 days
- Temperature range of 2 - 8 °Celsius
- Approx. 120 health facilities have a SolarChill unit installed
- 36 SolarChill units in Kenya serve a catchment population of more than 230,000 people
Example II: immunize

1. Creation of a vaccination plan

2. Local health workers and mothers get informed

3. Vaccination plan and participant list are updated

4. Transport of the vaccines without interruption of the cold chain

5. Follow-Up on children who have not been vaccinated

6. Exact amount of vaccines is packaged
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Cold Chain Reaction:
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The path towards the deployment of solar cooling solutions in agriculture

Roma, 4th November 2019
Dr. Georgia Badelt
How to contribute to a better world?

DEPLOYMENT of the climate-friendly technologies

The PRIVATE SECTOR has to “buy in”

Business has to be PROFITABLE
Key features of a (smart) business model

Customer Value  Costs
Revenues  Partners
Example I: Solar cold storage
## Is a decentralized solar cold storage competitive?

<table>
<thead>
<tr>
<th>Technology</th>
<th>LCOE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel generator</td>
<td>0.43 USD</td>
</tr>
<tr>
<td>Solar PV, with lead-acid batteries, replacement all 6-7 years</td>
<td>0.33 USD</td>
</tr>
<tr>
<td>Solar, with lead-acid batteries, replacement all 3 years</td>
<td>0.43 USD</td>
</tr>
<tr>
<td>Solar PV, with lithium-ion batteries</td>
<td>0.28 USD</td>
</tr>
<tr>
<td>Solar thermal storage</td>
<td>0.35 USD</td>
</tr>
</tbody>
</table>

*LCOE – Levelized Costs of Energy, i.e. costs for 1 kWh

**YES!!**

Of relevance:

- Battery management
- Selection of storage technology
### Example I: Solar cold storage

#### The viability

#### INPUT DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>System costs</td>
<td>28,500 USD</td>
</tr>
<tr>
<td>Cooling fee</td>
<td>100 N (0,27 USD)</td>
</tr>
<tr>
<td>Utilization rate</td>
<td>110% (based on daily records)</td>
</tr>
<tr>
<td>Interest rate</td>
<td>20%</td>
</tr>
</tbody>
</table>

#### KEY PERFORMANCE INDICATORS (KPI)
(Fee-for-Service model/ ownership model)

<table>
<thead>
<tr>
<th>KPI</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project IRR</td>
<td>48%</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>76,315 USD</td>
</tr>
<tr>
<td>Debt Service Coverage Ratio</td>
<td>1,36</td>
</tr>
<tr>
<td>Payback period</td>
<td>3 years</td>
</tr>
</tbody>
</table>
The supplying company is currently in upscaling phase

- Injection of equity finance of an impact fund
- Thinks about shifting from ownership/fee-for-service model to franchising model for accelerating upscaling
- However still raises grants, although commercial business plan allow to raise commercial loans (ATTENTION: Crowding-out effect)
Example II: Solar milk cooling system
## Example II: Solar milk cooling system

### The viability

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<th>Parameter</th>
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</thead>
<tbody>
<tr>
<td>System (retail) price</td>
<td>2,000 USD</td>
</tr>
<tr>
<td>O&amp;M costs</td>
<td>1,320 USD/yr</td>
</tr>
<tr>
<td>Utilization rate</td>
<td>60%</td>
</tr>
<tr>
<td>Loan ratio</td>
<td>100%</td>
</tr>
<tr>
<td>Interest rate</td>
<td>14%</td>
</tr>
<tr>
<td>Profit margin/l</td>
<td>0.15 USD</td>
</tr>
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#### KEY PERFORMANCE INDICATORS (KPI)

(supplier-credit/ rent-to-own business model)

<table>
<thead>
<tr>
<th>KPI</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project IRR</td>
<td>-61%</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>-1778</td>
</tr>
<tr>
<td>Debt Service Coverage Ratio</td>
<td>-0.11</td>
</tr>
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</table>
Example III: Solar milk cooling system - DEPLOYMENT?

It is very difficult to come to a full utilization of the system,

System costs have to be reduced:
Localization of production as much as possible

Cooperative is not able to pay the monthly instalments
Example III: Solar milk cooling system - DEPLOYMENT?

- A German start-up/spin-off of a University concentrates on the production and offer of the cooling UNIT, instead of the whole system.
How to promote the deployment of cost-effective and climate-friendly systems?

- Engaging the private sector,
- Promoting strategic partnerships,
- Developing smart business models,
- Strengthening local organizations,
- Engaging the finance sector.
Other key success factors

- **De-mystifying ideas** about market potential through careful and intensive field work; careful assessment of added value
- **Solid analysis of viability and profitability** on basis of FACTS & FIGURES
- **Simulating the commercial case** as much as possible in a demonstration project
- **Allow FAILURE, and give a chance to FURTHER DEVELOPMENT**: Donors should be patient, especially as private sector is not patient
Thank you very much!

Dr. Georgia Badelt
GeoCode International GmbH,
Director

Georgia.badelt@geocode-international.com
+49 1726652974
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