



# NCCD

National Centre for Cold-chain Development

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## Newsletter



## The CEO's Desk

NCCD is an organisation with a minimal team strength, but we have a large number of industry participants as our members. In addition we have chance to tap into knowledge of State Level Nodal Officers for Cold-chain Development (NOCCDs). The conjoined efforts of industry stakeholders, NOCCDs and NCCD's in-house team was recognised at last month's Agriculture Leadership Summit 2014. NCCD was awarded the Agribusiness Leadership Award and I give hearty thanks and congratulations to our member base.

Cold-chain when viewed in isolation is understood as merely temperature controlled logistics, as a service focused delivery system, where the revenue stream is linked to provision of logistics – the cost to the user is rent for service.

The business of Cold-chain when viewed beyond simplistic definitions, is actually a supply chain based business model, one that profits via activities that inter alia, range from sourcing, preconditioning, processing, warehousing, distribution, marketing and information flow. A proper cold-chain is actually the business of food supply, primarily benefiting from the empowering provision of environment controlling technologies, but such a business will include all other options and modes of supply and demand. True, the capacity of an individual or an organisation to develop own presence in all areas may not always be possible, but that is where collaboration and partnerships come in play. In this edition's cold-chain insights, an attempt is made to explain how a business presence across multiple aspects of the food chain may be the preferable model to execute for an optimal value chain.

One is honoured to share that Secretary (Department of Official Language, Ministry of Home Affairs), on receiving our last newsletter, noted that the contents were of a high level and that the newsletters be translated into Hindi for greater outreach for benefit of all stakeholders. Our readers may also be pleased to learn that for last few months, three industry magazines are replicating our articles and have freely dedicated a page to NCCD. We thank them for taking forward & sharing our efforts.

-Pawanexh Kohli

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### OP-ED INVITATION:

Readers are invited to articulate their ideas, concepts & comments which will be nominated as Op-Ed articles.

## EVENT HIGHLIGHTS

The 7<sup>th</sup> Agriculture Leadership Summit was inaugurated by Union Minister of Food Processing Industries, Smt. Harsimrat Kaur Badal, Mr. Suresh Prabhu (former Union Minister), Mr. Ashish Bahuguna (Secretary Agriculture), Mr. Jean M Charlet (Dy Ambassador of France) and Dr. MJ Khan.



The summit was held in New Delhi on 27<sup>th</sup> September and the deliberations put forth some recommendations for policy makers.

Highlighting these recommendations was the recognition that investment in agriculture is 3 times more effective in alleviating poverty than any other sector. As such, the summit suggested that Budgetary allocation to agriculture be enhanced from current level of ₹ 34,000 crores to ₹ 60,000 crores.

Another recommendation stemmed from the fact that job creation in agriculture sector was primarily



thanks to Governmental intervention with private industry playing a limited role. As such, it was put forth that youth entrepreneurs be promoted by Govt. to set up basic level-processing units at village level. This would include primary and secondary processing units. NCCD sees this as an important suggestion keeping in mind the need for more farm level pack-houses as cold-chain originators.

Among other key calls were the need to create more organisational & governmental support through creating a Mission for Soil Health; a mission for Post-harvest Management; establishing Commodity Boards for positioning and promotion; a National Crop Shift Program for promoting alternate crops; creation of a cadre of Foreign Agriculture Services; create a permanent Commission to plan and monitor Farmer Welfare programs. To have a nationwide operational platform and to improve market linkages for farmers, the setting up of Rural Business Hubs at 240,000 gram panchayats was also mooted. Keeping agriculture at the core of our future development, a recommendation was also made to introduce Agriculture as a subject in all disciplines up to class XII. With agribusiness going global, providing such exposure to students would help integrate the youth with this core sector.

The 7th Agriculture Leadership Summit closed with an awards ceremony in which efforts of individuals and organisations, who have made outstanding contributions in their fields are recognised. The National Awards Committee has Prof. M.S. Swaminathan, known as the pioneer of India's Green Revolution, as the chairperson with a dozen members of national eminence. The Leadership Awards ceremony was graced by Prof. P.J. Kurien, Hon'ble Deputy Chairman Rajya Sabha with Prof. Swaminathan presiding the ceremony. NCCD is honoured that it was presented the Agribusiness Leadership Award, for its leading role in driving a conceptual change in agri-business models through use of cold-chain as a supply chain link and associated development.



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CII's Food & Agriculture Centre of Excellence (FACE) organised the National Cold-chain Summit, its 5<sup>th</sup> edition, on Wednesday 15<sup>th</sup> October 2014. The core topics discussed were enabling Innovation, Integration and Investments. This edition of the CII Cold Chain Summit was developed in collaboration with NCCD, fetching healthy participation from NCCD members & other stakeholders.



The Union Minister of Food Processing Industries inaugurated the event, stressing the need to have a food map in the country so that investors have easy information to supply and demand matrices. She emphasised having zero tolerance towards food waste. The technical sessions developed on this theme and suggested topical ideas to promote innovation, integration and investments.

## CRICKET AND COLD-CHAIN

- Pawanexh Kohli

A cricket game or a hockey match takes a lot of planning. The players, and the team's objectives, are organised in preparation to encounter various obstacles, and plans are developed in advance to counter them. Each play has to be prepared and practised, and even then, every move, each over can require last minute revisions to the tactics deployed. When the action is in play, backups and a dynamic solution finding approach is needed off each participant. To succeed, not only must the team decide each team member's role and responsibilities before the match, they must also build in reserves and redundancy into their plans. While the actions must be driven towards a planned objective, scope for dynamic course corrections in case of disruptions is prepared for. This same logic is elemental when it comes to cold-chain logistics.

One of the critical aspects in all tasks that require team work, is clarity in communication and a harmonisation in the understanding of concepts and the terms used. Just like on a cricket ground, players need to be very clear about field positions such as *Slip* and *Cover*, in the business of cold-chain, a commonality in the interpretation & the grasp of defining terms is key.

The primary role of using standard definitions worldwide, in science and otherwise, is for the harmonisation and consensus of concepts, as well consistency in the measures used. Colloquial or informal usage of terms is usually not conducive to appreciating a collective & inclusive agenda, or in achieving the desired results. When Cold-chain solution makers interact, they must speak one language. NCCD tries to fulfil this need.

Once language & concepts are agreed upon, the foundation is established for developing a functional or a logic model. The other most important factor is developing a game plan. In cold-chain, this means having effective SOPs (*Standard Operating Procedures*). These procedures are written using the common language, employing standard definitions and to serve as operational instructions for handling and managing the various goods under care. The crucial part of SOPs is detailing of handovers or the process to pass on custody of the perishable goods.

From the moment temperature-sensitive goods leave source point (manufacturer or harvester), it is a race against time and inclement conditions to bring it to the consumers in usable state. Poor practice by anyone in custody of goods, can have an incremental and damaging impact on final value realisation. For example poor pack-house handling can cause the rejection of the goods.



### Alphonso Mango could become more dear in local markets next year

In May this year, the EU trade bloc banned import of Alphonso mangoes from India (see NCCD newsletter issue 3). A few weeks ago a European Union delegation visited India and observed the post-harvest practices. After studying the phytosanitary standards, there were indications that a resumption of exports to EU was on the cards. The lifting of the ban is expected to come with the condition that exports be routed through pack-houses, following established SOPs, instead of being directly routed from mango orchards.

The EU had banned import of mangoes after detecting fruit fly infestation in the consignments received. When prepared for markets at pack-houses, mangoes go through a pre-conditioning procedure – this involves the usual selection by quality parameters, de-sapping at a rack, a wash and blanch followed by a quick blow dry to rid surface moisture. Thereafter, grading is done before packing into equal sized lots for safe travel. The last stage is when the entire package is precooled down to ~12 °C before undertaking the onward leg of their journey to market. The organised system also include farm coding processes, mandatory to comply with food safety norms.



A cold-chain business and its associated cold-chain logistics network, will involve multiple stakeholders, whether the business is that of food, pharmaceuticals or others. Its stakeholders would be a combination of infrastructure owners and users, goods' owners and service providers, designers and equipment providers, consumers and producers, trade, health and safety regulators. The heart of this business is attention provided to, and in relation to, the value of goods under care and of essence to its operations is collaboration amongst these stakeholders.

Collaboration is a matter of consideration for associates of many business models, mostly aiming to optimise resource usage, reduce lead times, enlarge foot print, etc. In the cold-chain, besides all these other dependences that justify any collaborative approach, it is far more obligatory as a rule because of a fundamental cause. Lack of collaboration in the cold-chain results in a break in custody, and breaks in custody can result in total loss of value! The business of cold-chain is clearly the value chain of perishable goods, where value realisation is sensitive to environment and the care provided by its custodian during its post-production life (passage to market).

Since a series of logistics activities have direct and high impact on the product value in the cold-chain, the activity providers must preferably work under one umbrella. SOPs provide that umbrella, even where the entire value chain is under the control of a single entity. Each activity in the cold-chain has risks, of breaching the protocols (of care and custody) and the chain of custody, due to logistical necessity overlaps multiple infrastructure components and extends across physical distances. SOPs ensure that the various stakeholders share responsibility and understand the process or procedures for protecting cargo on its journey to the consumer.

Like in cricket, the best team efforts are inclusive, and the results (a win or a loss) is the cumulative effect of such teamwork. In building a game plan for cold chain logistics, a critical need is to bring stakeholders to work together and to establish how they will collectively overcome threats to commodities under their care. Developing SOPs must be result oriented – these must lead to a Service Level Agreement (SLA) defining expectations and key acceptable variation in expectations. SOPs facilitates all parties' understanding of their roles and responsibilities and allows to establish measures to evaluate risk-reward elements. SOPs are never cast in stone and should provide opportunity for exchanges between partners, to take a wider view of the chain of custody, to improve upon, be in synch with technological developments and to adopt & innovate to various dynamics that effect value of the goods under their custody.

Planning for contingent circumstances is a critical part of any SOP, pre-empting excursions, providing solutions, demanding a clear communication process up and down the value chain. Within a cold-chain, especially in a vast & diverse country like India, not all activity areas will offer the same level of infrastructure, handling and transportation; this can be especially challenging. An SOP must provide to counter these challenges, and at least offer a baseline against which to measure performance. This also helps diverse stakeholders, to correct and improve on the movement of perishable goods from point of production to end-use. SOPs cannot or should not be put forth by 3<sup>rd</sup> parties but preferably be developed between partners that make a cold-chain.

Like cricket, the cold-chain requires team effort, however, moving environment-sensitive goods is not a game. This is a task that impacts on value of goods, contributes to the wellness of farmers and consumers, is work whose efforts have serious ramifications. The closer that the farmers, carriers, warehouses, handlers, sellers and managers work together, the more able they are to protect the goods throughout its perilous but indispensable passage from harvest to consumers.

#### Pakistan orders ILRs from Japan

Increasing number of polio cases has drawn travel restrictions on Pakistanis, now required to produce polio certificate at the airport before foreign travel. To safe guard polio vaccines Pakistani govt has ordered for Ice Lined Refrigerators from Japan - 87 units will be provided by first quarter of next year. Ice Lined Refrigerators have inbuilt contingency designed to counter power outages. The ILRs ordered from Japan are solar powered & Pakistan's health ministry is trying to get more units from China. India had installed lakhs of ILRs at health care centres and many are in use at pharmaceutical outlets.

#### Start-up cold-chain company acquired by FSC

Brattle Foods, which was started four years ago by Harvard graduates Kunal Agarwal, Mrinal Sinha and Kiran Pendri, became the second-largest player in the food logistics segment after Snowman Logistics. Set up without any subsidy support, the organisation is being acquired by Kishore Biyani's Future Supply Chain, the deal is pegged at an estimated ₹ 150 crores. Snowman Logistics also raised a little more than ₹ 300 crore through its IPO in September. Brattle Foods operates its own infrastructure of specialised cold stores and a fleet of over 200 refrigerated vehicles. Brattle overtook many old timers in this race.



## COLD-CHAIN INSIGHTS

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- Pawanexh Kohli

At a recent formal discussion of a PPP proposal, the attending resource persons (*outsourced consultants*), rather categorically reasoned that food processing is not a part of cold-chain business and hence such units were not considered in the project under debate. Hearing such blanket statements is a very distressing experience, particularly when long term plans are being developed with the overarching aim of public good. Such single-minded differentiation between cold-chain and processing units stems from an academic or research bent of mind. Yet, if the aim is optimal utilisation of resources, with profitability and success in mind, then these narrow interpretations need to be shed and put aside, firmly. In the world of commerce, reason relates to align opportunities, maximise revenue, increase profitability options - common business sense.

If one is in the business of cold-chain for perishable produce, then food processing units will be an integral part of their cold-chain network design, and these will need to be an important part of said business planning. The cold-chain in question was a produce-owner model that extended from farm-gate procurement all across to last mile distribution. This meant deploying the complete gamut of food logistics and in designing such a network, every consumption point ought to be factored in. Ignoring the role that food processing units play in enhancing revenue, in extracting and optimising and maximising value from harvest would be imprudent.

Every cold-chain promoter, especially one with backward integration with farmers, is advised to critically assess the ability to either set up a processing unit or of partnering with existing units so as to develop multiple consumption points or destinations for their produce. The only reason to ignore processing units will be paucity of resources or a lack of comprehension of how and why cold-chains make business sense. Even a cold logistics provider will wish to link with processors.

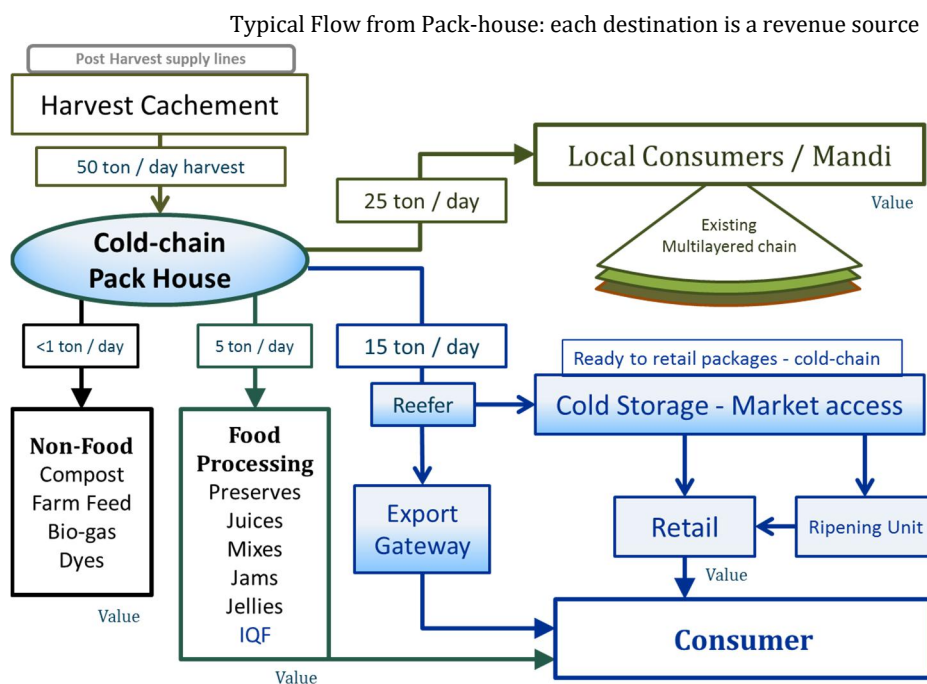
To analogise, an overview of the fresh poultry business and how it has progressed over the years is put forth. A few decades ago, live birds were transported and freshly slaughtered at point of sales in our cities. After end of each day, a lot of non-saleable leftovers was generated as waste – the offal was merely discarded, washed away. Today with the advent of cold-chain logistics, the fresh meat can be transported across long distance and this allowed the flourishing of organised poultry slaughterhouses. They have processing units as part of their business model, allowing the realisation of gainful value from parts of the carcass that would otherwise be redundant – giblets and sausages are the result (today even the unwanted feathers are brought into use for making paper, plastic, diapers, insulation, cosmetics, etc.). Similar is the case with grapes, where the pomace (leftover skins, pulp, seeds, and stems) from grape pack-houses are processed into other gainful use, leading to enhanced value realisation.

This same principle is to be applied for fruits and vegetables, at source points of apples, mango, strawberry or others. The pack-house is the location where the raw harvest is sorted and aggregated by market linked quality. The resultant assortments, are directed towards distinct value realisation routes – the late harvest produce to local close by markets for a fast sale (no cold technology may be needed), whereas the assortment that is judged safe for long travel would undergo preparation for such travel. This latter category would be subject to suitable cleaning, trimming, de-sapping, washing, etc, before being graded and packaged into transportable lots. Thereafter, a dose of rapid precooling would prepare the packaged load for staging for shipment by rail or road to the next destination in the logistics chain.

There would be yet another assortment, evaluated as unsuitable for the fresh market, being slightly overripe or late harvest quality or visually indented, etc. This sorted volume, if discarded would be a loss, and typically no business-minded person would prefer this to happen. This is where a facility for juicing, pulping, jelly making, pickling, etc. comes handy. Such facilities allow for further value to be appropriated and hence allows for majority of the raw procurement to get gainfully used. If there are no processing units factored into plan, owned or in collaboration, captive or as a market network, the weakest link in the value chain is hit with the most loss.



A modern pack-house is the initiator of the cold-chain for fruits and vegetables, and a cold store the midway platform. A pack-house is effectively the intelligent nerve centre of cold-chain, and it inherently sets off multiple logistics or supply lines catering to various demand centres. At such a pack-house, after the harvest is sorted into marketable or value based lots, they are then directed into different elemental value chains, some to continue within the cold-chain and some without.



As an integral part of the cold-chain, a modern pack-house not only preconditions or prepares designated volume for onward dispatch in the cold-chain, but after sifting the “raw arrivals” also feeds other supply lines which may not use temperature controlled technologies. A cold-chain business operator cannot ignore various other post-harvest market options for the produce they handle. If other market options do not exist, then these should be ardently pursued by the cold-chain business person, either to develop the utility or reaching out to others to do so.

It may not be obligatory that any cold-chain promoter develops her own processing units, but it would be preferable if able to extract the most out of all the material sourced. One is not obliged to directly develop all the infrastructure links in the chain, own rail wagons, or own an entire captive fleet of vehicles... Yet, every business mind knows, if one is able to extend control across the total value chain, the profits are better. A produce-owner model will aim to control and own at least a strategic share of the crucial links that contribute to the total value, while also outsourcing or partnering some assets. It is pleasing to report that some entrepreneurs who had established cold-chain logistics facilities at the back end are considering expanding into juicing units, etc.

In an industry still deemed (in some terms) fledging, where delivery services have a direct impact on the value realisation and where maximising such value requires other technological interventions, access to various physical links is necessary. Factoring in food processing units in business plans is sensible. A produce buyer, should preferably opt to be the marketer, and would find justification in owning or partnering with food processing units as these would be another source of revenue from his/her produce. These aspects need to be understood when developing business models. Links to food processing units will be natural to a cold-chain business model.

Viewing the cold-chain exclusively as a purely logistics activity may be true when considered for pharmaceutical goods and certain other cargos or when viewed from the prism of literal interpretation. Yet, in appreciating the concept from the business perspective, as a fresh produce supply chain, the logistics is only an enabler for market access while the business of cold-chain would encompass areas across the entire supply chain, and all types of demand for the produce would come under its purview. A Cold logistics operator is service oriented and the business of cold-chain is produce oriented. Logistics is a tool for the supply chain and we must seek to projectise resource intensive models, the aim being to achieve and maximise gainful realisation.

The model discussed here is the produce-owner model, where revenue is dependent on offtake of the produce sourced. If the business model is limited to rent seeking on assets owned or for service provision, the strategic concerns would be comparable.

- Pawanexh Kohli





## WAREHOUSING INFRASTRUCTURE FUND

In July 2014, in presenting the Union Budget, the Finance Minister announced the Warehousing Infrastructure Fund (WIF) with a corpus of ₹ 5000 crore for 2014-15. When announcing this fund, Shri Jaitely said, *“Increasing warehousing capacity for increasing the shelf life of agriculture produces and thereby the earning capacity of the farmers is of utmost importance. Keeping in view the urgent need for availability of scientific warehousing infrastructure in the country, I propose an allocation of ₹ 5,000 crore for the fund for the year 2014-15.”*

This fund is made available as a low interest funding window to cold-chain stakeholders and is now operationalised through the National Bank for Agriculture and Rural Development (NABARD). The scheme was developed with inputs from Ministry of Agriculture, WDRA, NCCD and other stakeholders. The scheme was launched and details presented to private industry stakeholders at a gathering on 29 October 2014 in Mumbai.

A unique feature of this window is that it is also made available to all non-State private business entities – individual entrepreneurs, companies, corporates, etc. The National Bank for Agriculture and Rural Development (NABARD), is known to normally fund only State Governments, entities owned or sponsored by State Governments, Panchayat Raj Institutions, agencies owned or sponsored by the Government of India, Cooperatives or federation of cooperatives.

The WIF 2014-15 window will be accessible to all organisations (private and government owned) for creating cold-chain infrastructure, provided that the project complies with the standards and guidelines as laid by NCCD. The rate of interest to be paid by the borrowers will be based on NABARD's Prime Lending Rate (PLR) which at present is around 9.25% per annum. To the PLR, a risk premium will be added based on the credit rating of the borrower. A borrower rated AAA+ (the highest rating by NABARD) will be able to avail the loan at PLR (9.25%) with zero risk premium. Other ratings will have an incremental 0.25% as risk premium added to the PLR. Loans from commercial banks to cold-chain sector have interest rates that range upto 14% per annum.

These loans can also be linked to credit linked back-ended subsidy from the Government, where and if applicable. The loans will be generally offered for a term of seven years with a two year moratorium. An extended tenor will also be available with an associated tenor linked premium.

All components under cold chain infrastructure like pack-houses, cold stores, refrigerated (reefer) transport, bulk milk coolers, etc., are eligible for loans. Cold-chain developers and business entities will be pleased to learn that another ₹ 2000 crores is being developed as a lending window for food processing units, under similar terms. In all, during 2014-15 a total of ₹ 7000 crores will be available for private business entities to access, at low interest rates, covering all aspects of cold-chain infrastructure.

To apply for a NABARD loan for any warehousing infrastructure, the earlier schemes required the borrower to give an undertaking to undergo accreditation and registration from WDRA. Under this scheme for WIF, this requirement has been amended for cold-chain infrastructure and

### Various benefits to cold-chain private sector by the Indian Government

- Low cost loan (9.25% to 10.0%) under WIF (Nabard) -
- Investment Linked Tax Deduction (150%) - Section 35-AD of IT Act -
- Credit linked Subsidy to projects 35% to 50% (MoA, MIDH), 25% (APEDA) -
- One time Grant-in-Aid for integrated projects 50% to 75% (MoFPI) -
- Service Tax exemption for storing, handling, transporting agricultural produce -
- Service Tax exemption for 'Erection, Commissioning or Installation' of Cold Storage and transport -
- Various Customs and Excise duty exemptions / rebates on cold-chain equipments -
- 100% FDI, automatic approval route, ECB route open -





WDRA accreditation is not mandatory to avail this fund. The term will be 7 years (table below).

It may be expected that scientifically developed cold-chain infrastructure will be capable of safely handling multiple commodities, designed for multi-temperature zones. Such designs also add to the usability by allowing to service many types of product types and will improve the viability of the business. The types of perishable goods that are regularly handled in the cold-chain are expected to change as more development happens in this sector and new cold stores would be future ready designs. Besides stores, this loan is also made available to the cold-chain transport sector (railways, roadways, waterways) and to set-up the all-important horticulture pack-houses that feed the cold-chain. Similarly, the start points in the dairy supply chain – projects to set up milk chillers - will be able to apply for loans under this fund.

#### Salient Features:

Activities Covered	Loans will be provided for proposals of projects involving creation of infrastructure for agricultural and allied produce including construction of: <ol style="list-style-type: none"> <li>Warehouses / Silos</li> <li>Cold storages</li> <li>other cold-chain infrastructure like pack houses, reefer vehicles, bulk coolers, individually quick frozen units, chilling/ freezing infrastructure, etc.</li> </ol> Modernization/improvement of the existing storage infrastructure projects will be considered on merit
Conformation to Norms of WDRA / NCCD	Dry and wet storage projects must conform to the norms / standards prescribed by Warehousing Development and Regulatory Authority (WDRA) / National Centre for Cold-chain Development (NCCD).  Borrowers to give an undertaking to obtain accreditation/registration from WDRA in case of dry storage infrastructure; follow the standards as guided by NCCD in case of cold-chain infrastructure.
Loans to Private Sector	Direct loans to private sector and to the State Govt. owned/sponsored entities not covered by govt guarantee, would be covered by the terms of lending as follows- <ul style="list-style-type: none"> <li>Max Quantum of Loan: 75% of Total Financial Outlay (TFO)</li> <li>Interest rate: PLR + risk premium (if loan tenure 7 years)</li> <li>Interest rate: PLR + risk + tenor premium (if loan tenure &gt; 7 years)</li> <li>Interest rate will be fixed for term loan on date of sanction</li> </ul> <p style="text-align: right;"><i>NABARD PLR (Prime Lending Rate) is currently 9.25%</i></p>

## SOLAR POWER FOR WAREHOUSES – MNRE SCHEME

Cold-chain users must be aware of MIDH support made available from this year for alternate technology applications at cold-chain projects. One of the supported options is installing rooftop solar power panels on cold store rooftops to feed the grid with the energy generated (grid interactive). Sale of unit energy generated to grid would provide a source of revenue to offset the electricity bills, as well as reduce solar incidence on roof tops, hence reducing overall heat load.

NCCD is pleased to inform that last month MNRE also launched a similar scheme for installing of grid connected Solar PV power plants on rooftops of buildings including warehouses of Warehousing Corporation of India, FCI & others. This MNRE scheme will be implemented by Solar Energy Corporation of India (SECI) & the same concept of Net Metering / Feed-in-Tariff is used. Under this scheme, SECI would bear the cost of installation and sell the energy while the rooftop owner would be paid a fixed rent of 50 paise per kW/hour of the energy sold by SECI. Large cold store owners could also apply.



## BANANA

- Pawanexh Kohli



### Some factoids about Bananas केला

The scientific name is *Musa sapientum*, which means "fruit of the wise men". High in vitamin B6 it helps brain functioning. The banana plant is actually the world's largest herb and closely related to vanilla and ginger. The earliest written reference to banana is in Sanskrit and dates back to around 500 BC. Some horticulturists suspect that Bananas are the earth's first fruit.



Bananas are the most popular fruit in USA even today, having been first introduced in 1880s. In 1910, due to its popularity, an ordinance was required by the City of St. Louis, prohibiting people from throwing the peel on the ground (also one of the suggested good deeds of the day in the Boy Scout manual was to pick up banana peels from the street). Bananas are said to originate in South Asia or Southeast Asia and India is the top producer in the world accounting for 28% of world production having > 600 cultivars. High in potassium, bananas are naturally slightly radioactive. Rubbing the inside of a banana peel on your teeth for about two minutes every day helps whiten teeth.

Containing tryptophan, it is said to promote happy feelings.

### Banana Respiration rate; ethylene production; heat load:

- ❖ @ 13°C: 10 - 30 ml CO<sub>2</sub>/kg·hr; >0.1 ul C<sub>2</sub>H<sub>4</sub> /kg·hr; >4400 BTU/ton/day
- ❖ @ 15°C: 12 - 40 ml CO<sub>2</sub>/kg·hr; 0.2-5 ul C<sub>2</sub>H<sub>4</sub> /kg·hr; >5200 BTU/ton/day
- ❖ @ 18°C: 15 - 60 ml CO<sub>2</sub>/kg·hr; 0.2-8 ul C<sub>2</sub>H<sub>4</sub> /kg·hr; >6600 BTU/ton/day
- ❖ @ 20°C: 20 - 70 ml CO<sub>2</sub>/kg·hr; 0.2-10 ul C<sub>2</sub>H<sub>4</sub> /kg·hr; >8800 BTU/ton/day

*The higher rates at each temperature range are for ripening bananas.*

Ripened Bananas generate 3 times more heat at a fixed temperature. A truck load of green bananas will add only 0.3 tons of refrigeration load but a ripened lot will require adding 1 ton of refrigeration (at 20°C). This is another reason why ripening should be done at the last mile, before consumption, besides other constraints. Bananas are highly perishable and climacteric by nature. On an average mature green bananas can get life enhancement of 3 weeks in the cold-chain. This time is best utilised to reach markets with the ability to compress time at ripening centres near markets. To get extended time to reach markets at a longer distance, CA technology is deployed on reefer containers and life enhancement of 4 to 6 weeks is possible. Use of CA in transport has also allowed for picking of bananas at a higher level of maturity (with more girth, more weight, improved flavour).

### Banana Handling:

- ❖ Ethylene – high sensitivity - do not store with ethylene producers.
- ❖ Rapid post-harvest cooling to 14°C to 15°C is most effective for optimal handling. Globally this is usually done while already in transit.
- ❖ A High relative humidity is essential to maintain quality. RH level of >90% is recommended.
- ❖ Packing in cardboard boxes is the norm, the design and stowage ensuring smooth flow of air around the contents. Transporting in whole bunches, over stacked, is a main cause for physical loss, poor quality and wasted value.
- ❖ Bananas are transported and stored at 13°C to 14°C and ripening initiated by dosing with 100-150 ppm ethylene at room temperature of 16°C to 20°C.
- ❖ The set point differs for cultivars; at lower temperatures chilling injury occurs. Chilled fruit has blackened skin & susceptible to added damage.

### Using bananas:

In Eastern Africa you can buy beer brewed from bananas. Banana flakes are a common processed food item. The fruit can be cooked into various dishes. fabric and paper is made from the plant fibre.





## NCCD Glossary of Cold-chain

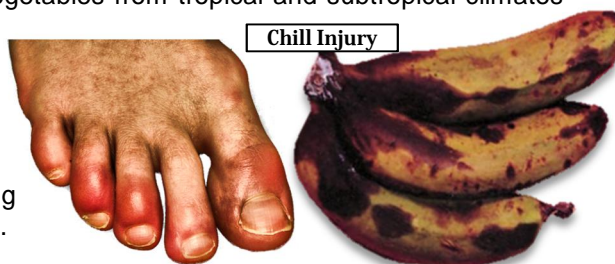
*Our CEO points out fine but crucial difference between temperature related injuries suffered by goods in care of the cold-chain. Understanding the results will help the users and the operators to assess causes and rectify procedures.*

**Chill Injury** [at temperatures above Zero°C] is the physiological injury to organic tissue caused by low but non-freezing temperatures. Chill Injury (CI) affects plants and can retard the growth and maturation of crops, though in many cases the plant can heal itself. For cold-chain businesses, the chilling of fresh produce during postharvest lifecycle is of economic importance and the damage is rarely recoverable. Each crop type has its own temperature tolerance level and cold-chain operators must maintain the produce above this limit – this defines the required set point or cold-chain temperature for each produce. The crop maturity at harvest also affects the susceptibility to chilling injury in some produce such as tomatoes, melons and peppers.

The injury to tissue, from exposure to lower than tolerable temperatures, results in a disruption of cellular functions and the tissue becomes weakened leading to cellular dysfunctions. Symptoms include surface lesions or pitting, internal discoloration, water logging in the tissue, failure to ripen normally and increased susceptibility to external microbial load (disease and decaying organisms).

The economic impact is reduced quality and loss of product value. Sometimes these symptoms are not visible or less severe until the produce is removed from low temperature space and warmed. Chilling injury develops more rapidly in fruits & vegetables from tropical and subtropical climates and slowly in those originating in cool temperate climates. Chilling injury intensifies with decreasing temperature and increasing duration. Drops of condensate falling on the produce can also cause chill injury.

In humans, the comparable is seen when suffering chilblains due to low temperature exposure of skin.



**Freeze Injury** [at temperatures below Zero°C] is the physical destruction to cellular structure caused by exposure to temperatures below freezing point. Also called frost damage, it is caused due to crystallisation of fluid (ice formation) inside the cell resulting in dehydrating the cells and physically disrupting (tearing) the membrane structure. Frost damage can happen on field and result in the demise of plants reducing yield or reduced produce quality.

At times, a frozen fruit will not show damage until the thaw occurs when the tissue will show tears and cuts. Freeze damage is also evident in all poorly frozen meats (fish, poultry, etc), where the cell fracture is visible as poor mushy texture in the thawed product. Quickly frozen meat is better than slowly-frozen meat; when frozen quickly, water turns into many, many tiny crystals. The tiny crystals are less likely to rip open cells (the same reason you can cut yourself on a big piece of glass but not on powdered glass). In humans freeze damage is called frost bite and complete tissue demise can occur.



Simply put, chill injury is the effect from exposure to low temperatures; freeze injury is the destruction resulting from ice crystal formation inside cells. One due to temperature, the other due to ice crystals.

In the perishable produce cold-chain, the most common damage is chill injury when temperatures are lowered below the established set points. Freeze point of fruits and vegetables are different than the chill point, the latter defining the carrying or storing temperature. In ice cream & meats freeze injury is common. Both require close monitoring and control of temperatures with equipment safeguards. Vaccine industry uses various thermo chromic labels on vials to monitor such temperature excursions.



## LUMINARY SPEAK



**Mr. Sanjay R. Bhoosreddy – Joint Secretary (GoI)  
Department of Animal Husbandry, Dairying & Fisheries**

*Livestock sector is increasingly becoming a crucial mainstay for our farmers, an economic buffer against climate vagaries and other disruptions. Do you see development where it becomes the core to India's agriculture?*

We need to realise that there are large areas where meat or fish is the staple food. Not all of India is purely vegetarian. For example, there are regions in our country where 80% of households eat fish or some other form of meats. In such areas, there already exist farms for whom livestock or fishing is the core activity. In the rest of our country, most of the field farmers also hold livestock to harvest milk, cow, goat or camel, which increasingly is an important multiplier to their income. So, I am of opinion that agriculture is not about limits but it opens up multiple options. For example, in case of poultry farmers, it makes sense to use the droppings as fish feed, for pond keepers it makes convenient to cultivate bees and horticulture, etc. Agriculture is truly not about any one core activity, but about having capacity to optimise on all possible resources. Hence, as our human and technical capacity improves in coming years, I foresee more integration of activities in our farming sector.

*One does not hear about a deficit of cold-chain logistics in the livestock - poultry or meat sector?*

That is probably because this sector captures most of the assets in advance of the needs of the fruits and vegetables sector. The horticulture sector competes for cold-chain logistics mostly in case of imported produce since they arrive using the cold-chain. Once own domestic produce, besides potatoes and spices, is capable of accessing the cold-chain there will be a shortfall, specially in case of temperature controlled transport. Currently the focus is to increase yield, besides assuring inputs and disease control. As yield increases, more supply chains options will be needed and the shortage could become acute. Increasing domestic demand for fresh meat and poultry is going to add to demand. Of course, our livestock exports already use cold-chain and there is always a need to improve services, capacity and availability of cold-chain. On the other hand, our animal vaccine program uses cold-chain and we have constant demand there.

*Do you have any guidance for the Cold-chain sector in India?*

Our growing dairy sector or our powerful presence in meat/egg/poultry exports could not have been possible without cold-chain. This industry is the obvious need of the hour, India has grown and is ready for such development. Our food security and the capability to feed other parts of the world depends on how our cold-chain develops. I understand that cold-chain requires more attention than ordinary logistics, yet that is why its an immense opportunity. As we develop at an even faster pace, this opportunity too will have been grabbed by those who have the vision to build a great legacy. Just like e-commerce has taken off against odds creating brands, cold-chain companies should also step forth and make their presence felt. I realise NCCD presents the cold-chain as a product business unto itself, more than just logistics services, owning the goods & the managing the supply chain. I see the market is ready and that too will come about.



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Op-Ed of the month  
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NCCD is an autonomous body set up by the Government of India with the aim to facilitate cold chain development across all user segments through policy intervention, capacity building and standardisation. NCCD has participation from private industry, policy makers, knowledge partners and government agencies.