



National Centre for Cold-chain Development

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Newsletter

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The CEO's Desk

In November 2014, we had occasion to share our concept of capturing stranded cold (waste energy) at LNG port terminals for use in "over-the-fence" cold distribution centres. This interaction happened at the Ports & Infrastructure conference in New Delhi. It is hoped that more port developers will come forth to partake in progressing this pioneering concept. In this newsletter, a few other possible applications of cold energy will be discussed.

This month also saw a few other newsworthy events – the launch of a major manufacturing facility by Danfoss in Chennai, a Global Agro Meet in Kochi, the ICE 2014 annual exhibition and awards ceremony, the WDRA foundation day celebrations and an India Farm to Fork summit.

NCCD also has initiated dialogue to start a Student Chapter focused on cold-chain solutions. We feel that more of our Youth should be involved in such development of national importance, even if the subject is not core to their curriculum. This month NCCD also introduced an additional web presence on social media with a Facebook site. Readers may like a visit to our page on Facebook (www.facebook.com/NCCD.India) to see other updates.

Readers and our members are also informed of the plan to publish an annual Journal of NCCD and technical articles, business case studies and new concepts are invited for inclusion in the Journal.

-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. Annual Journal will be published in 2015 & scholarly articles are invited.

EVENT HIGHLIGHTS

NCCD has found frequent support from our category-C members, who whole heartedly partake in our nation building exercises. One of these, Danfoss India – a subsidiary of a global corporate of Danish origins – has taken their commitments in India a step further. On 5-November, they commissioned and launched a manufacturing hub in Oragadam, Chennai. This 50 acre facility scales up and consolidates their efforts to make in India various equipment components critical to refrigeration and industrial automation, with the Asia-Pacific as its target market. Noteworthy is their on-site 1MW Solar Power park, use of recycled material and innovative designs, thereby demonstrating the technology and commitment to energy efficiency and the environment.

This ₹ 500 crore investment also consolidates their Research & Development efforts which will focus on India specific needs to support developing of improved energy efficiency applications in Cold-chain and Infrastructure. This facility is yet another step that will take cold-chain technology developed and made in India to global users, exporting energy efficient components and solutions to Asia-Pacific countries.





Learning Centre Inauguration: Satish Jamdar (Blue Star), Prem Jain (IGBC), Pawanexh Kohli (NCCD), Freddy Svane (Ambassador Denmark), Noel Ryan (Danfoss)



At this facility, a new Learning Centre was also inaugurated. Readers will be aware that team Danfoss was implementing the NCCD curriculum on capacity building in previous months. The NCCD course will shift to the new Learning Centre, from January 2015. In the previous months, more than a 100 officers from State governments along with NCCD members have undergone the training course. Recently, cold storage business owners from some States had also expressed a desire to personally undertake such a three day course.

In Kochi, Kerala, a Global Agro Meet was inaugurated by Hon'ble Minister of Agriculture, Shri Radha Mohan Singh on 6-November-2014. The conference and exposition was focused on High Value Agriculture and Food processing, showcasing the agri-ecosystem.



Snippets of Hon'ble Union Minister of Agriculture, Sh. Radha Mohan Singh at the Global Agri Meet



Mission Director (SHM, Kerala), Dr. K. Prathapan was key to organising the event, in particular the sessions on post-harvest discussions, ably supported by Mr. Melvin Jose (Nodal Officer for Cold-chain Development in Kerala). NCCD's CEO also addressed an interactive session on cold-chain and agri-business matters.

The Foundation Day of the Warehousing Development and Regulatory Authority was celebrated in



November. The event was attended by farmers, and warehouse owners, many among whom were lauded for their achievements in issuing NWRs (Negotiable Warehouse Receipts) in 2014. Hon'ble Minister of Consumer Affairs, Food and Public Distribution, Shri Ram Vilas Paswan gave the awards.

WDR Foundation Day (R-L): Sh. Ram Vilas Paswan (Hon'ble Minister), Sh. Dinesh Rai (WDR), Sh. Bal (WDR), Sh. Sudhir Kumar (Secretary, GoI).

WDR registered warehouses can issue NWRs, which enable the depositors to avail low cost credit against stored cargo as collateral. As of this writing, very few cold warehouses have availed this option but many more refrigerated warehouses are expected to take advantage in the coming years.

The cold-chain sector and its varied stakeholders gathered at the iconic ICE annual exposition, which was held this year in Ahmedabad, Gujarat (21 and 22 November). ICE 2014 also hosted an international cold-chain summit, where the latest happenings were shared by farmers, users, equipment suppliers and technology experts. The ICE exposition & conference, is the longest standing annual gathering in India, dedicated to the subject of cold-chain, and its successes paved the way for many other exhibitions, that in recent years have also focused on the cold-chain sector. The ICE events are held in partnership with GCCA (Global Cold Chain Alliance). An annual awards function is also held at each ICE event.

GCCA comprises of the World Food Logistics Organization (WFLO), International Refrigerated Transportation Association (IRTA), International Association for Cold Storage Construction (IACSC) and International Association of Refrigerated Warehouses (IARW) and represents 1300 companies in 65 countries. Mr. Rosenbusch, President & CEO of GCCA, Mr. Plant, Chairman of WFLO alongwith Mr. Khanna Director GCCA India & ICE Centre of Excellence graced the occasion.

Dr. B.R. Shah, Mission Director (SHM - Gujarat), inaugurated the conference and he and his team addressed the gathering to share developments and future plans for integrated development in cold-chain.

Senior representatives of NABARD provided a very informative discourse on the newly launched WIF lending scheme (₹ 5000 crores) at this conference. Also honoring the conference were the Presidents of the Cold Storage Associations of Gujarat, Madhya Pradesh, West Bengal, Bihar, UP, Telangana & the National Secretary of the Federation of All India Cold Storage Associations.

Industry stalwarts from other user segments and agri-entrepreneurs, all gathered for the conference and awards ceremony. Danfoss sponsored the annual awards ceremony - innovation, excellence and development efforts from across India were lauded. Read about the awardees on NCCD's FB page.





COLD-CHAIN INSIGHTS

- VII

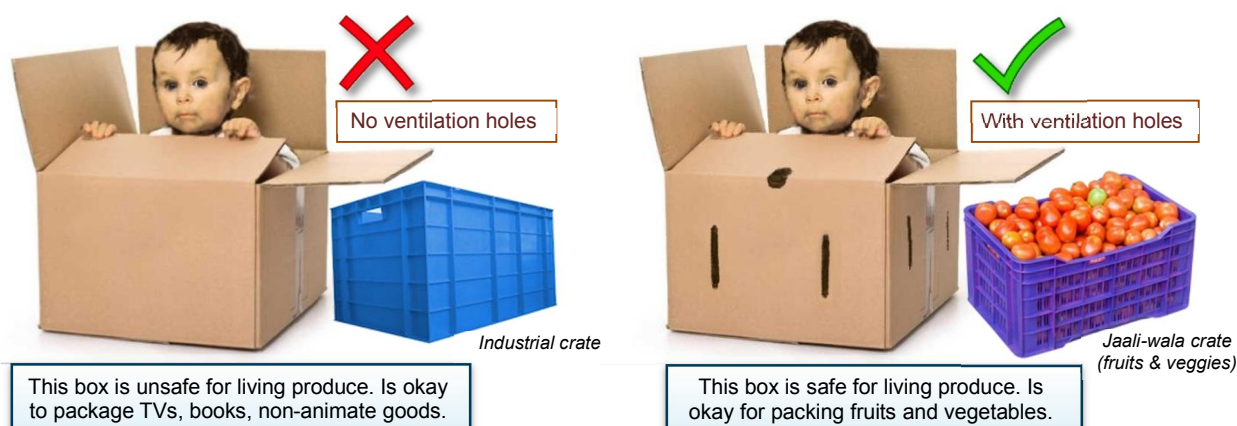
The importance of packaging, as a measure of loss reduction, is normally glossed over in deference to the other technology aspects. Refrigeration and energy efficiency usually take precedence as prime topics of discussion at most cold-chain debates. In reality, the principal role of the cold supply chain is to assure the physical & quality parameters (value metrics) of perishable goods, in course of their passage from producer to consumer.

Packaging type, design and material has special import in the cold-chain, specially when dealing with fresh produce. Whereas, the temperature control environment helps to enhance the saleable life span of the living produce, the primary feature of the packing is to cater to is the living processes of the produce. The packaging used is also most important to mitigate handling losses. In case of processed foods, the industrial production line typically includes the packing line, and the end format of the product pre-defines the pack (jars, cans, wraps, bottles, etc.). In this edition, we discuss the basics involved in relation to the fresh produce segment.

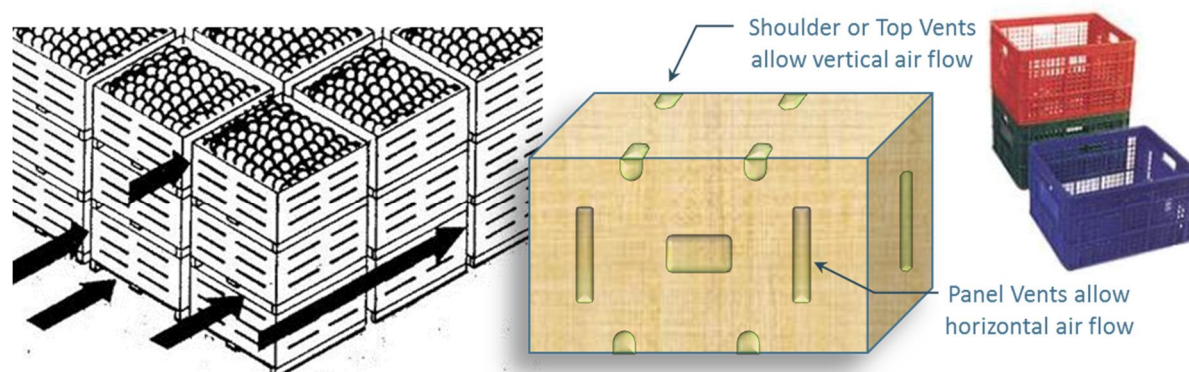
The key parameters that affect the market quality of produce, are well known – damage to skin and flesh of the fruit or vegetable, infestation, loss of moisture and tissue demise. The packing system used, especially in case of tender bodied fruits and vegetables, is most significant to mitigate these factors. In most instances, demise and decay is because of poor packaging.

The unit pack is created in a pack-house, initially designed keeping in mind that handling and transport exposes each load to dynamic stresses (causing impact and abrasion). Hence, even though the produce is graded by size, so as to evenly spread any load stress, the packing material used should also minimise chafing and contact damage with the walls of the package itself. The interstitial space between each unit fruit or vegetable also needs to be buffered. CFB (corrugated fibre board) cartons are internationally used for this purpose, with minimal selective use of hard plastic crates during storage or transport. Paper or natural fibre based packaging material is recyclable and less harmful to the environment. To further minimise handling concerns, the cartons are shaped and strengthened to withstand overstacking so that unit pallet loads can be created, which in turn facilitate faster handling and optimises storage space.

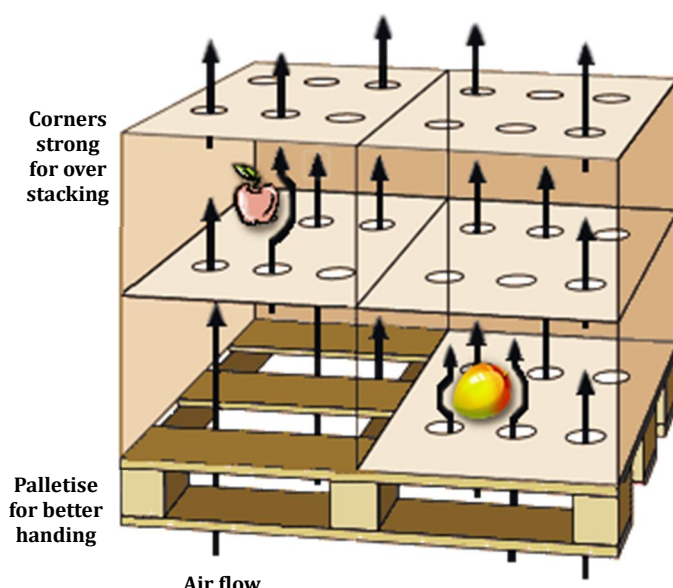
The other design parameter for fresh produce packaging, is to keep the produce living. This means that cartons or boxes used for storing fruits and vegetables must allow them to live & breathe – sustain sufficient flow of air. A closed box with no ventilation holes is extremely unhealthy for fresh produce. Much like a person in an airtight sealed car will suffer due to eventual lack of oxygen, while keeping the window partially open allows fresh air replenishment.



Unlike manufactured products, or those which are non-respiring (like ice-cream, medicines, frozen food, meats, etc.), all fresh fruits and vegetables are edible only as long as they remain living. The packaging used must therefore be designed so as to sustain an environment that allows for breathing functions to continue. Having suitably designed vent-holes, is also important



to allow for heat, that continues to be generated by the living fresh produce, to be extracted and not remain trapped in the box. While a crate or a box is necessary for good handling, it must not become an enclosure that traps heat and gases respired. The gases that are produced are CO₂ and ethylene which are also evacuated from around individual fruit and vegetable, inside the box, through these vent holes. Without such a box design, the produce would suffocate, surrounded by its own gases inside the pack.



The loading (called stowage) of boxes in a storage or transport chamber is also decided by the package design. When overstacking boxes on a pallet, care must be taken that the air holes are in alignment vertically and horizontally. Again, the intention is to allow smooth flow of air inside the box – keeping good air flow outside the box of produce is not sufficient unless the air can penetrate the box and circulate around individual pieces of the fruits and vegetables, and dissipate the exhaled gases and the heat envelope around them.

Using well designed boxes for fruits and vegetables, not only keeps them safe from mishandling, it also ensures the

temperature control is effective and allows for unitised load handling. The purpose is not just keeping cool but maintaining a living breathing atmosphere and protection from mishandling.

While the entire load is protected from undue heat ingress from the outside, by insulating the temperature controlled chambers, the inside cool environment has to be circulated to serve its purpose. This ventilation concept, must not be misconstrued to mean the cutting of air holes into the insulation of the chamber itself. The external chamber is a barrier to outside ambient air, but the unit box must facilitate internal cool air circulation. Ambient air-refreshing is kept to minimum.

It is vital to remember that in case of fresh perishables, the produce itself generates both heat and gases and these need to be evacuated – it is for this reason that perishables (horticulture) cold-chain is more knowledge intensive than cold-chain for manufactured products like ice cream or processed foods, in which cases it is only a matter of maintaining a set temperature.

The cold-chain is not always about temperature integrity, and operators have to be concerned about the environment integrity too, to specific needs of each produce or product that it serves enroute to market. This integral facet is initiated at source of produce, when it undergoes pre-conditioning, in preparation to enter the cold-chain. Good packaging is core to reducing wastage.

- Pawanexh Kohli



REFRIGERANTS - AN UPDATE

Refrigeration primarily relies on manipulating the latent heat properties of fluids called refrigerants. Refrigerants used are both natural fluids and synthetic manufactured fluids. The common natural fluids are ammonia, CO₂ and hydrocarbons. The synthetic refrigerants are products artificially produced by man and mainly are from family of fluorinated gases (F-gases). Most F-gases are very powerful greenhouse gases and contribute to global warming when emitted to the atmosphere. Since F-gases are synthetic and do not exist in the natural environment, their longevity is not limited by any natural cycles to absorb the emissions. Currently, the refrigerant scenario is undergoing rapid changes and alternates are being discussed & developed. The following article is submitted by ISHRAE an NCCD member.

Over the last 2 decades or so, with new learning on the global environment impact of artificial refrigerants, the use of refrigerants and the types refrigerants used has become a global concern. What began as a specific environmental issue of Ozone depletion took the larger shape in form of concern on Global Warming Potential (GWP) of refrigerants. This has led to the structured freezing and phasing out of many artificial refrigerants. Global research & development efforts for safe alternate refrigerants is underway. Any new refrigerant developed will require additional cost for change of equipment & technology, which is an important factor for developing economies.

Among the F-gases, CFC (ChloroFluoroCarbons) gases have already been phased out, though the HCFC's (HydroChloroFluoroCarbons) and HFC's (HydroFluoroCarbons) are widely used in different sectors. HCFCs are also due for phase-out; for Article 5 countries such as India, the phase-out schedule is tabled here.

HCFC Phase-out for Article 5 countries				
2013	2015	2020	2025	2030
Freeze at the 2009-2010 Average	10% reduction	35% reduction	67.5% reduction	100% reduction

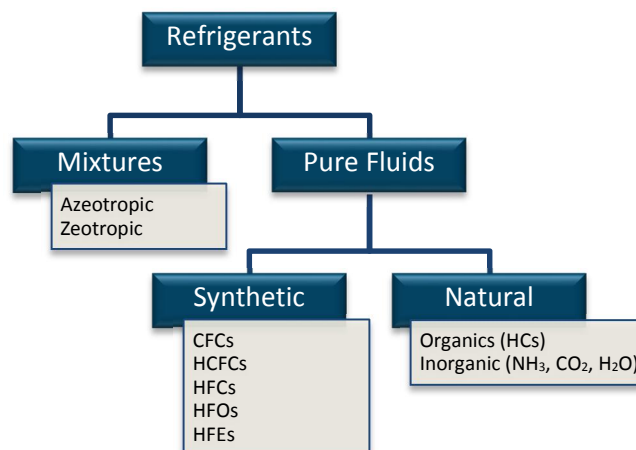
R-22, an HCFC refrigerant gas, is widely in use by the Air Conditioning sector. However, having an ODP (Ozone Depletion Potential) of 0.05, it is a controlled substance under Montreal Protocol. In India, R-22 is used in Window/Split/ Packaged Air Conditioners, Chillers and only to a very small extent in refrigeration (cold-chain).

Alternate Refrigerants

There is a growing usage of alternate refrigerants; however the alternatives depend on the sub-sector temperature levels. For example, for Chillers (+7°C chilled water temperature) there is a widespread use of R134a (which is an HFC with GWP of 1430) as well as R407C (which is a blend of 3 refrigerants with a "glide" phenomenon). In the air conditioning sphere, R410A has emerged as a favourite choice; though it has some negative characteristics; notably very high pressure.

R32 which is a HFC with a relatively less GWP of 675 is now being promoted by some Japanese and Chinese manufacturers as a suitable refrigerant specifically for small unitary product such Room/Split A/C's; although it is mildly flammable. As for the frozen sector (minus temperatures) the erstwhile azeotrope R502 (a mixture of R22 & R115) is phased out and the new alternate refrigerant being used is R404A. However the issue is its high GWP (3922).

Another HCFC of relevance particularly for Cold Stores / Refrigeration sector is R141b which has been used as a foam blowing agent during manufacturing of PU foam panels. This was a replacement of CFC-11. However the current status of HCFC-141b is that it will be completely phased out by 2015.



Refrigerant	GWP	Atmospheric life (years)
R-12	10,900	100
R-502	4,657	876.2
R-507A	3,985	40.5
R-404A	3,922	40.4
R-407A	2,107	18.2
R-22	1,810	12
R-407C	1,774	15.7
R-134a	1,430	14
R-32	675	4.9
R-290 (propane)	3.3	12 ± 3
R-600a (isobutane)	3	12 ± 3
R-1270 (propylene)	1.8	12 ± 3
R-744 (CO ₂)	1	29-36
R-717 (ammonia)	0	<0.019

Global Warming Potential is the relative measure between the heat trapped in gas in comparison to the amount of heat in same mass of CO₂ over specific time interval. GWP is expressed as a factor of CO₂ whose GWP value is standardised to 1. GWP is different from ODP.



In terms of flammability and toxicity, the old CFC's were intrinsically safe. However the new refrigerants are not in the same league. In fact, the biggest challenge faced worldwide is to develop refrigerants which will not endanger the operation and maintenance personnel as well as end users. ASHRAE has classified all refrigerants under 8 classes with A1 being safest and B3 most hazardous.

Class A1 has zero flame propagation A3 has highest flammability class. Similarly B1 is categorised as low toxic and B3 has the highest toxicity level. Ammonia, one of the oldest and most efficient as well as environmentally friendly refrigerant is classified as B2L (low flammability but high toxicity).

A concern that has come to the fore due to the global warming effect of new refrigerants, is the indirect impact related to energy consumed by the refrigerating equipment. This means the energy efficiency of the product using the refrigerant has a profound effect

on the greenhouse gas emission.

In fact, some tests established that this indirect effect can be about 42 times the direct effect caused due to leakage/ venting of the refrigerant directly into the atmosphere. Thus it is imperative in the current context for users and designers to select the most energy efficient product/system so as to minimize the total impact (direct + indirect) on global warming.

With these intricacies on environmental impact as well as hazards associated with synthetic refrigerants, there is a renewed interest worldwide in the so-called natural refrigerants. These include:

- a) Carbon Dioxide (CO₂);
- b) Hydrocarbons (C_nH_{2n, ±2});
- c) Ammonia (NH₃);
- d) Water (H₂O)

However none of the above choices are without some technical difficulties in implementation. For example, CO₂ has a low critical temperature of 31.1°C and high critical pressure of 7.3 MPa. This results into a transcritical cycle with pressures in the system going up to 120 bar and beyond. Systems need to be designed for safe handling such high pressures. CO₂ has been found to be a good refrigerant for heat pump water heaters. Ammonia; though widely used in the Refrigeration sector is not considered suitable for comfort air conditioning application due to its toxicity and flammability. Similarly, Hydrocarbons have issues of flammability which impose restrictions on system charge. However companies in India have been a pioneer in using isobutene in home refrigerators and have also introduced small window AC units using hydrocarbon as a refrigerant.

ISO / ASHRAE SAFETY GROUP

Increasing toxicity →	
Increasing flammability ↑	A3 Propane, methane
	A2 R-142b, 152a
	A2L R-143a, 1234yf
	A1 R-11, 12, 24, 114, 500, 134a
	B3 R1140
	B2 R-30, 40, 506
	B2L Ammonia
	B1 R-10, 21, 123, SO ₂

Ozone Depleting Potential (ODP):

Earth's protective ozone layer gets damaged by certain ozone depleting substances. This layer, composed of ozone molecules, extends from about 15 to 30 kilometres in the stratosphere above the Earth's surface and serves to filter 97-99% of the Sun's harmful ultraviolet (UV) radiation. Consequently, any thinning of the ozone layer allows more radiation to reach the Earth's surface - overexposure to UV rays can lead to skin cancer, cataracts, and weakened immune systems. In terms of ecological health, increased UV can lead to reduced crop yield and disruptions in the marine food chain.

Ozone depleting substances (ODS) vary in capacity to destroy ozone molecules and the Ozone Depleting Potential (ODP) is a ratio of the relative depletion caused by different substances in relation to value 1, which is assigned to trichlorofluoromethane (R11 / CFC11). CFC11 has 3 chlorine atoms in a molecule - each chlorine atom can destroy over 100,000 ozone molecules.

The Montreal Protocol is the first worldwide agreement designed to protect human health and the environment against the adverse effects of the depletion of the stratospheric ozone shield. The protocol is administered by the United Nations Environment Programme (UNEP), which maintains the list of ozone-depleting substances that are targeted for control, reductions, or total phase-outs. India's cold-chain primarily uses ammonia, a natural refrigerant with zero ODP.

-extract from NCCD Glossary (Aug-2014 edition)

Article contributed by Shri Avinash Shaligram on behalf of ISHRAE

M.Tech. from I.I.T., Bombay (1983). Currently, Professor of Mechanical Engineering in Pillai Engineering College, Navi Mumbai. Teaching experience of 6 years; both at the UG & PG level. Also worked in HVAC&R industry for 20+ years in R&D, Product Design and Testing. Special field of work: Chillers, Compressors, Heat Exchangers, Alternate Refrigerants, etc. Immediate Past President of ISHRAE Thane Chapter, Member of ASME, Member of Institution of Engineers (I) and Life Member of ISTE. (contact: agshaligram@mes.ac.in)

In summary, it is evident that the choice of refrigerant for each particular application has become extremely complex due to multiplicity of factors such as environmental legislations, energy efficiency, safety hazard, cost and availability.

The Montreal Protocol is an international treaty on Substances that Deplete the Ozone Layer and entered into force in 1987. The Kyoto Protocol is under the UNFCCC international environmental treaty aimed at stabilising greenhouse gas concentrations and came into force in 2005.



BRINJAL



Some factoids about Brinjal, बैंगन, भिंटा, वृन्तफल, वृन्ताकी

Known to have originated in the Indian sub-continent, its name is rooted in the Sanskrit *bhañṭākī* and *vātingaṇa*. The plant is said to have travelled east to China about 500 BC and the Portuguese took some into Europe about 500 years ago, pronouncing it beringela. It was called as eggplant in Europe because the white round variety, looked like goose eggs. For a long time in Europe, the eggplant was used more as a decorative garden plant than as food. Today China is the world's largest producer (approx. 30 million tons) while India is ranked second producing 13.9 million tons in 2013-14. Thomas Jefferson is said to have originally introduced the brinjal plant to the United States.

Containing phytonutrients like Nasunin which protects the lipids (fats) in brain cell membranes, eating brinjal is said to preserve the memory function of the brain. Eggplant also has small amount of nicotine and can help those who wish to quit smoking. Other advantages of eating brinjals range from anti-aging benefits due to large content of anthocyanins, it keeps skin tone supple and glowing, strengthens hair growth and keeps the scalp hydrated. Brinjal also helps bring down cholesterol and helps stabilise blood pressure. A rich source of fiber and low soluble carbohydrates it is helpful to control absorption of glucose in patients with type 2 diabetes.

Brinjals are traded around the world and require the cold-chain to make the transit to global markets. Even in the cold-chain, brinjals generally have about a 14 day life cycle. Hence storage periods are kept short term (minimal) in the supply chain, with most of its viable life being used in the transport leg, on the shelf (shelf life) or at consumer's home. Brinjals are chill sensitive over time and must be kept clear from condensate drips (chilled water) or direct blast of cold air below its safe set point. If exposed to temperatures below 10°C for more than 6 days, chilling injury will occur. This will lead to accelerated decay. On the other hand, high humidity level of 95% is preferred to maintain quality and prevent weight loss during its post-harvest trip to market (pre-cooling, transport, storage and distribution).

Brinjal Handling:

- ❖ Ethylene – high sensitivity - do not store with ethylene producers.
- ❖ Rapid post-harvest cooling to 10°C using Forced air cooling is the recommended method. Though room cooling after hydro-cooling is commonly practised.
- ❖ A High relative humidity is essential to maintain quality. RH level of 90-95% is recommended.
- ❖ Packing in cardboard boxes is the norm, with moistened wax paper. Transporting in hard body crates and bulk stacking, is a main cause for physical loss, poor quality and wasted value.
- ❖ Brinjals are transported and stored at 10°C to 12°C. At lower temperatures, chilling injury will surface within 2 days (at 0°C), 6 days (at 5°C), 10 days at <10°C). Visible signs of chilling injury are pitting, surface bronzing, browning of seeds and pulp tissue. Freeze injury will occur below 0°C.
- ❖ For short-haul selling cycles, lower temperatures can be used in-transit, staying within the safe temperature-time-chill factors.
- ❖ High CO₂ level of upto 10% is tolerated but CA technology does not enhance life, beyond the benefits of low O₂ levels.

Using Brinjals:

Brinjals are native to many dishes in India and the Eastern nations, and considered a staple in many parts of the world. Brinjals are consumed cooked, grilled, steamed, broiled, baked or pickled. The majority, about 98% of the eggplant in USA goes to the fresh market with some amounts processed for frozen entrees.



AGRICULTURE, THE GROWTH DRIVER

by Shri Sanjeev Chopra, Shri Mukesh Khullar, Shri Bjjay Kumar)

Why bother with agriculture?

The Indian economy is moving to a high growth trajectory, and many may feel more attention be focused on what is considered as the two main growth drivers, viz services and manufacturing. Yet, half our population continues to depend on agriculture and allied sectors as the principal source of income and livelihoods. It, therefore, is important to bring agriculture to the centre-stage of our development paradigm for five main reasons.



First, we cannot aspire to a double digit growth if this sector lags behind; Second, new jobs and livelihood opportunities have to be created, not on, but around agriculture (near farm jobs); Thirdly, we have to leverage the fact that in terms of global competitiveness, our agriculture fares better than our manufacturing sector; Fourth, agricultural development has a multiplier effect on Poverty reduction; and last but not the least, the diversified Food and Nutritional requirements of our (burgeoning) population have to be met primarily from domestic production - the world's most populous country cannot depend on imports to feed itself - and in doing so, India can also become the food production hub for the world.

India is changing: Will Agriculture Standby?

To achieve the above, a new market led strategy, that recognizes the changing income, demographic, livelihood, ecological and settlement profiles of India, becomes imperative. The State will continue to play a pivotal role to develop physical infrastructure and access to markets, besides of course, extending financial and policy support to Farmer Producer Organizations and co-operatives, which enable our predominantly marginal and small farmers to leverage the economies of scale and scope.

This, inter alia, means that a 'one-size-fits-all' strategy will not work, and we will need a differentiated strategy for different regions/commodities, depending on agro-climatic conditions, current levels of public and private capitalization, proximity to markets, export potential of specific produce and risk-bearing ability. The broad interventions will cover Urban Agriculture, PHM, Value Chains & Exports, Diversification and strategy for Rain fed agriculture.



However these strategic interventions can bear results only if the fertilizer and food subsidy regimes are rationalised which apart from sending the right signals to the farmer regarding his production decisions, will also release at least sixty to eighty thousand crore rupees annually to implement the recommendations listed below. Of this, forty percent to be earmarked for rain fed agriculture, and twenty percent each for the rest.

Edible Greens: A strategy for urban agriculture

First, we have to integrate agriculture in the urban space, and break the mental dichotomy of Rural being synonymous with agriculture, and Urban with manufacturing and services. We have to treat agriculture as a profession, and create a policy environment that retains and attracts bright women and men in the sector by ensuring access to capital, technology and markets.

To ensure availability of good quality fruits and vegetables (with organic and /or GAP certification), the Mission for Integrated Development of Horticulture and Rashtriya Krishi Vikas Yojana should earmark financial and technical resources for 'Urban Agriculture'. This would include financial and technical support for individuals and institutions taking up vegetable production in every available green space, besides the establishment of 'protected cultivation production zones' in peri-urban areas, on the lines of STPI (software technology parks)



incubation centres in an SPV mode, where individuals/organizations may take up cultivation of fruits, flowers and vegetables to meet the growing requirements of urban areas.

These could be developed under the existing international collaborations by inter allocation of resources. These 'zones' could also come up near the sewerage treatment plants to optimize use of water and compost, thereby ensuring a virtuous recycling of resources. Vertical Farming in select open spaces, especially on cantonment lands can address the F&V requirements of the large army establishments. These can then serve as Demonstration Centres for all corporates /institutions which have large campuses. Incidentally, Hero's industrial establishment at Manesar has developed a state of the art roof-top facility for production of fresh vegetables and herbs for their employees, thereby optimizing resource use efficiency.

The Imperative of Diversification

The 'business as usual' approach of concentrating all our efforts and energies into Green Revolution areas (Punjab and Haryana) to meet the food security needs of the country is passé. In reality, these areas face acute water stress and soil fatigue, and higher per capita input costs (including public expenditure on power and fertiliser subsidy), and water guzzling crops like rice and sugar must move to Eastern region which receives higher precipitation. GR areas have to make the transition to High Value Agriculture (HVA), including dairy, poultry, aquaculture, post-harvest management, processing, value addition and services to restore the ecological balance over the next ten years. Their proximity to NCR and air connectivity to Central Asia and Europe may be appropriately leveraged.



PHM, Value Chains and Exports

While continuing MIDH strategy of supporting PHM and integrated value chains in perishables, especially fruits and vegetables, albeit with a cap of 25% (30% for marginal farmers and producers in NE&H states), we should aim to have an annual target of \$100 billion of agricultural exports over the next three to four years. West Asia and Europe are emerging as important markets for high end Basmati, spices, fruits and vegetables, in addition to our traditional exports of tea and coffee. Working together with APEDA, this calls for commodity specific strategy and will involve brand building, traceability and trackability as has been done for grapes, cashew, mango and spices, amongst others, with the agenda to open conduits for international trade.

India's domestic market integration is equally, if not more important. The absence of an integrated national market for agricultural produce causes complications and associated loss. Karnataka's leadership role in market reforms must be replicated and up scaled to make



transactions in agriculture produce transparent, and with minimal time and cost. However, policy alone will not create a national market – it has to be backed by robust agri-logistics that will ensure the movement of produce - apples from J&K to Kerala, organic ginger from Mizoram to Punjab and Kiwi from Arunachal to Mumbai.

All efforts at market integration are to be with one result as the mainstay, effective and increased

commerce. Trading mechanisms between producers and consumers must be provided tools to make the material flow of goods and the flow of information streamlined, effective and scalable. This is where cold-chain as a supply chain technology plays the largest role. In fact, the cold-chain must originate at the point of production, or the farm gate establishment. These aggregation and conditioning centres when set up at village level, open up near-farm jobs, provides immediate feedback and allows market linked decisions at the hands of the producers.



Lead Author: Dr. Sanjeev Chopra (Joint Secretary (GoI) Department of Agriculture & Cooperation), with support of Shri Mukesh Khullar and Shri Bijay Kumar

Better Yields for Higher Returns

Last but not the least we have to focus on Rain fed farming systems. These areas face multiple jeopardy: poor public infrastructure in irrigation, power, road and rail connectivity, markets, educational institutions, banks and extension services.

These regions, mostly states in the East and North East require substantially higher capitalisation to break the vicious cycle of low productivity, low income and even lower savings. They realize lower Rupees per hectare by growing crops like millets, rice, pulses and oilseeds. Not only is the typical rice yield at 10-15 q/a much lower in

comparison to 40 q/a in Punjab, this disparity in yields is coupled with lack of/marginal presence of procurement agencies like FCI and NAFED which leaves the farmer at the mercy of intermediaries operating in monopolistic/oligopolistic situations.

While the National Food Security Mission and BGREI have made significant interventions to bridge the yield gaps in cereals, pulses and oilseeds in low productivity districts through a mix of technology demonstrations and inputs (seeds, fertilizers), these efforts can be redoubled to promote the Evergreen Revolution with focus on women, soil health, sustainability and resource-use efficiency. Commercial crops like onion, garlic, turmeric and where possible potato, guar gum, and fruits like melon, cantaloupe, guava and pomegranate which give higher returns and optimize water use will be supported in these areas.

Every district in the rain fed areas will have a Centre of Excellence based on the lead crop, besides the support to KVKs and creation of a network of warehousing and cold chain infrastructure, linked to Warehousing Receipts to prevent any distress sale. The target is that even these regions should achieve an agricultural growth rate of at least five percent to ensure a higher growth trajectory. Together with a double-digit growth in food processing and six to eight percent growth in HVA and urban agriculture, there is no looking back... only looking ahead to the sector playing an even more meaningful role in India's sustainable and inclusive growth story.

Value chain and supply chains

High yields have to be integrated with markets through connectivity, the kind that creates material links so that most of our yield can mature into monetised forms. A dynamic value chain – triggered at pack-houses and primary warehousing at farm gate, to refrigerated transport and cold stores to retail outlets – requires strategic focus on flow, rather than static storage; requires a new generation of entrepreneurs and leaders who will leverage technology, policy and funds to provide on-line trading platforms, as well as physical delivery from farms to consumers. One looks forward and welcomes this new generation; one that drives, connects and sustains India.



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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.