Section – I

Education and Health Care

The Crunch in Human Resource in Indian Agriculture

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Preamble

Agricultural Scientists Recruitment Board was established on 1 Nov, 1973 as an independent agency with the mandate to make available best human resource to man various positions in the ICAR institutes, this is considered a major milestone in human resource availability to Indian Agriculture. Having created a network of commodity and/or specialized institutions in the national agriculture system, today ICAR has largest chain of 97 institutes, 78 All India Coordinated Projects, 156 Regional Stations and 8 Zonal Project Directorates with nearly 600 Krishi Vigyan Kendras (KVK). The scientist's manpower available is around 5800 with around 200 research management positions. In addition to this agriculture being a state subject 46 state Agricultural Universities, 5 Deemed Universities of ICAR, one Central Agriculture University and 4 general Universities with well established agriculture faculty are involved in agriculture education, research and extension. These together employ nearly 25,000 agriculture teachers, researchers to meet the needs of human resource in agriculture. With the growth of agriculture sector, Universities based on land grand system first established in 1961 at Pantnagar are getting diversified as is seen from the (Table 1).

To bring an uniformity of standards in education in agriculture universities, ASRB conducts National Eligibility Test (NET) as a pre requisite for recruitment as Assistant Professor/ Lecturer. All India Agriculture Research Service (ARS) examination is conducted annually by ASRB along with NET to fill up vacancies in various disciplines under ICAR and the ICAR Institutes across the country.

Efficient, viable, vibrant and transparent human resource induction system in any organization is the key to its success and growth. It is all the more desirable for a research organization like ICAR that its human resource induction systems are regularly reviewed, refined and fine – tuned in line with the emerging organizational priorities as well as the latest assessment and evaluation tools and methodologies and accordingly position itself to meet the new challenges.

Table 1: PG Agri education in NARS: Diversification or Dilution?

Type of SAU	*No. of Universities*				
1. Agriculture	SAU's	DU's	CU's	CAU	Total
(Composite Type) original concept	18	00	04	01	23
2. Agri. (- Vet or Hort.)	17	02	00	00	19
3. Vet & AH/FISH Exclusive	08	01	00	00	09
4. Hort. Forestry Exclusive	03	00	00	00	03
5. Dairy Exclusive	00	01	00	00	01
6. Fisheries Exclusive	00	01	00	00	01
Total	46	05	04	01	56

Current Position

From around the end of 2004 an all time acute need was felt by ASRB to completely reorient and transform the rules, working procedure alongwith appraisal, assessment, evaluation and examination systems, complete with selection parameters and their respective methodologies along with commensurate upgradation infrastructure. This has enabled the board to identify and select the best available talent to man various positions in ICAR in emerging global technologies and competition. Extraordinary expansion of University education over past few years has led to an unprecedented expansion in the available talent pool though not always of the desirable quality for a research system. This has made the job of talent search more challenging. A critical analysis of the last five examination data (Table2) revealed some interesting features. It has become clear that there is horizontal expansion of education and at the every level, the optimum human resource ratio of 1:5 for interview are not available. There are number of subjects where even qualified candidates are not available for entry into research system. In the last ARS – NET exam (2011) from amongst 28,000 applicants only 3800 qualified for appearing in main examination out of which only 767 succeeded to have crossed the qualified marks to be eligible for personal interview.

It was expected that in 2010 -11 ARS examination when 250 vacancies were available atleast 1250 candidates should have been passed. This shows the lack of quality of post graduates coming out of Universities. Similarly, over the last five years 1164 new entrants to ARS were recruited by the Board. Out of this, 817 (70%) have been only from 10 Universities while the remaining 30% have been contributed by 45 Universities (Table3).

This certainly is a matter of concern and at national level some kind of introspection is necessary. However the trend for the last 5 years indicate that dominance of 'Top Ten' has reduced from 79% in 2006 to 62.6% in 2011. That means many other universities are taking interest in ARS examination and trying to improve the education.

Table 2: Requirement thorough ARS

Year	*Posts Advertised*	*Candidates Interviewed*	*Post filled*	*Ratio*
2005	160	590	145 (91)	1:3.7
2006	220	768	191 (87)	1:3.5
2007	283	952	249 (88)	1:3.4
2008-09 (combined)	439	1487	364 (82)	1:3.3
2010	290	767	212 (73)	1:2.3

*. Ration means for 1 vacancy five merit candidates are called (ideal ratio fixed by ASRB is 1:5)
**. Already 78 seats shall remain vacant, as candidates have not cleared theory examination. This will further go down after interviews.

Table 3 : Top ten performers from amongest SAU's in five ARS exam.

ni.	*Year*					
	2006	*2007*	*2009*	*2010*	*2011*	*Total*
IARI	24	28	49	77	47	225
TNAU	24	14	29	25	16	108
IVRI	13	33	20	33	07	106
GB Pant	07	11	15	32	07	072
CIFE	06	17	08	20	14	065
UASB	09	12	12	11	15	059
NDRI	11	12	16	09	10	058
ANGRAU	07	08	16	10	12	053
UASD	06	02	12	12	09	041
CCSHAU	07	08	08	09	07	039
Total	114	145	175	249	134	817
Total Passed	145	191	249	365	214	1164
Percent of Top Ten		78.6	75.9	70.3	65.8	62.6 70.1

The NET performance of the candidates have stagnant around 20% which needs improvement (Table 4).

Table 4: Net Performance

Year	*Total Appeared*	*Qualified*	*Pass%*
2001	11,927	5906	49.5
2003	11,696	6386	54.6
2005	12,524	1760	14.1
2006	10,973	618	05.6
2007	10,070	2311	22.9
2009	12,403	2623	21.2
2010	21,165	4901	23.2

ARS examination and trying to improve the education. The NET performance of the candidates have stagnant around 20% which needs improvement (Table 4).

Major Concerns

The analysis of these results at every level and also at lateral level for the post of Senior Scientist and above shows some major concern which need to be addressed early for better human resource development.

1. Decline in ratio of vacancies to eligible candidates for ARS indicate that the quality of PG education in our SAU's, need improvement.
2. High degree of variation in SAU performance at every level shall develop skewed representation of human resource in ICAR which will loose the national character of this body. Harmonization of courses, syllabi and teaching standards need to be done.
3. Declining Inter – NARS movement is evident as scientists reluctant to move to University or to ICAR during their growth. This is an undesirable trend as no ideas shall come into NARS.
4. Lack of leadership at SAU and ICAR level shall create a vacuum in RMP positions which needs to be addressed and developed suitably.

Parting Thoughts

Education in the Land grant system is a precursor to other functions like, research and extension. In India, we are facing a crisis of both knowledge and education in agriculture. On one hand, we have shortage of a skilled and educated workforce due to educational lag, on the other hand, we are also facing a crisis of knowledge in terms of expansion, development and deployment. ASRB has experienced this in scientists recruitment over the years. We are not able to find nearly 50 per cent competent manpower for the scientific posts advertised regularly by ASRB through lateral entry. The gap between supply and demand of educated workforce in agriculture and allied sciences is growing widely as also in other sectors. It is a matter of concern to all of us. A large part of the problem is infrastructural and in terms of quality. In quantity, we are surpassing the expected requirements with more than 56 agricultural universities and allied fields. Universities are expected to generate knowledge, while colleges concentrate on teaching. Instead there is confusion between the two. Unfortunately, our system is focused not on the production and creation of knowledge but on the mass production of an educated workforce. If we are to become a knowledge – based economy then first thing we have to do is to encourage a culture of research and independent thinking rather than getting through examination. Do away with learning for the sake of learning and also not produce just decorated educated degree holders who are an unemployable mass. This is the outcome of a lack of quality. Can our universities do something for this? If our country is to reap the benefits from information society to knowledge – based society then we need to reform and stream – line our education system to enable the development and assimilation of knowledge. Knowledge and education are often confused as one and they are used interchangeably. Albert Einstein, Physicist extraordinaire aptly summed up the difference when he pointed out that "Education is what remains after one has forgotten everything he learned in school". Education is defined as "a process of teaching, training and learning to improve knowledge and skills". Knowledge on the other hand is the information, understanding and skills that one gains through education or experience. That is why this famous education; K = E+I (SU) has been elaborated by the knowledge commission for knowledge based economy. It is accepted fact that education is key to the store – house of knowledge. Therefore, for the knowledge – based society, there is need to reform and streamline education system to enable the development and assimilation of knowledge. The world is already at the brink of knowledge revolution as scientists are exploring and mapping

newer kinds of knowledge from bio to nano technology, gene to genomics, space explorations to GIS and Weather Satellite Accuracy. These inventions have tremendous scope in agriculture research, particularly from the point of application when these are moulded through innovations suited for specific situations.

Swami Vivekanand very rightly said that, 'education must make person enough knowledge rich as to able him or her to distinguish what is good and what is bad'. We call him truly **'Gyani'** internally

so that he/she is able to take correct decision for farming/livelihood, environment and for their generations. Food, nutrition, livelihood securities shall automatically come and society will have not to impose their ideas on them.

The power of knowledge has been long recognized organized by Indian Orientalist from vedic times:

अपूर्व कोपी को ोयम्।
विद्यते तव् भारती।।
व्ययतो व धदीम् आयाती।
क्षयम आयाती संचयात्।।

In simple language it is said that:

सरसुति के भन्डार की, बडी अपुरव बात।
ज्यों खरचे, त्यौं–त्यौं बढ़े, बिन खरचे घटी जात।।

Epilogue

A critical analysis of human resource availability in agriculture and allied sciences has thrown different kind of challenges before educators and education system. Horizontal growth is certainly demanded in agriculture that the sight of quality should not be lost. Let us not create unemployable mass not only for regular employment but also for the principal profession of farming. There are instances where the educated agricultural graduates have been rendered useless in farming because they never learnt practicals. This is a sad state of affair. However, there are islands of beauty and our HRD managers must see that such islands are replicated. ASRB's scientists recruitment over the last six years has been extremely useful in identifying these gaps in human resource, hence suggests that ICAR need to introduce visiting teachers or professors position who will devote to teaching. We have created enough infrastructure and positions for regular and retired persons for research and extension, why not now support education and teaching in future.

Knowledge Sharing for Agricultural Research and Development in India

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Introduction

The Indian Agriculture has registered a phenomenal growth during the last four decades. With net sown area hovering around 142 million hectares, country is sustaining food security for the population of 1.2 billion through continuous increase in agricultural and livestock production. The Indian Council of Agricultural Research (ICAR) has played a pioneering role in ushering Green Revolution and subsequent developments in agriculture in India through its research and technology development that has enabled the country to increase the production of food grains by 4 times, horticultural crops by 6 times, fish by 9 times (marine 5 times and inland 17 times), milk 6 times and eggs 27 times since 1950-51, thus making a visible impact on the national food and nutritional security. Currently, India accounts for about 12 percent wheat, 21 percent rice (paddy), 25 percent pulses, 10 percent fruits, 22 percent sugarcane and 16 percent milk of global production. This is being achieved from 2.3 percent of the global land, 4.2 percent of the water and little over 11 percent of arable land having only 50 percent potential for irrigation, to support 18 percent of world's population. The Council is leading the country in the area of agricultural research, education and extension through its wide network of 97 Research Institutes and 589 Farm Research Centres (Krishi Vigyan Kendra) covering all the rural district and two in large the districts. In addition, ICAR supports 47 Agricultural Universities (SAUs) in their region specific research and academic pursuits.

The Information and Communication Technology (ICT) is playing a key role in agricultural growth and development in the country by providing timely and useful information in a demand-driven mode. As a commitment to deliver cost-effective and production-oriented technologies for the welfare of farming community, the Council has adopted ICT based information dissemination system. There are considerable resources of knowledge and information in the ICAR system that can be harnessed for realizing full potential of technological interventions developed so far. Several ICT-driven information delivery mechanisms have been developed for quick, effectual and cost-effective delivery of messages. The e-connectivity of ICAR institutes has been strengthened and state-of-art data centre has been established to cater the ICT services and provide connectivity to various stakeholders. Around 200 Farm Research Centres have been provided e-linkage for establishing an interactive interface between farmers and scientists. The research journals have been made available in open -access mode for the benefit of students, researchers, farmers and various stakeholders belonging to national and global communities. The ICAR research journals are now free and online for submission of manuscript, review and downloading of articles. Web based knowledge dissemination, weather based agro-advisory and news updates are some of the important features of the user-friendly website. Use of database, expert system, decision support system and web based dissemination of knowledge, inter and intranet services, i-telephony and video conferencing are some of the major initiatives for knowledge sharing.

IT Based Interventions for Sharing of Knowledge

The ICAR website (www.icar.org.in): Developed by using an open source content

management system called DRUPAL, the website is a unique platform for sharing and dissemination of information to a wide range of users and stakeholders in agriculture sector. The News section is updated daily with inputs from the centres of National Agricultural Research System across the country. Interesting Success Stories of Indian farmers are presented weekly on the homepage of website to inspire and motivate farming community. The Weather Based Agro-Advisory developed by subject matter experts is also updated weekly for the direct use of farmers. The website provides links to international agricultural organizations and to ICAR library and other libraries of interest. A useful link connects the visitors to the global agricultural news released from various international agencies. More than 2.05,436 visits are recorded per month from 157 countries.

The ICAR research journals (The Indian Journal of Agricultural Sciences and The Indian Journal of Animal Sciences) are available in open-access mode and have been downloaded in 157 countries from a knowledge portal developed and hosted by the Directorate of Information and Publications of Agriculture (DIPA) of the Council. The online research journals provide facilities like registration for reviewer, author, reader and manuscript submission for publishing. The status of articles submitted may also be viewed (http://epubs.icar.org.in). A host of other useful publications including newsletters can also be viewed on the website. The Hindi (national language) version of the website is also available with regular updates. Around one lakh farmers/ visitors are making use of updated information on website every month. The website has proven its potential for sharing and delivering knowledge at national and global level.

Major ICT-initiatives

Realising the need to share and disseminate agricultural information and knowledge to a large number of stakeholders, several innovative ICT based interventions have been developed and being implemented across the country by public and private sector organizations. Of the 56 major and prominent ICT initiatives, some important ones require special mention due to their wide reach and impact on the target group. AGRISNET, a project sponsored by ICAR, is in operation across the country since 2002 targeting state/district agricultural and allied departments. Ministry of Agriculture and Ministry of Communication and Information Technology, Government of India are implementing several ICT initiatives independently and also in collaborative mode for various stakeholders in agriculture which include farmers, traders, suppliers and scientist as well. AGMARKNET, ASHA and GRC are some of the major and successful initiatives. At State level, Madhya Pradesh, Andhra Pradesh, Himachal Pradesh, Gujarat and Rajasthan have successfully implemented ICT models for dissemination of agriculture information in rural areas. Some other important ICT initiatives in India are: Village Knowledge Center (VKC) started by M.S. Swaminathan Research Foundation (MSSRF), Gyandoot Project (Dhar District in MP), Warna wired village project(Sangli & Kolhapur district of Maharastra), Ikisan (A.P.), Milk collection centres of dairy cooperative (AMUL, Gujarat) Tarahaatcom (Uttar Pradesh), Bhoomi (Karnataka) etc.

e-Kutir is an innovative approach to develop a eAgro business centre in which basic necessary agriculture services will be made available by connecting the rural farmers to existing islands of expertise, capabilities and markets. The low cost ICT interventions are being leveraged to develop affordable and integrated service centres involving rural institutions and communities.

Knowledge Help Extension Technology Initiative (KHETI) is a participatory ICT Solution developed and experimented with rural poor farmers. The system and its functionalities is speeding-up communications amongst various stakeholders especially agriculture specialists, farmer representatives and farmers. In KHETI, now with the help of mobiles, one could create Short Dialogue Strips (SDSs) using 6 images and 1.5 minutes voices on their queries, problems and other areas of interest. The system is generating knowledge bank and spreading it at large for wide usage, benefits and empowerment of the poor agriculture community.

Agropedia (http:www.agropedia.in) is a state-of-the-art, one stop shop for all knowledge, pedagogic or practical, related to Indian agriculture. It has a variety of content holders like a library (where the content is verified for its correctness), an open wiki, a blog, a forum; all of them semantically tagged using knowledge models. Knowledge models capture semantic relationships that exist between various terms in a domain and are useful search and inference. Agropedia has

developed 11 knowledge models and uses them for tagging and searching the repository objects. These knowledge models are universal in the sense they are not restricted to India and can be extended and adopted to any agro-climatic zone. The Agropedia website with over 1100 digital documents is being accessed by more than 600 users every day from more than 140 countries.

e-Granth has been launched with the objective to strengthen Digital Library and Information Management under NARS. The project is creating Online Public Access Catalogue (OPAC) under "Indian Agricultural Research Group Catalogue" of all 12 library resources with Online Computer Library Centre (OCLC) partnership, and is digitizing important institutional repositories (limited to IARI, IVRI, ANGRAU and UAS, Bangalore) including rare books and old journals and to make them available in open access.

In an initiative having far reaching impact the Government of India is providing internet connectivity in each block of the six identified states for knowledge sharing on agriculture and rural development scheme.

A centralised and secure state-of–the-art data centre is being established for providing e-mail and website hosting services for the whole ICAR system with 10,000 user nodes. It will provide inter, intra and extranet connectivity for information systems, databanks and financial management systems. The data on genomics would be stored and shared with stakeholders. The important area of Bioinformatics is being explored and utilized as it has multiple applications in agriculture which include generation of powerful databases, designing user-friendly software's, managing vast genome sequence data, functional genomics, molecular diagnostics and synthetic biology. A National Knowledge Network Project of Government of India has provided link to 9 ICAR institutes/ SAUs and rest of the institutes will be linked gradually to 100 mbps broadband. Video Conferencing and IP telephony facility has been established at 23 selected ICAR institutes connected on ICAR-ERNET network to facilitate real time communication.

A Consortium for e-Resources in Agriculture (CeRA) is providing free online access to 2600 journals from 8 publishers to 126 NARS libraries. The site is receiving an average of 45,000 hits and 27,000 download per month. It is providing a new and competitive research environment where the scientists will have greater access to quality research material and spend less time in literature search. e-courses in B.Sc (Agricultre), B.V.Sc & A.H, B.Sc. (Hort.), B.F.Sc, B.Tech. (Dairy Technology) have been developed. In addition content creation in 56 courses, 2 courses in multimedia and more than 2000 visual/animations/ videos have also been created. Keeping in view the importance of the doctoral dissertations in agricultural research, a digital repository, Krishi Prabha is digitizing dissertations produced in India to ensure online and offline availability.

The Council is a designated National Input Centre for AGRIS database of FAO since 1975 under the mutual co-operation agreement with FAO. The inputs/records are prepared as per the internationally accepted standards of indexing and abstracting and so far nearly one lakh bibliographic references have been added to the AGRIS. The indexing process has been decentralized and as a capacity building measure, in-house and out-station database indexing trainings are organized. So far about fifty personnel from ICAR institutions, SAUs, Professional Societies etc. have been trained in indexing for AGRIS.

Outreach programme: Video films depicting successful technologies were produced and telecast over National and Lok Sabha channel. Dedicated radio (AIR) and television (Doordarshan) programmes on agricultural technologies has been launched. With a view to reach various stakeholders in agriculture, which include policy planners and entrepreneurs, corporate films on ICAR and its institutes, have been developed.

Mass Media as Message Multiplier

The World Bank funded project was launched with a view to utilize different modes of communication in an integrated manner for accelerated and sustainable delivery of messages. Mass awareness and diffusion of agricultural technologies at ground level is the overall goal. In a bid to improve and strengthen media relations, 16 media meets and interactions were held in different centres of the project wherein more than 500 media persons from print and electronic media participated. This activity culminated into more than 947 newspapers clipping in regional/national media. AIR and TV programmes are also being facilitated by the project teams in which subject matter experts share their experiences and directly interact with the farmers. Video films and audio capsules on success stories of agricultural technologies and innovations of farmers have been

produced and ready for dissemination and telecast. Showcasing of ICAR technologies is an important activity of the project with ample opportunity to develop a direct interface with the technology users. So far 23 events have been arranged where more than 2,500 farmers/ entrepreneurs received first hand information on the technologies direct from the technology generators.

As an effort to strengthen capacity building of agricultural scientists for agricultural communication and knowledge management 83 scientists were exposed to the nuances of the knowledge management and agricultural communication at Indian Institute of Management, Lucknow and Indian Institute of Mass Communication, New Delhi.

The e-Farm Science Centers

The Farm Science Centres (FSCs) are being provided internet connectivity through V-SAT in a phased manner to develop these centres as one stop knowledge and resource centres of location specific agricultural technologies. Clearance for setting up of Community Radio Stations initially at selected centres has been provided to disseminate information on local market, weather advisory, disease forecasting and FAQs. A hub has been created at ICAR Hq., New Delhi to provide e-linkage to 192 Farm Science Centres and 8 Zonal Project Directorates located across the country which is being gradually expanded to reach the unreached. The e-linkage facility is expected to foster an enabling environment to FSCs for developing close and fruitful partnerships and collaborations between subject matter specialists of FSCs and also research scientists, extension workers and farmers for sharing and up scaling appropriate technologies, best practices and innovative ideas among all stakeholders. The facility is providing internet access to global e-content on agriculture and development of FSCs web pages with user-friendly information such as FAQs, weather forecasting, calendar of activities etc.

A two ways audio and video multicasting and broadcasting is further facilitating and strengthening communication bond between stakeholders. It will also provide computer generated agro-advisory alerts to mobile phone holder farmers and other stakeholders in the zone.

Software has been developed for on-line reporting and monitoring system for management of FSCs and ZPDs. The on-line reporting system is a part of 'Any Time FSC, which is an intranet service of Division's portal 'Wagon Wheel Windows'. It facilitates hassle free entry of data, planning and execution of various activities, hands free generation of various reports and serves as national repository of information on technology assessment, refinement and demonstration by the FSCs. Recently held first on-line training benefited around 500 staff of FSCs and ZPDs.

The Farmer Mobile Advisory Service

The Farmer Mobile Advisory (FMA) is a unique programme of information delivery for advising the farmers with need based timely information on mobile phone. Initiated by the Extension System of the ICAR, under this service every farmer receives messages on Tuesday and Friday, that is, two messages per farmer in a week. Thus, a farmer will get 104 messages in a year.

The FMA is being implemented in 300 FSCs which includes 192 e-linked FSCs. It is expected that total 60,000 farmers will be benefitted by the 8, 40, 000 SMS send by these FSCs. Further, it has been planned that out of 200 farmers selected under FMA programme, around 75% will be the farmers beneficiary and 25% extension officers engaged in the technology dissemination. FMA involves all the major stakeholders of the agriculture development i.e. experts, farmers and extension functionaries/NGO personnel. It is based on the linear model of communication which involves four major components of communication process i.e. Sender, Message, Channel and Receiver.

Information Products in Print

Council produces a wide range of information products in print mode to fulfil the knowledge needs of students, scientists, extension workers and farming community. With around 200 titles on the stacks, ICAR is the leading publisher of high quality agricultural literature in the Asia. Among periodicals, the research journals namely The Indian Journal of Agricultural sciences and The Indian Journal of Animal Sciences are highly indexed journals with subscribers and contributors from foreign countries. Popular magazines are demand-driven, competitive and attractive in content and style with a good subscriber base and rural penetration. Due to tie-ups with related organizations such as Rural Development, Panchayat Raj, IFFCO and others the magazines have a far and wide reach in the country. These

Information Products of ICAR

A. Periodical Publications	B. Non- Periodical Publications
Research Journals	Handbook Series
Indian Journal of Agricultural Sciences (M)	Text Books
Indian Journal of Animal Sciences (M)	Agri-pop series
Popular/ Semi Technical Periodicals	Popular Books/ Bulletins
Indian Farming (M)	Special Reports
Indian Horticulture (BM)	C. E-Products
Kheti (M) in Hindi	CDs/ DVDs on ICAR Technologies (Video Films)
Phal Phool (BM) in Hindi	Set of 7 CDs- Inventory of Indigenous Technical Knowledge (ITK) in Agriculture
Newsletters	CDs of Indian Horticulture and Indian Farming covering full text articles (1996-2006)
ICAR News (Q)	CD of ICAR Vision 2020
ICAR Reporter (Q)	CD of National Agriculture Research Database
ICAR Mail/ ICAR Chithi (M)	CD of All Indian Coordinated Research Project
Agbiotech Digest (M) in 13 Languages	CD of Digital Photo Library
Annual Publications	
DARE/ ICAR Annual Report	Rajbhasha Alok

are important and effective tools of knowledge sharing as all the stakeholders in the agriculture, including farmers, share their views on the platform. Among the newsletters Agbiotech Digest in 13 Indian languages is the latest addition launched for creating awareness on biotech issues across the country.

The Textbook series is popular among students and teachers due to explicit contents based on syllabus of agricultural universities. Currently, 16 titles are available covering a range of disciplines across agriculture and allied sciences. The Handbook series comprises the most authoritative and benchmark publications on the Indian agriculture providing latest knowledge with an eye on minute details. Among five titles in the Handbook series, The Handbook of Agriculture is the most celebrated publication with around two lakh copies reaching to users from diverse sectors and interest. The Agri-Pop series of publications has been launched with a view to impart knowledge at grass root level in popular style. Specialised and focused research reports are published to cater the specific need of researchers in various agriculture and allied sectors and are available in digital format as well.

Considering the importance of knowledge as critical input in agricultural research and development, the Government of India has launched several innovative plans cutting across different departments to enhance the penetration of internet and mobile phone connectivity along with very useful value added services. However, many challenges are also in the way, such as creation of rural ICT infrastructure, development of appropriate and farmer friendly content and maintenance of regular flow of information in interactive mode. Besides, language and climatic variability also pose challenge in development of location specific information, which is a key to agricultural development. The recent efforts made in this direction with active involvement and participation of all the stake holders raise hopes to fulfil the dream of a knowledge society without any digital divide. Whereas it is important to continuously strive to develop new and better technologies, their effective delivery mechanism would greatly help in bridging the wide gap between the potential and realized productivity. More far-reaching, participatory and ICT driven technology delivery systems would be evolved for effectively linking research with its stakeholders.

Ten Commandments for Illness to Wellness

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Indo-Gangetic civilization was well known for its elucidation on a code of conduct for good health and freedom from illnesses. Charaka Samhita and Susrutha Samhita forming the basic tenents of Ayurveda, Sidha and Yunani insisted on a clean body for a clean mind. The Chinese "chi" believes in dynamics of energy for a refreshing and vibrant health. Recently Master Zhi Gang Sha discovered the great soul healing technique to cure body from accumulated and static energy, the root cause of diseases and illnesses. Master Sha believes in the supremacy of energy transfer in the movement and flow of energy, vital for healthy body, mind and spirit. My exposures and experiences at the World Wellness Organization (WWO) spread all over the Globe lead to certain code of conducts-Ten commandments-for a man, family, community, society, region, state, nation, continent and the whole world to be free from fear, egoism, jealousy and ultimately to a level of bliss emanating from wellness. I summarise these ten commandments as follows:

1. Meditate and Exercise

In this modern world which values activity, achievements and results, it is perhaps surprising that more people are turning to meditation. For all the activities of modern society, many still feel a fundamental need for silence, inner peace and a moment of reflection. Meditation reduces stress and helps us relax. Meditation is one of the five principles of yoga. It is an important tool to achieve mental clarity and health. Research shows that meditation can contribute to an individual's psychological and physiological well-being. This is achieved as meditation brings the brain wave pattern into an alpha state, which is the level of consciousness that promotes the healing state. Studies show that regular exercise improves chances of living longer, improves quality of life, reduces the risk of heart disease, helps lower hypertension and high cholesterol and so on.

2. Eat Moderately - The Ideal

By eating more meals with smaller portions you will not feel as hungry or deprived in between meals because you know you are going to be eating again soon.

The most important part to understand about eating more meals is that it is not a license to "pig out". Your goal is to eat smaller meals consisting of nutritious food that will satisfy the needs of your body. If you use the plan of eating more meals as an excuse to eat more junk food like burgers, fries or high fat snacks then you are not going to lose any more weight than you would on a normal diet. If, instead, you plan your meals so that you are constantly eating a smaller portion of something nutritious like a piece of fish, fruit or vegetable, then you will start to notice that you are less hungry overall and you need less food to fill up at each meal.

Study Shows that Frequent Meals can Lower Cholesterol

A study published in the British Medical Journal found that people who ate six small meals each day had an average cholesterol level that was five percent lower than those who ate only one or two big meals each day. The study, conducted at the University of Cambridge, found that eating more frequently also lowered levels of artery-clogging LDL cholesterol. Researchers aren't exactly sure why their cholesterol was lower, but eating throughout the day may put you at a

metabolic advantage, keeping energy sustained throughout the day and avoiding large blood sugar fluctuations. To help you begin eating small, frequent meals/snacks throughout the day, consider these pointers:

1. Always start the day off with a high-fiber breakfast.
2. Spread your calories evenly among meals and snacks throughout the day. Don't let more than 4 hours go between meals and snacks (unless you're asleep).
3. Keep in mind that the most successful cholesterol-lowering strategies are to moderate total fat intake, cut back on high saturated fat foods (like marbled meats, butter, cheese, baked goods and fast foods), eliminate trans fats (from foods containing partially hydrogenated oils) and substitute these foods with mono - and polyunsaturated fats (canola, olive and other vegetable oils, nuts and seeds).
4. Portion control is key! Small, frequent meals mean just that - small, controlled portions.
5. Choose fresh fruits, vegetables, raw nuts and healthy snacks.
6. Drink plenty of water throughout the day.
7. Avoid snacking late in the evening; hold off snacking at least 3 hours before going to bed.

Focus on Fruits

Eat a variety of fruits. For a 2,000-calorie diet, you will need 2 cups of fruit each day (for example, 1 small banana, 1 large orange, and 1/4 cup of dried apricots or peaches). Noni juice is an amazing fruit juice that contains the entire thing you look for a healthy body and mind.

Vary your Veggies

Eat more dark green veggies like broccoli, kale and other dark leafy greens; orange veggies, such as carrots, sweet potatoes, pumpkin, and winter squash; and beans and peas, like pinto beans, kidney beans, black beans, garbanzo beans, split peas and lentils. These contain lots of Phytochemicals or nuetraceauticals, very much beneficial for keeping you healthy and fit. Noni is one fruit juice that contains the highest amount of Phytochemicals - more than 150 and above.

Make half your Grains Whole

Eat at least 3 ounces of whole-grain cereals, breads, crackers, rice, or pasta every day. One ounce is about 1 slice of bread, 1 cup of breakfast cereal, or ½cup of cooked rice or pasta.

3. Go Vegetarian

There are literally hundreds of great reasons to switch to a plant-based diet and here are a few reasons to become a vegetarian.

You will add colour to your plate. Fruits and vegetables come in all colours of the rainbow. Disease-fighting colourful phytochemicals are helpful to prevent many chronic diseases. So cooking by colour is a good way to ensure you are eating a variety of naturally occurring substances which boost immunity and prevent a range of illnesses. The correlation between meat consumption and a wide range of degenerative diseases is well founded and established. The average bone loss for a vegetarian woman at age 65 is 18 percent; for non-vegetarian women, it's double that. Researchers attribute this to the consumption of excess protein, the average meat-eating consumes. Excess protein interferes with the absorption and retention of calcium and actually prompts the body to excrete calcium, laying the ground for the brittle bone disease osteoporosis. Animal proteins, including milk, make the blood acidic, and to balance that condition, the body pulls calcium from bones. So rather than rely on milk for calcium, vegetarians turn to dark green leafy vegetables, such as broccoli and legumes, which, calorie for calorie, are superior sources. Fibre absorbs un-mantled, excess fats; cleans the intestines; provides bulk and aids in peristalsis. Plant food is high in fibre content. You will be more "regular." Eating a lot of vegetables necessarily means consuming fibre, which pushes waste out of the body. Meat contains no fibre. People who eat vegetables tend to have fewer incidences of constipation, hemorrhoids and spastic colon.

4. Drink 3 Litres of Water Every Day

Water, the most powerful healing substance known to man! The human body is primarily composed of water. Water is not only beneficial but also vital to life. Water plays an enormous role in how well our body functions. Simply put the more fresh water we drink, the healthier we become. Knowing all this, it never ceases to amaze me when I hear people saying they "forget" to drink

water. Would these people need a reminder to breathe? Water increases not only the quality but also the length of our lives!

5. Eat 3 Hours before Sleep

Have dinner 3 to 4 hours before going to bed. The reason being that your dinner stays in your duodenum, the first part of the small intestine for 4 hours (before moving onto the 2nd part of the small intestine). If you digest food closer to your bedtime it will result in a restless sleep pattern for you. Your stomach should not be too full, but not too empty. Wait at least three hours after dinner before going to sleep. Digestion doesn't work well while asleep. Hence the extra calories which are produced may deposit and make you obese. The digestion and assimilation during sleeping hour are slow thus hyperacidity or indigestion may happen if you go to bed after a heavy dinner.

6. Check your Words

What comes out' defines about your communication. Your each word coming from your lips makes a huge difference in how people respond to you Think before you speak:

"The least amount said is better in a disagreement."

You could hurt someone unknowingly with the words you speak or the way you say them. Once the words leave your mouth, it is impossible to take them back. It doesn't matter how unintentional they may be, words can sometimes cut a lot deeper than a sword. Very often you'll hear people say, "I didn't mean to hurt your feelings," well if you didn't want to hurt feelings why couldn't you be thoughtful before you let the unpleasant words escape your loose lips.

I found this quote from Mahatma Gandhi that is good guidance for where I am today:

"Keep your thoughts positive because your thoughts become your words.

Keep your words positive because your words become your behaviour.

Keep your behaviour positive because your behaviour becomes your habits.

Keep your habits positive because your habits become your values.

Keep your values positive because your values become your destiny."

7. Vibrate Love

Loving is a journey...never a destination! A tear will vanish and not the heart that created it. Loving is still wandering through the arteries of our society, but not as visible as it used to be. Love can make this earth a paradise. But now a days everybody has forgotten that 4 digits. Every where there is war, the war in between two countries, the war in between two cultures, the war in between two languages and even the war in our thoughts. War not only takes the life of many people but also takes the peace from inside of the person. We are wandering for and searching for "the peace". But how can we get peace where there is no love. Only we can get peace if we will vibrate love in each and every person. Without this we cannot make our self-peaceful, our society peaceful, our nation peaceful and a peaceful world. Love is the master key that opens the gates of happiness. It should be started from you itself. You must first learn to Love yourself before you can give Love.

Tips on How to Love Your Self:

1. Stop all criticism:
2. Don't scare yourself :
3. Be gentle, kind and patient:
4. Be kind to your mind:
5. Praise yourself :
6. Support yourself:
7. Be loving to your negatives:
8. Take care of your body:
9. Mirror work: Look into your own eyes often. Express this growing sense of love you have for yourself. Forgive yourself looking into the mirror. Talk to your parents looking into the mirror. Forgive them, too. At least once a day, say: "I love you, I really love you!"
10. Love yourself; Do it now: Don't wait until you get well or lose the weight, or get the new job, or find the new relationship. Begin now, do the best you can.

"Give your hands to serve and your hearts to love.'' - Mother Teresa

8. Live Gratitude

Want to know a simple way to increase your enjoyment of life 100 percent? Develop an attitude of gratitude! Thankfulness in the heart makes all

of the struggles and trials of life more bearable, and increases your joy in the good times. So how does gratitude work, and what are some things a person can do to build more of it into their life?

Religion often plays a role in developing gratefulness. If we acknowledge the benevolence of a higher power that gives us our health, food, ability to work, and even the air we breathe, it helps us realize that we are not really responsible for everything we have.

9. Care Mother Earth

Out of the earth we have come and to the earth we shall return one day! Different forms of creation arise from the earth and at the end, merge back with the earth, as waves in the sea, they are individual waves and yet a part of the sea. All life depends on earth and all life originates from earth. Earth is our God, our mother. She is the basis for everything; our happiness, our sadness are all directly linked to Mother Earth. Civilizations come and go and the earth goes on forever. WE BELONG TO THE EARTH. Bible says we came out of the dust and even dust is a part of the earth.

10. Live Stress Free

65 Tips for Stress-Free Living

1. Identify and live by your values.
2. Complete the Past.
3. Plan for the Future.
4. Live in the Present.
5. Understand that if you can dream it, you can achieve it.
6. Allow others to live their own lives.
7. Recognize God in everyone.
8. Create reserves where you need them.
9. Focus on being and not doing or having
10. Choose to be the best you possible.

Organize and Manage Your Time

11. Plan your day efficiently each morning and prioritize all the tasks.
12. Use mornings to complete "thinking" work, use afternoons to reply to messages and hold meetings
13. Don't procrastinate! Do the hard important tasks first which your mind is trying in vain to avoid.
14. Write tomorrow's to-do list at the end of today incorporating unfinished work, so that you can draw a line under today and truly leave work behind.
15. Remember Parkinson's Law: "Work expands so as to fill up the time available for its completion." Studies have shown that people still get the same amount of work done even if they leave work 2 hours earlier because they simply worked more efficiently, knowing it has to be completed.
16. Compartmentalize your life, don't take work home unless its absolutely necessary.

Nutrition - Nutrition - Nutrition!

17. Dramatically reduce or completely eliminate caffeine and high sugar foods from your diet (these substances simply mimic adrenaline and make you feel more stressed!)
18. Eat more fresh fruits and vegetables, at least 5 portions a day (reduces risk of serious illness)
19. Reduce intake of fatty foods, alcohol, and red meat
20. Drink lots of water (not other drinks) throughout the day - at least 3 - 4 litres per day
21. Take at least 30min break for lunch - you'll be more effective in the afternoon if you do
22. Remember, your body is a finely tuned system...you wouldn't put thick grease into your car instead of petrol would you, so why put it into your body!

Exercise the Stress Away (In fact any activity is good!)

23. Take 30 minutes of cardiovascular activity at least three times a week (reduces adrenaline levels in the body).
24. Timetable activity into your week, e.g. join a gym or an aerobics class, or simply go for a jog.
25. Think activity! Playing in the garden with the kids can be just as aerobic as going to the gym!
26. Try and do more things outdoors to get more natural light.

27. Regular exercise boosts feelings of well-being, and can increase stress-resistance
28. Exercise increases immune function - meaningless colds and other illnesses
29. It increases both sex drive and the pleasure gained from sex...isn't that incentive enough!

Learn to be a Chill Man!

30. Your brain needs to switch off and relax everyday to recuperate (not sleeping or watching TV!)
31. Truly relax for at least 20-30 minutes every day, e.g. go for a walk, massage, yoga, stretching, meditation; breathing exercises, visualization, etc. (call the clinic for more info).
32. Research shows that our concentration goes down to 0 after 60 minutes. Take a few minutes break every hour at work and you'll find you'll be more effective.
33. Compartmentalize your life once again, nothing is that important to keep you worried all the time.
34. Make a conscious decision to relax every-time you find yourself stressed - it's a good habit to learn!

Become Emotionally Intelligent

35. Recognize your own stress signals when you're feeling rushed...it is your mind and body telling you to slow down and sort something out, so make the effort to resolve the issue bothering you.
36. Fear is False Evidence Appearing Real! Learn to be more in control of your emotions.
37. Don't be victimized by angry outbursts! Allow your mind to calm down before addressing a conflict.
38. Analyze what regularly gets you stressed and keep a stress diary...start to do something about them and then you will realize that your stresses are easier to overcome than you first thought.
39. Talk to yourself! Give yourself advice on how to cope as if you were advising your best friend.

Keep Sleep Deep

40. Did you know that most people are working around with the symptoms of mild sleep-deprivation?! Most people need at least between 7-8 hours of sleep, and stress increases when we don't get this.
41. Set a sleep routine and hit the sheets earlier...you'll be more productive the next day for it.
42. Do not drink caffeine, as it can stop you from sleeping.
43. Do something relaxing before going to bed, not watching TV! Go to bed with a relaxed frame of mind, and if something is bothering you, write it down and resolve to sort it out the next day
44. Eat earlier in the evening, and make the evening meal the smallest of the day.
45. Try having fruits only in your dinner before sleeping.

See the Funny Side

46. Keep humour in everything that you do...if you take life too seriously your stress levels will be higher
47. Everyone's life is full of hassles and inconveniences, but it is the people who don't take these too seriously that can cope better and be more effective.
48. Laughter relaxes the body, increases immunity, gives you perspective and you take yourself less seriously.
49. Reframe your stressful situation...imagine how the situation would be handled on an episode of Friends.

Develop Stronger Bonds with Family and Friends

50. Research shows that risk of illness is higher in those who don't have a strong social support network.
51. Work towards making your family ties more positive and satisfying, connect with them more.
52. Good friendships can insulate you from the effects of stress, e.g. see more friends after work.

53. Share your problems with family and friends, who can give you guidance and support you emotionally...they are your therapists!

54. Develop a hobby which you can do with family or friends.

Learning to Let Go and Accept

55. Whenever you encounter a potentially stressful situation, accept it rather than pushing against it.

56. Say "So What?" Will this really matter in 5 years' time?

57. Become less attached to everything working out perfectly, learn to let go of perfectionism.

58. Live in the present, stop worrying about the past and the future.

59. Realize that you only learn and progress as a person when you have difficulties to overcome...would a baby ever learn to walk if it didn't fall over quite a few times?

60. Research shows that we all need some kind of life philosophy in order to function effectively as human beings, and to feel fulfillment from life. Learn more about different philosophies and ways of life and see if anything appeals to you: spirituality, humanism, eastern philosophy, religion etc.

Plan Your Life

61. Studies show that we spend longer planning our holidays than we do planning our career and our lives.

62. If you don't plan your life/career, it's like continually changing trains at different stations but not knowing your destination.

63. Clarify your values and attitudes - what is really important to you in life?

64. Ask yourself questions like, "How would I like people to remember me in life" "What would I like to have accomplished in my life?", "When will I be happy?" and "What would I do if I had a year to live?"

65. Once you have established your values and goals in life, start planning your life!

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Fruits and Vegetables as Food and Medicine

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Introduction

Food is a source of energy required for sustenance of life, growth and maintenance of tissues and organs and its function. Plants are one of the primitive forms of life that came into existence on this earth before man. And ever since man plants have been a source of food.

Foods can be broadly classified into energy foods and protective foods. While energy is required for all bodily functions, protective foods confer a degree of resistance against diseases, correct some disorder and prevents occurrence of certain conditions due to deficiency of some elements and phytochemicals.

Importance of Fruits & Vegetables in Diet

Fruits and vegetables are one of the greatest gifts - Nature has bestowed on the man-kind. Most of the fruits contain 75-80% moisture and 18-19% carbohydrates without much fats and proteins. Besides minerals and vitamins, the essential phytochemicals are available in fruits. Every fruit has its richness in one or the other phytochemical which provides protection against diseases or helps in fighting against pathogens. Most of fruits contain iron, calcium and vitamin 'C', essential for our body, in correct proportions. Tomatoes and citrus fruits contain vitamin 'C' in abundance. All the yellow and red coloured fruits have high quality vitamin 'A'. Freshly plucked fruits contain acids, minerals, fibres and vitamins that soften the chyme (partially digested food in the small intestine) and help in evacuation so that constipation is avoided. The fibre helps in removing toxins and purify the blood. It helps in expelling the germs and rejuvenating the body. Some chronic diseases can be cured by eating certain fruits. Maximum health benefit of fruits can be achieved by consuming them fresh. Certain kind of diseases occur due to deficiency of nutrients while sometimes it may be due to its non-bioavailability. Fruits are rich in variety of antioxidants like carotenes, lycopene, anthocyanins, ascorbic acid, phenols, tannins, besides many more phytochemicals yet to be identified which, as crude extracts, have exhibited their protective property. The common diseases of man due to deficiencies of nutrients are listed on the next page.

Predisposing factors for Diseases

A balanced diet having essentially fruits and vegetables would take care of many of the disease conditions. However, lifestyle and diet are the two most important phenomena which are responsible for modern day diseases. Sedentary lifestyle has become the hallmark of modern man. Hence the requirement of energy for physical work has reduced while calorie consumption has increased resulting in lifestyle disorders like obesity, diabetes, hyperlipidemia, etc. Food habits have attained a level of fashion displaying its association with social status and modernity. Eating has become a pleasure rather than satisfying the hunger.

As the popular saying goes, **WE ARE WHAT WE EAT**. There is substantial evidence that changes in diet are responsible, in part, for the diseases that have emerged as dominant health problems in industrialized countries over the past century. Cross-country epidemiological studies have consistently demonstrated a difference in the prevalence of coronary heart disease, hypertension, diabetes and some types of cancer (Neel *et al.* 1998; Bingham 2000; Zimmet *et al.* 2001), which are related to differences in diet. These diets are usually monotonous and very restricted, lacking in fresh

Nutritional Deficiency and Its Symptoms

Nutrient	*Incidence of Deficiency*	*Typical Symptoms and Diseases*
Biotin	Uncommon	Dermatitis, eye inflammation, hair loss, loss of muscle control, insomnia, muscle weakness
Calcium	Average diet contains 40 to 50% of RDA	Brittle nails, cramps, delusions, depression, insomnia, irritability, osteoporosis, palpitations, periodontal disease, rickets, tooth decay
Chromium	90% of diets deficient	Anxiety, fatigue, glucose intolerance, adult-onset diabetes
Copper	75% of diets deficient; average diet contains 50% of RDA	Anaemia, arterial damage, depression, diarrhoea, fatigue, fragile bones, hair loss, hyperthyroidism, weakness
Essential fatty acids	Very common	Diarrhoea, dry skin and hair, hair loss, immune impairment, infertility, poor wound healing, premenstrual syndrome, acne, eczema, gall stones, liver degeneration
Folic acid	Average diet contains 60% of RDA; deficient in 100% of elderly in one study; deficient in 48% of adolescent girls; requirement doubles in pregnancy	Anaemia, apathy, diarrhoea, fatigue, headaches, insomnia, loss of appetite, neural tube defects in foetus, paranoia, shortness of breath, weakness
Iodine	Uncommon since the supplementation of salt with iodine	Cretinism, fatigue, hypothyroidism, weight gain
Iron	Most common mineral deficiency	Anaemia, brittle nails, confusion, constipation, depression, dizziness, fatigue, headaches, inflamed tongue, mouth lesions
Magnesium	75 to 85% of diets deficient: average diet contains 50 to 60% of RDA	Anxiety, confusion, heart attack, hyperactivity, insomnia, nervousness, muscular irritability, restlessness, weakness
Manganese	Unknown, may be common in women	Atherosclerosis, dizziness, elevated cholesterol, glucose intolerance, hearing loss, loss of muscle control, ringing in ears
Niacin	Commonly deficient in elderly	Bad breath, canker sores, confusion, depression, dermatitis, diarrhoea, emotional instability, fatigue, irritability, loss of appetite, memory impairment, muscle weakness, nausea, skin eruptions and inflammation
Pantothenic acid (B5)	Average elderly diet contains 60% of RDA	Abdominal pains, burning feet, depression, eczema, fatigue, hair loss, immune impairment, insomnia, irritability, low blood pressure, muscle spasms, nausea, poor coordination
Potassium	Commonly deficient in elderly	Acne, constipation, depression, oedema, excessive water consumption, fatigue, glucose intolerance, high cholesterol levels, insomnia, mental impairment, muscle weakness, nervousness, poor reflexes
Pyridoxine (B6)	71% of male and 90% of female diets deficient	Acne, anaemia, arthritis, eye inflammation, depression, dizziness, facial oiliness, fatigue, impaired wound healing, irritability, loss of appetite, loss of hair, mouth lesions, nausea
Riboflavin	Deficient in 30% of elderly Britons	Blurred vision, cataracts, depression, dermatitis, dizziness, hair loss, inflamed eyes, mouth lesions, nervousness, neurological symptoms (numbness, loss of sensation, “electric shock” sensations), seizures. sensitivity to light, sleepiness, weakness
Selenium	Average diet contains 50% of RDA	Growth impairment, high cholesterol levels, increased incidence of cancer, pancreatic insufficiency (inability to secrete adequate amounts of digestive enzymes), immune impairment, liver impairment, male sterility
Thiamin	Commonly deficient in elderly	Confusion, constipation, digestive problems, irritability, loss of appetite, memory loss, nervousness, numbness of hands and feet, pain sensitivity, poor coordination, weakness
Vitamin A	20% of diets deficient	Acne, dry hair, fatigue, growth impairment, insomnia, hyperkeratosis (thickening and roughness of skin), immune impairment, night blindness, weight loss
Vitamin B-12	Serum levels low in 25% of hospital patients	Anaemia, constipation, depression, dizziness, fatigue, intestinal disturbances, headaches, irritability, loss of vibration sensation, low stomach acid, mental disturbances, moodiness, mouth lesions, numbness, spinal cord degeneration
Vitamin C	20 to 50% of diets deficient	Bleeding gums, depression, easy bruising, impaired wound healing, irritability, joint pains, loose teeth, malaise, tiredness.
Vitamin D	62% of elderly women’s diets deficient	Burning sensation in mouth, diarrhoea, insomnia, myopia, nervousness, osteomalacia, osteoporosis, rickets, scalp sweating
Vitamin E	23% of male and 15% of female diets deficient	Gait disturbances, poor reflexes, loss of position sense, loss of vibration sense, shortened red blood cell life
Vitamin K	Deficiency in pregnant women and newborns common	Bleeding disorders
Zinc	68% of diets deficient	Acne, amnesia, apathy, brittle nails, delayed sexual maturity, depression, diarrhoea, eczema, fatigue, growth impairment, hair loss, high cholesterol levels, immune impairment, impotence, irritability, lethargy, loss of appetite, loss of sense of taste, low stomach acid, male infertility, memory impairment, night blindness, paranoia, white spots on nails, wound healing impairment

fruit and vegetables, and containing large amounts of fat and refined carbohydrates (Gracey 2000). Now a consensus has been reached which suggests that a predominantly plant-based diet rich in fruits and vegetables, pulses and minimally processed starchy staple foods reduces the risk for development of these diseases significantly.

One of the most important messages of modern nutrition research is that a diet rich in fruits and vegetables protects against dreadful diseases like cancer. The **greatest** message is that this same diet protects against almost all other diseases, too, including cardiovascular disease and diabetes. There are many mechanisms by which fruits and vegetables act as protective, and an enormous body of research supports the recommendation for people to eat more fruits and vegetables.

Modern Theory of Disease Development

Modern scientific research under *in-vitro* and *in-vivo* using latest equipments and gadgets has helped us in exploring the hidden mechanisms of disease and death processes. Oxidative stress has been reported to be responsible for development of most of the modern lifestyle disorders and diseases. Reactive oxygen species or free radicals are involved in oxidative stress. Reactive oxygen species (ROS), such as hydrogen peroxide, superoxide and hydroxyl radical are products of oxygen metabolism in all aerobic organisms. ROS are generated as a result of energy production from mitochondria (from the electron transport chain), as part of an antimicrobial or antiviral response, as well as detoxification reactions carried out by the cytochrome P-450 system. Environmental agents such as ultraviolet light, ionizing radiation, redox chemicals and cigarette smoke also readily generate ROS. The antioxidant defence system in most cells is composed of two components, the antioxidant enzymes component which includes enzymes such as superoxide dismutase, catalase and glutathione peroxidase, and the low molecular weight antioxidants component that includes vitamins A and E, ascorbate, glutathione and thioredoxin. These substances are the body's natural defence against endogenous generated ROS and other free radicals, as well as ROS generated by external environmental factors. Oxidative stress occurs when the production of ROS exceeds the body's natural antioxidant defence mechanisms, causing damage to biomolecules such as lipids, proteins and DNA (Gordon, 1996).

Oxidative stress has been thought to contribute to the general decline in cellular functions that are associated with many human diseases including Alzheimer disease, amyotrophic lateral sclerosis (ALS), Parkinson disease, atherosclerosis, ischemia/reperfusion, neuronal injuries, degenerative disease of the human temporomandibular-joint, cataract formation, macular degeneration, degenerative retinal damage, rheumatoid arthritis, multiple sclerosis, muscular dystrophy, human cancers as well as the aging process itself.

How Fruit and Vegetable Based Diet Helps in Fighting Diseases?

When the oxidative stress is acute, an external supplementation of antioxidants (both water-soluble and lipid-soluble) can reduce the damage caused due to ROS and free radicals. There are many substances that are protective in fruits and vegetables, so that the entire effect is not very likely to be due to any single nutrient or phytochemical. Steinmetz and Potter (1996) listed possible protective elements : dithiolthiones, isothiocyanates, indole-32-carbinol, allium compounds, isoflavones, protease inhibitors, saponins, phytosterols, inositol hexaphosphate, vitamin C, D-limonene, lutein, folic acid, beta carotene (and other carotenoids), lycopene, selenium, vitamin E, flavonoids, and dietary fiber . The most important mechanism by which these antioxidants act is likely to be by free radical scavenging in which the polyphenols can break the free radical chain reaction [de Groot and Rauen, 1998]. A number of studies have been carried out on the structure and activity of flavonoids (Formica and Regelson, 1995) and their role in disease prevention.

Since the mid 1980s, numerous studies have shown the relation between colorectal cancer and consumption of fruit and vegetables. The hypotheses as to how fruit and vegetable intake may reduce the risk of colon or rectal cancer are numerous and involve independently or additively the many potential anti-carcinogenic compounds found in fruit and vegetables (eg, fiber, carotenoids, vitamin C, folate, glucosinolates, and allium compounds) (Millen *et al*, 2007).

It is becoming clear that there is a relationship between antioxidants in a diet and immune functions. The antioxidants prevent the lipid peroxidation by preventing the loss of membrane fluidity which in turn determines much of the protective functions of immune cells (Middleton, 1998). The carotenes protects the immunity due to



its capacity to quench antioxidants and single oxygen [de Groot and Rauen, 1998]. Polyphenols, another antioxidant, acts by effectively scavenging free radicals. Recent studies have shown that flavonoids and polyphenols derived from fruits, avoid lymphocyte proliferation and IL-2 production. The prevention of proliferation of lymphocyte is associated with the inhibition of protein kinase C (PKC) activity, which is involved in cellular signal transduction.

Most of the phytochemicals in the fruits and vegetables helps in disease prevention through mechanism related to antioxidant activity, modulation of detoxification enzymes, stimulation of the immune system, decreased platelet aggregation, alterations of cholesterol metabolism, modulation of steroid hormone concentrations, hormone metabolism, blood pressure reduction, antibacterial and antiviral activity.

Traditional dietary recommendations were based on preventing nutrient deficiency disorders. Future recommendations also must take into account prevention of degenerative disease and slowing of the ageing process, caused by damage to nuclear and mitochondrial DNA (Tait, 2003). This is possible only by including liberal amounts of fruits and vegetables in our daily diet. It not only fills the belly and prevents us from overeating but also protects the body from diseases.

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Health Promoting Phytochemicals in Vegetables

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Introduction

"Let Food be thy Medicine and Medicine be thy Food" advised by Greek Physician approximately 400 BC. The history of human civilization is replete with instances of different cultures identifying foods and other natural materials that could correct disease state and maintain health. The term functional food emerged as rigorous research on food and its relationship with human physiology and biochemistry there by conferring protection against a range of chronic diseases as well as industrialization of food of the late 1990s. Functional foods are ones in which concentration of one or more ingredients have been manipulated to enhance their contribution to a healthful diet. There are many families of functional food and they help body in varieties of ways. Some of them block vital metabolic pathway that are associated with the development of chronic diseases while others stimulate protective enzyme system. Two major subset of functional food are phytochemicals and zoo-chemicals. Phytochemicals are naturally occurring non-nutritive plant chemicals that have protective or disease preventive properties. Vegetables contain wide range of phytochemicals.

Chronic Disease and Vegetable Phytochemicals

Scientific findings during the last few decades demonstrate strong positive correlations between the dietary intake of phytochemical rich vegetables and the prevention of major diseases. Certain vegetable groups have been shown to protect specific type of cancer. Crucifers has been shown to protect lungs and chemically induced cancer. Alliaceae protect against stomach cancer. Based upon overwhelming evidence American Heart Association has concluded a diet high in vegetables may reduce the risk of cardio vascular disease in human. In addition of cancer and cardiovascular disease, a diet with high vegetables has been linked to reducing diabetes, rheumatoid arthritis, macular degeneration and gastric ulcer. Based on the above mentioned fact, ICMR recommended consumption of 300 g vegetable for maintenance of better health.

Glucosinolate

Cole crops, mainly cauliflower, cabbage, knolkhol, broccoli, brussels sprout, kale, radish, horse radish are principle sources of glucosinolate. Invitro and *in vivo* studies have reported that isothiocyanate affect many step up cancer. Epidemiological data show that a diet rich in crucifer can reduce several type of cancer and risk can be significantly reduced by an intake of as little as 10 g per day. However, intact glucosinolates have no biological activity against cancer, the breakdown product have been shown to stimulate mixed-function oxidases involved in detoxification of carcinogens. This break down takes place through the action of endogenous myrosinase enzyme that is released by disruption of the plant cell through harvesting, processing and mastication. However these tissues are cooked or steamed the enzyme are completely inactivated. It has been suggested that micro flora present in the stomach is capable of converting glucosinolate to active compound. The different hydrolysis products of Glucosinolate are Sulphoraphane, indole-3-carbinol, allyl-isothiocyanate, phenyl-isothiocyanate produced from Glucoraphanin, Glucobrassicin, Sinigrin, Gluconasturtin respectively.

Lycopene

Lycopene is unsaturated carotinoid lack of b-ionone ring structure responsible for no vitamin A activity. Tomato and water melon are two important source of lycopene. Besides these two, carrot and *Momordica chochinchinensis* are also potential source of lycopene. Cherry type tomato contain higher amount of lycopene than normal tomato. Processed tomato product contains 2-40 times higher amount of lycopene. The consumption of tomato and tomato product containing lycopene has been shown to associate with lower risk of cancer and cardiovascular disease. Disease preventing mechanism of lycopene is due to its strong free radical quenching activity. Scientific investigation revealed that high amount of lycopene intake is associated with reduce risk of prostate cancer.

Phenolics

Among the major phytochemicals present in vegetables phenolics in particular have received renewed focus. This is due to strong antioxidant properties exhibited by chelating metal ions, inhibiting lipid oxidation, inhibiting radical forming enzyme or quenching free radicals. Polyphenols reduces the risk of cardiovascular, cerebrovascular and peripheral vascular diseases. A more recent area is the emerging role of polyphenolic compounds in the treatment of neurodegenerative diseases, such as Alzheimer's and Parkinson's diseases. In this context phenolic and flavonoids assumed the status of "Guardian of Health" and are being commonly referred as "Star Nutrient of the Millennium".

There are classified into four major groups, Anthocyanin, Flavonoids, Flavones and Isoflavone. Flavonoids are largest group of phenolics present in vegetables. Important source of these phenolics are presented in table-1.

Table 1: Common source of polyphenolic compound in vegetable

Phenolic group	*Principle source*
Anthocyanin	Purple cabbage, Purple Broccoli, Brinjal, Sweet Potato, Rhubarb, Radish, Carrot, onion
Flavonoids	Onion, Lettuce, Endive, Horsh radish, Tomato, Bean.
Flavones	Celery, Tomato, Brinjal, Garlic, Onion.
Isoflavone	Soybean, Pea, Chick pea, Broccoli, Asparagus, Alfalfa, okra.

Thiosulphides

Thiosulphides are organo-sulfur compounds mainly found in onion, garlic, shallot, chive, leek etc. Alliin, Methiin, are major thiosulphides in intact tissue of *Allium* species. Thiosulphides are highly unstable. When the tissue are cut, chewed, cytosolic allin is rapidly lysed by vascular enzyme alliin lyase or allinase into highly unstable diallyl thiosulphinate (Allicin) which is again converted into alkyl alkane thiosulphinates. These compounds are related to reducing cancer mainly stomach cancer, cardiovuscual disease. Thiosulphides reduces cholesterol and other fatty acid synthesis, prevent lipid peroxidation of LDL, enhance fibrinolysis and improve fluidity of erythrocyte, increase antioxidant status and inhibit angiotension converting enzyme. Thiosulphides have also been shown to stimulate the immune system, by activating T cell proliferation and reducing blood glucose level in diabetes by stimulating insulin secretion by the pancreas.

Lutein

Lutein is nonprovitamin A Xanthophylls which is transported by lipoprotein and selectively accumulated in macular region on retina. In that region it absorbs blue light, quench photochemically induce singlet oxygen and prevent our eye from photo oxidation. Thus lutein protects the lens and macula from development of cataract and age related macular degeneration. Vegetables are good source lutein particular leafy vegetables. Principle lutein rich vegetables are Kale, Parsley, Spinach, Broccoli, Collard other green leafy vegetables.

Dietary fibre

Dietary fibre is the edible plant or animal material not hydrolyzed by the endogenous enzymes of the human digestive tract. Intake of dietary fibre is associated with reduction of cholesterol, increasing stool bulk, attenuating glyceimic and in insulin response and improving laxation. Based upon fermentability dietary fibers are classified into two major groups: partially fermented and low fermented. Vegetables are good source of well fermented dietary fiber are chicory, onion, jerujalem artichoke, guar where potato, corn, legume good sources of partial or low fermented dietary fiber.

Selenium

Interest in selenium as a phytochemicals has increased dramatically in the last three decades as a results of several studies that demonstrated that increased risk of disease with low selenium intake. Two important vegetables are rich source of selenium broccoli and garlic when grow on high selenium rich soil. In plant tissue selenium is present as selenomethionine and selenocystein. Selenium is integral part of selenoprotein like glutathion peroxidase, iodothyronine diodinase which protect our body from oxidative damage. Deficiencies of selenium lead to two severe disease keshan disease and keshan-beck disease.

Folate

Another important phytochemical that have been linked to improved human health are the folates (Folic acid and tetrahydrofolate). Folates are involved as cofactor in carbon transfer reactions in DNA biosynthesis. In vegetables major source of folates are broccoli, brussels sprout and potato. Deficiency of folates is lead to neural tube defect - spina bifida in foetus and neurotoxicity, cognitic defect, colon cancer risk.

Saponine

The major saponins are found in vegetables are cheratins which have hypoglycemic properties or other action of potential benefit against diabetes mellitus. Bitter gourd is the sources of cheratins. Other hypoglycemic compounds found in bitter gourd which have same property are Insulin like peptide and alkaloids. These compounds prevent glucose absorption from intestine, regenerate insulin producing cell and potentiate the effect of insulin and thus prevent diabetes.

Phytosterol and Stanol

Phytosterol and stanol are alcoholic derivatives of cyclo pentano perhydro phenanthrene and essential constituent of cell membrane. Over 40 plant sterol identified b-sitosterol, compesterol, stigmasterol are most abundant. Among vegetables soybean and sweet corn are good source of phytosterol and stanol. They reduce blood cholesterol by inhibiting cholesterol absorption and thus prevent cardiovascular disease.

Conclusion

Naturally occurring phytochemicals have potentiality to overcome growing problem of non-communicating diseases like cancer, cardiovascular disease, alzeimer, diabetes and so on through there multiple health promoting function. Vegetables are rich sources of different kinds of phytochemicals with specific health benefit. Some of the vegetable are major source of more than one phytochemical. However the benefit of these phytochemical sometime achieved through releasing of bioactive compound through enzymatic action by tissue damage. In some cases processing improved the phytochemical content and bioavailability.

Section – II

Economic Development

Dynamics of Horti-Business Linking the Farmers with Market

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Horticulture, covering wide range of crops, has emerged as an important sector for effective land use planning, and improving the farm income besides ensuring nutrition and healthcare. The horticulture is now looked for food, nutrition and healthcare, and the country has recorded impressive growth, and there is an enhanced farm income as well as better employment. This has been possible due to technology adoption and policy environment for the development. However, incomes to the farmer are volatile because of number of unforeseen factors, like weather, pest and disease outbreak and marketing which necessitate the effective management of both production and marketing. To ensure the better price to farmers, many initiative have been taken by the Government i.e. alternate marketing, reforms in APC regulation, setting of modern exchange, trade guarantee fund, back-end computerization online trading but bulk of farmers, who are small and marginal require finance immediately after harvest. Therefore, there is a need for linking the farmers with market which should have facilities for technical advice for growing as per consumer's need, infrastructure for grading packing and storage and information to move to the choice of market. If risk of price fluctuation and value for the produce is ensured, farmers will be encouraged to use inputs and adopt technologies leading to higher production and surplus for market.

Since, most of horticultural produce are perishable, and seasonal in nature, high price uncertainty is noticed. Suddenly, during the harvest prices drop due to excess supply, but prices rises sharply in season of reduced supply. Hedging is possible and various mechanisms for enhancing farmers profitability has been tried which primarily include contract farming, creation of *Apni Mandi's* where farmer's can sell their own produce and off late in transit market system, which has backward and forward linkages. These efforts have been successful in enhancing farm profitability, but there is need for enhanced linkages of farmers with market which can be direct marketing or indirect marketing. This will require appropriate production system, choice of varieties as per need of consumer, post harvest handling and finally consumer acceptance. Since health conscious population is growing, ample opportunities are also increasing for farmers who have been nurturing horticulture scientifically.

Natinal Secnario of Horticulture

Area, production, productivity, availability and export of horticulture have increased manifolds, which provided ample opportunities for utilization of waste lands, employment generation and effective land use planning. Diversification, recognised as one of the options for improving land use planning has dramatic impact. The technology-led horticulture has shown impressive impact on production, productivity and profitability of all horticultural crops. The production of horticultural produce has jumped 8 times from the level of production during 1950-51. Currently, the total production of horticultural produce is 231.6 million tonnes from the 9% of the total cultivated area in India, which contributes 30.4% in value term to GDP of Agriculture (Fig. 1) and the trend of development, has been marked as "Golden Revolution". But there is a growing demand for horticultural produce both in domestic and overseas markets, and, at the same time competition is also increasing. During the last two decades, the production of horticultural produce

has increased manifold but the gap in demand and supply continues. However, with declining land and water and with a threat of climate change, there is rising concern for meeting the growing requirement.

The diversification through horticulture has proved best option for the farmers to meet the need for food, nutrition, health care besides providing better returns on farm land and employment. The technology which transformed the horticulture are genetic resource management (72,794 accessions) and development of new cultivars (1796 cultivars), use of *in-vitro* propagation, micro irrigation, plant architectural engineering and management and health care using diagnostics, root stock and value addition and on farm processing and protected cultivation of high value crops.

General Feature of Marketing

Farmer's marketing practices and evolution of marketing system is guided by the shelf life of the commodity. Horticultural crops are primarily perishable and high in volume, thus need a definite market decision and practices for careful and timely disposal. Owing to the changing needs and increase in marketed surplus and need to make these available in the off season and at places other than production. careful harvesting, handling, storage, transportation, packaging, grading and processing are required to be performed either by farmers or by market functionaries. The marketing system, apart from performing physical and facilitating the transfer of the farm produce from farms to the consumers and farms inputs from manufacturers to the farmers, also performs the functions of discovering prices at different stages of marketing & transmitting the price signals all along the marketing chain including to the farmers. The structure and framework of agriculture/ horticulture marketing in India has undergone several changes during the last three decades owing to increase in the output of horticultural commodities, marketed surpluses; increased urbanization coupled with spendable income levels, which demand for diversified horticultural products.

Dynamics of Markeing

At the time of independence, marketing system for agriculture/horticulture produce was in the infancy stage, and the production, by farmers, was to meet the family needs. Farmer's –producers used to exchange the surplus left with them for meeting family needs. Later on due to technological adoption and developmental efforts by the Government, farm production and marketed surplus increased manifold. The concept of production for home shifted to production for market. Further specialization in production increased and farmer's become price conscious and as a consequence marketing aspect started receiving attention. Regulation of marketing system in the country brought changes in marketing and in marketing practices. The marketing channels such as direct to consumers, through wholesalers and retailers, through public agencies or co-operatives and through processors came into existence. With the time, there has been conspicuous change in the type of middleman existing in the marketing system over time expect that the role of processors has increased the demand for processed horticultural products in packed form. Today in the consumer driven market, public and co-operative agencies have emerged in the marketing chain. With the changing scenario, the instrument based marketing system has to make headway. Therefore, marketing system provides important linkage between the farm production sector and the non-farm segment of the economy and plays a critical role in improving the economic conditions of farming community and converting the subsistence economy into a dynamic and rapidly growing economy.

Status of Marketing of Horticulture Crops

Horticultural crops are highly seasonal and perishable and capital and labour intensive requiring additional care in handling and transportation. Being high in volume and perishability, horticultural produce lead to huge post harvest losses in handling and transportation, the estimates of which range anywhere from 10 to 18% of the harvested produce each year. Their seasonal production pattern results in frequent market gluts and associated price risk, thus forcing the farmers into distress sale to pre-harvest contractors and commission agents. Marketing network for horticultural crops thus involves a number of intermediaries like the pre-harvest contractors, commission agents, wholesaler, retailer operating between the producer and the final consumer. Each of these market intermediaries performs a specific market function of assembling or distribution that involves a cost to them, there by each claiming a share in the market margin.

Though, it is said that an efficient market provides for the distribution of market margins in proportion to the task performed by each market intermediary, it is seldom so. The price spread along the marketing channel is directly proportional to the number of market intermediaries involved along the channel. In a market function, the physical movement of the produce is along the chain, while the monetary and information flow is in the reverse direction. It is the access to information that empowers a market intermediary to bargain or take away a larger share in the marketing margin. Most of the fruits being voluminous and highly seasonal are sold through the Pre-Harvest Contractor (PHC) at the field much before they come to harvest. Very often, the PHC takes most of the production risks due to pests and diseases and also the cost of maintenance, while he makes his margin through bulking. Vegetables, barring cabbage and cauliflower, are mainly sold through the commission agents at the market, who intern transports the produce to the distant markets and makes his margin, while traditional flowers are self marketed at the wholesale auction centres.

Market Information on Essential Component

In a typical market operation, each one of the market intermediary contributes by way of either a transfer function or an assembly function. In this process, each one tries to optimize their risk and maximize their margin. The distribution of market margin depends purely on the access to information and the strategy that is being adopted in forwarding the trade. The primary focus therefore is to increase the accessibility to information by all the market intermediaries so as to enable a level playing ground for them. Such an increased access to market information is expected to bring about the market regulation automatically there by reducing the monopoly power of any single market intermediary. Therefore, the main effort so far in the market regulation activity has been to create marketing infrastructure, such that it enhances the access to market information, besides the enactment of market regulation acts and market interventions whenever required.

Chnging Phase of Markets

Horticulture, with its wide array of crops is key sector of the Indian economy that has been recognized for its potential for assured livelihood support. The multifold enhancement of budgetary allocation by the Government of India to this sector with every passing plan since the VIII plan period amply highlights the growing significance of this sector. The sector's performance in terms of increased production and productivity, expanding export earnings are suggestive of high growth, while some of the micro level indicators such as the unit value realization of the commodities in export earnings, proportionate share of producer in consumers' rupee for a number of perishable commodities show signs of stagnancy. This is especially so with regard to linking producers to markets, with the persisting domination of market intermediaries like the pre-harvest contractors and commission agents in the trade of horticultural crops. In contrast, changing institutional and infrastructural interventions through public and or private investment into R&D and marketing have shown signs of successes in pockets. In the anticipation of growing inflow of FDI into agricultural wholesale/retail marketing in future and its associated objective of linking farmers to markets, it is of significance to review status and prospects of various initiatives into the arena of linking farmers to markets involving horticultural crops.

Eefforts At Linking Farmers to the Merkets

Linking farmers to markets and to processors has been a well recognized means of augmenting seasonal gluts and associated price crash, especially for perishables. However, the linkage between producers and processors is rather weak due to inconsistent demand for the processed produce. Efforts have constantly been on to link farmers to the markets so that the marketing channels and the role played by different market intermediaries are minimized. These efforts include creation of alternate marketing channels which provide better pricing policies and reduce the margins, contract farming for assured buy back and hence assured price and supply chains for creating and sustaining value addition for some commodities.

In order to link farmers with market, several operation, involving different horticultural commodities with distinct pattern of partnership of public, private and other organizations are also being attended. Important factors contributing to their success include, scale of operation, uniformity/simplicity of produce and technological intervention backed by financial support. Notable among these are the '*apni mandi'/ ulawar sandhe / raithu bazaar*, popular in the states of Punjab,

Tamil Nadu and Andhra Pradesh respectively. These efforts provide an opportunity for the producer to sell directly to the consumer without the exploitative middleman. The model assures fair price for the producer and farm fresh produce to the consumer. The price discovery however is pinned to the nearby wholesale or retail market in the region.

Contract Farming: An approach, Link Farmer with Buyer

Contract farming in sugarcane was successfully demonstrated way back in 1932 in Bihar. In horticulture, the earliest attempt of contract production could be traced way back to the early 70s, with the Indo Bulgarian production complex, involving cultivation of horticultural crops. The Indo-Bulgarian project which was initiated during April 1974, aimed at linking production, processing with marketing based on the experience of the Agro-Industrial complexes of Bulgaria. Two centers were identified, with one based at Karnataka and the other based in Bihar. The project was planned with a three phase development plan, involving the objectives of introduction and expansion of the cultivation of some of the popular Bulgarian varieties in India. The Karnataka State Agro-Industries Corporation (KSAIC) was identified as the nodal point for processing tomatoes, which were to be delivered at the factory by the growers themselves. Initiated during the *kharif* season in 1976, the scheme could not make much head way due to the failure by the farmers to supply their produce to the processing industry. However, during Rabi season the same year, farmers were willing to supply the produce. Analysis of the reasons for this behaviour highlighted that the market price was the main contributing factor for the farmers' disinterest for supplying to the processors. The significant feature of the model was the introduction of Bulgarian varieties for demonstration purposes, which did not get adapted to Indian conditions. The lesson's learnt has now led to many success stories of contract farming with private and public sector organizations.

Success Stories of Contract Farming

The case that drew much public attention include, contract cultivation of tomato under PepsiCo in Punjab, contract production of hybrid seed production of vegetables, contract production of tomato, gherkins etc., to name a few. Contract cultivation of potato helped growers realize 15% higher price than the market price in Punjab. It may be noted that in most of these contract cultivation models, the linkage of farmer with the market is only partial as the farmer is not directly linked to the market. Further, the model does not include creation or strengthening of infrastructure or the objective of empowering the farmer to operate independently in a new market, there by making them unsustainable in the long run. However, model adopted by Jain Irrigation Limited, Jagaon for white onion cultivation, has been successful model. The company provides seeds, inputs and technology backup and ensure the purchase of produce on pre-agreed price. The model also hedges the risk by ensuring the minimum rate of purchase as well as market rates. Studies done in contract farming in potato have clearly indicated, that, if the price of produce in market increases more than 15% compared to agreed price by farmers, there is faltering by the growers. Therefore, contract farming model should ensure minimum price of the produce as per the standard and also provide the benefit of increased price of produce in market. The experiences also suggest that farmers must be served well to give them the feeling that they are major links and benefit is flowing to them. The welfare activities done for farming community also influence the farmer for owning the operation, consequently the contact farming become win-win situation.

Success Atory of Co-operative Marketing

Maharashtra being the pioneer in bringing together growers into a cooperative format, have been successful in operationalising several forms of export oriented grape production facilities. As a three tier system formed at village, district and state level, the cooperative format helped integrating production with marketing. Technological interventions in the form of on farm conversion of fresh grapes to raisins and export oriented production demonstrate the need for integrated approach of production with marketing through processing or value addition. Public sector R&D institutions in close collaboration with the state government have successfully demonstrated the model for linking producers to markets through farm specific technical support. In the precision farming model of Tamil Nadu, the emphasis is more on providing day-to day technical support in the production process, besides assured and effective means of utilizing available water for enhanced production. A team of scientists also

advice the producers on the selection of markets for safe disposal of their produce.

While a number of efforts have been made at linking farmers to markets through technology led production, steps has also been taken for market led initiatives. In the traditional market network, the wholesale and retail level market intermediaries perform arbitration and assembly function and amass disproportionally higher margin along the network. Having better access to market information, these market intermediaries for centuries have been able to regulate market price and take away a major chunk of the consumers' rupee. Any effort to regulate their activities and bring in accountability has not yielded expected positive results. Further, the growing network of such market intermediaries has been hindering modernization of horticultural produce markets. It is primarily to counter their activity that a number of new initiatives have sprung up in the arena of horticultural marketing. A number of private/ corporate sector initiatives have emerged setting up alternate market networks that aim at reducing the number of market intermediaries and also assure 'quality' produce for the consumers.

New Initiatives for Marketing

Modern Retail Outlets

The basic tenet of most of these initiatives is to 'modernize' the perishable produce markets by creating an altogether new market network that links producer to the ultimate consumer that satisfies the needs of both. Spensors, Food world, Farm fresh, Reliance, Subhiksha, and More are some of these initiatives operating across different cities since the last decade with procurement centres and distribution channels from producer to the ultimate consumer. Creating modern state of the art infrastructure for efficient handling of perishable horticultural produce to minimize the unaccounted for post harvest losses is one of their objectives. Besides achieving this objective, these initiatives have also created and redefined employment opportunities to skilled manpower in the horticultural produce marketing sector. Some of them integrated their operations with other food and cosmetics, while few have set up exclusive horticultural produce markets alone.

Sourcing of Horticultural Produce

The sourcing of fresh fruits and vegetable from farmers' fields has not yet been standardized in a number of these initiatives, due to socio-political issues surrounding the farm sector. The scale of operation being relatively small, they encountered problems in procuring directly from the farmers. The range of produce dealt with also was relatively small, making it difficult to identify the source of such highly seasonal produce. Procuring the right quantity of the right produce at right price being the trickiest of the issues, a number of these corporate and private sector initiatives had to fall back on the traditional market intermediaries for day- to day procurement deals. The traditional market middle men having been in business for long and having mastered the art of negotiation and arbitration have at times blocked the progress of these new market initiatives. With high attrition rate and not having sufficient practical experience, many of these new retail market initiatives have cut down their operations or closed shop altogether. This may need critical examination to put forward the idea effectively.

Price Setter Role

Though the new initiatives have created market infrastructure and have successfully corporatized horticultural marketing, they could not take the role of 'price setter' so far. The traditional wholesale market still continues to be the price setter, with all the other formats making adjustments to realign the margins along the market chain. Studies have demonstrated that they are not on par with the traditional marketing networks, when measured using the conventional measures of 'marketing efficiency' and 'price spread'. The value addition along the marketing channels may be much higher than that from a traditional marketing network, from the consumer's point of view, but they also fall short in terms of 'sustainability' in the long run.

Market Information - Key deciding Factor

Access to market information being the 'key factor', some of the initiatives has developed their business models along the lines of market information. Keeping in view the need of the small and marginal growers, the ITC's e-choupal ensures easy access to market information. The efforts at initiating futures trading practices into the arena of marketing of perishables are yet to take shape under Indian conditions. In the age of information and communication technology, the access to market information and technological solutions has well been sought through the use of mobile networks.

Linking Farmers to Markets — Need for A New Pradigm

Linking farmers to markets, especially in case of highly perishable commodities like horticultural produce has been deliberated upon for long. Efforts in the past have shown success in small proportions. Efforts never the less have successes in modernizing horticultural market, created infrastructure and opened up employment opportunities, but have not been able to sustain the 'link' between farmer and market or redefine the price discovery mechanism. Keeping in view the changing global order and the growing significance of horticulture as the commercial cash crop that leads in all crop diversification modules, a paradigm shift is envisaged in the arena of linking farmers to market.

Acces to Market and Information

Access to market information and market intelligence is the basic tenet of the new paradigm. Daily price and arrival information of all horticultural crops in the important/ close by markets needs to be made available to the farmers. The information on weekly price trend in the nearby markets will enable the farmers to stagger their harvests to suit the market need. The information on changing weather parameters along with the possible outbreak of pests and diseases as a ready reconer is an essential feature of such a system. Given the broad based usage of cell phones, creating and sustaining such networks is easy and accessible.

Identifying the farmers, traders and other market intermediaries is prepared and a data base created for future use at different markets. Such identification could help plan for the future. Market intervention protocol is an essential feature of the new paradigm, given the seasonality factors in the production of horticultural crops. The market intervention function could be through. The seasonality lead market gluts and associated price crash in vegetables in the most common feature that leaves many small farmers devastated. State governments in several states have already initiated occasional procurement at a predefined minimum price to safe guard the interest of the farmers. The identity cards will be of significance in such cases for ensuring the benefit reaching the needy farmer.

Ensuring Minimum Support Price and Hedging

Minimum support price (MSP) to horticultural crops are not available except for copra. Perishability of horticultural crops is a major constraint, in market operation by designated agencies. Thus, minimum support price for horticultural commodity has not been agreed. However, in time of glut, to safeguard the interest of the farmer market intervention schemes, which ensure minimum price to farmers operated on the request of State Government. One of the options available in commodity future are fixed price forward sales or purchase of commodity, which hedges against the fall of prices. This is implemented with a put option for farmers or a call option for buyers. However, forward contact option is yet to be implemented by Government of India. Small and marginal farmers need finance immediately the harvest operation is done. Many a time, they are opt for pre-contract of the orchards to have better liquidity. Warehouse receipt finance provides options to the farmers, wherein produce is sold to traders and buyers hold the stock till the prices rises. This mechanism is used to extend sales period beyond harvest season and secure collateral for obtaining finance. Extending the cheaper credit to farmers can easily be done through warehouse financing in banks purchase suitable hedge on the price of the commodities, assuming only a minimal credit risk. However, this needs infrastructure for storage.

Infrastructural Support

Infrastructure for effective marketing horticultural crops is of importance for linking the farm gate to market gate post harvest handling and packaging, grader facilities, cold chain and ripening facilities. These are:

Post-harvest Handling and Packaging

In order to avoid quantitative and qualitative losses adequate facilities of cleaning, grading and packaging at the farm level are necessary. In absence of such facilities, farmer's income goes down due to low price and low quality. There is need to make cleaning, grading and packaging a regular practice by farmers for ensuring good price tag. Grade standards for many fruits and vegetables are now available and to implement grading, grading infrastructure viz. grading machines, quality testing laboratories for testing the graded products is pre-requisite.

Cold Chain Infrastructure

According to an estimate, the country

accounts for nearly 10 and 13% of the world's production of fruits and vegetables, respectively, but experiences post harvest losses due to various factors primarily due to lack of proper cool chain, storage, handling and logistics. The application of refrigerated technique in the preservation and storage of perishable horticulture produces such as fruits, vegetables and flowers, therefore assumes significance. With the introduction of various schemes by Government of India through National Horticulture Board, the size of the Indian cold chain industry is increasing and has reached to more than Rs. 100 billion and is estimated to grow to Rs. 400 billion by the year 2015. The technical standards and protocols for the cold chain including cold storage for fresh horticulture produce and controlled atmosphere storage are available with National Horticulture Board. The infrastructural support for establishing cold chain is necessary to facilitate marketing system and ensure for higher return to farmers, which a part of scheme of NHB. Reefer containers/vans for transport of perishable commodities for domestic and export marketing is essential. The availability of reefer containers/vans have increased from 400 in the year 2001 to more than 5000 each of 8 tonnes capacity now to handle the available supply of perishable horticultural produce. But it is not enough to handle the increasing production of horticultural produce.

Ripening Facilities

Ripening being an important physiological process for several fruit crops and assumes importance for the process of artificial ripening such as for banana, mango, plum, papaya and few others. There have been reports that large quantities of fruits are ripened using calcium carbide, which emits harmful gases phosphor, arsenic etc and thus is prohibited under PFA (Prevention of Food Adulteration) Act section 44AA. However the technical standard for ripening with ethephon gas or liquid is developed for most of the climacteric fruits. Under controlled conditions of temperature, humidity and ethylene concentration in air tight, ethylene proof room. The standards, layout design of automated controlled system of ethylene gas injection are now available with complete guidelines with NHB. Such infrastructural system in the supply chain very well links farmers at the value chain gate for effective marketing and profitability.

Production As Per Mearket Needs

Most important aspect in linking the farmers with market is to organize the production of selected commodity in phased manner to meet the need of intended market. Small brinjal will be more preferred in Maharashtra, while big brinjal will be needed in Delhi market. Similarly, Alphanso may fetch better price in Maharahtra while Dassheri and Langra could be precious in Delhi market. Thus the skill of marketing would be to plan for the crop production as per the need of market and assure the quality standards and stable supply. This will need a collective thinking of farmers in group so that crop production and marketing could be organized to meet market needs, which will need infrastructure to support the industry.

Conclusion

The changing dietary habits, increasing per capita income, high understanding about the nutrition and health care of the people, have brought a shift to diversified farming. In this context, horticultural crops have proved best option of diversification for effective land use and better income to farmers besides higher employment. Production management technologies developed for different horticultural crops has improved the production, productivity and availability of horticultural produce. But due to high volume, perishability and seasonality horticultural produce has faced the challenges of marketing, many a time glut and shortages. Various initiatives have been taken to link the farmers with market including contract farming and creation of infrastructure. Market regulation has been reframed to suit to direct marketing encouraging many of private sector players to take up marketing. There has been ample improvement in quality management and accrued benefit to farmers. Forward market and warehouse receipt to hedge the risk of farmers have also got the attention and has lead to strengthening of the links. However, large numbers of small and marginal farmers have little benefit of various initiatives and needs the mechanism which can link the resource poor farmers to market.

Linking Farmers to Market, Experiences of the Farmers

SUDHANSHU KUMAR
Village & Post Nayanagar, Dist. Samastipur, Bihar

Litchi grows in abundance in Bihar. All the produce literally is locally consumed. The main problem that I as a farmer face is that there are no market linkages for the farmer so that he can confidently grow and then sell his produce at a remunerative price. Bihar specially lacks this cool chain facility and thus the farmer suffers. The cool chain facility is too expensive for an individual farmer to set up by himself.

Let's first examine the exact scenario at the farmers end. After having planted an orchard comprising 1100 hundred trees at a village called Nayanagar in Samastipur district of Bihar and after waiting patiently for 6 to 10 years for the orchard to reach a commercially viable position I was caught in a dilemma. How do I sell the fruits at the maximum profit? I had three options:

Option No. 1 – I could pluck the fruit and sell them locally to retailers who come to the orchard on a daily basis. The problem here is that there is always the uncertainty whether the buyers will come back the next day. This is because on the way these retailers will buy litchi from several other orchards if they are offered a good deal. Now on the route to an orchard these pheriwalas and cyclewalas will buy from whoever sells cheapest. So eventually there is no guarantee of prices. It fluctuates on a daily basis. Same way the buyers fluctuate. One day they are there in large numbers next day there may be none or too few. These uncertainties, after a season or two, deterred me from handling my own orchard. So we tried option two.

Option No. 2 – I decided to pluck and pack the fruit and send it to nearby markets. Nearby, means the immediate close by towns or far of places like Ranchi, Delhi and Luckhnow etc. The problem that we faced there was that when we reach these far of places we were literally held at ransom by the local mandi. Invariably the rates always change. The people there know that it is a perishable item and if delayed it will spoil and become useless. So we panicked and of loaded the produce at whatever price we got. These markets are ungoverned and unregulated and follow their own rules. I as a farmer coming from a far of place have the truck hire charges on my mind. I can't unload unless I am assured of a price and payment or I will have to look for a cool chain for storage. This will entail further expenses. Since litchi will spoil very fast so my target is to unload only if a deal is struck. The truck owner is not ready to wait or will charge extra. The person with whom I have talked usually starts finding fault in the product and says that he can't give the agreed rate because I as a farmer have defaulted on the quality. After facing this entire problem I was forced to off load my produce at whatever price available and leave the place thinking that I was better off selling to the local retailers at the orchard itself.

In both the above two options there is always the problem of uncertainty of the buyer, his verbal inconsistency, his rate and his untimely arrival. Then there is the problem of the rejected fruit – cracked, scorched etc what do I as a farmer do with all this fruit. It goes for a waste. I barely get any price for it. All this added to the loss and pushed me into the hands of the orchard contractor which is the next option.

Option No. 3 – The orchard contractor or 'vyapari' is the third option left for me. Here I sell the orchard for a tenure of 3 years at a mutually agreed price. It is the vyapari's responsibility to look after the orchard, spray, plucking of the fruits and selling the produce. I as a farmer get the mutually agreed price in instalments over the whole

season. Here also we see that the vyapari gets away with paying less by making some excuse or the other – bad weather, storm, no rain etc etc. These 'vyaparis' give a very poor price for the produce of the orchard. They give the logic that because we are taking all the risks and making all the expense we will pay you less. On the other hand it is clear that the 'vyapari' is an outsider. He does not own the orchard. He is there for only a short duration. He has no vested interest in the long term standing of the orchard. This leads to the orchard losing out on maintenance in the long run. It is exploited for the opportunity it provided and then the vyapari disappears. A new one will come up at the next season or after three years. So whose responsibility is it in the end to look after the long term perspective of the orchard. I thought the 'vyapari is doing it and the vyapari thinks - I am here for a short while why should I bother.

For a long time I thought did I make a mistake by choosing to plant fruit trees. How am I ever going to sell the fruits for a profit or for a higher price when every person is trying to take advantage of me as a farmer. The government has no backup system in place in Bihar. Nodal markets and market hubs and a centralised processing and storage centre are still a distant dream in Bihar. I was really getting frustrated and was in despair. I was desperately looking for a fourth option which I eventually got more as a chance rather than design.

In the year 2005 my patience and determination finally paid off. The season was good. The fruits on the trees showed promise. Though, the thought of selling it was already haunting me. When I wanted to sell the orchard for a price of Rs. 125000 to the local 'vyapari' he wasn't willing to give me more than Rs. 80000. While this bargaining was going on I happened to meet a man from a nearby town. He advised me that if you can take up the challenge you could supply your litchi to exporters at Muzaffarpur and rid yourself of all this middle men. I immediately went to Muzaffarpur and contacted an exporter. The exporter told me that it would not be possible for you to supply Litchi of export quality because we require Litchi by 9 a.m. in the morning and you will not manage it. I realized that I was 110 Km from Muzaffarpur it would take a truck four hours to cover this distance because of the bad roads. The litchis would never reach in time. I went back home disheartened and disappointed, at home we sat down to discuss the problem and reached a conclusion that we will pluck the Litchi from 9 pm at night to 4 am in the morning and pack the trucks and dispatch them latest by 5 a.m. so that the Litchis would reach the factory by 9 to 9.30 a.m. After deciding on this strategy we phoned the factory that the Litchi will reach you by 9 - 9.30 a.m. they were very sceptical but said ok though they warned that they will reject the Litchi if it reached late. So we took around 90 labourers and many gas lights, ladders, high stools and tractors for their head lights, to the litchi orchard to use them to assist night plucking of fruits. We managed to pluck litchis all night, graded it and packed them in plastic crates and covered them with litchi leaves after loading it onto the truck so that the scorching heat would not affect the litchi. It was dispatched by 5 a.m. as decided and it reached its destination by 9:15 a.m. 85% of the litchis were accepted as export quality. We were able to send eleven trucks (Tata 407) in 8 nights to the exporters and were paid Rs. 326000 for it. So from Rs 80000 that the local merchant was offering us we got 326000 after staying awake for eight nights. This proved really worthwhile. The best part was that even the damaged fruit was taken for pulping. So it became a win win situation.

To link up to the market system I realised as a farmer that I have to have volume, quality and adopt Good Agricultural Practices (GAP) so that I can stand up to the market and place myself in a unique position to sell my produce.

So with the above goal in mind I sat down to analyse how I can further develop the orchard and what are the problems that need to be tackled. The first problem that came to mind was irrigation. I had to have total control on irrigation and for this a drip and sprinkler system was the only option because in the summers irrigating all the trees at the same time is very important. So I contacted Jain irrigation, Jalgaon and asked them for a solution and they came and installed a system which I am proudly using today to full potential. The system cost me 350000 and it returned its cost in one season. The cost was high because I was installing a drip and sprinkler systems together. Drip for irrigation and sprinkler for micro climate control to prevent fruit cracking during the hot and dry season. It was during this time that the Horticulture mission came into existence. This seemed like a heaven sent opportunity and I readily availed the subsidy facility offered. The other problem that I thought of was increasing the fruit setting in the trees. For this it was recommended to get bee keepers to put up there boxes in my

orchard so I went about locating the bee keepers and invited them to come to my orchard and stay there for the flowering period.

In the season 2007-08 I had the Drip and Sprinkler in place and functioning. The bee boxes were in place (200 in all). I saw excellent fruit setting and made a rough calculation that the orchard would yield 10-15 lakh rupees in that season. The trees were still small, the orchard was still young and growing, another five years and we should get a yield of 20-25 lakh rupees. After all the fruits are sold to the exporters in kilograms so there is a big incentive to increase fruit size. Compare this with the local method of selling, in a bunch of hundred litchis. Fruit size makes no difference. On the other hand the exporter gives four times the local price. Now I sell my litchi to exporters get around 9 to 10 lakh rupees.

The future of litchis is very bright and so the next step would be to market it on my own and link up farmers locally to my network so that there is symbiotic development. I think instead of trying to export litchis to distant countries we should link up to our local country markets. South India and West India have a large potential for selling litchi. These markets have not been tapped properly nor have the litchi fruit growers been able to market their produce there. Once I gain the confidence of self marketing, I can open a pack house. The next big step would be Organic Farming of litchi to get better returns in the international market. I have decided to use the technique of organic farming in my litchi orchards and this value addition can increase income from my litchi orchard. With this goal in mind I opened a dairy farm at my village. Now I can use cow dung and vermicompost in my orchards.

Today the government should help us farmers by providing small refer vans and mobile sulphitation units so that a farmer can process and store his litchi at the farm itself and move it out when he has treated and prepared a sufficient amount to transport economically.

Today, I realize that though my orchard took a strenuous journey of 19 years to arrive at a profitable position, today if I was to plant a new orchard with the experiences gained the orchard would yield good results in half that time. I have already demarcated 35 acres of land for a new orchard. I can say with confidence now that litchi alone can provide the profits for a farmer for a comfortable to luxurious life depending upon the techniques applied.

Perishable Producer-Processor Collaboration: A Challenge

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"The gap between producers and processors of perishables persists till date despite several government initiatives, thereby restricting private investment into the food processing sector ".

A number of government policies have been devised to promote private investment in processing perishables, thereby resulting in several success stories in the segment. To name a few, mango processing in Chittoor-Kolar-Krishnagiri belt of the southern states, green peas in Uttarakhand and Himachal Pradesh, litchi in Bihar, white onion in Junagarh-Amreli belt of Gujarat, minimally processed cut and frozen vegetables around Mumbai and so on.

However, despite such success and several policy interventions, bringing together producers and processors of perishables within the organised sector continues to be a challenge.

Government Initiatives

The launch of two new schemes namely, 'Mega Food Parks' and 'Cold Chain, Value Addition and Preservation Infrastructure including Integrated Cold Chain and Strategic Distribution Centres' have been applauded by the leaders of the food processing industry. These schemes are seen to be giving adequate dose of front-ended financial incentives and decision-making freedom to private sector investors in setting up Mega Food Parks.

But, it is a matter of concern that a number of promoters of Mega Food Parks, which target processing of locally grown fruits and vegetables, are reluctant to develop supply chain by initiating dialogue with the producers. Some of them are actively considering starting in-house production of fruits and vegetables for uninterrupted supply of raw materials.

The other scheme of 'Cold Chain, Value Addition and Preservation Infrastructure including Integrated Cold Chain and Strategic Distribution Centres' will reportedly set up integrated cold chain infrastructure with fruit ripening units for marketing fresh horticultural produce only.

Loopholes

However, unfortunately, the consultants and investors who perpetually advocate increased dose of capital subsidies and tax exemptions as pre-requisites for the success of the food processing sector, have conveniently ignored the critical issue of ensuring an efficient raw material supply chain, which can be done by bridging the gap between producers and processors.

India has a vast domestic market for fresh horticultural produce. The country is endowed with nature's bounties, which offer seasonal fruits and vegetables round the year and a number of off-season fruits and vegetables too. This not only influences consumption pattern of processed food, but also directs pricing of raw materials.

Fruits and vegetables for household consumption in fresh form generally fetch premium price and therefore farmers do not offer the entire bulk of their produce for processing. To address the issue, the projects for processing of perishables must include a mix of utilisation of fresh horticultural produce for table purposes as well as

processing. This involves developing a different business model. But India's over-dependence on imported technology for processing, which is suitable for large volume of production in one unit, is hindering the process of establishing such a business model.

However, there are certain varieties suitable mainly for processing such as white onion varieties with high TSS (total soluble solids), potatoes with low sugar and higher solid contents suitable for making chips and French fries and grape wine, where production volume may not be constrained by the aforementioned factors. To ensure uninterrupted supply of raw materials, processors must get prepared to develop a suitable business model of buy-back with large number of producers, who may be small and marginal farmers.

Therefore, contract farming models based on risk sharing formula adopted by seed and poultry industries are more suitable for bringing processors and producers of perishables together in a symbiotic relationship to generate a win-win situation for both.

The Right to Food Versus the Right to Trade: Shaping the Contours of the Debate

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Of all the debates in the agriculture sector, the most crucial is the one on food security, and the means to achieve it. Should we be satisfied with the fact that at the global level, there is enough 'food reserve' to feed the world - and therefore the focus should be on 'food aid' and logistics – the ability to move large volumes of grain to food deficit areas ? Should regions, especially those which have not yet achieved critical food security reserves support plantation crops and commercial floriculture over and above traditional food crops which also contribute to livelihoods in this sector. Should the demands of the Amsterdam flower auction markets take priority over shorgum and tapoica crop of Uganda Rwanda and Burindi ? Should Africa be putting large tracts of land to plantation crops as these generate revenues for the government , or should the focus be on ensuring that' basic foods' should get the priority in terms of research and extension activities.

Unfortunately, the debate on the above issues is often cast as a debate between those who support a liberal economic regime, and those who are in favour of state intervention in an important sector of economy – for in most countries, agriculture continues to be a dominant sector - both in terms of GDP contribution, and certainly in so far as employment is concerned. The dominant theme song of the multilaterals and the larger producers led by the US is that if agriculture production can be organised efficiently in any part of the globe, it should be shipped and supplied to wherever it makes economic sense to do so, irrespective of the implications on ecology, equity and livelihoods. Thus several regions in Africa which could have produced maize for local consumption are forced out of the maize economy because imported maize is cheaper in urban centres which have the 'appetite' for the same. What is true of maize in east Africa, is, by implication true of milk and diary products, wheat and rice in other parts of the world. The same is true even within a nation state, but where the political sovereign can intervene to moderate prices; the issue can be resolved within.

During this columnist's visit to Africa last week, it was pointed out that even though East Africa as a region could produce enough maize for itself, the cheaper imports from US had virtually forced the farmers to go back to plantation crops like sugarcane and cotton – which by their very nature cannot usher rural prosperity unless the processing and marketing sector is in the hands of the producers co-operatives. Given the entrenched nature of the existing establishments in these sectors, it is doubtful if a vibrant co-operative sector can actually emerge as a viable competition.

Strategies to Supply Injury Free Fruits and Vegetables to Markets and Processing Units

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Introduction

Producing about 44 million tonnes of fruits and 87.5 million tonnes of vegetables (Economic Survey 2000-2001), India stands at 3rd and 2nd position, respectively in the world. Even though India ranks amongst first five in production of most of fruits and vegetables, the post harvest losses are high ranging from 20 to 40% and processing only to the extent of about 1%. While there are various reasons attributed to this scenario, injury caused to fruits and vegetables during harvesting, handling, transportation and open market sale is one of the important contributing factors. The injury could be physical (mechanical) such as cuts or puncture, impact or shock, compression (squeezing or squashing), vibration or shaking; physiological losses caused by conditions that increase the rate of natural deterioration such as high temperature, low humidity, direct sunlight, chilling or freezing etc; phytopathological losses which are the result of microbial spoilage due to the infection by one or more pathogens and indirect losses caused by lack of required infrastructure. Injury caused due to any of the above types reduces the market price drastically as also processed product quality. It is thus imperative to develop and follow certain strategies to minimize these injuries to fruits and vegetables for supplying to markets and processing units. It is likely to augment availability of fresh and nutritious commodity to consumers, high recovery and better quality of processed products besides higher returns to the grower.

1. Fruits and Vegetables' Processed Products in India

Some fruits and vegetables processed for different products in India are listed below:

1.1 Fruits

Mango- Juice, RTS, Nectar, Squash, Jam, Preserve, Toffee, Amchur, Pickle, Chutney, Canned mango, Mango powder, Mango concentrate; **Pine apple** - Canned pine apple, Juice, Squash, Syrup, Jam; **Orange (citrus fruits)** - Juice, Pickle, Marmalade, Squash, Cordial, Barley water, Candy; **Apple** - Jam, Preserve, Juice, Chutney, Cider; **Grapes** - Wine, Juice, Raisin, Munakka; **Dates** - Dried date; **Aonla** - Preserve, Jam, Candy, Syrup, Pickle, Chutney, Triphla; **Banana** - Canned Banana, Dried Banana, Toffee, chips.

1.2 Vegetables

Potato - Chips, Papad, Starch, Canned potato; **Tomato** - Sauce, Chutney, Pickle, Puree, Paste, Canned tomato, Juice, Soup, Jam; **Chilli** - Pickle, Paste, Powder, Sauce; **Peas** - Canned peas, Dried peas, Pickle.

2. Types of Injuries Caused to Fruits and Vegetables

2.1. Mechanical Injury: High moisture content and soft texture of fruits, vegetables and root crops make them susceptible to mechanical injury, which can occur at any stage from production to retail marketing because of:

3.1.1. Impact Injuries, Resulting from: Dropping the product onto a hard surface; dropping the product into the back of a car; excessive drops during loading and unloading; suddenly stopping or accelerating a vehicle.

3.1.2. Vibration or abrasion injuries result when produce is able to move within a container

because of; vehicles with small wheels and bad shock-absorbers; weak crates; bad roads; transmission vibrations.

3.1.3. Compression injuries are caused by improper packing and inadequate package performance resulting from: over-packing of crates and boxes; too high stacking of crates; weak packaging.

3.1.4. Puncturing injuries resulting from: nails or splinters from the crate or box; fingers or nails of a person; other crates, fork-lifts, etc.; hard and sharp stalks of fruits.

Injuries caused can take many forms: Splitting of fruits or roots and tubers from the impact when they are dropped; internal bruising, not visible externally, caused by impact; superficial grazing or scratches affecting the skins and outer layer of cells; crushing of leafy vegetables and other soft produce.

Injuries cutting through or scraping away the outer skin of produce will: Provide entry points for moulds and bacteria causing decay; increase water loss from the damaged area; cause an increase in respiration rate and thus heat production.

Bruising injuries, which leave the skin intact and may not be visible externally cause: increased respiration rate and heat production; internal discoloration because of damaged tissues.

3.2. Injuries from temperature effects. All fresh produce is subject to damage when exposed to extremes of temperature. Commodities vary considerably in their temperature tolerance. Their levels of tolerance to low temperatures are of great importance where cool storage is concerned:

3.2.1. Freezing injury - All produce is subject to freezing at temperatures between 0 and -2 °C. Frozen produce has a water-soaked or glassy appearance. Although a few commodities are tolerant of slight freezing, it is advisable to avoid such temperatures because subsequent storage life is short. Produce which has recovered from freezing is highly susceptible to decay.

3.2.2. Chilling injury- Some types of fresh produce are susceptible to injury at low but non- freezing temperatures. Such crops are mostly of tropical or subtropical origin, but a few temperate crops may also be affected.

3.2.3 High temperature injury - If fresh produce is exposed to high temperatures caused by solar radiation, it will deteriorate rapidly. Produce left in the sun after harvest may reach temperatures as high as 50 °C. It will achieve a high rate of respiration and, if packed and transported without cooling or adequate ventilation, will become unusable. Long exposure to tropical sun will cause severe water loss from thin-skinned root crops such as carrots and turnips and from leafy vegetables.

3.3. Diseases and pests- Diseases caused by fungi and bacteria commonly result in losses of fresh produce. Virus diseases, which can cause severe losses in growing crops, are not a serious post-harvest problem. Insect pests that are mainly responsible for wastage in cereals and grain legumes are rarely a cause of post-harvest loss in fresh produce. Where they do appear, they are often locally serious, e.g. the potato tuber moth.

3.3.1. Diseases- Losses from post-harvest disease in fresh produce fall into two main categories.

Loss in quantity, the more serious, occurs where deep penetration of decay makes the infected produce unusable. This is often the result of infection of the produce in the field before harvest.

Loss in quality occurs when the disease affects only the surface of produce. It may cause skin blemishes that can lower the value of a commercial crop. In crops grown for local consumption, the result is less serious since the affected skin can often be removed and the undamaged interior can be used. Fungal and bacterial diseases are spread for the most part by microscopic spores, which are widely distributed in the air and soil and on dead and decaying plant material. Produce can become infected:

- through injuries caused by careless handling, by insect or other animal damage, or through growth cracks;
- through natural pores in the above- and below-ground parts of plants, which allow the movement of air, carbon dioxide and water vapour into and out of the plant;
- by direct penetration of the intact skin of the plant. The time of infection varies with the crop and with different diseases. It can

occur in the field before harvest or at any time afterwards.

3.3.2. Pests- Although relatively few post-harvest losses of fresh produce are caused by attacks of insects or other animals, localized attacks by these pests may be serious.

- Insect damage is usually caused by insect larvae burrowing through produce, e.g. fruit fly, sweet potato weevil, potato tuber moth. Infestation usually occurs before harvest. Post-harvest spread is a problem where produce is held in store or is exposed to lengthy periods of transport.
- Rats, mice and other animal pests again are sometimes a problem when produce is stored on the farm.

4. Strategies for Injury Free Production, Harvesting, Handling and Packaging of Fruits & Vegetables

The strategy of decreasing losses is more economical because it requires smaller inputs per unit of the final product than a strategy of increasing production extensively, especially in the short term. The inputs that would be used for loss reduction are usually accessible and in most cases do not require expensive imports. Traditional subsistence agriculture systems account for a large proportion of agriculture production practices in developing countries. Within these systems exist simple techniques to avoid post-harvest losses. Vegetables and fruits are among these perishable items. They are excellent sources of complex carbohydrates, vitamins, and minerals. It is unlikely that these necessary nutrients are provided in correct proportions by the high percentage of calories eaten as grains in the underdeveloped countries of the world.

Understanding the food pipeline-pre-processing, transport, storage, processing and packaging, and marketing-is important. At any joint in the food pipeline there is loss. These losses increase proportionately as the time between harvest and consumption increases. Where there is no refrigeration or other means of extending shelf-life, more primitive ways of food preservation may be available, for example, sun drying or pickling. Wooden boxes can be used instead of dirt pits for storing foods. Proper storage could easily include rough sheds with good air circulation and shielding from direct sunlight, which raises the temperature and accelerates decomposition.

4.1. Production practices - Pre-harvest production practices may seriously affect post-harvest returns in quality and quantity and result in the rejection or downgrading of produce at the time of sale. Some of them are:

4.1.1. Water supply (Irrigation)- Growing plants need a continuous water supply for both photosynthesis and transpiration. Bad effects can be prevented by:

- Not to apply too much irrigation, which can lead to brittle and easily damaged leafy vegetables and to increased tendency to decay;
- Scarcity/lack of rain or irrigation can lead to low juice content and thick skin in citrus fruit, so should be taken care.
- Dry conditions followed by rain or irrigation should be averted, which can give rise to growth cracks or secondary growth in potatoes or to growth cracks in tomatoes

4.1.2. Soil fertility, use of fertilizers-Lack of plant foods in the soil can seriously affect the quality of fresh produce at harvest. On the other hand, too much fertilizer can harm the development and post-harvest condition of produce. Some of the effects are:

- Proper dose of nitrogen should be applied since lack of nitrogen can lead to stunted growth or to the yellow-red discoloration of leaves in green vegetables, e.g. cabbage;
- Proper dose of potash should be applied since lack of potash can bring about poor fruit development and abnormal ripening;
- calcium-moisture imbalance can cause blossom-end rot in tomatoes and bitter pit in apples, so it should be taken care of.
- Proper dose of boron should be applied since boron deficiency can lead to lumpiness in papaya; hollow stem in cabbage and cauliflower; the cracking of outer skin in beets.

4.1.3. Cultivation practices-Good crop husbandry is important in achieving good yields and quality of fresh produce. Certain aspects are particularly important, such as:

- Weed control-weeds are commonly alternate or alternative hosts for crop diseases and pests, and those growing in fallow land near

crops are as important as those growing among the crop. Weeds also compete with crops for nutrients and soil moisture;

- Crop hygiene-decaying plant residues, dead wood, and decaying or mummified fruit are all reservoirs of infection causing post-harvest decay. Their collection and removal are crucial factors in the reduction of post-harvest losses.

4.1.4. Agricultural chemicals. These are of two types:

- Pesticides and herbicides are used as sprays or soil applications to control weeds, disease and insect pests. They are dangerous because they can damage produce by producing spray burns if used incorrectly, and they can leave poisonous residues on produce after harvest. In most countries there are laws to control the use of pesticides, which should be used only in recommended concentrations. Strict observance of the recommended delay between the last spraying and the harvesting is required in order to keep poisonous spray residues from reaching the consumer. Advice on regulations should come from extension or other agricultural department officers.
- Growth-regulating chemicals are used in the field mainly to improve the marketability of fruit in order to control the time of fruit set and to promote uniform ripening. They are of little importance to small-scale production. Their effective use requires specialist knowledge, and they are mainly applicable to large-scale commercial production.

Food safety also begins in the field, and should be of special concern, since a number of outbreaks of food borne illnesses have been traced to contamination of produce in the field. Common-sense prevention measures include a number of *don'ts*

- Don't apply raw dairy or chicken manure or slurries to a field where a vegetable crop such as leafy lettuce is growing.
- Don't apply manure to an area immediately adjacent to a field nearing harvest maturity.
- Don't forget to clean equipment that has been used to apply manure to one field before moving it to another field in production.
- Don't irrigate with water from a farm pond used by livestock.
- Don't harvest fruit from the orchard floor for human consumption as whole fruit or nonpasteurized juices, especially if manure has been spread or animals allowed to graze.
- Don't accumulate harvested product in areas where birds roost.

4.2. Harvest Handling

Quality cannot be improved after harvest, only maintained; therefore it is important to harvest fruits, vegetables, and flowers at the proper stage and size and at peak quality, immature or overmature produce may not last as long in storage as that picked at proper maturity. Cooperative Extension Service publications are an excellent source of information on harvest maturity indicators for vegetables and fruits.

Harvest should be completed during the coolest time of the day, which is usually in the early morning, and produce should be kept shaded in the field, Handle produce gently. Crops destined for storage should be as free as possible from skin breaks, bruises, spots, rots, decay, and other deterioration. Bruises and other mechanical damage not only affect appearance, but provide entrance to decay organisms as well.

Postharvest rots are more prevalent in fruits and vegetables that are bruised or otherwise damaged. Mechanical damage also increases moisture loss. The rate of moisture loss may be increased by as much as 400% by a single bad bruise on an apple, and skinned potatoes may lose three to four times as much weight as non-skinned potatoes. Damage can be prevented by training harvest labor to handle the crop gently; harvesting at proper maturity; harvesting dry whenever possible; handling each fruit or vegetable no more than necessary (field pack if possible); installing padding inside bulk bins; and avoiding over or under-packing of containers

4.2.1 Pre-cooling

Pre-cooling is the first step in good temperature management. The field heat of a freshly harvested crop-heat the product holds from the sun and ambient temperature-is usually high, and should be removed as quickly as possible before shipping, processing, or storage. Refrigerated trucks are not designed to cool fresh commodities but only maintain the temperature of

pre-cooled produce. Likewise, most refrigerated storage rooms have neither the refrigeration capacity nor the air movement needed for rapid cooling. Therefore, pre-cooling is generally a separate operation requiring special equipment and/or rooms. Rapid pre-cooling to the product's lowest safe temperature is most critical for crops with inherently high respiration rates. These include artichokes, brussels sprouts, cut flowers, green onions, snap beans, asparagus, broccoli, mushrooms, peas, and sweet corn. Crops with low respiration rates include nuts, apples, grapes, garlic, onions, potatoes (mature), and sweet potatoes.

4.3. Post-harvest Hauling

4.3.1. Field and farm transport. Routes for the movement of produce within farm, fields should be planned before crops are planted. Farm roads should be kept in good condition because great damage can be inflicted on produce carried over rough roads in unsuitable vehicles. Containers must be loaded on vehicles carefully and stacked in such a way that they cannot shift or collapse, damaging their contents. Vehicles need good shock absorbers and low-pressure tyres and must move with care. Jolting of laden containers can aggravate damage to produce on rough roads, even at low vehicle speeds.

4.3.2. Transport from the farm. The destination of the produce leaving the farm will usually be one of the following:

- A local market - produce is usually in small containers carried sometimes by animals or in animal-drawn carts, but mostly by vehicles owned or hired by growers; public transport is sometimes used.
- A commercial packing house or processing plant-produce carried by trucks may be in palletized field containers, in bulk bins or in hand-loaded sacks or wooden or plastic boxes; where vehicles wait in the sun or rain for long periods before unloading, only the top part of the load should be protected by a covering; grass or leaves are not recommended for this purpose because they restrict ventilation and may be a source of disease; complete enclosing of the load with a tarpaulin is disastrous because it restricts ventilation and the temperature of the produce rises rapidly.

4.4. Selection of packaging for fresh produce: Suitable packages and handling techniques can reduce the amount of damage to which fresh produce is exposed during marketing:

- to keep the packaging itself from damaging produce during handling and transport, wooden boxes or cardboard cartons must be properly assembled; nails, staples and splinters are always a danger in wooden boxes;
- individual items of produce should be packed to avoid rubbing against each other during handling and transport; loose-fill packs are particularly susceptible to vibration damage;
- bruising results from overfilling containers or from the collapse of boxes; collapse may be caused by weak walls of boxes, by the softening of cardboard walls because of moisture or by the failure to stack boxes so that the side and end walls support those above; stacks of boxes should never exceed the height that has been recommended by the maker; produce in woven jute sacks or nets is especially susceptible to shock damage; sacks of 25 or 50 kg capacity are normally used for relatively low-value produce, such as root and tuber crops, and are often roughly handled on account of their weight; where possible, handling of bagged produce should be minimized by stacking sacks in unit loads on pallets or in pallet boxes.

4.4.1. Effect of packaging on other types damage

Heat, Chilling or Freezing

Packaging in general has poor insulating qualities and will have little effect on preventing damage from heat or cold. Lack of ventilation in packaging delays cooling and may contribute to high-temperature damage arising from heat generated by the produce itself. Recently developed expanded polystyrene packages have good insulating properties and are used, topped with ice, to transport vegetables with high respiration rates. The availability and cost of such packages make them inappropriate in most developing countries.

Moisture and free water damage

High humidity and free water (e.g. rain) quickly weaken cardboard boxes, which get soggy

and collapse when wet. This problem can be overcome in manufacture only by waxing the cardboard or by facing it with moisture resistant plastic.

Decay of produce packed in wet sacks or in wet wooden or cardboard boxes will be accelerated.

Chemical Contamination

Packaging will not protect produce from contamination by outside sources of chemicals. The containers themselves become impregnated and contribute to the contamination.

Sacks and "knocked down[1]" wooden or cardboard boxes awaiting assembly should not be stored in the same area as chemicals.

Packaging can be a major item of expense in produce marketing, so the selection of suitable containers for commercial-scale marketing requires careful consideration.

Besides providing a uniform-size package to protect the produce, there are other requirements for a container:

- it should be easily transported when empty and occupy less space than when full, e.g. plastic boxes which nest in each other when empty, collapsible cardboard boxes, fibre or paper or plastic sacks;
- it must be easy to assemble, fill and close either by hand or by use of a simple machine;
- it must provide adequate ventilation for contents during transport and storage;
- its capacity should be suited to market demands;
- its dimensions and design must be suited to the available transport in order to load neatly and firmly;
- it must be cost-effective in relation to the market value of the commodity for which used;

  it must be readily available, preferably from more than one supplier.

5. Role of Crop Specific Cooperatives for Market and Infrastructural Support

The government is extensively engaged in development of agricultural marketing and infrastructural facilities like construction of link roads , rural primary markets, rural godowns, krishi upaj mandi samities (KIMS), grower/producer/ marketing cooperatives societies and post harvest management, required for efficient marketing system and optimum utilization of surplus agricultural produce, so that farmers shall get remunerative prices for their produce and protected from the exploitations of middle-men where as the consumers should also be able to obtain the quality produce and its processed products at the same time and also to enable the consumer to obtain quality produce and processed products at a reasonable prices. Other important works that are entrusted are training to marketing personnel, publicity and propaganda, monitoring and market research, to initiate other works/ programmes for the benefit of the fanners.

In a country like India where majority of farmers are small and medium size growers of fruits and vegetables, organizing infrastructural requirements for safe handling, storage, transport and marketing is not economical at individual farmers' level. In this direction crop specific cooperatives may prove a boon for significant contribution in post harvest management of fruits and vegetables and assuring reasonable prices to the growers. Some such models namely Milk Cooperatives in Gujarat, Sugar Cooperatives and Grapes Cooperatives (Mahagrapes) in Maharashtra are worth emulating by fruits and vegetables growers. The role of these Cooperatives could be

i) to liaise between market and processing agencies for supply of quality raw material,

ii) to assure reasonable price to the grower by reducing role and share of middle men,

iii) to organize central packaging, grading, pre-cooling, and transport facilities for produce.

iv) assisting Extension Service Centres in transforming latest technologies to growers

v) ensuring bonded quantity of a particular fruit/vegetable procurement from the grower.

vi) apprising govt, agencies on local & crop specific problems.

6. Developing Fruits and Vegetables Markets in the Country

The government has developed markets with required facilities for food grains but the horticultural produce needs special attention on

two accounts i.e. protection from sunlight and hygiene in the compound. The fact is that government aided fruits/vegetables markets in the country are rare and seen only at few places. Such markets should he developed in all cities specifically for fruits and vegetables as these cannot be shared with grain markets which are often at outskirts of a city. For such a development, a policy on it is required.

7. Conclusion

Targeted towards improving availability of quality fruits and vegetables to markets and processing units, strategies at production, harvesting and post harvest levels appropriate to Indian scenario are suggested . These are as under:

Production Practices

Irrigation - Too much or too less irrigation be avoided. Avoid irrigation of vegetables after severe dry conditions. Do not irrigate vegetables with water from a farm pond used by animals or municipal waste water.

i) Fertilizers and manures - Proper doze of nitrogen should be applied. Required doze of potash, calcium, boron are also essential in some fruits and vegetables. Don't apply raw dairy or chicken manure or slurries to a field of growing vegetables,

ii) Cultivation practices - Weed control measures be followed. Collect and remove decaying plant residues, dead wood and decaying or mummified fruits as they are all reservoirs of infection causing post-harvest decay.

iii) Agricultural Chemicals - Pesticides and herbicides used as spray or soil applications are used only in recommended concentrations. Strict observance of the recommended delay between the last spraying and the harvesting is required in order to keep poisonous spray residues from reaching the consumer.

Harvest Handling

i) Harvest should be completed during the coolest time of the day, which is usually in the early morning.

ii) Keep the harvested produce under shade.

iii) Handle produce gently to keep it as free as possible from skin breaks, bruises, spots, rots, decay and other deterioration.

iv) Follow appropriate pre-cooling of freshly harvested produce

Post-Harvest Hauling

i) Avoid rough roads and unsuitable vehicles,

ii) Vehicles need good shock absorbers and low pressure tyres and must move with special care.

iii) Containers must be loaded on vehicles carefully and stacked in such a way that they cannot shift or collapse.

iv) Protect truck/ trolly carrying fruits/ vegetables from rain/direct sunshine. Avoid complete enclosing of load with a tarpaulin as it restricts ventilation and augments rise in temperature of produce. Cover in such a way that enough ventilation is available.

v) Avoid covering or padding with grass or leaves because they may be a source of disease.

Selection of Package

Besides providing a uniform size package to protect the produce, there are other requirements for a container:

i) it should be easily transported when empty and occupy less space than when full, e.g. plastic boxes which nest in each other when empty, collapsible cardboard boxes, fibre or paper or plastic sacks;

ii) it must be easy to assemble, fill and close either by hand or by use of a simple machine;

iii) it must provide adequate ventilation for contents during transport and storage;

iv) its capacity should be suited to market demands;

v) its dimensions and design must be suited to the available transport in order to load neatly and firmly;

vi) it must be cost-effective in relation to the market value of the commodity for which used;

vii) it must be readily available, preferably from more than one supplier.

Organize Crop Specific Cooperatives

These co-operatives are required to facilitate.

i) development of agricultural marketing and infrastructural facilities like construction of link roads , rural primary markets, rural godowns, krishi upaj mandi samitxes (KUMS) and post harvest management.

ii) efficient marketing system and optimum utilization of surplus agricultural produce, so that farmers shall get remunerative prices for their produce and protected from the exploitations of middle-men where as the consumers should also be able to obtain the quality produce and its processed products at the same time, to enable the consumer to obtain quality produce and processed products at a reasonable prices.

iii) training to marketing personnel, publicity and propaganda, monitoring and market research, to initiate other works/ programmes for the benefit of the farmers.

iv) develop fruits and vegetable markets in the urban areas. These markets should provide hygiene conditions for fruits and vegetables, protection from sunlight and fruits/ vegetables waste disposal arrangement. The shops in the market with minimum infrastructure facilities could be rented out to desired ones.

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Entrepreneurship and Brand Development

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If we look at our subject matter "**Entrepreneurship and Brand Development"** in the context of the theme of the Conference "**HortiBusiness- linking Farmers with Market**", we find ourselves looking at an Entrepreneur as the Prime Mover, linking farmers to the market in HortiBusiness. Brand Development being an Essential part of Entrepreneurial thought process with long term focus.

1. The path we will follow in our effort to arrive at the heart of our subject matter will be-
    a. Understanding the spirit of entrepreneurship.
    b. Conceptualizing the Form of entrepreneurship relevant to "Linking the Farmer with the Market" in Horti-Business in Indian context, while preserving the spirit.
    c. Understanding the significance of the role of Brand for an Enterprise, and the way the Brand should be developed.
2. Joseph Schumpeter, the famous Austrian-American Economist and Political Scientist (1883-1950) defined entrepreneurial qualities in its widest sense as "An Entrepreneur is a person who is willing and able to convert a new Idea or Invention into a successful Innovation". If we narrow its scope to economic activity, the definition of J. B. Say, an eminent 19th century French Economist is quite comprehensive;"The Entrepreneur shifts Economic Resources out of Lower end into Higher Productivity and Greater Yields." We can further consolidate it with the Dictionary definition of an Entrepreneur as a person who organizes and Manages any Enterprise, especially a Business, usually with considerable Initiative and Risk.
3. Few traits which come out clearly from these definitions of entrepreneur are
    a. Open-mindedness,
    b. Innovativeness,
    c. Ability to improve Productivity and Yields of Economic Resources,
    d. Ability to Organize and Manage enterprises, and above all
    e. Ability to take Risk, or Readiness to charter untraded paths.
4. Let us try to understand whether we further need to be sensitive to any particular aspect or nuance of Entrepreneurship, while dealing with Horti Business especially in Indian context. We will take wider meaning of the term Business inclusive of Production, Selling, Dealing etc making an overall commercial sense related to the activities pertaining to Horticulture. Looking at the Horti Business as series/chain of value addition may help us more than the classical division of the business into suppliers of Inputs, Horticulture/Agro Operations, Marketing/Selling of the Produce, etc.
5. Let us first try to identify the Stakeholders of this Value Chain. They are the
    a. Input suppliers, Inputs being- Seed, Fertilizers & Nutrients, Plant protection Chemicals, Post

Harvesting Care materials including Packaging materials etc.

b. Suppliers of Equipments, Appliances, and related Technology.

c. Providers/Facilitators of Knowledge concerning Horticulture Operations- Research Institutions, Agricultural Universities, Laboratories, Government Departments- Central & State etc.

d. Farmers or the Growers of the Horticulture Produce. Here we should keep ourselves aware of the reality that the average Land Holding of the Farmers in India is very low (app 2 acres per head).

e. Post harvesting Facility Providers- Logistics like Transportation, Storages etc.

f. Processors engaged in different degrees of Processing of the Horticulture produce.

g. Enterprises engaged in Marketing, Distribution & Selling.

h. The End Consumer.

i. The last but not the least, the Human Population, Fauna and Flora integrated with, and sustaining on the Ecosystem exposed to the Operations of the HortiBusiness.

6. Another important aspect of this Business is that the stage for major part of the operational activity is Rural India. The end consumers are majorly urbanite, be it domestic market, or exports.

7. At this juncture let us revisit our subject matter "Entrepreneurship and Brand Development", in the context of the theme of the Conference "HortiBusiness- linking Farmers with Market". Linking the Farmers with Market can be taken at this stage in a wider sense meaning making the Market drive the whole chain. There should exist a perceived need, existing or potent, in the market of a product in which the Horticultural produce, raw or processed to different degrees, is a significant input. The existence of the Market is the first step an Entrepreneur scouts for, and once that is perceived, the rest falls in line as natural Backward Integration. Furthermore each Stakeholder, other than that described in "i" above, can play the role of an Entrepreneur, the span ranging from one's own area of value addition to encompassing the whole integrated chain. It can work out in combination also. Amul Dairy and Gujarat Milk Co-operative movement is an apt example of shared entrepreneurship of Stakeholders.

8. We have already seen that Major part of the Operation in HortiBusiness takes place in Rural or to some extent Semi Rural India. The word "Farmers" in the theme of the Conference "HortiBusiness-linking the Farmers with the Market" is emphatic of this aspect. Hence we need to look at the subject matter of this presentation "Entrepreneurship and Brand Development" in the broader context of Rural Indian background. In 3rd paragraph we have highlighted the essential traits of Entrepreneurship, which is valid across all cross-sections of enterprises. Let us now investigate what more is required for its success in the Rural setting centered around the operations of Horticulture.

9. It will be pertinent here to understand the conditions prevailing in the rural India with the help of some Statistical Ratios and observations, which are an essential part of economic survey.

a. More than 65% of the total population resides in the villages

b. Rural India provides more than 50% jobs

c. 16 to 18% of GDP is contributed by Agriculture, and Agro based Operations.

Impediments

d. Per-capita income in villages is a meager 20.00R/day.

e. Far to be achieved in the areas of

i. Accessibility through Road, Rail

ii. Basic Education

iii. Basic Healthcare

iv. Sanitation & Drinkable Water

10. It will be naïve to expect, as the things stand

today, Entrepreneurs coming from the Rural India with the challenge of mobilization of Material Resources, including Finance, and Knowledge Resources, inclusive of Science & Technology, the HortiBusiness demands. Though there are scores of schemes offered by the Government to encourage HortBusiness, the Entrepreneurs of Rural India are deprived of resources, and infrastructure required to avail themselves of these.

11. From where then will come the First Generation Pioneer Prime Movers to activate the Chain of HortiBusiness? The answer is obvious; it is the responsibility of the privileged Urban Indians to take up this challenge. They are in a position to mobilize the required resources, material including Finance and Knowledge, of their own as well as the encouragements offered through different Schemes by the Government. Added to this lies another critical factor; Urban India is the major market, and it is the Market, which need to Drive the Chain.

12. What will motivate the Prime Movers (Entrepreneurs) to take the plunge?

    a. The nascent state of the business, thereby virtually green field.

    b. Huge losses at different stages in the prevailing traditional practices.

    c. Hurdles of Underdeveloped & Ill-developed state of Rural India.

    d. "Sky is the Limit" possibilities of Expansion and Growth of Business.

    e. "High Priority" status in perceivable future irrespective of Socio Political schools of thoughts governing the Nation.

    If we keep in mind the essential Entrepreneurial traits, all these factors singularly, and in combination have the potential to fire the imaginations of a Classic Ambitious Entrepreneur seeking Fortune. But one point mentioned under the Stakeholders list namely "Human Population, Fauna and Flora integrated with, and sustaining on the Ecosystem exposed to the Operations of the HortiBusiness" is indicative of new Dimensions, which will play very crucial part in this proposition.

13. Let us now ask ourselves the question "What is the type of Entrepreneurship are we looking for"? Once this is zeroed upon, the Branding, and its Development will be a logical deduction.

    Turn Over (TO), Return on Investments (ROI), Market Capitalization etc, etc are well accepted norms to decide the worth of a business to venture in as well as to gauze the Entrepreneurial success. Let us ponder whether there exist some other dimensions gaining equal if not more importance in the context of Globalization, and Ecological crisis faced by our Planet and it's reflection on fast growing concern, and gaining importance of criteria like Corporate Social Responsibility (CSR) etc.

    The TO, ROI driven Reductionist, Utilitarian models have served their purpose under to a great extent insulated notions of Nation States. In these models, the Wealth is created by whipping up the Ambition, and Greed of Entrepreneurs, and a part of the Wealth created thus is distributed by the State following different Socio/Economic/ Political schools of thoughts. Following these models the Western Nations gained spectacular materialistic Prosperity benefitting almost every section of the society over last three or four centuries. It is natural for the developing Nations aspiring for similar materialistic prosperity to follow the suit.

14. The Scientific & Technological Revolution in general, and Revolution in Computation, & Communication Technology in particular has changed the rules of the game over last century, especially post 2nd World War. Geographical barriers are evaporating off fast. Economy is getting integrated irreversibly. Threats, external like Ecological and Environmental and internal like Social Unrests triggered by disparity of opportunities, are becoming more and more shared realities. Not to speak of Nations, insulated Prosperity is causing great ire in traditional societies as well. The Message of the Age is Shared Opportunity, Prosperity, and Progress by all the Stakeholders. No arguments are necessary to establish the efficacy of this principle for any Entrepreneurial activity in Rural India that too with Agro activity as the Core Process.

Do we have any such model to refer to? Yes, the Concept of Social Entrepreneurship with some modification fits well into our requirement.

15. A social entrepreneur is motivated by a desire to help, improve and transform Social, Environmental, Educational, and Economic conditions. Key traits and characteristics of highly effective social entrepreneurs include ambition and a lack of acceptance of the status quo or accepting the world "as it is". The social entrepreneur is driven by an emotional desire to address some of the big social and economic conditions in the world, for example, poverty and educational deprivation, rather than by the desire for only ROI, and Market Capitalization. Social entrepreneurs seek to develop innovative solutions to social problems that can be copied by others to enact change. Social entrepreneurs act within a market aiming to create social value along with material wealth through the improvement of goods and services offered to the community. Their main aim is to help offer a better service improving the community as a whole and are predominately run as non-profit schemes. Zahra *et al*. (2009: 519) said that "social entrepreneurs make significant and diverse contributions to their communities and societies, adopting business models to offer creative solutions to complex and persistent social problems". Though the concept of social entrepreneur has evolved around nonprofit organizations, to evolve a Globally Competitive organization in HortiBusiness keeping the Social focus intact does not suffer from Contradiction. The enlightened approach towards all the Stakeholders has the Potentiality to create the required Synergy to achieve desired levels of wealth, and prosperity for all.

16. Till now we have covered, the Challenges of Empathy infused Entrepreneurship in the backdrop of Market Driven HortiBusiness in India. In the concluding part let us fathom what type of Brand should adorn the spirit of Entrepreneurship enumerated above, and how should it be developed.

17. Brands can be defined as "Sponges for Content, for Images, for Fleeting Feelings. They become Psychological Concepts held in the minds of the Stakeholders. These are also the personalities *that identify* products, services or companies (names, terms, signs, symbols, or designs, or combinations of them) and how these relate to key Stakeholders (constituencies: customers, staff, partners, investors etc). The experiential aspect consists of the sum of all points of contact with the brand and is known as the brand experience. The psychological aspect, sometimes referred to as the brand image, is a symbolic construct created within the minds of people, consisting of all the information and expectations associated with a product, service or the company(ies) providing them. Already the concept of a Brand commensurable with our concept of Entrepreneurship akin to social entrepreneurship exists, which is known as Ambient Brand.

18. An **Ambient Brand** is a movement, where the brand is organized around values and social needs instead of promoting a specific product. It is a virtual space, defined by values and occupied by a community of likeminded people. Whereas a traditional brand is entirely dependent on products and their parent corporations, an ambient brand is an independent social movement that companies can participate in. They are not selling products, they are allowing their company to participate in a social movement and allow their brand to be identified with this. It exists as a shared values space where consumers gather, converse and ultimately transact with organizations that appear to be in alignment with the values associated with that community. Corporations do not create ambient brands. They must qualify for inclusion within them by demonstrating that they share the values and will service the interests of their associated communities. The term as it is defined here was coined by Sara Batterby, a brand strategist in San Francisco. The Entrepreneur who, will play the role of the Prime Mover imbibing the spirit of social entrepreneurship as already explained need to create the Ambient Brand which, does not belong exclusively to his/her enterprise but allows all the Stakeholders a space to align, and share the value based Identity while maintaining their individual entrepreneurial spirit kindling the spirit of Co-operative endeavour.

19. What should be the strategy to develop the Brand? Brand Development can be defined as "The Process of Creating Styles and Themes to express the Organization in a way that is consistent with the **Mission, Values, and Strategic Vision** of the Organization". Companies seeking to experience long-term success need to create the most compelling, relevant, and consistent brand experiences for their Stakeholders. The mechanism of developing the Brand is a vast subject in it, and is left at this stage because of limitation of my professional expertise in the field, as well as the scope of this presentation.

Conclusion

a. Centre of gravity of HortiBusiness lies in Rural India.

b. It has to be made Market Driven, or Market Need Oriented to be economically viable, and globally competitive.

c. It has the potentiality to become epicenter of Shared Progress & Prosperity for Rural India suffering from deprivation, and lack of development imbibing Co-operative spirit. This need to be achieved without compromising with globally shared concerns for Ecology, Environment, and Sustainable Agro Practices.

d. The Entrepreneurial Challenge is to make it happen.

"So long as the millions live in hunger and ignorance, I hold every man a traitor who, having been educated at their expense pays not the list heed to them". The concept presented in the presentation is inspired by this bold and empathetic declaration of Swami Vivekananda, and is offered as a humble homage to him.

Contract Farming in Vegetables

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While the farmers are complaining that they are not able to get a remunerative price for their produce with the existing marketing arrangements, the processing industry is talking about non-availability of quality raw material in sufficient quantity. The government policies are also under severe criticism for not being able to sort out this dichotomy. Riding on this, the corporate houses are coming forward with an argument that their direct engagement of farmers through contracts would offer the rural population a better deal they presently enjoy. In this context, a lot is talked and written about contract farming. Interest in contract farming as a mechanism to coordinate linkages between farmers and agribusiness firms has grown recently, in view of the international trends towards tighter alignment in agri-food supply chains.

Contract farming is defined as a system for the production and supply of Agricultural/ Horticultural produce under forward contracts between producers/suppliers and buyers. It involves a farmer or a group of farmers, who are contracted to grow the contractor's crop on his or their land at a pre-agreed price. Based on this, the quantum of produce is harvested and delivered to the contractor depending up on the anticipated yield and contracted acreage. Thus, contract farming essentially involves a pre agreed price between the company or buyer and the farmer, along with measures of quality, quantity, acreage of land to be farmed and duration of contract. In some cases, the buyer also commits to support production through, for example, supplying farm inputs, land preparation, providing technical advice and arranging transport of produce to the buyer's premises. Another term often used to refer to contract farming operations is 'out-grower schemes", whereby farmers are linked with a large farm or processing plant which supports production planning, input supply, extension advice and transport. Contract farming is used for a wide variety of agri-horticultural products.

The essence of such an arrangement is commitment of the producer to provide the desired commodity at a time and price in required quantity to the known and committed buyer/contractor.

The main benefits of contract farming are:

- Reduce load on the Central & State level procurement system.
- Increase private sector investment in Horticulture.
- Brings about a market focus in terms of crop selection by Indian farmers.
- Improves access to local and export markets.
- Generates steady source of income at the individual farmer level.
- Promotes Grading, Processing and Value addition.
- Generates gainful employment in rural areas and flatten seasonality associated with such employments.
- Promotes rural self-reliance in general by pooling locally available resources & expertise to meet new challenges.
- Enhances farmers' access to production inputs, mechanization and transport services, extension advice etc.
- Assures quality and timeliness in delivery of farmers' produce.
- Improves local infrastructure such as roads and irrigation facilities, collection centres, etc.

- Lowers transport costs, as coordinated and larger loads are planned, an especially important feature in the case of more dispersed producers.

In India, the system of contract farming may be traced back to the colonial period when cotton and indigo were produced by the Indian farmers for the English factories (Asokan and Singh, 2003). In Indian context, contract farming covers loose buying arrangements, simple purchase agreements, supervised production with input provision, with possibly tied loans/advance and risk coverage, and managed production with input provision and tied loans/advance. Introduction of new crops and varieties as well as techniques of production also forms a part of some contracts. Quality parameters may be integral parts of contracts, but are not always understood properly. Defaults occur mainly through availability of alternate channels of disposal to farmers and sources of supply to buyers, which the mere mention of exclusivity in contracts cannot overcome. Effective reciprocity of terms and conditions is not always assured. Contract agreements range from oral deals to formal, registered written contracts.

Application Areas for Contract Farming

The following are the prime candidates, each of which is marked by an absence or an underdevelopment of competitive domestic markets:

- Seed multiplication.
- Organic foods, vegetables, fruits ,flowers and exotic produce/plants.
- Export crops.
- Aromatics, herbal and medicinal plants.
- Other cropping activities with specific requirements of quality/cultivation practices.

Some Examples of Contract Farming in Vegetable Crops

Contract farming is one of the different governance mechanisms for transactions in horti-food chains. The use of contracts (either formal or informal) has become attractive to many fruit/ vegetable producers nationwide because of benefits such as the assured market and access to support services. It is also a system of interest to buyers who are looking for assured supplies of produce for sale or for processing. Processors are among the most important users of contracts, as they wish to assure full utilization of their plant processing capacity. A key feature of contract farming is that it facilitates backward and forward market linkages that are the cornerstones of market-led, commercial horticulture. Well managed contract farming is considered an effective approach to help solve many of the market linkage and access problems for small farmers.

Tomatoes, chillies and okra under PepsiCo/ HLL/Nijjer programmes in Punjab, Sun-sip/Clean Foods in Andhra Pradesh and Karnataka; gherkin production in south Indian states, smaller projects involving specialized export vegetables crops or culinary herbs, etc still actively use contracts in their own restricted areas. M/S Namdhari Fresh located in Bangalore are getting different vegetable crops grown on contract farming for fresh vegetables for export as well as domestic markets. ITC Agro Ltd. has entered in to contract farming with vegetable farmers in Karnataka for their minimal processing and export in French Beans, Tomato, Okra, Carrot and Sweet Corn.

This practice of having a face to face with farmer and the company has begun more than two decades back with PepsiCo having started contract farming in tomato in Punjab. It introduced tomatoes on a large scale in a non-traditional area, Punjab, with purchase contracts backed by research and extension support ((PAU and PAIC). It was closely followed by a similar programme by Nijjer. These met with enthusiastic farmer response and Punjab is now a major tomato-growing area. The companies also introduced chilli cultivation with success among a subset of their contract growers. Riding on high sales of its snacks brands like Lays and Uncle Chips, Pepsico has engaged 12,000 farmers for contract farming in potato across the country putting a major share in West Bengal. Frito Lay India has contract farming agreements with farmers in Punjab, Karnataka, Maharashtra, Madhya Pradesh, Uttar Pradesh, Jharkhand, Uttaranchal and West Bengal and is planning to increase contract farming of potato in India by almost four-fold over the next three years.

Part of world's largest producer of French fries and potato speciality, McCain Foods Pvt Ltd has undertaken contract farming of potatoes on around 1,000 acres in areas such as Deesa, Vijapur, Palanpur, Himmatnagar and Anand of Gujarat. The company has got a turnover of 6 billion dollars. Thapar Group's Global Green Company is in to contract farming of gherkins in Andhra Pradesh

and Karnataka. Most of the products are exported to more than 23 countries across the globe. This company alone processes 30,000 tonnes of gherkins and has a contract farming arrangement with 12,000 farmers. In India, about 25 companies of varying capacity are involved in Gherkin contract farming spread over South India.

Vegetable Seed Production Under Contract Farming

Most of the vegetable seeds produced and sold by the private as well as public sector corporation are being produced in the farmers' field on contract farming basis. Chilli, capsicum, tomato, watermelon, okra and French beans are the vegetables whose seed production is mainly based on contract farming. The companies purchase the seed on the predetermined price according to the crop characters and seed yield. These prices vary from year to year and across the companies. Farmers take up this venture as in most of the cases seed production is more profitable than fresh vegetable production. This also serves as a means to overcome the price fluctuations in fresh vegetable produce. The most concentrated vegetable seed production belts are located in Ranebennur and Koppal region of Karnataka, Nasik and Jalna region of Maharashtra, Hyderabad and Nijamabad area of Andhra Pradesh, and Niligiri region of Tamil Nadu.

Vegetable Crops Grown on Contract Farming

Gherkin: Gherkin is a classic example of a crop being produced and marketed on 100 per cent contract farming. It is also a 100 per cent export oriented crop. Contract farming in Gherkin is successful mainly because the demand oversteps the supply in the international market. Another reason for its success is that the company supplies seeds, technical know-how and also plays a supervisory role in crop management practices through their own employees. Gherkin cultivation and processing in India came into being entirely to serve the pickled gherkin markets in Europe and the USA. Many private companies are into contract farming of gherkins in Karnataka, Andhra Pradesh and Tamil Nadu. Under this arrangement the companies supply high quality seeds, chemicals and Know how to farmers; arrange for supervision of their farms by agri-experts employed by the companies and buy back the entire produce at the time of harvest at prices ranging from Rs 3 – Rs 12 per kg depending on the quality. These companies process the gherkins and export them predominantly to North America and Europe. There are about 50,000 small and marginal farmers in Karnataka, A.P. & TN growing gherkins in an area of about 25,000 ha. The production of gherkins in India is about 2,35,000 metric tonnes in which Karnataka's share is about 60 per cent. Efforts are being made by the industry towards helping small and marginal farmers of the state and more and more farmers are being brought under the fold of contract farming. Karnataka is the Agri Export Zone for gherkins.

Tomato: Tomato Contract Farming started in Punjab by PepsiCo.

With technology back-up, tomato yields increased threefold, from 16 - 52 tonnes /ha. Production of tomato in the state of Punjab, went up to 200,000 MT, from 28,000. Technology spread to non Pepsi growers also. Although fresh market prices for tomato dropped with increased availability, due to the buyback arrangements by PepsiCo the farm incomes increased.

Capsicum: Of late, a highly successful and remunerative contract system is gaining importance in year round production and supply of colored capsicums. The crop is grown under protected structures, mainly, poly houses and net houses as a peri-urban vegetable production system in and around big cities such as Bangalore, Hyderabad, Pune, Delhi, Ludhiana etc. This simple contract involves good technical guidance and marketing linkage as a buy back arrangement with most stable price offered as compared to any other vegetable crop in India.

Jalapenos: Jalapenos are chillies or hot peppers of 4-5 cm long and both green and red are processed either whole or chopped (pepper rings) based on the consumer preference.

Beans (Haricot Stringless): Fresh pods which are 6-7 cm length with 0.5mm diameter are preferred. These are exported as whole pods or minimally processed as well as lactic acid fermented products to Europe and USA.

Baby corn and chilli: Karnataka is emerging as one of the leading states in contract farming in vegetables with around 22 companies (both domestic and multinational) offering contract farming for a variety of vegetables. Baby corn and chillies introduced respectively in 1999 and 2002 are the new ventures. Studies (Nagaraj *et al*, 2008) indicated that the production cost of contracted

farmers was Rs.9948/ac compared to Rs. 9653/ac in case of baby corn. In case of chilli, the cost of production worked out to Rs.24484/ac for contracted farmers compared to Rs.23493/ac for non-contracted farmers. The effect of contract farming was clearly visible on transaction cost involved in marketing of the produce and purchase of inputs. The transaction costs were substantially higher in case of non-contract farmers (Rs.2318/ac for baby corn and Rs.4991/ac for chilli) compared to contract farmers (Rs.79-89/ac). The difference is mainly attributed to the quality inputs supplied by the firms. However, the productivity of baby corn (22.6 q/ac vs. 16.2 q/ac) and the net returns realized (Rs.10610/ac vs. Rs. 3035/ac) by the contract farmers were higher than those of the non-contract farmers. In case of chilli also the returns realized by the contract farmers were higher compared to non-contract farmers.

Conclusion

The Government's National Agriculture Policy envisages that "Private sector participation will be promoted through contract farming and land leasing arrangements to allow accelerated technology transfer, capital inflow and assured market for crop production, especially of oilseeds, cotton and horticultural crops". Contract farming is seen as an effective means of generating supplies for processing industries and exporters, with a potential of adding value to agriculture in India. It is practiced commonly abroad. In India, it is seen as an opportunity with mixed feelings because of not becoming economically very attractive propositions based on Pepsi experience in Punjab and BHC Agri India Pvt. Ltd. Project on fruits and vegetables in Kuppam and hence, not getting popularity among farming communities.

The ideal contract is one in which the contractor supplies all the material inputs and technical advice required for cultivation at the farm gate, while the farmer supplies land and labour. The most important requisite for success is assured and remunerative price for the produce at the time of harvest. A code of conduct has to be developed to promote successful and socially sustainable and equitable contract farming systems. Despite several constraints like breach of contracts, delay in payments and delivery of inputs, in general, contract farming has resulted in improvement in the productivity of the crops grown and also provided assured reasonable income to the farmers. With agriculture/horticulture increasingly seen as a risky proposition, the promise of economic security within the contract farming system may be very attractive. In fact, the recent amendment to the APMC Act provides for contract farming of the produce. In the years to come definitely contract farming is likely to play a pivotal role in vegetable production system benefiting all the stake holders involved. To help in this direction based on FAO model, there is a need to establish a **"Contract Farming Resource Centre"** to offer a "one-stop" site, where information on contract farming is freely made available

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Technology Infusion through Contact Farming: Description of Success Story in Potato Crop

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Introduction

Contract Farming has been a recent concept in India. The process of contract farming involves cultivating and harvesting of a crop on behalf of big business establishments (corporate), Government agencies or some other entity and forwarding the produce to the other contracting body at a pre-determined price (Singh, 2002). In return, the contracted farmers get assurance of a fixed price which is generally higher than the market price. The role of contract farming in Indian rural economy is becoming more and more important, as the organized farming is catching up consistently (http://business.mapsofindia.com/rural-economy/contract-farming.html).

In order to exercise better control over supply chain logistics corporate- houses are showing increasing interest in contact farming operations in India.

Another definition of contact farming defines the concept as "farming under an agreement between farmers and a sponsor (processing and/or marketing firm) for the production and supply of agricultural products under forward agreements, frequently at predetermined prices". Thus, under contract farming, the farmers grow selected crops under a buy back agreement with an agency called sponsor engaged in trading or processing and the latter contributes directly to the management of the farm through input supply including planting materials as well as technical guidance through intermittent crop supervision and also markets for the produce. Hence, farmers bear only the production risk while the price risk is borne by the sponsor company. However, in some cases, the sponsor company does bear the production risk, depending on the stage of crop at which the contract is made. Sometimes the contract is made at flowering or fruiting stage and the company bears the production risks beyond this stage. Such arrangement facilities small farmers' to participate in the production of high value crops like fruits, vegetables, flowers etc. and benefit from the market-led growth (Paty, 2005).

Types of contracts: Different types of contracts can be opted by the contracting parties. The basic and perhaps the most common is provision of market to the farmers. Under this contract farmers are offered specific price for a specific quality, quantity and timing of sale by the sponsor company. The second type of contract, in addition to market provision, involves provision of resources such as selected inputs, credit facility and technical advice for better crop management. The third type of contract provides management specifications in addition to the first two provisions. Under such provision the grower follows specific package of practices recommended by the sponsor company. In case of potato, PepsiCo and McCain India have adopted contract farming involving all provisions of the concept for procuring potato tubers for their potato chips and French fries making facilities, respectively.

Crops suitable for contract farming: Perishable crops which can't be stored for a long time after harvest and need fresh consumption, bulky productions which are costly to transport, plantation crops where long term marketing relations are required, specialized produce which is suitable for use as seed, processing or specialized uses (e.g. specific medicines), and uncommon or unfamiliar products which don't have common markets are best suited for contract farming. In case of potato, contract farming is very common in seed

potato and processing quality potato production. Some of the important agricultural commodities grown under contract farming arrangement in India are as follows:

- Food Grains - Rice, Wheat, Maize, Sorghum, Jowar, Bajra, Lentil and Chick pea etc.
- Nuts - Cashews, Almonds, Groundnut, Walnuts etc.
- Fruits - Bananas, Cherry, Lemon, Mandarins, Mango, Apples, Grapes, Oranges, Turnips, Papaya and Pineapple etc.
- Vegetables - Potatoes, Bitter gourd, Stripe Gourd, Pumpkin, cauliflower, Cabbage, Tomato, Gherkins, Asparagus, Carrots, Onion, Drum Sticks, Beans, Lady's finger, Spinach, Cucumber, Mushroom and Mushroom Spawn etc.
- Seed of spices - Basil Seed, Cumin seeds, Celery Seed, Sesame Seeds, Sesbania Seed, Sunflower Seeds, Mustard Seeds, Psyllium Seed, Fennel Seed, Fenugreek Seed and Tamarind Seed etc.
- Spices - Black Pepper, Chilli, Cinnamon, Cloves, Coriander, Cumin, Dry Ginger, Cardamom, Fenugreek, Clove, Ginger and Turmeric etc.
- Tea & Coffee - Black Tea, Coffee, Coffee Beans, Leaf Coffee and Green Tea etc.
- Others - Betel nut Leaves, Betel nut, Bidi Leaves, Chewing Tobacco, Arecanut, Snuff, Opium, Jute and Rubber etc.

Benefits of contract farming: The key benefits of contract farming in Indian conditions can be summarized as follows:

1) Realisation of remunerative price is one of the biggest challenges for small and marginal farmers. The pre-determined prices which are generally higher than the open market prices, along with assured market provide greatest help for such farmers through contact farming (Glover, 1987). Importance of this phenomenon further increases in case of the products which don't have traditional markets.

2) More than 80% of Indian farmers are small or marginal in size of operational holding. These farmers have very little or sometimes no access to modern technologies and technical support. Contract farming provides them a platform to get quality inputs, appropriate technology, skill transfer, farm credit and technical support which result in augmentation of farmers' income and productivity (Scott, 1984).

3) Corporate bodies engaged in value addition of agricultural output get assured quality and timely availability of a product in required quantity which reduces risk of these bodies too.

4) Sponsoring agencies in some cases have been found responsible for improved local infrastructure, such as roads and irrigation facilities in sugar out-grower areas, tea roads, dairy coolers/collection centres, etc.

5) The sponsoring agency takes care of the coordinated and planned movement of the output to the consumption destinations rather than odd movement as in case of the traditional marketing system. It results in lower transport costs, price fluctuations and wastage of produce.

6) Contact farming has been found responsible for encouraging better handling and grading of the produce resulting in lower post harvest losses.

7) Contract farming is a potent tool of enhancing private investments in agriculture through public private participation (Singh, 2008).

8) Contract farming arrangements have been responsible for enhanced growth in food processing sector in general and potato processing in particular. All major potato processors in India have been actively involved in potato contract farming in order to mitigate supply risks of their raw material.

Risks in contract farming: Contract farming just like any other bi-partite relationship has inherent risks associated with it.

1) If the terms of the contract are not respected by one of the contracting parties, then the other party suffers. Common contractual problems include farmer sales to a different buyer (side selling or extra-contractual marketing) or company's refusal to buy products at the agreed prices resorting to the downgrading of product's quality. In case the farmers sell produce to competing buyers of the sponsoring agency then a grim situation may arise.

2) Sometimes, the contractors default by failing to pay agreed prices or buy less than the pre-agreed quantities due to over estimation of raw material demand at some earlier stage or contracting more than required area. Due to mismatch of operations at entrepreneurs' level, payments made to farmers are sometimes not realised and the cheques bounce.

3) Sponsoring agencies may take advantage of unorganised farmers and over-price inputs and exaggerate the cost of facilities provided e.g. the transportation cost. Recent media report tells "in Bangladesh, (March 27, 2011) over a hundred 'contract potato growers' of Thakurgaon and Panchagarh districts blocked Debiganj-Nilphamari road at Debiganj upazila headquarters for two hours on Thursday as food processing company Bombay Agro Limited has declined to buy potato from them as per the agreement. If the company does not buy the potato as per agreement, the contract growers of Thakurgaon and Panchagarh districts will count huge losses. Under the situation of uncertain return it becomes very difficult for farmers to invest additionally on adoption most advanced recent technology for improving the production quantity and quality. As the adequate return to the increased production from the investment in improved technology is not ensured, farmers dissuade from adopting them.

4) Due to poor technical advice, drastic changes in market conditions or failure of sponsoring agency to carry out the planned operations the farmers may suffer financial losses and sometimes seriously indebted.

5) If sponsoring agency doesn't properly study agro-climatic and socio-cultural conditions of the farmers to be contracted then there is a risk of shortfall in anticipated yields and quality. There are cased when sponsoring agencies have pushed unsuitable technologies and incompatible cropping sequences.

6) The cases of farmers' economic exploitation by monopoly buyers all over the world have also been reported.

Actions required to mitigate contract farming risks: Creation and strengthening farmer organisations to better access appropriate services such as credit, extension services and market information and improving their contract negotiating skills can redress the chances of exploitation of farmers and poorly formulated contracts and their enforcement. Tripartite contracts where state government, e.g. the Tamil Nadu state government, is one of the party in the contract can play very important role in safeguarding the interests of unorganised small and medium farmers in India.

Facilitating agencies: Several agencies, mostly the government ones, are acting as facilitating agencies for smooth running of contact farming and saving the interests of resource poor and unorganized Indian farmers. The important names in the list of such agencies are Karnataka State Agricultural Marketing Board, Krishi Maratavahini, Madhya Pradesh State Agricultural Marketing Board, Maharashtra State Agricultural Marketing Board, Pune, Meghalaya State Agricultural Marketing Board, Orissa State Agricultural Marketing Board, Bhubaneswar, Punjab State Marketing Board, Rajasthan State Marketing Board, AP Agricultural Marketing Board, Domestic & Export Market Intelligence Cell, Tamil Nadu Agricultural University and Agri Marketing Board and HP State Agricultural Marketing Board (http://business. mapsofindia. com/rural-economy/contract-farming.html).

Contract farming models: There are five types of contract farming model. These are the centralized model, the nucleus state model, multipartite model, the informal model and the intermediary model (Hill and Ingersent, 1987; Eaton and Shepherd, 2001). The centralised model of contract farming operates when the sponsor contracts a large numbers of farmers to buys a produce with strict quality control after providing technical support and field supervision. The nucleus state model is a slight variation of centralised model and here the sponsor also manages a central estate of plantation. In case of potato the sponsor under this model performs research or breeding providing the farmers with throughput of fast changing technology. The third type of contract farming model is multipartite model which involves a variety of organisations including the statutory bodies for better ensuring the interest of resource poor farmers. The fourth model of contract farming is the informal model which is generally adopted by individual entrepreneurs and small companies without a

formal production contract. In case of potato some traders and cold store owners opt for this type of contractual arrangement in farming. The fifth and the last is the intermediary model where sponsor establish linkages between farmers and intermediaries. However, there is risk that the sponsor may lose control over the production and quality in such arrangement.

Technology Transfer Through Contract Farming

Agricultural extension being a state subject has not been addressed adequately in many parts of country and different agencies involved in extension mechanism have failed to take the appropriate technology to ultimate users due to some constraints or laxities. In spite of giving popularity to the programmes like "lab to land" we still need to do much in this field. The technological gaps have been found wide and broad indicating that large number of farmers is either still not aware or not using the latest technology in the field of crop husbandry. State agricultural extension machinery is in place in various states of the country yet the intended outcome is still eluding us. Similarly India has well established network of 588 (http://www.icar.org.in) Krishi Vigyan Kendras (KVKs) across all states (Table-1).

However, large number of farmers and very small size of operational holdings in the country still makes the agricultural extension mechanism far from perfect. Sponsoring agencies involved in contract farming with their more focussed and localised approach has been quite successful in delivering results in the field of agricultural extension.

Table 1: Zone wise and state wise details of KVKs in India

Zone	*State(s)*	*No. KVKs*
I.		
	Delhi	1
	Haryana	18
	Himachal Pradesh	12
	Jammu and Kashmir	14
	Punjab	17
	Total in zone I	**62**
II.		
	A & N Islands	2
	Bihar	38
	Jharkhand	22
	West Bengal	17
	Total in zone II	**79**
III.		
	Assam	21
	Arunachal Pradesh	12
	Manipur	9
	Meghalaya	5
	Mizoram	8
	Nagaland	8
	Sikkim	4
	Tripura	4
	Total in zone III	**71**
IV.		
	Uttar Pradesh	67
	Uttarakhand	13
	Total in zone IV	80
V.		
	Andhra Pradesh	30
	Maharashtra	39
	Total in zone V	**69**
VI.		
	Rajasthan	32
	Gujarat	25
	Total in zone VI	**57**
VII.		
	Chattisgarh	16
	Madhya Pradesh	47
	Orissa	30
	Total in zone VII	**93**
VIII.		
	Karnataka	28
	Tamil Nadu	30
	Kerala	14
	Goa	2
	Pondicherry	2
	Lakshadweep	1
Total in zone VIII		**77**
Total in the country		**588**

Source: http://www.icar.org.in

Contract Farming in Potato

All major potato processors have undertaken contract farming operations in India. The models adopted by all of them are similar to the one adopted by the PepsiCo India who is also the one of the oldest in this concept in the country. The model of PepsiCo has been emulated by other companies like ITC, Merino Industries and Satnam Agri Ltd (Singh, 2008). For better understanding of the concept this model has been thoroughly elaborated.

Model of PepsiCo India

PepsiCo India (previously known as Pepsi Foods Ltd) started its first potato chips manufacturing plant at Channo, district Sangrur in Punjab. Later the company added two more

plants to its manufacturing capacities in India at Ranjangaon near Pune in Maharashtra and Sankarail near Howrah in West Bengal. At present the company requires about 140000 t processing grade potatoes every year. In order to meet its raw material requirements the company has been adopting contract farming in the state of Punjab, Maharashtra, Karnataka, Jharkhand and West Bengal with more than 14000 farmers at an area over 12000 acres. The company has devised a model of contract farming called the "Partners in Progress Model" (Fig. 1).

The salient features of this model has been the supply of quality seed-potato, addured technical support, monitoring of crop health, facilitation of farm credit and crop insurance to the contracted farmers.

Seed-potato: Company provides good quality seed potato to its contract farmers in all operation areas. For this it is undertaking contract farming operations for seed-potato multiplication at farmers' fields after getting in-vitro material from its state of the art tissue culture facility at Jalandhar. Although price of seed-potato provided by the company is much higher (sometimes more than double) than the one prevalent in the market, yet the quality of the seed justifies higher price.

Agro-chemicals and fertilizers: Company purchases identified inputs (Table-2) from different companies at a lower price and provides such inputs to contract farmers at lower than their open market price. Through this activity company not

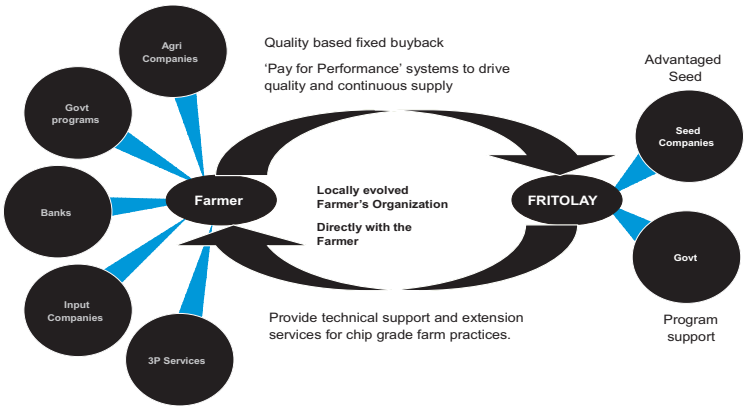

Fig. 1. "Partners in Progress" contract farming model adopted by PepsiCo (Chaturvedi, 2007)

Table 2. Potato disease/ pest management schedule adopted by PepsiCo India in Hassan area of Karnataka in 2009 under contract farming

Sr. No.	*Days of Crop*	*Chemical & quantity*	*Spray volume/ acre*	*Target disease & pest*
1.	Seed treatment	Manzet 500g	200 l.	Stem blight
2.	28-30 DAP	Manzet 500g	200 l.	Late blight
3.	38-40 DAP	Equation Pro 200 ml Dicophal 500 ml Quinolphas 500 ml	200 l.	Late blight, mites & green insects
4.	48-50 DAP	Curzate M8 600g	200 l.	Late blight
5.	58-60 DAP	Lanet 500g Equation Pro 200 ml Quinolphas 500 ml	200 l.	Late blight, black head moth & green insects
6.	68-70 DAP	Acrobate 200g Paliram 400g	200 l.	Late blight & early blight

Instructions

1. If there are chances of rain then add 250 ml gum per acre in the spray
2. Ensure that the spray reaches every part of the plant surface all the times
3. If it is a cloudy weather then spray should be repeated every 5-7 days
4. If necessary, increase quantity of fungicide and water to be used for spray

only ensures lower price to its contract farmers but quality of inputs is also ensured.

Crop health monitoring: Crop health is regularly monitored with the help of agronomists hired by the company and in serious cases the scientists from the Central Potato Research Institute, Shimla. Such vigilance helps farmers to reap higher yield of desirable tubers and realise better net profits as compared to the non-contract farmers in the area.

Buying at the farm gate: Small and marginal farmers have the biggest headache of taking their small volumes of the produce to the markets and get remunerative prices. Generally the farmers have to pay higher for transportation cost due to lack of adequate weight to suit the capacity of the vehicle and lack of capability to negotiate in order to protect his economic interests. In order to save farmers from such hardships company facilitates quality check, grading, bagging and transportation of the produce from farm gate. The account payee cheques are provided to the contract farmers as quality based value of their produce in order to avoid any kind of financial fraud or cheating.

Institutional support: Besides above mentioned support the company talks with other companies and provides other institutional facilities (through other companies) such as credit and insurance facilities to its contract farmers at lower interest/ premium.

Technology Transfer Mechanism of Pepsi Co India

Training of extension team: Company's selected team of extension persons is given rigorous training in order to transfer technology to small and un-educated farmers more efficiently and quickly.

Farmers' education: Farmers are educated on the importance of improved technology though distribution of literature, organising group meeting and question answer sessions and through the use of audio-visual aids.

Demonstration plots: Making use of the extension principal "seeing is believing" demonstration plots/ experiments are conducted at farmers' fields by the company. Through this activity the latest technology is spread among target farmers though personal belief and word of mouth.

Technical support: Farmers are provided technical support along with reminder-cum-activated/ stimulated activity accomplishment mechanism by the staff of the company. The field agents keep constant touch with the contract farmers though cell phones or repeated field visits. If some farmer is late in undertaking an activity listed in the schedule of disease cum insect management (Table 2) then he/ she is reminded and activated to complete the same.

Customised solutions: Taking into consideration the illiteracy and lack of awareness of its contract farmers on scientific use of agro-chemicals (particularly in Hassan district and adjoining areas) the company provides customised packets of agro-chemical having numbering and labelling in local language. All the packs to be used in one spray are again packed in bigger packet and numbered as spray number and date. In this way contract farmers get six packets for six sprays/ treatments along with the date of use written in terms of "days after planting".

Contract Farming Experience

Singh (2008) shared the practical experience of contract farming in the state of Punjab for *Basmati* paddy, Groundnut, mint oil, ware potato and seed potato (Table 3). Out of the total quantity disposed of by the farmer (produced under contract farming), cent per cent was procured by the contracting firm in case of ground nut and mint oil. However, in case of *Basmati* paddy, potato and

Table-3: Price advantage under contract farming in Punjab

Direct contract by the firms	*Output sold by the farmers (%)*	*Output procured by the firm (%)*	*Average price paid by the firm*	*Average market price*
Basmati paddy	99.5	86.6	1112.0	1271.0
Groundnut	100.0	100.0	1300.0	-
Mint oil	100.0	100.0	408.0	-
Potato	**97.6**	**75.9**	**467.0**	**195.0**
Potato-seed	**100.0**	**97.7**	**345.0**	**167.0**

Note: The average price is in Rs per litre for mint and Rs per quintal for all other crops, Source: Singh (2008)

seed potato the contracting firm procured 87, 78 and 98%, respectively. Contract farmers got average price for Basmati paddy lower than the average open market price by 12.5% while this price in case of potato and seed potato was higher by 2.4 and 2.1 times, respectively.

The per acre value of output under contractual and non contractual farming arrangement in Punjab was compared (Table 4). Two types of contracts viz. direct contract by the sponsoring firm and indirect contract by the firm were compared with the open market value of the output. It can be observed that large, very large and average of all farm categories received lower per acre value of their output under indirect contracts as compared to non contractual farmers by 8, 10 and 7%, respectively. However, these farm categories, respectively, received 20, 23 and 25% higher per acre value of their output under direct contract by the firm as compared to the non contractual farmers. The small and medium farmers got 12 and 42% higher per acre value of their out under direct contract of the firm as compared to non contractual farmers. These two farm categories received 3 and 19% higher per acre value of their output under indirect contract as compared to the non contractual farmers.

Table 4. Comparison of value of output under contract and non-contract farming in Punjab (Rs/ acre)

Category of farmers	Contract farmers		Non-contract Farmers
	Direct contract by the firms	Indirect contract	
Marginal	-	-	21,140
Small	28,616	26,453	25,621
Medium	35,792	29,921	25,135
Large	37,056	28,502	30,899
Very large	38,856	28,499	31,555
Aggregate	38,511	28,531	30,724

Plate 1. Revelation of the process of high quality seed potato production and transfer of technology from CPRI to a progressive farmer

Plate 2. Educating farmers on latest potato production technologies and developments

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Linking Farmers to Markets Through Hi-tech Horticulture – A Case Study of Cut Flowers and Exotic Vegetables from Pune

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Liberalization of seed and planting material import policy of the Government of India during the mid 80s has been be a starting point for 'hi-tech' horticulture that includes the cultivation of high value crops under protected conditions. Though it was initially found suitable exclusively for the production of export oriented cut flowers, the technology since then has been applied to augment the ill effects of pests and diseases in other crops like exotic and high value vegetables as well. The term 'hi-tech' preempts polyhouse based production systems that are 'high cost' as well, though in reality, much of the polyhouse structures now are low cost ones and are easily adaptable even under small scale. The hi-tech technology has in effect opened up a number of horti-business options for small and marginal producers involving flowers and vegetables across the country. In fact several national banks including NABARD have visualized a growth model that helped trigger livelihood support through horticultural development. A number of 'self help groups' that grew carnations under polyhouse in Ooty, integrated horti-business development models for the production of organic vegetables, cut flowers and exotic vegetables have since been in operation. One such initiative by a group of cut flower producers based in Pune that has reaped the benefits of an integrated yet individualistic approach has been presented here considering the business model, factors that helped in their success and the issues that need attention.

Materials and Methods

The data for this study has been collected through personal interviews and discussion with the Abhinav farmers association from Pune and represents the data for the last three years from 2007-2010. Data set includes the process of bringing the producers together and forming the association, the investment into infrastructure and fixed assets, variable expenses, yield, return and profits earned. Simple tabular analysis of the data for estimation of costs returns and profits has been attempted.

Status and Performance of Cut Flowers and Exotic Vegetables in Pune Region

Pune with its semi-arid agro climate is ideally suited for the cultivation of a number of horticultural crops of commercial significance such as grape, pomegranate, onion and cut flowers. Keeping abreast with the hi-tech boom that had started in the early 90s, Pune along with Bangalore in Karnataka and Calcutta in West Bengal has been a recognized centre for the export oriented production of cut flowers, especially rose. A total of over 50 hi-tech units, i.e., polyhouse based production units for the cultivation of rose have been set up in Pune district during the early 90s that have shown profitable with high earnings under polyhouse grown conditions.

Pune has also diversified into the production of carnations subsequently. It is reported that a total of over units producing carnations have been operation in the district. The Abhinav growers association is one among these that has specialized in carnation production.

Abhinav Growers Association, Pune, The Model

Abinav farmers club in Pune was formed in 1999 with a group of 23 farmers on 4 acres of land for the exclusive cultivation of carnation under polyhouse conditions. The group expanded to cover 216 members with 126 hectares under

cultivation. Ruled merely by the economics, the group only has 73 growers holding carnation on 23 hectares, while the rest has been diversified into other crops including exotic vegetables.

Their production model includes bulk procurement of inputs directly from the dealer resulting in a 25% saving in individual's cultivation expenses. Training in the cultivation aspects, grading and packing facility helps the producers undertake quality produce. Majority have 1000 m2 polyhouses. From the cumulative harvest of over 46 lakh cut flowers, 80 percent is sold in the distant domestic market at Delhi while the rest goes to nearby Mumbai market. The model includes the common refrigerated cold van that procures flowers from individual group members' farm gate and the same transported to Delhi by train three times a week. The group markets through an agency based at Delhi, called Flower Power, at a commission of 10% of the gross realization.

Each member of the group has a unique code number which gets reflected on all the boxes that gets procured from his farm, the remittances from each box based on the quality gets directly credited to the individual's bank account the next day. This arrangement ensures traceability and also quality based pricing. The details of the quantity sold and remittances made individually are also provided weekly by the company.

Till 2005 they found carnation cultivation a very profitable venture as they used to get Rs. 3.20 per stem fetching them a net gain of up to Rs. 1.20 per stem on variable costs alone. However, since, 2007-08 their production costs have increased and the average price per stem fell to Rs 2.65 thereby substantially reducing their profits. Further, the growers have not been able to meet the burden of overheads and amortized annual fixed expenses.

Factors that Contributed to the Success of the Model

The growers who have been with the group for over ten years now are of the opinion that factors such as (i) Collective procurement of Inputs, (ii) Demarcation of area and expected yield, (iii) facility for farm gate collection of produce and (iv) Quality based and quick individual remittances have been responsible for the profitable running of the horti-business venture. Since this was a venture initiated by the growers and run by them, they hold a great pride for its success.

Need for Crop Diversification in Hi-tech Production Systems

In view of the declining profitability of carnation due to incidence of wilt and increased soil salinity, as could be seen from Table1, the group felt the immediate need to diversify into other crops since 2006-2007. Thus each farmer started allotting at least 1000 square meters of area for exotic vegetables under the same polyhouse without the application of any inorganic fertilizers and chemicals for three years. Though the yields were lower, they were able to realize some return for their investment. Subsequently, the group has obtained the necessary certification for organic production of exotic vegetables in the same polyhouse.

As a result, presently (as on 2010-11) around 100 ha is under exotic vegetables representing a total of 216 farmers. The economics of carnation in its full bloom and shift to exotic vegetables has been presented in Table 2. In an area of 1000 sq. meter they earn Rs. 3,60,000 and their cost of production is 1,35,000 and the net profit is 2,25,000.

Their cost of production of per kg exotic vegetable is Rs. 15, and farm gate price they get

Fig. 1: Carnation and Exotic vegetable grown under polyhouse

Table1: Costs, returns and profits from sale of carnation

Sl. No.	Particulars	Unit	Annual Profitability Value Rs/1000m²		Total Value after two years Rs. Value Rs/1000m²	Total costs and returns Rs. /ha (10,000 m²)
1.	Variable Costs					
	Material Inputs (red earth, fertilizers and pesticides)	Rs.	1,00,000	1,00,000	2,00,000	10,00,000
	Labour	Rs.	60,000	60,000	1,20,000	6,00,000
	Others Miscellaneous	Rs.	15,000	15,000	30,000	1,50,000
2.	Marketing costs(Cost of corrugated box, cold van and train fare)	Rs.	46,000	46,000	92,000	4,60,000
3.	Amortized annual fixed costs	Rs.	4,07,916	4,07,916	375833.4	40,79,160
4.	Total Cultivation expenses (1+2+3)	Rs.	6,28,196	6,28,196	12,87,533	62,81,960
			Ist year	IIYear	Rs/1000 mts2	
5.	Yield	Stems	2,00,000	2,00,000	4,00,000	20,00,000
6.	Price	Rs.	3.20	2.65		2.93
7.	Gross returns	Rs.	6,40,00	5,30,000	11,70,000	64,00,000
8.	Net returns (7-4)	Rs.	11,083	-98,917	-87,833	1,18,040
9.	Benefit Cost ratio (7/4)		1.02	0.84	0.93	1.02

per kg is Rs. 40. As they have directly linked with Malls in Pune and Bombay there is no cost involved in transportation and marketing. Since the growers use the same polyhouse, their overheads come down. The economics of shifting from carnation to exotic vegetables taking a total of five years has been presented in Table-2.

As could be seen from Table 2, though the cultivation of exotic vegetables at the moment seems profitable, the group has to bear the overheads of the loss from carnation cultivation also into account. Thus even two to three years after shifting from carnation, a farmer will not be able to break even till the forth or fifth year or so. Also the model's objective of collective action also falls through since the marketing of exotic vegetables is individual based and not group based. Thus, despite the efforts on their own to get linked to market, farmers may not be able to obtain profitability as expected. The technology as such may be highly useful, it needs to be constantly supported and up graded.

As is well known, carnation is one of the exotic cut flowers that have been introduced into India as a very profitable horti- business option. Despite the technical and financial support growers may not be in a position to reap high profits as professed.

While the significance of linking farmers to market conceptually is important, it is also equally

Table 2: Comparative economics of Cut flowers Vs exotic vegetables under hi-tech system

Particulars	Year – wise costs and returns					Total at the end of 5 years
	1	2	3	4	5	
Crop grown	carnation	carnation	Exotic vegetables organic			Total
Fixed costs	407917	407917	407917	251750	251750	17,27,251
variable costs	175000	175000	75000	40500	40500	5,06,000
Marketing Costs	46000	46000	20000			1,12,000
Total	628917	628917	502917	292250	292250	23,45,251
Yield	200000	200000	75000	10000	10000	
Price	3.2	2.65	2	40	40	
Gross Returns	640000	530000	150000	400000	400000	21,20,000
Net Returns	11083	-98917	-352917	107750	107750	-2,25,251
BCR	1.02	0.84	0.30	1.37	1.37	0.90

important that the economic feasibility and long term viability of these options need to be evaluated taking real-time situations and prices into account. It is unfortunate that not may such project evaluation methods or protocols have been developed or standardized by either researchers or financial institutions. Institutions like NABARD do employ conventional methods of financial fitness estimates, but seldom include the possibility of crop loss to such an extant to include crop diversification. As could be seen from the experience of Abhinav society, crop diversification at the nick of the moment alone seems to have helped the growers sustain losses and still continue in the business. Though more analysis could be incorporated into this study, it is presented based on the experiences of the group to bring home the essentialities of the concepts in linking farmers to markets.

Conclusions and Suggestions

The growing popularity and profitability of horticultural crops, especially cut flowers has lured a large number of farmers towards the cultivation of this crop in the recent past. In view of the financial assistance that is available under various schemes, farmers are also inclined towards forming 'self help groups' or growers association that preempts collective action. While all these efforts work towards the goal of linking farmers to market, their sustainability in the long run is dependent on a number of indigenous and exogenous factors. Collective action being the basic tenant, does preempt formats such as collective procurement of inputs and disposal of produce. The other important factor is the scope for 'quality based pricing' as individual group member would like to retain his/her specificity.

The study brought forth the impact of collective action in the form of enhanced profitability for the group as a whole both from cut flower and exotic vegetable cultivation.

However, the most important points that emerged out of this study include,

i) Need for alternate strategic plan for ***crop diversification*** and ***market identification*** in anticipation of crop/market ***failure*** due to both biotic and a biotic factors.

(ii) Need for addressing the production, marketing and ***sustainability*** issues involved in all such collective action formats.

iii) Policy perspective on safe guarding the interest of farmers who get involved into such groups such as ***insurance*** cover against yield loss or fluctuating prices,

iv) setting up of '***Kissan service centres'***, or a horti- business process development unit, a body that provides hands on experience into farm business development and also an assurance of marketing support at least till such time the farm business is well set.

iv) ex ante evaluation of economic feasibility and viability of initiating such programmes in the face of uncertainties and protective safe guards.

Marketing and Export of Subtropical Fruits-Status and Prospects

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Preamble

India, with its rich agro-ecological diversity in the sub-continent, sustains and promotes cultivation of tropical, subtropical and temperate fruits culture across the country. Majority of the fruits, particularly mango, guava, papaya, aonla, bael and other underutilized fruits could be grown virtually in majority of the regions of the country, except in the temperate zones where occurrence of frost precludes their successful culture. Amongst these fruits, mango is the most acclaimed one as it is entwined in the cultural ethos and heritage of the country and rightly known as the '*King of Fruits'*. The diversity of cultivars presently existing in the country has co-evolved with respective agro-ecologies over centuries and assumed the status of region specific importance due to unique soil and environmental profiles hence, the local taste and preferences prevail. A few of them have also been accorded the status of '*Geographical Indicator*'. Guava, the poor men's apple, is another fruit which could be cultivated throughout the country successfully and particularly adapts well to dry land horticulture. On the other hand, papaya cultivation though is seriously limited by occurrence of seasonal frost and viral infections yet finds favour with the growers particularly of Andhra Pradesh, Maharashtra, Gujarat, Rajasthan and other states largely owing to shorter crop cycles and economics. Similar is the case with banana cultivation.

As stated earlier, the mango is the most important fruit crop of the country, occupying 37 per cent of the total area (6.10 million ha) allocated to all fruits, producing only 18.62 per cent of the aggregate production (68.5 million MT) of all fruits during 2008-09. India contributed about 42 per cent of the total mango production (35.71 Million MT) in the world, making it the most important mango producing country. The state of Uttar Pradesh is ranked first as it produced about 27 per cent of the total mango production (12.75 million MT). It allocated about 11.8 per cent of the total area under mango in the country and is ranked third, with a productivity of 12.8 MT. On the other hand, Andhra Pradesh, which is ranked first in terms of area (21.6 percent) produced 19.8 per cent of the total mango production with a productivity of 5.1 MT. Maharashtra ranked second in terms of area (19.8 per cent), and sixth in terms of total production (5.6 per cent). The state, however reported the lowest productivity of 1.6 MT. Banana cultivation is not significant in Northern India. However, its cultivation is reportedly picking up in the region, with the advent of 'Grand Naine' variety, with its wide adaptability and availability of disease and nematode free tissue cultured planting materials. Guava is another important fruit crop that accounted for 3.34 per cent of the total area and 3.32 per cent of the total fruits production in the country. Uttar Pradesh is the most important state allocating 16.7 per cent of the total area (0.2 million ha) and contributing 18.2 per cent to the total guava production (2.27 million MT) in the country with other states Maharashtra, Andhra Pradesh, Gujarat, Rajasthan and Bihar emerging as important ones in the recent years. The status of area, production and productivity of different fruits during 2008-09 is presented in figures 1-6.

Marketing establishes effective link between producers and consumers locally and/ or distant locations, with or without the help of intermediaries and is the most important and vital in the value chain of production and postharvest system of any crop with potential to translate crop outputs to economics and sustainable livelihoods of farming

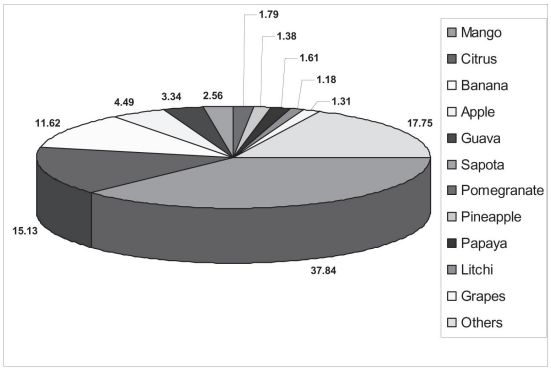

Fig.1: Area (% of total) of major fruit crops in India during 2008-09

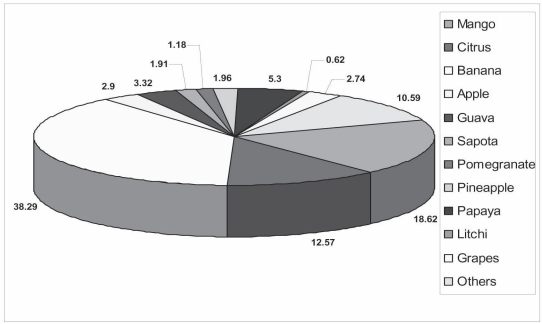

Fig.2. Production (% of total) of major fruit crops in India during 2008-09

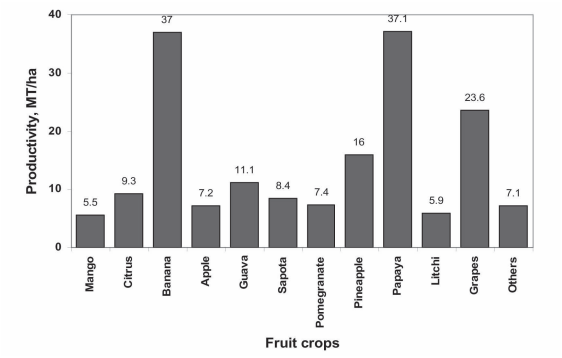

Fig.3. Productivity of major fruit crops in India during 2008-09

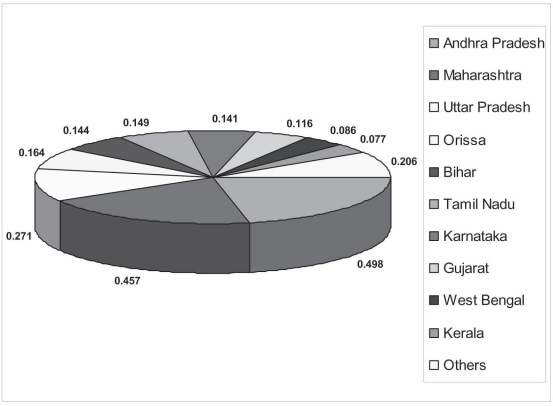

Fig. 4. State-wise area (% of total) of mango during 2008-09

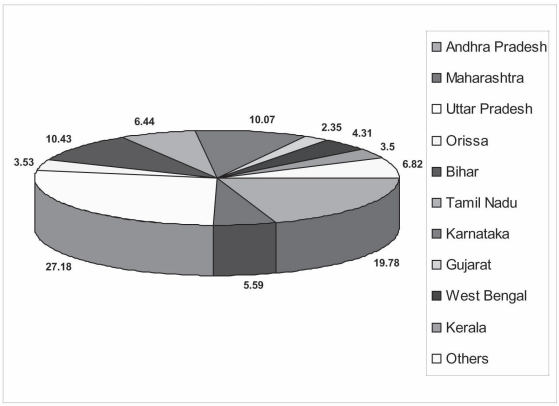

Fig.5. State-wise production (% of total) of mango during 2008-09

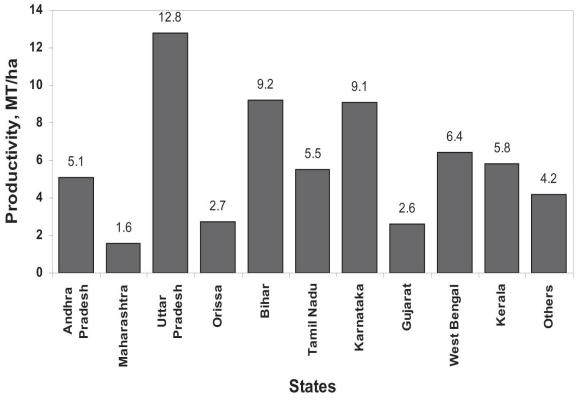

Fig. 6. State-wise productivity of mango during 2008-09

communities and others in the supply chain. Any efficient marketing system is expected to offer optimum profitability to producers, ensure delivery of products in their natural state/quality and guarantee reasonable prices to the consumers. This assumes all the more significance in the case of fruits, e.g., mango, guava, papaya, banana etc., as they are highly perishable with their quality deteriorating rapidly during the post harvest handling. The market envisages assemblage of producers and supply chain managers/consumers at a focal point facilitating effective transfer of produce ownership. Any deficiency at this point renders the process unfavorable to the producer and the ultimate consumer. This has become all the more relevant in view of the globalization and the post GATT era as the quality including food safety is the prime concern. The prevailing world trade order under WTO envisages free flow of goods and services of international standards amongst the countries and due attention is required for generating produce of internationally acceptable quality in adequate quantities for ensuring competitiveness and profitability to the producers. In this background, the present paper analyzes different facets of marketing, both domestic as well as exports, with a view to augment profitability to the producers for sustainability of production and livelihood.

1. Dynamics of Domestic Markets

The domestic markets consist of different stakeholders, i.e., producers, intermediaries, including pre-harvest contractors, commission agents, wholesalers, retailers and ultimately the consumers. The orchardists predominantly avail one of the following three major marketing channels and at times with some modifications:

i. **Channel-I** : Orchardists → Consumers
ii. **Channel-II** : Orchardists → Commission agents/ Wholesalers → Retailers → Consumers
iii. **Channel-III** : Orchardists → Pre-harvest Contractors → Commission agents/ Wholesalers → Retailers → Consumers.

The Channel-I is essentially a feature of local or rural/farmer lead markets. Consequently, it is beset with the limitations of large volumes of produce disposal and access to major wholesale or distant markets for which channels II and III become indispensable. In the major producing regions however, majority of the producers (60-70 per cent) resort to produce disposal through the pre-harvest contractors, availing the Channel-III for accessing the wholesale markets located either in the production centers or at the distant markets. Evidently, this channel is a lengthy one and orchardists and the ultimate consumers both are vulnerable to exploitation as it first entails lower margins to the producer in the post harvest scenario. Some studies have indicated that the share of the producer in the consumer is approximately 60-65 per cent in the case of channel-II *vis-à-vis* 40-50 per cent through channel-III depending upon targeted markets. Despite this, majority of the producers still adopted the Channel-III, owing mainly to avert possible production risks, comprising natural calamities viz., thunder/hail storms, etc., and biotic stresses viz., incidence of diseases, insect pests and fruit drops during different stages of growth and development. The lack of market information/intelligence, cold chain transport etc., and price risks are the other factors that forced producers to sell off their produce through pre-harvest contractors. The risks involved wide fluctuations in the prices of the produce arising due to dynamics of supply and demand and/ or collusion of different intermediaries unfavorably influencing the market forces thus impacting adversely the growers' profitability. Consequently, it would be prudent to analyze the prevailing status of a given cropping season carefully, evaluate the crop prospects well in advance and appraise the deficiencies at different levels to generate market intelligence for sensitizing the stakeholders. Such an approach perhaps could empower the producers with information and equip them to handle crop disposals intelligently. Putting in place effective institutional mechanisms to handhold growers' initiatives in this regard however is crucial.

1.1. Producers Level Issues

Presently the producers continue to follow traditional methods of fruits production and handling practices. They need to be replaced with improved crop production practices developed by research Institutions under the National Agricultural Research System (NARS) in order to ensure good horticultural practices for augmenting production quality. In summary, this requires integration of efficient pre-harvest practices for enhanced post-harvest life. At the producers' level, the following major limitations are found widely:

- The widespread prevailing practice of trading through pre-harvest contractors though came into existence for insulating the weather and price risks, it has in fact led to

the deterioration of orchard health and thereby affecting the quantity and quality of produce adversely, as the pre-harvest contractors are mainly interested in harvesting the crop of a given season rather than sustaining and promoting the orchard health.

- The pre-harvest contractors usually borrow money from the commission agents in the wholesale markets to make advance payments to the producers with the assurance to render the produce of that season to that particular commission agent. They paid higher commission (about 10 per of the traded amount) to the commission agents *in lieu* of the borrowed capital as against the normal (about 6 per cent).
- The harvesting and handling practices continued to be traditional and thoroughly unprofessional despite improved and efficient harvesters and post-harvest protocols being available. This impacted adversely the quality and post-harvest life of the fruits. Further, lack of sorting, grading and adoption of post-harvest protocols such as pre-cooling, treatments to enhance shelf-life and use of approved ripening protocols have led to augmented post-harvest losses and reduced competitiveness in markets.
- Fruits need to be harvested at proper maturity, depending upon destination, so as to obtain optimum quality, shelf-life and minimize the losses during transportation. In some of the regions, orchardists excessively irrigate the guava fields for increasing the size of fruits and then harvest them at green stage to transport them to long distances, resulting into suboptimal quality at the destination, while in some other regions, the fruits are harvested at full mature stage, which results in poor shelf-life and over ripened fruits at the retailer level.
- The sorting, grading and packaging practices adopted in mango and guava are not only informal but also unprofessional. The fruits are normally sorted out just to place smaller fruits in the bottom layers and large attractive fruits in the upper layers with a view to mislead the consumers. They are generally packed in bamboo or Arhar/pigeon pea (*Cajanus cajan* L.) stalk baskets or wooden boxes of 10 to 20 kg capacity depending upon the distance and targeted markets. Such practices do not protect the fruits sufficiently against possible damages /bruises during transportation and the fruits start losing shelf-life and quality rapidly. The use of Corrugated Fiber Board (CFB) Boxes having sufficient strength, proper ventilation and lamination are the better alternative. Their high cost has rendered their use limited. The CFB boxes cost however could go down with large scale adoption. In recent years, use of plastic crates for packing fruits for nearby markets is also being observed and provisions for the same under National Horticulture Mission is available.

1.2. Transportation System

The efficient and quick transportation is very crucial in the entire scheme as it facilitates rapid movement of the produce from the production centers or the primary markets to the targeted destinations at distant markets of the major consumption centers. The efficiency of this process is of great significance in view of highly perishable nature of fruits. The availability of faster road net works is *sine-qua-non* for the transportation process to succeed. However, the prevailing transportation system of fruits devoid of cold chain concept continues to be very primitive and non-conducive for minimizing the post-harvest losses. The trucks that are used for transporting non-perishable produces and commodities are being used for transporting highly perishable fruits also. These trucks do not have proper cushioning and exert lot of thrust and pressure on the packages and fruits resulting in disintegration of packages especially in the lower layers and leaves pressure marks on the fruits adversely impacting the shelf-life, quality and marketability. In this context, it is essential to integrate efficient post-harvest protocols involving cool chain concept that incorporates pre-cooling, grading, packaging, storage under controlled low temperatures and humidity and transporting the fruits in reefer containers up to the target destinations. The packing line and cool chain concepts are still in infancy to the Indian horticulture and due attention is needed.

1.3 Marketing System

The effective market is a place which provides interface to the sellers i.e., producers and the buyers

i.e., wholesalers, retailers or even the consumers. The commission agents strike the deal through different methods and the produce exchanges the hands. Following difficulties are commonly encountered during the process:

- Although all the agriculture markets in the country are regulated, the acts, rules and procedures of regulated markets have not been implemented fully in letter and spirit. The act envisages open auction, commission to be paid by the buyer and the auction of the produce to be conducted by the employees of the marketing committee or at least in his presence, etc. However, these rules are not in operation in majority of the agricultural markets. The concealed auction is still in vogue in some of the premier markets and the producer is mostly unaware of the successive bids during the auction process. He comes to know of it only at the end of the auction, but by this time it is too late for him to make a wise decision, commodity being highly perishable and it becomes extremely difficult to stall the trading process at that point as the possibility of fruits being rendered unmarketable looms large.
- The prevailing conditions in the majority of markets are very unhygienic impacting adversely, the post-harvest life of fruits.
- The practice of ripening fruits with the use of calcium carbide is still in vogue on an alarming scale in almost all the markets despite its ban by Government of India in 1954. The recent court order reiterating its ban and its strict implementation has opened up opportunities to opt for alternative methods especially use of ethylene for ripening of fruits.
- Proper storage and ripening chambers at the markets are virtually non-existent. The fruits are frequently stored unscientifically in open spaces. Affordable, low-cost ripening chambers of varying capacities, having ethylene generator facilities, are needed to be established.
- Majority of the cold storage facilities available were primarily developed for potato storage. The cold storages, available at some of the premier wholesale markets, need to have facilities of controlled atmosphere with differential temperature and humidity manipulations fine tuned and rendered specifically suitable for different subtropical fruits and their respective cultivars.

1.4. Market Information System (MIS)

Appropriate information generation, record keeping, monitoring and information retrieval systems in majority of the wholesale markets of perishable fruits are either lacking or grossly inadequate. The market information is a crucial and enabling requirement in the decision making process at all the levels. The information on crops/ variety-wise arrivals, respective prices at different points of time during the season in different markets enable the orchardists in harvesting and directing the produce to local/distant markets in order to avert glut and price risks. Majority of the markets in the country do not have effective MIS while some of the premier wholesale markets despite putting in place MIS in operation, prevailing time lag in the updating of information, precludes either its relevance or applicability. Even otherwise, the information generated has failed to integrate with markets in the absence of efficient networking arrangements.

Perhaps a satellite based system using LAN and WAN technologies may need to be put in place. All the production centers, commission agents and stakeholders need to be linked to Local Area Networks (LAN) at the market place. Different terminal markets are also required to be connected to the Wide Area Network (WAN) loop. The new system will ensure monitoring of transactions and transparency. The facility would enable the user to retrieve the information at a distant place any time and facilitate selling or forwarding decisions on a time scale.

1.5. Alternative Marketing Systems

It has long been felt that there exists multiplicity and complexity of the market functionaries that render the marketing system inefficient. This not only reduces the margin of profitability to the producer, but also increases the end price of the produce to the consumer. The prevailing long channel also increases the chance of avoidable holding of perishable produce in the post-harvest system leading to losses. Therefore, there is a need to telescope this channel for the benefit of all the stake holders. Following alternative marketing system has succeeded elsewhere and thus may have scope for adoption in our context too:

- The individual farmers have very low volume of produce. Consequently, they are not in a position to impact the market and have to be dependent on the unscrupulous market intermediaries thus realizing unrealistic prices. This also hampers efficient technology transfer. Individually they would not be in a position to trade or export the produce as quality, volume and traceability have become important criteria. Therefore, it is necessary that the farmers come together by either forming cooperatives or self-help groups or cartels.
- Contract farming is another option. The agency enters into contract with groups of farmers in large contiguous areas and provides them total technology, seed/ planting material and inputs, the cost of which is recovered from the sale proceeds. The system ensures efficient marketing and return to the orchardists. The system provides large volumes of uniform quality produce for trading.
- Of late, 'farmers markets' have also emerged in states like Haryana, where the farmers themselves trade their produce with the buyers directly. The markets have all the required infrastructure and refrigerated shelves where the commodity could be displayed for trade. The system telescopes the market channels drastically and producers' margin increases. However, the system has the limitation to trade in large scale at distant places.
- The direct purchase and trading through a network of retail chains by private commercial houses, e.g., TCI, Reliance, Bharti Delmonte, Essar, Indian Oil Corporation etc. has also emerged. However, this is a new concept and rules and procedures need to be evolved and standardized to safeguard the interest of the producers otherwise business angle may usurp the benefits in the long run.

2. Export Markets

2.1. Mango and its Products

India has been a traditional exporter of mango and its products. It exported 74.46 thousand MT of fresh mangoes worth Rs. 200.54 crore (Table-1) during 2009-10. In fact, this value of export was all time record, although the quantity of the export was about 11 per cent lower than the previous year. Bangladesh emerged as the leading importer of Indian mangoes (33.55 thousand MT), although it has been fluctuating over the years (Table-2). It accounted for about 45 per cent of the total quantity of mango exports from India. However, the price realization of mango was low in Bangladesh as the value of the export was only Rs. 32.96 crore, which was only 16 per cent of the total value of mango exports. Except for the UAE, the export of mango to gulf countries, the traditional importer of Indian mangoes, has stagnated or has even depicted an over all decline. The UAE imported 25.61 thousand MT of mangoes worth Rs. 103.83 Crore, with a share of 34 and 52 per cent of quantity and value respectively of mango exports from India. Other countries are way behind. Bangladesh preferred North Indian Cultivars Himsagar, Langra, etc., mostly from Kolkata and Malda Markets, while the Gulf and other states mostly preferred Alphonso and to some extent Kesar cultivars, which have higher shelf-life and accessed these markets in acceptable conditions. On the other hand, the North Indian Cultivars had short shelf-life rendering them difficult for export to distant markets through sea transport.

Mango pulp is the most important value added product, as the country exported 186.20 thousand MT of pulp worth Rs. 744.61 Crore. The product accounted for 78.78 per cent of the total export of all mango products taken together. Similarly, value of the pulp export accounted for 73.46 per cent of the total value of all mango products exported from India. In fact, the quantity of pulp export recorded all time high during 2009-10, although its value dropped down marginally (01.1 per cent). Saudi Arabia was the most important importer of mango pulp from India with a trade of 63.48 thousand MT worth Rs. 221.56 Crores during 2009-10. It accounted for 34.09 and 29.76 per cent of the total quantity and value of mango exports from India, respectively. The Netherlands is fast emerging as the assembly market for the European Union Countries. It needs special attention while planning for harnessing the European Union Markets.

2.2. Guava

The export of guava fruits from India was only 516.27 MT worth Rs. 113.39 lakh during 2009-10 (Table-3). Its export has witnessed a declining trend over the last three years. Nepal has been the leading importer of Indian guavas during these three years,

which also has been declining consistently. This country accounted for 11.55 per cent of the total guava exported from India. The price realization for guava in Nepal was also found to be low in comparison to the Gulf countries. However, as the fruit is highly perishable, exporting to Nepal appears more feasible. During 2009-10, Oman has emerged as the leading importer of Indian guavas by accounting for 15 per cent of total guava exports from India.

In the foregoing analysis it is evident that mango exports needs adequate support and policy initiatives. Consequently, major problems in export of mango from India are shortlisted hereunder along with strategies suggested to overcome them.

3. Problems in Exports

- Dependence on single variety, i.e., Alphonso, for exports. The export basket needs to be diversified.
- Irregular bearing tendencies and low productivity of north Indian commercial mango cultivars, viz. Dashehari, Chausa, and Langra.
- Very high influence of environmental factors on quality production e.g. high fluctuations in temperatures during flowering, fruit setting and production period and high wind velocities
- Inadequate management of biotic and abiotic stresses affects the sustainability of production and increases the risks.
- Low shelf life of many of the commercial cultivars.
- Lack of colored varieties and poor acid - sweet blend for exports.
- Majority of the cultivars are available during April-June and consequently face stiff competition from temperate fruits in the European markets. Many of the countries have year round availability of mangoes.
- Costly air freight structure leads to higher landed costs; sea transport, however, involves longer duration, leading to deterioration in quality of the fresh fruits.
- Lack of export infrastructure comprising cold chain, reefer van, packinghouse, etc., Although, some facilities have been created under Agri-Export Zone (AEZ) for mangoes, in Lucknow and Saharanpur, the orchardists are not very enthusiastic about them. Consequently, there has to be attitudinal changes, focus and enabling policies.
- Lack of awareness about the international quality standards amongst the stakeholders, i.e. orchardists, intermediaries in the domestic market, exporters, etc., including TBT and SPS issues at different control points.
- Virtual absence of certifying authority in North India for audit at different stages (control points) in the export system.
- The market structure needs to be reoriented to cater to the requirements of the domestic as well as export markets. Similarly, comprehensive and efficient marketing information networks are needed.
- The holding size of the orchardists is small, which makes technology transfer and adoption difficult. Consequently, contract-farming approach needs to be introduced for targeting export markets.

3.1. Strategies for Augmenting Exports

- The exporters and government agencies should promote export of fresh as well as processed products through aggressive marketing, advertisement and brand promotion. APEDA is engaged in creating dependable export infrastructure through establishment of Agri-Export Zones (AEZ) for mangoes.
- Development of colored hybrid varieties of high quality and off-season varieties through intensive research efforts. The new cultivars need to have higher shelf life of about 30-40 days under ambient or cool chain conditions.
- Development of integrated protocols for handling and storage for exports.
- Integrated control of various pests and diseases and permissible residue limits; food and environmental safety issues.
- Establishment of Vapor Heat Treatment (VHT)/ gamma irradiation plants for the control of fruit fly /post harvest problems.
- Diversifying exports to European and American markets which have untapped potential, besides the Middle East.

- Creation of super fast road network to reduce the time taken for transporting the perishable produce to the ports for using the sea route, which is much cheaper than the Air transhipment.
- Making the producer aware of the international quality standards for exports.

It is therefore evident that there is not much scope to increase the export of mango to gulf countries and the country needs to explore alternate markets. These markets could include European Union or American markets. However, the produce has to conform to the international quality standards viz. CODEX and EUREPGAP Standards for Exports. The latter has been modified as GLOBAL GAP. The CODEX and EUREPGAP (Euro-Retailer Working Group for Good Agricultural Practices) standards for exports involve modification of existing system of production and post harvest handling in line with international standards. Therefore, there is an urgent need to make the exporters aware of the international requirements. Some of the farmers in Maharashtra have adopted GLOBALGAP standards and the produce certified by independent agencies as GLOBAL GAP compliant. The salient features of these standards are as under:

3.2. CODEX Standards

- The color of fruits should be characteristic of the variety.
- The fruits should be fresh and firm and should not be damaged, which includes damaged, cracked, diseased or infected fruits.
- The fruits should be clean and the package should not contain other fruits and materials.
- The fruits should not have rotting marks and turpentine streaks.
- The fruits should not be infected with fruit fly and stone weevil.
- Chilling injury should not be present.
- The fruits should not be moist or should not have water condensations. Stalk, if present, should not be more then 1.00 cm.
- The fruits should be uniformly ripened.
- The mangoes have been placed into following three categories.

S. No.	Class	Weight (g)	Range (g)
1.	A	200-350	± 075
2.	B	351-550	± 100
3.	C	551-800	± 125

- The packet should contain fruits of uniform variety, quality, and weight and produced at single location. The visible fruits should represent entire packet.
- The package should be new, clean and should be able to protect the fruits. Printing and labelling should not be with poisonous ink or gum.
- The package should clearly indicate all the parameters, viz., name of exporter, variety, size, class, weight, location of production centre, etc.
- There should not be any insecticide residues in the fruits.

3.3. GLOBALGAP Standards: It is Complementary to CODEX

- The Global GAP is a set of normative documents suitable to be accredited to internationally recognized certification criteria such as ISO Guide 65. Representatives from around the globe and all stages of the food chain have been involved in development of these documents.
- In addition, the views from stakeholders outside the industry including consumers and environmental organizations and governments have helped in the preparation of documents.
- This widespread consultation led to a robust and challenging, nonetheless achievable protocol, which farmers around the world can use to demonstrate compliance with GAP.
- The new Version GLOBAL GAP IFA V 3.0 Sep. 07 standards can be used from January 1, 2008. The new integrated farm assurance standards includes all the existing scopes (i.e. fruits, vegetables, flowers and ornamentals, tea, animal husbandry, combinable crops, etc.) and replaces all previous standards including V2.1.
- Traceability of the produce to the production centre.

- Record keeping and internal self- inspection.
- Varieties and root stocks
  - Choice of variety/root stock
  - Seed/rootstock quality
  - Pests and diseases resistance
  - Seed treatment and dressing
  - Propagation materials
  - Genetically modified organisms
- Site history and site management
- Soil and substrate management: Soil mapping, soil erosion, soil fumigation, substrate, etc.
- Fertilizer use : Quality and type of fertilizers, records application, machinery, fertilizers storage, organic fertilizers(human sewage sludge must not be used), etc.
- Irrigation/fertilization: Predicting irrigation requirements, method of irrigation and fertilization, quality of irrigation water (sewage water must not be used), Supply of irrigation/fertigation water.
- Crop protection : Basic elements of crop protection, choice of chemicals, record of application, pre harvest intervals, application equipments, disposal of surplus application mix, crop protection product storage, residue analysis, empty container disposal, obsolete crop protection products.
- Harvesting: Hygiene, harvesting equipments, packaging containers, produce packed at the farm, etc.
- Produce handling : Hygiene, post harvest washing, on farm facility for produce handling and storage.
- Waste and Pollution management : Identification of waste and pollutants, waste and pollution action plan
- Workers' health, safety and welfare: Risk assessment, training, facilities, equipments and accident procedures, protective clothing, etc.
- Environmental issues.
- Complaint forum.
- Certification of above from an independent certification agency.

4. Conclusions

This paper attempts to analyze the weaknesses of the marketing system of the fruits particularly mango and guava at each level and traces its linkage with the pre harvest system with a view to attain higher volume of quality produce for domestic as well as export markets. It recognizes that the present market system is not geared up to handle volumes and quality efficiently. The system from farmer to the market functionaries needs through revamping. The infrastructure for market information and handling of perishable commodities is inadequate. Emerging marketing systems, like co-operatives, self-help groups, contract farming, farmers markets and corporatization appears inevitable. The international standards for exports of fresh commodities are very stringent and need to be adopted. The outlined standards take care of all

Table-1: Export of Mangoes and its Products from India (2009-10)

Sl. No.	Mango and its products	Quantity		Value	
		('000 tons)	%	Crore Rs.	%
1.	Mango Fresh	74.46		200.54	
		Products			
1.	Pulp	186.20	78.78	744.61	73.46
3.	Jam	44.90	19.00	245.89	24.26
6.	Squash	0.65	0.27	2.92	0.29
2.	Slice (dried)	2.10	0.89	7.81	0.77
4.	Slice (brine)	0.58	0.25	2.61	0.26
5.	Juice	1.91	0.81	9.76	0.96
7.	Flour	0	0	0	0
8.	Kernel	0.003	0	0.02	0
	Total	236.34	100.00	1013.62	100.00

aspects including environment, workers' safety, quality and safe produce for the consumers in respective countries. If we have to compete effectively at international level in the developed market economies, these standards must be adopted.

Table-2: Indian Exports of Fresh Mangoes to Major Destinations during 2009-10

Country	*Quantity ('000 tons)*	*Proportion (%)*	*Value (crore Rs.)*	*Proportion (%)*
Mangoes fresh				
Bangladesh	33.55	45.06	32.96	16.44
UAE	25.61	34.39	103.83	51.78
Saudi Arabia	3.15	4.23	13.45	6.71
Kuwait	0.80	1.07	5.20	2.59
U.K.	2.96	3.98	17.47	8.71
Total	74.46	100.00	200.54	100.00
Mango Pulp				
Saudi Arabia	63.48	34.09	221.56	29.76
Yemen Rep.	21.75	11.68	68.50	9.20
UAE	17.05	9.16	61.36	8.24
Kuwait	11.01	5.91	39.69	5.33
Netherlands	16.07	8.63	90.13	12.10
Total	186.20	100.00	744.61	100.00

Table-3: Export of Guava to Major Destinations (Quantity in MT and Value in lakh Rs.)

Sl. No.	*Guava*	*2007-08*		*2008-09*		*2009-10*	
		Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1.	Nepal	*604*	4.97	267	1.98	59.65	4.36
2.	UAE	372	6.52	252	5.69	44.60	15.51
3.	S. Arabia	365	8.96	363	7.55	15.82	3.20
4.	Sudan	103	1.84	252	4.08	-	-
5.	Oman	36	0.56	113	2.34	78.01	17.85
	Total	2,49	41.72	1,691	30.44	516.27	113.39

Cold Chain for Horticultural Produce: Quality Produce for Export /Domestic Market

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Introduction

A cold chain is a temperature controlled supply chain. An unbroken cold chain is an uninterrupted series of storage and distribution activities which maintain a given temperature range. It can be used for extending and ensuring the enhanced shelf-life of products such as fresh horticultural produce and processed foods.

India produces 53.1 and 91.6 million tons of fruits and vegetables and ranks second in world after Brazil in fruits and China in vegetables, respectively; but a major chunk, 25 to 40%, is lost during post-harvest handling. Major causes of these losses of fruits and vegetables are their fragile nature and prone to damage by virtue of improper harvesting, non conducive ambient conditions, manual handling, biological process of ripening and very low level of processing, only about 2%, to convert them to value added products of long shelf life. There is a need to reduce these losses to the level of minimum possible and increase the processing percentage to at least 10% in the 11th five year plan.

We lack infrastructure at almost all stages, beginning from harvesting to consumption. Post harvest infrastructure as enumerated below have been identified to be developed on priority basis namely; 1) Safe harvesting methods and equipment for individual fruits and vegetables, 2) Pre-cooling facilities at farm, 3) Pack house comprising equipment for washing, sorting, grading and packaging before dispatch, 4) Refrigerated vans/ trucks/rail to transport to sea and air ports and to retailers, 5) Multi-chambered cold stores dedicated for fruits and vegetables at port/retailer levels and 6) Process and machinery for converting to value added products.

Various works on these aspects have been reported in our country. Maturity indices and technique to measure them are available. The most vital part of cool chain, pre-cooler for farm level, is available in form of evaporative cooled storage structure of 2 to 5 tonne capacity at CIPHET, Ludhiana and mobile cool chamber for short distance transport from farm to cool rooms. The evaporative cooled chamber can also be used as a pack house at farm. The imported refrigerated trucks, multi-chambered cold stores are available in country. However, indigenous units based on regional environmental conditions need to be developed using locally available insulating materials like coir fibre. The efforts are needed to utilize low energy evaporative cooling as well as use of solar and wind power augmentation to make them more economical and affordable for use in catchments areas. This paper discusses about the status of above enumerated infrastructure available in the country and steps to be taken to develop them to reduce the post-harvest losses of fruits and vegetables substantially.

The impact of cold chain development in the country for horticultural crops will be directly on reduction of colossal wastage of perishable farm produce worth Rs. 63,000 crore annually. It will indirectly reduce the primary product-push inflation, also will reduce the food subsidy bill, ensure quality produce to the consumers, boost rural employment and drive agriculture growth to the targeted 4%. The huge losses to fruits and vegetables are mainly due to lack of adequate storage and other facilities which are estimated at more than the total production of fresh fruits and vegetables in Great Britain. The aggregated cost for providing cool chain facilities for the current storage capacities and benchmarking it with current

production levels is estimated at Rs. 15700 crores, considering facilities such as Pre-Cooling, Pack House Units, Ripening Chambers, CA Storages, Reefer Vans, CPC, Refrigerated ULD Containers, Refrigerated Containers, Retail Cabinets, Mobile Retail Cabinets etc.. Although government has accorded 'priority sector' status to the food processing sector, the fact remains that enough attention is usually paid at the pre-harvest stage for boosting the levels of production by techniques like crop rotation, soil conservation, pest control, fertilizers, irrigation etc., but post harvest issues such as cold chain facilities are addressed inadequately. One of the means towards achieving this could be tax concessions to corporate investment which would improve the entire value chain and make Indian agriculture more competitive.

Under the existing provisions of section 80-IB(11) and (11A), setting up and operating a cold chain facility for agricultural orvalue added produce, of fruits or vegetables is eligible for 100% deduction of its profit and gains for five years and 25% (30% in case of company) for the next five years However this incentive has not proved attractive enough and hence the establishment of cold chain and other modernized technology for up gradation of storage handling and transportation etc. should be granted infrastructure status and the tax benefit thereto provided under section 80 – IA instead of section 80–IB. The associated benefit that would accrue due to such investment to the Indian economy can certainly justify the comprehensive direct tax incentives in the form of 100% tax holiday in respect of the profits should be made available for a period of at least 10 years and the assessee given the option to claim this tax holiday for any 10 consecutive years out of 15 years beginning the year in which undertaking commences businesses or commercial operations. Such tax holiday benefit should be available in respect of the entire cold chain infrastructure including cold storages, freezing chambers & cold chain transportation system; dehumidified temperature controlled storage; refrigerated/ insulated containers for perishables and processed products; cleaning and grading centres; and packaging centres.

It is extremely important that the tax incentive be extended to various types of activities involved in the complete supply chain of the food processing industry and agro based industry. In other words, benefit should be available for all activities starting with acquisition of seeds/breeds, plantation, various aspects of processing, preservation, including cold chains (specially controlled atmospheric storage system). Handling, storage, transportation, packaging and repackaging, wholesaling and retailing are interlinked and cannot be separated to meet the requirements of the end customer and to take benefits of efficient supply chain. This would ensure that the tax incentive is available to entrepreneurs who carry out all activities in the industry in an integrated manner as well as entrepreneurs who are involved in providing one or more out of the entire gamut of activities in the supply chain.

Hence it is clear that storage or marketable life of crops can be extended by various treatments applied to them after harvesting the produce. The most important of these is temperature manage-ment, including the cold chain where the temperature of the crop is reduced rapidly directly after harvesting to stabilize it; it is then maintained under these conditions until it reaches the consumer. Therefore, application of cold chain technology for horticultural produce not only can reduce the losses but also give better price to the growers and traders and consumers would get quality produce.

Benefits of Cold Chain Technology

Employment Generation

The cold chain establishment will activate to number of economic activities. The cold chains will start at the farm level only with pre-cooling facility, which will generate rural employment. Further, due to value addition in the food processing industry, a large number of jobs would be created for people living in rural and semi-urban areas of the country, thereby increasing purchasing power in the hands of such people, and increasing the standards of living. The multiplier effect of investment in food processing industry on employment generates 2.5 times higher than in other industrial sectors, higher than any other sector and for poverty alleviation effect is three times to the GDP growth in other sectors.

Better Price Realization for Farmers

The enormous losses of Agri-produce annually due to gaps in the cold chain such as poor infrastructure, insufficient cold storage capacity, unavailability of cold storages in production catchments, poor transportation infrastructure, etc which leads to instability in prices, farmers not

getting remunerative prices, rural impoverishment resulting in farmers' frustrations and suicides. Tax benefit for cold chain infrastructure would enhance the shelf life of agricultural products as well leads to a substantial amount of value addition to the products sold. This would reduce not only wastages of produce but also lead to a greater value in the hands of the farmer, the income levels expected to go up by 20% over a period of 5 years by the way of better realization, value addition, strengthening of cold chain and integration of supply chain.

Improvement in Quality

Apart from containing the loss of Agri and Horticultural produce, one of the larger benefits would be improvement in the quality of the produce. The improved quality would result in increasing export of horticultural products and indirectly realizing in better prices for the farmers, better raw material for processing thereby improving the efficiency of value addition and end product quality.

Impact on Subsidies

The Government provides food subsidy and input subsidies such as on fertilizers, seeds, credit, irrigation etc. The food subsidy of the Government of India is estimated at Rs 24,200 crores. The fertilizer subsidy for the year 2005-06 amounts to Rs 17,253 crores. It is important to note that in view of an enormous amount of subsidies and hence wastage taking place in this sector as subsidy is not reaching the actual beneficiaries, the government bears an additional brunt of subsidies to fill the gaps created in meeting the demand of consumers. Nearly 35-40% of the Agri and food produced is wasted in India that is valued at Rs 58,000 crore approximately. This aspect has cascading effect as the government has to bear the burden again and again on the wastage that is taking place. In this regard, we stress that grant of tax holiday to cold chain establishment would not only reduce wastage of Agri produce, but would certainly curtail the burden of subsidies that the government doles out at various places.

Economic Multiplier

The development of adequate cold storage capacity/cool chain would help not only in increasing the shelf life and minimizing post-harvest losses through proper preservation but would also help the farmer in taking timely marketing decisions. Value addition through food processing can generate demand for agricultural raw materials and also have a multiplier effect on the rural economy. The FAIDA report of Mc Kinsey says that food has one of the highest economic multipliers for any industry. In India, the multiplier for food industry is 2.4. This is much higher than that for industries such as power and telecom. A multiplier of 2.4 means that for every Rs 100 of new revenue generated in the food industry, Rs 240 of revenue would be generated elsewhere in the economy, i.e., in industries such as transport, refrigeration, pesticides, fertilizers, etc.

Cold chains are essential for storage and distribution of perishable goods and temperature sensitive pharmaceuticals and biological preparations and forms an integral part of their supply chain. The present cold storage capacity in the Country is grossly inadequate and with a positive future outlook for the agro, food processing, retail and pharmaceutical industry there is an urgent need to scale up and develop integrated cold chain facilities across the Country.

Scenario of Existing Cool Chain Technology in the country

At present there is 1568 cold storage located in the country. Presently these are mainly used to store potato which is a key perishable commodity used throughout the year. The supply chain from production clusters to the markets ought to be strengthened including grading, pre-cooling, packaging, storage and marketing of fresh farm produce. The organised retail both in fresh and processed food products which has begun taking shape in the metros and other large cities will further is extended to other small towns as well.

The Government of Madhya Pradesh proposes to develop modern cold chain facilities in the State. The key component of the facility would be the temperature controlled warehouses of varied capacities, refrigerated transport vehicles and other auxiliary facilities. The envisaged project would have end-to-end capabilities across the entire supply chain and would cater to the requirement of various industries where controlled atmospheric conditions are necessary for storing raw materials, intermediate and finished goods. The foreign direct investment by leading global players for strengthening the backward linkages and infrastructure, including cold chain, could provide a boost to processing and help in reducing waste of fruits and vegetables. Some of the examples of modern cold chain existing in India are given below

McDonald's India's Cold Chain

McDonald's unique 'cold chain', on which the fast food major has spent more than six years setting up in India, has brought about a veritable revolution, immensely benefiting the farmers at one end and enabling customers at retail counters get the highest quality food products, absolutely fresh and at great value. McDonald's, through its unique cold chain, has been able to both cut down on its operational wastage, as well as maintain the freshness and nutritional value of raw and processed food products. This has involved procurement, warehousing, transportation and retailing of perishable food products, all under controlled temperatures. Setting up this extensive cold chain distribution system has involved the transfer of state-of-the-art food processing technology by McDonald's and its international suppliers to pioneering Indian enterprises.

Trikaya Farms in Talegaon, Maharashtra is having facility to bring the horticulture produce under 2ºC temperature from farm within 90 Minutes and thus avoiding the post harvest losses to the great extent. Trikaya Agriculture, a major supplier of iceberg lettuce to McDonald's India, is one such enterprise that is an intrinsic part of the cold chain. Exposure to better agricultural management practices and sharing of advanced agricultural technology by McDonald's has made Trikaya Agriculture extremely conscious of delivering its products with utmost care and quality. Initially lettuce could only be grown during the winter months but with McDonald's expertise in the area of agriculture, Trikaya Farms in Talegaon, Maharashtra, is now able to grow this crop all the year round. McDonald's has provided assistance in the selection of high quality seeds, exposed the farms to advanced drip-irrigation technology, and helped develop a refrigerated transportation system allowing a small agri-business in Maharashtra to provide fresh, high-quality lettuce to McDonald's urban restaurant locations thousands of kilometers away.

Post harvest facilities at Trikaya include a cold chain consisting of a pre-cooling room to remove field heat, a large cold room and a refrigerated van for transportation where the temperature and the relative humidity of the crop is maintained between 1ºC and 4ºC and 95% respectively. Vegetables are moved into the pre-cooling room within half an hour of harvesting. The pre-cooling room ensures rapid vacuum cooling to 2ºC within 90 minutes. The pack house, pre-cooling and cold room are located at the farms itself, ensuring no delay between harvesting, pre-cooling, packaging and cold storage.

Cold Chain Equipment Suppliers in India

Cold Storage Rooms

Cold storage rooms are made of PUF having density of 40+/2 Kg/ cubic m. Flooring is either bare slab and concrete or aluminium chequered with ply wood. Cladding of the PUF is with 0.5/ 0.6 mm PCGI. Any other cladding viz. SS, aluminium can also be provided.

Fully owned by Container Corporation of India (Concor), Fresh and Healthy Enterprises Ltd (FHEL) is a first of its kind initiative in India, which aims to provide complete cold chain logistics for fruits and vegetables from farm to retailer. Incorporated in 2006, FHEL is drawing its expansion plans after tasting success with its pilot project. They have plans for about 13-14 such facilities, maybe of smaller size, maybe not all for 1,000 tones, depending upon the types of fruits available. The firm also aims to fully utilize the current capacity (12,000 tonnes at Rai) along with diversifying into other fruits like pears, cherries and mangoes. Initially for the pilot project to establish the Rai-HP cold chain, Concor invested Rs 100 cores. Besides, Blue Star and ACHEME, New Delhi and few other firms are supplying the equipments and other accessories need for creation of infrastructures needed for cold chain management of horticultural produce in the country.

Recommendations

1. On farm short term cool storage structures developed at CIPHET should be popularised at collection centres. The developmental project on designing the need based high capacity structures be encouraged.
2. The hybrid cold storage structures using evaporative cooling, earth tube heat exchangers and modern air conditioning system combined together be developed.
3. To make effective the cold chain implementation and avoid contamination during transport, the designated color should be assigned for the trucks carrying food items and government incentives be provided for that so that washed and cleaned transport vehicles for horticultural crops

could be made available in the country along with refer vans for long distance transport.

4. The cold store facility (below zero temperature-walk in coolers) need to be popularized for storing the pulp and purees in the production catchment. Now a days walk in coolers with TMS (Thermal management system to take care power cut for some duration) facility of 10'x10'x10' are available at very affordable cost. This will encourage production catchment processing of vegetables and fruits in to pulp and puree which is a raw material for many tertiary value addition industries.

5. Low cost washing system need to be developed for washing of fruits and vegetables at orchard site.

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Oil Palm Marketing and Export

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Oil palm (*Eleais guineensi*, Jacq.,) popularly known as African Oil Palm or Red Oil Palm found originally in the wild form in the forests of Guinea Coast was used by the natives all over Africa as vegetable oil. Palm oil is one of the 17 major oils traded in the global edible oil and fat market. It is consumed as food for the past more than 5000 years. Today, it is the largest source of vegetable oil in the world. Oil Palm with its two types of oil namely, palm oil (mesocarp oil) as well as palm kernel oil (seed oil) which is lauric oil is gaining importance in the food, functional foods, pharmaceuticals, cosmoceuticals, as well as bio fuel and bio lubricants industries. The residue is the very valuable proteinacious residue that is a valuable animal feed, palm kernel cake. Oil palm is the highest oil (4 to 6 MT of oil /ha /year) producing perennial palm tree which starts yielding from 2 to 3 years up to 25-30 years of economic bearing. Oil palm is one of the world's most efficient bearing crops in terms of land utilization, efficiency and productivity. The high and increasing yields of the oil palm have led to a rapidly expanding world industry, now based in the tropical areas of Asia, Africa and America. The most productive parts of the industry at present are in Malaysia and Indonesia, which provide most of the oil entering international trade.

Palm oil production in Malaysia has increased from 0.1 million MT during 1960 to 10.84 million MT in 2000-01 and increased to 15.00 million MT in 2005 and as on 2009 it is 17.565 million MT. In Indonesia too, palm oil production has increased many folds progressively from 0.11 million MT in 1960 to 7.10 million MT in 2000, 13.60 million MT in 2005, and 21.104 million MT in 2009.

The global palm oil production in 2000 was 21.90 MT and it increased to 33.32 MT in 2005. As on 2009 the total global palm oil production is 45.261million MT. And presently out of 50.499 million MT of palm oil as on 2009-10, Indonesia produces 21.14 million MT and that of Malaysia 17.57 million MT which constitutes 87% of total palm oil production. Thailand produced 1.31 million MT followed Nigeria (0.870), Colombia (0.802), and Papua New Guinea (0.47 m MT).

Ivory Coast, Ghana, Myanmar, Philippines and Brazil also produce palm oil in significant quantities. The global average in the year 2000 was 3.32 MT oil/ha/year. During 2000, the average yield was 3.63 MT oil/ha/year in Malaysia, 3.45 MT oil/ha/year in Indonesia, 4.23 MT oil/ha/year in Papua New-Guinea and 4.11 MT oil/ha/year in Costa Rica. This also has considerably increased due to the development and cultivation of high yielding hybrids in Malaysia but decreased many other countries.

Early Trade

The oil palm industry was very largely centered on Africa until the time of World War II. The origin of the trade is an interesting story. The Portuguese founded a fort at Elmina in Ghana in 1482, and reached Benin City in southern Nigeria in 1492, but the commercial opportunities were small compared with those in South America or the Spice Islands in present-day Indonesia, and the Portuguese interest remained fairly small. Nevertheless, other countries also built forts and settlements along the coast, especially after the West African slave trade started in 1562. The trade diminished greatly after 1807, when the slave trade was banned in British possessions and ships. During the whole of this time palm oil was used in international trade only as food for the slaves.

After 1807 the slave trade became progressively more risky and alternative commerce developed, in which ivory and timber were then the most important commodities. In 1790 less than 130 t of palm oil was imported to England. There was virtually no knowledge of it or of its uses, or even an accepted name for it in English until 1804. Trade restrictions, the small number of traders, the serious danger of disease, and the lack of access to the interior for the European traders, and the continuing illegal, but profitable, traffic in slaves to South America prevented any major developments. A fluctuating level of trade continued until the 1830s. After that the British Government deliberately encouraged the oil palm trade, although a decreasing illegal slave trade to the Americas continued until the palm oil trade finally took off in the 1850s. Palm oil was exported from the Benin River, from Bonny and from the Caliber River in growing amounts, the whole area becoming known as the Oil Rivers. The final demise of the slave trade was in large measure due to the fact that there was a profitable and thriving alternative trade immediately available.

The early trade was conducted by traders from their ships, because of the great danger of disease on the West African coast and the uncertainties of living on the land. The control of all trade on land lay wholly with local chiefs and middlemen in the ports, and the quality of oil was therefore very variable. Later land-based expatriate trading posts were established after a British Consul was appointed for the Oil Rivers Protectorate. The trade was around 12,000 t/year in the 1830s, but reached 30,000 t in the 1860s and 87,000 t by 1911. This growth was partly due to improved communications and security in southern Nigeria, where the oil palm trade was profitable to farmers, who responded actively to good prices by increasing the supply of oil .It, was also due to economic development and new inventions in northern countries, which greatly increased the demand for the oil. Palm oil was wanted for soap, candles, margarine, lubricants for machinery and industrial processes. Prices in the 1860s were around £40/t, in real terms far higher than the present world price.

The demand for palm kernel oil also increased sharply. Exports of kernels started in 1832, the kernels being produced by African women who cracked the nuts one by one. The trade rose rapidly, so that by 1905, 157,000 t of kernels were exported by British territories in West Africa, and by 1911 this had reached 232,000 t valued at £3,400,000. The quantities of kernels were much larger than those of oil, relative to the production of the palms, probably because of the large local consumption of the latter. The export of both oil and kernels increased gradually to a maximum before and after World War II, during which demand was extremely high, but it declined gradually in the decades afterwards.

Here, the word 'domestication' is used in a rather unusual way, because all the main crops that have been farmed for millennia are still giving increasing yields today, although there is no doubt that they have been 'domesticated' for a very long time indeed. The first importation was 32 barrels of oil in 1590, and soap was made from it as early as 1589. Its main use came 200 years later, when by the 1830s almost all soap made in Britain was from palm oil. A little later in the century it became normal to use it for candles, composed largely of palmitic acid, although they were called 'stearic candles'. In extreme situations these can also be used as food. At one time palm oil was used to produce lighting gas. By the middle of the nineteenth century new uses were being invented rapidly, including as lubricants on the railways and as a flux in the tin-plate industry, which grew on the need for canned foods. Later, margarine was developed, producing another large demand. Glycerol (glycerine) from palm oil had numerous uses of its own. This explosion of demand for palm oil that really ended the slave trade in West Africa, as local chiefs found it more profitable to export the oil.

Palm Oil import during the last 10 years increased tremendously from 11.245 million MT in 1998 to 36.177 million MT in 2009. In the same way export of palm oil also increased from 10.898 million MT to 36.210 million MT for the same period.

Indian vegetable oil situation is different. The following table clearly shows that the demand is increasing continuously and we are all the time importing oils particularly palm oil (Table 1 and 2).

Even though, India started commercial Oil Palm cultivation in the year 1960 at Thodupuzha, in 60 ha and subsequently in 3705 ha in Kollam District in Kerala State and in 1500 ha in Little Andaman during1980 s the cultivation did not pick up since the performance was not encouraging and also the Government of India did not permit the conversion of forest land to Oil Palm. The concept of irrigated Oil Pal put forth by me worked out in 1985 and thereafter irrigated Oil Palm as small and

Table 1: India's vegetable oil Supply & Demands ('000 MT)

I*NDIA's S&D for*	*2007-08*	*2008-09*	*2009-10*	*2010-***11**
Opening Stock	750	1025	1250	1430
Production	7,145	6,680	6,260	6965
Imports	**6,300**	**8,640**	**9,240**	**8800**
Consumption	12,995	14,920	15,220	15720
Exports	175	175	100	100
Ending Stocks	1025	1250	1430	1375

Table 2: The break- up of various oils imported ('000 MT)

000 tonnes	2010-11	2009-10	2008-09	2007-08	2006-07
Soya	1000	1660	990	750	1335
Palm	7000	6700	6770	5270	3665
Sunflower	550	630	590	30	200
Laurics	250	250	240	200	200
Others			50	50	215
Total	8800	9240	8640	6300	5615

marginal farmers' crop have come up first in Andhra Pradesh. Subsequently, Oil Palm Demonstration Project of 1000 ha each in three states *viz;* Andhra Pradesh , Karnataka and Maharashtra and Oil Palm Development Project (OPDP) from VIII th Five Year Plan , implemented in 11 potential states have resulted in bringing out 1.64 lakhs ha of Oil Palm. It is envisaged that one million ha to be brought under oil palm in another 10 to 15 years which may produce 3.5 to 4.5 million MT of palm oil and 0.35 to 0.45 million MT of palm kernel oil .

Consumption of vegetable oil is income elastic and population is also increasing continuously which definitely result in more demand for vegetable oil in the country. So India will have more domestic market rather than export. Indian oil palm growers are having assured mark*et al*l the time and the price also is fairly good compared to many other crops. The marketing arrangement for oil palm fruits are set. The farmers after harvest hand over the Fresh Fruit Bunches at the collection centres set at different places by the processors. The fruits will be weighed in the presence of farmer and money will be remitted in the bank account with in two weeks. This system is working well and farmers are not having any problem for marketing. Palm oil use as bio fuel is yet another area gaining more demand. Marketing and export after meeting domestic problem will not a problem.

Export of Grapes: Issues and Strategies

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Among the fruit crops, table grapes have acquired important position in the export arena. Commercial table grape cultivation in India is restricted to tropical belt comprising Maharashtra, Karnataka, Tamilnadu and Andhra Pradesh states. About 94 per cent grape is cultivated in this belt. Other than these states few pockets of Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Madhya Pradesh and Mizoram are also growing grapes. The current area and production under grapes in India is estimated at 84000 ha with an annual production of 1878000 tonnes. While 74.5 per cent of grape produced is available for table purpose, nearly 22.5 per cent is dried for raisin production, 1.5 per cent for winemaking and 0.5 per cent is used for juice. The grape export from India started in 1991 with the initiation of economic liberalisation. The major importers of Indian grapes are UK, The Netherlands, Germany, USA, UAE, Saudi Arabia, Qatar, Oman, Bahrain, Sri Lanka, Bangladesh, Mauritius, Singapore and Hongkong.

Table 1: Country wise grape production during 2009-10

S. No.	Country	Production	Share (%)
1.	Italy	82,42,500.00	13.53
2.	China	73,84,656.00	12.12
3.	U S A	64,11,660.00	10.52
4.	France	60,00,000.00	9.85
5.	Spain	52,86,300.00	8.68
6.	Turkey	42,64,720.00	7.00
7.	Argentina	29,00,000.00	4.76
8.	Chile	25,00,000.00	4.10
9.	India	18,78,000.00	3.08
10.	Australia	17,97,012.00	2.95

Source: Food & Agricultural Organisation (FAO)

Table 2: Trend of grape export from India

Year	Quantity (t)	Value (million')
2007-08	96,963.57	31,78.252
2008-09	1,24,627.98	40,86.127
2009-10	1,31,153.64	54,53.386

Table 3: Major grape growing pockets in different states

State	District
Maharashtra	Nasik, Sangli, Solapur, Pune, Ahamednagar, Satara, Osmanbad
Karnataka	Belgaum, Bijapur, Bagalkot, Kolar, Bangalore
Tamil Nadu	Theni, Coimbatore, Dindigul, Dharampuri
Punjab	Bhatinda, Ferozpur, Muktsar, Sangrur
Andhra Pradesh	Rangareddy, Mehboobnagar
Haryana	Fatehabad, Sirsa, Hissar

Standards

Agmark: The Directorate of Marketing and Inspection gives this designation to agricultural and processed foods who comply the standards. AGMARK standards are available for fresh grapes also. Compliance of AGMARK standards is mandatory for export of grapes.

Grade Designation and Quality of Table Grapes

1. Table Grapes shall be fruits obtained from varieties (cultivars) of *Vitis vinifera* L.
2. Minimum Requirements

i) Bunches and berries of Table grapes shall be:

a) Clean, sound, free of any visible foreign matter;

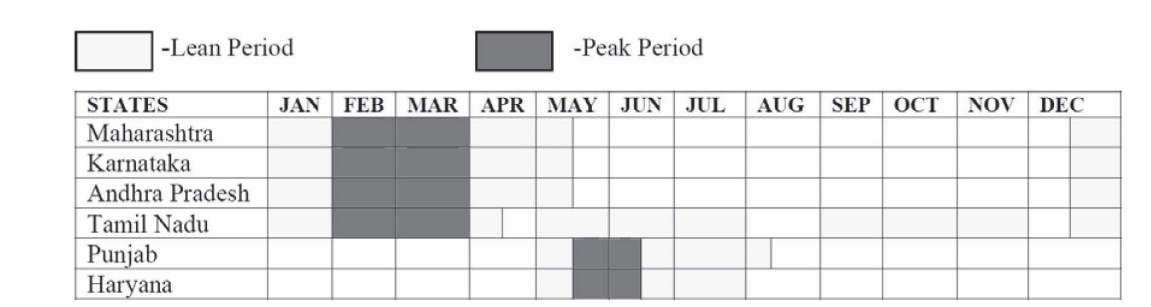

Fig.1: Harvesting period of grapes in various states

b) Free of pests, affecting the general appearance of the produce;

c) Free of damage caused by pests or diseases;

d) Free of abnormal external moisture;

e) Free of any foreign smell and/or taste;

f) Free of all visible traces of moulds;

ii) Berries shall be intact, well formed and normally developed;

iii) Table grapes shall comply with the residue levels of heavy metals, pesticides and other food safety parameters as laid down by the Codex Alimentarius Commission for Exports.

Table 4: Criteria and description of grades
According to Agmark standards grapes are classified into following classes:

Grad edesignation	*Grade requirements*	*Provision concerning sizing*	*Grade tolerances*
Extra class	Grapes must be of superior quality. The bunches must be typical of variety in shape, development, colouring and have no defects. Berries must be firm, firmly attached to the stalk, evenly spaced long the stalk and have their bloom virtually intact.	As per table '5'	5% by weight of bunches not satisfying the requirements of the grade, but meeting those of class I grade or exceptionally coming within the tolerances of that grade.
Class I	Grapes must be of good quality. The bunches must be typical of variety in shape, development and colouring. Berries must be firm, firmly attached to the stalk and, as far as possible, have their bloom intact. They may, however, be less evenly spaced along the stalk than in the extra class. Following slight defects may be there, providing these do not affect the general appearance of the produce and keeping quality of the package.- a slight defect in shape.- a slight defect in colouring	-do-	10% by weight of bunches not satisfying the requirements of the grade, but meeting those of class II grade or exceptionally coming within the tolerance of that grade.
Class II	The bunches may show defects in shape, development and colouring provided these do not impair the essential characteristics of the variety. The berries must be sufficiently firm and sufficiently attached. They may be less evenly spaced along the stalk than Class I grade. Following defects may be there, provided these do not affect the general appearance of the produce and keeping quality of the package. - defects in shape- defects in colouring- slight sun scorch affecting the skin only,- slight bruising,- slight skin defects	-do-	10% by weight of bunches not satisfying the requirements of the grade, but meeting the minimum requirements.

Foot Note: Pigmentation due to sun is not a defect.

iv) Table grapes shall have minimum soluble solids of 16 degrees Brix.

v) Table grapes shall have minimum sugar/ acid ratio of 20:1.

Provision Concerning Sizing

Size is determined by the weight of bunches (in g). The following minimum (in g) requirements per bunch are laid down for large and small berries grapes.

Table 5: Provision concerning size

Grade	*Large Berries (g)*	*Small Berries (g)*
Extra class	200	150
Class I	150	100
Class II	100	75

Size Tolerance

Extra Class, Class I, Class II: 10% by weight of bunches not satisfying the size requirements for the grade, but meeting the size requirements for the grade immediately below.

Documents Required for Export

Documents Related to Goods

a)Invoice b) Packing List c) Certificate of origin

Documents related to shipment

a)Mate Receipt b) Shipping Bill c) Bill of handing d) Airway Bill

Documents related to Payment

a)Letter of Credit (L/C) b) Bill of Exchange

Documents related to quality of goods

a)Phytosanitary Certificate b) GLOBALGAP Certification c) Health Certificate

Organic Certification

a)Certificate indicating material produce is based on organic farming in case of organic produce.

Documents related to Foreign Exchange Regulations

a) GR Form: Documents required by RBI which assures to RBI that the exporter will realize

b) The proceeds of goods within 180 days from the date of Shipment.

Other Document

a) Bank Realization Certification (BRC): This is the advice given by Foreign Exchange Bank after the realization of money from Importer.

Food Safety Issues: Before establishment of Food Safety and Standards Authority of India, the issues related with food safety were not addressed in organized manner. Now FSSAI is looking these aspects very keenly. But in European Union food laws are very strict. The MRL values of pesticides are most important factor for grape export. Being an exporting country, the compliance of food safety system in grape export chain is primary responsibility. In India, the food safety in table grapes is ensured through a unique pre-harvest residue monitoring system called Grapenet. Grapenet is the first internet based residue traceability software system established in the country, for monitoring of pesticides in fresh table grapes for export to the European Union countries. This software was developed by APEDA with inputs from all the stakeholders in grape industry. This is first of its kind initiative in India that has put in place an end-to-end system for monitoring agrochemical residues, achieve product quality standardization and facilitate tracing back from retail shelves to the farm of the Indian grower through various stages of sampling, testing, certification and packing.

National Research Centre for Grapes – Leader in agrochemical residue management in the country: Since its establishment in 1997, the National Research Centre for Grapes is actively monitoring the residue dynamics of various agrochemicals in grapes and environment to ensure their safe usage in viticulture in the country. In 2003-2004, this institute was designated by APEDA, Ministry of Commerce, Government of India as the National Referral Laboratory (NRL) for monitoring of pesticide residues in table grapes to be exported to European Union countries. Initially the mandate pertained to pesticides for the management of diseases and insect pests, which were subsequently expanded in 2010 to monitor the residues of plant growth regulators also. Apart from the recommended agrochemicals in table grape, other chemicals listed under the Central Insecticide Board, Govt. of India are also tested to check their misuse or as contaminant in this crop. Besides conducting the residue trials on new generation agro-chemicals, this Centre also surveys

the table grapes from local markets, pack-houses, etc. and screens their status with regards to residue contamination. A field level representative sampling technique has also been standardized by this institute for residue monitoring which is unique in its approach. In this, it was found that 5 kg samples comprising of small bunches drawn randomly from all over a vineyard area of 1 ha resulted in sampling imposed variations in residue contents with relative standard deviation of \<12%, which was satisfactory considering natural variations. This could minimize lab-to-lab variation during the monitoring results for any specific farm.

After the establishment of this Centre, the quality of Indian grapes has improved significantly. The extent of export as well as price realization by the growers also improved with the implementation of Grapenet traceability system. The export realization increased from US $ 78.54 (2007-08) to 115.03 (2009-2010). To minimize pesticide residues in grapes, this Centre prescribes the followings.

- Use only the recommended and approved pesticides that has label claim for usage in grapes as per the registration with the Central Insecticide Board and Registration Committee, Union Ministry of Agriculture, Government of India
- Do not spray banned as well as non-recommended chemicals
- Strictly adhere to the recommended dose of application including the recommended volume of water to be sprayed on per hectare or per acre basis based on canopy of vine.
- Strictly maintain recommended Pre-Harvest Interval to minimize consumer risk regarding detection of residues.
- Promoting Integrated Pest Management
- Sequencing the pesticides in relation to their persistence particularly in the last 2 months period before harvest.
- Adoption of Bio-control measures during last 30 days before harvest
- Managing the usage of pesticides and PGRs very carefully in last 60 days before harvest to ensure the MRL compliance of EU countries.

Measures for enhancing competitiveness for exporting grapes: Following measures need to be adopted for enhancing competitiveness for exporting grapes.

- Competition of India is with countries like Chile, South Africa and Israel, which produce quality grapes. Therefore, India must maintain superior quality free from pesticide residues etc. for keeping up momentum of exports.
- There is huge demand of grapes in Hong Kong, Singapore, Malaysia etc., India needs to exploit this opportunity, by holding fruit shows, exhibitions and buyer- seller meets frequently.
- India needs to enhance its competitiveness by making grapes available during Ramzan period in Middle East countries and in Malaysia, Indonesia etc., by altering pruning time for fruiting.
- India can further enhance its competitiveness by economizing on logistics by exporting from eastern port to South East Asian countries and by intensifying production in Andhra Pradesh.
- Similarly, grapes can be made available during Christmas period by changing pruning time for fruiting.

Linking Flower Growers to Market-an Innovative Approach

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Flowers are intricately entwined in the social fabric of our country and no function is complete without flowers. The domestic industry is growing at annual rate of 7-10%. Currently the turnover is around Rs 1000 crore. The area under production of flowers is around 1.60 lakhs hectares confined mainly in Tamil Nadu, Andhra Pradesh, Maharastra, Karnataka and West Bengal with a production of 8,70000 MT of loose and 4.3 millions of cut flowers. *(NHB: Indian horticulture database, 2008).* The floriculture sector is highly disorganized and no systematic data is available at present. Globalization of the Indian economy and subsequent liberalization of Seed Act paved the way for the advent of protected cultivation in India during early 1990s. The scope of floriculture in India has increased tremendously, which is evident from the 220% increase in area from 53, 000 ha (1993- 94) to 1, 60,720 ha (2007-08) and more than 270% increase in loose flower production (2, 33,000 in 93-94 to 870 M. T. in 2007-08 and 680% increase in cut flower production (555 in 93-94 to 4342 million nos. in 2007-08).

India is endowed with different climatic zones, good quality soil and water, sufficient sunshine; low costs of labour, infrastructure and investments and, hence, there is great potential for the ornamental based industry. The human resource, which is the chief determining factor for any industry, is readily available here. The huge skilled manpower base can be successfully employed for implementation of new technology with relatively reasonable emoluments. The wage level in India is nearly 10.5 times cheaper than that of similar employees in the Netherlands and Japan. Moreover, India is having the largest pool of technically qualified people in the world. In spite of these advantages, India's share in the world flower market is 0.7 per cent only.

Floricultural Enterprises

Loose Flowers

The consumption of traditional loose flowers especially of marigold, China aster, jasmine, crossandra, barleria, etc. has increased tremendously (>90% of total flower crops area). This sector, despite of its potential, is still unorganized. Efforts are to be made to develop organized marketing and, research is required on developing high yielding varieties for year round production particularly in chrysanthemum, China aster and marigold and in promotion of crops like annual chrysanthemum, *desi* rose, etc.

Protected Cultivation

Though High-tech cultivation of cut flowers in protected green houses is limited in area (5% of total flower crop area), it contributes significantly to total floricultural exports. At present, there are about 110 export-oriented floricultural units in operation covering an area of 500 ha. These units are growing mostly roses, but can be diversified into other crops like orchids, anthurium, etc. as the demand for tropical flowers is increasing worldwide. India has several advantages and great potential to increase the acreage under intensive production and ultimately to increase the floricultural exports, provided the units are opened in ideal locations with sound technological back-up.

Growing high Value Flowers

The farmers with small holdings can take

advantage of growing high value flowers to get higher return per unit area as these products fetch a very high price. The flowers like asiatic lily, protea, heliconia, bird of paradise, etc. can be successfully grown under the favorable climatic conditions to improve their livelihood from the limited cultivable land.

Dry Flowers: An upcoming Industry

Presently the dry flower industry, though have huge potential for export as well as for domestic market, is not well organised and depends on the plant material available naturally in forests and no systematic growing of specialised flowers exists anywhere in the country. This alarms fear of extinction of these targeted species. As the demand for dry flowers is increasing at an impressive rate of 8-10%, thus there is a great scope for the

Indian entrepreneurs. Dry flowers constitute more than two third of total floricultural exports from the country. For making dry flowers; flowers and plant parts are generally collected from wild sources. Some flowers that are used for air-drying include Dahlias *(Dahlia hortensis)*, Poppy seed heads *(Papaver somniferum)*, Roses *(Rosa)*, Delphinium, Lavender *(Lavandula augustifolia)*, African Marigold *(Tagetes erecta)*, Strawflower *(Helichrysum bracteatum)*, Cornflower *(Centaurea cyanus)*, Statice *(Limonium sinuatum)*, Globe amaranth *(Gomphrena globosa)*, and Lotus pods etc.

Flower Seed Production

Seed production of seasonal flower crops offers higher returns and is a lucrative business in some of the states. It is being done in considerable area in Punjab and Karnataka for export. Of late, their demand is also increasing in the domestic market. Development of varieties including F1 hybrids for novelty and higher yield, standardization of seed production technology meeting international certification standards are researchable issues to be addressed to.

Nursery Industry

Plant material of various kinds (seedlings, budded plants, rooted cuttings, bulbs, tubers, corms, annual seed, etc.) is required for commercial flower production, pot plant production (and their rentals), for adding to home garden and for landscaping (corporate landscaping, bio-aesthetic planting, etc.). Lack of quality planting material is one of the major bottle neck for not realizing the full potential of floriculture enterprise in India. This segment may not require much research, but, requires adequate extension for transferring the already developed technologies. On the research side, the use of PGR's can further be exploited in propagation and seed production of ornamentals.

Essential Oils

In India, flower crops grown for essential oil production are limited and include mainly rose, jasmine, tuberose, etc. *Rosa damascena* is exclusively cultivated for extraction of essential oils, rose water, attars, gulkand, etc. in certain pockets of Rajasthan and Uttar Pradesh. Research should be focussed on development of varieties with higher oil content and identification of superior clones and standardization of distillation methods for higher oil recovery. Further, diversification of more crops and standardization of production technology needs to be included in the research agenda. Promotion of this sector also encourages ancillary industries like steam distillation and use of indigenous technical knowledge (ITK) for making value-added products, thus generating large employment.

Natural Dyes from Flowers

Marigold pigments are widely used in the poultry feed industry to enhance the colour of the yolk of the eggs and also used in food and textile industry. Isolation of xanthophylls/carotenes from marigold, calendula etc. has been standardized. More crops and procedures can be standardized for full exploitation of native ornamentals. In some parts of the country *Butea Monosperma* (Palas) flowers are used as dye for colouring clothes. It is natural, safe and fast in dyeing.

Trends in Floricultural Marketing

The world economic scenario is changing very rapidly, influencing the international trade. Consumer perception is changing and marketing has become consumer-driven, which demands quality produce, cheaper price, better assortments, range of products and services. Traditional market is getting saturated, whereas increase in expandable income in non-traditional areas is creating new markets. The challenges, therefore, are to widen the market-base and to capture the new emerging market. Being a new sector, floriculture faced several constraints in its development and it took time for people to appreciate the economic

importance of floricultural activity and its potential for yielding better returns.

The domestic market for flowers and potted plants is picking up very fast in the country due to the growing habit of the use of flowers, rise in population and uplift of general economic conditions. In addition to the use of cut flowers and loose flowers as gifts and for regular decoration, there is also an increase in demand for flowers and potted plants in the ever-growing commercial complexes, offices, business centres, banks, hotels, auditoria and conference rooms. The concept of Valentine's Day, Mother's Day, father;s day, Teacher's Day etc. is fast catching up in India also. One strong point in favour of commercial floriculture in India is the ever-increasing domestic market. By attaining excellence in flower production for export in volume, quality and standard over years of experience, the domestic market has enriched simultaneously in India. Reliable information on the statistics of domestic trade need to be channelized.

Challenges

The Asian growers could easily loose their large European market, in view of the strong competition from growers from Africa and Latin America, who may have lower freight costs and no or little import duty to pay. Importers will rely the flowers from cheapest source. In addition, the growers in Holland, with the advantage of producing right in the heart of the most developed market with low or no transportation cost or duty, would always enjoy the best marketing opportunity. The Japanese and the US markets with relatively low import volume will continue to satisfy their supplies from nearby countries. The other growing Asian markets like Singapore, Hongkong, South Korea, etc. are hardly in a position to accept large volumes. One also needs to consider the emerging new markets in Middle East countries and Russia. Domestic market could be developed, but without international market it would benefit little. Therefore, challenges are to be competitive through innovations and strategic marketing which should address all the links in chain including cooperation.

Emerging New Market

The development of floriculture in India, China, Vietnam etc. is backed by a potential domestic market. Unlike to that of traditional growing countries of Europe, America & Africa where domestic trade is saturated, but the market potential in the Asian countries offers opportunities for supplying to the local market as well. This unique development is on account of the rapid strengthening of economies in the region, high population densities, and the consumer perception. It is to be expected that consumption will grow further and increased supply over demand may create marketing problem. In order to address this, it is essential that marketing strategies with standard quality, post-harvest technology management skills and supply chain management are developed.

Changing Marketing Patterns

Florist shops selling mainly regular products in the past have been taken over by big retailers and it will have impact on the distribution and commercial processes related to the trade. As unlike of small quantities supplied to the retail florist shops, big retailers shall demand large quantities at fixed price and times. This would put pressure on the traditional market places, such as auctions and retail markets. The commercial transaction and distribution of production will be separated, which will result in changes to new distribution structures in the near future. The information technology will have to support this development where virtual market will emerge, requiring branding and certification of product to ensure quality and delivery. Entry of many enterprises in the floriculture market is of prime importance for increasing globalization of floriculture market, which has led to more competition. This leads to more opportunities and better options for consumers.

Ensuring Products Quality

The plants of new varieties were available, though at exorbitant cost in the past. However, the situation has eased with several leading floriculture companies granting plant multiplication rights to established companies in other nations. This has been a welcome step for enhancing the availability of quality plants, but it adds to cost. During the last five years, there has been a consistent growth in the number of flower producing countries, particularly among the developing nations in Asia, Africa and Latin America, which has remitted higher supply thus reduced prices. With a highly perishable product like flowers, even a small over-supply can have a dramatic effect on prices. Thus, the challenges are to regulate production as per the consumer, create more demand by promotion

of flower products. Domestic market has to be strengthened to absorb the products not meeting the high standard of export market to cushion the risk in marketing. Traditional markets like the USA, Japan and Europe will be more critical regarding qualities and environmentally friendly production and a wider assortment. Therefore, quality regulation and supply chain management have to address the challenges.

Marketing Database

Since, market is going to be highly competitive requiring advance planning for production and shipment, reliable data of production, sales and consumer requirement would be essential. More consumer focus, rather than production focus, is necessary to increase per capita floral consumption. Regular market information is needed to expand markets, in past all the efforts were targeted at advancement of production technology but market focused approach having backward and forward linkages are the need of the hour.

Boosting Floricultural Trade

Rapid technological agri-business, international economic integration, saturated markets and free market mechanism have provided opportunity, but also the challenges. Retailing on markets will be more complex. Service, quality and reliability would be an essential factor for securing position in international market. Producers have to organize the production so as to supply the necessary quantities according to the required quality standards. Any parties in the chain, which do not contribute to higher added value, will disappear. The advantages of large-scale market could be found for efficient purchasing process and also in terms of logistics and use of information technologies. Accordingly, our efforts have to be directed to harness the potential through strategic promotion of market. Strategies could be for policy support, infrastructural development, professionalism in market management, networking of markets and quality assurance.

Ensuring Quality of Product

Branding, grading, packaging, transporting, quality control, supply assurance, market development, market promotion and research have to be given priority. Successful and experienced entrepreneurs have to take a lead in forming consortia to develop strategies for marketing. Branding of products ensures quality of produce and makes the product acceptable to consumer. But branding would need promotion to get the trust of consumer about reliability of indigenous ornamental plants. China has an abundance of wild and garden plants, which can be developed into cut flowers. It has already come with such products. In India, many of the specialty cut flowers having great market potential, can be easily grown. But promotion would be needed.

Development of Professional Skill and Knowledge Management

Opportunities for cut flower development in India. This would need professional skill, which could be achieved through training of personnel for different types of production management, varying post-harvest handling and marketing. Dissemination of pertinent information would be needed to manage production. Therefore, a key factor for realizing production opportunities is effective human resource development supported by public and private sectors. Thus educational institutions or organizations could facilitate dissemination of information to management of flower euprpreurers or provide training of technical personnel involved in operations. Enlisting the support of floriculture professionals from outside to coordinate activities in research and education for the purpose of furthering floriculture development would have significant impact on the pace and scope of cut flower development in the country.

Promotion of Flower Uses

Currently flowers are used as gifts on special occasions, meetings, celebrations, Valentine days, Christmas, marriage etc. To promote the use of flowers, it would be essential to have national campaign attached with various occasions besides promoting the impact of authentic values on health and improving working efficiency. Product would also be desired to convey the messages, which could attract youth resultantly, and household consumption shall increase.

Government as Facilitator of Floriculture

The Government should provide support through policy environment, education, research and information services. The Government may have also to play a role in setting standards related to quality, environment and welfare. Barriers to international trade are removed to facilitate speedier delivery. Government should also

encourage growers' cooperatives and marketing through creation of infrastructure. Growers cooperatives shall analyze the market and keep continuous contact with domestic and foreign market players and organization in order to assist production and trade. Growers' cooperatives with support of government should promote market through advertising, participation in trade fair and public awareness campaigns, sales promotion and trade support. Both public and private research should be promoted keeping in view the need for innovation to be competitive.

Government Initiatives for Floricultural Development

A major initiative for floriculture development was taken during the VIII Plan by launching a Central sector scheme on Development of Floriculture with an outlay of Rs 14.3 crore. The scheme was continued during IX Plan and was subsequently subsumed under Macro Management Scheme. Area expansion under open field conditions, protected cultivation, setting up of Model Floriculture Centres (MFC) and Human Resource Development are some of the activities taken up under the scheme.

Area expansion of different types of flowers such as cut flowers, bulbous flowers and loose flowers is being promoted under the scheme. The area expansion programme is backed up with programmes for production of quality planting material through nurseries and tissue culture units. The NHM Scheme has enabled the coverage of 0.697 lakh ha of flowers, so far.

There are provisions of taking up protected cultivation of horticultural crops under the NHM and TMNE schemes, which is being utilized for cultivation of flowers also under greenhouse conditions. The pattern of assistance for greenhouse cultivation is @50% of cost to the small and marginal farmers and 33% to other farmers. Two types of green-houses, viz. hi-tech greenhouse with a cost ceiling of Rs 650/m2 and normal greenhouse (Rs 250/m2) could be constructed under the schemes.

The National Horticulture Board (NHB) has also been providing credit-linked back-ended capital investment subsidy @ not exceeding 20% of the total project cost with a minimum limit of Rs 25 lakh per project (Rs 30 lakh per project in North-Eastern states) for taking up commercial projects on hi-tech horticulture, of which floriculture is a key sector. This has resulted in a large number of entrepreneurs coming forward for taking up projects on floriculture, particularly in Gujarat, Karnataka, Maharashtra, Tamil Nadu and Uttarakhand. The details of projects sanctioned by NHB during 2008-09 are given in Table 3.

With a view to provide a forum for addressing the problems of flowers growers, the Government of India has facilitated the formation of 19 Growers Associations under the ambit of the Confederation of Indian Horticulture. The Flower Growers Association and The Orchid Society of India are among these, which are actively involved in development of floriculture sector in country.

Export Promotion

The APEDA, under the Ministry of Commerce, has been actively involved with the growers and exports to boost the export of flowers, particularly to Europe, Japan, America, Australia and Singapore. The APEDA is implementing a number of schemes for export promotion of agricultural produce, including floriculture products. Of which, the schemes on Market Development and for Infrastructural Development provides assistance mainly for strengthening the infrastructural facilities. Under Market Development Schemes, 100% assistance is being extended for packaging development and dissemination of market information, whereas 25% assistance is being provided to exporters for the use of packaging material as per the specified standards. Under the Scheme for Infrastructural Development, assistance is being provided @25% of cost for setting up various types of infrastructural facilities. The APEDA is also implementing the programme on Agri Export Zones (AEZs). So far, six AEZ for floriculture has been set up, one each in Uttarakhand, Maharashtra, Karnataka and Sikkim and two in Tamil Nadu.

Setting up of AEZ, besides developmental programmes in the NHM clusters has provide an impetus in international trade of floriculture. The floriculture exports have registered a significant increase, from Rs 249.6 crore during 2003-04 to Rs 649.8 crore during 2006-07. The export earnings for April-September 2008 has been to the tune of Rs 187.9 crore. The North-Eastern states have also made significant inroads in the export of flowers like Anthuriums, orchids and roses to japan, Europeand the Middle East. The details of quantity and value of exports of floricultural items is given in Table 4.

Conclusion

Floriculture, which includes production and trade of cut flowers, potted plants, foliage, dried flower and plants, bedding plants and stashing material (bulbs, plantlets and seed), is experiencing a rapid change with growing per capita expendable income. Consumption of flowers has increased both in traditional and non-traditional centres. With increasing demand, production centres have expanded from traditional centres (USA, Japan, the Netherlands and Columbia) to new centres, Latin America, Africa and Asia. In Asia, India China, Vietnam and Sri Lanka are moving in direction of intensive floriculture. New consumption centres are also emerging in Asia and Eastern Europe. The scenario provides opportunity to capitalize on the strength and convert weaknesses into opportunity, However, in consumer-driven market, quality of service and delivery system will play a significant role. Marketing is no more a meeting of buyer and seller, but it is complex, which is driven by quantity of product and reliability of delivery. New distribution structure with the aid of IT is likely to be in place, which would be a virtual market, demanding branding, cataloguing and quality assurance.

All these developments provide opportunity for production and marketing. This would need strategic marketing approach having backward and forward linkages coupled with horizontal and vertical integration. By providing sufficient attention and support, attaining the goal of reliable production of high-quality product consistent in quantities could be attained. Resultantly, Indian flower sector would soon become a major player in the region as well as in European flower market. Moreover, given the rapidly increasing rate of spending among Asian consumers for cut flowers, it is also reasonable to expect that the Asian flower industry will soon surpass consumption rate for cut flowers compared to other regions. Stronger commitment, in terms of education, research, funding and communication would be a driving force to become a leader of commercial floriculture worldwide, in years to come. The challenges are to capture emerging trend in marketing through innovation and skilled professional management. Therefore, strategies to promote effective marketing should include, quality assurance, transportation hub development for effective delivery, institutional support for information and training, specialty production, reducing cost and widening products, developing domestic market, promoting indigenous plants and flowers, developing professional skill and knowledge management, promoting uses of flowers and providing policy support product and delivery. Therefore, there is a need for quality products and delivery and to develop quality certification system, as developed in Holland, which ensure the quality for the brand. This would accelerate the demand for the product.

Climate Change - Adaptation and Mitigation Strategies for Environmentally Sustainable Livestock Production

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Livestock sector in India is vital for rural economy as it supports employment generation, social as well as nutritional security to the millions of resource poor farmers who are engaged in farm operations. In order to provide nutritional security through animal protein in the form of milk, meat and egg, increasing livestock and poultry production and productivity is the need of the hour. India houses 16.10, 56.50 and 16.50 percent respectively of world's cattle, buffalo and goat population occupying first position in milk, 3rd in egg and 5th in broiler production in spite of the production system being predominantly based on agro-by-products and crop residues. Medium to large herds of cattle and buffalo, however exist in the periphery of large towns and cities mainly for supply of milk (peri-urban system). Small ruminants and pigs are reared under extensive and semi-intensive systems of production. Resource-poor small and marginal farmers and landless labourers' are the main custodian of the livestock owning 71% of cattle, 63% of buffaloes, 66% of small ruminants, 70% of pigs and 74% of poultry. The vast number of livestock associated with production systems based on crop residues and agricultural wastes is a cause of major concern as this is going to add to the total pool of Green House Gases(GHG). The major contribution to GHG's from livestock is CH_4 due to enteric fermentation. In addition to the green house effect of methane, it also represents a loss of 8-12% of the gross energy of feed given to the animals. The excreta of animals, if not properly managed also contribute significantly to green house gases. On a global scale, agriculture and in particular enteric fermentation in ruminants (predominantly cattle and small ruminants) produces between 21 and 25 per cent of the total anthropogenic emission of methane. In India, out of the total 27 per cent GHG emission from agriculture sector, 40 per cent is estimated to be the contribution from its 485 million livestock which amounts to about 10.4 to 10.6 million tons, the major contribution coming from cattle and buffalo (92%) and rest from small ruminants (7%). Singh (2001) reported that methane production by Indian cattle, buffalo, sheep and goat was 76.7, 97.0, 11.6 and 10.1 g/head/d, respectively. The notable fact is that by 2012 India shall be bound by the restrictions of the Kyoto protocol that makes it mandatory to restrict our methane emission to a specified level and this might be much lower than the present level of methane emission. Therefore, for economic and eco-friendly livestock production, it is essential to minimize the production of methane and other gases to conserve nutrients and protect the environment.

Generation of a database on methane production under different production systems adopting a common protocol would be useful in drawing mitigation strategies. The possible strategies to mitigate methane emission from the livestock are: replacing non-productive or low productive livestock with high productive livestock, enhancing degradability of poor quality roughages, use of alternate hydrogen sinks, feed additives like Ionophores, plant secondary metabolites and chemicals and the use of biotechnology techniques. The other strategies could be ration balancing and strategic supplementation of feeds.

The most obvious adaptation strategies due to climate change are the study on shelter management. Development of information system on the animal responses to Temperature Humidity

Index (THI) under different agro-ecological zones and allele mining for biotic stress are few options which could determine the type of livestock suitable and adaptable in different agro-ecological conditions. Research on development of molecular markers like Heat Shock Protein (HSP) to assess the animal response to heat stress is important to suggest adaptive strategies.

Methane Mitigation Strategies

Management of the H_2 production in the rumen is the most critical factor to be considered when developing strategies to control ruminant CH_4 emissions (Joblin, 1999). It should therefore be possible to reduce CH_4 productions by inhibiting H_2 liberating reactions or by promoting alternative H_2-using reactions or routes for disposing of H_2 during fermentation (Boadi *et al*., 2004).

Nutritional Strategies

Strategic Supplementation of Limiting Nutrients

The nature and rate of fermentation of carbohydrates influence the proportion of individual VFA formed and thereby the amount of CH_4 produced in the rumen. Johnson *et al.* (1996) reported that fermentation of cell wall carbohydrates produces more CH_4 than fermentation of soluble sugars, which produce more CH_4 than fermentation of starch. This is a consequence of decreased rates of ruminal fermentation and passage out of the rumen that favour a higher A : P ratio. On the contrary, high grain diets fed at high intake levels are associated with high rates of ruminal digestion and passage that favour higher propionic acid production (Hegarty and Gerdes, 1998). They also reported that supplementation of UMMB to paddy straw reduced CH_4 emission in Sahiwal calves. Singh (2001) reported reduced CH_4 emission from lactating cows following the supplementation of their diet with UMMB. When brewer's grain was added to timothy hay (60 parts) and corn (25) based diet, there was reduced CH_4 emission by goats. Maximum reduction (12%) was recorded in freeze dried brewers grain when compared to those dried at 60°C (10%) or 130 °C (8%) (Bhatta *et al.*, 2007). Strategic supplementation of limiting macronutrients from locally available concentrate supplements (grains of finger millet (Eleucine coracana)) improved milk yield in lactating crossbred cows by 12% with concomitant decrease in methane production (unpublished data). Thus optimizing the diet to match production level will reduce CH_4 production. However, the decision to increase grain component in ruminant rations to reduce CH_4 production in India, must take into account the importance of ruminants in converting fibrous feeds unsuitable for human consumption to high quality protein.

Addition of Oils and Fats

Oils are rich source of energy, but some of the components of oils have anti-microbial activity and oils in general also have anti-fibrolytic activity and therefore, free oils cannot be fed beyond a certain level. Oil cakes are a better source of feed ingredients which can be included in the ration of animals to increase energy content and a rumen modifier. Kumar *et al.* (2007a) tested eight oil cakes to study their effect on *in vitro* methanogenesis using a substrate of wheat straw and oil cake in the ratio of 75:25, respectively. Soybean cake containing diet showed the highest and castor bean cake (expeller extracted, EE) the lowest gas production. The methane production was highest with soybean cake followed by cotton seed cake, groundnut cake, mustard seed cake, castor bean cake (solvent extracted, SE), castor bean cake (EE), karanj cake (SE) and karanj cake (EE). The feed with soybean cake showed significantly ($P<0.05$) higher number of holotrichs in comparison to the other groups. Castor bean cake and karanj cake inhibited methanogenesis significantly, but these two oil cakes also affected *in vitro* dry matter degradability of feed adversely, which might be due to the presence of anti-nutritional factors. Therefore some detoxifying pretreatment is needed before these cakes can be included in the ration of animals. Beauchemin and McGinn (2006) reported that adding canola oil at the rate of 4.6% of dry matter intake inhibited methane emission by 32% and decreased methane emissions as a per cent of gross energy intake by 21%, but this decrease in methane emission was primarily attributed to reduced feed intake and lower total tract digestibility of feed, especially the fibre component.

Effect of Diet

Methane generation in rumen depends upon various feed factors like the level of feed intake, digestibility of feed consumed and total easily

degradable carbohydrates in the ration. In addition to these the ratio of cell wall components and easily fermentable carbohydrates is equally important for methanogenesis in the rumen (Torrent *et al*., 1995). The partitioning of fermentable dry matter (DM) between microbial protein synthesis and fermentation products would alter the pattern of hydrogen production and hence methanogenesis. Methane production (moles) increased as the proportion of dry matter fermented to short chain fatty acids (SCFA) increased and this was related to decreasing water soluble carbohydrate (WSC) to cell wall (NDF) ratio of the diet.

The degradation of lignocellulosic feeds is slower as compared to starch and high sugar containing diets and such poor quality feeds yield more methane (Czerkawski, 1969). Methanogenesis decreases with improving the quality of feed either by increasing the digestibility of lignocellulosic feeds by some chemical (Moss *et al.,* 1994) or microbiological treatment or by replacing these feeds with good quality concentrate feeds (Cecava *et al.,* 1990). The inhibition in methanegenesis is accompanied with increased propionate levels and decreased acetate to propionate ratios and better feed conversion efficiency.

Four green forages, 2 leguminous (berseem and cowpea) and 2 non-leguminous (maize and oats) were tested against control feed of wheat straw and concentrate mixture (1:1 ratio) in *in vitro* gas production test. Gas production (ml/g DDM) was significantly lower ($P<0.05$) in green forages as compared to control, but between the green forages, leguminous forages produced lower gas than non-leguminous forages. Methane production was similar in all the forages and control. Total protozoa count was the highest in control followed by maize and the least in berseem, cowpea and oats and was significantly lower in all the forages than that in control. Ammonia nitrogen released during fermentation of feed was significantly higher with leguminous green forages and control as compared to non-leguminous green forages (unpublished data).

Therefore, methane production can be lowered by manipulating the feeding strategies of livestock. Improved nutritional quality of feed is one such method which can be used to inhibit methanogenesis. Animals grazing the lowest quality pasture will produce the highest amount of methane per unit product (Kirschgessner *et al*. 1995). The treatment of paddy straw with urea resulted in a significant improvement in digestibility of nutrients and a significant depression in methane generation by the animals (Sahoo *et al*., 2000). Even the different roughage sources like paddy straw, sugarcane bagasse and wheat straw caused different levels of methane production. Paddy straw supported more methane production than the other two roughage sources tested (Chatterjee *et al*., 2006). Therefore proper selection of roughage source in the ration of ruminant may help in reducing methanogenesis to some extent. In addition to that inclusion of grain in the diet can be an option to reduce methanogenesis, but this option may have to be exercised with caution looking into the availability and their alternate use.

Species of forage and its stage of growth

McAllister *et al.* (1996) and Moss *et al.* (2000) noted that CH_4 production in ruminants tends to increase with maturity of forage fed, and CH_4 yield from the ruminal fermentation of legume forages is generally lower than the yield from grass forages. Robertson and Waghorn (2002) observed that grass maturity accounted for the increased proportion of GEI lost as CH_4 from cows. Selective grazing that is associated with grass maturity is also a factor to consider in the variation of CH_4 production. Bhatta *et al.* (2008) recorded lowest CH_4 production in goats fed sole Alfalfa hay when compared to those fed total mixed ration. The lower CH_4 loss observed with legumes compared to grasses can be attributed to the lower proportion of structural carbohydrates in legumes and faster rate of passage that shift the fermentation pattern towards higher propionate production (Johnson and Johnson, 1995). Different proportions of berseem (Singh and Mohini, 1999), maize and concentrate mixture (Singh and Mohini, 2004) with wheat straw decreased CH_4 production *in vitro*.

Complete feed blocks/ Total mixed rations

Feeding complete feed blocks comprising 70 percent roughage and 30 per cent concentrate ingredients could be an alternate approach as it ensures nutrient balancing leading to better productivity and lowering methane production by 10 per cent. Similar effects have been observed when animals are provided total mixed rations blended with roughage and concentrate feeds. This approach could be best suited under our conditions as it helps in better utilization of unconventional feeds, reduces wastage and helps in lowering methane production.

Manipulation of Rumen Fermentation

Ionophores

Mathison *et al*. (1998) described Ionophores as highly lipophilic substances, which are able to shield and delocalize the charge of ions and facilitate their movement across the membranes. Monensin is the most commonly used and studied ionophore, with others such as lasalocid, salinomycin and laidomycin (Singh and Mohini, 1994) also being used commercially. Ionophores that are added to ruminant diets to improve the efficiency of feed utilization have been shown to decrease CH_4 production (Mathison *et al*., 1998; Moss *et al*., 2000). The monensin feeding have been associated with the selective reduction of gram-positive ruminococci, and the proliferation of gram-negative bacteria with the concurrent shift in the fermentation from acetate to propionate and decrease in CH_4 production (Newbold *et al*., 1988). Cattle studies have shown that CH_4 production was not suppressed with prolonged or repeated use of ionophores (Van Nevel and Demeyer 1995) may be due to the development of resistance. Strains of rumen methanogens differ in susceptibility to monensin (Chen and Wolin, 1979) and prolonged use of antibiotic may simply select for non-susceptible strains (Boadi *et al*., 2004).

Defaunation

Defaunation, that is the partial/total elimination of protozoa from the rumen by dietary or chemical agents has been shown to reduce ruminal CH_4 production by about 20-50% depending on the diet composition (Itabashi *et al*., 1994). Protozoa in the rumen are associated with a high proportion of H_2 production, and are closely associated with methanogens by providing a habitat for up to 20% of rumen methanogens (Newbold *et al*., 1995a). The reduced ruminal methanogenesis observed with defaunation can be attributed to factors such as a shift of digestion from the rumen to the hindgut (Van Nevel and Demeyer, 1996) or the loss of methanogens associated with protozoa during defaunation (Hegarty 1999). However, this process could lead to reduced digestibility of poor quality roughages not much suitable where agricultural crop residues are the major roughage source.

Probiotics

The addition of *Saccharomyces cerevisiae* reduced CH_4 by 10% *in vitro*, but was not sustained over a long period (Mutsvangwa *et al*., 1992). The specific mode of action of probiotics is still not known. It has been proposed that probiotics provide nutrients, including metabolic intermediates and vitamins that stimulate the growth of ruminal bacteria, resulting in increased bacterial population (Newbold *et al*., 1996). Another theory indicates that probiotics stimulate lactic-acid- utilizing bacteria, resulting in a reduction of lactic acid and a more stable ruminal environment. The effects of probiotics on fermentation pattern are not consistent across experiments and between strains pf yeast (Newbold *et al*., 1995). Doreau and Jouany (1998) found no effect of *Saccharomyces cerevisiae* on fermentation in lactating dairy cows, while Takahashi *et al*. (1997) observed that a probiotic preparation significantly increased (+18%) CH_4 production in sheep. Although many commercial microbial preparations are available in India as ruminant feed additives, there is a necessity to establish their potential *in vivo* for reducing CH_4 production. Further, there is also a need to identify the dietary and management situations in which probiotics can give consistent production benefits and added effect of reducing CH_4 emissions (Moss *et al*., 2000).

Tannins, Saponins and Plant Secondary Metabolites

Tannins constitute one of the important secondary metabolites which have anti-microbial activity and are present widely in different groups of plants. More attention has been paid to condensed tannins in comparison to hydrolysable tannins, perhaps due to lower risk of toxicity. Tannins present in *Calliandra calothyrus* reduced nutrient degradation and methane release per gram of organic matter degraded in *in vitro* experiments in rumen simulation technique (RUSITEC) (Hess *et al.*, 2003) and the feeding of *Lotus pedunculatus (Lotus)* containing condensed tannins caused 16% reduction in methane production (Waghorn *et al.*, 2002). The condensed tannins in di*et al*so influence protein and cellulose degradation in the rumen. In studies with tropical forages, increasing levels of CT in the diet (0-2.3%) decreased N digestibility but had no effect on either feed intake, organic matter (OM) or neutral detergent fibre (NDF) digestibility (Perez-Maldonado and Norton, 1996). Tannins reduce fibre digestion by complexing with lignocellulose and preventing microbial digestion or by directly inhibiting cellulolytic

microorganisms. The effects of tannins on rumen protozoa are variable. Newbold *et al*. (1997) investigated that tannins were not responsible for the antiprotozoal activity of *Sesbania sesban* while Saravanan (2000) observed 75% reduction in the protozoal number in sheep fed on a diet containing 0.5% condensed tannins obtained from leaf extract of the plant *Uncaria gambier.*

Microbial activity in the rumen may be affected by the use of saponins. The microbial population increased by low saponins supply, but decreased when doses became excessive (Wallace *et al.*, 1994). The protozoal counts in rumen fluid decreased with higher saponin doses like with sarsaponin from *Y. schidigera* (Hristov *et al.*, 1999), quillaja saponin (Makkar and Becker, 1996) and with saponin rich plants or fruit pulp (Kamra *et al.*, 2000).

Lila *et al.* (2003) studied effect of different concentrations of sarsaponins on different substrates. As the concentration of sarsaponin increased from 1.2 to 3.2 g/L, fermentation of soluble potato starch, corn starch and hay plus concentrate decreased methane production considerably. Agarwal *et al.* (2006) reported that ethanol extract of soapnut (*Sapindus mukorossi*) significantly reduced methanogenesis in *in vitro* experiments accompanied with a significant increase in propionate content and a reduction in acetate to propionate ratio.

Acacia saponins decreased gas production, but increased microbial protein without affecting true digestibility. On the other hand, addition of Quillaja saponins did not affect gas production, but increased microbial protein and truly degraded substrate. The effects of Yucca saponins differed from those of Quillaja or Acacia saponins. Yucca saponins decreased gas, increased microbial protein and increased true digestibility, suggesting that the saponins affected partitioning of degraded nutrients such that higher microbial mass was produced at the cost of gas, and/or short chain fatty acids (SCFA) production (Makkar, 2005).

Plants contain a large number of compounds which are not involved in the primary metabolism, but are present extensively and therefore are classified as plant secondary metabolites, which primarily act as a deterrent against invasion by the foreign bodies and infection by the pathogens. These plant secondary metabolites usually have anti-microbial activity against a variety of microorganisms and therefore have been selected for testing their ability of inhibit methanogens and the process of methanogenesis in the rumen. As in many countries of Eurpean Union and many states in the United States have already banned the use of antibiotics as growth promoters in livestock production, the use of plant secondary metabolites in the ration of animals is gaining importance. The plant secondary metabolites usually help in reduction of methanogens by the following mechanisms:

- Inhibition or selective removal of ciliate protozoa (Santra *et al*., 1994, Newbold *et al.*, 1997)
- Improvement in fibre degradation (Sahoo *et al*., 2000, Waghorn *et al*., 2002)
- Better propionate production (Patra *et al*., 2006, Calsamiglia *et al*. 2007)
- Direct inhibition of methanogenesis (Garcia-Gonz´alez *et al*. (2006)

Several laboratories throughout the world are extensively screening a large number of plant secondary metabolites which can be used for rumen manipulation for inhibition of methanogenesis and improving fermentation of feed for extracting more nutrients from poor quality feeds. Some of the recent reviews summarize the results of these preliminary screening experiments and show a potential for their economic exploitation by the livestock farmers (Wallace, 2004, Kamra *et al*., 2008, McAllister and Newbold, 2008).

Propionate Enhancers

As a result of growing awareness of the threat of microbial resistance to antibiotics, there is an increasing interest in alternatives to antibiotics as growth promoters (Moss *et al*., 2000). Dicarboxylic acids such as fumeric and malic acids have been studied *in vitro* as feed additives in ruminant diets. Fumeric acid, which is reduced to succinic acid, is an intermediate in the propionic acid pathway. Reducing fumeric acid may provide an alternate electron sink for H_2 since H_2 ions are needed in this reaction. Isobe and Shibata (1993) observed that the proportion of acetic acid and propionic acid increased following the addition of fumeric acid. Bayaru *et al*. (2001) found that CH_4 production was reduced by 23% when sorghum silage treated with fumeric acid was fed to Holstein steers. Malate, which is converted to propionate via fumerate, also increased propionate production and inhibited CH_4 production *in vitro* (Martin *et*

al., 1999). However, malate did not affect CH_4 production, although it stimulated daily gains in steers (Martin *et al*., 1999).

Reductive Acetogenesis

Joblin (1999) noted that a technology that may hold some promise in the long-term of diverting electrons from methanogens is the production of acetic acid by acetogens. In the gut of termites and rodents, acetogens convert excess H_2 to acetic acid, which is then utilized by the host (Joblin, 1999). However, in the rumen the number of acetogens is few and cannot compete effectively with methanogens for H_2 ions, because they have a lower affinity for H_2 than methanogens (Nollet *et al*., 1998). Increasing the populations of acetogens through exogenous inoculations into the rumen could be useful for competing against methanogens (Joblin, 1999). However, previous attempts at inducing acetic acid by inoculation with acetogens were not successful (Nollet *et al*., 1998).

Mitigation of rumen CH_4 emission is essential and can be effectively achieved by strategies that improve the efficiency of animal production. The dietary/nutritional strategy that improve productivity with no potential negative effects on livestock health and production and are cost effective has a better chance of being adopted. The approach for mitigation also depends on the production systems and agronomic practices in the region.

Adaptation of Livestock to climate change

Adaptation is often used as a term for the characters or traits observed in animals that are the result of selection. It is also defined as a process the means by which natural selection adjusts the frequency of genes that code for traits affecting fitness. It could be best described as short-term compensatory changes in response to environmental disturbance.

Changes that occur in cattle during climatic stress are compensatory and are directed at maintaining or restoring thermal balance. These include sweating, rapid respiratory rate, greater vasodilation with increased blood flow to the skin surface, reduced rate of metabolism, decreased DM and nutrient intake and altered water metabolism.

Hormonal Changes During Heat Stress

The plasma growth hormone concentration and growth hormone secretion rate declined with hot temperatures (35°C). Growth hormone content in milk of low, medium, and high production groups declined when Temperature-humidity index (THI) exceeded 70, possibly reflecting suppressed production of growth hormone so that metabolic heat production is reduced. The thyroid hormones reduce in response to heat stress, which is probably an attempt to decrease the metabolic heat production in the cow. Greater plasma content of epinephrine and norepinephrine with high ambient temperatures is an indicator of stress response and reduces rate of passage in the digestive tract so as to decrease metabolic rate. The level of prolactin was found to rise tremendously under heat stress in buffaloes (Roy & Prakash, 2007). Cortisol response to heat stress challenge is often variable, but workers evaluating the effects of increasing fibre content of the diet on the response to hot, humid weather reported a linear increase in plasma cortisol with increasing fibre content of the diet (West *et al*., 1998).

Determinants for Assessing Severity of Heat Stress

Nutritional Factors

Feeding excessive quantities of nutrients, e.g. crude protein, can contribute to reduced efficiency of energy utilization, potentially adding to stress levels. So, a thorough understanding of dietary modifications to minimize heat stress is necessary.

Feed DMI starts to decline and maintenance expenditure increase when environmental temperatures exceed 25°C. Milk yield and TDN intake decline slightly when the THI exceed 72 and decline sharply when THI exceed 76. Milk yield declines when body temperature exceed 38.9°C, and, for each 0.55°C increase in rectal temperature, milk yield and intake of TDN decline 1.8 and 1.4 kg, respectively.

During hot weather, declining DMI and high lactation demand requires increased dietary mineral concentration. However, alterations in mineral metabolism also affect the electrolyte status of the cow during hot weather. The primary cation in bovine sweat is K, and sharp increases in the secretion of K through sweat occur during hot climatic conditions. The absorption of macrominerals, including Ca, P, and K, declined during hot temperatures but trace element requirements increased with elevated

environmental temperature (Kume *et al*., 1989). Cows supplemented with 0.55% Na during hot climatic conditions also demonstrated greater feed DMI and milk yield compared with those receiving 0.18% Na (Schneider *et al*., 1986). Cows in early lactation during hot weather exhibited a marked decline in plasma Na, K, and Cl concentrations during the day, with concentrations returning to normal at night . Electrolytes are key element of acid-base chemistry and their supplementation during heat stress may be critical to homeostatic mechanisms.

Water is the most critical nutrient for cattle and all other livestock, and the need is intensified for those subjected to hot climatic conditions. Water losses through the lungs increased gradually and losses from the skin increased sharply as ambient temperature increased from about 16°C to 35°C. Cows acclimatized to 21.1°C and then exposed to 32.2°C for 2 wk showed increased water consumption by 110%, and water losses from the respiratory tract and from the skin surface increased by 55% and 177% at the higher temperature. Water turnover is related to DMI, and milk yield and respiratory-cutaneous water loss by the cow are major factors increasing ion outflow under heat stress. Water consumption may have a direct cooling effect via the reticulorumen in addition to the cooling effects of panting and sweating.

Shelter Management

The most obvious environmental modification is the use of shade. So shelter management is one of the key parameter to reduce heat stress. Shading in a hot, humid climate was found to reduce rectal temperature by 2 to 4.1%, respiratory rate by 29 to 60%, improved DMI by 6.8 to 23.2%, and milk yield by 9.4 to 22.7% compared with unshaded cows. Cows shaded during the dry period yielded 4.5 and 13.6% more milk at 100 and 305 d postpartum and delivered calves weighing 3.1 kg more compared with cows receiving no shade. Grazing cows that were unshaded had higher respiratory rates and rectal temperatures than shaded cows, and shaded cows with no concentrate supplementation had milk yield similar to that of unshaded cows fed 3.5 kg/d of concentrate (Valtorta *et al*., 1996). Shading was found to be profitable, whereas concentrate supplementation without shade was not.

Additional benefits from cooling cattle with fans and sprinklers can be derived in hot or hot and humid climates. Use of fans and sprinklers reduced rectal temperature and respiratory rate but when used together the effects were synergistic; this also reduced diurnal variation of body temperature. Much of the response to cooling is a direct result of increased DMI. Physiological improvements with cooling included greater circulating growth hormone concentrations and lower prolactin concentrations (Igono *et al*., 1987) associated with 2.3 and 2.0 kg/d increase in DMI and milk yield respectively. Cooling with fans and sprinklers during the dry period increased mean 150-d milk yield by 3.5 kg/d, and the effect was greater with increasing age (Wolfenson *et al*., 1988).

Heat Shock Proteins

At the cellular level, eukaryotic cells respond to stresses by the production of a specific set of proteins called heat shock or stress proteins. The definite function of heat stress proteins is unknown, but they are thought to help the cell to survive this stress. Animals have been shown to acquire thermo-tolerance by exposure to a conditioning body heat dose and hyperthermia of whole animals induces the synthesis of stress proteins. It is unclear, however, whether the acquisition of thermo-tolerance is related to the increased synthesis of stress proteins.

The most studied of these proteins have molecular weights of approximately 90, 70 and 27 kDa and are referred to as HSP90, HSP70 and HSP27 etc. Cells also contain a constitutively expressed protein similar to HSP70 that has a slightly higher molecular weight and lower isoelectric point. The most intensely studied of these proteins has a molecular weight of approximately 70 kilo Daltons and is therefore called HSP70. The HSP70-related or cognate HSP70 protein and has been identified as the clathrin uncoating ATPase that is present in high amounts in the brain. Bovine endometrial tissue, liver, spleen, brain, muscle tissues, lymphocytes from whole blood and bovine conceptuses were found to respond to heat stress by an increased synthesis of HSP70 and HSP90. This wide range of HSPs are the confirmatory physiological biomarkers for stress determination.

Allele Mining for Abiotic Stress

One of the strategies for combating the impending climate change is to develop a livestock

population having high frequency of better adaptive genes for stress and heat tolerance. There are a number of genes that are involved in the thermoregulation and homeostatic mechanism of mammals. The approach would be to identify the animals that can tolerate a high TH index and identify the candidate genes either through substractive hybridization or DDRT. Once the candidates are identified, markers can be developed that can be included in the breeding programme for adaptive tolerance.

There are no systemic study in Indian context across all species of livestock with regard to Stress Physiology, and how to combat the effect of all forms of stresses, better adaptation and increase production. A holistic approach is required to solve the present problems and studies are underway to investigate the presence of specific bio-molecule (HSPs) which can acts as potential biomarker for animal adaptation. Molecular mechanism of animal behavior (stress, reproduction, lactation, feeding, shelter seeking etc.) with advanced tools of nanotechnology and on-field study by telemetry facility, will definitely produce valuable output of research to augment the production and sustainability.

Protected Cultivation of Vegetables – An Alternative for High Profitability

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In spite of considerable progress achieved during the last three decades in vegetable production in India, the average productivity of different vegetable crops is still low as compared to the best yields at national and world level, indicating the scope to enhance the yield in different vegetable crops by many folds along with its quality. This is because of an appealing gap between potential yield and the actual yield of various vegetable crops. For many vegetable crops, the yields realized are even less than 50% of their potential yield. Some time the farmers who are growing their vegetable crops during main season are even not getting back their cost of cultivation, but the prices of the same vegetable produce is very high during off season. Several biotic and abiotic stresses are the major factors for low productivity and poor quality in several vegetable crops under their open field cultivation more specifically during rainy and post rainy seasons in different vegetables. The increasing demand of off-season and high quality vegetables in various markets of the big cities has calls the attention of the vegetable growers for diversification from traditional way of vegetable cultivation to modern methods of vegetables cultivation in an agri-business model.

Protected cultivation of vegetable crops offers the best choice for diversification from traditional production systems to this modern technology for a number of reasons. Production of crops under protected conditions has great potential in augmenting production and quality of vegetables, in main and off season and maximizing water and nutrient use efficiency under varied agro climatic conditions of the country. This technology has great potential especially in peri- urban agriculture, since it can be profitably used for growing high value vegetable crops like, tomato, cheery tomato, coloured peppers, parthenocarpic cucumbers cultivation, healthy and virus free seedlings production in an agri- entrepreneurial model.

Protected cultivation in partially modified environment structure is useful in combating both biotic and abiotic stresses that limit the productivity and quality of vegetable crops. This requires careful planning and attention to detail, including timing of production and harvest to coincide with high market prices, choice of varieties adopted to the off season environment, and able to produce economical yields of high quality produce etc.

Large number of farmers, who are doing traditional agriculture in peri urban areas of the country can successfully diversify their traditional agriculture by using various levels of protected cultivation technologies for production of vegetable crops looking to availability of resources, availability of emerging markets of usual and unusual off season vegetable crops, year round demand of high value vegetables like standard tomatoes, coloured peppers and parthenocarpic cucumbers etc. High quality nursery raising in vegetables is the other area, where improvement over the traditional system of nursery raising is required. All kind of protected technologies may not be economical and useful to the farmers in India, because of their very high initial, running and maintenance cost, but some protected technologies are low cost, simple and highly profitable under Indian conditions and more specifically for peri-urban areas, which can be straightway adopted by Indian farmers for production of different high value vegetable crops and nursery raising in profitable agri-business models.

1. Modern Nursery Raising Technology

To ensure high productivity and high quality of the produce, raising of high quality seedlings through use of good quality seeds at right time and at a appropriate place is one of the cheapest but most important way. Most of the Indian farmers are raising their vegetables flowers and fruits like papaya seedlings under open field conditions, which are always inferior in quality, as the seedlings are infected with virus when raised in open during rainy and post rainy season. On one side soil borne fungus and nematodes create severe problem for raising the seedlings in soil media in open fields during hot summers and rainy season but on the other hand the very high cost of hybrid seeds in vegetables has also warranted the farmers to improve or change their traditional nursery raising method to increase the productivity and quality of vegetables. Plug tray nursery raising in vegetable crops has already working as a full scale industry in several European countries, Israel, USA, Morocco, Turkey, Japan and China. Under this system seedlings are raised in plastic multicelled plug-trays in artificial soil-less media in specially designed greenhouses or other protected structures. A large number of virus free healthy seedlings of different vegetables can be raised in a small area of green house in plastic plug-trays by using soil-less media for growing vegetables either for main season or for their off season cultivation. With the use of this technology it is now almost possible to raise healthy vigorous seedlings of different cucurbits; otherwise it was not possible in the traditional system of nursery raising. The farmers or unemployed agriculture graduate youths of our country can very successfully start nursery raising as a agri entrepreneur in major vegetable growing pockets of the country. By this way the vegetable growers will get the virus free or off-season healthy nursery as per their requirement and it will also generate additional employment in agriculture sector. Therefore, this is the first and most important step for enhancing productivity and profitability in vegetables through protected cultivation.

2. Insect Proof Net Houses for Safe Vegetable Cultivation

Usually the farmers are growing their vegetable crops like tomato, chilli, sweet pepper, okra etc under open fields. But during rainy and post rainy season it is very difficult to grow these crops successfully due to leaf curl and yellow vein mosaic and other viruses, respectively. These viruses are mainly spread by insect vectors like whiteflies, aphids, thrips, jassids and sometimes also by hoppers. The population of white fly after on start of monsoons is very high and it remains in the open environment up to end of October depending upon the temperature. The farmers are using several insecticides for several sprays to control these vectors, even they could not control these vectors and their tomatoes, chilli or okra crops are highly infected with viruses. The second most common and most severe problem in tomato, brinjal and okra is the fruit borer against which the growers are using huge amount of insecticide even they are unable to control this insect. The only way to control the virus and fruit borer is to put a mechanical barrier between the crops and open environment and this is possible with the use of insect proof net of 40 or 50 mesh in form of net houses or insect proof net covered walk in tunnels. By this way the growers can directly reduce the use of insecticides and they can grow virus free crops of tomato, chilli, sweet pepper and okra during rainy or post rainy season. But for growing these crops under insect proof net houses, it is pre-requisite to raise virus free healthy seedlings of these crops either in the greenhouse or by covering the nursery beds with insect proof net. The farmers can erect these insect proof net houses by using half inch size GI pipes after bending them in half circle shape. Other insect proof net houses can also be made by covering all sides and top with insect proof net of 40 or 50 mesh, but the net should be UV stabilized. Under these net house crops like sweet pepper, tomato, chilli or okra can be grown successfully without infestation of viruses or other insects like fruit borer etc. and the growers can save the huge amount spent on pesticides. Insect

Table 1: Seedlings production under plug tray technology

Area of Nursery	*Total nursery a batch 30 days (in lakh)*	*Production in of batches per year (in rupees)*	*Expected No. No. of seedlings per year (in lakh)*	*Approximate Cost of seedling (in lakhs)*	*Expected Net profit (man days)*	*Employment generation*
500 m^2	2.0-2.5	6	12.0-15.0	0.50	1.0-1.5	600

proof net houses can also be fabricated in greenhouse design for maximum utilization of the space through vertical growing of high value vegetables. These structures can be fabricated with a cost of Rs.250-300/m^2Such structures can be covered with 40-50% shading nets during critical summer months (April – June) and with plastic during critical winter months (Dec- Feb) with transparent plastic under arid and semi-arid climatic conditions. High value vegetables like tomato, cherry tomato (crop duration 7-8months), two crops of parthenocarpic cucumber (summer and post rainy season) and capsicum (crop duration 7-8 months). The basic objective of Insect proof net house vegetable cultivation is to minimize the use of pesticides in fresh vegetable cultivation for producing safe vegetables.

Table 2: Crops for Nursery raising under insect proof net house

S.N.	*Crop*	*Planting time*	*Objective of nursery raising*
1.	Tomato	June 15–July 15	Production of virus free healthy nursery
2.	Chilli	June 15–July 15	Production of virus free healthy nursery
3.	Capsicum	August 15 –September 15	Production of virus free healthy nursery
4.	Early cauliflower	May 20 – June 20	(By using 40% black shade net) Production of healthy nursery by reducing soil born problems
5.	Tomato Chilli Brinjal	15-30 December	Production of healthy nursery by protecting against frost in winters
6.	Cucurbits	December 25 – January 10	Off- season production of nursery by using plug tray technology

3. Zero Energy Naturally Ventilated Greenhouses for High Value Vegetable Cultivation

Naturally ventilated greenhouses are the protected structures where no heating or cooling devices are provided for climate control. These are simple and medium cost greenhouses which can be erected with a cost of Rs.650-700 sq. meter and these greenhouses can be used successfully and efficiently for growing year round parthenocarpic slicing cucumber, off season muskmelon, tomato and sweet pepper crops for 8-9 months duration. These structures are having a manually operated cross ventilation system as and when required. Looking to the year round, increasing demand of high quality parthenocarpic slicing cucumber in upmarket of the metro and other big cities of the country, this is one of the most suitable and profitable crop for cultivation under naturally ventilated green houses in peri-urban areas of the country. Three successful crops of cucumber can be grown in a naturally ventilated greenhouse in a period of one year. Muskmelon is the second crop, which can be successfully cultivated for its complete off-season availability, which can fetch very high price of the off-season produce in the up markets of the metro and other big cities of the northern parts of the country.

Similarly high value vegetables like standard tomatoes, cherry tomatoes and coloured peppers are three crops which can be grown for long duration (8-10 months period) under naturally ventilated greenhouse conditions. In metro cities like Delhi there is year round demand of these high quality vegetables in the up markets viz. five star hotels, shops of embassies or high commissions of various countries situated in Delhi. They are ready to pay very high price for the high quality produce; therefore, it may be a profitable venture only if this technology is adopted around metro cities of the country. Greenhouse vegetable production is a highly intensive enterprise requiring substantial labour and 24 hour-a-day commitment, which restrict the adoption of this technology. But now the time has come when the vegetable growers in various parts of the country can use the naturally ventilated green house technology for cultivation of high value vegetables for high profits.

4. Vegetable Cultivation under Shade Net Houses

Shade nets are perforated plastic materials

Table 3: Vegetable cultivation schedule and economics under zero energy naturally ventilated greenhouse (1000m^2)

Crop Schedules	*Crop and Duration (months)*	*Expected Yield (q/1000m^2)*	*Expected Cost Benefit Ratio.*
1.	Tomato (July – Mid May)	150–180	1:2.25-2.50
2.	Capsicum (August – Mid May)	30–40	1:2.00-2.25
3.	Parthenocarpic Cucumber (Mid July – Mid May) three crops	100–120	1:2.50-3.00

used to cut down the solar radiation and prevent scorching or wilting of leaves caused by marked temperature increases within the leaf tissue from strong sunlight. These nets are available in different shading intensities ranging from 25% to 75%. Leafy vegetables and ornamental greens are recommended to be grown under shade nets whose growth rates are significantly enhanced compared to unshaded plants when sunlight is strong. The basic objective of shade net is to reduce radiation and temperature up to some extent during critical summer months (May-Sept.). Black colour shade nets are most efficient in reduction of temperature compared to other colours like green, white or silver etc. as the black colour is the maximum absorbent of heat. Mostly leafy vegetables like beet leaf and green coriander are preferred to be grown under shade nets, but it is also suitable for growing early cauliflower and radish cultivation during June to September months.

4. Off Season Vegetable Cultivation Under Walk in Tunnels

Walk in tunnels are the temporary structures erected by using G.I. pipes & transparent plastic. Walk in tunnels are used for complete off season cultivation of vegetables like bottle gourd, summer squash, cucumber etc. during winter season (Dec. – mid February) the basic objective & utility of walk in tunnels is to fetch high price of the complete off season produce to earn more profit per unit area. The ideal size of a walk in tunnel can be of 4.0 m width and 30m length (120m^2) and total cost of fabrication may be Rs.12000-14000/.

Objectives and Utility of the Walk in Tunnels

1. Off season cultivation of vegetables for earning more income.
2. Walk in tunnels are only erected over the crop during the peak winter months of December - mid February and there after the structure is removed from the crop.
3. Since, the plastic is used only for two months (Dec. -mid February) therefore, life of the plastic can be 8–10 years.
4. These temporary plastic structures are suitable for off season vegetable cultivation in northern plains and low hills.

6. Off-season Cultivation of Vegetable Crops Under Plastic Low tunnels for Higher Profit

In most parts of our country the farmers are growing various vegetables during their main season of cultivation, but the prices of those vegetables are very low and sometime the vegetable growers are even not getting back the cost of cultivation of the vegetables. But the same

Table 4: Vegetable cultivation schedule and economics under shade net house (1000m^2).

Crop Schedules	*Crop and Duration (months)*	*Shading Intensity*	*Expected Yield (q/1000m^2)*	*Expected cost benefit ratio*
I	1. Green Coriander (April – May)	60–70%	6.0–8.0	1:2.50-3.50
	2. Green Coriander (June – July)	60–70%	6.0–8.0	
	3. Beet Leaf (Aug. –Sept.)	60–70%	8.0–10.0	
	1. Beet Leaf (April – May)	60–70%	8.0–10.0	
II	2. Early Cauliflower (June – September)	60–70%	12.0–15.0	1:2.50-3.00
	3. French Radish (October – November)	60–70%	8.0–10.0	

Table 5: Expected Cost Economics of Off Seasons Crops Grown under Walk in Tunnel

S. No.	*Crop*	*Crop Duration*	*Yield (t/ha)*	*Expected cost benefit ratio*
1.	Summer squash	Mid November–Mid February	40-50	1:2.0-2.5
2.	Bottle gourd	Mid October – Mid February	25-30	1:2.5-3.0
3.	Cucumber	Mid October– 30 February	15-20	1:2.5-3.0
4.	Pumpkin	Mid October– Mid February	30-40	1:2.0-2.5
5.	French bean	Mid October – December	6-8	1:2.5-3.0
6.	Tomato	Mid October – Mid February	20-25	1:2.0-2.5

vegetables are sold on very high price during their off-season in several cities of our country. The demand of off-season vegetables is increasing day by day in several big and medium sized cities of the country, which provide wide scope of vegetable production through off-season cultivation of some vegetables mainly the cucurbits in peri-urban areas of the country. Plastic low tunnel technology is a simple and profitable technology for off-season cultivation of cucurbits during the winter season in northern plains of our country. Crops like summer squash can be grown as a complete off-season crop, whereas other cucurbits like muskmelon, round melon, bottle gourd, cucumber, bitter gourd, watermelon can be advanced by 30-40 days over their normal growing season.

Plastic low tunnels are flexible transparent coverings that are installed over single or multiple rows of vegetables to enhance the plant growth by warming the air around the plants in the open field during winter season when the temperature is below 8^0c. Plastic low tunnels are often used to promote the growth of plants during the period of winter season. Low tunnels are supported above the plants by using hoops of GI wire and a clear or transparent plastic of 20-30 micron is covered/ stretched over the hoops and the sides are secured by placing in soil. The plastic is vented during the growing season as the temperature increase within the tunnels. The farmers can grow different varieties of summer squash (round fruited, long fruited) which is a emerging crop along with cultivation of netted muskmelon varieties in place of traditional varieties. Bitter gourd and round melon are two other crops with increasing demand and which usually fetches very high price during off-season and can be grown successfully by using the plastic low tunnel technology. This technology is highly suitable and profitable for the farmers living in northern plains of India.

7. Quality Seed Production of Vegetables Under Protected Conditions

Recently there has been a technical shift towards the production of high quality hybrid seed of important high value vegetables under protected conditions. Selection criteria of protected structures to be used for vegetable seed production certainty depends upon few important factors viz., climatic conditions of the area selected for seed production, vegetable crop, type of seed crop, season of seed production and targeted quantity of seed production. Generally semi-climate controlled greenhouses are only suitable for hybrid seed production of determinate type varieties/hybrids of standard tomato, cherry tomato, sweet pepper and parthenocarpic cucumber varieties, which are suitable for protected cultivation. Seed yield of such crops can be 3-4 times more compared to their open field cultivation along with high quality of seed. Similarly, zero energy naturally ventilated greenhouses are also equally suitable for hybrid seed production of these high value vegetable crops, where the seed yield is usually 2-3 times more than open fields, but the cost of seed production is only one third (1/3) of the seed produced under semi-climate controlled greenhouse conditions.

Insect proof net houses are the most suitable and low cost protected structures suitable for quality hybrid or seed production of OP varieties in large number of vegetables viz., tomato, sweet pepper, chilli, okra, brinjal and several cucurbitaceous vegetables. The major objectives of seed production under insect proof net houses are to grow virus free seed crops, to protect the seed crops against other major insects/pests like shoot and fruit borer in brinjal, fruit borer in okra and tomato, fruit fly in cucurbits, leaf minor in cucurbits and solanaceous vegetables and red pumpkin beetle in cucurbits. Not only this, insect proof net house also provides protection to the seed crops again mild frost conditions. Some other low cost protected structure like walk in tunnels and plastic low tunnels are used for off season seed production or advancing the season of seed production, but these structures are technically suitable only for northern plains of India during winter season. Massive work on quality seed production of vegetables is being carried out at the Centre for Protected Cultivation Technology, IARI, New Delhi and excellent results in hybrid seed production of brinjal, pumpkin, bitter gourd, cucumber and summer squash has been recorded as compared to open field seed production of these crops. Hybrid seed production by using insect proof net houses can be highly profitable venture for progressive farmers in various regions of the country.

Conclusion

Keeping in view the increasing demand of off season and high value vegetables in several big cities of the country, there is an urgent need for diversification from the traditional agriculture by production of high value vegetable crops under

different protected conditions for increasing their productivity and quality not only for getting high returns but in a Horti-Business model. Nursery raising under protected cultivation is highly suitable for such horti-business model or can be adopted as a agri entrepreneur business in major vegetable growing areas of the country by unemployed youths who are graduate in agriculture or post graduate in horticulture. Low cost protected technology like plastic low tunnels or walk in tunnels, shade net houses can be used for off season vegetable cultivation for getting high returns from off season produce. Similarly insect proof net houses can be used on a large scale for safe vegetable cultivation by way of minimizing the use of pesticides in vegetable cultivation and virus free quality seed production in large number of vegetables in a horti-business model.

Prospects of IPM for QualityVegetable Production

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Summary

Insect pests are major biotic constrains in vegetable production in India. Among these tomato fruit borer (*Helicoverpa armigera*), brinjal shoot and fruit borer (*Leucinodes orbonalis*), chilli thrips (*Scirtothrips dorsalis*) and mite (*Polyphagotarsonemus latus*), fruit and shoot borer (*Earis* spp.) on okra, diamondback moth (*Plutella xylostella*) on cole crops, fruit fly (*Bactrocera cucurbitae*) on cucurbits are important ones. Average yield loss due to major insect pests in different parts of the country are reported to vary from 33 to 40 per cent. Through intensive and integrated research efforts, success is achieved in managing pest problems in vegetables by means of mainly chemical method, which accounts to 13-14 per cent of the total pesticide use in India. Indiscrimate use of pesticides has led to many fold problems. In this context IPM is a critical subsystem of integrated crop management and use of bioagents and biopesticides along with cultural, physical and chemical could be main focus for economically viable, socially acceptable and environment friendly options to avoid pesticide residue and to meet the international standard for export. Various novel and biorational insecticides with unique mode of action are also in progress and being utilized in pest management. Thus, many potential elements of pest management have been recommended but majority are not of value to end users in practical sense for pest management under field condition. Public-private partnership in production, distribution and quality control of different components of IPM is imperative otherwise we will continue to talk of alternative methods of control for another several years.

Introduction

Insect pests are the major biotic constraints to vegetables production. In India, the losses due to major insect pests infesting vegetable crops have been reported to the tune of 33-40 per cent (Table 1). In recent past, with changes in the cropping pattern, ecosystems and habitat, climate, and introduction of input intensive high yielding varieties/hybrids, a shift in pest status has been realized in time and space. Many pests have adopted new hosts, developed resistance to pesticide and often there are secondary out breaks. During the last decade the export of vegetable from the country have been affected considerably due to pesticide residue. Very recently, Bydgai chilli lots from India were rejected at the international pests of importing countries due to large pesticide residue. High pesticide residue and presence of aflatoxin are the two important problems which act as major constraints in increasing export to Europe, Japan and USA. As a part of new food safety law, USA prescribed for zero tolerance where as EU set its MRI of 0.01 PPM. So, import of chilli can be achieved only through an Integrated Pest Management (IPM) out of the need for sustainable crop protection strategy against the background of increasing pesticide use and deleterious effect of residues in the environment.

Adverse Impact of Insecticide Usages in Vegetables

Resurgence and resistance: Resurgence of sucking insects due to frequent application of synthetic pyrethroids is well known. Resurgence of yellow mite on chilli and red spider mite on okra and brinjal has been recorded due to the application of acephate, cypermethrin, deltamethrin, fenvalerate and ethion. In okra and brinjal, synthetic pyrethroids targeted for controlling the borers resulted in a new problem i.e., heavy

Table 1: Yield losses due to major insect pests in vegetables in India

Crop/Pest	*Yield loss (%)*	*Crop/Pest*	*Yield loss (%)*
Tomato		Cabbage	
Fruit borer (*H. armigera*)	24-65	Diamondback moth (*Plutella xylostella*)	17-99
Brinjal		Cabbage caterpillar (*Peiris brasicae*)	69
Fruit and shoot borer (*Leucinodes orbonalis*)	11-93	Cabbage leaf webber (*Crocidolomia binotalis*)	28-51
Chillies		Cabbage borer (*Hellula undalis*)	30-58
Thrips (*Scirothrips dorsalis*)	12-90	Cucurbits	
Mites (*Polyphagotarsonemus latus*)	34	Fruitfly (*Bactrocera cucurbitae*)	
Okra		Bitter gourd	60-80
Fruit borer (*H. armigera*)	22	Cucumber	20-39
Leafhopper (*Amrasca biguttula biguttula*)	54-66	Ivy gourd	63
Whitefly (*Bemisia tabaci*)	54	Musk melon	76-100
Shoot and fruit borer (*Earias vittella*)	23-54	Snake gourd	63
		Sponge gourd	50

resurgence of jassid and red spider mites. Similarly, the control failure against brinjal shoot and fruit borer, tomato fruit borer, diamondback moth and tobacco caterpillar due to repeated use of same insecticide is often reported indicating the development of insecticide resistance in these pests (Table 2).

Phytotoxicity: The plants also suffer from adverse impact of excessive pesticide use, reflected through many direct or indirect phyto-toxicity symptoms in the plant. Chilli and brinjal crops consume maximum insecticides for management of thrips-mite complex and borer, respectively. In brinjal, it occurs as flower drop, hardiness and discolouration of fruits, reduced and delayed bearing and leaf scorching. The cocktail spray in chilli some times deforms the shape of the leaves, confusing with symptom of a virus disease. Imidacloprid formulation when applied to cucumber (*Cucumis sativus*) and tomato (*Lycopersicon esculentum*) developed phytotoxicity symptoms of leaf chlorosis of the oldest leaves and distorted growth and marginal necrosis of newer leaves within a week after application.

Insecticide residues: Although India's average consumption of pesticides per hectare is fairly low (300-500 g/ha) to that of the developed countries (17 kg/ha in Taiwan, 12 kg/ha in Japan, 3 kg/ha in Europe and USA,) but the level of pesticide residues is high in India. Pesticide consumption

Table 2: Important insect pests showing resistance/resurgence against major insecticides

Insect	*Resistance/ resurgence*	*Insecticide*
Diamondback moth (*P. xylostella*)	Resistance	Cypermethrin, DDT, fenvalerate, malathion, parathion, quinalphos, Diazinon, methomyl, monocrotophos, cartap hydrochloride, carbaryl, ethyl parathion, carbosulfan, Bt subsp. *Aizawi*, Bt subsp. *kurstaki*
Tomato fruit borer (*H. armigera*)	Resistance	Cypermethrin, endosulfan, fenvalerate, Quinalphos, Carbaryl, *Bacillus thuringiensis*, organophosphate, synthetic pyrethroids
White fly (*B.tabaci*)	Resistance	Cyfluthrin, cypermethrin, endosulfan, monocrotophos, Quinalphos, methamidophos
Brinjal shoot and fruit borer (*L. orbonalis*)	Resistance	Quinalphos, synthetic pyrethroids
Okra jassid (*A. biguttula biguttula*)	Resistance	Malathion, monocrotophos
Yellow mite of chilli (*P. latus*)	Resurgence	Acephate, cypermethrin, deltamethrin, fenvalerate, monocrotophos, imidacloprid
Bitter gourd aphid (*Aphis malvae*)	Resurgence	Deltamethrin, Permethrin, malathion
Red spider mite of brinjal (*Tetranychus urticae*)	Resurgence	Deltamethrin, fenvalerate
Brinjal aphid (*Myzus persicae*)	Resurgence	Cypermethrin, deltamethrin
Red spider mite of okra (*T. urticae*)	Resurgence	Ethion

also varies geographically, states like Punjab and Haryana takes more than 15 per cent of the total pesticide used in the country. The residue problem becomes more severe when the Good Agricultural Practices (GAPs) are not followed. The farm gate vegetable samples analyzed after collection from various states of India indicated 55 per cent of the samples to be contaminated with major group pesticide. The condition of pesticide contamination in vegetables in Uttar Pradesh and Kerala is alarming. In 2001 it has been found that in vegetable samples like brinjal, cabbage, cauliflower, okra, chilli and tomato nearly 61 per cent samples were found contaminated with pesticide residues while 12 per cent exceeded the prescribed FAO tolerance limits. The residues found belong to the organochlorines, organophosphorus and synthetic pyrethroids.

Important Considerations for Pest Management to Minimize Pesticides Residue

In view of growing concern among the public for pesticide contamination and residue in vegetables, non-chemical methods of pest control are being emphasized in development of Integrated Pest Management (IPM) technologies. Thus, there is need for adoption of compatible multiple techniques of pest management based on cultural control practices apart from other bio-control approaches and non-chemical methods to reduce the toxic residues in the produce and cost of inputs. Routine agronomic practices like selection of varieties, intercultural operations, sowing/planting date, trap cropping/intercropping should be suitably modified to make the environment uncongenial for pests, and also to enhance the activity of natural enemies.

Selection of varieties: In vegetables very less number of resistant / less susceptible varieties has been developed (Table 3). Pests of sucking nature can be combated to a greater extent with the adoption of resistant varieties**.**

Tillage and Planting time: Deep ploughing of the field after the harvest reduces the activity of fruitfly, red pumpkin beetle and cut worm as these insects remain in the soil in earthen cocoon to complete the dormant stage of their life cycle.Careful consideration of sowing / planting date in vegetable reduced the attack of red pumpkin beetle, fruit fly, shoot and fruit borer. Early planting of cucurbits in November escapes the attack of red pumpkin beetle, whereas flowering beyond October in bitter gourd suffers less from fruit fly. Sowing of okra during second week of June retain less population of borers, thereby incurred maximum healthy yield, whereas July planted brinjal face the ravages of shoot and fruit borer. Thus, synchronization of most susceptible stage of the crop with the inactive period of insect pest reduces the infestation and chemical intervention.

Use of barriers: At I.I.H.R., Bangalore and I.I.V.R., Varanasi, use of nylon net as a barrier along with infested shoot clipping for control of brinjal shoot and fruit borer could reduce the borer incidence by 16%. However, the cost of nylon net is high, and studies are, therefore, being conducted on the use of live barriers like maize. Presently, this technology is being popular in many parts of the West Bengal to prevent fruit and shoot borer of brinjal.

Intercropping: Intercropping of crops with diverse plant geometry and insect pests breaks the standard mono-cropping and limits the infestation

Table 3: Tolerant varieties of some vegetable crops against major insect pests

Crop	*Pest*	*Varieties*
Tomato	Fruit borer (H. armigera)	Arka Vikash, Pusa Gaurav, Pusa Early Dwarf, Punjab Keshri, Punjab Chhuhara, Pant Bahar, Azad, BT 1, T 32, T 27
Brinjal	Shoot and fruit borer (*L. orbonalis*), Aphid, jassid, thrips, whitefly	SM 17-4, PBr 129-5 Punjab Barsati, ARV 2-C, Pusa Purple Round, Punjab Neelam, Kalyanpur-2, Punjab Chamkila, Gote-2, PBR-91, GB-1, GB-6
Cabbage	Aphid (*Brevicoryne brassicae*)	All season, Red Drum Head, Sure Head, Express Mail
Cauliflower	Stem borer (*Hellula undalis*)	Early Patna, EMS-3, KW-5, KW-8, Kathmandu Local
Okra	Jassid (*Amrasca biguttula*)	IC-7194, IC-13999 New Selection, Punjab Padmini
	Shoot and fruit borer (Earias vittella)	AE 57, PMS 8, Parkins long green, PKX 9275, Karnual special
Onion	Thrips (*Thrips tabaci*)	PBR-2, PBR-6, Arka Niketan, Pusa Ratnar, PBR-4, PBR-5, PBR-6
Round gourd, Pumpkin, Bitter gourd		Fruit fly (*B. cucurbitae*) Arka Tinda Arka Suryamukhi Hissar-II

Table 4: Combination of different intercropping effective in vegetable pest management

Crop combination	*Target pest*	*Crop combination*	*Target pest*
Cabbage + Carrot	Diamondback moth	Cabbage + French bean	Root fly
Broccoli + Faba bean	Flea beetleFruit and shoot borer	Cabbage + TomatoCabbage +	Diamondback moth
Brinjal +coriander/Fennel		Chinese cabbage	
		Cabbage + coriander	Diamondback mothAphids

from the pest (Table 4). Diverse nature of plant not only obstructs the adults from egg laying but also the release of volatile allelo-chemicals from a particular crop deters the adult insect from damaging the crops. All such planting combination enhances the activity of predators and parasites, too.

Trap crops: Mustard as trap crop along with cabbage has been successfully utilized for the management of diamondback moth, aphid and leaf webber on cabbage. This technology was developed in 1989 in which sowing of two rows of bold-seeded Indian mustard every after 25 rows of cabbage has been found successful. Mustard attracts more than 80% of the cabbage pests. Only mustard crop is sprayed with diclorovos 0.1%. Recent studies indicated Chinese cabbage to be the potential trap crop for diamondback moth. African marigold in tight bud stage functions as good trap crop to attract the adults of H. armigera, besides it also attracts the adults of leafminer for egg laying on the leaves. Maize plants sown in combination with bitter gourd and applied with bait spray controls fruit fly adults. Planting castor as a trap crop diverts the population of Spodoptera litura from cowpea.

Biological control

Predator and parasites: Most of the natural enemies are underexploited for pest management in vegetables. Among the egg parasitoids, *Trichogramma* spp. has been utilized to some extent for control of tomato fruit borer. Inundative release of egg parasitoids *Trichogramma brasilensis* @ 2,50,000/ha are also recommended for control of fruit borers on okra and tomato. Five to six releases at weekly interval @ 40,000/ha with the first release coinciding with 50% flowering in tomato is recommended. *Chrysoperla zastrowi arabica* is an effective predator for control of white fly, aphid, jassid and eggs of some lepidopterous borers, when the first instar larvae are released @ 50,000 /ha. The larval parasitoids of diamondback moth, *Cotesia plutellae* and *Diadegma semiclausum* can be incorporated into biological pest management because of their potential in suppressing the pest larvae. These will prove effective in areas where diamondback moth poses a serious problem because of insecticidal resistance.

Insect Pathogens: Vegetable pest control through microbial intervention is so far limited to few pests only. *Bacillus thuringiensis* (*Bt*) @ 300-500 gm is the most extensively used biocontrol agent against *P. xylostella*, *E. vittella* and *H. armigera* in vegetables. Application of HNPV and SNPV @ 250 - 300 larval equivalent (LE) in the evening hour with some UV protectants like teepol (0.1%) and adjuvents like molasses (1%) reduce the populations of the pest to a great extent. Use of entomopathogenic fungi, which unlike other micorobial agents have great potential and gaining importance against both chewing and sucking insect pests in vegetable crops. Among these V*erticillium lecanii* at 2.8 x 10^9 spores/ml against diamondback moth in cole crops, *Nomuraea rileyi* @ 1.2 x 10^8 conidia/ml against *S. litura* in cabbage and *H. armigera* in tomato and *Beauveria bassiana* @ 1.6 x 10^4 conidia/ml against white fly on cucubits and jassids on okra have been found highly effective. Some important parasitoids and microbial agents recommended against vegetable pests are given (Table 5).

Botanicals: Botanicals, being non-persistent and safe to mammals, possess in depth promise in pest management. Neem products have shown efficacy against insects like jassids, aphids and leaf miners. Application of crude neem seed kernel extract (4%) controls diamondback moth very well. Neem products mixed with reduced doses of insecticides (endosulfan half recommended dose) proved better against jassids and borer of okra showing synergistic action. Sprays of neem and Pongamia soaps were found highly effective in controlling insecticide resistant DBM in cabbage and *H. armigera* in tomato

Chemical Control

There is large number of reports of successful

Table 5: Biocontrol agents recommended in vegetable crops

Bioagent	*Dose*	*Target pest*
Trichogramma brassiliensis	2,50,000 parasitised eggs/ha (Inundative release)	Okra shoot and fruit borer
	50,000 parasitised eggs/ha (Weekly inoculative release)	Tomato fruit borer
Chrysoperla zastrowi arabica	50,000 first instar larvae/ha (weekly release)	Okra aphid Cabbage aphid
HNPV	250 LE/ha (10 days interval)	Tomato fruit borer
SNPV	250 LE/ha (10 days interval)	*Spodoptera litura*
Bacillus thuringiensis	500 g ai/ha (10 days interval)	Diamondback moth
		Shoot and fruit borer of brinjal and okra
		Tomato fruit borer

chemical control of vegetable pests. But insecticide resistance development in *P. xylostella*, *H. armigera*, *S. litura*; resurgence of whitefly, red spider mite and yellow mite have now threaten the widespread use of synthetic insecticides. However, these insecticides can be judiciously used considering economic threshold level, waiting period and initiation of control measures through pheromone / light trap catches. Except their bio-efficacy, bio-safety parameters like picking interval and waiting period were thoroughly adjudged prior to their recommendation (Table 6). Vegetables with less picking interval should be sprayed with insecticide having less waiting period.

Instead of going for routine schedule application of insecticide, need based spraying based on economic threshold level will help to reduce pesticide consumption and environmental abuse. ETL based application schedule helps maintaining minimum pest residue for survival of natural enemies. ETL for many vegetable pests have been worked out (Table 7).

Role of new group of insecticides: To avoid the persistent residues, choice of chemical plays a crucial role. According to Central Insecticide Board a list of novel pesticides have been approved for good agricultural practices (GAP) meant for export of vegetables. In recent years, several new insecticide groups having new chemistries *viz.*, neonicotinoids, oxadiazines, diamides, ketoenols, phenylpyrazoles, pyridines, flonicamid, METI acaricides, diafentiuron, tetrazines, thiazolidinones, oxazolines and insecticides from soil microorganisms such as avermectins, milbemycins, spinosyns, pyrrole insecticides and insect growth regulators like benzoylureas, triazines, diacylhydrazines, juvenile hormone analogues/mimics have been discovered and commercialized for uses in modern crop protection.(Table 8).

Table 6: Waiting period (in days) of important insecticides used in vegetable crops

Pesticide	*Cabbage*	*Brinjal*	*Cauliflower*	*Tomato*	*Pea*
Malathion	7	1	7	-	3
Fenvalerate	10	5	3	3	-
Endosulfan	10	3	10	5	-
Cypermethrin	7	3	-	1	-
Phosphamidon	-	-	-	-	6
Carbaryl	-	25	25	30	-
Quinalphos	-	10	27	-	-
Dimethoate	10	-	7	-	-
Imidacloprid	-	-	-	-	-
Thiamethoxam	-	3	-	5	-
Indoxacarb	7	-	-	5	-
Spinosad	3	-	3	-	-
Emmamectin benzoate	3	3	-	-	-
Lufenuron	14	-	5	-	-
Novaluron	5	-	-	1-3	-

Table 7: Economic threshold level for major insect pests of vegetable crops

Crop/Pest	*Economic Threshold Level (ETL)*
Tomato	
Fruit borer (*H. armigera*)	8 eggs/15 plants or 1 larva/plant or 1 damaged fruit/plant
Whitefly (*B. tabaci*)	3 nymphs/leaf or 4 adults/leaf
Leaf miner (*Liriomyza trifolii*)	26 mines/trifoliates or 6 adults/6 rows
Brinjal	
Fruit and shoot borer (*L. orbonalis*)	0.5-5 % shoot and fruit damage
Chillies	
Thrips (*S. dorsalis*)	2 thrips/leaf
Mites (*P. latus*)	1 mite/leaf
Okra	
Leafhopper (*A. biguttula biguttula*)	4.66 hoppers/leaf
Shoot and fruit bore (*Earias vittella*)	5.3 % of fruit infestation
Cabbage	
Diamondback moth (*P. xylostella*)	2 larvae/plant at 1-4 weeks after transplanting or 5 larvae/ plant at 5-10 weeks after transplanting.
Cabbage leaf webber (*Crocidolomia binotalis*)	0.3 egg mass/plant
Pea	
Pea aphid (*Acyrthosiphon pisum*)	3-4 aphids/stem tip
Radish	

Table 8: New biorational insecticides for use in vegetables

Common name	***Crop***	***Target pest***	***Dose/ha (g a.i.)***
Imidacloprid 17.8% SL	Chilli	Jassid, aphid, thrips	25-20
	Okra	Jassid, aphid, thrips	20
Thiamethoxam 25% WG	Okra	Jassid, aphid, whitefly	25
	Tomato	Whitefly	50
	Brinjal	Whitefly	50
Thiacloprid 21.7% SC	Chilli	Thrips	54-72
Fipronil 5% SC	Cabbage	DBM	40-50
	Chillies	Thrips, aphid, fruit borer	40-50
Indoxacarb 14.5% SC	Cabbage	DBM	30-40
	Chilli	Fruit borer	50-60
	Tomato	Fruit borer	60-75
Spinosad 2.5% SC	Cabbage/cauliflower	DBM	15.0-17.5
Spinosad 45% SC	Chillies	Fruit borer	73
Chlorantranilprole 18.5% SC	Cabbage	DBM	10
	Okra	Fruit and shoot borer	9.5-11.0
Emamectin benzoate	Cabbage	DBM	7.5-10.0
	Chilli	Fruit borer, thrips, mite	10
	Brinjal	Fruit and shoot borer	10
Chlorfenopyre 10% SC	Chilli	Mite	75-100
Spiromesifen 22.9% SC	Brinjal	Red spider mite	96
	Chilli	Yellow mite	96
Diafenthiuron 50% WP	Cabbage	DBM	300
	Chilli	Mite	300
	Brinjal	Whitefly	300
Lufenuron 5.4% EC	Cabbage/cauliflower	DBM	30
Novaluron 10% EC	Cabbage	DBM	75
	Tomato	Fruit borer	75
	Chilli	Fruit borer, tobacco caterpillar	33.5
Buprofezin 25% SC	Chillies	Yellow mite	75-100
Flufenoxuron 10% DC	Cabbage	DBM	40

Source: *www.cib.org.in*

Integrated Pest Management Technologies

Researchers conducted at Indian Institute of Vegetable Research, Varanasi, Indian Institute of Horticultural Research Bangalore and under All India Coordinated Research Programme on Vegetable Crops various IPM technologies have been developed for many important pests of vegetables. IPM technology developed at IIVR indicated that from 15-20 days after transplanting installation of plastic funnel traps baited with sex pheromone lures just above the plant canopy @ 100/ha at 10 m distance from trap to trap, along with clipping of damage shoots and fruits at weekly interval and need based foliar spray of NSKE (4%) reduces the borer infestation to the maximum extent. Similarly for the management of fruit fly (*Bactrocera cucurbitae*) in cucurbits. Installation of used mineral water bottle trap, baited with cue lure saturated wood blocks (ethanol: cuelure: carbaryl in a ratio 8:1:2) @ 25 traps/ha prior to flower initiation have been used successfully against fruit fly. The bait spray containing malathion (50 EC) 20 ml + 20 liters water + 500 g molasses sprayed randomly on 250 plants/ha covering whole field has also been recommended.

For fruit borer (*H. armigera*) management, planting one row of marigold (45 days old seedling) as trap crop after every 16 rows of tomato (30 days old seedling) along with two releases of *T. brassiliensis* @ 2,50,000, parasitized egg/ha during peak flowering stage at interval of 10 days have been found effective. The trap crop combination along with two sprays of endosulfan (0.07%) in the intercropped tomato reduced the fruit damage by 50% as compared to unsprayed sole tomato. Spray of HaNPV @ 250 LE/ha twice after flowering effectively manage the fruit borer.

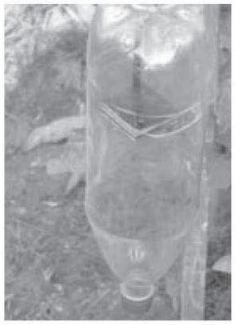
For diamondback moth (DBM) management in cole crops, growing of paired rows of mustard as trap crop after every 16 rows of cabbage (sowing of first row of mustard 15 days prior to cabbage planting and second row 25 days after cabbage planting) and spray of dichlorvos (0.1%) on the mustard plants have been found successful used for the control. More recently Chinese cabbage as a trap crop has been found better than mustard which can be taken advantage for the management of DBM in cabbage.

Seed treatment of tomato with imidacloprid or thiamethoxam (3 g/kg seed) control whitefly population up to 30 days and minimize the TLCV incidence. Netting of nursery is also advocated to protect from whitefly infection.

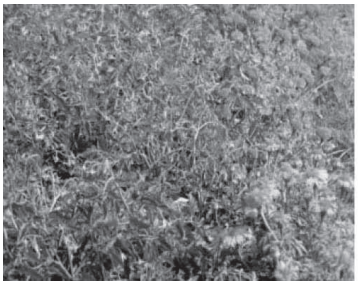
In okra, seed treatment thiamethoxam or imidacloprid @ 3 g/kg seed mixed with polymer (hydrocarbon oil) @ 50 ml/kg seed improved the persistency of treated chemical beyond 35 days upto 62 days in the management of jassids in okra. NSKE (4%) mixed with half of the recommended dose of endosulfan showed synergistic action and found to be effective against fruit borer in okra.

Shoot Cliping in Brinjal

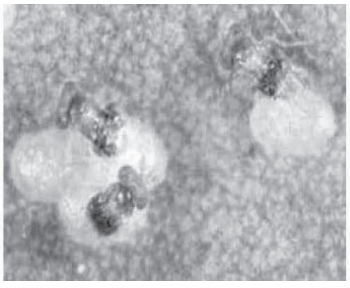
Pheromone Trap in Brinjal



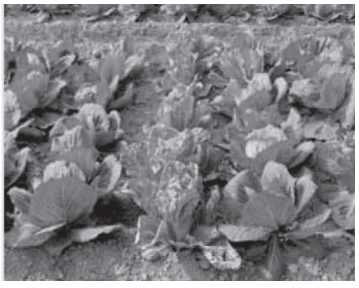
Bottle trap for fruitfly in Cucurbits



Marigold as Trap Crop in Tomato



Egg parasitoid *T. brassiliensis*



Chinese Cabbage as Trap Crop for DBM

Conclusion

Many potential elements of pest management in vegetable crops and others have been studied and recommended but most are not sufficiently advanced to be of value to end users in practical sense under field conditions. Improving mass production, formulations, shelf-life, quality control and delivery system of biopesticides and natural plant products, monitoring the pesticide residues in major vegetable crops and MRLs for each pesticide with respect to each group of vegetable along with emphasis on monitoring of major insect pests of vegetables to insecticide resistance and insect resurgence should be stressed upon. Successful IPM technologies should be implemented and promoted on wide area basis in the farmer's fields .Role of public-private partnership in production, distribution and quality control of different components of IPM such as resistant varieties, natural plant products, biopesticides and natural enemies is imperative, otherwise we will continue to talk of alternative methods of control for another many years.

Management of Plant Genetic Resources vis-a-vis IPRs and Technology Transfer in India

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The Intellectual Property and Technology Management Unit will naturally look for objectivity in management of all intellectual properties in the Indian Council of Agricultural Research (ICAR). Objectivity in approach assumes special importance when we realize that the world will require additional 70 per cent food production to feed a population of nine billion people by 2050. The present day complexities are naturally more challenging for developing and least developed countries who had not foreseen the spate of international developments particularly during the past about 50 years. Today, the new challenges of growth and development are to be met alongside additional international commitments like: conservation of environment and biodiversity, its valuation and monitoring, honouring claims of intellectual property, requirement of stringent quality standards, new requirement of international trade, facilitated access to genetic resources and so on.

To meet the fast increasing future demands, nation states require enabling environment in terms of laws, rules, regulations and programmes. Naturally, there is requirement of 'smarter' policies, science and implementation. This requires much faster reforms in the working environment of all kinds of actors, be it government departments, non-government organizations, private sector, civil society organizations, farming societies and the like. The paper focuses on ICAR initiatives, its proactive approach to meet its national role and requirement; and informs about Govt. of India's policies and implementation. The paper particularly dwells on the issue of IP management with respect to enhanced germplasm utilization in the light of international and national developments.

The development of agriculture sector remains critical to achieve the desired economic growth and poverty alleviation. In addition to contributing directly in improved rural incomes and employment, the technological advancement in agriculture sector is imperative in stimulating overall economic growth in the country. Public sector agricultural research system spearheaded by the Indian Council of Agricultural Research (ICAR) and the State Agricultural Universities have played a pivotal role in agricultural research and development with respect to increase in crop, animal and farm productivity. Since independence of the country, the wide application of fruits of agricultural research, in the form of improved cropping, plant protection, animal husbandry and fisheries practices have witnessed strides in agricultural production.

Access to good quality seed of improved cultivars is recognised as the essential vehicle for accelerating agriculture growth. This has generated lot of interest among private entrepreneurs including multi-national corporations. However, international developments of the last about five decades have made management and use of plant germplasm at the national level much more challenging.

Germplasm and Intellectual Property Protection

Traditionally, systems for intellectual property protection were principally applied for mechanical inventions, or artistic creations. The development of new plant varieties had been the prerogative of the farmers or a part of public good where the genetic resources and associated knowledge was freely shared as the common heritage of mankind. However, as the development of new plant varieties

could take 10 to 15 years and involved substantial investments; using both conventional and modern biotechnological tools, it was perceived by many to be the products of human intellectual effort and ingenuity, amenable for intellectual property protection. As plant breeding became an increasingly commercialised activity, dominated by private investments by transnational corporations, global debates on the issue led to the emergence of the concept of 'Plant Breeders' Rights' or intellectual property protection for new plant varieties. While the existing seed legislations in most of the countries regulated the procedures and standards for variety release/notification, seed certification and quality control, the plant variety protection was advocated as a means to provide incentive for innovation, encourage private investment in plant breeding/seed industry and increasing its contribution to the overall development of agriculture. The earliest international plant variety protection system, established in Europe as an inter-governmental organization, was the Union for Protection of New Varieties of Plants (UPOV) adopted principally by some industrialized governments in 1961. The UPOV Act 1961, came into force in 1968, and has since been revised in 1972, 1978 and 1991.

Further impetus for the stringent IPR regimes for plant varieties was imposed by the TRIPS agreement leading to the World Trade Organisation (WTO, 1994). Under Article 27.3(b) of TRIPS (Trade Related Intellectual Property Rights), it became obligatory for the member countries "to provide protection to plant varieties either by patent or by an effective *sui generis* system or by any combination thereof". While the developed countries had initiated the process much earlier and most had a well-established mechanism of patent or plant variety protection, such legislations have come up in some of the developing countries only during the recent past, since 1990s. Many of these countries have either joined the UPOV or modelled their legislation on it rather than providing intellectual property protection to new plant varieties in the existing patent laws.

Appreciating the fact that development of new plant varieties is basically an improvement on an existing product of nature nurtured by farmers and communities for ages, rather than a technological innovation, India adopted the *sui generis* approach and legislated the 'Protection of Plant Varieties and Farmers' Rights (PPVFR) Act 2001' which was developed by integrating the rights of breeders, farmers and communities, and taking care of the concerns for equitable sharing of benefits. This legislation provides protection to extant, new and essentially derived plant varieties and gives the breeder exclusive monopoly rights over the production, marketing and sale of the varieties.

Access to Germplasm

Concurrent to the debate on providing intellectual property protection to plant varieties, this period also witnessed fervent debates at national and international forums on the issues related to conservation and sustainable utilisation of the genetic resources. The major concern being access to genetic resources and the sharing of benefits accrued out of their use to individuals and corporations. The issues became much more complicated as in many of the 'genetic resource rich' developing countries the agricultural research and development has largely been state sponsored, whereas, in most of the developed technology-rich countries, agriculture research and development was sponsored by transnational corporations, often guided by financial benefits. This led to political polarisation of countries on the increasing demand for genetic resources and the need to control or maintain their free flow.

The Convention on Biological Diversity (CBD) recognised the sovereign right of nations to exploit their own biological resources. The CBD affirmed that the holders have rights over their knowledge, innovations and practices, whether or not they are capable of being protected by IPRs, although there is still an obligation for governments to safeguard these entitlements either through a new IPR law or by other legal or policy measures. It also established a new participatory relationship between provider and user of genetic resources incorporating the instruments of 'Mutually Agreed Terms' and 'Prior Informed Consent (PIC)' for access to genetic resources. Subsequently, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) arrived as a legally binding international instrument that aims to guarantee the future availability of the diversity of Plant Genetic Resources for Food and Agriculture. It seeks to establish principles for facilitating access to plant genetic resources and establishing fair and equitable mechanisms of benefit sharing under the Multilateral System and as per Standard Material Transfer Agreement

(SMTA). Commensurate with the CBD, the ITPGRFA also recognizes the enormous contribution that farmers and their communities have made and continue to make to the conservation and development of plant genetic resources. This is the basis for Farmers' Rights, and includes the protection of traditional knowledge, and the right to participate equitably in benefit-sharing and in national decision-making. The ITPGRFA, however, assimilates the IPR dimensions, and is an attempt to facilitate exchange of plant genetic resources for food and agriculture; it basically guides countries for a business plan on PGR as a management instrument.

National Response and Reorienting the Research

As compliance to the new requirements of IPR protection, the Government of India amended or enacted legislations. These have implications to agricultural research and development as well. The important laws include the Patents Act, 1970 amended in 1999 2002 and 2004 and 2005; The Geographical Indication of Goods (Registration and Protection) Act, 1999; and the Protection of Plant Variety and Farmers' Rights (PPVFR) Act, 2001. In addition, the Biological Diversity Act, 2002 emanating from the obligations under the CBD, has a profound influence in defining the national IPR climate in agricultural research and development. Consequently, as an implication of the extending regimes of IPRs, and imposed regulations on access to genetic resources, the plant scientists today are confronted with new dimensions of obligations. While some of the issues are legal, others are political and ethical. It is imperative, therefore, that our agricultural research and development system is reoriented to get maximum advantage from the new regime.

Variety Development Programmes

The Indian national agricultural research system is well recognized for its contributions in the form of development of high-yielding varieties that play a pivotal role in enhancing crop productivity. With the enactment of the Protection of Plant Varieties and Farmers' Rights Act, it has become relevant to bring about changes in the varietal development programme, and harmonise them with the relevant provisions of the Act.

The protection for new varieties is available for genera and species notified by the PPVFR Authority. New crops are regularly added to the list. Any new variety to be granted IP protection has to meet certain specific criteria. The PPVFR Act requires identity features of the applicant variety for distinctness, uniformity and stability (DUS) as per the crop-specific testing guidelines.

Biotechnological Research and Development

Indian Patent Act as after the last amendment in 2005 provides for product patents in India unless otherwise excluded in the Act. The scope of patentable subjects has also been expanded and it includes microorganisms, microbiological processes and non-biological processes for production of plants and animals. However, plants and animals, seeds, including essentially biological processes used for propagating plants and animals have been specifically excluded from patentability. Thus, synthetic genes (as distinct from naturally occurring gene segments), and products such as vaccines, enzymes, hormones, etc. can be considered for patentability.

Management of Plant Genetic Resources

The IPR regulatory frameworks have made a substantive effect on management of genetic resources particularly the ability of individuals to acquire, exchange, or use genetic resources. After the enactment of the Biological Diversity Act 2002, the export of plant genetic resources is governed by National Biodiversity Authority (NBA). Under this Act, access to genetic resources for non-Indians (foreigners), non-resident Indian company or a company with non-Indian participation in its share capital or management requires mandatory permission of NBA. Thus, an institutional framework is necessarily to be established for documenting exchange/supply of germplasm and tracing its movement to other parties.

The PPVFR Act requires that the application for registration of plant varieties should be accompanied with complete passport data of the parental lines from which the variety has been developed, along with the geographical locations in India from where the parental material has been taken, and all information relating to the contributions if any, of any farmer, village, community institution or organisation in breeding, or developing the variety. Thus, it mandates the breeders, organisations and genetic resource centres to maintain complete record of the passport information of the material/germplasm used in the

breeding programmes. It is important to make all-out efforts to update passport information and document the same. This would not only help plant breeders to register their varieties under the PPVFR Act but also assist farmers and communities in realizing benefit-sharing. Also, the plant variety applications require that the genetic material used to develop the product has been lawfully acquired, and also the source of material. This obligates adherence to Material Transfer Agreements (MTA) for genetic resources accessed from institutions or gene banks and prior informed consent of farmers or communities if material is obtained from them.

Recent Initiatives in ICAR

The ICAR is gradually and firmly moving towards IP management and technology transfer in an organized manner, to respond to the requirements of these new challenges. It has implemented its guidelines on "Intellectual Property Management and Technology Transfer/ Commercialization" that provide the required policy framework for management of intellectual assets in the institutes.

Institutional Mechanism

In ICAR, the premise of centralized planning and decentralized execution for intellectual property management is being followed through a 3-tier mechanism. All the ICAR institutes have been empowered to handle various intellectual property and technology management matters on day-to-day basis through the establishment of the Institute Technology Management Units (ITMU). In the middle-tier, five Zonal Technology Management & Business Planning and Development (ZTM&BPD) units have been identified at NIRJAFT, Kolkata for East zone; CIRCOT, Mumbai for West zone; IARI, New Delhi for North-I zone; IVRI, Izatnagar for North-II zone; and CIFT, Kochi for South zone. These institutes having relatively more experience in generating technologies with commercial potential serve in synergy with the ITMUs in their respective zones, and work out the best-fit strategies and work plan for technology transfer and realization. Further, the techno-legal and policy matters/concerns that may arise in the course of implementation of the guidelines are addressed by the Central Technology Management Committee at the ICAR headquarters, which is the apex decision-making body, chaired by the Director General ICAR.

A XI Plan Scheme on IPR has also been implemented to provide the required opportunities to the ITMUs and ZTM&BPD Units for developing the institutional capacity and the trained human resource in this direction. Further, under the component 1 of the National Agricultural Innovation Project (NAIP), initiative has been taken for establishing technology incubators at these five ZTM&BPD Units.

Human Resource Development

Realising the need for appropriate capacity building in terms of human resource, IP management training-cum-workshops were organized by ICAR all over the country. Nearly 1000 inter-disciplinary scientists and staff engaged in the area of technology management in the ICAR institutes and SAUs were sensitized and re-oriented to this new dimension. The focus of these programmes was to provide initial exposure to the nuances of the overall subject of IPRs and technology transfer, which included issues related to plant variety protection and aspects related to access and licensing of genetic material. In addition to in-house efforts of creating awareness, ICAR scientists and other concerned staff have been nominated for training in various prime institutions in India and abroad. With these efforts of capacity building, which will further continue in future, it is expected that the trained persons would spearhead the change process and provide leadership for IP management in the institutes.

IP Portfolio and Technology Tansfer

The capacity building and HRD efforts made in the past two years have started giving the desired dividends. While in 2001, the ICAR patent portfolio had 33 applications, it had increased to over 450 applications by 2010' end. In addition, since the initiation of the plant variety protection in the country, ICAR institutes have filled over 1000 applications for plant varieties developed through the efforts of All India Coordinated Research Programmes in various crops notified under the PPVFR Act. These applications include both extant and new varieties developed. As the new genera are notified by the PPVFRA, more applications shall be filed.

Traditionally, the emphasis in ICAR was on free transfer of innovated technology and knowledge but the changed times require a more professional approach, including towards exchange and supply of plant germplasm. Thus, dissemination of ICAR technologies and materials

in partnership with public and private sectors is being promoted on the principles of joint IPR ownerships and pre-decided licensing rights on mutually agreed terms. Various ICAR institutes have entered into MoUs with private and public sector companies for commercialization of plant varieties/hybrids.

Appreciating the need for development of effective public-private partnerships for dissemination of technologies, an ICAR-Industry Meet 2010 was organized from 28-29 July 2010 at New Delhi. The Meet was organised focussing on four core areas of agri-technologies, wherein use of germplasm and technologies had equal emphasis. The desired impetus is now providing for developing effective partnerships for transfer of technology. this year's ICAR-Industry Meet is again being organized on 23 May' 2011. Similarly, commodity-specific as also region-specific Industry Meets are organized to project ICAR's goods and services, so as to nurture entrepreneurship and enterprise development in the agriculture sector.

Harnessing the Advantages of IPR Regimes

Economic benefits do not flow by seeking IPR on a technology. The IPR protection at best establishes the ownership and serves as a potent tool for negotiating a successful commercial deal. The financial benefits depend upon its economic value and marketability. Therefore, it is important to consolidate intellectual assets of the institutes. For genetic resources, it would require that a comprehensive programme for characterization and evaluation is undertaken to identify germplasm, including landraces/traditional cultivators, which may be novel, unique, and distinct. Such germplasm may have one or more outstanding traits, such as resistance to disease(s), high protein content, bold grain etc. that have potential for use in academic, scientific or applied research, or in crop improvement, but may not have direct commercial value. These germplasm should be provided with national identity, inventoried (registered) and conserved with the National Bureau of Plant Genetic Resources (NBPGR). This would strengthen the ownership claims and thereby the opportunity of sharing benefits in case the same germplasm is utilised for developing new varieties by someone else for commercial gains. This is a mechanism of registration of plant genetic resources in National Bureau of Plant Genetic Resources of ICAR in New Delhi. This helps in traceability of individual contributors of genetic stocks which are not registered under the PPVFR Act.

Commercialisation of any technology involves an amount of intrinsic risk and most institutions lack the necessary experience, competencies and tools for undertaking these activities. The public-private partnerships provide an opportunity to leverage valuable private resources, expertise or marketing networks, through licensing, assignment and joint ventures. It is, however, imperative that internal competence is generated for assessing and evaluating IPR value of innovations and manage the IPR portfolio. Further, the institutes will have to be better equipped with reliable data on performance of the technology, as this would not only impact the expected vendibility but would also help in getting a better deal during negotiation with potential partners.

Although seeking IPR protection is not obligatory and the institutions have the option of keeping any or all technologies developed by them in public domain, these technologies can always be tactically modified by the others to establish IPR on them. This is more so in case of technologies related to genetic resources which have high appropriability. On the other hand, IPR protection of all eligible technologies generated in the institutions may also not be a sustainable strategy, as it would require enormous funds and resources to manage and monitor the IPR portfolios. The best option, therefore, would be to critically vet the technologies, professionally assess its economic worth, and selectively seek IPR protection for important and strategic technologies. The other technologies which either do not have potential for commercialisation or where their diffusion is required as a social responsibility can be left in public domain for free access. The success would, however, depend on the ability to generate enough revenue from the protected technologies that would not only compensate the cost involved in the establishment of IPR and its maintenance but also provide resources to undertake additional research and development work and help in discharging the social responsibility.

Fruits & Vegetables Sector Marketing An Overview

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India is the second largest producer of fruits & vegetables in the world with an annual production of around 205.25 million tonnes. It has the distinction of producing almost all-tropical and exotic fruits and vegetables because of varied climatic conditions. Due to the short shelf life of these crops, as much as 30-35% of fruits and vegetables perish during harvest, storage, grading, transport, packaging and distribution. Only 2% of these crops are processed into value-added products. Hence, there is a need for maximum commercial utilisation of fruits and vegetables and to adapt production and marketing activities to the requirements of the world market and to cater to domestic demand which, over the past few years, has been increasing because of various socio-economic factors. If the nutritive value of the processed food products could be maintained, this sector will emerge as a major value-added food industry.

The Horticultural development had not been a priority until recent years in India. It was later in the post 1993 period that focused attention was given to horticulture development through an enhancement of plan allocation and knowledge-based technology. Despite of this decade being a period of "golden revolution" productivity of the horticultural crops has increased only marginally from 7.5 tonnes per hectare in 1991-92 to 10.7 tonnes per hectare in 2009-10. During 2009-10. India has produced 223.1 mt horticultural crops (NHB, 2010). In 2009-10, total area under fruits and vegetables had been 13.7 million hectares and total production had been 205.25 million tones (NHB, 2010). Of the 931.8 million tons of vegetable produced in the world, India's share is 133.7 million tons. All taken together, India's share of the world's vegetable market is 14.8 per cent. Presently, the horticultural crops cover 20.9 million hectares, i.e. roughly 7 per cent of the gross cropped area and contributes 18-20 per cent of the gross value of India's agricultural output. India is the second largest producer of fruits and vegetables in the world next only to China and accounts for about 16% of the world's production of vegetables and 10% of world's fruits production. Share of fruits and vegetables in total value of agricultural exports has increased over years from 9.5 per cent in 1980- 81 to 24.55 per cent in 2009=10. But we are still lagging behind in actual exports of these produce. For example, India produces 65 per cent and 11 per cent of world's mango and banana, respectively, ranking first in the production of both the crops. Yet our exports of the two crops are nearly negligible of the total agricultural exports from India. It is a known fact that horticulture sector in India is constrained by low crop productivity, limited irrigation facilities and underdeveloped infrastructure support like cold storages, markets, roads, transportation facilities etc. There are heavy post-harvest and handling losses, resulting in low productivity per unit area and high cost of production. However, on the other hand India's long growing-season, diverse soil and climatic conditions comprising several agro-ecological regions provide ample opportunity to grow a variety of horticulture crops. Thus, efforts are needed in the direction to capitalize on our strengths and remove constrains to meet the goal of moving towards a horticulture lead agricultural growth in India. The foreign trade policy 2004-09 emphasized that to boost agricultural exports growth and promotion of exports of horticultural products is important. Horticulture contributes nearly 28 per cent of the GDP in agriculture and 54 per cent of export share in agriculture.

Acreage under Horticulture

Horticulture which include fruits, vegetables, spices, floriculture, and plantations-is 20.8 million hectares in 2009-10. With production of 71.5 MT and 133.7 MT, respectively, in 2009-10, India even now is the second largest producer of both fruits and vegetables in the world. India occupies first position in the production of cauliflower, second in onion and third in cabbage. The National Horticulture Mission (NHM) was launched in May 2005 as a major initiative to bring about diversification in agriculture and augment income of farmers through cultivation of high value horticultural crops. The National Horticulture Mission (NHM) aims at doubling horticulture production by 2012.

Production Area

Vegetables are typically grown in India in field conditions; the concept is opposed to the cultivation of vegetables in green houses as practiced in developed countries for high yields. The fruits and vegetables considered important by the horticulture board are mostly grown in the areas of Jammu & Kashmir, Himachal Pradesh, hilly regions of North Uttar Pradesh, Bihar, Tamil Nadu, Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Assam, Madhya Pradesh, Rajasthan, Punjab, Tripura, West Bengal and Orissa.

Growth Promotion Activities

Ongoing liberalization and the emergence of and integrated global market have opened new vistas for Indian horticulture. In fact, till very recently, India's main policy focus that until recently was only on grains and cereals, has been changed in a timely manner, with the launch of National Horticulture Mission in 2005-06 by Government of India with a mandate to promote integrated development in horticulture, to help in coordinating, stimulating and sustaining the production and processing of fruits and vegetables and to establish a sound infrastructure in the field of production, processing and marketing with a focus on post harvest management to reduce losses. It envisages to double the production of horticulture produce by the end of 1912. This enabled India to exploit its true potential. Since liberalization and withdrawal of excise duty on fruit and vegetable products there has been significant rise in the growth rate of the industry. No industrial license is required for setting up Fruits & Vegetables Processing industries; setting-up 100% EOUs require specific Govt. approvals. Many subsidies, irrigation plans, loans, pre and post harvesting schemes led to the following figures of production

Fruits and Vegetables: India's Production Status

Mango, Guava, Banana & Peas : World's largest producer

Lemon, Onion, Brinjal, Cabbage, Cauliflower, Pumpkins & Gourds, Total Vegetables and Total Fruits : World's 2nd largest producer

Coconut : World's 3rd largest producer

Oranges : World's 4th largest producer

Papaya, Lettuce & Pineapple : World's 5th largest producer

Tomato : World's 6th largest producer

Citrus Fruits/ Mosambi & Cassava : World's 7th largest producer

Sweet Potato : World's 9th largest producer

Apple: World's 10th largest producer

Grapes: World's 16th largest producer & World record in productivity

Fruits and vegetables are processed into a variety of products such as juices and concentrates, pulp, canned and dehydrated products, jams and jellies, pickles and chutneys etc. The extent of processing of fruits and vegetables varies from one country to another. Historically speaking, processing of fruits & vegetables in the simplest form like pickling, sun-drying and/or making preserves has been practised in the country from very ancient times almost in every home. Since then it has been progressing fairly well and has been meeting the entire local demand and has successfully entered the exports market.

Competitiveness of Indian Horticulture

Commodity that a nation should produce and export is determined by the principal of comparative advantage. The comparative advantage tells about that capability of the country to export a commodity, while the competitiveness of the commodity in the world market is determined by the measure of export competitiveness.

Export Competitive Commodities

- Fruits: Banana, Papaya
- Vegetables: Brinjal, Cabbage, Cauliflower, Peas

Commodities with Comparative Advantage

- Fruits: Mosambi, Mango and Guava and
- Vegetables: Onion

Fresh Fruits and Vegetables Characteristics

- **Perishability of products:** Involvement of many bio-physio-chemical processes make its highly vulnerable to damages at short intervals and thus contributes to product's limited shelf life.
- **Seasonability of production:** The inconsistent supply due to the close involvement of many biotic and abiotic factors of production break the cycle of the produce availability in the market throughout the year.
- **Bulkiness of products:** The bulkiness of the fresh produce adds to the transportation, handling and packaging charges. Alongwith makes its prone to pre and post harvest damages in the supply chain accounting upto the extent of 20-40 percent.
- **Quality variation of products :** Non adherence to GAP practices leads to variation in quality
- **Irregular supply of products:** Seasonability and non planned insufficient production creates gluts and shortages in the market.
- **Small Holdings size & scattered production processing:** As majority of the Indian farmers falls in marginal and small category.

Rising of Fresh Fruits and Vegetables Consumption

- **Rising income/Economic growth:** Spurge in the sensex and improved living paved the way for the fresh fruits and vegetables
- **India's burgeoning middle-class:** Emergence of the majority middle class and drastic changes in the demographic figures mainly the substantial rise of the youth population viz. more than 50 percent of Indian population is under the age of 35 years. This given the needed thrust to fresh fruits and vegetables consumption
- **Demographical changes :** Due to vast cultural and social diversity available in India majority of which is vegetarian, fresh fruits and vegetables found driver's seat in the food palate of every Indian.
- **Health awareness:** Due to emergence of new diseases and improvement in education level provided the demand for the fresh fruits and vegetables among the population due to its disease prevention and health promoting properties.
- **Increased literacy:** Improvement in the education status backed with higher income and the awareness about fresh fruits and vegetables indirectly leads the way for higher demand and consumption.
- **New diseases prevalence:** Eruption of new diseases due to the resurgent changes in the food habits and lifestyle also created the much needed thrust for the fresh fruits and vegetables among the masses, due to its disease prevention and health promoting properties.
- **Trade liberalization /Globalization:** Aftereffect of the WTO and the globalization the fresh fruits and vegetables are available almost round the year from one or the other production pockets at reasonable prices and desirable quality in sufficient amount.
- **Development of better infrastructure & transit facilities:** Public-Private – Partnership efforts brought the necessary infrastructure viz. coolchains, better roads, transportation and storage facilities for the perishable commodities in the investment shying sector to the satisfactory status.

Marketing of Fresh Fruits and Vegetables

Marketing plays an important role not only in stimulating production and consumption, but in accelerating the pace of economic development. The marketing system plays a dual role in economic development in countries whose resources are primarily agricultural. Marketing comprises all the operations, and the agencies conducting them, involved in the movement of farm-produced foods, raw materials and their derivatives from the farms to the final consumers, and the effects of such

operations on farmers, middlemen and consumers. Agricultural marketing deals with all the activities, agencies and policies involved in the procurement of farm inputs by the farmers and the movement of agricultural products from the farms to the consumers. The agricultural marketing system is a link between the farm and the non-farm sectors. It involves all the aspects of market structure or system, both functional and institutional, based on technical and economics considerations, and includes pre and post-harvest operations, assembling, grading, storage, transportation and distribution. The expansion in the size of farm output stimulates forward linkages by providing surpluses or food which requires transportation, storage, processing, packaging and retailing to the consumers. Increasing demands for money with which to purchase other goods leads to increasing sensitivity to relative prices on the part of the producers, and specialization in the cultivation of those crops on which the returns are the greatest, subject to socio-cultural, ecological and economic constraints. It is the marketing system that transmits the crucial price signals. The fruit and vegetable marketing in India is highly decentralized having wide capacities. There has been concern in recent years regarding the efficiency of marketing of fruits and vegetables, and that this is leading to high and fluctuating consumer prices and only a small share of the consumer rupee reaching the farmers. It is overviewed by many committees and reports that Indian farmers are good producers but not good marketer. As early as 1976 National Commission on Agriculture pointed about the inefficiency in agricultural marketing with particular to fresh perishables and strongly recommended in following words that "It is not enough to produce a crop; it must be satisfactorily marketed." Marketing of horticultural crops is complex especially because of perishability, seasonality and bulkiness. Fruits and Vegetables are an item of daily consumption, they are essential in human diet but they are very perishable in nature. Therefore, the cultivation of fruits and vegetables is generally concentrated around towns and cities, so that they can be harvested and transported to the nearby market immediately and in fresh form. With the increase in transport and communication facilities, fruits and vegetables cultivation has spread in interior areas where irrigation facilities are available. This is because growing vegetable crops is more profitable than any other seasonal crop particularly the foodgrain crops. The spread of fruits and vegetables cultivation in rural areas has solved the perennial problems, particularly of transport, handling, packing and storage. There is also some regional specialisation in growing some fruits and vegetables. They are grown in one area but marketed in other areas for creating wider market and also to fulfill the demand of some people, who have liking for them. This also involves long distance transport. For this purpose good roads in the interior villages is necessary. Fortunately there are good state and national highways, but there are no good roads in the interior. Sale of the fruits is generally through pre-harvest contactors, so that the farmer gets an advanced payment and cover his risk. Vegetables are usually sold through commission agents and very little of pre-harvest contacting is done. Due to this the net returns are generally low. Farmers spend means to devote more time to their field crops rather than to the orchards. If the farmer does the marketing of his produce himself then the net returns to him would be double. So also in the marketing of fruits and vegetables, producer cannot go to wholesale market or long distant market and he has to depend on some intermediaries to sell his fruits and vegetables. Therefore, in the marketing of fruits and vegetables costs are involved for grading, packing, transport, loading/ unloading, fees, etc. In addition, the intermediaries also take some margins for them. These costs and margins determine the final price to be paid by the consumer. After deducting market costs and margins from the final price paid by the consumer, farmer gets his net price, which is referred to "Farmer's share in consumer's price". This determines efficiency of marketing.

Sometimes, agricultural commodities directly pass from producers to consumers. But in indirect marketing agricultural commodities generally move from producers to consumers through intermediaries or middlemen. The number of intermediaries may vary from one to many.

Agencies

Producers: Most farmers or producers, perform one or more marketing functions. They sell the surplus either in the village or in the market. Some farmers, especially the large ones, assemble the produce of small farmers, transport it to the nearby market, sell it here and make a profit.

Middlemen: Middlemen are those individuals or business concerns which specialize in

performing the various marketing functions and rendering such services as are involved in the marketing of goods.

Wholesalers: Wholeselling is the one ion of goods is the wholesale dealers. Wholeselling is the one that covers activities of all individuals or businessmen, which sell to or negotiate sales with customers, who buy for resale or industrial use.

His position is that of an intermediary between manufacturer and retailer.

Wholesalers are classified as:

- Local wholesalers, who deliver their purchases to local retailer.
- Provincial wholesalers some time called as distributor selling to the retailers of a particular district or a state and
- National wholesalers located at a strategic place and distribute goods all over the country.

Retailers: He is the last link in chain of middleman, who sells directly to consumer. He takes title to goods, sells and sets up business usually amidst the consumer's groups. He buys his requirement usually from the wholesalers. Retailers in producing areas may have direct contact with producers and buys goods from them for resale.

Co-operative Marketing Societies

Main function:

- Selling the produce of member's.
- They also undertake outright purchases.
- Provide storage facilities for storage and grading and
- Save cultivators from exploitation by traders and help farmers in getting fair

  price for their produce.
- Performing functions of processing of raw produce.

Pucca Arhatias: He is the real purchase in the wholesale market on his own behalf of acting for some businessmen, firms in consuming markets. Big industries play as their agent and order him to purchase certain quantity within a given range of price. When pucca arhatia trades on his own, he dispose of his produce brought by him through dealers in different parts of country.

Katcha Arhatia: He also advances money to the cultivators and village banias on the condition that the produce will be disposed off through him alone and hence charges a very nominal rate of interest on the money advanced. Katcha arhatia charges commission for services rendered by him. Important link between the village cultivator or traders on the one hand.

Village Merchants: He is an important agency in the collection of produce and more so when the mandi is situated at a considerable distance from the village. He advances from his shop either on credit or for exchange of foodgrain or so price given for cultivator's produce. The quantities of agril. Produce so collected are either disposed off in the mandi or retained for resale in the village in the processed forms, such as rice, flour, oil etc.

Intinerant Traders: They are small merchants, who move from village to village and buy the produce from cultivator's house. They give a lower price than selling in the nearby market and in setting transportation take into consideration, the factors such as cost of transportation, market charges and profit margin.

Transport Agency: This agency assists in the movement of the produce from one market to another e.g. railways, trucks, bullock carts, camel carts, tractor trolleys.

Communication Agency: It gives information about the prices prevailing, and quantity available and transactions e.g. post, telephone, telegraph, newspapers, radio. Advertising Agency: It enables prospective buyers to know the quality of the product and decide about the purchase of commodities e.g. newspapers, radio, television, cinema slides.

Auctioners: They put produce for auction and bidding by the buyers.

Government Agencies / Institutions: In addition to individuals, corporate, co-operative and government institutions are operating in the field of agricultural marketing. Some important institutions are:-

The State Trading Corporation (STC)

- To make available supplies of essential commodities to consumers at reasonable prices on a regular basis;
- To ensure a fair prices of the produce to the farmers so that there may be an adequate incentive to increase production;

- To minimize violent price fluctuations occurring as a result of seasonal variations in supply and demand;
- To arrange for the supply of such inputs as fertilizers and insecticides so that the tempo of increased production is maintained;
- To undertake the procurement and maintenance of buffer stock, and their distribution, whenever and wherever necessary;
- To arrange for storage, transportation, packaging and processing;
- To check hoarding, black-marketing and profiteering.

Vicious Marketing Channels

The channels of marketing is an important aspect of agricultural marketing affecting the prices paid by consumers and shares of them received by the producer. The shorter the channel, lesser the market costs and cheaper the commodity to the consumer. When the channel is long with more intermediaries, prices are more and producer's share is less. The channel which provides commodities at cheaper price to consumer and also ensures greater share to producer is considered as the most efficient channel Several studies have been carried out in India on this topic for different commodities and in different regions and the results are of mixed nature due to local socio-economic conditions and infrastructure facilities

Normally producer's shares in different commodity groups are as follows:

- Food grains- 55 to 65%
- Other commodities- 60 to 70%
- Fruits- 30 to 40%
- Vegetables- 40 to 50%

Channels of Vegetables

- Producers–consumer (village sale)
- Producer–retailer–consumer (local sale)
- Producer–Trader–commission agent–retailer–consumer.
- Producer–commission agent–retailer–consumer
- Producer–primary wholesaler–secondary wholesaler– retailer– consumer (distant market).

Channels of Fruits:

- Producer–consumer (village sale)
- Producer–Trader–consumer (local sale)
- Producer–pre-harvest contractor–retailer–consumer
- Producer–commission agent–retailer–consumer.
- Producer–pre-harvest contractor–commission agent– retailer–consumer
- Producer–commission agent–secondary wholesaler– retailer–consumer (distant market).

These channels have great influence on marketing costs such as transport, commission charges, etc. and market margins received by the intermediaries such as trader, commission agent, wholesaler and retailer. Finally this decides the price to be paid by the consumer and share of it received by the farmer producer. That channel is considered as good or efficient which makes the produce available to the consumer at the cheapest price also ensures the highest share to the producer.

Constraints

- **Lack of basic infrastructure** viz., cool chains, logistics and supply chain management. The infrastructural problems, pertaining to the cold storage facilities are dual as some places don't have the cold storage while some places have the problem of under-utilisation of the existing cold storages. The utilisation is even lower than 30 per cent of the total capacity in many cases. Development of competitive international transportation, linked to domestic air transport or road and rail transport would help in reduction of post harvest losses.
- **Preponderance of Intermediaries** in the channel results in unfair and exploitative practices in marketing of fresh produce is very common.
- **Lack of proper grading** and quality control system.
- **Scattered productions** and sometimes in isolated places where even the transportation facilities and other infrastructure is not sufficient for the perishables.

- **Lack of unity and organization skill among the farming community,** which proves a major impediment in the formation of cluster groups and co-operatives.
- **Inefficient & Imperfect markets**: Due to prevalence of many intermediaries and malpractices followed by them in the price fixation and auction of the perishables in between the marketing channel results in uprise of consumer's price in the producer's share.
- **Concept of consumer packaging practically unknown in domestic markets :** Improper pre and post harvest handling without any sound packaging leads to heavy loss ranging from 20-40 percent of the produce at the time when its reaches the final consumer.
- **Lack of forward & backward linkages:** Absolute lack of the much needed quality inputs and extension backup at proper time and after harvest processes.
- **Ignorance to new methods of cultivation** and dependence on traders for extension knowledge.
- **Perishability and Storability:** Having limited shelf life due to its typical bio-physio- chemicals constitutions, fresh fruits and vegetables penetration is restricted to the certain niche markets and stakeholders. Besides the presence of insufficient numbers of storages and coolchain facilities adding to the woes
- **Low exports :** Emergence of many competitive markets with comparative advantages in awake of the globalization and the imposition of different Tariff and Non-tariff barriers to save the domestic industry by the protectionalist nations using sanitary and phytosanitary measures (SPS) as their benchmark resulting in the limited exports of the perishable commodities. The window of international demand for the horticultural products is very small. Thus a planned strategy is to be made to target the markets during that period.
- **Freight charges:** High air freights are also hindrance for cost effective exports. For the exports large fluctuations in the production of fruits and vegetables causes problem in being a regular trade partners.
- **Long marketing channel:** Prevalence of many of the intermediaries in between the supply chain robbing the lion's share of the producer's by deeply penetrating the consumer's pocket.
- **Non-functional AEZ:** Even after 10 years of starting of the Agri-Export-Zones in deferent specific production pockets of different produces, full implementation is at its nascent stage due to many socio-political reasons. Thus the final benefit doesn't reaching to the destined.
- **Poor Post harvest care & handling of the produce:** Improper pre and post harvest care and handling leads to heavy loss ranging from 20-40 percent of the produce.
- **Absolute lack in co-ordination** b/w production targets of concerned department & action plan of the marketing directorate
- **Prevalence of primitive methods of selling** and price fixation like, secret sale, private negotiation, under cover etc.
- **Meagre involvement of Government** & other co-op. marketing agencies alike to the private agencies

Indian market gains momentum

India is a land of huge potential, and always would be. It was a mood of resignation captured that modern forms of food retailing would never take off in India during lifetime. It is the retail 'revolution', coupled with the economic boom that looks set to provide the impetus for India's fresh produce sector to make real strides. Everyone singles out the supply chain challenge, resulting from a chronic lack of infrastructure, as the key hurdle to the modern retailers that are setting up shop in India, but the real challenge will be at the front-end rather than the back-end, where they must change the way fresh produce is marketed as well as the mindset and tastes of the Indian consumer. For instance, the Indian consumer 'eats curry, not vegetables', making fresh produce a value- driven purchase. Fruit and vegetable retail in India is low margin, high cost, not the other way around. Traditional small vendors with few overheads thrive in this climate, offering consumers a service that inspires loyalty. Changing consumers' behavior may be the main hurdle for India's modern retail sector, but there are plenty of others to overcome - poor infrastructure, shortage of expertise, high real estate costs to name a few.

Indeed, it's possible that the fledgling retail revolution will falter and fizzle out, given the size of the challenges ahead. But this looks unlikely, as major corporates are driving the push and the momentum has already been gained. Indeed, Fresh Produce India would have departed with a sense of the challenges and complexity of the Indian market, but a genuine optimism that the country is finally on track to deliver on the huge potential it offers.

Direct Marketing Models in India

It has been realized that the marketing channel for farm products which are highly perishable (fruits, vegetables and flowers) should be as short as possible. Perishable farm produce should move quickly from farmers to consumers. If farmers directly sell their produce to the consumers, it will not only Save losses but also increase farmer's share in the price paid by the consumers. Therefore, direct marketing by the farmers is being encouraged as an alternative channel. Some examples of these channels are given below:

Kisan Mandi

An innovative concept of 'Apni Mandi' has been introduced in some states. Apni Mandi is also called 'Kisan Mandi', as it is different from the traditional mandi or market yard, where the produce moves to the buyer through either a commission agent or trader. In Kisan Mandi there is a direct contact between the farmer producer and the buyer who is generally the consumer. This system does away with the middlemen. In Kisan Mandi, farmers sell their produce directly to the consumers without involvement of the middlemen. The price spread in Kisan Mandi is considerably low. These are working satisfactorily in the case of fruits and vegetables.

The main objectives of popularising the concept of Kisan Mandi are:

- Better marketing of agricultural produce especially of fruits and vegetables.
- Ensuring direct contact of the producer-farmers and the consumers and thereby enhancing the distributional efficiency of the marketing system.
- Increasing the profitability of agricultural crops for the producers by minimization of marketing costs and the margin of the middlemen.
- Ensuring the availability of fresh fruits and vegetables and other farm produce at reasonable prices to the consumers.
- Removing social inhibitions among the farmers for retail sale of their produce .
- Encouraging additional employment to the producers and thereby enhancing their incomes.
- Promoting national integration by inviting the farmers of other states to sell the produce grown by them directly to the consumers in Apni Mandis of other states and
- Providing business techniques to the farmers so that in the long-run they may adopt this practice for other crops and enterprises too.

Shetkari Bazar: On the lines of farmers' markets in other statesviz., Apni Mandi in Punjab, Haryana and Rajasthan since 1988

Krishak Bazar : Government of Orissa has taken a programme of establishing Krishak Bazars in the state of Orissa in the year 2000-01 with the purpose to empower farmer-producer to compete effectively in the open market to get a remunerative price for his produce and to ensure products at affordable prices to the consumers.

Mother Dairy Booths: Mother Dairy, basically handling milk in Delhi, was asked to try its hand in retail vegetable marketing by direct purchasing vegetables from the farmers, Moving them in specially built vehicles, storing them in air conditioned godowns and distribute them to the consumers through its retail outlets if 1989 after the notorious onion and potato price crisis. Mother Dairy management has opened retail outlets in almost all important colonies of Delhi for providing vegetables to the consumers at reasonable prices.

Cooperative Marketing Society

When producers of agricultural commodities or any other product form a society with an objective of carrying out marketing of their produce, such society is called as co-operative marketing society. The need for co-operative marketing arose due to many defects observed and experienced in the private and open marketing system. Those are several malpractices prevail in the marketing of agricultural produce. For example, arbitrary deductions from the produce, manipulation of weights and measures and cheating the farmers, collusion between the broker

and the buyer while fixing the prices, delay in payment of amounts due to farmers, etc. The result is the farmers are indebted to trader - moneylender. In such circumstances co-operative marketing society can largely help the farmers reduce the malpractices and offer honest and correct services. There exists a chain of intermediaries between the producer and the final consumer. They include village merchant, itinerant trader, wholesaler, commission agent, pre-harvest contractor and retailer. They take their own margins for the services, they render. But these margins are generally exorbitant, making the commodities costly for the consumers and reducing the producer's share in the consumer's price. A co-operative marketing society can eliminate some or all of the intermediaries and can reach to the consumers and establish direct trade relations with them. This will make commodities cheaper to the consumers and also ensure good quality of produce to them because much of the handling is avoided.

There are some services such as transport, storage, financing, grading, packing, loading/ unloading, which are, carried out by some private functionaries who charge high rates for these services. A co-operative marketing society performs these services efficiently and at cheaper rates. A co-operative marketing society provides market finance to farmers and ensures better returns to their produce. Besides marketing society can act as an agent of credit co-operative society and help to recover loans advanced by credit societies. At present, most of the financial needs of the farmers are fulfilled by trader - moneylenders at very high rates of interest and with the condition that they will sell their produce through them. This can be avoided, if there is co- operative marketing society.

Organisation: Under the system of co-operative marketing whole responsibility of marketing is taken up by the farmers themselves, organized on co-operative basis. The area of operation of marketing society is usually fixed with reference to local conditions - area based or commodity based. The commodity-based societies related to grapes, oranges, banana, pomegranate, etc. have wider jurisdiction covering the major areas growing each crop. There are societies at the producer's level and they federate at state or national level to deal with bigger markets including foreign markets for export of their produce.

Membership: Membership of a co-operative marketing society is open to individual farmer who produces the crop for which the society is formed. Other co-operative societies in the area can also become institutional members.

Functions

- To arrange for the sale of members produce to the best possible advantage.
- To undertake activities in connection with grading, pooling and procurement of produce of the members.
- To provide storage facilitates to their members by renting or owning the godowns and thereby facilitate to grant advances against pledge of produce.
- To protect members from all types of malpractices eliminates the middleman in the chain of marketing.
- Co-operative marketing society ensures grading, etc. and supply of good quality material to consumers.
- It teaches business methods to farmers and serves them as agency for supply market information.
- The society is able to stabilize prices over a long period by adjusting the supply with the demand.
- Marketing societies are also encouraged to undertake export trade so that they can give better prices to their members.

Contract Farming/Contract Marketing

Contract farming or marketing essentially is an arrangement between the farmer-producers and the agri-business firms to produce certain pre-agreed quantity and quality of the produce at a particular price and time. It can only be a pure procurement transaction or can extend to the supply of inputs or even beyond. Contract farming is emerging as an important mode of procurement of raw materials by agri-business firms in India due to the developments in the field of agricultural marketing, changes in food habits and in agricultural technology in the new economic environment. This is an important initiative for reducing transaction costs by establishing farmer-processor linkages in addition to the already existing methods of linking the farmers to the consumers. The distinction between 'sales' and 'contract to sell' needs to be understood clearly. In the case of sale, the title or ownership of goods is

transferred at once whereas in the 'contract to sell', the goods are transferred at a later date. A contract to sell is not in the true sense of the word a sale, rather it is merely an arrangement to sell. A contract is an agreement but an agreement is not necessarily a contract. In contract farming, companies or organizations engaged in processing and marketing of agricultural products are entering into contracts with the farmers. They provide inputs to the farmers and buy back the product at a rate specified in advance.

Following type of inputs and services are normally provided by the company to the farmers.

- Seeds of the variety they need for processing/marketing
- Guide lines to grow the crops
- Pesticides which do not result in residual toxicity
- Extension services
- Fertilizers/hormones required for the crop
- Other material if not locally available.

Contract farming/marketing is beneficial both for the producer-farmers as well as to the processing company in several ways:

To the farmer, contract farming -

- Reduces the risk of price/production
- Ensures the price as market is assured
- Increases the quality consciousness
- Ensures higher production because of better quality seeds and pesticides
- Reduces marketing costs
- Provides financial support in cash or kind.
- Ensures efficient/timely technical guidance almost free of cost.

To the company, contract farming

- Ensures supply of quality agricultural produce at right time and at lesser cost to the company
- Canalizes direct private investment in agricultural activities.
- Ensures that the toxicity level is reduced as per requirement for export.

Government is increasingly looking towards the corporate sector to augment the rural incomes and employment through agro-processing. In this context, policy makers see the contract farming/ marketing as an important avenue to ensure greater private sector participation in agriculture.

The important weaknesses of contract farming are:

- Contract farming is involved mostly in cash crops which may lead to shift in area from food crops which, beyond a limit may endanger food security, biodiversity and agricultural crops cycle of the country.
- Contract farming may create the danger of imposition of undesirable seeds.
- The temptation of getting commercial profits from cultivation of a variety of the crop may cause permanent damage to the land.
- Market making outside the country may cause market breaking inside the country.

Food Laws & Regulations in Fruits & Vegetable Sector

European Union

In addition to national legislation of individual European Union member countries, the production and marketing of fruit products are regulated by EU Council Directives. The Directives define the products and stipulate authorized processing and treatment, authorized addition of sugars, authorized food additives, etc. The Soft Drinks International (a part of the British Soft Drinks Association) have published a Code of Practice and a technical manual for production and marketing of fruit juices. This code is accepted by the National Fruit Associations within the EU and is understood to have the support of the European Commission. Fruit processors and traders in most parts of the world also follow it. It contains information on the various EC directives & regulations and has separate sections for 18 different juice varieties. It also contains a guide for good hygiene practice for the fruit juice industry.

United States of America

According to the International Trade Centre (UNCTAD/WTO), the US Food & Drug

Administration (USFDA) applies the same regulations to imported processed food

stuffs, including food products, as applied to domestic products. These regulations are known as "Standards of Identity, Quality and Fill". The standards relate to the precise description of the

product, the definition of optional ingredients, labelling and the standard fill of the container. The United States Department of Agriculture (USDA) has issued a number of official standards for grades of processed fruits and vegetables and related products, for designating different levels of quality. These standards provide quality control programmes and official grading of such commodities, thereby helping the consumer to understand the product better. They are formulated on a voluntary basis by producers and buyers. It is said that exporters, whose products conform to these standards, will therefore, find market access simplified and avoid the risk of costly delays at the port of entry. For those products for which official standards have not been established, such as tropical fruit products end-users impose their own specifications. These usually refer to the physical and chemical characteristics of the product, e.g., colour, flavour, variety of fruit, brix level, acidity/sugar ratio & pulp content. Exporters must, therefore, ensure that detailed specifications are received from their buyers and that the product they ship complies exactly with these specifications. ITC recommends verification by an independent analyst at the time of shipment for acceptance by the buyer.

India

In India, APEDA took due cognizance of the above international developments & embarked on a programme to financially extend assistance to processing unit to implement HACCP, which is an internationally recognised quality assurance system for manufacturing units engaged in the food industry. APEDA's strategy in the first instance was to select geographical regions where there is a maximum concentration of processing units engaged in tropical fruits like Mango pulp. The cluster approach that APEDA has adopted for example in the Chittoor District of Andhra Pradesh , is not only benefiting the local units directly, but also provide a stimulus to other such units to initiate such quality assurance systems. The units centred in Gujarat and Maharashtra has base for manufacturing Alphonso and Kesar Mango varieties. These units are the next focus of APEDA's pro-active programme to ensure implementation of HACCP.

Hazard Analysis and Critical Central Point

Hazard Analysis and Critical Central Point (HACCP) is a process control system designed to identify and prevent microbial and other hazards in food production. It includes steps designed to prevent problems before they occur and to correct deviations as soon as they are detected. Such preventive control systems with documentation and verification are widely recognized by scientific authorities and international organizations as the most effective approach available for producing safe food. HACCP involves a system approach to identification of hazard, assessment of chances to occurence of hazard during each phase, raw material procurement, manufacturing, distribution, usage of food products, and in defining the measures for hazard control. In doing so, the many drawbacks prevalent in the inspection approach are avoided and HACCP overcomes shortcomings of reliance only on microbial testing. HACCP enables the producers, processors, distributors, exporters, etc, of food products to utilize technical resources efficiently and in a cost effective manner in assuring food safety. Food inspection too, would be more systematic and therefore hassle-free. It would no doubt involve deployment of some additional finance initially, but this would be more than compensated in the long run through consistently better quality consistently and hence better prices and returns.

Hazard Analysis and Critical Central Point (HACCP) is a process control system designed to identify and prevent microbial and other hazards in food production. HACCP involves a system approach to identification of hazard, assessment of chances to occurrence of hazard during each phase, raw material procurement, manufacturing, distribution, usage of food products, and in defining the measures for hazard control.

Codex Standards

There is a growing world interest in harmonising food standards for the protection of consumer's health with the facilitation of international trade. The Urguay Round Agreements on the application of Sanitary and Phyto- Sanitary Measures (SPS) and Technical Barriers to Trade (TBT), both encourage the international harmonisation of

food standards. The worldwide interest in codex activities, therefore, indicates the global acceptance of the codex philosophy. Despite

difficulties in adopting the Codex Standards, the process of harmonisation is gaining impetus. An increasing number of countries are aligning their food standards with those of the Codex Alimentarius. Acceptance of Codex Standards has enabled many countries to gain acceptance of their products in international markets. Under WTO the Codex Standards are the basic standards with reference to which settlements of disputes on quality are made.

Quality Control

With increasing concerns for food safety in major consuming countries & after the last WTO agreement countries are free to lay down stringent food laws which developing countries like India need to take serious note of. HACCP has become mandatory in most developed countries like USA & E.U. & it is a matter of compulsion for developing countries like India to meet the mandatory requirements of the major consuming countries.

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Indian Policies: Fruits & Vegetables

Though no industrial license is required for setting up Fruits & Vegetable Processing industries, setting-up 100% EOUs require specific Govt. approvals. This sector is regulated by the Fruit Products Order, 1955 (FPO), issued under the Essential Commodities Act. The Department of Food Processing Industries administers this order. The order lays down product specifications and quality control requirements on production-hygeine, relabeling and marketing of processed fruits and vegetables.

All processing units are required to obtain a license under this order. Periodic inspection of units is also carried out. In addition, consignments of fruit & vegetable products intended for export are subject to pre-shipment inspection under the FPO. Recognised Export Houses and Star Trading Houses are however exempted from this inspection. Some items like: pickles & chutneys, tapioca sago and tapioca flour are reserved for exclusive manufacture in the small scale sector.

Export of fruit & vegetable products is freely allowed. Many fruit and vegetable processing industries are eligible for automatic approval of foreign technology agreement and up to 51% foreign equity participation. These include: tomatoes, mushrooms and other frozen vegetables, fruit, nuts, fruit-peel, fruit jellies, marmalades, fruit juices and vegetable juices etc.

Post harvest losses in horticultural crops

Post harvest losses in horticultural crops range from 15-50 per cent. At micro level, these looses increase the marketing cost of the product and at macro level they also reduce the per capita availability. Thus there is need to develop technologies, methods and mechanics to reduce these losses. There is need to remove the distortions in the present supply chain, create more integration between the different links of the supply chain and reduce these losses. This will result in net gain to producers, consumers and to the nation. Farmers usually procure inputs from the retail market and end up selling their produce in the wholesale market. Buying at retail price and selling at wholesale price is the most uneconomic way of business. Thus the involvement of an institutional structure in coordinating the demand of individual farmers of the village can reduce the total cost of inputs to them. The market needs to be demand driven rather than supply driven. The price of the produce should not be based on the prevailing whole sale price but on the basis of cost of cultivation of that produce. Farmers should be their own price setters rather than price followers.

There is also an immediate need to integrate the production, marketing and processing processes of the produce to get maximum benefits from fruits and vegetables cultivation. There are problem with price structure in the marketing, the price offered by them is not justifying the prevailing whole sale price or even the cost of production of the produce. Further successful implementing of the core marketing strategies will help in future expansion of the domestic and international markets. But the exports face certain tariff and non-tariff barriers too. To enhance exports their is a need to develop air transport cargo system specialised for fresh fruits and vegetables, along with the airports, road and rail connectivity with the area of procurements. Countries capability to generate surpluses for exports depend on its ability to tab the potential of small farmers. For this assistance from APEDA and exporters association

as well as training to the farmers is necessary. Quality control, longer shelf life is crucial for exports. Organic production of fresh fruits and vegetable is important to capture markets in Europe.

Several steps are required to improve the agricultural supply chain. Farmers should start dealing with large corporate, which in-turn would reduce large mark-up due to the large number of intermediaries coming into picture. Contract farming is likely to start by large retail players who will start dealing with the farmers, providing them with the right quantity and timely supply of inputs and ensuring the forward links upto the disposal front. As competition by the private sector players increase, investment in logistics and infrastructure would also increase which would lead to an increase in the efficiency of complete agricultural chain.

One important measure would be to bring more markets under regulation and supervision of a well-represented market committee. Another measure would be the promotion and perhaps enforcement of open auctions in the markets. Yet another measure could be efforts to bring more buyers and sellers into the markets, bringing them closer to perfect markets. The direct participation of farmers should be increased. Market infrastructure should be improved through storage (godown) facilities, cold storages, loading and weighing facilities. Improvement in the road network, and cold-chain facilities are also of substantial importance. Greater transparency of the operations through supervision and systems can also help substantially. The market integration and efficiency can also be improved by making up-to-date market information available to all participants through various means, including a good market information systems, internet and good telecommunications facilities at the markets. Thus, efforts are needed in the direction to capitalize on our strengths and remove constrains to meet the goal of moving towards a horticulture lead agricultural growth in India.

Promoting Hortico-business in India

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Indian Agriculture is striving hard to attain the nutritional security for surging population by 2020. This is the most important challenge being confronted by the Indian Agrarian community. Besides, we have to prepare our farmers to face the compliance of WTO implications on Indian Agriculture. The need to increase the food security and at the same time conserving the natural resource base, requires real participation by Indian farmers. In the present context of globalization, liberalization and shift that has occurred in the world agriculture, has bounded the farm sector to maneuver on the models driven by information, awareness and end-to-end approach. The growing investment needs of agriculture sector in the present context and the reform process in the economic sector have initiated the need for new initiatives to revive and rejuvenate Indian Agriculture, from subsistence to market driven commercial venture. The independent farmer of yesterday is dependent on many players today than ever before to compete in present era of open economy. The commercial agriculture needs high technology, high level of inputs, and management of supply chain in an organized manner, necessitating the change from Agriculture to Agribusiness.

Agribusiness is the buzzword these days and is the main force behind the commercialization of agriculture. Contract farming, one stop shop, opening of the retail stores, setting up of the terminal markets, launching of agribusiness and agri-clinics, establishment of agro-processing units etc. have proved that agribusiness is very much happening in India. It has not only helped strengthen the forward and backward linkages but has also created opportunities for employment. With the advent of corporate players, many successful agribusiness models have been developed. Even Co-operatives like Gujarat Co-operative Milk Marketing Federation have developed a model that has become a successful case study (Amul). Many agribusiness projects are being undertaken by both public and private parties on Public Private Partnership mode.

To attain and sustain the double digit growth, the country has to develop the capacity to identify, develop and choose the strategic options in order to create solid economic fundamentals even under the emerging difficult social, economic, and political situation. Further the choice would have to be largely in the sectors which are supported by the domestic resource base. Agribusiness is one among the sectors which stands as a strategic link between agriculture, estate, livestock, fishery, forestry and the development of upstream and downstream agriculture industries, where the service sector is included within.

Agribusiness in India has potential of mitigating one of the major problems of rural India i.e. unemployment by creating over 25 crore jobs in rural India even without direct involvement of the Government. It can transform Indian agriculture, similar to China under Deng and America under Roosevelt. It has to be taken as a starting point followed by as a sustaining force to transform Agriculture truly as a commercial entity. No country is blessed with as much of nature's bounty as we are: large tracts of fertile land, 9 to10 months of sunshine, average rainfall of over 1000 mm and great biodiversity.

Farm Input Sector

Following technological revolutions in Indian Agriculture, the Farm Input Sector has been

growing fast to meet the surging demand for purchased inputs (seed and planting materials, fertilizers, agrochemicals, machines, feed, concentrate, energy (diesel, electricity), veterinary pharmaceuticals etc). Value of farm inputs marketed in 2004-05 was Rs 727 billion including seeds, fertilizers, pesticides, repair and maintenance services, livestock feed/fodder, organic manure, and electricity/diesel (Acharya,2007)[10]. The share of private sector in input market is growing with the entry of multi-national companies therein. Almost all major global players of the sector now exist in India. Indian pesticide industry is ranked second in Asia and twelfth in the world in value terms.

Farm Production Sector

Diversity in agro climatic conditions and biodiversity in plants, animals, insects, and micro-organisms offers advantage to India for growing high value farm produce including fruits, vegetables, flowers, and livestock and aqua products. In India majority of farmers belong to the category of small and marginal holders. While the number and proportion of and area cultivated by such holders have been growing, the average size of operational holding has been declining over time. Over 60 percent of households own less than one hectare of land. However, a redeeming feature is that small farmers (including landless) have higher livestock ownership (60 to 80 percent of all livestock population) including crossbred cattle. Small farms produce 41 percent of country's total grains and over half of total fruits and vegetables despite being resource constrained[1]. Women play a pivotal role in agriculture- as labour, farmer, co-farmer, family labour, and manager /entrepreneur of farms. They constitute 40 percent of the agricultural work force and 20 percent of rural households as de-facto head (due to widowhood, desertion, or male out-migration) [3]. Indian Agriculture scene is undergoing fast change in terms of diversity in range of products and greater sophistication in pre and post production activities with the creation of critical infrastructural facilities like cold storage, refrigerated transportation, packaging, quality control etc. The sector is now poised for a leap with the introduction of new technology like IT and biotechnology.

The Horticulture Boom: Horticultural crops including fruits, vegetables, flowers, plantation crops, spices, coconut, medicinal and aromatic plants, mushrooms, cashew, and cocoa, having large commercial potential, have gained significant share in the crop portfolio. The boom in this sector in recent past is evident from the rise in its share in the total agricultural output, employing about 24.5 percent of the total cultivated area. Besides providing nutritional and livelihood security and helping alleviate poverty and generating employment, the sub-sector sustains a large number of agro-industries, which generate huge additional non-farming employment opportunities. Horticulture contributes nearly 28 percent of Agricultural GDP and 54 percent of Agricultural export (2005-06)[12]

Almost all types of horticultural crops are grown in India. Temperate fruits are grown in north Himalayan region while subtropical and tropical fruits, vegetables, ornaments, mushroom, spices are cultivated in rest of India. Spices and plantation crops are found in peninsular region. Arid zone crops are grown in western India. The production of vegetables has substantially increased from 58.5 million tones during 1991-92 to 111.77 million tones during 2006-07[31]. Yield has increased substantially with adoption of hybrid seeds and also with increased cultivation of disease and pest resistant varieties. The domestic floriculture industry has also witnessed an unprecedented growth in recent past and has also been getting increased acceptability in world markets. The floriculture industry has been growing at an annual rate of 17 per cent, which has also seen a number of corporate houses entering the fray. Higher standards of living and the growing desire to live in an environment-friendly atmosphere have led to a boom in the domestic market as well. The export of cut flowers has been identified as a thrust area at the national level.

India has potential to be a global agricultural power. Agricultural products have potential to earn about $14 billion from export.

Food Industry Sector

India is, globally, the second largest producer of food, next only to China. It is also the world's largest producer of cereals and milk, second largest producer of rice, wheat, sugar, fruit and vegetables and inland fish and third largest producer of cotton and seventh largest producer of fish (which includes both inland and marine fish production). India is endowed with a large production base for a variety of raw materials covering food crops, commercial crops and fibres owing to its varied agro-climatic conditions. Despite its strong raw

material base, India accounts for only 1.5 per cent of the international food trade. India's food industry comprises six key segments: Dairy Products, Food processing, Fruits & Vegetables, Meat & Poultry, Fisheries, Packaged Foods, and Beverages.

The food processing industry is a dominant segment of the food industry with a 32 per cent share. While India has abundant food supply, the processed food industry is still in its nascent stage—only 2 per cent of fruits and vegetables and 15 per cent of milk is processed. Despite this, the food processing industry ranks fifth in size, contributing 6.3 per cent to GDP, 19 per cent to India's industrial workforce and 13 per cent to exports. Processed food exports have, in fact, increased from US$ 6.98 billion in 2002-03 to US$ 20.51 billion in 2006-07, recording a whopping 193.83 per cent growth rate. The processing food segment accounts for 29.4 billion, in a total estimated food market of about $91.7 billion. The food processing industry is one of the largest industries in India. It currently ranks fifth in terms of production, consumption, export and growth prospects.

The turnover of the total food market is approximately US $ 69.4 billion out of which value-added food products comprise US $ 22.2 billion. The food processing industry, which has been growing at 7 per cent, is likely to register a growth rate of over 10 per cent in the near future, on the back of a step-up in investments and increase in consumer demand.

- India's food processing sector covers fruit and vegetables; meat and poultry; milk and milk products, alcoholic beverages, fisheries, plantation, grain processing and other consumer product groups like confectionery, chocolates and cocoa products, Soya-based products, mineral water, high protein foods etc.
- According to latest official statistics, India exported processed fruits and vegetables worth Rs 5240 million in 1997-98. The horticulture production is around 102 million tones. Foreign investment since 1991, when economic liberalisation started, stood at Rs 8,800 crore. Products that have growing demand, especially in the Middle East countries include pickles, chutneys, fruit pulps, canned fruits, and vegetables, concentrated pulps and juices, dehydrated vegetables and frozen fruits and vegetables.
- Among plantation, tea emerged as major foreign exchange earner. India is the largest producer and exporter of black tea. However, Indian tea faces a stiff competition within the country as well, specially threat of Sri Lanka's presence in the Indian market is looming large.
- Alcoholic beverages are another area where India witnessed substantial foreign investment. Foreign investment in this sector stood at Rs 7000 million which about 70 percent of the total investment made so far. The IMFL (Indian Made Foreign Liquor) primarily comprises wine, vodka, gin, whisky, rum and brandy. Draught beer is a comparatively recent introduction in the Indian market. The Indian beer market is estimated at Rs7000 million a year. One of the major advantages for any investor eyeing the Indian liquor market is that India offers enough raw materials like molasses, barley, maize, potatoes, grapes, yeast and hops for the industry.

Without a strong and dependable cold chain food processing industry which is based mostly on perishable products cannot survive and grow. Even at current level of production, farm produce valued at Rs 70,000 million is being wasted every year only because there is no adequate storage, transportation, cold chain facilities and other infrastructure supports. Cold chain facilities are miserably inadequate to meet the increasing production of various perishable products like milk, fruits, vegetables, poultry, fisheries etc.

Food processing sector is poised for fast growth and is getting fast organised. The industry ranks fifth in size (6 percent of GDP) and has high potential for growth (existing growth rate 8.6 percent) [12]. The export of processed food was US$ 20.51 billion in 2006-07 recording a whopping growth rate over 2002-03 level. The processed food market accounts for 32 percent (US$ 70 billion) of the total food market in India (US$ 218.75 billion).

Marketing and Trade

Current agricultural marketing system in the country is the outcome of several years of Government interventions. The system has undergone several changes during the last over 50 years owing to increase in marketed surplus; increase in urbanization and income levels and

consequent changes in the pattern of demand for marketing services; increase in linkages with distant and overseas markets; and changes in the form and degree of government intervention. Agriculture being a State subject, the main Act for market regulation, the Agriculture Produce Market Regulation Act (APMC), is to be enacted/ amended/ implemented by the State Governments. The existing marketing system is serviced by a network of more than 7,500 regulated markets and about 28,000 Rural Primary Markets, 15% of which are also regulated. Under the APMC Act no processor or exporter could buy directly from the farmers, thereby discouraging the private sector from integrating with the farmers or engaging in food processing/ agricultural export sectors. Further as the private sector was prevented from setting up agricultural markets, they did not invest in marketing infrastructure.

Present policy thrusts are encouraging farmers for collective and direct marketing; promoting organized trade; creating enabling environment for greater participation by the private sector in marketing system including infrastructure development. The increasing focus on liberalization, privatization and globalization is both a challenge and an opportunity for our farmers. For them to avail this opportunity optimally, it is imperative that relevant internal reforms in the agriculture marketing system are accorded top-most priority. As a major initiative, the Government of India drafted a Model Agricultural Produce Marketing (Regulation & Development) Act, 2003. While all the States/UTs had agreed to amend their respective APMR Act to bring about the requisite reforms in line with the Model Act, the APMR Acts of 17 States/UTs have been amended only in a limited manner. Besides, the APMR Act originally has not been adopted/ repealed in 7 States/UTs. The States have amended their Acts in respect of Contract Farming, Direct Marketing, and Setting up of private markets. The spirit in which the Model Act was conceived is not being fully embodied in the Rules being drafted by different States.

Some basic features of the prevalent system and associated problems are:

- The market size and farmers' market linkages are continuously expanding.
- Private trade, which handles 80 percent of the marketed surplus, has not invested in marketing infrastructure due to excessive regulatory framework.
- Direct marketing by farmers to consumers remains negligible.
- Of 27,294 rural periodic markets, where small and marginal farmers sell their produce, 85 percent lack facilities for efficient trade.
- Due to poor handling at the farm gate about 7 percent of grains, 30 percent of fruits and vegetables and 10 percent of seed species are lost.
- The Agricultural Produce Markets Committee (APMC) legislation in most of the states hampers contract farming initiatives and private sector investment.

The experience of agricultural development in India has shown that the existing systems of delivery of agricultural inputs and marketing of agricultural output have not been efficient in reaping the benefits of technology. The timely, quality and cost effective delivery of adequate inputs still remains a dream. There are plenty of distress sales among farmers as also temporal and spatial price variations in the markets. Producers' share in consumers' rupee has not been satisfactory. The market performance parameters like absolute share of the producer in terms of remunerability, fluctuations in prices across seasons, large spatial price differences and lack of proper market outlets itself, are the issues which have become increasingly crucial in the present context.

There are structural weaknesses in agricultural markets like unorganized suppliers as against organized buyers, weak holding capacity of farmers, and the perishable nature of the produce. In the environment of liberalization and globalization, the role of the state in agricultural marketing and input supply is being reduced, and an increasing space is being provided to the private sector to bring about better marketing efficiency in input and output markets. On the other hand, processors and/or marketers face problems in obtaining timely, cost effective, and adequate supply of quality raw materials.

Constraints

Diversion of productive agricultural land to non agricultural purposes is a serious constraint. Potential to increase production through increase in area under cultivation appears limited. The consumption pattern is diversifying towards high-value agricultural commodities. The constraints in transition to high-value agriculture include lack of

necessary information on production methods, marketing opportunities, and the probable distribution of net returns on crops not grown by farmers earlier. This problem is particularly serious when the target consumers have very specific quality requirements and/or strict food safety requirements.

Other major constraints at the national level include outdated and multiplicity of laws, regulations, and taxes; inadequate backward and forward linkages; poor infrastructure for marketing and high transaction costs; inadequate outreach of services and credit to farmers; lack of modernization in storage techniques and transportation methods; inadequacy of information on standards and requirements for exports; low value addition at farm gate; and low capital formation in agriculture. There is a need for radical policy reforms and removal of physical constraints. Active participation by civil society organizations and private sector is also called for.

Recent Initiatives

For promoting hortico-business in the country, several initiatives have been taken which have created favourable environment for its growth. Some marketing related restrictions have been withdrawn or replaced. The amendments in State Agricultural Produce Markets Regulation Acts based on Model Act 2003 are being made to facilitate setting up of private markets, direct purchases of farmers' produce and contract farming arrangements. Several monetary concessions have been announced by the central and state governments. These include 100 percent excise exemption for 10 years, 100 percent income tax exemption for five years (later withdrawal in phases) and capital investment subsidy of 15 percent (up to Rs 30 lakh).

Boosting Production

Contract Farming: The organized sector is using contract farming model for meeting its requirements for retailing, processing or export purposes. The area covered under contract farming is so far limited and mainly confined to the states of Tamil Nadu, Punjab, and Orissa. This institutional arrangement however is picking up across the nation. The main companies involved in contract farming are Hindustan Unilever, WIMCO, Pepsi, Food Pro, NDDB, Maxworth Orchards, Cadbury India, BILT, ITC, JK Paper, AV Thomas, Reliance, Agrotech, Godrej Agro, United Breweries, DCM Shriram, Marked, L&T, and Escorts[1].

Crop Diversification: The government is encouraging farmers to diversify to high value options such as horticulture, floriculture and oilseeds. The National Horticulture Mission was initiated in 2005-06 with an allocation of US$ 145 million, with a goal to double production from the present level of 150 million tones to 300 million tones by 2011-12. The mission intends to ensure an end-to-end approach with backward and forward linkages covering research, production, post-harvest management, processing and marketing, under one umbrella, in an integrated manner [8&11].

Marketing and Pricing

The Government of India has launched about 40 schemes in agricultural marketing. These schemes promote private investment in domestic trading, post harvest management, exports, quality management, and support initiatives for capacity building, food safety and improving market information.

Regulatory Measures: To improve the marketing system of farm products wholesale agricultural produce markets began to be regulated in the 1950s and 1960s. This legislation has already covered 7566 markets (2008) i.e. almost 99% of the identified wholesale markets in the country. The Model APMC Act 2003 after comprehensive scrutiny has been reformulated in consultation with state governments, trade and industry, and circulated to the states for adoption. When fully adopted, it will help improve the efficiency of the marketing system and encourage private sector investment in agricultural marketing. However both state governments and traders/commission agents are resisting its adoption. So far 17 States have amended their APMC Acts however in most cases amendments are only cosmetic in nature. The Legislation provides for direct marketing and procurement from farmers; private sector participation in infrastructure provision; creation of Special Commodity Markets; single point levy of market fee; and contract farming.

Marketing Infrastructure: In the year 2005-06 the government introduced a scheme called Development/Strengthening of Agricultural Marketing Infrastructure, Grading and Standardization to induce large scale investment from the private and cooperative sectors for setting up agricultural markets, marketing infrastructure

and support services such as grading, standardization and quality certification. NABARD and the NCDC are implementing the scheme.

Other reforms initiated include setting up of **Farmers' Market** formats; enactment of **The Integrated Food Law**; launching the Scheme for setting up **modern terminal markets** under National Horticulture Mission (NHM); Development of post-harvest/cold chain infrastructure, CA storage facilities, refrigerated transportation by road/rail, and perishable cargo centers at air and sea ports under NHM initiated; setting up of **Mega Food Parks** taken up; and launch of the Central Sector Scheme **Marketing Research and Information Network (AGMARKNET).**

Gap Analysis of Hortico-Business Sector

The Indian hortico-business Sector has potential to bring prosperity in farm sector, and to other stakeholders. Growth in the sector is visible but the pace is less than the potential. To suggest exploitation of the potential a critical analysis of weaknesses, gaps, and implementation hurdles faced by the sector is done.

Production System

Land Relations: Land related weaknesses and gaps are

- Small size of holding, resulting in low commercial surplus.
- Lack of land market and out dated tenancy provisions, creating problems for popularizing corporate/ contract farming.
- Diversion of agricultural land to non-agricultural purposes due to outdated Land Acquisition Act.
- Weakness in law, policy and programmes for recognising women as owners/ joint owners/ farmers/cultivators/tenants and thus denying them access to credit and risk mitigation instruments.
- About 60 percent of cultivated area is under rain fed/ non-irrigated condition.
- Only 68 percent of irrigation potential created is being used.
- Watershed management and rainwater harvesting efforts are very limited particularly in dry land agriculture.

Technology: Promotion of hortico-business needs massive diffusion of technology in farm sector. Following weaknesses and gaps in this context need immediate attention:

- Lack of location specific technologies particularly for dry land areas resulting in low productivity of crops.
- Skill gap amongst stakeholders on cutting edge technologies like precision farming, protective cultivation, organic farming, biotechnology, intellectual property rights, Seed Act, Good Legal Practices, international laws, weather forecasting, etc. which is pre-requite to efficient and effective agribusiness system.
- Weak public extension system and limited participation of private sector in transfer of technology programme. Further, the public sector extension is largely confined to production and ignores value addition and marketing activities.
- Inadequate private investment in research and skill up gradation due to various regulatory restrictions.

Input Supply

- Weak system for quality control in farm inputs delivered to farmers as also for creating awareness amongst them about the same, resulting in supply and use of sub-standard / spurious inputs.
- Inadequate availability of vital farm inputs at right time and at reasonable price for instance inadequacy of quality seeds and planting material
- Lack of adequate emphasis on development / supply/ promoting the use of micro nutrients.
- Lack of coordination in public and private sectors for research on evolving efficient input mix.
- Low research and development investment in evolving new molecules
- Existence of information gap at farm level about right type/ quality of input to be used and source thereof.

Processing and Value Addition

Value addition particularly at farm gate is very

low on account of poor connectivity, non scientific post harvest handling, unorganized marketing, and knowledge deficit on grading, packaging, sorting, pre-cooling methods etc among stakeholders. Lack of mobile and common infrastructure for post harvest management is another gap. Lack of credit, insurance and cool/cold chain infrastructure prevails. Capacity building of people engaged in village and agro processing is needed in terms of market intelligence, good processing, marketing, and trade practices. Research and development efforts particularly on quality control, labeling, and packaging are weak. Food regulations are archaic.

Marketing System

- Long chain of Intermediaries; Multiple and cumbersome Licensing Procedures; Multiple Tax Regimes; Inadequate Infrastructure Facilities; and Price Instability.
- The fragmented nature of markets to make them more integrated market place; Direct procurement from the farmers;
- Institutionalize Contract Farming needs with both backward & forward linkages
- Encouraging private investment in market infrastructure development
- Private mandis should be permitted to be set up outside the purview of the APMC Act
- High pre and post harvest losses, particularly in perishable products, on account of poor road conditions, non availability of cool/cold chain, and poor knowledge on scientific pre and post harvest management practices.
- Inadequate number of specialized markets particularly for high value products-fruits, vegetables, flowers, fish, etc.
- Marketing intelligence system is outdated and hence there in a need for IT-led market extension by efficiently enriching and implementing AGMARKNET and other similar portals/ websites.
- Almost non existence of capacity building activities for farmers and other stake holders on post harvest techniques, marketing, quality control, and value addition.

Credit and Insurance

Access to credit empowers farmers (particularly poor and women), small processors, and small market functionaries to upgrade and upscale their activities. Existing access to credit and risk mitigating measures are weak. Specifically efforts are called for to improve following areas

- Lack of knowledge of farmers about various financial schemes, micro-financial institutions (MFIs) and insurance products.
- Limited application of Information and Communication Technology in MFIs.
- Lack of effective farmer's friendly risk mitigation measures.
- Poor credit discipline and repeated loan waivers.

Reforms required in this sector include reduction in contract size to allow small farmers to hedge their risks through the exchange may not be feasible due to cost & viability considerations. Hence, there is an urgent need for developing innovative aggregation models to ensure that even small farmers can benefit from futures trading. The aggregator would consolidate the produce of various farmers and provide the required logistical support services including transportation, grading, assaying & warehousing. Aggregators can be agro-extension service providers, produces' co-operatives, corporate using the end-products or banks.

The Development Strategies

Hortico-business promotion strategy in the country should aim at providing conducive marketing and financial infrastructure, policy and regulatory environment, good technology back up, and friendly institutional arrangement that enhances farm production and income, value addition, orderly marketing with minimum post harvest losses, and place quality product through consumer friendly retailing or export.

The Production System

The second green revolution, also known as knowledge agriculture, should use labour intensive high technology for high value crops, having competitive advantage in global market too. The production process be accomplished under precision farming mode where no production input is wasted be it land, water, fertilizer, or manpower. The selection of product-mix should be based not only on resource base but also on market demand. To make the knowledge agriculture work following enabling conditions are to be met

- Timely availability of farm inputs through organized, efficient, and effective outlet(s). Strict monitoring of quality parameters, packaging, and pricing is also called for.
- Encouraging production of adequate amount of quality seed and planting material and making the same available at reasonable price at required time to improve seed replacement rate.
- Promoting the balanced use of nutrients by farmers including micro nutrients so as to improve the total factor productivity and resources use efficiency.
- Promotion of cluster approach of production of commercial crops to ensure scale economies to growers, processors, marketers, and traders.
- The extension system will have to build competency in farmers and other stakeholders on complete package of production and marketing activities including value addition at farm level.
- Backward and forward linkages of farmers with suppliers and potential buyers (processors, organized retailers, exporters etc) will have to be explored in terms of contract farming or some such arrangements.

Processing and Value Addition

The value addition in food products is envisioned to increase to 35 per cent by the end of 2025, especially commercial processing of fruits and vegetable is expected to increase to 10 per cent by 2010 and to 25 per cent by 2025. The Food Industry which employs 1.6 million workers directly at present is expected to provide jobs to 37 million workers by 2025. This 'potential' can be realized only if a conducive policy climate is created which encourages the growth of this capital intensive sector. The measures include exemption of processing activities from the provisions of industrial licensing except for beer and alcoholic drink; automatic approval for raising 100 per cent foreign equity; and exemption of fruit and vegetable products from excise duty.

Without a strong and dependable cool/cold chain system, the food processing industry cannot survive. The government is to put emphasis on establishing cold storage chains throughout the country with private participation. The scheme should aim at reducing the post-harvest losses too. Connectivity of production centres/ clusters through motorable roads is also needed. The sector should also be given the access to credit from formal financial institutions for investing in fixed capital and new technologies and thus expand viably; providing required infrastructural facilities including electricity connection, reliable power supply, availability of raw materials, transportation, etc.

Marketing System

- Ensuring effective implementation of Model Agricultural Produce Market Regulation Act and Rules made under the same in all states should be the priority.
- **Promotion of Contract Marketing** to ensure private sector participation in farming, input supply and technology transfer; capital flow; marketing; risk mitigation etc.
- Harmonizing national grade standards with international grade standards; and upgrading grading facilities at all the stages of marketing chain is also needed.
- **Strengthening Marketing Infrastructure:** It includes developing rural primary markets; modernizing principal market yards; set up new wholesale markets by the private sector; set up Terminal Markets in PPP mode; set up farmers' markets; creating commodity specific markets for fruits, flowers, medicinal and aromatic plants, and vegetables; creating Cool chain infrastructure facility and automated weather stations under PPP format; promoting GAP (Good Agricultural Practices), and farmers' organizations .
- Strengthening **Agricultural Marketing Information System** using **ICT** including Integrated Website for all stakeholders in Agricultural marketing services; AGMARKNET with SWAN and NICNET; Computerization of all rnandies; and Development of Agricultural Commodity wise Portals is vital.
- **Promotion of Exports/External Trade:** Strategy includes creating awareness about sanitary and phytosanitary standards; making national standards harmonize with international standards; strengthening quarantine system; promoting agricultural

commodities in destined markets aggressively; etc. Threefold path for making a sustained and determined drives for finding global markets for agricultural exports is **once in, stay in**; capturing world markets for value-added horticultural products; and holistic pursuit of global goals.

Summing Up

The future growth of the hortico-business hinges critically on further policy reforms. The critical reforms envisaged are.

Direct marketing permitting and encouraging private sector players to establish a private yard/ market and undertake direct procurement for producers.

Private sector participation in infrastructure provision permitting and encouraging private players to provide infrastructural facilities such as warehouses, pre-cooling, cold storage, ripening chambers, laboratories, Kisan Bhawans, electronic auctioning, etc.

Designation of some markets as 'Special Markets,' permitting and encouraging the establishment of a Special Market/ Special Commodity Market for one or one group of commodities.

Quality standardization, promoting quality standardization through grading of notified agricultural commodities in consonance with regulations.

In Contract Farming, making contracts registered with the Sponsor Registering Authority to lower chances of the parties reneging on the contract. Also establishing Dispute Settlement Authority is suggested.

The promotion of hortico-business in India calls for effective actions in the following areas also

- Capacity building of
- Farmers in good agronomic practices, good pre and post harvest activities, on farm value adding techniques (packaging, grading etc.), good marketing practices (including marketing information and contracted farming) and in utilizing available credit and insurance options.
- Small processors in quality assessment of raw materials (while procuring and handling), good processing practices, and good marketing practices.
- Exporters in good legal practices, documentation, negotiation, and SPS requirement of importing countries etc.
- Strengthening public extension system though capacity building of extension officials in value addition, post harvest, marketing activities in addition to production and protection as also by ensuring effective participation by private sector and non-government organizations therein.
- Developing and implementing models for specialized market/terminal market/sub-market yards (rural market) and market mapping in terms of location, infrastructure, training centres, cold/cool chains including common sharable infrastructure facilities.
- Promoting cultivation of export oriented commodities like wine grapes, orchids, and medicinal herbs in suitable areas to earn foreign exchange.
- Promotion/replication of institutional arrangements like Maha Grapes, Suguna, AMUL and e-choupal to empower farmers and for giving boost to agribusiness.
- Promoting Research and Development activities in cutting edge technologies including precision farming, organic farming, biotechnology, integrated plant protection, and information and communication technologies.
- Identification and generation of technologies in mission mode for high value crops for different agro-climatic situations. Emphasis is to be laid on farming system approach rather than commodity approach. Cluster approach of commercial production for providing scale economies will be beneficial.

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Resilient Food and Nutrition System: Analysisng the Role of Crops and Fruit trees Diversity in Enhancing Human Nutrition and Health

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Introduction

One of the world's greatest challenges is to secure adequate food that is healthy, safe and of high quality for all, and to do so in an environmentally sustainable manner. There are currently an estimated 925 million people suffering food and nutrition insecurity. In addition to those who are hungry, there are also 195 million children under five years of age who are stunted and of those children, 90% live in just 36 countries. Micronutrient deficiencies, known as hidden hunger, undermine the growth and development, health and productivity of over two billion people. With the growing demand of an ever-increasing human population, it remains unclear how our current global food system will sustain itself. Compounded with climate change, ecosystems and biodiversity under stress, population growth and urbanization, social conflict and extreme poverty, there has never been a more urgent time for collective action to address food and nutrition security globally. In this context, multi-sectoral approach that incorporates nutrition sensitive interventions from other sectors, such as agriculture, education and social protection that address underlying causes of malnutrition in very important. Some suggested nutrition sensitive interventions include:

- Agricultural extension services promoting better crop diversity and biodiversity for improved nutrition;
- Integrated farming systems exploiting the synergies of horticulture, aquaculture and small livestock rearing to reduce waste and expenses on agricultural inputs and increase food production diversity;
- Improved household food production and livelihoods;
- Education, communication for development and social marketing strategies that strengthen local food systems and promote cultivation and consumption of local micronutrient-rich foods;
- Research and development programmes for the breeding of selected crops and livestock with enhanced nutritional quality; and
- Improved post-harvest management (food storage, transformation, handling and processing) to reduce losses in terms of quantity and nutrients content also contribute to nutrition security.

Role of Agricultural Biodiversity to Improve Nutrition Security

Agriculture is the bedrock of the food system and biodiversity is critically important to food and agriculture systems because it provides the variety of life. Biodiversity is essential for humanity, providing food, fiber, fodder, fuel, and medicine in addition to other ecosystem services. It is estimated that of a total of 300,000 plant species, 10,000 plant species have been used for human food since the origin of agriculture. Out of these, only 150 - 200 species have been commercially cultivated with four – rice, wheat, maize and potatoes – supplying 50% of the world's energy needs and 30 crops providing 90% of the world's calorie intake. Intensification of agricultural systems has led to a substantial reduction in the genetic diversity of domesticated plants in agricultural systems. Some of these on-farm losses of crop genetic diversity have been partially offset by the maintenance of genetic diversity of seed resource banks. In addition to the extinction of species, the loss of unique populations has resulted

in the erosion of genetic diversity contained in those species and populations. Yet the implications of this loss for the biodiversity and quality of the global food supply is scarcely understood and measured from a nutrition perspective. Agricultural biodiversity is the basis of the food and nutrient value chain and its use is important for food and nutrition security as potentially: (i) a safety net against hunger; (ii) a rich source of nutrients for improved diet diversity and quality; and (iii) a basis to strengthen local food systems and environmental sustainability.

One area that requires further understanding is the role of agricultural biodiversity for improving diet diversity and dietary quality. Lack of diversity has been shown to be a crucial issue particularly in the developing world, where diets consist mainly of starchy staples with less access to nutrient-rich sources of food such as animal proteins, fruits and vegetables. Research has demonstrated a strong association between diet diversity and diet quality, and nutritional status of children. It is also clear that household dietary diversity is a sound predictor of the micronutrient density of the diet, particularly for young children and studies have also shown that dietary diversity is associated with food security and socioeconomic status, and links between socioeconomic factors and nutrition outcomes are well known. Therefore, It is critical to understand how the global agriculture system, and the benefits derived from agricultural biodiversity, influence the drivers of global dietary consumption, patterns and nutrition and health status, particularly for the developing world, and its changing food and nutrition system.

There are important yet unanswered questions that remain about agricultural and ecosystem biodiversity and its role on improving diet diversity and quality, ensuring nutrition security and promoting health benefits. To address these issues, Bioversity International has developed its Nutrition Strategy and it is hoped that through this strategy and Bioversity International's global research agenda, answers to following key research questions below will become available and provide clarity for governments, development programmers, value chain and food sector actors, academic and research institutions, health and agriculture workers, farmers and communities:

1. How does agricultural biodiversity on farm contribute to household consumption diet diversity and quality?
2. How can we link agricultural diversity to improved nutrition and health outcomes and benefits and does it make an impact?
3. Can agricultural biodiversity be scaled for commercial use while maintaining biodiversity and ecosystems, and improving human health?
4. What does agricultural biodiversity imply for peri-urban and urban markets, and what do trends in urban markets imply for potential success of agricultural biodiversity?
5. How can we better use and promote local knowledge of agricultural biodiversity to improve the health of households?
6. What new tools and methodologies can be created and validated that measure agricultural biodiversity that can be associated with dietary patterns?
7. How can biodiverse ecosystems provide sustainable livelihoods and improve nutrition for local populations and what can be done to sustain, preserve and protect such ecosystems?

One of the important components to promote nutritious crop/fruit tree species cultivation is to increase our understanding of how consumer demand, both local and international, can increase the variety and quality of food produced by smallholder famers and how smallholder farmers, as netbuyers of food, can access nutrient-rich foods sourced from agricultural biodiverse farming systems in informal and formal markets. Attention has to be focused on understanding how to promote consumer demand these crops/fruit tree species grown in agriculturally biodiverse systems and on how to facilitate an increase in production of these products amongst smallholder farmers in developing countries. It is furthermore, essential, to understand how higher production of foods sourced from agricultural biodiverse landscapes can increase knowledge and demand for consuming these foods. Value chain approaches and other market mechanisms, from a demand perspective, aimed at ensuring a fair price for these crops/fruit tree species grown in biodiverse systems need to be researched and replicated in diverse settings.

In this context, it is necessary to

- Conduct research aimed at understanding national and international consumer preferences and how this demand can boost

production of such foods in developing countries;

- Investigate technologies, tools and certifications which will allow such crops/ fruit tree species to be protected by regulations and recognized by consumers thus providing an incentive towards their production and demand in markets;
- Develop projects aimed at promoting the demand and increasing the supply of nutrient-rich products and identifying poverty reduction strategies by upgrading along the value chain;
- Provide courses, organize workshops and disseminate nutritional information such crops/fruit trees species products to consumers to promote access, purchasing, knowledge and demand for high quality nutritious foods along the value chain.

Beekeeping as a Fifth and Most Important Input for Overall Sustainable Development of Agriculture

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A. Introduction

Beekeeping is a very fascinating occupation. Though the honeybees are best known for the honey they produce, their economic role in nature is to pollinate hundreds and thousands of flowering plants and assure setting of seed or fruit. Honey bees thus play very important role in pollinating various agricultural and horticultural crops and increase their yield and improve the quality of produce. Beekeeping supplements income generation to the rural people. Honeybees have been offering services to the society through ensured pollination in cross-pollinated crops as well as by providing honey and a variety of beehive products. It is being increasingly realized that bees could be less expensive input for promoting sustainable and eco-friendly agriculture and enhancing crop productivity. The potential benefits, due to bee pollination, in the form of increase in yields of various crops including fruits & vegetables, oilseeds, pulses and others, varies from 2% to 33150%. Studies reveal that the income generated through enhancement in crop yield is much more than the income generated from honey production. Honey Bees have their vital role in sustaining plants bio-diversity resulting in environmental stability.

Beekeeping industry has quadruple benefits; 1) providing self employment to rural and forest based population, 2) production of honey, pollen and beeswax, venom and royal jelly, 3) providing employment to rural educated youths in collecting, processing and marketing of bee-products and the most important 4) cross-pollination of various agricultural and horticultural crops and improving their quality and increasing their yields.

B. Beekeeping Industry in India

After independence, Govt. of India took policy decision to revive various traditional village industries and an All India Khadi and Village Industries Board (KVIB) was formed in 1954. Through coordinated efforts of well-knit organizations like KVIC, State KVIBs, Beekeepers' Co-operatives, Public Institutions, etc. the beekeeping industry came on the map of village industries of India within two decades. In 1981 an All India Coordinated Research Project on Honeybee Research and Training was launched by ICAR involving Agricultural Universities.

In1994-95, the Ministry of Agriculture took initiative of launching a Central Sector Scheme entitled "Development of Beekeeping for Improving Crop Productivity", during the VIII Plan. The scheme had various components covering R & D, production & distribution of honey bee colonies, organizing trainings and awareness programmes and support for setting up honey processing plant, etc. A Beekeeping Development Board also functioned under the Chairpersonship of Secretary (A & C) to coordinate the beekeeping activities. The Scheme was approved for continuation during the IX Plan. However, the scheme got subsumed under the Macro Management Scheme, with effect from October, 2000. The focus on beekeeping also got diminished under such an arrangement. The Department facilitated efforts by forming the National Bee Board as a Registered Society under Societies Registration Act through Small Farmers' Agri.-Business Consortium (SFAC) in 2000. With effect from May, 2005, beekeeping has been included as an activity under National Horticulture

Mission (NHM) for promoting cross pollination of Horticultural Crops.

At present there are about 1.5 million bee colonies in India, with estimated annual production of around 65000 metric tonnes of Honey including honey from wild honey bees. The average yield of honey from domesticated bees is quite low. India is one of the honey exporting countries. The major markets for Indian honey are Germany, USA, UK, Japan, France, Italy and Spain.

In India two types of honey viz; apiary honey (of domesticated bees) and squeezed honey (of wild bees) is produced. *Apis cerana and Apis* mellifera are two types of bees which are being domesticated and kept in hives.

In India honey is not used in the form of food as its per capita per year consumption is only about 8.40 gms. But in other countries where it is considered as a food for example, in Germany, per capita honey consumption is 1.800 kg. In world, on an average, its per capita consumption is 200 gms. whereas in Asia, Japan has the highest per capita honey consumption i.e. about 600 gms.

C. World Scenario of Beekeeping

About 50 million bee colonies, mostly, Apis mellifera, are maintained all over the world. The world production of honey is estimated at about 14 lakh M.Tons. There are 15 countries in the world which account for the 90 per cent of the world honey production. China is the only Asian country producing nearly 2.5 lakh metric tonnes of honey. China produces about 13000 metric tonnes of beeswax as against 43500 metric tonnes of world production. China also produces 1000 metric tonnes of pollen and 800 metric tonnes of royal jelly and is the biggest exporter of honey, beeswax and other bee products. China like India has indigenous A.cerana bee colonies and has introduced European A.mellifera bees. There are about 70 lakh A.mellifera bee colonies and 30 lakh A.cerana bee colonies in China and they have a plan to increase this number to 5 crore during next few decades.

D. Constraints in Beekeeping

The major constraints confronting the development of beekeeping are given as under:

i) Lack of scientific data on the choice of honey bee species for commercial beekeeping and for promoting cross pollination;

ii) Lack of quality nucleus stock of bees;

iii) Lack of infrastructure for producing large volumes of genetically superior queen bees for supply to beekeepers;

iv) Lack of technical knowledge for efficient management of bee colonies for higher honey yield;

v) Lack of infrastructure at grass root level and national level for promoting beekeeping;

vi) Poor quality control for production of honey and other beehive products;

vii) More emphasis for production of honey instead of other bee products such as bees wax, pollen, propolis, bee venom and royal jelly;

viii) Lack of adequate laboratories for disease prevention, control, analysis and testing of quality of bee hive products;

ix) Lack of institutional support for beekeeping in terms of bank loans, etc;

x) Lack of proper pricing policy for honey and those engaged in packaging, processing and storing honey;

xi) Lack of consumer awareness of honey and its products;

xii) This is a non-traditional newly introduced industry;

xiii) Tribals and illiterates from forests and remote rural areas generally practice this industry;

xiv) In this industry there is an interaction of two living materials-honeybees and living plants;

xv) Flowering of plants and secretion of nectar and production of pollen – sole food of honeybees, is influenced by climatic conditions;

xvi) The behaviour and life cycle of honeybees depend completely on climatic and floristic conditions, which vary from place to place;

xvii) De-forestation;

xviii) Indiscriminate use of insecticides, pesticides, weedicides, etc.;

xix) Wild fires;

xx) Mono-Cropping culture;

xxi) Pollution of water and air; and

xxii) Global warming & unforeseen changes in climatic conditions.

E. Potential/ Opportunities

India has vast potential for Beekeeping. The diversity in flora and fauna provides more opportunities for the development of beekeeping industry. The National Commission on Agriculture had visualized the need for deploying about 150 million Bee colonies for pollinating the agricultural crops in the country. This industry does not need any sophisticated technology, high capital investment or infrastructure. Compared to the potential, not even the fringe of it, in terms of number of honeybee colonies is achieved. There is thus great potential and opportunities for the development of beekeeping industry in India. Beekeeping industry has great self-help potential for the rural people, tribals, marginal and small farmers, land-less labourers, etc. The great potential and opportunities in beekeeping are given as under:

a) As per the cropped area under the major insects pollinated crops, about 200 million bee colonies are required in the country to enhance the yield levels of these crops at par with the yield levels of developed countries. It will provide jobs to about 215 lakh persons.

b) Honey has great food value and provides cash income;

c) Beeswax which is twice as much costly as honey is in great demand;

d) Other products, viz., bee-collected pollen, propolis, bee-venom and royal jelly are several times costlier than honey and beeswax;

e) Providing bee pollination service to farmers for increasing crop production & quality and productivity of honeybees – A double benefit service;

f) Maintenance of biodiversity by pollination of flowering plants;

g) Apitherapy medicine using bees' products; and

h) Processing and value added products of bee-hive products; etc.

F. Role of Honeybees in Increasing Production & Productivity of Agricultural and Horticultural Crops.

Till mid-20th century, honeybees were equated with the production of honey and beeswax. But since past 3-4 decades, utilizing honeybees to pollinate large number of agricultural and horticultural crops to increase per acre yield has become a routine practice in many developed countries. Many commercial beekeepers in America prefer to provide honeybee colonies on rental basis for pollination service rather than to take honey production. According to Agricultural Scientists value of additional yield obtained by pollination service rendered by honeybees alone is about 15-20 times more than the value of all the hive products put together (Dr. Kaloo, 2004).

Experiments on effect of bee pollination on various crops were conducted by Central Bee Research and Training Institute (CBRTI) and various Agricultural Universities under All India Coordinated Project on Honeybee Research and Training (ICAR). A cross section of the cross fertile crops, self sterile crops with different degree of self-sterility and even self fertile crops benefited by bee pollination are: Oilseed (Mustard, rape seed, toria, lahi, safflower, sunflower, etc.), Orchard Crops (apple varieties, pears, plums, cherry, strawberry, raspberry, persimmon, litchi, citrus varieties, grapes, cucumbers, squashes, melons, alomond, peach, guava, gooseberry, etc.), Legumes (Alfalfa, berseem and other clovers, vetches, broad beans, dwarf beans,Arhar, etc.) and Vegetables (radish, cabbage, turnip, carrot, onion, cauliflower, gourds, etc). The crops-wise details of increase in yield of various crops due to bee pollination are given as under:

Further the following benefits are also associated with the beekeeping:

i) **Employment Generation:** Beekeeping has vast potential in employment generation and according to estimates 3,00,000 man-days are generated for maintaining 10,000 bee colonies. Besides, it also creates employment opportunities in appliances and equipment manufacturing sector. It is estimated that around 75,000 man-days are created for manufacturing enough appliances for 10,000 bee colonies.

ii) **Enhanced Income Generation:** Production and employment are the basic factors to bring enlistment and prosperity. As per one study the net income from 100 bee colonies works out to be around Rs. 2,00,000/- annually through beekeeping and allied activities.

Oilseeds	% increase in yields	Legume/ pulses	% increase in yields
Mustard	128.1 to 159.8	Alfalfa	23.4 to 19,733.3
Rai	18.4	Berseem and other Clovers	23.4 to 33,150
Rapeseed	12.8 to 139.3	Vetches	39 to 20,000
Toria	66 to 220	Broad Beans	6.8 to 90.1
Sarson	222	Dwarf beans	2.8 to 20.7
Safflower	4.2 to 114.3	Kidney beans	500 to 600
Linseed	1.7 to 40	Runner beans	20.6 to 1,100
Niger	260.7	Arahar	21 to 30
Sunflower	20 to 3,400	Other pulses (Moong, Urd, Masoor, Peas, etc.)	28.7-73.8
Orchard crops	% increase in yields	Vegetables for seed/ fruits	% increase in yields
Apple varieties	180 to 6,950	Radish	22 to 100
Pears	240 to 6,014	Cabbage	100 to 300
Plums	6.7 to 2,739	Turnip	100 to 125
Cherry	56.1 to 1,000	Carrot	9.1 to 135.4
Straw-berry	17.4 to 91.9	Onion	353.5 to 9,878
Raspberry	291.3 to 462.5	Brinjal	35-67
Persimmon	20.8	Cucumbers	21.1 to 411
Litchi	4,538 to 10,246	Miscellaneous crops	
Citrus varieties	7 to 233.3	American cotton	5 to 20
Grapes	756.4 to 6,700	Egyptian cotton	16 to 24
Squashes	771.4 to 800	Buckwheat	62.5
Guava	70-140	Coffee	16.7 to 39. 8
Papaya	22.4-88.9		
Mosambi	36-750	This increase in yield is in addition to the value of honey and other hive products. Bee pollination also improves the quality of seed/ fruit.	
Orange	471-900		

It may be remembered that all the bee products are used either as food or in pharmaceutical and cosmetic industries. For this reason, hygienic collection, handling, processing, storage, etc. and maintaining National and International purity standards are of prime importance.

It is also worthwhile to mention that beekeeping /honey bees work as an input of agriculture which is essentially required for its development. Therefore, beekeeping/ honey bees should be treated as fifth input for overall development of Agriculture in sustainable manner in the country. It regulates the efficacy of other four inputs used in agriculture, particularly in the crops which need pollinators for pollination support. World wide about 85% of the crops grown need pollinators for pollination and setting of fruits & seeds and honey bees are the best and most important pollinator which can sustain with changes in atmosphere/ climate.

G. National Bee Board (NBB)

In view of the importance of beekeeping in overall sustainable agriculture and rural development and to make the effective functioning of the Society (NBB), the National Bee Board (NBB) was reconstituted by the Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India under the Chairmanship of Secretary (A & C) in June, 2006 and further in Oct, 2008. The main objective of the NBB is overall development of scientific beekeeping in India by popularizing state of art technologies relating to nucleus stock production, capacity building and training of bee breeders and beekeepers, processing, etc. and to increase the productivity of crops through pollination and increasing the honey production for enhancing the income of the beekeepers/farmers.

The funds ear-marked under pollination support component of NHM and Technology Mission for Integrated Development of Horticulture in N.E. and Hilly States (TMNE now HMNEHS) will be/are used for overall development of beekeeping in the country. The State Departments of Horticulture /State Horticulture Missions (SHMs) are the implementing agencies for these Missions (NHM & HMNEHS) at State level. The Board (NBB) have been involved in conducting various capacity

building programmes including seminars, trainings, publications, etc. under NHM & HMNEH (TMNE) schemes of DAC as per availability of funds. There is need to make efforts to marry and integrate the beekeeping programme with other programmes of agricultural and rural development at all the levels.

Some facts about beekeeping are given as under:

- Many colourful and different looking flowers are developed as an adaptation for the bees and other pollinators, not to please human.
- When honey bees with pollen is landing in next flower, there will be pollen enough left on bees' body hairs to pollinate new flower, by delivering some grains to flower's stigma and pollination takes place.
- The value of bee pollination in Western Europe is estimated to be 30-50 times the value of honey and wax harvests in this region.
- The great value of bees as pollinators has been known for many years, but unfortunately, this knowledge is not widely appreciated and understood.
- Nectar and pollen are not used by other livestock: only bees harvest these resources. Hence, no competition with anyone. Without bees these valuable resources could not be harvested and go waste.

Marketing and Export of Temperature Fruits

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Temperate fruits like apple, walnut, pear, peach, apricot, cherry, plum etc. are grown in the temperate region of our country. Besides yielding income, these fruits have a excellent nutritive value. To ensure profitability, an effective marketing strategy, therefore, needs consideration as to where, when and in what form the product to be marketed. The export of temperate fruits from India is very less. This calls for efficient production and marketing efforts. Significant development has taken place in international trade regime for fair play and non-discriminate trade. Many countries are interested in Indian market for temperate fruits, because of market access provision in the world trade organization regime. The increasing consumption of fruits coupled with increase in income will certainly help such nations to export until India takes remedial measures to increase productivity and improve quality of the fruits.

Marketing is a process that creates consumer utilities. Marketing management thus becomes very important for consumer satisfaction and profitability. Markets exist because of consumers preferences and their willingness to pay for a product. It is, therefore, important to prepare the fruits for the market as per the consumers likings. Therefore, importance of proper pre and postharvest management like maturity indices, harvesting, grading, packing and transportation, should be kept in mind for marketing of temperate fruits. Packing, transportation and handling needs to be carefully done to avoid mechanical damage to fruits.

Marketing and Export of Temperate Fruits-Considerations

Maturity indices and harvesting: Maturity indices/harvesting stage determine the quality of fruits and its shelf life. Maturity standards have been calculated and standardized based on days to harvest from full bloom and TSS in apple. Royal Delicious, Red Gold, Rich a Red, Red Delicious and McIntosh are ready to harvest after 120-135 days from the date of full bloom with T.S.S. ranging from 12-14^{o} Brix. Similarly, pear cv. Bartlett, peach cv. July Elberta, plum cv. Santa Rosa and apricot cv. New Castle and Royal should be harvested after 122, 101, 94, 84 and 100 days after full bloom respectively.

Grading: Proper grading of fruits are essential for fetching higher income. Four apple grades are recommended as proposed by UNDP for domestic and international market viz., extra large (80 mm diameter), large (75 mm), medium (70mm) and small (65 mm), while Chadha and Awasthi (2005) proposed **India No.1:** Apple which are mature but not overripe, clean well formed and free from decay, breakdown, diseases, broken skin, visible water core, injury caused by russetting, sun burn, spray burn, hail etc. **India No. 2:** Fairly well formed. **India Utility**: Mature, clean and free from decay; **India Processing Peeler***:* Apple which are not smaller than 6.25 cm in diameter, fairly well formed, not seriously sun burn, damaged by bruising and hail or other indentation and ***India processing juice****:* free from decay, injury and damage from other factors.

Packaging techniques: Different packaging materials are recommended like corrugated fibre box plastic (CFB) and wooden box for apple, apricot, peach, nectarine, pear and plum. CBF packing is preferred over wooden box, which is available in different varieties like Regular slotted container, fully overlap slotted container, half slotted container, overlap slotted cartoons etc. The regular slotted containers are most demanded shipping containers.

Storage techniques: There are different systems of storage such as low temperature storage, evaporative coolers, zero energy cool chamber, controlled atmospheric storage, etc. hypobaric storage are available for storage of temperate fruits.

CA Storage: Although it involves high cost but these structures are becoming common in temperate region along with normal cold stores. It is the modern storage technology based on CO_2 and 0_2 balance wherein CO_2 concentration is maintained between 2-5% and 0_2 at about 3%. It is based on the principle of reduced respiration under high CO_2 concentration.

Preparation of value added products: Processed products, ready to use beverages have gained tremendous popularity and their production accounted for major share in advanced countries. These various commodity based products are important for reducing the post harvest losses besides providing high returns and employability. Important value added products which have been manufactured and marketed in temperate fruits are gaining popularity through out the country.

Table 1. Value added products from temperate fruits

S.No.	Fruit	Value added product
01.	Apple	canned, osmosed apple, apple powder, juice, carbonated drinks, toffee, preserve/ candy, jam, jelly, cider and wine
02.	Apricot	Squash, appetizer, dried apricot, osmotically dehydrated apricot nectar, powder, instant chutney, leather/bar, toffee, protein enriched products, jam, canned apricot, wine, kernel oil
03.	Plum	squash, appetizer, low caloric health drink, nector, canned, osmosed plum, jam, chutney, plum-ginger chutney, dry fruit chutney, plum wine and brandy
04.	Peach	canned, juice, jam, pulp and chutney
05.	Pear	canned, carbonated drink, fruit chutney, vermouth.
06.	Seabuck thorn	Juice, jam, squash and jelly,

In order to capture full benefits of our position in the world, it is very essential to improve the infrastructure for storage and handling, Packaging, cold chain, transportation and marketing for management of post harvest losses through various stages of supply chain.

Quality Standards of Different Temperate Fruits for Marketing and Export

Apple: Fruit size and shape, firmness crispness, lack of mealiness, flavor, including soluble solids, titratable acidity and flavor volatiles. free from defects such as bruising, decay, stem or blossom-end cracks, bitter pit, scald, internal browning, or shrivel.

Pear: Fruit shape, size and free from insect damage, mechanical injuries (impact, compression, and/or vibration bruising), decay and other defects. Sweet taste, pleasant aroma, and juicy, buttery texture are desired eating characteristics of ripe pears (flesh firmness range between 2 and 4 force).

Plum: High consumer acceptance is for high soluble solids content (SSC) fruits. Fruit acidity, SSC/acidity ratio, and phenolic content are also important factors in consumer acceptance. Plums with 2-3 kgs force flesh firmness are considered "ready to eat".

Sweet Cherry: Color intensity and uniformity; size; firmness; free from decay; and free from defects including insect damage and scars. Flavor depends upon solids/acid ratio and absence of off-flavors.

Apricot: Fruit size, shape and free from defects and decay. High consumer acceptance is attributed to with high (>10 per cent) soluble solids content (SSC) and moderate acidity (0.7-1.0 per cent). Apricots with 100-200 gm force flesh firmness are considered "ready to eat". Apricot cultivars have a rapid rate of fruit softening (200 gm force per day at 20°C).

Peach and Nectarine: High consumer acceptance is attributed to high soluble solids content (SSC). The fruit acidity, SSC/acidity ratio, and phenolic content are also important factors in consumer acceptance. Fruit with 100-200 g force flesh firmness is considered "ready to eat". Fruit below 40-60 force are more acceptable to the consumer.

Marketing Channels

Marketing channel comprises of various marketing functionaries that are engaged in distribution of the produce from producers to the consumers. Some of the important links of marketing, with regards to their nature and usefulness in the marketing system of temperate fruits are:

Pre-harvest contactors: The practices of leasing-out came as handy alternatives for marketing of temperate fruits. The pre-harvest contractor is still a major market functionary in

the temperate fruit trade. The specialized nature of its marketing business and the fluctuating production levels force many apple growers to shift their natural and management related production and marketing risks to pre-harvest contractors. These contractors take the title to the produce, after entering into a lease agreement with the growers. To account for natural fluctuations, the lease in some cases may be signed for 2-3 years as well.

Forwarding agents: Forwarding agents, help in dispatching the produce to different markets. They arrange for trucks and loading and unloading of the produce. For this purpose, the forwarding agents charges forwarding charges for the growers.

Commission agents: The commission agents are the market intermediaries between buyers and sellers. These agents, unlike pre-harvest contractors do not bear any marketing risks and only facilitate the transactions for which they charge commission. The commission charges by them in the trade vary in different markets.

Public agencies: Temperate fruit cultivation in hilly regions of the country is an economic and environmental necessity the northern hills states of the country are attempting horticultural development through diversified farming of temperate fruits. With this in view, a world bank funded horticultural produce marketing and processing corporation (HPMC) has been established. The aims of HPMC are to help reduce marketing cost, extend fruit trade, to extend marketing period through cold storaging, improve fruit quality and provide options to fruit growers to store and/or process their produce through these agencies.

Marketing Costs

Management of producers costs is important for economic sustainability of fruit farming. The marketing costs of temperate fruits have increased significantly in their absolute terms. The perishable nature of fruits, seasonality in supply and distant travelling of the produce are some of the major factors which define the magnitude of various types of costs and margins. Major components of produce marketing costs are costs of transportation, including costs of labor. Almost 40 per cent of the total costs came transportation if the produce is routed to the market through forwarding agents.

Marketing Management Strategies

Marketing of temperate fruits is expensive as well as complicated affair. The marketing process requires effective amalgamation of physical infrastructure, technical capacities and management capabilities. Commercialization of temperate fruits has brought into focus the need for efficient marketing. To meet fast changing consumer demands for variety, colour, size and processed forms, the marketing management has to be innovative from the initial marketing stage of picking grading and packing of apples.

Export

In order to be successful in exporting one must fully research its markets. No one should ever try to tackle every market at once. . All goods for export must be efficiently produced. They must be produced with due regard to the needs of export markets. India's merchandise exports reached a level of US$ 178.7 billion during 2009-10 registering a negative growth of 3.5 percent as compared to a growth of 13.6 percent during the previous year. Notwithstanding the deceleration of the growth in 2009-2010, India's export sector has exhibited remarkable resilience and dynamism in recent years. Our merchandise exports recorded a compound annual growth rate (CAGR) of 22.0 per cent during the five year period from 2004-05 to 2008-09 as compared to the preceding five years when exports increased by a lower CAGR of 14.0 per cent. According to latest WTO data (2009), India's share in the world merchandise exports increased from 0.8 per cent in 2004 to 1.3 per cent in 2008. India also improved its ranking among the leading exporters in world merchandise trade from 30th in 2004 to 21st in 2009. India's exports have not been affected to the same extent as that of other economies of the world during the phase of global slowdown. After declining consistently for the first seven months of the year 2009-10, India's exports reversed the trend in October, 2009 by registering a positive growth of 3.4%. The upward trend has been maintained since then wherein exports grew at the rate of 30.0 % in November 2009; 20.3% in December, 2009, 18.7% in January, 2010, 34.8% in February, 2010; 54.1 % in March 2010, 38.5 % in April 2010, 30.1 % in May 2010, 43.8% in June 2010, 11.7 % in July 2010, 22.5% in August 2010, 23.2 % in September 2010, 21.3% in October, 2010, 26.5% in November 2010 and 36.4% in December 2010. (Table 2.1) The extent of sustained recovery of exports would ultimately depend on the strength of the recovery of global demand. The Government had set an export target of US$ 175 billion for 2009-10. With merchandise exports reaching US$ 178.7

billion in 2009-10, the actual exports exceeded the target by 2.1 per cent which is a remarkable achievement during a period of recession in India's major export destinations.

Horticultural exports contribute about 8 per cent in total agricultural exports. The export of temperate fruits like apple, pears, peach, cherry, walnut and plum etc. is very less. This calls for efficient production and marketing efforts. Significant development has taken place in international trade regime for fair play and non-discriminate trade. Many countries are interested in Indian market, because of market access provision in the World Trade Organization (WTO) regime. The increasing consumption of fruits coupled with increase in income will certainly help such nations to export until India takes remedial measures to increase productivity and improve quality of the products. Therefore, many efforts are needed to exploit the world market potential especially for temperate fresh fruits when India have tough competition in fruits from USA, France, Belgium, Australia, Italy, Spain, China etc.

Certification of Temperate Fruits for Export

Taking into consideration that European Commission (EC) has instructed its member countries to introduce checking operations with regard to import of fresh fruits at their respective points of entry and whereas the European Commission shall allow in the normal course entry of such commodities if checks have been carried out in the exporting country and all relevant information is provided to them in this regard, Directorate General of Foreign Trade, Ministry of Commerce and Industry has issued a Public notice No. 28 (RE-2002)/2002-2007 dated 02-08-02 laying down, that all the fresh fruits exported too European Unions may be inspected (DMI), Department of Agriculture and Cooperation, Ministry of Agriculture, Ministry of Commerce and Industry set up a standing committee on fresh fruit and vegetables under the chairmanship of the chairman, Agricultural and Processed Food Products Expert Development Authority (APEDA) to look into formulation of export standards for fresh fruits and vegetables. Taking above facts into consideration, DMI is implementing Certification scheme for export of temperate fruits to EC countries.

Labeling, Packing and Marking for Export

An important stage for export of temperate fruits is their preparation for shipment. This involves labeling, packaging, packing and marking of export consignments. Labeling requirements differ from country to country and the same should be ascertained well in advance from the buyer. The label should indicate quality, quantity, method of use etc. Special international care labels have been specified for the handling and packaging of fruits. Packaging fulfills a vital role in helping to get your export products to the market in top condition, as well as in presenting your goods to the overseas buyer in an attractive way. While packaging, quality should not be compromised merely to cut down costs, packaging should also be in conformity with the instructions issued by the importer. Packing refers to the external containers used for transportation. The shape of packing cases play a very important role in packing the cargo, and the nature of packing material to be used will depend upon the items exported As regard specification for the size, weight and strength care must be taken to ensure that the weight of standard case does not exceed 50 Kg. for easy handling of the cargo. Before packing and sealing the goods, it should be ensured that all the contents are properly placed in the case and the list of contents of packing notes should be prepared so that the buyer, the Customs authorities and the Insurance authorities can easily check the contents of each and every case. The consolidated statement of contents for a number of cases is called the Packing List, which should be prepared in the prescribed standardized format.

Marking means to mark the address, number of packages etc. on the packets. It is essential for identification purpose and should provide information on exporters' mark, port of destination, place of destination, order number and date, gross, net and tare weight and handling instructions. It should also be ensured that while putting marks, the law of buyer's country is duly compiled with.

All shipping cases should be marked a number with special symbols selected by the exporters, so that the competitors cannot find out the details of the customers and the country of destination or supplier's country of dispatch. Care should also be taken to ensure that the marking conforms to those written in the invoice, insurance certificate, bill of lading and other documents. The International Cargo Handling Co-ordination, Association has set out for the use of exporters a number of recommendations for the marking of goods carried by ocean-going vessels. They are equally useful for sending goods by other modes of transportation.

Constrains for Export of Temperate Fruits

The fresh fruit export from India is very small owing to a number of constraints. These constraints relates to production practices, issues related supply chain, market access and non-tariff restrictions and governmental policies.

1. Supply Chain Issues

a) Uneconomic scale of operation

b) Lack of consistency in supply and quality

c) Lack of cost competitiveness due to statutory change, intermediation and wastages/losses

d) Inadequate and inappropriate storage and distribution infrastructure

2. Market Access Issues

a) Import policy barriers

b) Standards, Testing, Labeling and Certification requirements

c) Export subsidies and domestic support

d) Government procurement

e) Lack of brand time middle and high-age

3. Technological constraints

a) Vast majority of holdings are small and un-irrigated

b) Low productivity of crops due to inferior genetic stocks and poor management.

c) Inadequate supply of quality planting materials of improved varieties.

d) High incidence of pests and diseases.

As a result, the productivity per unit area is low, resulting in high cost of production. Further, the quality of produce in many cases is far from satisfactory. The future growth of horticulture industry will largely depend on new and globally competitive technologies.

Indian Scenario for Export of Temperate Fruits

Temperate fruits have a high income elasticity of demand. As income goes up, demand rises rapidly, especially in the middle and high-income groups in developing and developed countries. There is an increasing tendency in developed countries to diversify the diet by consuming a wide variety of fruits. Conditions for increasing production of temperate fruits are very favourable in the country. There are many temperate fruits that fetch high price in world trade. Thus the efficient production of high value temperate fruits on small farms can help alleviate rural poverty.

Production of Some Important Temperate Fruits in India

Production of temperate fruits is on the increase recording. The following table indicates area and production of temperate fruits in India.

Export of Temperate Fruits from India

The varied climatic and soil conditions in the country are facilitating production of temperate fruits. India is not only growing temperate fruits very successfully but is also exporting to global markets. Relative to the huge production of temperate fruits the export is very less. Broadly this points out to the huge potential India has in

Table 2: Area ('000ha), Production ('000 tons), productivity (t/ha), export and import ('000 tons) of temperate fruits and nuts in India.

Crop	*Area*	*Production*	*Productivity*	*Export*	*Balance for Domestic consumption*	*Import*	*Total for Domestic Consumption*
Apple	273.52	2563.14	9.37	26.88	2536.26	35.90	2572.16
Pear	34.64	173.31	5.00	0.79	172.52	-	172.52
Peach	16.14	58.06	3.60	0.01	58.05	0.06	58.11
Plum	22.04	60.31	2.74	1.03	59.28	-	59.28
Apricot	18.46	48.95	2.65	0.08	48.87	-	48.87
Cherry	3.91	11.85	3.03	0.04	11.81	0.06	11.87
Almonds	23.26	163.83	7.04	-	163.83	33.12	196.95
Walnuts	110.70	34.54	0.31	9.08	25.46	0.32	25.78
Total	502.67	3113.99	6.19	37.91	3076.08	33.5	3145.54

Source: NHB and APEDA 2009-10.

Table 3: Export of different temperate fruits and nuts.

Year	2007-08		2008-09		2009-10	
	Qty (tons)	Value in Million Rs.	Qty (tons)	Value in Million Rs.	Qty (tons)	Value in Million Rs.
Apples	32655.268	333.079234	44552.17	522.200523	26880.296	321.03357
Apricots	77.444	1.018626	163.367	1.890261	88.972	1.043562
Cherries	51.747	1.373718	17.015	0.218645	41.261	0.784524
Peaches	0.000	0	4.02	0.0209	0	0
Pear and Quince	75.990	2.067805	81.129	2.431495	79.809	2.209629
Plums and Sloes	835.863	0.808815	2052.878	18.824594	1035.161	10.335598
Walnuts including kernals	6692.075	1620.314475	5696.33	1412.359417	9071.709	1978.0374

Source: DGCIS Annual Export

Table 4: Export of different products of temperate fruits

Name of fruit	2007-08		2008-09		2009-10	
	Qty (tons)	Value in Million Rs.	Qty (tons)	Value in Million Rs.	Qty (tons)	Value in Million Rs.
Apple preserved	21.485	1.114806	0	0	0.2	0.015541
Apple juice	225.606	6.288932	0	0	7.781	1.411344
Apricot preserved	0.585	0.07132	0	0	0	0
Cherries preserved	3.744	0.107511	12.028	0.339723	18.93	1.202728
Peaches preserved	0	0	0.2	0.024	0.3	0.107104
Walnut kernels	6531.175	1602.804183	5401.598	1386.159955	8707.185	1949.291

Source: DGCIS Annual Export

Table 5: Major export markets for the export of temperate fruits

Name of fruit	Name of countries
Apple	Bangladesh, Nepal, United States, Ireland, United Arab Emirates, Qatar, Saudi Arabia, Singapore, United Kingdom, Sri Lanka, Maldives, Netherland, Canada, China and Germany.
Apricot	Bangladesh, Hong Kong, United States, United Kingdom, Botswana, Reunion, Mozambique, Tanzania Republic, Madagascar, Canada, Nepal, Oman and Australia.
Cherries	Bangladesh, Kenya, Nepal, Kuwait, Seychelles and Bahrain.
Peach	Nepal
Pear and Quince	Saudi Arabia, Bangladesh, Nepal, Maldives, Singapore, United Arab Emirates, Canada, France, Germany and Japan
Plum and Sloes	Bangladesh, Nepal, South Africa, Maldives, Singapore, Nigeria, Oman, United Kingdom, Bahrain, Germany and China
Walnut	Egypt Arab Republic, Spain, United Kingdom, China, Germany, France, Netherland, united Arab Emirates, Greece, Hong Kong, Kuwait, Italy, Denmark, Algeria, Belgium, Sweden, Thailand, Australia, Taiwan, New Zealand, Portugal, Cyprus, Nepal, Jordan, Austria, Uruguay, United States, Saudi Arabia, Bahrain, Lithuania, Switzerland, Russia, Argentina, Norway, Tunisia, Swaziland, Albania, Japan, Kenya, Ghana, Canada, Indonesia, Ireland, Singapore and Latvia.

Source: DGCIS Annual Export

the export of temperate fruits to global markets. There is an impressive growth in the exports of temperate fruits in the past few years. The following tables shows export of different temperate fruits and their products.

Foreign Trade Policy for Export

The Foreign Trade Policy (FTP) 2009-14 was announced on 27th August, 2009 in the backdrop of a fall in India's exports due to global slowdown.

The short term objective of FTP (2009-14) was to arrest and reverse the declining trend of exports as well as to provide additional support especially to those sectors which were hit badly by recession in the developed world. The Policy envisaged an annual export growth of 15 per cent with an annual export target of US$ 200 billion by March 2011 and to come back on the high export growth path of around 25 per cent per annum in the remaining three years of this Foreign Trade Policy i.e. up to 2014. The long term policy objective for the Government is to double India's share in global trade by 2020.

Export Inspection Council of India (EIC)

The Export Inspection Council of India (EIC) was set up by the Government of India under Section 3 of the Export (Quality Control & Inspection) Act, 1963 as an apex body to provide for sound development of export trade through quality control and pre-shipment inspection. The Act empowers the Central Government to notify commodities and their minimum standards for exports, generally international standards or standards of the importing countries, and to set up suitable machinery for inspection and quality control. The EIC is assisted in its functions by the Export Inspection Agencies (EIAs) located at Chennai, Kochi, Kolkata, Delhi and Mumbai having a network of 35 sub-offices and laboratories to back up the pre-shipment inspection and certification activity. In addition, EIC also designates inspection agencies and laboratories to supplement its own activities as required.

The main functions of EIC are (i) to advise the central government regarding measures to be taken for enforcement of quality control and inspection in relation to commodities intended for export and (ii) to draw up programmes for quality control and inspection of commodities for exports.

Export Competition

In terms of the draft proposals, developed countries are required to eliminate all forms of export subsidies by 2013. Developing countries could have to do so by 2016. In terms of the AOA, developing countries had the flexibility to provide certain subsidies, on export marketing costs, internal and international transport, freight charges etc. According to the current proposals, this provision would continue to be available to developing countries till 2021 i.e. 5 years beyond the year 2016 when they would be required to phase out all other forms of export subsidies.