Proceedings of Brainstorming on Food Processing, Food and Nutrition Security

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Innovative Thought Forum Ahmedabad Proceedings of Brainstorming on Food Processing, Food and Nutrition Security

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Innovative Thought Forum

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PREFACE

Innovative Thought Forum (ITF) is an agnostic, non-governmental and non-political organization established with an aim to work for the welfare of Indian people. The forum is built on the doctrine of equity for serving the humanity without any prejudice to Individual(s), or any section of the society on the basis of caste, doctrine, religion or economic status. The forum provides a platform for organized discussions in the form of round table meetings or seminars and workshops on India centric problems to find either technology solutions or bring out policy level discussions. The forum, however, will also like to involve in demonstration program for showcasing the potential of new developments and also bring together organizations or individuals for entrepreneur establishments.

The first two discussions were organized on the subject of Land and Water, and Agriculture. These issues are not only the backbone of Indian Economy, but essential for employment and to provide food security. As India's population grows beyond 1.2 billion, the challenge of feeding her people also grows. The question is not only to provide sufficient food, but there are challenges of equity and nutrition issues. India continues to face problems in providing nutritious food to millions of people facing malnutrition and chronic undernourishment.

Food processing, which is the first organized link between farm gate to the dining plate, can play a vital role in solving India's problem of providing nutrition security. Value addition to food should take place at the farm in rural areas. This will stimulate rural growth in the same manner, as the IT has done in fuelling the urban growth. Food processing is considered to be a sunrise industry in India, with a huge potential to process raw food into nutritious food. There is a vast gap between food processing industry in India and those in the developed countries. ITF has therefore initiated this discussion to identify potential technologies that can be used to process certain raw foods.

Food processing may also play a vital role in the campaign for "Make in India". This industry is totally Indian made, where the raw product, intermediate processes and final products have to be made in India. India, being rich in biodiversity, smart interventions are possible here. We intend to discuss these issues in this seminar with a hope to provide techno-economic solutions to the industry. In our seminar on Agriculture in July 2015, a concept of Solar Pump Agro Farming Co-operative has resulted in a number of projects in Gujarat, making a farmer a net power provider in place of a power consumer.

Finally we are thankful to Dr.Bajranglal Gupt, who has taken time from his busy schedule to be amongst us and Dr.V.Prakash, former Director of CSIR – Central Food Technological Research Institute, to anchor the program and present his keynote address. Of course, we are extremely thankful to all the speakers and participants for sparing their time and contributing to the richness of the deliberations.

S.B Dangayach.

N.K Bansal.

New Delhi. R.C Jhamtani.

SETTING THE STAGE

Bajranglal Gupt

At the outset, I will like to express that I am not an expert on the subject of food processing and it is difficult for me to speak on the subjects in the midst of so many subject experts present here. The topic of food processing is India centric and more appropriately Bharat centric from the point of view of Bharat and Bhartiyta in our people. According to FAO, the definition of food security is as follows:

"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"

Intrinsic to this definition are four pillars of food security, namely, availability, stability of supply, access and utilization of food by the body. While not always explicit, each pillar contains nutrition considerations and components crucial to the links in the chain between national food economics, households and individual well being. In these two definitions or concepts, questions arise i) Is there any meaningful difference in these concepts? and ii) if there are no differences then there may be linkages between the two.

With reference to India, what is the situation of food security and nutritional security in the country? When we talk of nutrition, one needs to take a view on malnutrition, over-nutrition and micro-nutrition. In this context, I want to suggest to you to take a Bharat centric approach. We need to adopt a holistic and integrated approach. In many policy issues regarding our national problems we adopt a fragmented approach. Bhartiya philosophy is to view the problems as well as solutions through an integrated approach and the same is true to the problem of food and nutrition security.

The word security, however, tends to give an impression that there is an involvement of an external agency who is responsible to ensure provision of food and nutrition. Is it the responsibility of the government, industry or society? Bhartiya chintan regarding "Aahar" corresponds to "Sukhi and Swastha Jeevan", while discussing food and nutrition security, we need to have also a qualitative approach along with the quantified approach to food and nutrition security. First thing that should be tackled is " What to grow and how to grow" . In our agriculture, we have adopted inorganic chemical fertilizer and artificial seed. This has, though resulted in increased food production but the quality of food has deteriorated. Our farmers earlier use to apply compost in the agriculture fields resulting in the growth of delicious and nutritious food. Having overproduced rice and grains, we need to have interventions now. Organic farming is being discussed nowadays again. Agriculture technology, agronomics, water use, natural seed etc need to be redesigned and remodeled to evolve and adopt refined practices.

GM food has been a topic of intense discussions presently. Questions have been raised about its safety. There are sharp divisions amongst thinkers and experts. One group is deadly against the GM crops, while the other group supports it, citing our increasing burdening population. However, if we go ahead with GM crop without deliberations on its adverse effects on human health and environment, then we shall be adopting a non-returnable path.

We have been talking about, with pride about our progress in the production of vegetable and fruits and milk, India being the highest producer in the world in the case of later. However, we need to face the fact that per capita consumption of both the products is on decline. We Indian, need to think about this inequality. Knowledgeable farmers are also warning about the quality of seed. High yield

variety of seed is not suitable for Indian soils. We used to have two thousand five hundred (2500) varieties of rice, suitable to Indian conditions. This biodiversity seems to have been lost now. In olden days, not many decades ago, people used to have kitchen farms providing organic nutritious food. Times have changed dramatically since then. Now-a-days, even farmers have to go to Mandi to procure essential food items. Another big problem, in our country as well as in other parts of the world, is the wastage of food, which is estimated to be as high as thirty percent. Packaged food and modern practices have further led to an increase in the waste. It is ironical that on one hand we have hungry people, while there is extravagance on the other side. Storage of food has been a severe problem in our country. In the absence of adequate food storage facilities, farm crops are rotting in the fields. Practical smaller on farm solutions need to be developed and practiced along with large silos and warehouses.

Another problem that one needs to address is that of what to eat and what not to eat ?. Doctors, practicing allopathic medicines advice to eat anything that one can digest. However, Indian literature on "Aahar" provides vast knowledge and suggestions on these issues with reasoning. In "Aahar" different food has to be cooked for old, children and for pregnant women. Food changes with change in season. Time to take food is also very important in the Indian literature. First grasp of food is required to be taken at the time of breathing by left nostril, suggested by Charak, the great Indian food expert. According to a story, Charak once adopted the form of a big bird and asked a few learned people about the appropriate habit of eating food. Every learned person narrated his own thinking on the subject with big explanatory notes. Charak was dissatisfied. Learned people then asked the bird about his opinion. He recommended about eating food in three words:

Mit Bhuktam (Eat less)

Hit Muktam (Hitakari Bhojan)

Rit Bhuktam (Eat food with honestly earned money)

Along with the importance about the way of eating, equally or more important is the method of cooking. If the cooking technique is not proper, then the food loses its nutritional value. Now-a-days we keep food in a refrigerator. Food stored in a refrigerator for a long time loses its nutritional value. The next important point about the nutritional value of the food is the manner of feeding the food. The way and the feeling with which the food is served, affects health and nutrition. Sentiments and affection during feeding, help in better digestion. Sharing of food with others also provides immense happiness as described by Charak, an ancient Indian food scholar and technologist. Immense gap between rich and poor could be narrowed by sharing of food. Defective pattern of consuming food affects life span and health. Keeping of ethics should also be adopted in our food consumption. We need to qualify the type of food for rural, urban and tribal areas separately. As per Indian situation, what means could be adopted should be considered carefully for providing nutrition. Total dependence on technology for processing of food is also raising serious questions. Climate change is a phenomenon induced by new technology. India needs to find technologies that are India centric and environmental friendly for processing of the food.

Towards the end I will like to say, that there so many programs going on in the country about food and nutrition security. Very often there are contradictions between these programs which lack coherence and miss many links, leading to more problems rather than solutions. There are many NGO's that are involved in food and nutrition programs at grass root level and in many villages. I am involved in a few programs like this. We are trying to find a coordination between these NGO's with

minimum dependence on the government. If interventions from you expert are possible then we would welcome it. In the presentations to come now, I am sure there will be guidance for our program then I would very much very welcome to introduce these in our projects.

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FOOD AND NUTRITION SECURITY: INNOVATIVE FOOD SCIENCE AND TECHNOLOGIES FOR SUSTAINABLE SOLUTIONS.

V. PRAKASH

1. Introduction

We may start with ideas from Bajrangiaiji, that Bharathyta (India) and an integrated approach is required in India to tackle the problem of food and nutrition security. This will lead us to wellness and health. Food and nutrition are synonymous in the social system. According to United Nations Population Division and Population Reference Bureau, there is enough space for everybody to grow provided equal opportunity is available. The number of people in low income countries is likely to grow about 7.5 billion by 2050, where as the population in high income countries will remain to almost present level, namely 1.7 billion (Fig.1) . India will remain in the category of low income countries. In contrast to the income, however, low income countries will be rich in human resource (Fig. 2). India is and will be a place that is rich in skilled human resource.

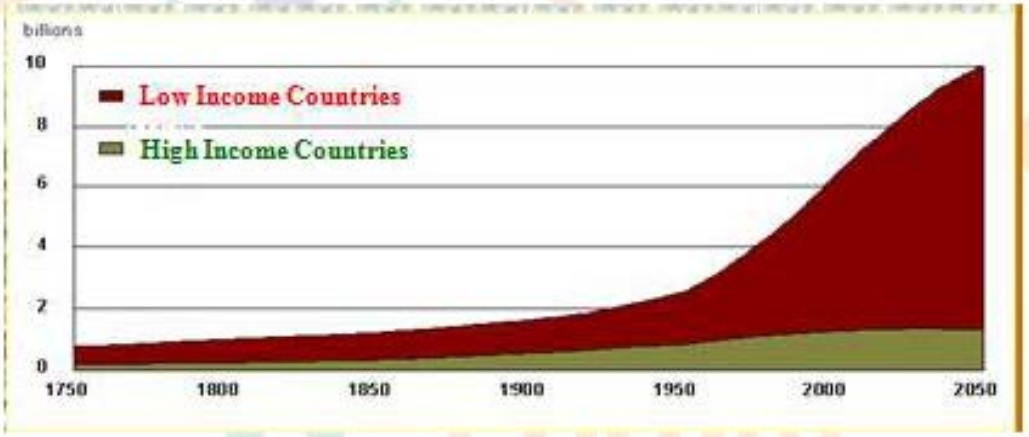

Fig.1: Population trends in low and high income countries

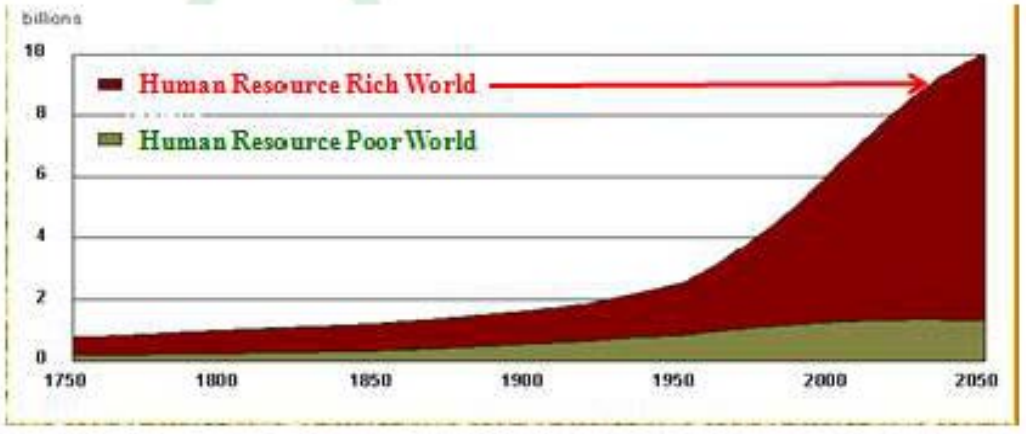

Fig.2: Trends in the human resource in low and high income countries

Today India is self sufficient in food and very rich in biodiversity, growing almost every kind of food. There are thirty five countries in the world, especially in Africa, which require external assistance for food (Fig.3)

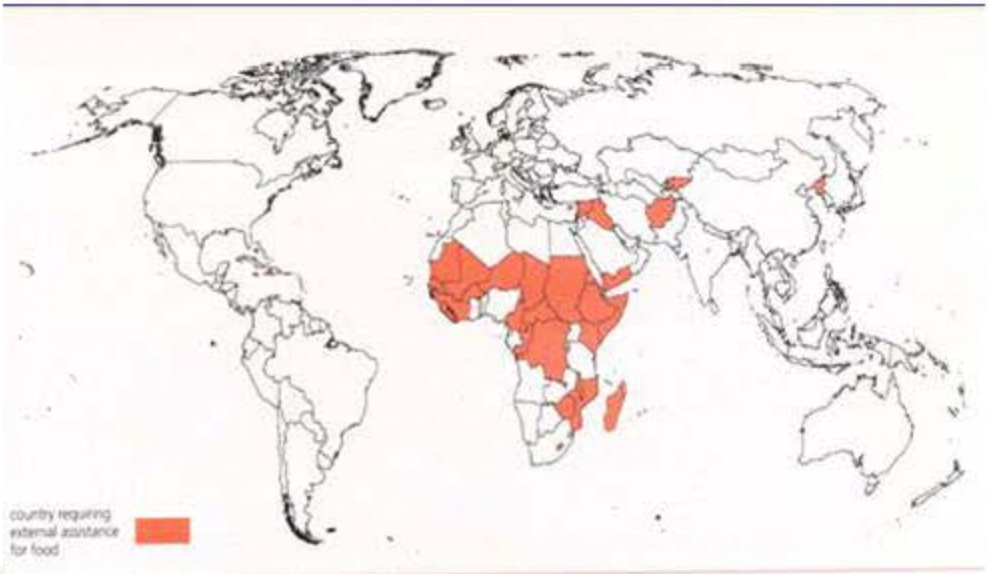

Fig.3: Thirty five countries in the world which require external assistance for food.

2. India's Food Economy

However, food is becoming expensive and unaffordable in many Indian families. Average Indian household spends nearly forty three percent (43%) of annual expenditure on food and the rest on all other items as depicted in Fig. 4.

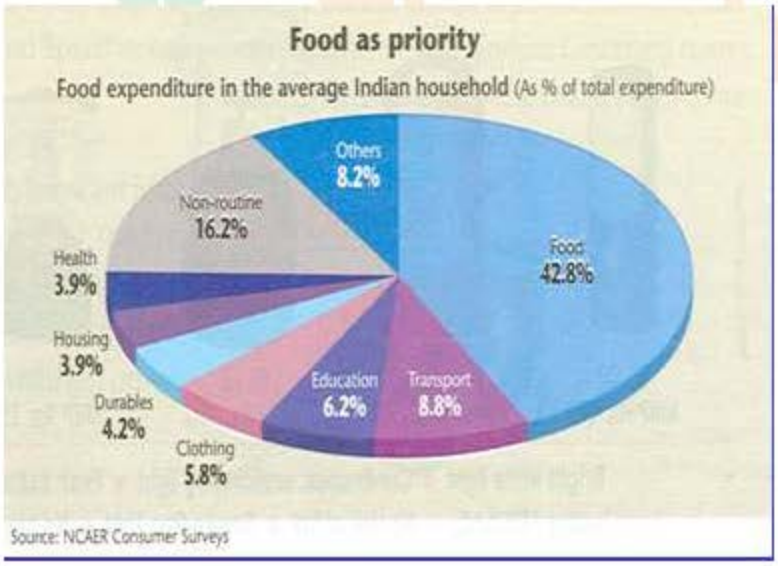

Fig. 4: Distribution of expenditure by an average Indian family

Our country's economy depends upon eight factors, which are (a) Indigenous grains and consumption, (b) Socio-economic imperatives, (c) Dynamic research and development, (d) Internal and external market pressures, (e) Fiscal policies, (f) Skill based human resource (g) Trade and economic blocks, and (h) Cost effectiveness, local sustainability and sustainable grain consumption. With reference to indigenous grain consumption, I cite the example of Kesri Dal, which has been banned because of its toxic nature. However, traditional way of cooking Kesri Dal was to soak it seven times in hot water and throw away the soaking water and then it was free from toxins. However, introduction of pressure cooker has changed the cooking habits and hence the problem. Every

tradition therefore has social-economic imperatives. For research and development, I have preferred to use the world dynamic research and development. Such research may be qualified in to two categories, namely surface research and deep research. Surface research is sometimes useful to find answers to simple problems, the solutions for which may be available in the literature. Deep research is required to find new products and for innovations. The last factor that I have used with reference to food economy in the country is the sustainability of grain. Grain can be replaced by any other agriculture variety, let it be spices, fruits or any other agriculture commodity.

3. Integrated and Innovative Approach.

Agri-sector in our country needs an innovative and integrated approach. There is a series of steps in flow-chain for enhancing the food quality along with agri-sector empowerment for better remuneration to farmer. This flow chain consists of three main factors:

Quality

Regulatory

Monitoring

In the quality of agri-sector, there needs to be a balance of three main items of food chain, which are life support crops, horticulture and animal husbandry. We need to grow grain, pulses and other value added products in a balanced manner. With respect to value, therefore, agro-processing needs to be scientific and organized. India therefore requires a value added mixed culture approach.

The second most important factor is the regulatory mechanism. There is a need to regulate our farming system and the agro-industry. Majority of our agro-industry is still disorganized. Agro-sector requires technology and skill up-gradation. There are about 1.8 million un-organized food processing centers. If these centers are provided adequate technology and skills, there will be tremendous addition of value in our food products. For each farm product, however, technology has to be identified, verified & refined and then transferred.

The third important aspect in the integrated agri-sector is the monitoring. In contrast to nutrition security, a very well maintained program, food sector remains largely unmonitored. A good monitoring system leads to better farm income, a good market potential and better quality of life for the grower. An innovative and integrated approach leading to sustainable quality food chain consists of a number of steps as shown in Fig. 5

Fig. 5: Steps in a sustainable quality food chain

The crux of the matter is to link the informal food processing centers to organized food processing centers with involvement of farmer, grower and producer to the market. Role of R&D and innovation in the food grid needs to be recognized and implemented (Fig. 6). Government remains a motivator by drafting policies and implement food and nutrition programs.

Fig. 6: R&D innovation in food grid in India

Role of R & D and academic institutions should be appropriately catalyzed to bring the technology to field level and ultimately value added food to the market. For innovation we need to deal with a tree involving bio-informatics, bio-pharmacy, bio-agriculture, bio-infra involving aqua life and the fisheries.

We are good in agriculture but very poor in infrastructure. There is an example from Vishakhapattanam, where the harvested fish is being transported in an auto rickshaw in a very unhygienic fashion. We have a long coastal line of 8000 km and we need to improve upon our infrastructure of storage, transport and delivery for healthy and economic food system. We have tremendous food losses and food wastage from farm to folk. Along with large silos, we need to provide localized simple storages for the harvested crop. Also, the food wastage needs to be minimized. According to an estimate, food wasted in the whole world can feed one billion hungry people across the world. In spite of the fact that milk is a highly perishable product. Kurien solved the problem through dairy movement. Amazing changes are likely to take place in climate and weather. Weather patterns may become common. Unpredicted and un-prevented rains in Chennai are example of change climate patterns in our atmospheric system. The country has to develop a reliable information system about weather forecast to the farmer. Communication in this context however needs to warn about the problem as well as provide the solution to counter it.

5. Research Development and Innovation

Production process in India lacks the inputs of R & D and therefore the innovation. Fig. 7 shows the individual company sales of Indian business enterprises and the growth curve of the same

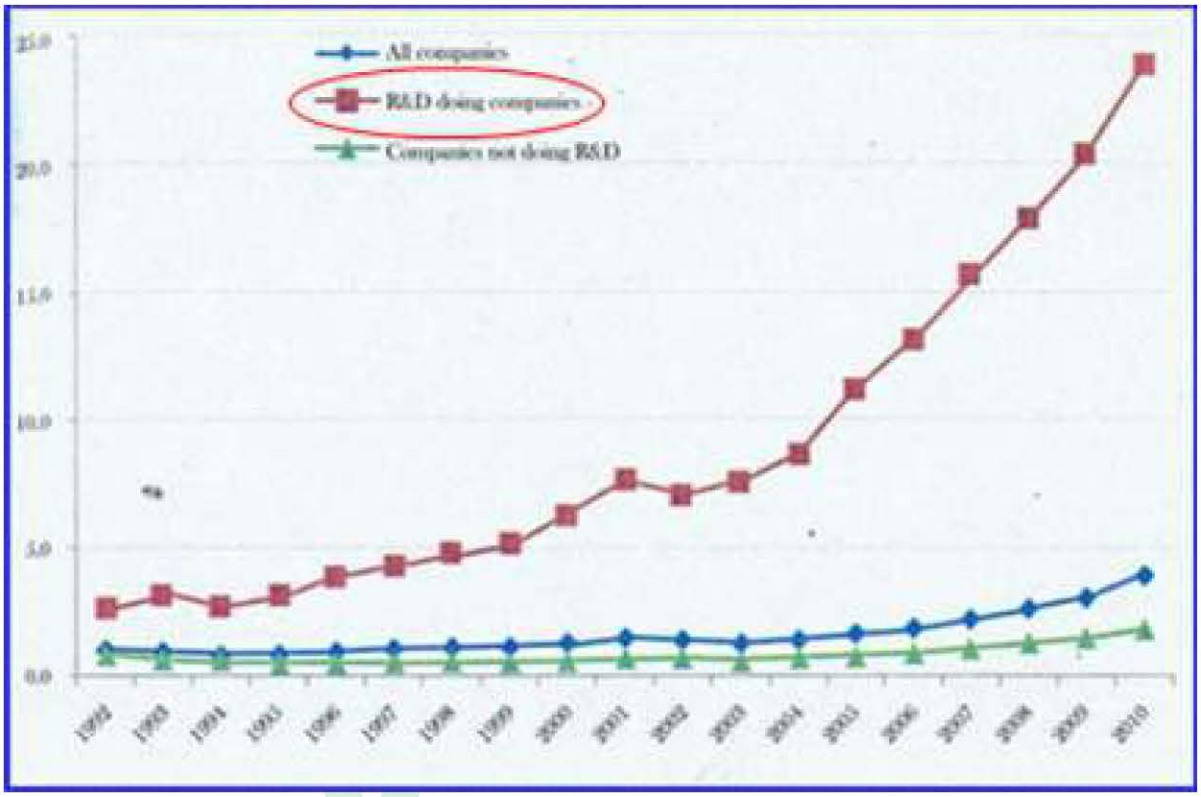

Fig. 7 Sales of Indian Business Enterprises which are involved in R&D and the ones those are not.

that are involved in R & D component and also those which are not involved in any R&D. Clearly the industries, who innovate in their products through the results of R&D, grow at a much faster rate than the other ones. The key to any productivity today is not only new ideas, new paths and new products but translational innovation. To a large extent today in the market both in the SME sector and global companies, more money rolls in and rolls out by incremental innovative Technologies (IIT). The IIT need not be a leap frog but follow the path of Delta Incremental Innovative Technologies (DIIT). DIIT makes a huge change in the risk taking by the team, gain consumer's confidence and acts like a turnaround in the business confidence of the "Start ups". Food processing Industry needs to be updated constantly about the new technologies for the market. Also very often process innovation becomes more important than product innovation. There may be many technologies in the market. But the technologies that have science and technology input have better chances for success. The role of science and technology is of very vital importance in any industry.

Has our country attempted to capitalize it fully? Perhaps India requires multi-models and not one single model fitting all. Also we may need to integrate this with translational innovation models in the food chain of reversing rural to urban Pan India. Raw product will come from the rural areas but the value addition happens in an urban area. In this context, I refer to a report of the FAO on losses and waste in the context of food (www.fao/fs/cfs-hlpe). In fig.8, a schematic representation is given about the definition of food losses and wastes along the entire food chain, where as Fig.9 depicts the causes of food losses and waste and the steps for prevention.

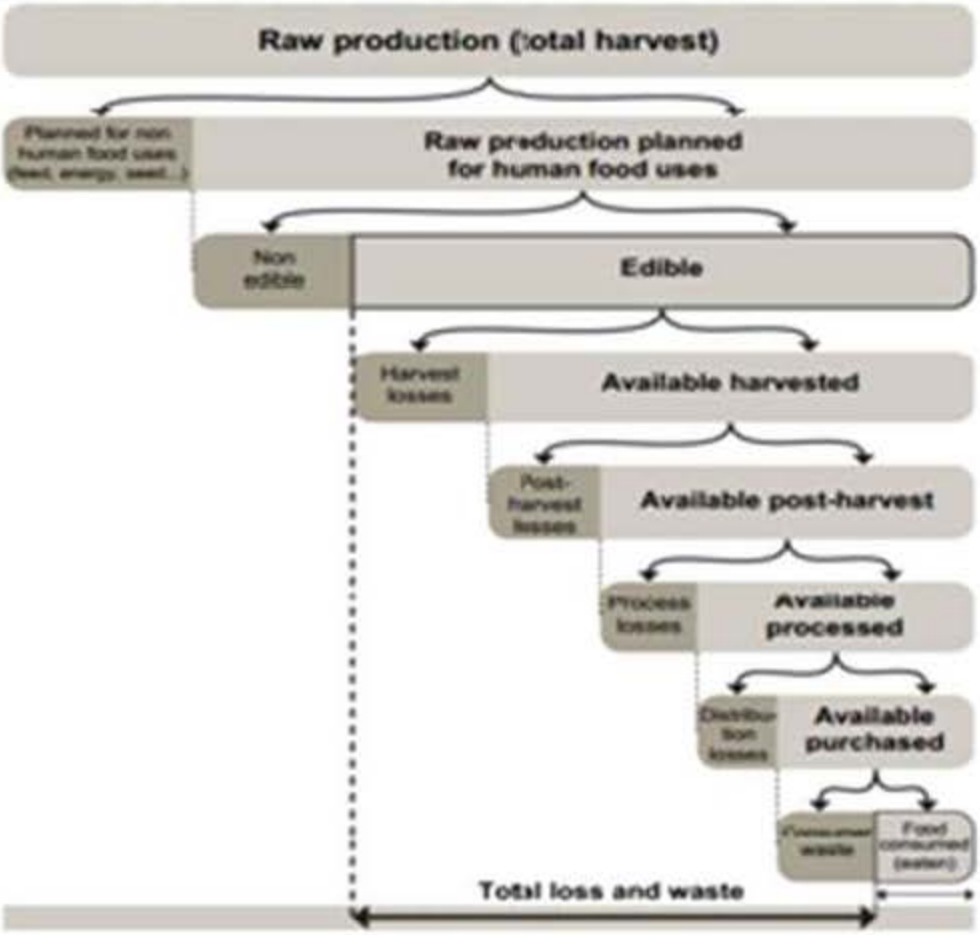

Fig. 8: Schematic representation of food losses and food wastage

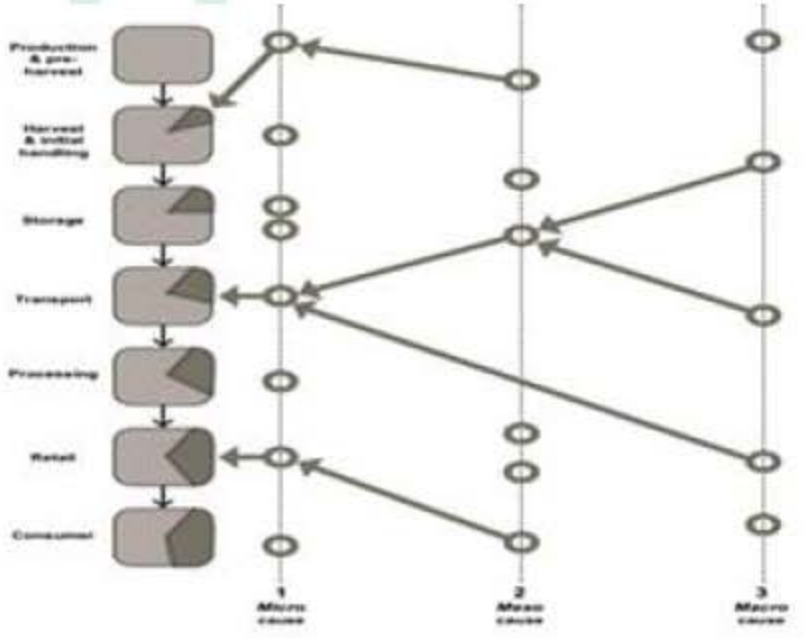

Fig. 9: Losses along the food chain and organization

6. Value Addition in Food Chain.

To get more value for food, it is important to have value addition in food chain through innovative adaptable, accessible and affordable technologies in small / cottage scale industries. Very often experience and science based approach inclusive of traditional distilled wisdom and societal informatics lead to innovation producing vital products with high market value. A few examples will illustrate this point. Fig. 10 shows the structure of rice. We use rice for the last ninety years without knowing that rice is a refined product. We remove the husk and eat the final product. Rice bran is a very important product in raw rice which yields rice bran oil. We had distilled it in our family.

Fig. 10: The lipid manager

Rice bran oil is India's olive oil. Over a period of time the process chain of producing rice bran oil is given in Fig. 11. However, the promotion of rice bran oil remains a bottleneck in India. Promotion of rice bran oil as healthy alternative to olive oil will increase the acceptability of rice bran oil as cooking oil in India. It will be a cheaper and better alternative.

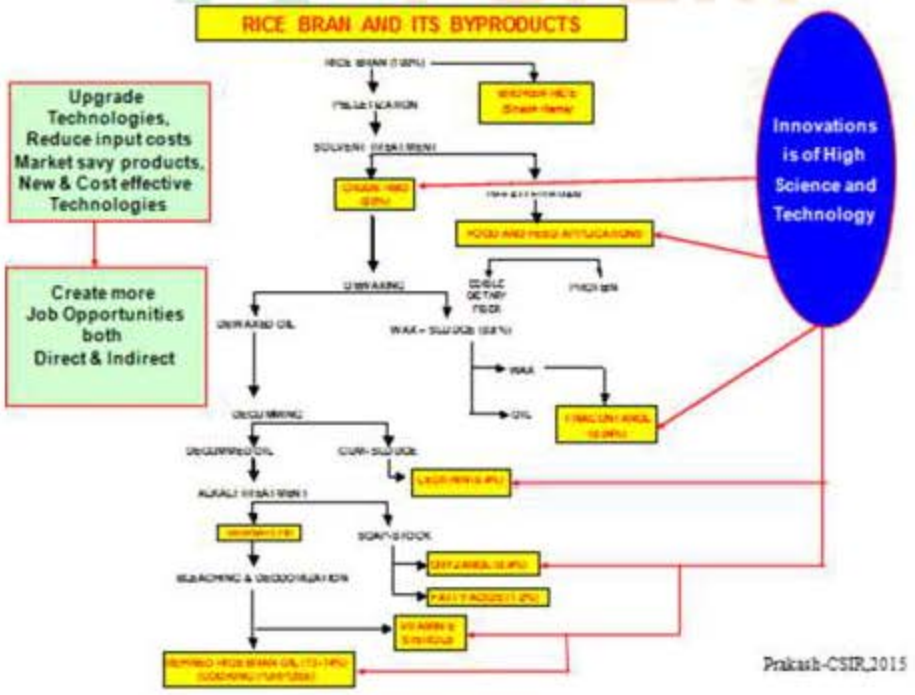

Fig. 11: Rice bran and its byproducts.

Another example is that of a wheat mill, which is a complex machine in large plants. Indians however, wants flour from a normal stone chakki and CFTRI Mysore, asked mill to introduce a chakki inside a mill of capacity of producing 200 tons/hr flour. Another big success story is our country is that of milk. Being one of the largest producing countries in the world, India's capacity will soon be 200 million liters per year. Every dairy equipment is being produced in India, that converts milk in to various value added products (Fig. 12).

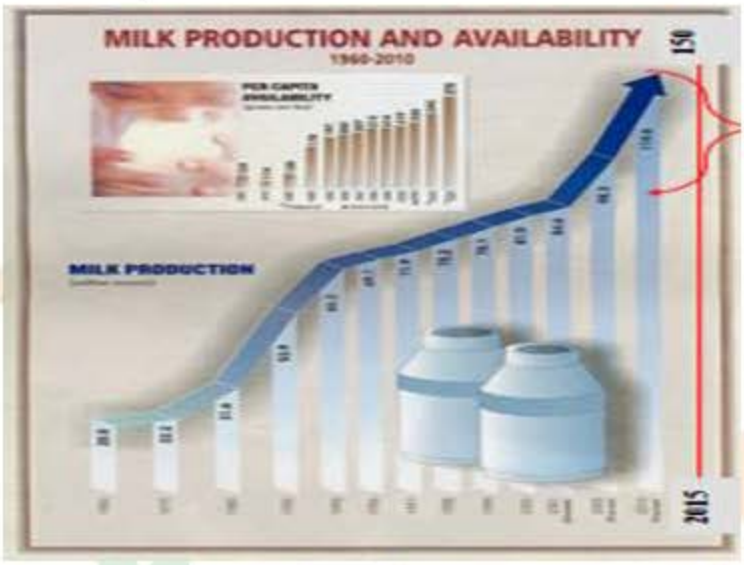

Fig. 12: Value addition is the key to induced milk production.

Our individual farmer is an innovator, in Bangalore a farmer used a solar panel driven milk extracting mechanism from a cow. There are several other innovation in our final processing like multi-chapatti making equipment for mid-day meals to school children, papad innovation momentum, a motorized motor roller for pan-cakes and chapattis, rice destoner (separating stones from rice) etc are various examples of innovation in small processing systems and processes.

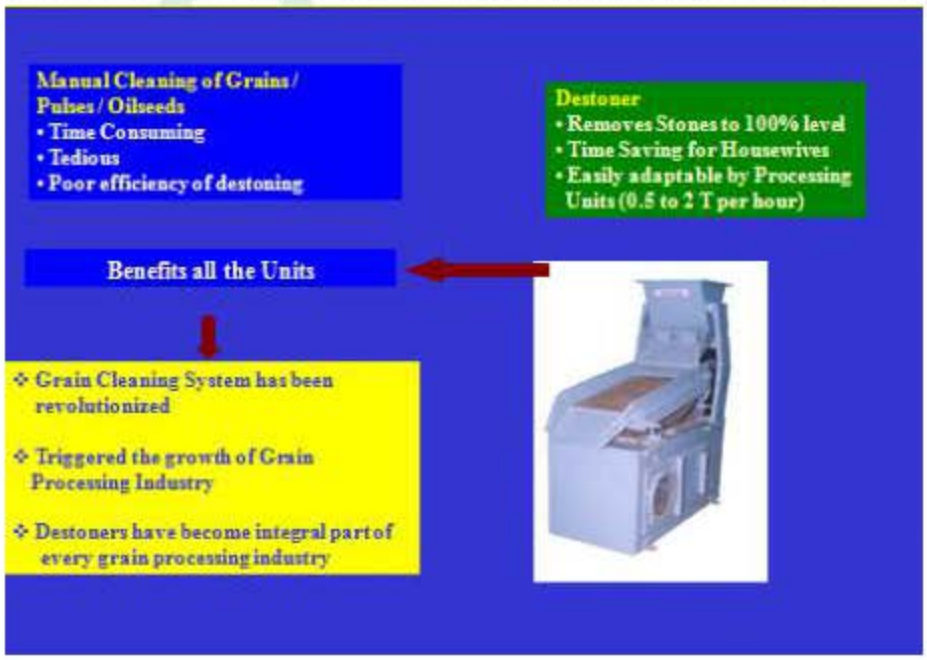

Fig.13: Rice destoner

Value Addition at Farm Level

There have been several examples of value addition at farm level in India and some need intervening policies. One desired practice is to introduce sustainable inter-cropping system so that pulses can be grown in Kharif season. Pulses can fetch higher prices than the grain (wheat & rice etc). Inter-cropping system may also include herbals with innovative farming providing still more income to the farmers.

7. Agri-food and Appropriate Innovative Technologies.

Agri-production and productivity has tapered considerably in our county, may be due to syndrome "Produce more – but also lose more" (quote from Dr. Ayyappan DG, ICAR). Public private partnership has made a great difference in this context at some places. However, PPP model combined with value addition can make a bigger difference and lead to double PPP, which means:

Produce: Process more

Process : Progress more

Profit : Promote more.

Using this model, emergencies of a crop holding can be avoided. Value addition "Mantra" should be right before harvesting, a year ahead and not after harvesting. Agriculture gadgets which are adaptable for moving the agri-products from land to processors and from land to production units (involving bio-engineering), and all the way, down. Perhaps value addition can be done on the deck of van using the richness of India in IT & BT. Focus should be on what needs to be done on a pilot scale so that replication and scale up is possible with incremental innovation.

8. Food Safety in the context of Food and Nutrition security.

With reference to our methods of growing & storage of food, the question arise as to "how safe is our food?". Food safety is an implied need and requires 100% assurance. Regulation is very important in this context. In the context of food safety there is a need to define risk, responsibilities, monitoring, consumer confidence and analytical challenges. Chemistry is becoming of permanent interest in developing analytical tools to measure food safety. We need to distinguish between fresh and processed, shelf life and safety, packed food and foods in restaurants and public places. We need to integrate our traditional food, ethnic food and herbal based food in integrity into nutra-ceuticals. There is an immense biodiversity of a few traditional and ethnic foods in many countries. I noticed during my tour to Sri Lanka, a ministry named as Ministry of Food, Nutrition and Indigenous food combined and integrated at the top level and have a paradigm shift towards rural , quality, process and policy along with and not just urban, quantity, production and technology.

9. Conclusions

In today's world of health and consciousness, we should also be alive about mental health, especially BMI may not be the correct indicator of good health, because this physical parameter can vary in a variety of physical attributes. One needs to be mentally healthy also to be physically healthy and vice versa.

In context of food and nutrition security, we have invented a word "Ayurceutical" combining Ayurveda with food and nutrition. Ayurveda is based on the belief that nothing is right for everyone and everything is right for some one. This belief comes from the fact that everyone of us is different

and unique, with different hormonal, enzyme levels and neuro-transmitter levels. There is therefore a need to design matching nutrition chart for each individual. Ayurveda, a 5000 years old science, evaluates a person's digestive system, nervous system and other systems of body function and body structure to design specific diet suited to the one's need. We need to further strengthen our traditional knowledge of herbs, food and nutrition for physical and human health of our citizens.

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FOOD SECURITY AND OPTIMAL NUTRITION

Prema Ramachandran.

1. Introduction.

For generations, important people in the food chain of India starting from food grower, food processor and marketer have helped to supply adequate food to match demand in the country. Otherwise, it would not have been possible for India to grow sufficient grain, milk and horticulture products not only for domestic consumption but also for export. However, we need someone to answer the legitimate questions of the grower, like shifting of country's goals and objectives frequently. Fifty years ago, we were told to grow grain and now we are told to grow pulses and vegetables. If we, the policy makers, fail to answer their questions, then we may expect a response as to why should we agree to changing goals of yours. So we need to inform the grower timely about the Nation's goals and objectives regarding food security.

As healthy and informed citizens of this country, everybody takes care of providing food and nutrition to his/her household and family. We have been changing our nutrition parameters over the last three years. Earlier it was weight, then height and weight and now the related one the BMI (Body Mass Index). We have conflicting numbers. On one side India has maximum number of un-nourished population and on the other hand large number of obese people who are in danger of hyper tension problems. One can ask the question as to whether we are considering right parameters to define nutrition, mal-nutrition and over-nutrition. However, with changing times from severe famine sixty years ago to self sufficiency in grain and rice, there have been changing definitions of food and nutritional security. Because of changing life style, physical activity of Indian people has decreased and there has been an access to inexpensive high fat, high energy food stuff. We need to define our parameter of food security and nutritional status as per Indian conditions. In any given community, persons from poor segments are shorter. But it may not be appropriate to make cross-country comparisons of stature. Indians being shorter than Caucasians doesn't mean that Indians are undernourished. In this presentation, therefore I would like to put the problem of food and nutrition security in right perspective.

2. Perspective

Before the year 1960, India was facing an extreme problem of food insecurity. Eighty per cent of Indians were poor, under-nourished and anemic. Morbidity and mortality rates were high with an average longevity of 35 years. Increasing food grain production and becoming self sufficient in food grains was given the highest priority. Through a grain revolution after 1970's there is a self sufficiency in food production. R & D has played a major role in this revolution. Nobel peace prize winner Norman Borlaug came to India in 1965 (after American green revolution) and introduced many high yield varieties of wheat and rice along with the use of chemical fertilizer and pesticides. Borlaug transferred the technology to us,. However adequate policies and implementation from lab to land have done wonders in India. The communication from a researcher to poor and illiterate farmer happened and this played a critical role in India's food grain economy. Indian government and experts conceptualized and implemented the interventions like:

- Irrigation and increased cultivation area.
- Land reforms to insensitive farmer for investing time and money.
- Fixed minimum support price in spite of objections of economist.

- Farm level procurement of rice and wheat.

This success is one of finest examples of what Indian can achieve when driven to a corner. Today we may call it "a mission mode Public-Private Partnership to achieve a national goal in record time". However, no one had heard of a mission mode at that time.

3. Storage for Improving Household Food Security.

The county's success to achieve self sufficiency in food grain, has thrown new challenges to India's food security. However the availability of food at the national scale has not ensured food to each household and nutrition to each individual. Our large population remains poor and spends more that seventy percent of their earnings on food and still seventy percent remain under nourished. Morbidity and mortality rates remain high. We need to provide need based food to every household through subsidized food grains and provide nutrition, health and family planning services. Access to cheap health care for treatment of morbidity will improve nutritional status in children.

India invested in comprehensive multi-sectoral interventions to improve food security, nutritional and health status of its citizens in mid 1970's. The world food summit in 1996 re-defined food security as a situation in which " all people at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active and healthy life. India's initiative of comprehensive intervention to achieve holistic food security, preceded the FAQ redefinition of food and nutrition security in two decades.

4. Newer challenges to Food Production

After green revolution of the 1970's and record production in food grains, Indian agriculture is showing fatigue with deteriorating soil health and nutrition. Besides unavailability of adequate quantity and quality of food to many millions India's requirement of pulses and vegetables has not been met for last few years. Having realized this fact, Government of India launched a National Food Security Mission in 2007 with the objectives of :

- Restore soil fertility and productivity
- Increase production of rice and wheat
- Enhance farm profits to insensitivize farmers to grow more food.

The impacts of the mission are visible by growth in India's food grain production and the projection that the country should remain self sufficient in food grain production till 2030.

However, the aspect of nutrition along with the food availability remains a concern. Pulses are major source of proteins in Indian diet. However, pulse production has remained stagnant for the last decade at 13 MT per annum. Fig. 1 shows the production trends for various food products since 1960-61. The production of pulses and oil seed shave remained at constant level since then.

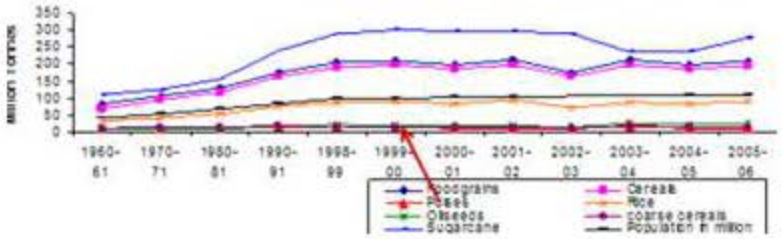

Fig.1: Nutrition orientation of food production programme: Pulse production

Due to limited supply of pulses and oil seeds, the cost of pluses and edible oil is rising beyond affordability and leading to reduced consumption in households. This year also, the availability of pulses has been low. However, under National Food Security Missions, pulse production has been increasing at a rate of 2 MT/w. With better weather forecast by the ministry of Earth and sciences, India should be self sufficient in pulse production (24 MT/a) by the year 2017.

Fruits and vegetables provide essential micro-nutrients and prevent deficiencies. Low vegetable consumption is the major factor responsible for widespread anemia and micro-nutrient deficiencies among a sizeable population in the country. True, many families can't afford fruits, but most of the time seasonal vegetables are cheap and easily available locally. Vegetables provide antioxidants, bioactive substances and fiber, which prevent over nutrition and non-communicable diseases. Balanced diet (food to food fortification) with cereals, pulses and vegetable prevent micronutrient deficiencies and NCD. The focus on production, processing and marketing of low cost nutrient rich vegetables, so that they are available throughout the year at affordable cost is essential. One should create awareness amongst affected population so that they can buy and eat more vegetables and achieve reduction in micro-nutrient deficiencies. India's initiatives to improve nutrition orientation in food production (10th Five year plan 2012, NHE & NFSM) preceded the FAO' s advocacy for nutrition sensitive agriculture (2013) by a decade (Fig. 2).

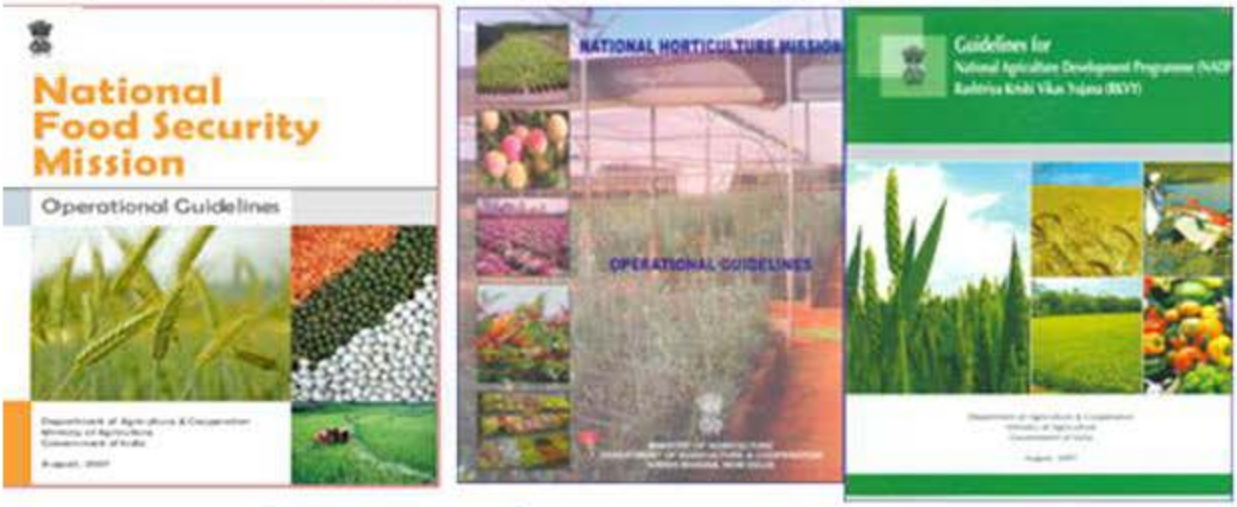

Fig. 2: National Food Security Missi

5. Food Security and Dual Nutrition Burden.

Developing countries are currently undergoing economic, social, demographic, health and nutrition transitions. The term " dual nutrition burden" was coined in the nineties to denote the phase of ongoing nutrition transition in low and middle income counties, characterized by persistent under-nutrition mainly among poorer segment of population and emerging problem of over-nutrition seen mostly among the urban affluent segments. Currently in India, under-nutrition and over-nutrition is observed in all segment of population. Micro-nutrient deficiencies are seen both in under and over-nourished persons from all segments of population.

In countries with increasing income, people have increased access to energy dense, high fat, high salt foods, increased energy intake and rapidly rising over-nutrition. In India increases in GDP was accompanied by a progressive reduction in energy consumption (Fig.3) . Only in small segments there was no increase in intake of energy & rich food stuff. The reduction in energy intake perhaps protected Indians from rapid rise in over-nutrition rates.

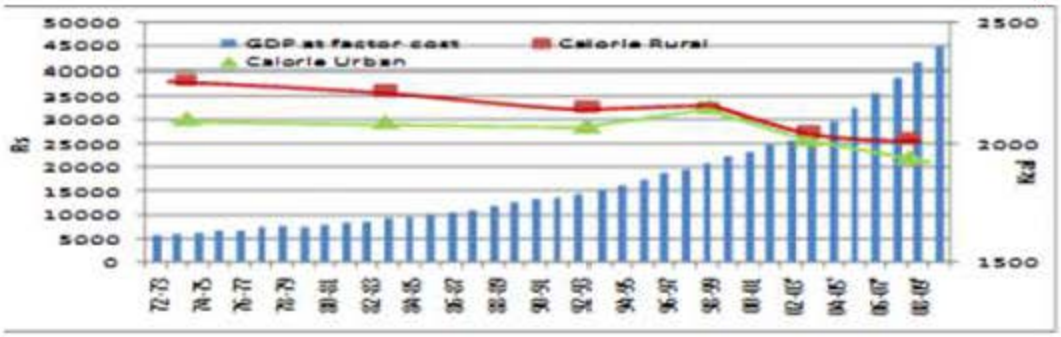

Fig.3 Unique Indians: GDP rise with decreasing energy intake

6. Impact of Poverty Alleviation Programme: Subsided Food Grain:

Cereals are the major source of energy. Over the last four decades, there has been a decline in cereal consumption (and energy intake) among the rich and increase of cereal consumption amongst the poor. (Fig.4).

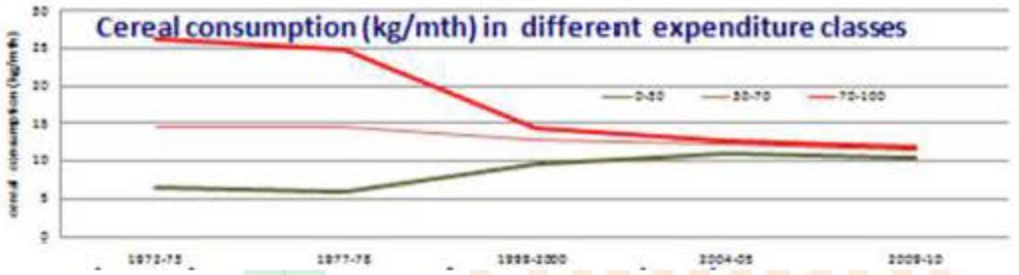

Fig. 4: Impact of poverty alleviation programme and subsidized food grains on cereal intake

From the year 2009-10 onwards, cereal intake is similar in all groups and is sufficient to meet their requirements. Prosperous Indians changed their cereal consumption before we changed the Recommended Dietary Allowance (RDA).

During the period between seventies and nineties, there was massive expansion of health infrastructure and improved access to primary health care. This resulted in steep fall in the prevalence of under-nutrition in under fives (U5) during this period (Fig. 5). However, Integrated Child Development Service (ICDS) project covered very few children. Hence, the fall in under-nutrition was mainly due to healthcare reducing the danger of mal-nutrition and the risk of infection.

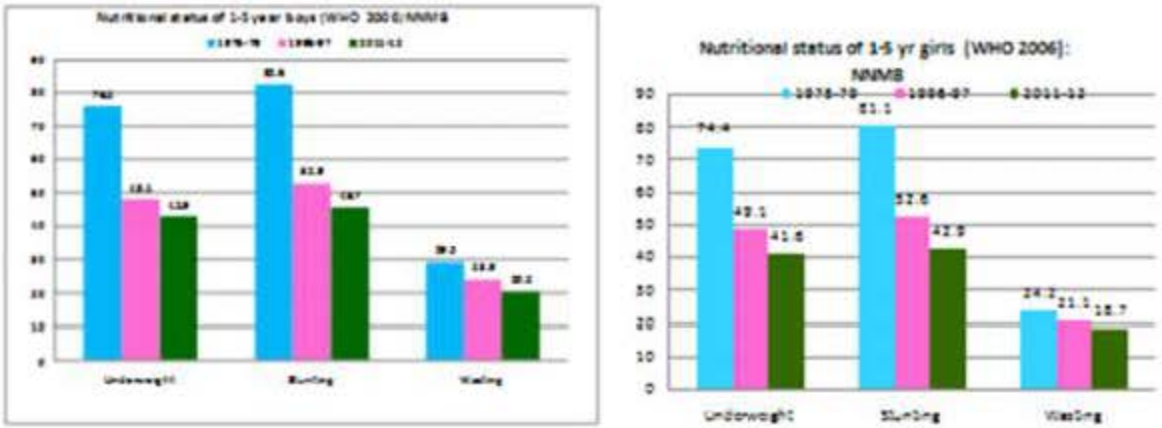

Fig. 5: Time trends of under-nutrition in U5 children

7. Physical Activity Patterns

Fig. 6 shows the relative time spent for different physical activities in the developed and developing countries. While there is a dominance of occupation and domestic related physical activity in developing countries, the discretionary physical activity is dominant in the developed courtiers

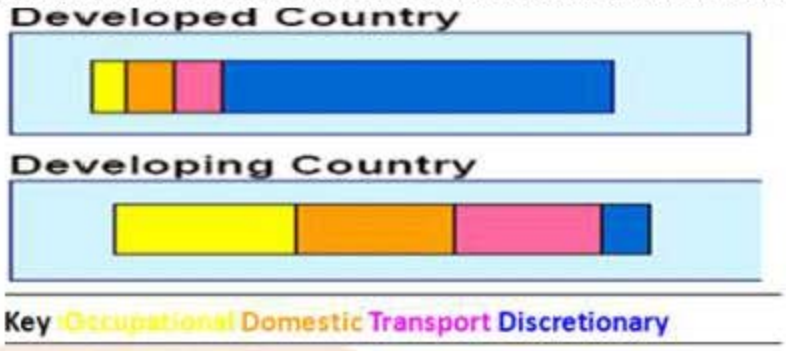

Fig. 6: Physical activity patterns.

Indians used to spend a lot of energy in occupational activities and domestic chores. Also they used to walk from one place to another without mechanized transport. The life styles have however changed and there is a trend of Indians becoming increasingly sedentary. Over the last two decades, there has been progressive increase in mechanization of transport, occupational and household activities. Consequently, there has been a reduction in physical activity and energy needs in both urban and rural areas and even among the poor. Moderate physical activity is essential for good health. Efforts are underway to build awareness on importance of

physical activity and create conducive environment to increase discretionary physical activity among all segment of population.

8. Trends in nutritional status of women

Data from National Nutrition Minority Bureau indicate that here has been a slow but steady decline in prevalence of under nutrition in both men and women (Fig.7). Since the Nineteen nineties there has been a slow but progressive increase in over-nutrition heralding the duel nutrition burden era.

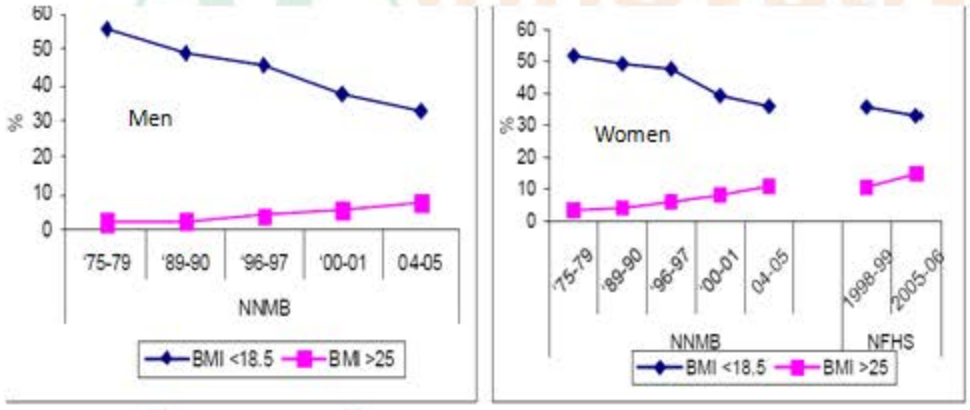

Fig. 7: Trends in nutritional status of women

Fig.8 shows the emerging problem of over-nutrition in the world. India is still among the countries with least prevalence of over-nutrition. The country should strive to maintain this current position and prevent escalation in the risk of NCD.

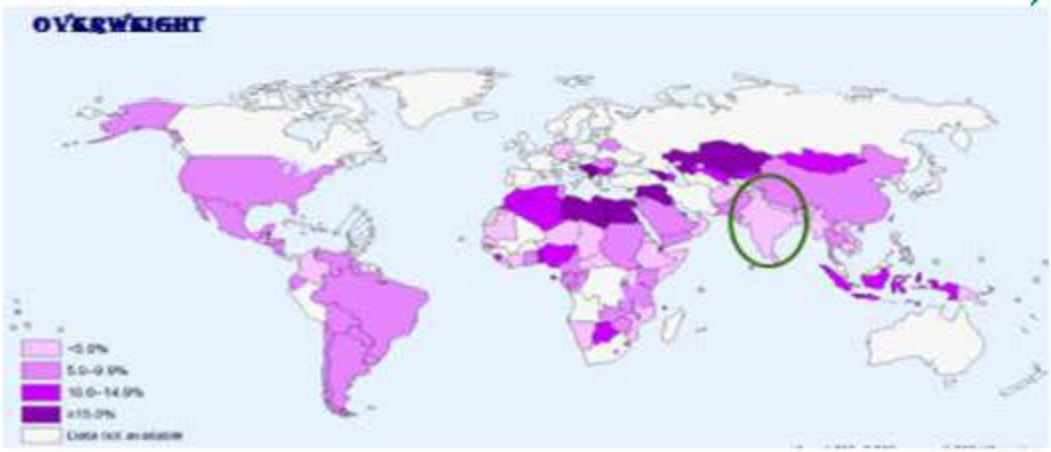

Fig.8 : Emerging problem of over-nutrition

However, inspite of a good average scenario, there has been slow rise in over-nutrition amongst Indians, 80 million Indians being overweight. Indians with more body fat are prone to abdominal adiposity and metabolic syndrome. NCD in Indians can start at an early age even at lower BMI. Obesity and associated risk of NCD, can lead to escalating health care costs, unaffordable to individuals, families and the nation. Fig. 9 shows that in comparison to 1990, the non-commercial life style based diseases will increase to 57%. In the 1990s communicable diseases and NCH (haemoglobin) accounted for over 50% of disease burden in 2020; whereas in the 2020s non-communicable diseases (NCD) will account for 50% disease burden. NCDs occur at an early age in Indians and require lifelong expensive treatment

Fig. 9 : Health Implications of rise in obesity

9. Assessment of Nutritional Status in Dual Nutrition Burden

In the current century, over-nutrition and adiposity are emerging public health problems right from the childhood. Lack of physical activity in all segments and high calories intake in some segments have been the major causes for over-nutrition. Tools used for the assessment of nutritional status now include dietary intake and physical activity measurements. From weight and height measurements BMI is computed and used for assessing current nutrition. Wherever possible amount of body fat is measured and its location assessed in over-nourished children. Usual a handy balance and height measurement equipment can be used to assess BMI (wt/ht2) using a mobile. WHO (2006) has described the nutritional intake requirement in children with low BMI, normal BMI and high BMI (Fig. 10).

Fig. 11 shows the three women, tall and low BMI, normal height and normal BMI and short and high BMI. When under-nutrition was the only problem weighing was sufficient to assess nutritional status of individuals. However in the dual nutritional era, height and weight both have to be recorded to calculate BMI.

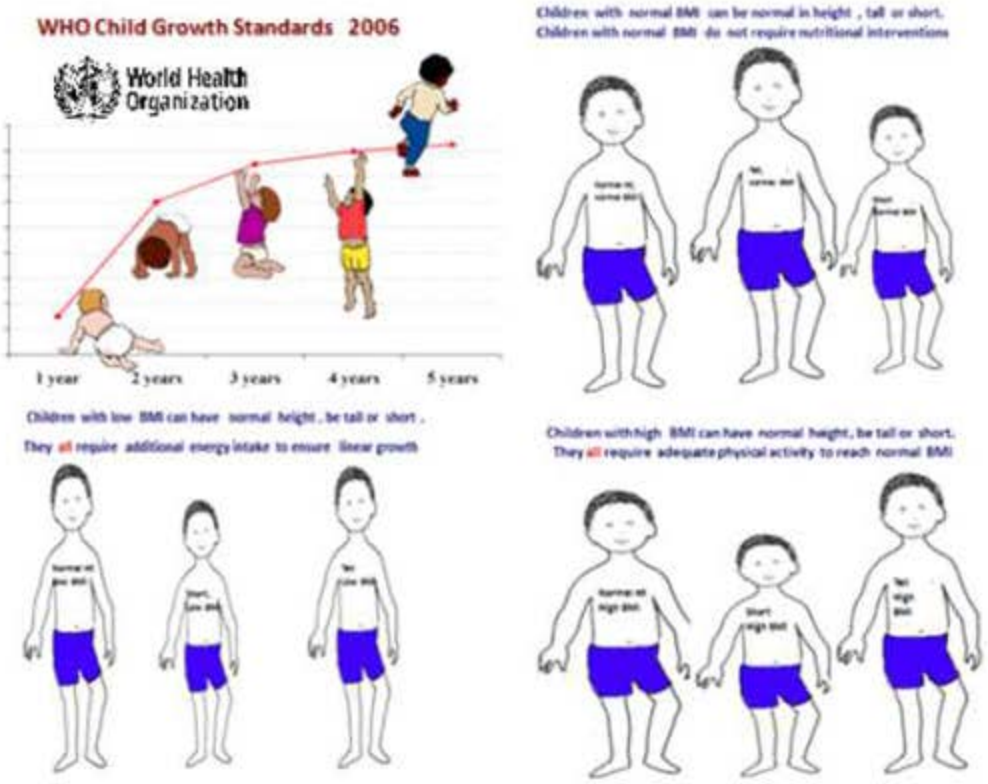

Fig. 10: Children with normal BMI don't need nutritional intervention: children with normal BMI may be normal height, short or tall

Fig. 11: Assessment of nutritional status in dual nutrition burden era

10. Right Parameters to Monitor Food Security.

FAO and all countries monitor performances regarding food security using select process and outcome indicators. Major indicators used are self sufficiency in food production, economic growth, poverty alleviation and freedom from hunger. All these parameters correlate food security. With respect to nutrition security, one measures nutrition in infants and under five mortality and also under-nutrition in pre-school children. Relation of nutrition security to food security is not direct. Very often, good nutrition also depends upon good health care.

Under nutrition in under-five children is a very important indication for food security. Stunting, underweight & wasting in India are amongst highest in the world. This leads to India's low ranking in nutrition reports. All around the world, 178 million children under the age of five are stunted. Stunting and underweight rates, in pre-school children in India, are similar to sub-Saharan Africa. However, under weight and stunting are not associated with any functional deficit. In India, one third of infants are born with low birth weight (weight <2.5 kg) and wasting (<2.SD of the weight for age) and one fifth are stunted at birth. Size at birth is a major determinant of growth in childhood and adolescence. High stunting and underweight rates in low weight infants at birth, who grow along their trajectory, are not due to food insecurity or chronic energy deficiency. Poor infant care and feeding practices are common causes of stunting and underweight and not the food insecurity in these households.

Majority of Indians are iron deficient and anemic. Though there is no decline in prevalence of anemia but severe forms have nearly been eliminated. Micro-nutrient deficiencies especially anemia is the most common deficiency globally and also in India, but these are not included under food insecurity indicators. Government of India has Iron Plus initiative to combat anemia through increased intake of iron through vegetables, IFA supplement in vulnerable groups and detection and treatment of anemia in pregnant women. Key to success is however effective implementation. Some of the measures and recommendations are given in Fig. 12.

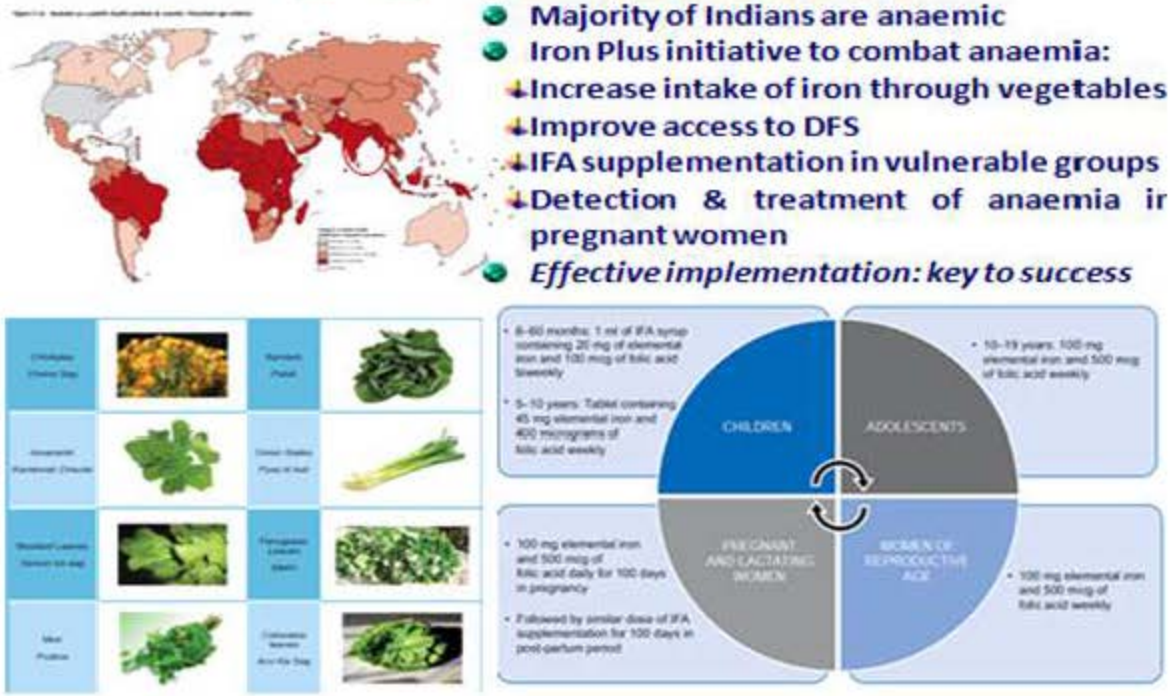

Fig. 12: Combating anemia: Iron plus initiative

11. Conclusions

India is self sufficient in food grain since the 1970s. There have been steady improvements in poverty reduction and per capita income. The government schemes, like MGNREGA provides employment. Public Distribution Systems (PDS) is available to all with NFSA providing subsidized food to two third of population. There are some massive food supplementation progammes like ICDS and MDM. Access to primary health in India is universal. Therefore, India's performance in providing national household and individual's food security is good and will improve over the next fifteen years.

However, stunting and underweight numbers in U-5 children in India are high. But this is not related to household food insecurity. High LBN, stunting and underweight in India are not associated with adverse health effects such as high morbidity and mortality. Reduction in the number of stunted and under-weight children are taking place and will continue though slowly.

One in six Indian children and a third of young adult are thin. Early detection and management will reverse wasting & prevent stunting in children. Detection and correction of wasting in young adults will improve work capacity and in women improve birth weight of the offspring.

In India, prevalence of over-nutrition is still low. Nutrition and health professionals and awareness in population will strive to prevent the projected rise in over-nutrition and NCD. Indian population is green and will remain so. Majority in India is normally nourished and they will be adding to the number of years of health & good quality of life.

Innovative Thought Forum

ENERGY IN FOOD INDUSTRY

N.K BANSAL.

1. Introduction

World's demand for food will increase substantially in the next decades due to increase in world's population form 7.1 billion in 2013 to 9.6 billion in 2050 (UN 2013, Nellemann et al 2009). Fig. 1 shows the projections of food demand in the world. It is observed that though all types of food, namely, cereals, vegetables, oils, meat and milk and dairy products will have an increasing demand; however there will be tendency to consume more dairy products, fruits and vegetables and meat. Though the quantities differ but the trends are identical and will remain same also for the developing countries also (Fig. 2). People in the developed countries already consume more meat, milk and dairy products (Fig. 3).

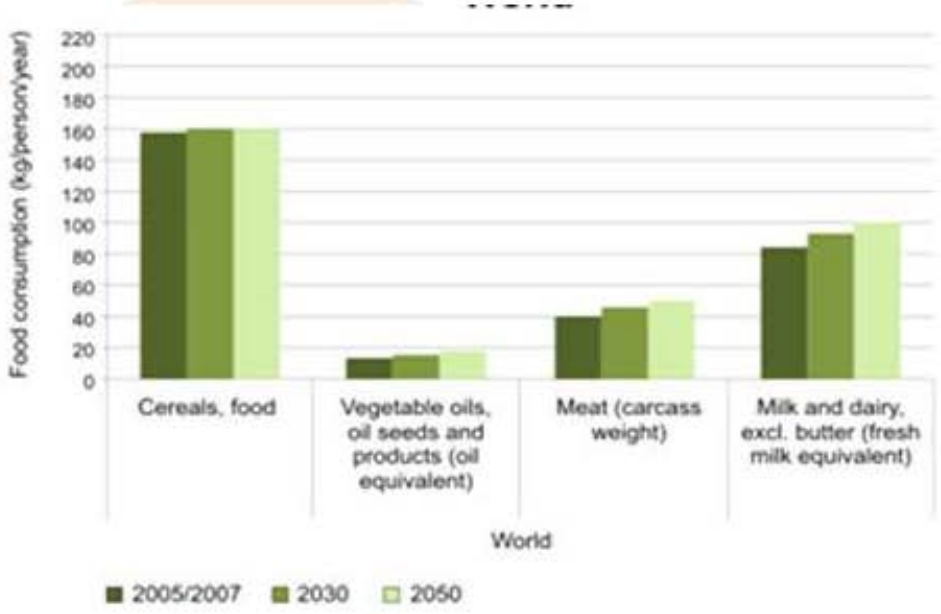

Fig.1: Projections of food demand in the world

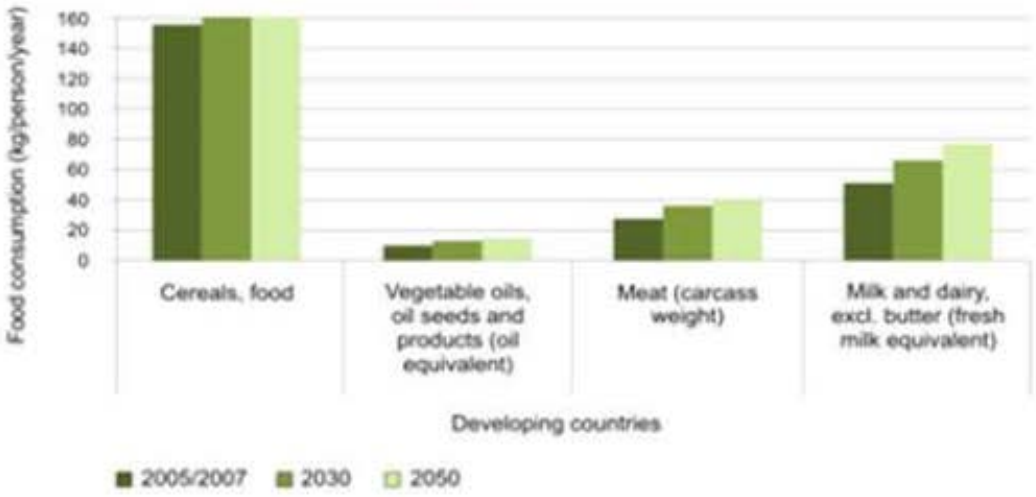

Fig. 2 : Projections of food demand in the developing countries

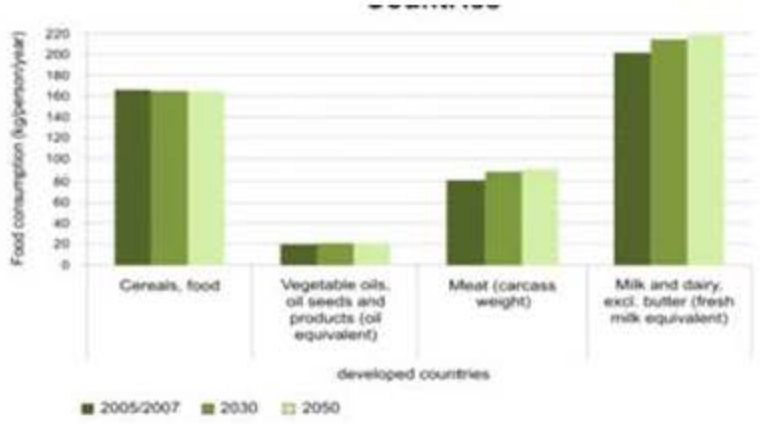

Fig.3: Projection of food demand in the developed countries

As India's population grows over 1.2 billion, the challenge of feeding her people also grows. Food processing industry which is said to be the sunrise industry of the Nation is positioned to be a vital part of providing adequate and nutrition food to the citizens. Food industry can play a central role in improving country's nourishment, since it is the first organized link between farm produce and shelf (FICCI 2013). India's food mix will continue to move away from grain and pulses towards more dairy, fruits, vegetables, meat and edible oils. Aggregate energy intake level, in this process, is set to increase. It is predicted that by 2030, global population growth and impacts of climate change will require increase in food production by 50%, energy demand by 45% and water by 30%.

According to FAO (2011 a), the agri-food sector currently accounts for, directly or indirectly, around thirty percent of world's total and energy use. The greenhouse gas emissions from agri-food sector amount to about 10 GT of CO2 equivalent per year, roughly 20% of world's overall emissions in 2010 (Oliver Janssens- Maenhout, Munteen & Peters 2010).

2. Energy in Food Production.

A precise accounting of energy consumed in food production and food processing is extremely challenging. Food is very composite entity and amount of energy required to bring it from farm to fork varies greatly, from one product to another. Even when considering the same type of product the energy consumption differs appreciably, reflecting changes in cultivation area, farming practices efficiency of processing and storage, season of production and/or consumption, transportation needs etc.

Food supply chain consists of several successive steps, each needing energy for specific purposes. Fig.4 shows various steps in the food processing and Fig. 5 shows FAO (2011) estimates of energy share in all the steps of food processing in general; for world's average as well as for high -GDP and low-GDP group of countries.

Fig. 4: Chain of steps in food processing

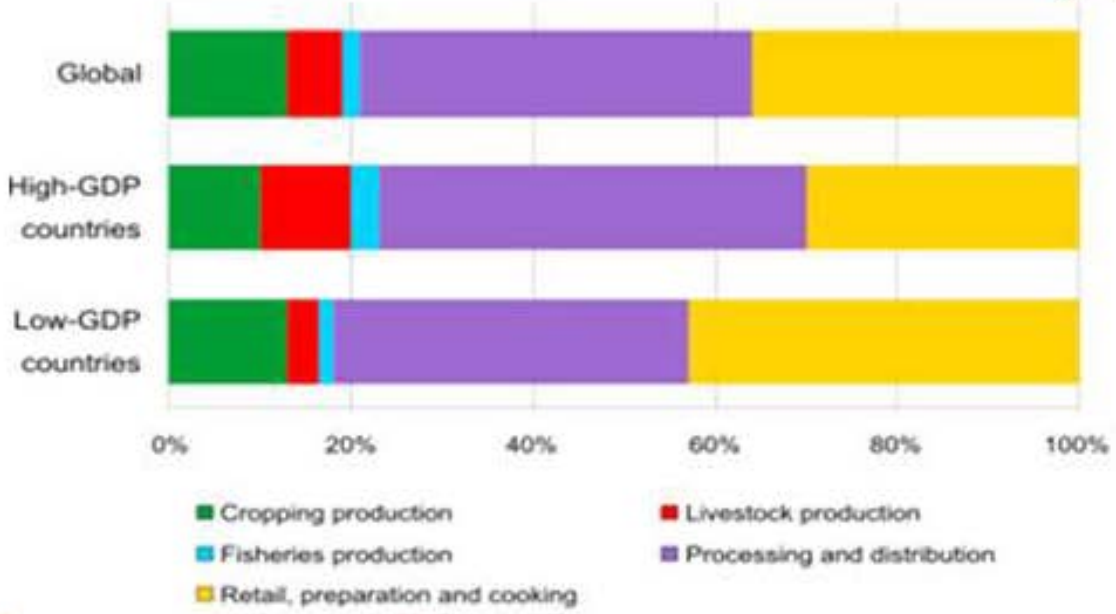

Fig. 5: Contribution of energy consumption in various steps of food production for GDP base group of countries

It is observed that the energy consumed in agriculture is almost the same in all countries, but the share of energy used for retail, preparation and cooking is considerably higher in low-GDP countries (about 45% in low-GDP and 30% in high-GDP of the total energy use). The embodied energy of the product is the sum of all energy inputs along the production chain. Embodied energy in food products not only accounts for direct energy use such as diesel and electricity, but also indirect energy contained in fertilizer and pesticides etc and the energy needed for transport and to operate irrigation systems.

3. Energy consumption in Indian Agriculture

The last seminar on Agriculture, I had discussed the energy consumed in producing various agriculture crops in India. The data about crop wise energy consumption is not available in India. However, a global picture has been discussed by Jha et al (2012).

Consumption of different commercial sources of energy in agriculture from the year 1980-81 to 2009-10, is shown in Table -1. It is noted that consumption of electricity increased sharply between 19880-81 and 2000-01 owing to rapid expansion of tube well irritation in Indo-Gangetic plains. After 2001, the increase has been increasing steadily between 1990 & 2000. Fertilizers and pesticides have been increasing relatively slowly, but the consumption of diesel increased steeply between the period 1990-2000. Source wise consumption of various energy inputs shows that total commercial energy input to India agriculture has increased from 425.4 x 109 MJ in 1980-81 to 3222.5 x 109 MJ in 2009-10. Consumption of energy per hectare of net sown area has increased from 3 thousand MJ to 22.8 thousand MJ during this period. Energy consumption for gross cropped area increased from 2.5 thousand MJ/ha to 16.5 thousand MJ/ha during the same period. This clearly indicates manifold increase in the energy intensity of Indian farms.

Table -1 : Commercial Energy use Patterns in Indian Agriculture (Jha et al 2012)

Year	Diesel (000 tonnes)	Electricity (GWh)	Nitrogen (000 tonnes)	Phosphorus &Potassium (000 tonnes)	Pesticides (000 tonnes)	Total Energy (10^9 MJ)	Energy Input 10^3MJ/ha	
1980-81	101 (6,579)	14,489 (1,72,863)	3,678 (2,22,892)	1,836 (17,650)	45 (5,400)	425.38	3.04	2.46
1990-91	318 (2,082)	50,321 (6,00,329)	7,997 (4,84,630)	4,649 (38,459)	75 (9,000)	1,169.43	8.11	6.24
2000-01	7,497 (4,90,863)	84,729 (10,10,816)	10,920 (6,61,764)	5,781 (57,284)	44 (5,229)	2,225.98	15.74	12.01
2008-10	11,212 (7,34,131)	1,20,209 (14,34,093)	15,580 (9,44,148)	10,806 (1,05,075)	42 (5,018)	3,222.46	22.85	16.52

*Figures in parenthesis indicate a common energy unit of MJ.

Increase in the energy input in Indian agriculture has significantly impacted the input cost of farming sector. Figure-6 depicts the relation between commercial energy use and gross value of agriculture output in real terms (2004-05 prices), which increased from Rs. 385.4 thousand crores in 1980-81 to Rs. 856.7 thousand crores in 2008-09. In the same period, total energy use increased from 425.38 x 109 MJ to 3222.46 x 109 MJ. Gross value of agriculture output per thousand MJ of energy declined from Rs. 9060 in 1980-81 to Rs.2788 in 1997-98 and thereafter remain stagnant with marginal fluctuations (Fig. 6). In view of the declining ground water table and increasing nutrient deficiencies in soil the direct and indirect energy requirement for sustaining current yields may increase further.

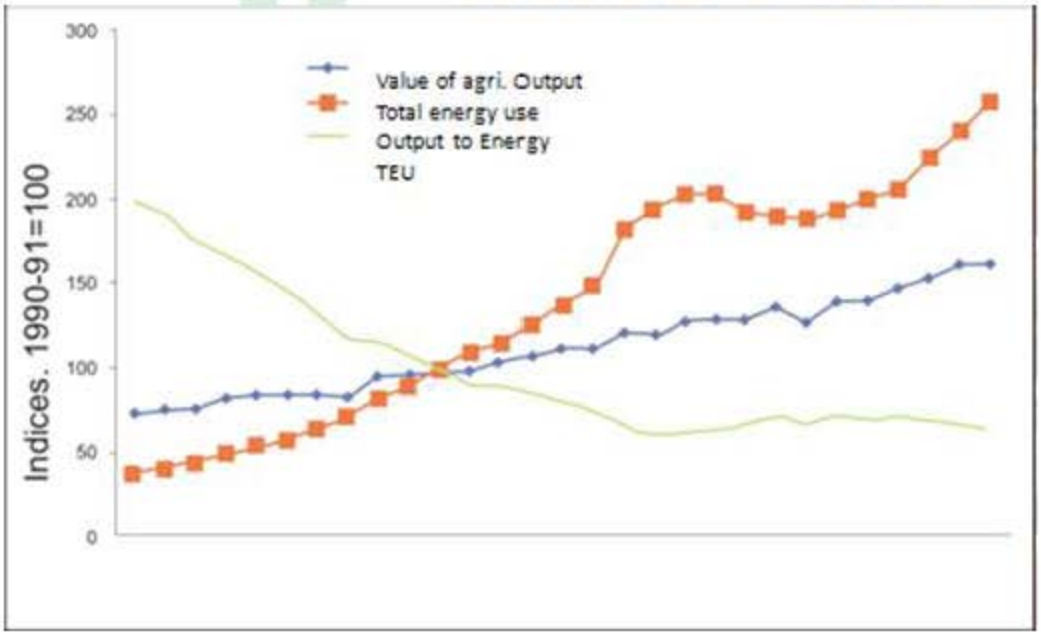

Fig. 6: Value of Agri-output and Energy Use in Indian Agriculture

In many states like Punjab, Haryana, AP, Gujarat and Tamil Nadu, farmers have installed large capacity pumps with automatic starters in view of erratic electricity supply. This results in over flooding irrigation and removing surface urea along with flowing water. When this water flows in to ponds and lake, there is algae formation endangering aquatic life. Also, in spite of the fact that fifty eight percent of Indian agriculture is rain fed. India already consumers more energy per hectare that the corresponding energy consumption in the industrialized countries (Table-2).

Table 2: Energy use Intensity for cereal Production in various regions:-

Region /Country	Energy consumption (MJ/ha)
Africa	756
Latin America	2588
Far East	3234
Near East	5740
All Developing countries	4032
USA	30034
Industrialized countries	13104
India	16520

4. FAO's Energy Smart food program (ESP)

Considering the importance of energy reduction in food production, FAO has started an energy smart food program with the following objectives:

- How should the countries carryout the energy analysis of agri-food chain?
- How much energy is currently used and produced by agri-food chain?
- How and to what extent can an energy smart food system contribute to energy access to the poor?
- How much improvement is possible in reducing energy consumption in the agri-food chain?
- What proven and implementable energy smart alternatives exist?
- Which energy smart systems are applicable to a given country context and how do they vary by scale?

Out of this ESF program of FAO, the first step is the Sustainable Crop Production Intensification (SCPI) program of FAO that avoids tillage, promote judicious use of organic and inorganic fertilizer, integral management of pests, diseases and weeds to reduce needs of pesticides and encourage water efficient management. All these practices contribute to reducing use of fossil fuels in agriculture.

Avoid Tillage and Practice Crop Rotations:

In a project in the Democratic People Republic of Korea, soil tillage was eliminated, permanent soil cover was introduced and crop rations were implemented to improve soil conditions. This led to reduction in fertilizer requirements and significant fuel savings.

http://www.fap.org/ag/ca/doc/workpaperkorea.pdf

Fertilizer Use

Biogas digester systems were introduced in Bolivia to produce organic fertilizer for farm use. The biogas systems were also used for household cooking and lighting. The results were increased crop productivity, improving livelihood of woman folk, improved household air quality etc.

http://www.vlc.fao.org/uploads/media/07_InformeGirasTechnicas_2_.pd.f

Pesticides

The need for insecticides and fungicides can be reduced through greater use of pest control methods based on principles of Integrated Pest Management (IPM)(FAO 2011b.). In this farmers grow mixed crops of direct seeded maize, hyacinth bean and pigeon pea. This system produces good surface mulch, so that the weed management can be done by hand without using any herbicides. Every few years fields are rotated into wheat. The average maize yield increased from 1 ton/ha to 6 ton/ha. Livestock manure was used as fertilizer.

5. Energy in Food Processing in European Union: JRC food basket.

Since there is no data about energy consumption in food processing in India and lack of authentic studies in this area, it has been found useful to illustrate the methodology and results of energy consumption in food processing of various products assessed by a Joint Research Centre (JRC) of the European Union (Monforti-Ferrario et al 2015).

Different food products need very different amounts of energy per unit of mass depending upon their nature, their origin and the kind of processing they have been subjected to. Refined products and products of animal origin generally need an amount of energy several times larger than vegetables, fruits and cereal products.

While the EU has made important progress in incorporating renewable energy across the economy, the share of renewable in the food system has relatively remained small. Renewable in EU food production accounted for just 7% of energy used in food production and consumption in 2013.

In order to general estimates of energy in food production through the entire life of the product it is essential to define a "reference" EU food basket. The basket can't be too detailed so the analysis could be performed within reasonable amount of time and resources. JRC basket's representative products for each food category are based on the following methodology:-

- Products consumed in large quantities should belong to the potential food basket.
- One preferably should have prior knowledge of embodied energy and GHG emissions
- Products whose consumption tend to be increasing in the last ten years (for example frozen food, precooked meals).

Table 2 shows the seventeen products as the most representations for the nutrition basket of the EU. The group of products in this table consists of 61% of the total consumed food in the EU -27.

Table 2 : Products of the JTC Food Basket

Product Group	Basket Product
Meat & Sea food	Beef, Pork, Poultry
Dairy products	Milk, cheese, butter.
Crop based products	Olive oil, Sunflower Oil, Sugar
Cereal based products	Bread
Vegetables	Potatoes
Fruits	Orange, apples
Beverages	Coffee, mineral water, beer
Processed meals	Meat based meals.

5.1: Energy Flows & GHG Emissions

A details analysis of the overall environmental impacts of the JRC food based has been developed through the LCA of each product (Monforti-Ferrario etal 2015), following a harmonized methodological framework.

System boundaries consider a cradle-to-grave approach; for each stage of the life cycle, the authors developed the process-based life cycle inventories for the selected representative products. For each product, system boundaries include the agricultural and production stage, the packaging production and disposal, the logistics – including international trade, domestic distribution and retrial. In particular, to assess the impact of retail, the following assumptions were made: product is purchased in a large store; the energy consumption of the store is allocated to the various products according to their weight (Nielsen e at, 2003); for products that require a refrigerated storage the electric energy consumption is evaluated on the basis of the volume occupied (considering the specific weight of the products) and the time spent in the store (EPD, 2012); the losses occurred in the shop undergo a waste treatment which, therefore, is charged at retail. Food losses throughout the life cycle have also been accounted for.

The production chain has been divided into six parts, each considering one or more stage (see table 3)

Table 3, Production parts and stages of food production chains

Production Parts	Production Stages
Agriculture / breeding	• Cultivation of crops • Animal rearing • Food waste management(relevant part)
Industrial processing	• Processing of ingredients • Slaughtering, processing and storage of meat • Chilled or frozen storage • Food waste management (relevant part)
Logistics	• International transport of imports • Transport to manufacturer • Transport regional distribution centre • Distribution • Transport to retailer • Retail • Food waste management (relevant part)
Packaging	• Manufacture of packaging • Final disposal of packaging
Use	• Transport of the product from retailer to consumer's home • Refrigerated storage at home • Cooking of the meal.
End of life	Final disposal of food waste. Wastewater treatment.

Special care was given to assessing the quality of data used in the study on the basis of the following parameters, developing a 'pedigree' data matrix:

- Time-related coverage: age of data;
- Geographical coverage: geographical area from which data for unit processes has been

collected;

- Technology coverage: specific technology or technology mix;
- Completeness: type of provided flow;
- Consistency: coherence of data with the methodology and assumption of the study.

Fig.7, shows the amount of energy embedded in the JRC food basket in units of MJ/per EU citizen, broken down for the 17 products and their production steps. Fig.8 shows the same data per kg of product.

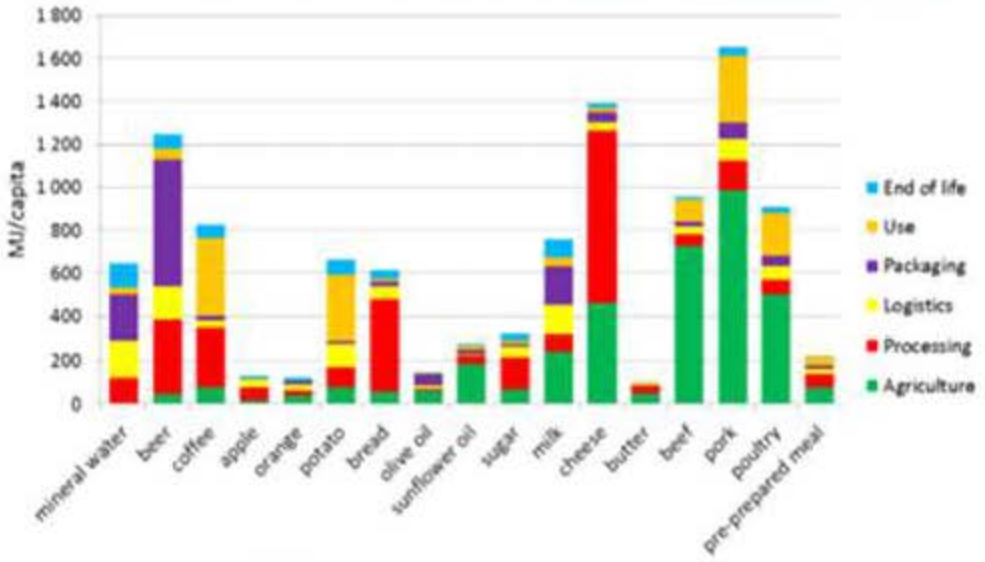

Fig. 7: Per capita embedded energy consumption in JRC food basket's products

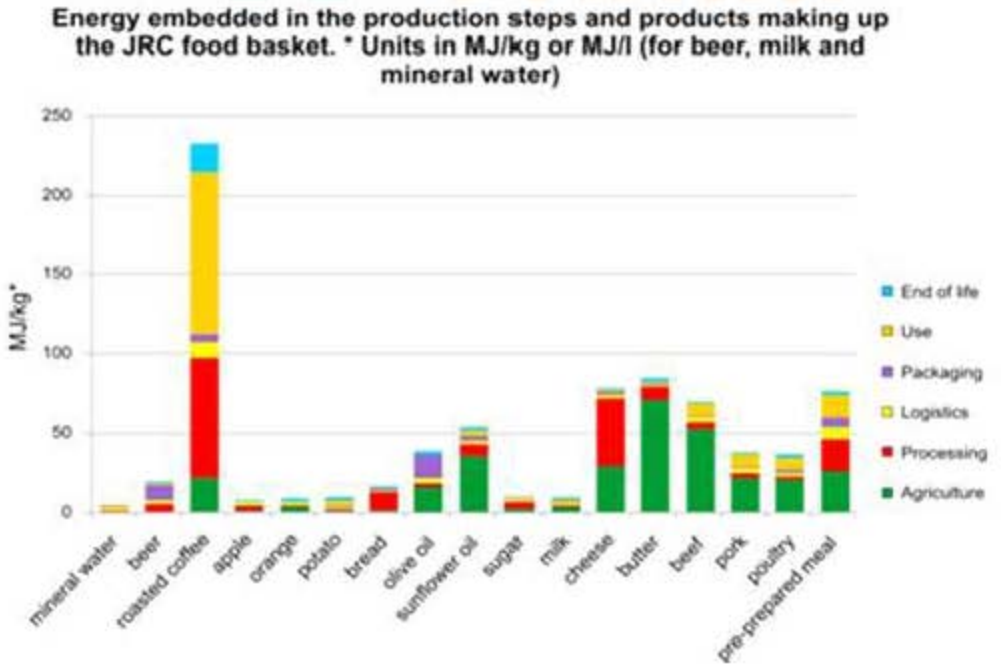

Fig. 8: Energy consumption per Kg or per litre for various food products in JRC food basket

Fig. 8 confirms that livestock and dairy products (except milk) incorporate a substantial amount of energy, while vegetable and bread are less energy intensive per kg of the product. Data for coffee represents the stage up to grain or powder as the final product. Fig. 9 shows the share of energy embedded in a kg of each of the 17 products and along the different production steps. The relative weight of products in each production step is very different in different products. For instance, the relevance of the agriculture step (including livestock raising) for meat and dairy related products is overwhelming, while packaging plays an important role in the bottled products like milk, oil beer and mineral water.

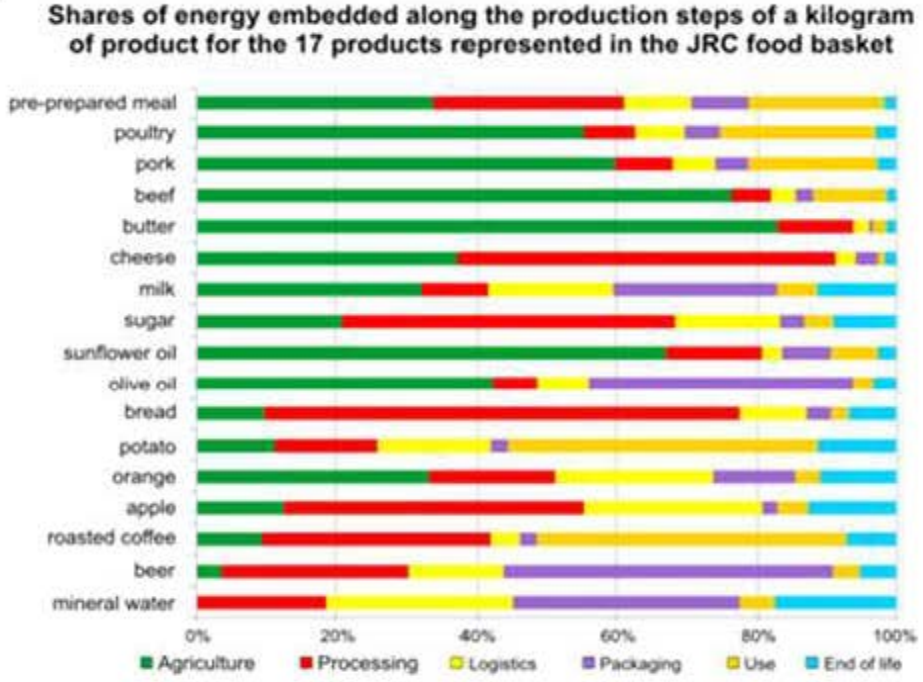

Fig. 9: Percentage share of embedded energy along the production steps of a kilogram of product in the JRC food basket

Fig. 10 shows the GHG emissions related to the whole life cycle of the products in the JRC food basket again in units of kg CO2/kg and kg of CO2/EU citizen. It is to be noted that emissions from agriculture are particularly significant to for dairy and meat products; agriculture emissions account for 73, 81 and 71%for milk, butter and cheese respectively. In the case of beef, pork, and poultry, the respective GHG emissions are 95%, 84% and 84%.

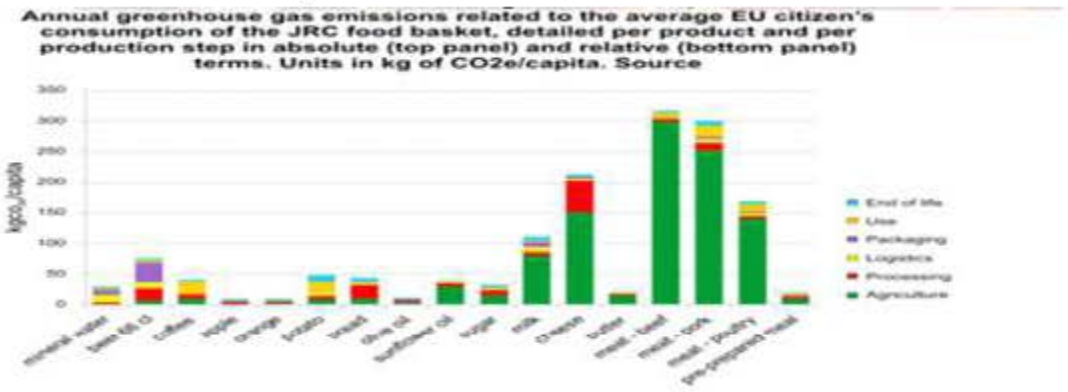

Fig. 10: Annual greenhouse gas emissions related to EU's citizen consumption of JRC food basket detailed per product and production steps

Fig. 11 also shows the results of energy analysis in terms of average energy embedded in the food consumption by each EU citizens, including the amount of energy loss in food wastages.

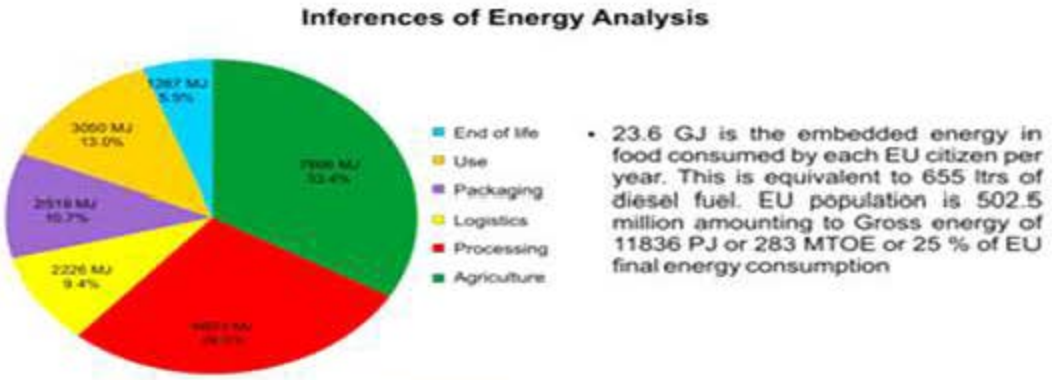

Fig.11: Embedded energy in each step of 1 Kg of food production of an average EU citizen

From Fig. 11, it is inferred that 23.6 GJ is the embedded energy in the food consumed by each EU citizen per year. This is equivalent to 655 liters of diesel fuel. Population of EU being 502.5 million, the gross energy use for food production in EU come out to be 11836 PJ or 283 M to E of 25% of EU final energy consumption. One also infer that

- One third energy is embedded in agriculture (livestock, breeding, and waste management) and about a quarter in industrial processing.
- Industrial processing, logistics and packaging consume about half of the total embedded Energy.
- Agriculture and logistics consume about 60% of the bulk being supplied by fossil fuels.

With respect to greenhouse gas emissions therefore, the maximum emissions are from EU agriculture followed by processing, logistics, packaging, use and end of life (Fig. 12)

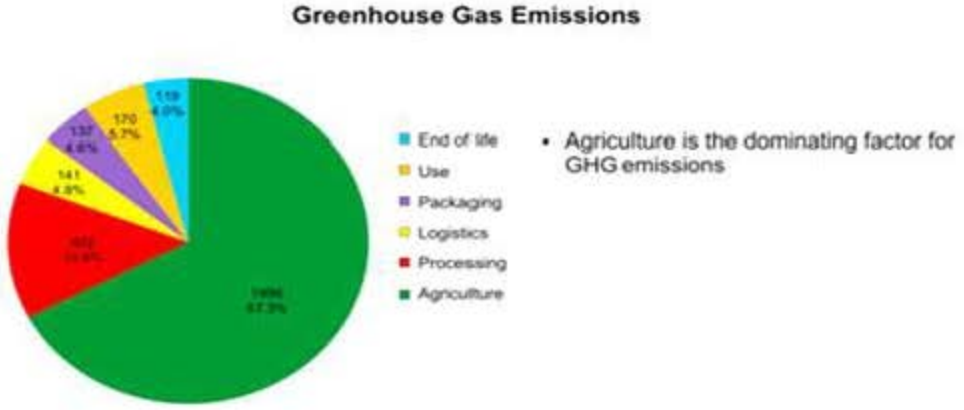

Fig.12: GHG emissions during various steps of food production.

6. Energy Efficiency in EU Food Production

Obviously, with the dual aim to use less energy and also contribute to reduction in GHG emission, it is desirable to reduce energy use in EU food. Above a certain threshold, increase energy

consumption does not necessary translate in to increase in yield. Woods et al (2010) have demonstrated the overall non-linear relationship between energy inputs and yield, Wood et al have also shown that too small energy input may lead to a very small yield and lead to an overall higher energy demand per tonne of harvested crop. A proper balance has to be found from case to case basis. Following key steps may be helpful in reducing energy inputs in agriculture.

Optimizing fertilizer production:

Use of fertilizer is the dominant energy contribution as indirect energy flow in agriculture. According to Fertilizers Europe (2014), the production of nitrogen based fertilizers commonly used in Europe requires 10-14 MJ/kg energy, depending upon the actual product. For urea, however, it is 23 MJ/kg. If the energy input is measured with respect to nutrient, then nitrate fertilizers need 40-50 MJ/kg of nutrient, while potash and phosphorous 5 and 0.35 kg of nutrient respectively. On an average nitrogen fertilizer production is 10 times more energy intensive than phosphorous and potassium. According to Ramirez and Worrel (2006), the full application of least available techniques guidelines in the fertilizer industry worldwide would lead to a decrease in the embedded energy in fertilizer of 19% globally. A physical limit for nitrogen fertilizer is a minimum of 24 MJ/kg. For immediate and min-term advantage one should avoid un-necessary fertilizer applications through well designed cultivation processes.

In heavily mechanized agriculture systems, use of machinery is a important direct energy input. Farm mechanization includes tractors, equipment for cultivation and planting and harvesters, together with equipments for irrigation, drying & storage.

Conservation agriculture as described in section 4 aims at reducing the energy and environmental burden related to farm mechanization, fertilizer applications and other energy intensive practices. Conservation agriculture includes significant changes in farm practices such as conservation tillage or no tillage, integrated pest management, weeds and water precision farming and controlled traffic farming (Euv Ag Eng. 2010).

Water use in agriculture is crucial. Many crops require intensive irrigation. Animal products and especially, beef are particularly water demanding; for example one kg of beef requires more than 15000 litres of water (Hoeksen et al 2011, Pimetel 1997). Intensive need for water provisions implies important energy needs. Studies have shown that improvement in irrigation system could lead to sizeable energy savings. Optimizing pump size according to peak and off peak water requirements could save substantial energy. Use of wide spread solar pumps could also save fossil energy for irrigation.

Food – Water – Energy Nexus

According to FAO (2014), agriculture presently uses 70% of fresh water withdrawals and is largest use of water. Also over the entire agri-food chain, the food production and supply chain consumers 30% of total global energy (FAO, 2011a). Green revolution achieved through the use of pumping groundwater, has enabled food security, it however also depleted water resources and aquifers. Food production has become vulnerable to energy prices, often resulting in farmer's vulnerability. A details study of food-water-energy nexus can help us to understand wider implications in their area and broaden the scope for interventions to include; water demand management, improved surface irrigation, irrigation technologies and agriculture practices.

7. Conclusions

Energy use in food production, food processing and food supply chain is a complex but important issue. With gowning burden of fossil energy related to the problems of greenhouse gas emissions, it will become imperative to choose our agri-system imports of fertilizer, machinery, water and energy in a rational way to reduce energy and environmental impact of the Indian food system. Detailed energy analysis will yield define policy guidelines to improve energy efficiency conserve resources and reduce GHG emission and help in the government's commitment to reduce carbon food print of the Indian agri-economy.

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FOSTERING INNOVATIONS AND SUSTAINABLE ENTERPRISES TOWARDS ACHIEVING FOOD AND NUTRITIONAL SECURITY: ROLE OF DRYLAND CROPS AND AGRIBUSINESS INNOVATION PLATFORM.

Saikat Datta Mazumdar.

1. Introduction.

The International Crops Research Institute for the Semi-arid Tropics (ICRISAT) is a non-profit and non-political organization that conducts agriculture research for development in Asia and Sub-Saharan Africa with a wide array of partners throughout the world. ICRISAT was established in the year 1972 with a vision to develop dry land tropics into a prosperous, food secure and resilient region. The mission is to reduce poverty, hunger and malnutrition and to control environmental degradation of dry land tropics. The institute was established in the year 1972 and it is a number of the consultative group on International Agriculture Research (CGIAR).The mandate crops of (ICRISAT) are sorghum, pearl millet, pigeon pea, chick pea and groundnut.

The strategy of ICRISAT is to catalyze an inclusive market oriented development (IMOD). Two basic parameters of ICRISAT programme are :

1) Access to inputs and market opportunities and

2) Prosperity.

The programme therefore envisages to substitute subsistence by market oriented innovative product and aim at high value agriculture economy. The institution manages risks by providing social assistance to generate resilience for productivity. The three main elements of IMOD are (I) harness markets in ways that include the poor, (ii) reinvest gains in innovations that move small holders along the pathway of development and (iii) manage risks that are stumbling blocks for poor, building their resilience.

2. Innovation and Entrepreneurship

M. Porter's work on globalization stresses on Invention and Entrepreneurship and these are at the heart of national advantage. Innovation is the process of creating new goods and services that provide unique value for demanding customers who are willing to pay for that value. The Entrepreneurship (I+E) increase the rate of economic growth (Fig.1) and creates prosperity by :

- Increasing wages by creating continuous demand and competing for human capital, knowledge and resources,.
- Reducing unemployment.
- Connecting local economics to the global economy facilitating clusters and knowledge / technology transfer.

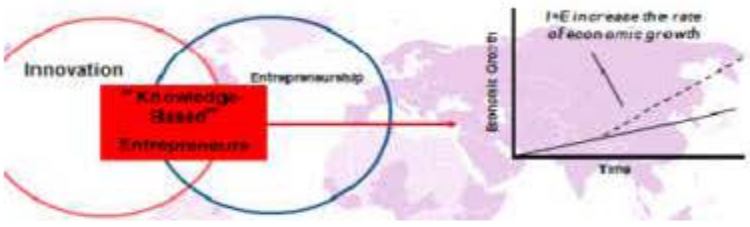


Fig.1: Innovation and Entrepreneurship increase economic growth

The stages of growth for a start up enterprise from idea to maturity are shown schematically in Fig. 2. Five stages of growth of any company show the need for incubation support during conceptualization.

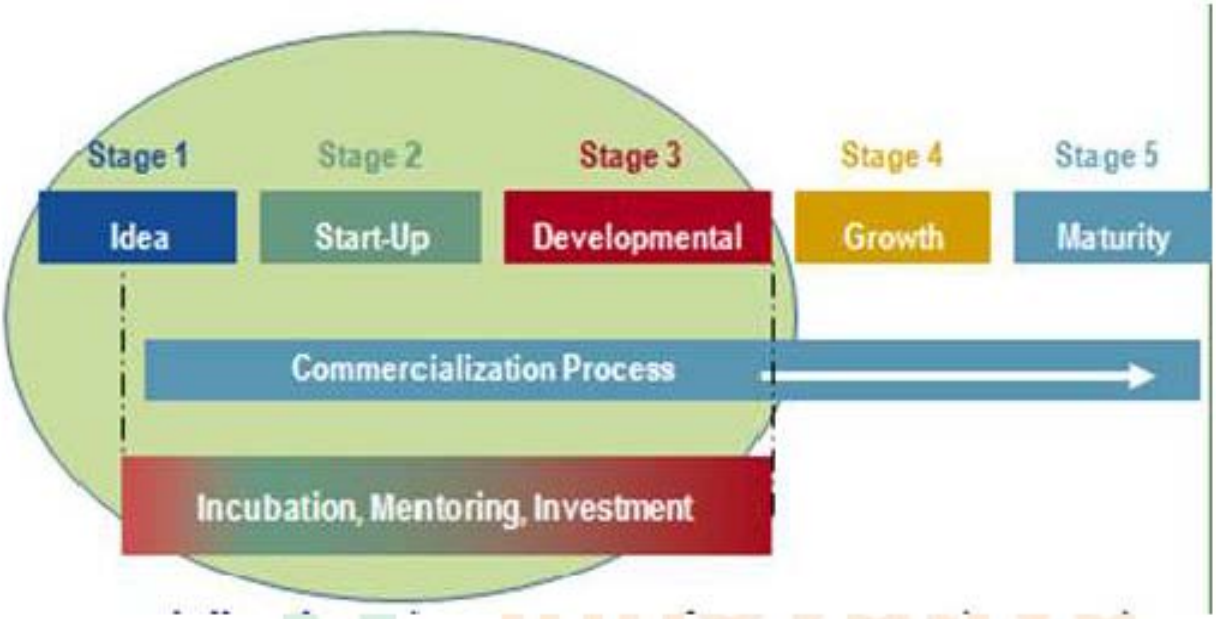


Fig. 2: Stages for the growth of a start up enterprise

Once the product achieves maturity, commercialization requires a reference of strategic and tactical actions intended to achieve market entry and sustained competitiveness of new innovative technologies, products and /or services.

3. Agri-business and Innovation Platform.

ICRISAT has also created an Agribusiness and Innovation Platform with the following objectives:

- To serve as a mechanism for agro-technology exchanged from ICRISAT and its partners to the private-public sector.
- To identify and promote innovations and handhold entrepreneurs to establish sustainable agri-and food processing enterprises.
- To act as a catalyst for IMOD by linking the small holder farmers to different stakeholders across the agricultural value chain, by providing mew products and services.
- To facilitate socio-economic development, especially promoting new livelihood opportunities for women.

This platform envisages enhancing agricultural development through entrepreneurship, innovation and partnerships. This leads to value added food products and agri-enterprise development. Three elements of agri-business incubation are (1) creation of competitive agri-business enterprise, (II) Nutri plus knowledge (NPK) for value addition and post-harvest management and (III) Innovation and partnership (Fig. 3).

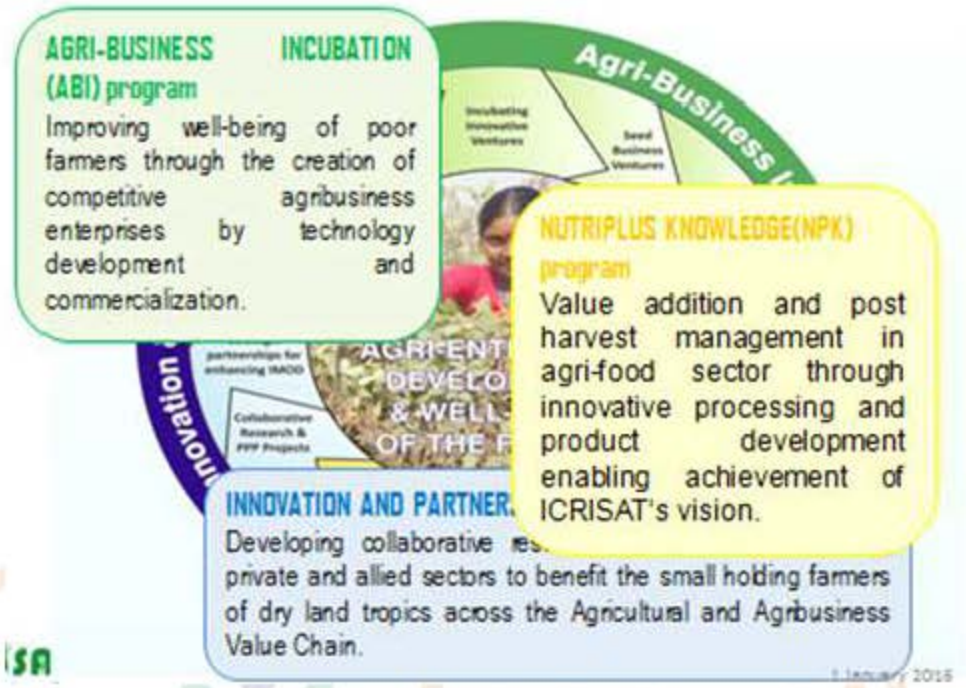


Fig. 3: Elements of agro-business incubation

NPK program of ICRISAT works towards understanding the nutritional potential of crops, explore opportunities for value addition through process technologies, provide technology & support and conduct entrepreneur development workshops for quality control and quality assurance. A number of innovative products based on dry land crops, have been developed and illustrated in Fig. 4.

Fig. 4: Dryland crop based innovative products

This enabling environment of NPK creates successful innovations and enterprises. The entire network of Indian Agribusiness Incubators (NIABI) is given in Fig. 5.

Fig. 5: Network of Indian Agro-business incubators

4. Six Value-chain Based Agri-business Incubators in Africa.

Supported by DANIDA (Royal Danish Ministry of Foreign Affairs) and led by FARA – Uni BRAIN (University of Business and Research in Agriculture Innovations), ICRISAT has started six agri-business incubators in Zambia (fruits and vegetables) at AgBIT, Ghana (poultry and piggery) at CCLEAg, Uganda (coffee) at CURAD, Kenya (Sorghum) at SVCDC, and Mali (agro-forestry)at WAARI. Various locations are shown in Fig. 6.

Fig. 6 : Six Value chain based Agri-business based incubators in Africa

Under India-Africa Forum Summit (IAFS-II), the Ministry of Food Processing Industries, Govt. of India has established five food processing business incubators in five counties as depicted in Fig. 7

Fig. 7: Food Processing Business Incubation under India-Africa forum summit

To provide adequate support, five food testing laboratories have also been set up in Gambia, Congo, Nigeria, Zimbabwe and Rwanda.

Fig.8: Food testing laboratories under India- Africa Forum GOI

5. Major Challenges in Agriculture Value chain

There are major challenges in the agriculture value chain as (1) finding solutions for major constraints to crop productivity, (2) developing new varieties that raise the yield as well as the nutritional quality in low potential areas, (3) Create opportunities for diversification in agricultural value chain, (4) amplify the impact of agriculture by linking to nutrition and entrepreneurship – the "Agriculture–Nutrition wheel".

This requires a holistic approach by sustainable intensification, addressing value-chain, considering social dimensions and addressing cross-cutting issues. Sustainable intensification requires management of soil, water and energy, crop improvement and seed access, diversifying farms & developing on farm practices and technologies. The agri-business can be build by promoting

and improving post harvest processing, value addition and food safety, facilitating market access through IMOD and proving business incubation and market development. The main social and cross-cutting issues consist in analyzing key problems and identify opportunities and empowerment of women and attracting skilled youth to agriculture. The agriculture- nutrition wheel is the guiding frame work of ICRISAT as shown in Fig. 9.

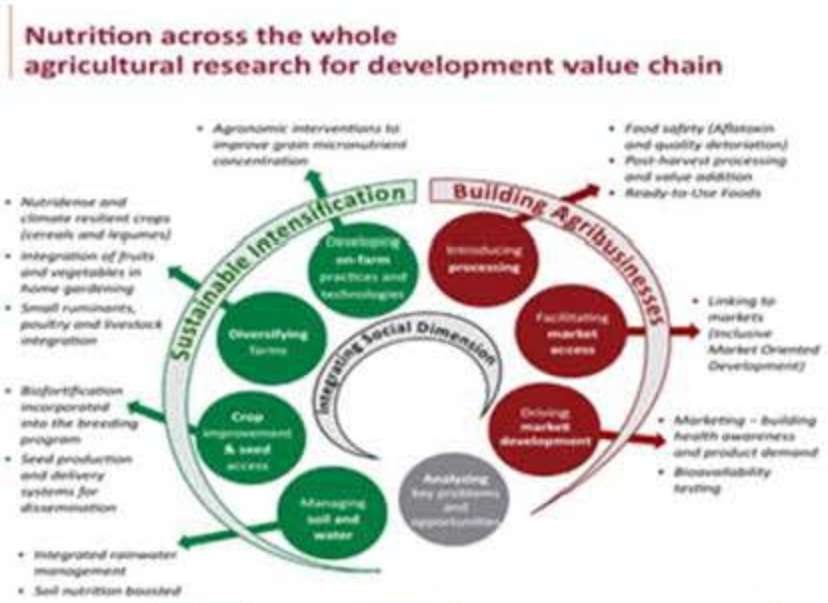


Fig. 9 (Slide 22)

The Fig. 10 shows various centers and laboratories that are partners to ICRISAT to develop and promote "Innovation and Excellence" in food processing and nutrition.

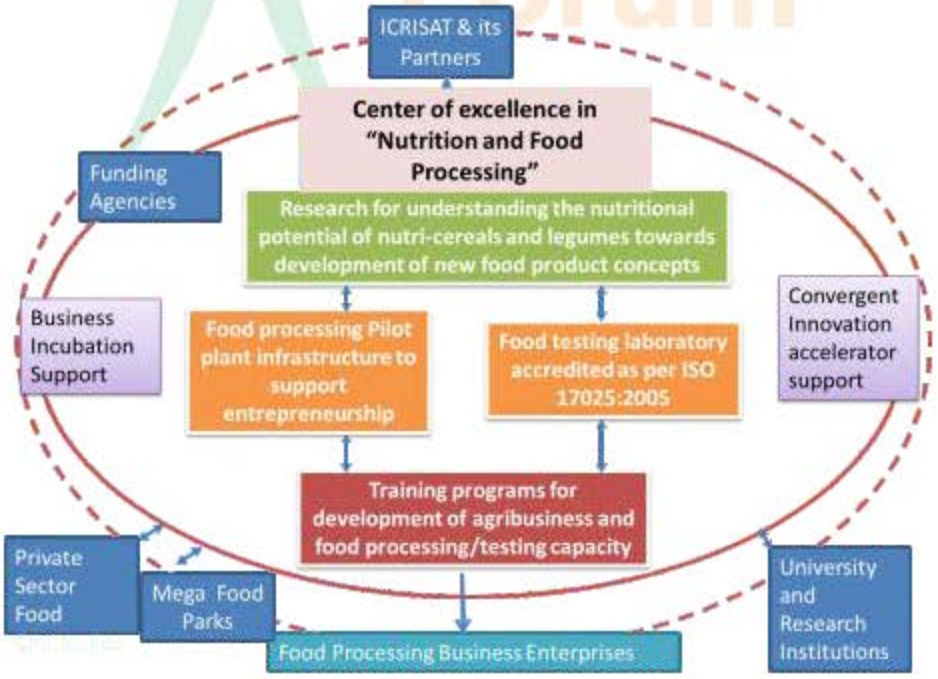


Fig. 10: ICRISAT and its Partner

DAIRY DEVELOPMENT IN INDIA

N. R BHASIN

1. Introduction

According to livestock census of 2012 (Census 2012) India has about three hundred million cattle, which includes 108 million buffaloes, 152 million indigenous cattle and 40 million exotic crossbreed cattle. The census also shows that in comparison to 2007, the exotic breed has increased by 20.2%, indigenous cattle population has decreased by 8.94% and that of buffaloes increase by 3.2% in the year 2012 (Table 1).

Table 1: Livestock population in India

Livestock	Population (000) Year 2007	Population (000) Year 2012	% Increase/Decrease
Exotic/Crossbred Cattle	33,060	39,732	20.18
Indigenous Cattle	1,66,015	1,51,172	-8.94
Buffaloes	1,05,342	1,08,702	3.19

19th Livestock Census 2012

Source: http://dahd.nic.in/

India's milk production has increased remarkably and expected to reach around 200 million tonnes per annum in the year 2021-2022; India is already the largest milk producing country in the world. Numbers are given in Table 2. All these developments in India's white revolution are attributed to great Dr. V. Kurien, the Indian dairyman.

Table 2: Growth of annual milk production in India

Year	Quantity (in Million Tones/Annum)
1950	17
1960	201
1970	21.2
1980	30.4
1990	57.4
2000	78.3
2005	91
2007	102.6
2008	107.9
2009	112.2
2010	116.4
2011	121.8
2012	127.9
2013	133.0
2014	137.7
2015	142.0*
2021-22	200.0*

2. Dairy Vision 2025

In view of the growing global competition, India's farmer is at stress compelled to sell milk at a lower price. We need to be careful and take required measures. The focus should be to develop strategies for increasing productivity of the animals to achieve targeted production and improve profitability of the farmers. Some of the national objectives in this effect are :-

- Cross breeding of cattle with exotic germ plasm to increase productivity.
- Selective breeding in case of buffalo to increase the productivity.
- Improvement in feeding to increase the productivity.
- Strategies to review the demand and supply mismatch and to identify the measures that will assort in proper policy formulation leading to structured assessment.

The dairy industry is primarily in the hands of private sector. Institutions operated by the Government like the DMS need to be privatized. Government should not involve in milk schemes or processing plants etc. Instead the government's policies should facilitate cooperative and private sector to identify opportunities that stimulate growth to achieve stipulated desired growth.

3. The Story of Amul

The story of Amul at Anand proved to be a turning point in India's milk production. Located in Gujarat (Fig. 1), the model of Anand is given in Fig. 2. The cooperative structure is a three tier

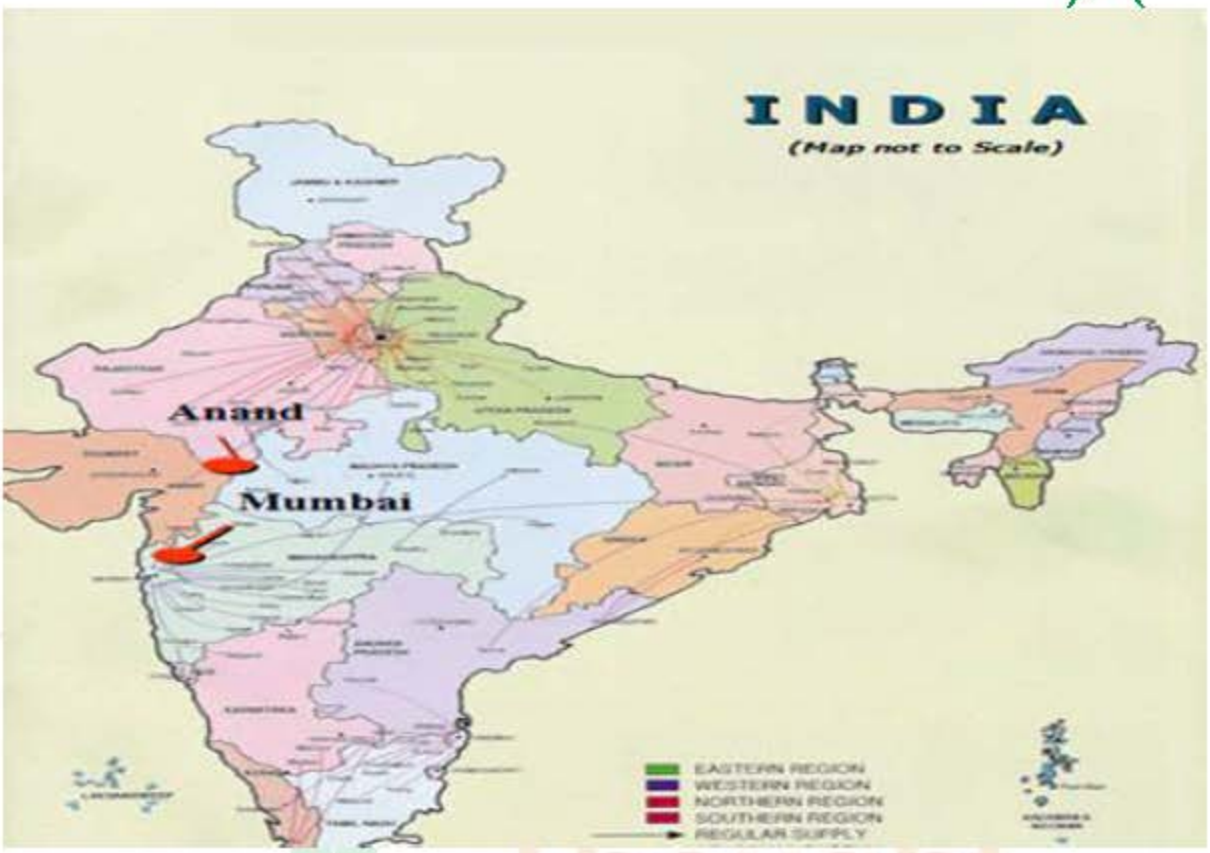


Fig.2: The story of AMUL

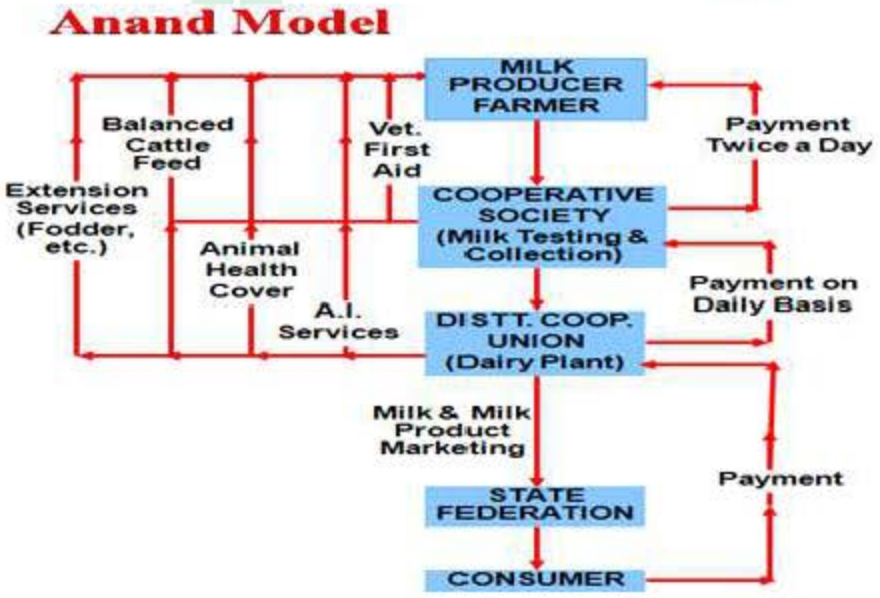


Fig.3; Anand Model

management process, namely Village Milk Producer Cooperative Society, District Milk Producer Unions and State Cooperative Milk Marketing Federation. Various steps in milk procurement, processing, payments and marketing are illustrated in Fig. 4.

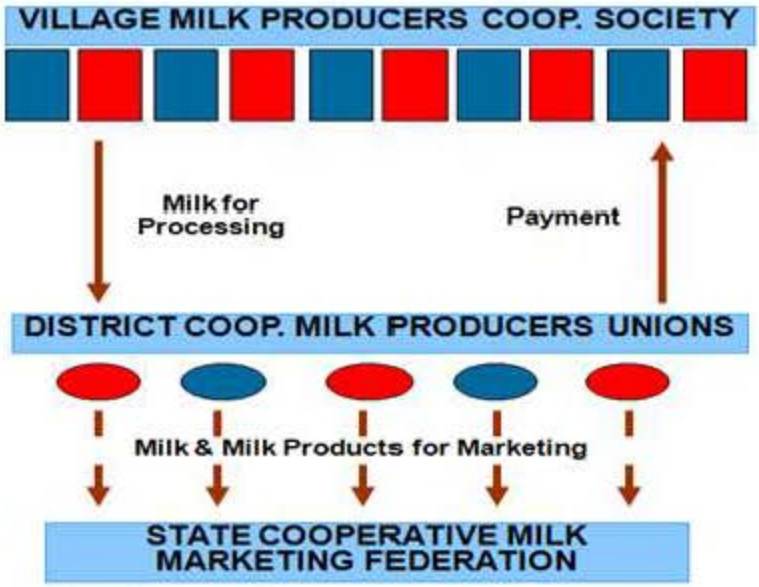


Fig. 4: Three tier cooperative structure

Agriculture and livestock contribute about 15% and 4% to national GDP. Major livestock products and their yield are given in Table 3.

Table 3 : Major Livestock products and their annual yield

Year	Milk (MT)	Eggs (Million Nos.)	Wool (Million Kgs)
2000-01	80.6	36,632	48.4
2001-02	84.4	38,729	49.5
2002-03	86.2	39,823	50.5
2003-04	88.1	40,403	48.5
2004-05	92.5	45,200	44.5
2005-06	97.1	46,166	44.9
2006-07	102.6	50,663	45.1
2007-08	107.9	55,000	45.0
2008-09	112.2	55,600	42.7
2009-10	116.4	59,800	43.2
2010-11	121.8	63,020	48.3
2011-12	127.9	66,450	44.7
2012-13	133.0	69,731	46.1
2013-14	137.7	74,752	47.9
2014-15	142.0*	-	-

It can be observed that while the production of milk and eggs in constantly rising, that of wool is almost constant since 2000-01.

4. National Dairy Development Board (NDDB)

NDDB was founded in 1965 to plan and spearhead India's dairy programmes like operation Flood, to help the country emerge as the largest milk producer. The third phase of operation flood was

completed in 1996. NDDB has placed dairy development in the hands of milk producers and professionals to manage cooperatives. After Gujarat, World bank assisted products were started in Rajasthan, Madhya Pradesh, and Karnataka etc.

5. Economy of Dairy Sector

The dairy sector has developed through cooperatives with 1,62,186 dairy cooperative societies all over India (2013-2014). India's first automated dairy Mother Dairy was established in Gujarat. From 17 MT in 1950-51, dairy sector now handles 142 MT of milk. India's biggest dairy cooperative group , namely, Gujarat cooperative Milk Marketing Federation with annual turnover of more than Rs. 20,000 crores is owned by Amul.

Milk processing is a mixed sector with private, cooperative and other managed sectorial organizations. The processing capacities in these sectors are given in Table 4.

Table4: processing capacities in different sectors

Sector	Registration Granted	Capacity Litres/Day
Private	765	73,251,000
Cooperative	263	43,250,000
Others	37	4,046,000
Total	1065	120,547,000

Source: Dairy Division, DAH&DF, M/O Agriculture (As on 31st March 2011)

Dairy product export started in the year 2000-01 with a contribution of 18.64 million dollars, has reached 198.0 million dollars in 2014-15 . R and D has been an important and integral part of National Dairy Movement. Besides various state and central agriculture universities, National Dairy Research Institute at Karnal, Regional station of NDRI at Bangalore and Kalyan, CFTRI Mysore are the main active R & D institutions, supported by the Govt. of India.

6. Indian Dairy Association (IDA)

Established in the year 1948, with headquarter in New Delhi; IDA is the apex body of the dairy industry in India. Its members are from the cooperatives, MNC's, corporate bodies, private institutions, government and public sector units. IDA function very closely with the dairy producers, professionals and planners, scientists and educationists, institutions and organizations associated with the development of dairy movement in India.

IDA instituted "Dr. Kurien Award" in the year 1991 by the IDA to honor individuals who have contributed significantly to the development and growth of the Indian Dairy Industry. This is the highest award and is given once into years. IDA also provides various fellowships and best paper award during various events, conferences, seminars etc.

QUALTIY IMPEDIMENTS IN FOOD SECTOR – POSSIBLE SOLUTIONS

Deepa Bhajekar

1. Introduction

For a well nourished and healthy world, the security of food and nutrition needs to be assured in all the countries and for all children, young and adult of the world's population. It is reported that (Lancet Service 2008) one out of every three deaths of children under five years old is the result of malnutrition. The world loses up to 2-3%of GDP to under nutrition and therefore the World Bank repositions "Nutrition" as central to development. It is reported that due to food price spike in the year 2010, 44 million additional people were pushed into poverty (World Bank 2011) and 2 billion people suffer from deficiencies in micro-nutrients like iron, zinc and vitamin-A (Leveraging Agriculture for Improved Nutrition and Health 2020, conference Brief 2011). World's Bank (2009) reports that 75% of the world's poor population lives in rural areas and there are 850 million under-nourished people across the globe (FAO, IFAD and WFP, 2011).

2. Food Security

There are four dimensions of food security namely:

A) Physical Availability of Food: The supply side, determined by the level of food production, stock level and net trade.

B) Economic and Physical access to Food: Adequate supply of food does not guarantee household lever food and security. Food access depends on incomes, expenditure, markets and prices in achieving food security objectives.

C) Food utilization: The way the body makes the most of various nutrients in the food, food utilization involves care and feeding practices, food preparation, diversity of diet and intra-household distribution of food.

D) Stability of other three Dimensions: One needs stability of food access on periodic basis. Weather political conditions or economic factors have an impact on the status of food security.

There are challenges regarding food availability at different stages, namely, on farm, in logistics and storage, during processing and during packaging and shelf life. Farm challenges include climatic variation, high heat and humidity leading to rotting of produce, age old harvesting practices (damaged produce), no temperature control, no proper storage facilities and manual practices and challenges during storage and transportation includes

- Fungal and bacterial growth due to improper storage and transportation conditions.
- Lack of proper practices of stacking and systematic labeling.
- Cross contamination among produce during storage.
- Expensive refrigerated trucks for transport of fresh fruit and vegetables.,
- Pests across the chain.

One needs to provide modern transport facilities to reduce/minimize produce loss as well as storage formalities for an increased shelf life.

3. Challenges during Food Processing

Food processing in India has several challenges like:-

- Manual handling of products – Inadequate mechanization.
- Lack of detailing in monitoring processing conditions.
- Post process handling – no consistent systems
- Lack of infrastructure.
- Lack of systems and traceability

Similarly, there are challenges in packaging and shelf life like :-

- High capital investment
- Permeability of packaging material
- Atmosphere under which packaging is done.
- Time taken in packing
- Lack of technology that increases the shelf life of fresh products.

4. Ideas for Implementing in India

In order to reduce post harvest losses especially those of high moisture produce like fruits and vegetables, a few implementable ideas are :

- Dehydration of fruits on farm
- Modified atmosphere packaging (MAP) of fresh fruits and vegetable on farm to increase self life
- Commercialization of traditional Indian foods
- Fortifying staples commonly used in India as step forward in eliminating rural mal-nutrition

Dehydration of fruits on farm can be done by using solar energy and employing solar dryers. If produce is dehydrated immediately post harvest, then nutrients are preserved. Specific local produce can be dehydrated together community drying, providing employment to locals.

Some examples of fruits' dehydration on the farm(s) are given in Fig. 1

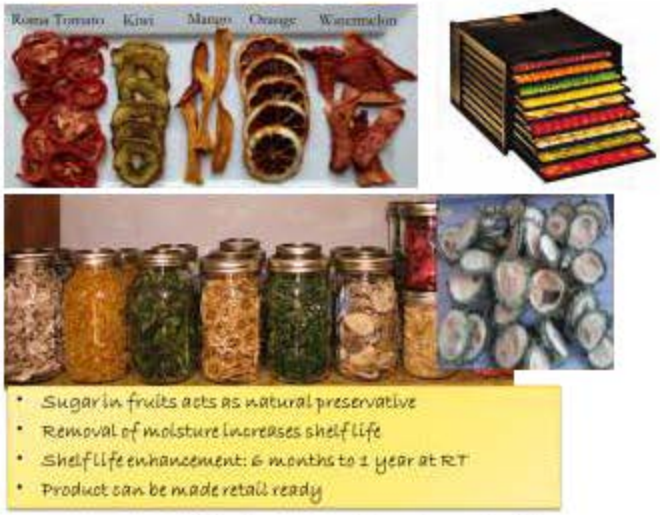


Fig. 1: Dehydration of food at the farm

5. Modified Atmosphere Packing (MAP)

MAP is also known as gas flushing, protective atmosphere packing or recued oxygen packaging. Modified atmosphere enables fresh or minimally processed packaged food products to maintain visual textural and nutritional appeal. The recommended percentage of O2 in a modified atmosphere for fruits and vegetable for both safety and quality falls between 1 and 5%. A packet of mixed salad, for example, might consist of 5% oxygen, 15% carbon-dioxide & 80% nitrogen. Shelf life of the product increases to eight days in contrast to 3 to 4 day under air. A comparison of shelf life of a few food products with and without MAP is given in Table 1. The table also provides information on various food items and the recommended gas tx in MAP.

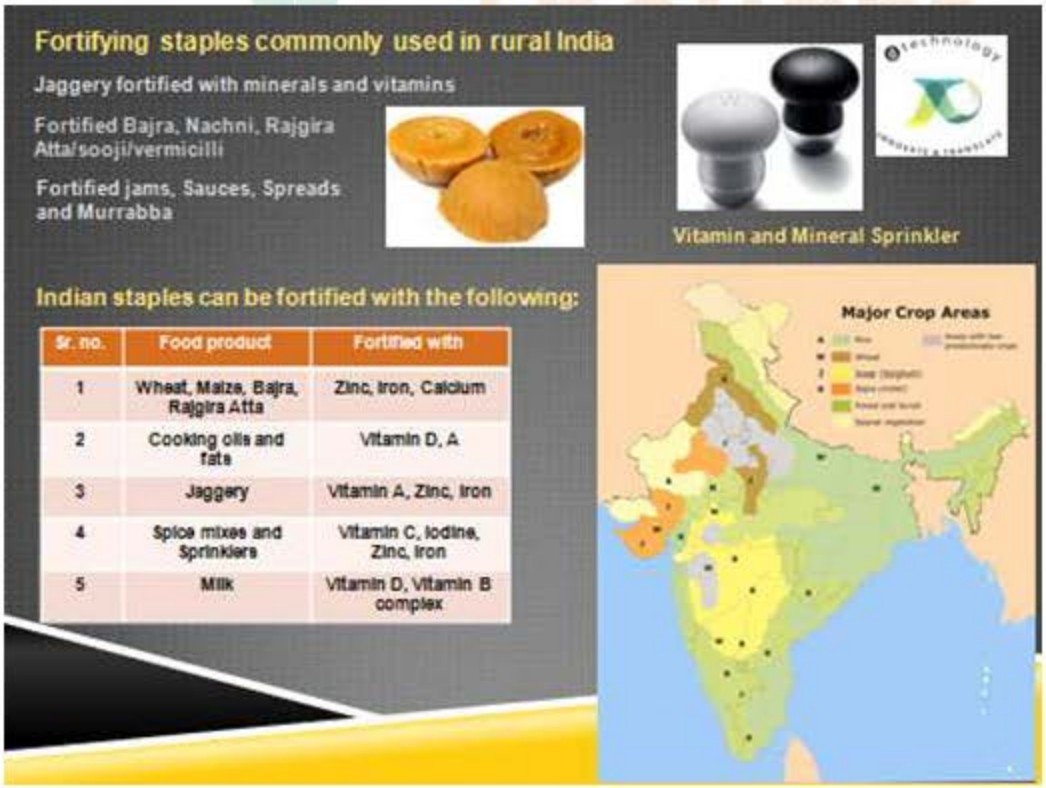
Table1: Normal MAPAX shelf life as compared to normal shelf life in air

Food	Typical shelf-life in air	Typical shelf-life with MAPAX®
Raw red meat	2 - 4 days	5 - 8 days
Raw light poultry	4 - 7 days	16 - 21 days
Raw dark poultry	3 - 5 days	7 - 14 days
Sausages	2 - 4 days	2 - 5 weeks
Sliced cooked meat	2 - 4 days	2 - 5 weeks
Raw fish	2 - 3 days	5 - 9 days
Cooked fish	2 - 4 days	3 - 4 weeks
Hard cheese	2 - 3 weeks	4 - 10 weeks
Soft cheese	4 - 14 days	1 - 3 weeks
Cakes	several weeks	up to one year
Bread	some days	2 weeks
Pre-baked bread	5 days	20 days
Fresh cut salad mix	2 - 5 days	5 - 10 days

6. Long life traditional Indian Foods

Some of the traditional Indian products & their respective shelf life is given in Fig. 2 . Such foods are already available in the market in India as well as abroad. Some common nutritional deficiencies observed normally in India are Vitamin-D, Calcium, Vitamin B Complex, Iron, Zinc, Iodine, Vitamin-A, and C. A number of fruits and vegetable contain these micro-nutrients, like banana, papaya, mango, orange, pea, broccoli, carrot, beans, beet root, mushrooms etc. Typical Indian staples can be fortified with minerals and vitamins as shown in Fig. 3.

Fig. 2 Long life Indian traditional foods



Sr. no.	Food product	Fortified with
1	Wheat, Maize, Bajra, Rajgira Atta	Zinc, Iron, Calcium
2	Cooking oils and fats	Vitamin D, A
3	Jaggery	Vitamin A, Zinc, Iron
4	Spice mixes and Sprinklers	Vitamin C, Iodine, Zinc, Iron
5	Milk	Vitamin D, Vitamin B complex

Fig. 3: Fortifying staples commonly used in rural India

VALUE ADDITION AND NUTRACEUTCALS FROM FISH AND SHELL FISH

Srinivas Gopal

1. Introduction.

Since the period of Paleolithic about 90,000 years ago, fishing for livelihood and sustenance has been an important activity. Ancient Assyrians, Romans and Chinese were famous for their farming. Now fisheries sector has undergone a rapid transition addressing food and nutritional security. The fisheries sector addresses avenues for employment, income generation and livelihood support. Fish is an excellent resource for proteins, vitamins, trace elements and polyunsaturated fat (omega – 3 fatty acids). There is a growing awareness of beneficial role of fish and other marine foods in human nutrition. The sea food plays an important role in lowering the risk of major nutrition related chronic diseases.

2. Biomedical Applications of Seafood Products

Fish and other marine life are rich sources of w-3 FA-EPA & DHA. EPA and DHA constituting 70-75% of total PUFA (Poly unsaturated Fatty Acids). Marine organism accumulates this through their food chain. In Norway, fish was considered to be a poor man's diet, but now–a-days it is rich man's diet. Though in India, per capita fish consumption is only 7 kg annually, but it is increasing slowly. Fish protein represents 15.6% of animal protein supply and 5.6% of total protein supply. 60% of people living in the developing world obtain 40-100% of animal protein from fish. Proximate composition of fish is water 65-90%, protein 10-24%, fat 1-22%, minerals 0.5-2% and carbohydrates 1-2%. A comparison of the various nutrients in the fish muscles and those of cattle and poultry is given in table-1.

Table 1: Proximate Composition of Beef and Fish Muscle

Constituent	Fish muscle (as w/w%)			Beef muscle	Chicken muscle
	Minimum	Normal variation	Maximum		
Protein	6.0	16-21	28.0	21.0	22.6
Lipid	0.1	0.2-25	30.0	3.0	1.2
Carbohydrate		<0.5			
Ash	0.4	1.2 - 1.5	5	1	1.2
Water	28	66-81	90	75	75

Fish proteins have excellent nutritive value (the digestibility of protein is more 90%). Fish has a very high biological value as they contain all essential amino acids in right proportion; rich in lysine and low in tryptophan. It is also a good dietary source of taurine, which is a non-protein amino acid, found to be rich free amino acid pool beneficial in treating heart disorders. Proteins in fish have positive role in reducing blood cholesterol and also protect in diabetic renal diseases. Fish lipids are healthy; approximately 50% of the fatty acids in lean fish and 25% in fattier fish are PUFAs. In contrast beef has only 4-10% PUFAs.

3. Fish as Health Food

Fish is a health food because it provides a balance diet when consumed along cereals. A health food should contain all the principal constituents in the right proportion. Marine as well as fresh water or brackish water fish are good from nutrition aspect. Fish is safe and there are less taboos connected to fish.

The link between fish and oil and heart disease has been the subject of thousand of scientific papers. Fish is rich in long chain n-3 polyunsaturated fatty acids. Coronary disease, while being one of the biggest killers in the world, is practically unknown amongst the Eskimos. Eskimos also have a reduced tendency to blood clotting and longer bleeding time.

Fish oil reduces blood cholesterol and triglyceride levels. They, however, have no effect on the levels of low density lipoprotein cholesterol; but they do raise HDL by about 10%. Dietary supplementation of fish oil has shown modest reduction in blood pressure. Fish oil improves the functionality of cell membranes and also inhibits platelet aggregation.

Docosapentaenore acid (DPA) and Eicosapentacnoric acid (EPA) reduce vaso-constriction by competing with arachidonic acid for enzyme cycloxygenase. EPA converts cycloxygenase to thromboxane A3, which is only a weak vasoconstrictor unlike thromboxane A2. Thromboxane A2 is formed by the action of cycloxtygenase on arachidonic acid.

4. Atherosclerosis & Stroke

Accumulation of cholesterol along with a depot of other metabolic materials on and in the vessel walls surrounding the heart is described as Atherosclerosis. Stroke refers to blockage of blood flow to a part of brain. It may be due to high blood pressure, excess weight or dietary sodium.DHA and EPA reduce blood cholesterol, triglycerides, LDL, VLDL and increase HDL. Thus the lower rate of CHD and reduce the risk of atherosclerosis.

W-3 fatty acids affect prostaglandin metabolism. The kidney becomes active by controlling retention and removal of water. Excess sodium is removed decreasing the risk of the stroke.

5. Cancer, Rheumatoid Arthritis & Diabetes.

Etiology of cancer is uncertain, complex & multi-factorial. About 35% of all cancers are related to the way we eat. W-3 fatty acids have anti-cancerous effect. These fatty acids also destroy cartilage destroying enzymes responsible for join destruction. W-3 FA therefore acts as a natural supplement.

Impaired insulin production and / or function leading to impaired glucose metabolism is characteristic of adult onset type-ii diabetes. Excess weight can be controlled with diet & exercise. Diet containing w-3 fatty acids will allow tissue to more efficiently absorb & metabolize glucose in the absence of insulin. The diseases such as asthma, diabetes, psoriasis, thyrotoxicosis, multiple sclerosis etc can be moderated by w-3 FA.

DHA is critical to normal eye & vision development. Along with another fatty acid called linoleic acid w-3 FA makes more than one third of fatty acids in human brain and retina. Accumulation of DHA in brain takes place at the last trimester. DHA is a membrane component required for the growth of dendrites. It also increases memory power.

6. Recommended Intake of Fish

American Heart Association recommends including fatty fish at least twice a week in the diet. Fish provides 0.5-1 g of PUFA per day and 50-100 g sardine daily. It is advisable to eat fish and sea food at least 2-3 times a week though five times a week would be ideal.

7. Squalene

Squalene is an isoprenoid compound found in the liver oil of deep-sea sharks. It provides hydrostatic lift and enable the shark to maintain neutral bouncy. Squalene also has immense medical applications. It has several clinical applications like anticancer, antioxidant, detoxification of xenobiotics, hypocholesterolimic, blood purifying property, anti-aging property, oxygen control and generation of body hormones.

Fish protein hydrolysate (FPH) is used to formulate infant foods, soups, protein containing beverages to enhance their protein content & nutritive value. It is also used as milk replacer and FPH has inhibitory effect on lipoxigenase. It has synthetic effect when used with synthetic antioxidants. FPH contains some important bioactive peptide fraction like gastrin, calcitonin gene related peptides (CGRP) & some growth promoting peptides which play key role in our metabolic pathways. FPH suppresses both hypertension and atherogenesis.

Chitin is a polymer of B(1-4)-N-acetyl-D-glucosamine(NAG) and it is the second most abundant organic compound next to cellulose on earth. Polysaccharide found in the outer skeleton of insects, crabs, shrimps and lobsters and in the internal structures of other invertebrates. Deacetylation of chitin with strong alkali yields chitosan, polymer of B(1-4)-D-glucosamine.

8. Applications in Food & Nutrition

NAG moiety present in human milk promotes the growth of bifidobacteria and produces lactase required for digestion of milk lactose. Cow's milk contains limited amount of NAG moiety and therefore infants fed on cow's milk may have indigestion. NAG (n-acetyl glucosamine 1-phosphate) supplementation helps to overcome lactose intolerance in humans & animals by changing micro flora of gut. Chitosan has hypolipidemic & hypocholesterolemic activity.

9. Medical and Pharmaceutical Application of Chitin & chitosan

One of the applications is to provide biodegradable drug delivery systems. Partially deacetylated chitin like 6-0-carboxymethyl chitin, which is readily soluble in water & remarkably higher susceptibility by lysozyme than chitin & chitosan can be fabricated into gels & films as self regulated drug delivery system. Floating and swelling properties of chitosan in acidic medium are used for the preparation of chitosan granules with internal cavities for sustained release of drugs. Chitin & chitosan are useful for enhancement of dissolution properties of poorly soluble drugs such as griseofulvin, phenytoin, flufenamic acid & indomethacin. Chitin and chitosan can be used as a substitute for the widely used microcrystalline cellulose (MCC) in tablet preparation.

Albumin blended chitosan membrane can be used for haemodialysis and chitin powder can be used for wound dressing. Chitosan can be used for the treatment of burns, because it forms a tough, water absorbent & biocompatible film over the burn. When applied to open wounds, it provides a cool and pleasant soothing effect. Chitosan film has oxygen permeability sufficient to prevent oxygen deprivation of tissues. It gets slowly degraded by enzymes and therefore need not be removed frequently from the wound.

Chitosan is used for making ideal contact lenses. It has all the required characteristics like

optically clear, mechanically stable, gas particularly oxygen permeability, wettability immunologically compatible. Antimicrobial & wound healing property of chitosan along with excellent film forming capability make chitosan suitable for ocular bandage lens.

In dentistry, chitosan could be used as a transparent membrane or as a thin powder soaked in antibiotic solution. It accelerates wound healing, promoted regular fibrin formation and favored epithelialisation. Chitosan is also used to treat gingivectomy.

10. Technology Transfer

The central institute of fisheries has transferred many technologies to food and pharmaceutical companies. A process was developed to make bio-absorbable surgical sutures from fish gut collagen. This makes sutures available at an affordable cost and reduces pollution by the fish gut.

On hydrolysis of chitin with concentrated acids under drastic conditions gives relatively pure amino sugar D-glucosamine. Glucosamine, which occurs naturally in the body, plays a key role in the construction of cartilage – the tough connective tissue that cushions the joints. Glucosamine stimulates the production of glycosaminoglycans (the key structural components of cartilage) as well as the incorporation of sulphur into cartilage. Sulphur is necessary to make and repair cartilage. Glucosamine is effective for easing osteoarthritis pain, aiding in the rehabilitation of cartilage, renewing synovial fluid, and repairing joints that have been damaged from osteoarthritis. It also has antiulcer effects.

Chondroitin Sulfate obtained from shark cartilage is used for the treatment of arthritis. It is a part of a large protein molecule that gives elasticity to cartilage. Shark corneas have been used for human cornea transplant. Chondroitin sulfate has anti-arthritis and anti joint inflammation properties besides possessing anticancer characteristics also. Chondrotin sulfate, dermatan sulfate and hyaluronic acid collectively called glucosaminoglycans are used for the body for the synthesis of proteoglycans. While chondroitin provides cartilage with strength and resilience, glucosamine inhibits inflammation and stimulates cartilage cell growth.

Fish calcium has ideal calcium phosphorous rate of 2:1. Commercial calcium capsules are essentially calcium carbonate, while calcium from fish is calcium phosphate (DCP, TCP, HAP) nutritionally much better. Waste components of fish are rich in calcium (Fig. 1).

Fig. 1: Waste Components rich in Calcium

Fish bone is a important source of calcium in the form of dicalcium phosphate with high bio availability. Calcium powder processed from the back bone of Tuna can be used to combat calcium deficiency in the diet of children. Method of production mainly involves removing of gelatin from the crushed bones and pulverizing the reaming portion. The fish calcium capsule "CALCIFIT" developed by ICAR-CIFT is being commercially adopted and marketed.

Hydroxyapatite (HAP) is seen embedded in the organic matrix of collagen, normally associated with the natural materials such as bone and fish scale. These mineral crystals are responsible for the bone hardness, strength and rigidity, and collagen fibers provide flexibility. It is one of the few materials, classified as a bioactive natural material that supports bone in growth and osteo-integration; hence popularly known as the second generation calcium supplement. Hydroxyapatite and calcium phosphate based biomaterials have attracted considerable interest in the field of tissue engineering. Among the main areas of application of HAP, the most promising areas are orthopedics and orthodontics, where bone tissue has to be replaced, partially or totally.

The studies indicate that the total global biomaterials market is expected to be worth US$ 58.1 billion by 2014, growing at a compound Annual Growth Rate (CAGR) of 15% from 2009 to 2014. The manufacture of biomaterials and devices depend on both cost effective production technology and the availability of cheaper raw materials. Fish processing waste offers a rich source of this highly valuable mineral composite. The content of hydroxyapatite in fish scale and bone ranges from 40-45% (w/w). Hydroxyapatite from such natural sources is biologically safe and is economical as it is prepared from cheaper raw materials. Worldwide, fish industry waste is considered as an important pollutant having serious impact on the environment. For preparing hydroxyapatite crystals from fish scales by controlled heating technique.

Fish protein hydrolysate

- Used to formulate infant foods, soups & protein containing beverages to enhance their protein content & nutritive value.
- Used as milk replacer
- FPH has inhibitory effect on both lipoxigenase
- Synergistic effect when used with synthetic antioxidants.
- FPH contains some important bioactive peptide fraction like gastrin, calcitonin gene related peptides(CGRP) & some growth promoting peptides which play a key role in our metabolic path ways.
- FPH suppresses both hypertension & atherogenesis.

Collagen

- Found in skeleton, fins, skin & air bladder(source of pure collagen).
- Properties like abundance, biocompatibility, non antigenic & non toxic nature, strength, biodegradability etc tremendous application in different fields.
- Use in the production of anti-thrombogenic surfaces, burn cover dressings & controlled drug delivery systems.
- Used as a bone filling material.

- Premature ageing of skin due to hyperglycemia attach in diabetic patients can be cured using collagen.
- Surgical suture from fish gut collagen.
- Collagen-chitosan membrane – as a barrier device for guided tissue regeneration in human periodontal infrabony & furcation defects.

11. Market Applications & Technology Transfer

Main applications of fish nutraceuticals have been sports nutrition, functional food, infant nutrition and clinical nutrition. Largest suppliers in India are DMV Nutrinationals (Leading), Arla Food Ingredients, Glanbia, Davisco, Nestle Nutrition & Mead Johnson.

Technology from CIFT has been transferred to the following industries:

- M/s. India Seafoods, Kannamaly, Cochin.
- M/s. Matsyafed, Quilon/ Trivandrum
- M/s. Gadre Marine Exporters, Ratnagiri.
- M/s. SPAMCHE Industries, Cochin.
- M/s. Higashimaru Feeds (India) Ltd., Cochin
- Through NRDC, Delhi-At Jakarta
- Mr. Sudhir Chaudhury, Lapecherie, Veraval-project report only.
- M/s. FDC Ltd., Bombay
- Unilab Biosciences Pvt. Ltd, Hyderabad.
- Surgical sutures: Reddy's laboratory, Hyderabad.
- Collagen: Chitosan membrane for burns and periodontal applications:- Eucars Pharmaceuticals Pvt. Ltd., Chennai.

INNOVATIVE FOOD PRODUCTS : SPECIAL EMPHASIS ON FRUIT AND VEGETABLE PRODCUTS.

ASHUTOSH UPDHYAY

1. Introduction

Every value addition to a raw product needs a kind of innovation. An innovation is the implementation of a newer significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, work place or external relations. With respect to a product, we can look for Product Innovation, Process Innovation and Marketing Innovation. Product innovation is the introduction of a good or service that is a new or significantly improved with respect to its characteristics or intended uses. The product should have significant improvements in technical specifications, components, user friendliness or other functional characteristics. Process innovation is the implementation of a new or significantly improved production or delivery method. This may yield significant changes in techniques, equipments and / or software. Marketing innovation consists in the implementation of a new marketing method involving significant changes in product designs or packaging, product placement, product promotion or pricing.

2. Process Innovation - Various methods of processing

Out of various methods of processing of food products, the successful used one is (i) Food Radiation, (ii) Non-thermal processes (iii) Packaging innovation. Controlled radiation of food inhibits sprouting in tuber and bulb crops enhancing the shelf life by 5 to 6 days. Similarly, in case of banana, radiation delays ripening by 5-6 days.

Non-thermal process have been introduced for better quality and for greening the sector, Three technologies namely (a) Membrane technology, (b) Pulsed electrical fields (PEF), (c) Ultra high pressure (UHP) fall in this category In the membrane technology, one uses nano-filtration and ultra filtration and reverse osmosis separation. This process could be sustainable processing techniques and useful in completing sustainable report, that could become mandatory. Nestle and Kellogg food companies are already submitting their sustainability report. Pulsed electric fields help to destroy both spoilage organisms and pathogens and it is useful in extending the shelf life. Ultra high pressure techniques are useful to pasteurize fruits juices, jams and jelly etc. Normally the products are subjected to pressure up to 100 to 1000 Mps.

3. Food Preservation through Packaging Innovation

Controlled modified atmosphere (CA/MA) storage and packaging has emerged as most significant food preservation technology. This is referred to as Modified Atmosphere Packaging (MAP). The technology does not require any additives and involves least or no processing. It extends the shelf life of the product by 7-8 days.

4. Fabricated Foods

Fabrication of food means to put together various nutrients in desired proportion and imparting a composite organoleptic quality through the use of additives and suitable processing. The resulting product has more economic value and substitutes of analogs. A combination of factors like pH, temperature, etc, weakens the target micro-organisms thus keeping them under control. It is seen that a combination of such hurdles acts as synergistically at concentrations much lower than

those used singly. Usefulness of hurdle technology lies in the fact that it is possible to achieve high levels of safety assurance using relatively milder treatments. This allows the development of fresher and more natural foods with desired organoleptic characteristics.

5. Value Addition to Underutilized Food Products

There are many food products that have high nutritive values but they are underutilized. We discuss a few of these products, their value and advantages of value addition.

Green Leafy Vegetables

In nature, there are many underutilized greens of high nutritive value, which can nourish the ever increasing human population. Many of these are adoptive and tolerant to adverse climatic conditions. Though these greens can be grown at lower cost and even on marginal lands, they have remained underutilized due to lack of awareness and adequate technologies. Nutritive value of a few under-utilized green leafy is given in Table 1.

Table 1: Nutritive value of green leafy vegetables

Green Leafy Vegetables	Moisture (g %)	Protein (g %)	Fat (g %)	Fiber (g %)	Ash (g %)	Energy 9Kcal)	ß Carotene (mg %)	Vit C (mg %)	Ca (mg %)	Iron (mg %)
Drumstick Leaves	74	5.6	0.8	0.9	1.8	97	6.2	189	435	1.7
Chekurmanis	77	7.0	1.9	1.2	2.8	87	5.7	192	500	24
Bird Chilies Leaves	76	7.4	1.4	0.8	2.4	90	3.3	15	340	6.1
Curry Leaves	60	8.5	1.6	2.5	4.7	139	25	37	680	1.3
Basella Leaves	94	1.2	0.3	0.03	1.5	63	4.0	84	201	9.0
Agathi Leaves	70	8.0	1.0	1.9	3.1	81	5.4	148	802	3.5
Colacasia Leaves	84	3.1	0.6	2.9	2.6	45	3.5	7	225	10
Arise Leaves	84	4.1	1.0	1.8	2.1	53	2.8	22	150	9.3
Pumpkin Leaves	80	4.0	1.0	2.0	2.9	64	4.3	35	300	0.3

Under a sponsored research project by the ICAR (Dr. P Rajya Lakshmi 2002), many recipes were suggested with under-utilized green leafy vegetables. The final products are Paratha, Samosa, Dhal, Snack Items, Curry and Powders etc.

Fruits

Another example of underutilized fruit is Ber (Zizyphus mauritiana Lam). Ber fruits are highly nutritious, rich in ascorbic acid and contain fairly good amount of Vitamin A and B complex, minerals like calcium, phosphorus and iron. Different products are made from Ber to make it available round the year . It is rich in carotenoids and phenolics including caffeic acid, p-hydroxybenzoic acid, ferulic acid and p-coumaric acid. It has been widely use in the folk medicines for treatment of allergies, constipation, insomnia, depression, chronic bronchitis, fever and liver enlargement. Some value added products prepared from Ber are RTS beverages, squash etc.

Wood apple (Limonia acidissma) is a dry land fruit; it is rich in natural acids, such as oxalic acid, tannic, mallic and citric acid. It is a source of calcium, phosphorus, iron and vitamins A, B and C. Leaves of wood apple plat contain essential oil, used as astringent. Wood apple gum is used as an ointment to

calm irritated skin and the fruit is good digestive problems. Various products that have been made from wood apple are given in Fig. 1

Fig. 1: Wood apple based value added products

Roots and Tubers

Several roots and tubers such as Yam, Colacasia, Beetroot, and Sweet potato are underutilized. Similarly Jack Fruit (Aretocarpus heterophyllus Lam) is an important fruit that contain carbohydrates such as sucrose, maltose glucose and fructose. They also contain fair amount of carotene and small amount of Vitamin C. Like any other fruit, Jack fruit also contains fat, calcium, phosphorus, iron etc. It is also a good source of pectin and can be utilized for the preparation of pectin, pectin extracts, jam and jellies. Various products like squash, nectar, and syrup have been from jack fruit.

Bael (Aegle Marmelos) is a very indigenous fruit tree of India and it is one of the most useful medicinal fruit. It lacks popularity because of its hard shell, excessive mucilage and large number of seeds but has great potential for processing. Certain bio-chemical constituents namely alkaloids, coumarin and steroids have been isolated from different parts of the bael tree. The ripe fruit promotes digestion, mild laxative and helpful in treating inflammation of the rectum. Many value added products like jam, squash, toffees and sherbat powder have been made from Bael.

6. Natural Food Colours: Underused in F & V addition

Natural food colour from fruit/vegetable powders were extracted using different food grade media like water, acid (citric acid), alkali (sodium bicarbonate, salt solution(NaCl) and solvent (ethyl alcohol). There may be slight variation for each of the products like papaya, jamun, pumpkin, beetroot, drumstick leaves and bringaraja leaves. Concentration of colours in all these products along with extraction medium is given in Table 2.

Table2: Concentration of colors in under-utilized fruits and vegetables extracted with different media

Extraction Medium	O.D. Values					
	Papaya	Jamun	Pumpkin	Beetroot	Drumstick Leaves	Bhringaraja Leaves
Acidic	0.053	0.598	0.206	2.018	0.033	0.018
Alkaline	0.133	0.104	0.493	0.63	0.667	1.595
Salt Solution	0.055	0.057	0.229	1.983	0.096	0.398
Aqueous	0.174	0.071	0.337	1.883	0.111	0.542
Hexane + Water	0.016	0.04	0.013	0.871	1.975	1.511
Acetone + Water	0.025	0.099	0.183	0.734	0.081	0.42

Corresponding nutritional parameters are given in Table 3

Table 3: Nutritional characteristics

Items	Antioxidant activity (TBARS %)	Crude Fibre (g/100g)	Total ash (g/100g)	Micronutrients			
				Fe (mg/kg)	Zn (mg/kg)	Ca (mg/kg)	Vit C (mg/100g)
Papaya	246.77	6.71	3.80	272.55	0.0	3007.35	572.29
Jamun	206.45	3.16	3.20	193.26	18.71	2474.90	344.94
Pumpkin	275.81	8.58	6.27	61.94	19.21	2194.41	78.34
Beetroot	356.45	5.79	6.66	107.08	15.34	1317.13	374.80
Drumstick Leaves	291.94	10.13	7.53	149.21	20.57	18690.24	103.69
Bhringaraja leaves	448.39	11.93	16.33	307.80	24.00	21865.00	10.00

7. Natural Food Colours & Value Added Products

Several value added products like extruded snacks, toffees and health drink mix are provided adequate colour found in natural foods. One example is that of pink mushroom. This product grows well at a temperature of 25-32oC and relative humidity of 80-87%. It is rich in vitamins and minerals but low in fat and calories. It is a high protein content and good and cheap source of biocolours (Raghavendra 2006). Other products that are cheap and very useful for biocolours are pumpkin and prickly Pear. Yields of bio-food products in g/100 g from pumpkin and prickly pear are given in Table 4.

Table 4: Yield of bio-food colors(g/100g) extracted from pumpkin and prickly pear with different media

Extraction medium	Yield (g/100 gms)	
	Pumpkin	Prickly Pear
Acidic	0.36	0.56
Alkaline	0.28	0.48
Salt solution	0.34	0.35
Aqueous solution	0.24	0.40
Hexane + water	0.44	0.43
Acetone + water	0.32	0.28
Ethyl alcohol + water	0.30	0.32

Reference :Extraction, Stability and Utilization of Bio- Food colors from Pumpkin (Curcubita Maxima) and Prickly Pear (Opuntia Lasiacantha) by Priya Mandana and Dr.K.Uma Maheswari, 2007

Antioxidant activity of bio-food colors extracted from pumpkin and prickly pear with different media is given in Table 5.

Table 5: Antioxidant Activity of Bio Food Colors extracted from Pumpkin and Prickly Pear with different media

Extraction medium	Antioxidant Activity (%)	
	Pumpkin	Prickly Pear
Acidic	27.0	33.0
Alkaline	0.097	0.184
Salt solution	0.075	0.158
Aqueous solution	0.091	0.115
Hexane + water	0.064	0.132
Acetone + water	0.118	0.141
Ethyl alcohol + water	0.086	0.092

8. Nano-technology and extraction of bio-colours

Feasibility of extracting natural food colours from selected fruits and vegetables using nano-technology has been explored. Vegetables like tomato and beet root and fruits like papaya and black grapes were subjected to infra-red-drying and grounded into fine powder. Nano-particles were synthesized using oxalate decomposition method. Physio-chemical characteristics were studied to establish stability during the storage. Flow chart for synthesis of nano-particles is given in Fig. 2.

Fig. 2: Flow Chart for Synthesis Of Nano Particles

In order to establish the size and structure of nano-food colours , Fourrier Transform Infra Red (FT-IR) measurements were made. The measurements showed that the colour of the respective extract was clearly encapsulated by the zinc nano particles. Structure of papaya, tomato, black grapes and beet root are shown in Fig. 3.

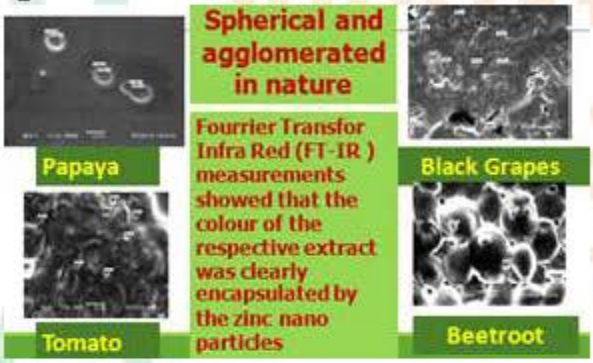


Fig. 3: SIZE AND STRUCTURE OF NANO FOOD COLOURS

Table 6 shows the size of NFCs from selected fruits and vegetables. Quantity of bioactive compounds and zinc in NFC's from selected fruits and vegetables is given in Table 7.

Table.6: Size Of NFCs Obtained From The Selected Fruits (Papaya & Black Grapes) And Vegetables (Tomato & Beet Root)

Sample	Range (nm)	Average (nm)
Papaya	695.0-723.0	713.0
Black grapes	668.0-796.0	736.0
Tomato	772.0-965.0	859.0
Beet root	859.0-991.0	925.0

Table 7: Quantity of Bio active compounds and Zinc in Nano Food Colours Obtained From The Selected
Fruits (Papaya & Black Grapes) And
Vegetables (Tomato & Beet Root)

Bioactive compounds	Bio active compounds in (100gm)	Zinc (mg %)
Total carotenes (papaya)	92.16 µg	3.94
Anthocyanins (black grapes)	118.91 mg	6.81
Lycopene (tomato)	4.68 mg	2.95
Betalains (beet root)	5.28 mg	7.51

9. Processing of Fresh-cut Tropical Fruits & vegetables.

Fresh cut products (ready to use, packaged and refrigerated fruits and vegetables) are one of the most rapidly growing food categories now a day. In Israel, the fresh cut industry includes large food companies as well as smaller farm-owned factories. In an innovative approach electrolyzed water is used as a decontamination agent. Alternative decontamination agents are sought in order to substitute active chlorine compounds. Electrolyzed water showed similar or even higher decontamination efficacy than hypochlorite solutions with an active chlorine level 5-20 times higher. No increase of THM concentration on electrochemically treated leafy vegetables as compared to the produce washed with potable water. The level of THM (Trihalomethane) in drainage water, after electrochemical treatment, was 20 times lower that the levels in waste water after standard hypochlorite treatment.

A schematic diagram of EO water generation system has been shown in Fig. 4.

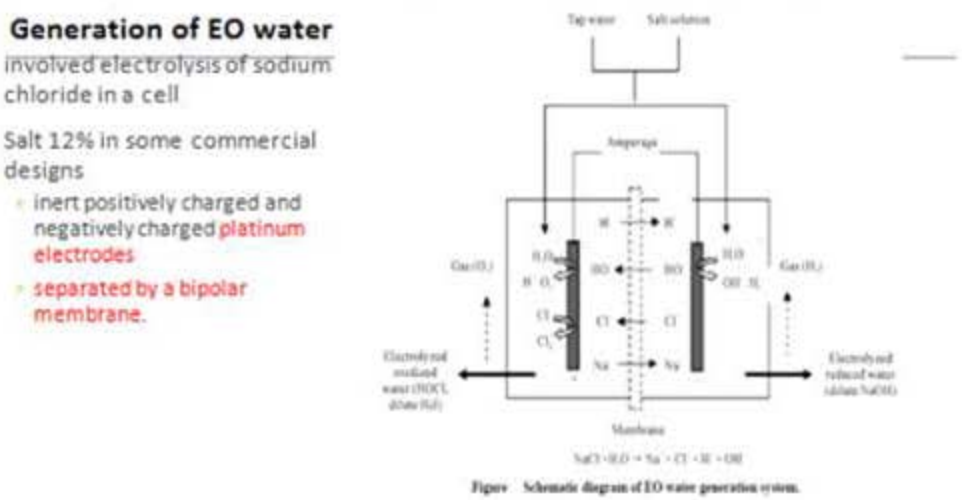


Fig 4: Generation of EO water

Enzymatic oxidative browning of mechanically wounded tissues is one of the intrinsic problems in fresh cut fruits and vegetables. In apples, the efficient anti-browning composition based on entirely on food grade ingredients was formulated and implemented by the industry. Various steps in the treatment are given in Fig. 5.

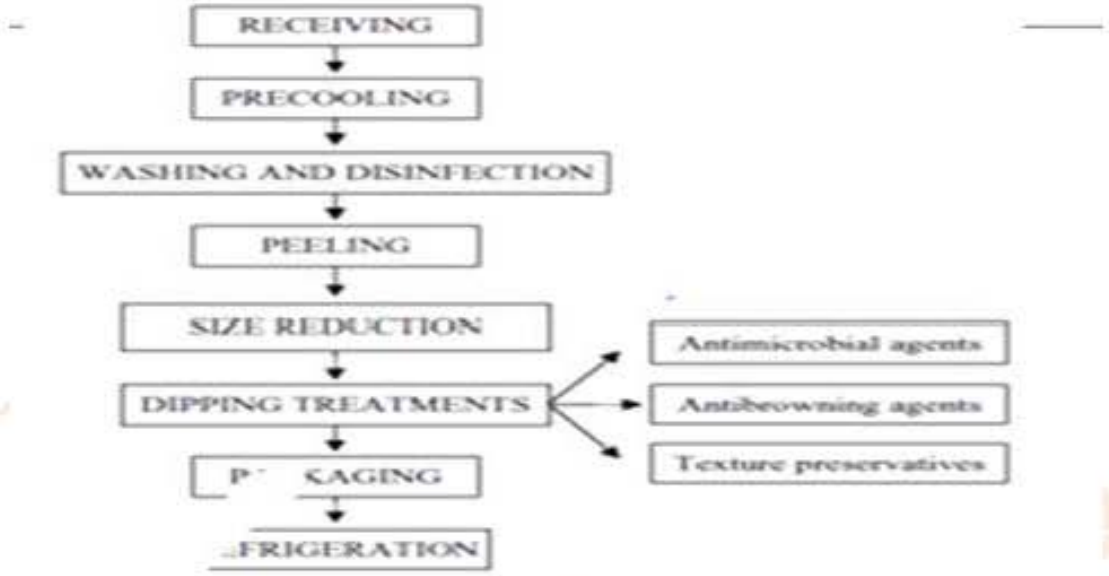


Fig. 5: Approach to enzymatic oxidative browning in apples

During the processing and storage there are microbial threats due to pseudomonas spp and psychotropic pathogens such as listeria monocytogens, Aeromonas hydrophila and Yersinala eterocolitica, other bacteria are in the mesophiles range such as Salmonella, Escherichia coli0157:H7 and Clostridium botulinum are of major concern. Microbiological RISKS MUST BE REDUCED AND CONTROLLED. Dipping treatments after peeling and / or cutting reduce microbial loads and enzymatic oxidation. Mixture of acidulants such as citric acid or combination of 1% AA + 0.2% citric acid or 1% AA+ 0.5% sodium chloride is recommended for dipping.

The problem of ethylene production under stress, and loss of flavor can be controlled by adequate dipping. 0.001 M 4-Hexayl resorcinol (4HR) + 0.5 M isoascorbic acid + 0.05 M calcium propionate + 0.025 M homocysteine maintain the freshness of apple slices for 4 weeks at 5oC. Respiration rate of fresh cut vegetables or fruits is higher than that of the whole product. Cooling and storing below 5oC controls the respiration.

Edible coatings

Edible coatings are a good alternative or complimentary to MAP packaging. These coatings reduce gas exchange rates and especially the water vapour rates between the fruit product and its environment and also for incorporating additives. Edible coating can be composed of one or more ingredients of protelc, lipidic or polysaccharide nature. Polysaccharides and proteins are normally hydrophilic and do not behave well at moisture barriers. Lipid coatings on the other hand, have good barrier properties for water vapour but may not be compatible for fresh-cut fruits. Combined or emulsified, like Casein-lipid emulsions and cellulose polymers, may be an alternative to improve the quality of some pre-cut fruits.

10. Global Trends

Fruits and vegetables are migrating into new categories such as sweets, bread and yogurt. The majority of consumers are open to flavor experimentation when it comes to food and drinks. Fruits and vegetables lovers are more likely to find the concept of products with new or exotic flavours appealing. Innovations are appearing that incorporate vegetables in bread, sweets and yogurt

Time scarcity, couples with a desire for healthier food, is creating demand for snack based fruits and vegetables. Vegetable manufactures to develop convenient products that consumers easily eat and save time. Some examples are given in Fig. 6.

Frozen rice bites with fruit fillings
Sanquan Guo Ran – China

Frozen alcoholic cocktail in a 180ml plastic pouch (coconut and vodka cocktail)

5 Apple Variety Pack

Laser Printing

Fig. 6: Reshaping the idea of what makes it onto your plate and into your stomach

Solvnet Inc – supplement has initiated products to provide all essential nutrients and it can be customized for preferences, allergies and disease management. Specification of apple juice with sodium alginate to transform into tiny balls has led to the so-called molecular gastronomy.

NON-THERMAL PROCESS: ENERGY TECHNOLOGIES FOR FOOD AND NUTRITION SECURITY

U.S ANNAPURE

1. Introduction

India is a country with an agrarian economy with 33% contribution to GDP and supporting 69% of the work force and earns 19% of the export. With a total crop output of 600 million tones, India is only marginally less than the United States (608 million tonnes) and second to China (800 million tones). India is the second largest producer of fruits (46 million tonnes) and vegetables (80 million tonnes) next to Brazil and China respectively.. Though India produces more raw materials for food and has reached self sufficiency, the projected population growth of 1500 million by 2030 AD induced challenges in the areas of productivity and production should not be ignored. The ever increasing population not only demand food to live but also fabrics to wear and shelter to reside. All these facilities shares the land under production and hence the land required for cultivation is reduced. It therefore, becomes imperative to increase the availability of food material by reducing post harvest losses which account for 10-15% in the case of durables and 25-30% in the case of perishables. By converting all agriculture and allied production into food or value added products, it may possible to feed another about 120 million population in future.

As on date, less than 2% of perishable farm produce is processed in India and 7% of this is converted as value added products. Indian food industry value is over 5,00,000 crores and the worth of value added foods produced from these industries is over 2,25,000 crores. The food industry in India is however, caught in a vicious cycle which is characterized by inefficiencies, wastages and value losses of the order of Rs.50,000 crores. This is mainly due to obsolete technologies, inefficient methods, and operation by un-skilled or non-technical persons. For any improvement, it is necessary to adopt better technologies to improve shelf life, quality and preserve nutritional and sensory value.

2. Food Processing

Food processing is the transformation of raw ingredients in to food, or of food into other forms. Food processing typically takes clean, harvested crops or butchered animal products and uses these to produce attractive, marketable and often long shelf-life food products. Food processing prevents, reduces and eliminates infestation of food with microbes, insects or other vermin. It prevents microbial growth or toxin production by microbes or reduces these risks to acceptable levels chemical or bio-chemical reactions are stopped or slowed down to make food more attractive and palatable. As a result the storage stability and shelf life are improved maintaining nutritional properties of food products.

3. Food Preservation Processes.

Various thermal as well as non-thermal processing for food preservation are given in Table 1 .

Table 1:Food preservation processes

Thermal Processing	Non-thermal Processing
Thermal processing	High Hydrostatic Pressure(HHP)
Aseptic packaging	Pulsed Electric Field
Baking	Ultrasound
Frying	Irradiation
Microwave	Gas, cold plasma
Drying	Ozone
Extrusion	Electron Beam
Chilling	Oscillating Magnetic Field
Freezing	Pulsed Light (PL)
Freeze drying	
Radio frequency	
Infrared	
Ohmic heating	

In thermal processes, heat treatment of foods is necessary to kill harmful micro-organisms in foods. Conventional thermal processes often result in undesirable changes in food, such as loss of colour, flavor, and functionality that can be avoided by using alternative minimal processing strategies. Consumers' demand for minimally processed foods with nutrient retention, high quality, additives free, convenient and "fresh like" food products, along with assurance for safety is often met by non-thermal processes.

4. Non-Thermal Technologies

Non-thermal technologies often retain the highest possible quality in stressful storage environment and provide shelf-stable food with fresh food attributes.

4.1. High Pressure Processing

High pressure processing (HPPP) is a novel method for non-thermal processing of food. It received wide attention compared to conventional thermal processing. HPP is also turned as hyperbaric pressure processing, ultra high pressure, high hydrostatic pressure and pascalization. In HPP, the food is subjected to elevated pressures (up to 900 MPa or 9000 atm) with or without the addition of heat to achieve microbial inactivation or to alter the food attributes in order to achieve desired qualities. Schematic of HPP is shown in Fig. 1

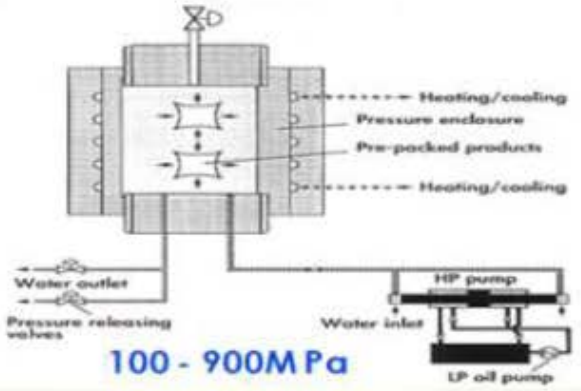


Fig.1 : High Pressure Processing

In HPP, the pressure is equivalent to the weight of three African elephants (~ 5 tons each) on top of each standing on 18mm dia disk at the base. The application of hydrostatic pressure to foods results in instantaneous and uniform transmission of pressure throughout the food products. As a result of continuous pressure results a number of changes occur in microbial cell membrane, cell morphology, and biochemical reactions, which can ultimately lead to microbial inactivation? (Fig. 2)

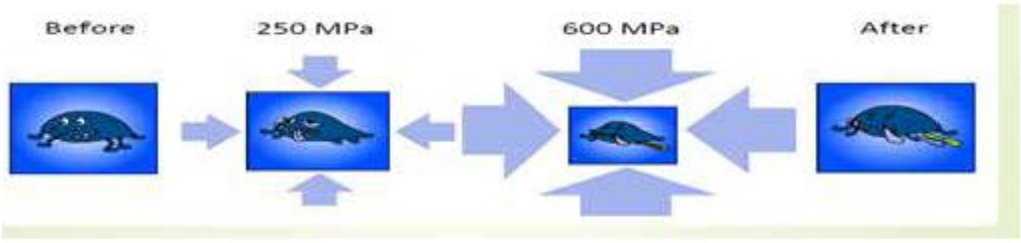


Fig. 2: Working of HPP

HP pasteurization reduces the number of (vegetative) micro-organisms and prevents product spoilage. Treatment time is generally less than three minutes and shelf life extended to months at room temperature. HPP also permits the inactivation of micro-organisms and enzymes at low temperatures, while valuable low molecular constituents, such as bioactives, vitamins, colours and flavor remain largely unaffected. According to estimates, the HPP market could approach Rs. 70 billion annually in 5 to 7 years time period.

HPP offers several benefits to consumers as well as to the industry. For consumers, it provides minimally processed food with no added preservatives. The product includes high quality beverages such as fruit juices, increased product choices, more stable and novel dairy products.

For industry, HPP provides improved process efficiencies and offers opportunities for development of new products and intermediates. It provided improved shelf life and better quality meeting consumer's demand for more natural foods.

4.1.1 HPP and food constituents

Casein in skimmed milk is disrupted by high pressure affecting he visual appearance. Fat globules are not significantly damaged. Enzymes are not destroyed during high-pressure pasteurization and hence the raw cheese might retain its original flavor notes. Yogurt from pressure treated milk was creamier than one prepared from conventional method.

Pressure treatment influences the ripening of some types of cheese. Combined lethal effect of high pressure and bacteriocin (nisin or lacticin) and or temperature treatments are very promising to provide prolonged storage stability. Orange juice was microbiologically stable for at least 21 days. Its organoleptic properties remained well accepted, and had flavor and vitamin content similar to freshly squeezed juice.

4.1.2 HPP Products

HPP products are commercially available in Japanese and European markets like jams, jellies, juices, salad dressings, fish, meat products, sliced ham, rice cakes and yogurt.

4.2 Pulsed Electric Field (PEF)

PEF is a non-thermal process for food preservation that uses short bursts of electricity for microbial inactivation and causes minimal or no detrimental effect on food quality attributes. Very

short pulses (micro-to milliseconds), at electric field intensities ranging from 10-80 kV/cm, applied to a food product held between two electrodes inside a chamber, normally at room temperature. PEF can be sued for processing liquid or semi-liquid food products. Some of the PEF equipment is shown in Fig. 3.

Fig. 3 :Pulsed Electric Field Food Processing Equipment

PEF offers high quality fresh like liquid foods with excellent flavor, nutritional value and good shelf life. Since it preserves foods without using heat, foods treated this way retain their aroma, taste and appearance.

4.2.1 Working of PEF

When biological cells are subjected to an electric field, the permeability of cell membrane is influenced inducing structural changes and local membrane break down. This phenomena, called electroporation, has lead to studies into the applications in food and bio-processing. This technique has been used for microbial genetics to introduce foreign material, such as DNA into cells (Fig. 4)

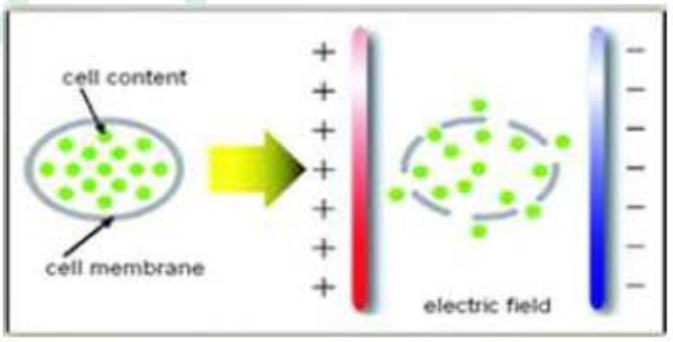


Fig. 4: Functioning of Pulsed Electric Field Process

4.2.2 Advantages of PEF

PEF kills micro-organisms while maintaining the original colour, flavor, texture, and nutritional value of the un-processed food. PEE inactivates vegetative micro-organisms including yeast, spoilage, micro-organisms and pathogens. It can therefore be also used for pasteurize fluids such as juices, milk and soups without using additives. This technology can substitute the convention heat pasteurization or it can operate at room temperature to retain quality and heat sensitive vitamins. PEF causes the

formation of large, permanent pores in cellular tissues, which can be used to improve juice yields while increasing the concentrations of functional components and enhance the characteristics of dried produce. It can support or replace conventional processing techniques such as enzymatic maceration and mechanical disintegration.

4.2.3 Problems with PEF

Micro-organisms are destroyed by PEF. But spores, with their tough protective coats, and dehydrated cells are able to survive which means refrigeration is required to extend shelf-life. There are gaps in our knowledge about physical rather than chemical preservation methods using PEF. Quantitative studies on food pathogens, real (existing or new) food matrices and the resulting quality of products (positive and negative) as well as life-cycle analysis (carbon food-print) have not been fully addressed, and proper legislation is still to be put in place. However, low electric field strength and / or pulse number causes reversible cell rupture stimulating a stress reaction in plants or cell cultures and allowing enzymes or proteins with potential health benefits to be harvested.

4.3 Plasma

Plasma is an ionized gas consisting of free electrons, ions, reactive atoms, neutral molecules and photons. When a gas like plasma is subjected to an electric field, charged particles are accelerated producing collisions with the atoms and molecules. Consequences of these collisions are new charged particles (ions, electrons and free radicals), chemical reaction with sample surface and creation of photons in the UV range. UV radiation and collision with heavy ions have a strong effect on the survival of biological species (bacteria, virus etc) ,creating important structural damage on the cell membrane.

4.4 Ultrasound.

Sound waves at frequencies higher than the audible range (16 kHz) are known as ultrasound. While diagnostic ultrasound (> 1000 kHz) is used for measuring flow rate and flow profile, composition, particle size, emulsion stability, imaging of foods etc, power ultrasound (20-1000 kHz) can be used to improve process efficiency like:

- Enhancing oxidation processes.
- Controlling enzymatic reactions (activation and inactivation)
- Simulation on living cells
- Enhancing emulsification and extraction
- Surface decontamination
- De-foaming
- viscosity modification

Ultrasound induces cell damage. Inner cytoplasmic membrane may be the point of ultrasonic damage since no significant difference in killing rate for either gram +ve or gram -ve bacteria. (Fig. 5).

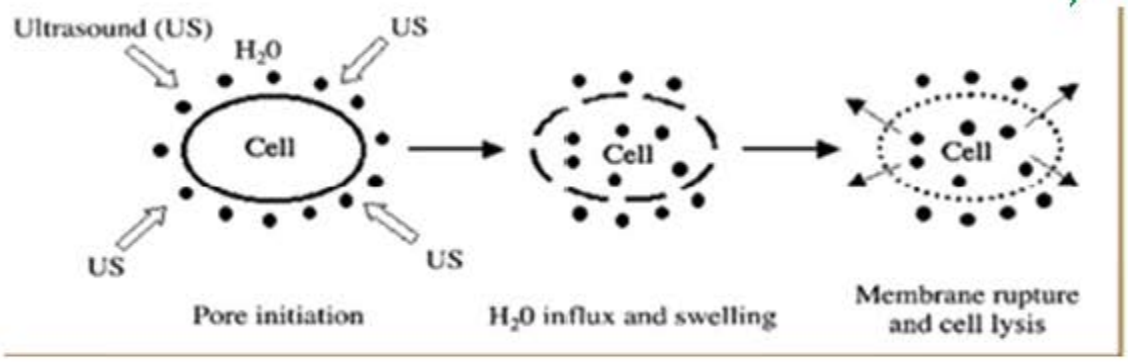


Fig. 5: Ultrasound induced cell damage

Ultrasound is one of the more advanced food technologies that has the advantages of high product yields, shorter processing times, reduced operating and maintenance cost, improved taste, texture, flavor & colour and reduction of pathogens at lower temperature. It can not only be applied to improve the quality and safety of processed foods but offers the potential for developing new products with unique functionality. While the technology has great promise, it will have to be carefully developed and scaled up for unique applications.

5. Conclusions

Non-thermal food processing is still an evolving field. Some non-thermal processes seen to have better potential than others. Equipment cost (though coming down) is still a major limiting factor. The quality of the processed food is however better compared to thermal processes with respect to nutritional and sensory value.

TRANSFORMATION OF RURAL INDIA THROUGH FOOD PROCESSING

Sharad Sarin and Abhinav Chaturvedi

1. Introduction.

By the year 2025, India will be US dollar 5 trillion economies. Presently it is around USD 2 trillion. Out of this, the rural India will account for nearly 40%. India's share of wallet is shifting from basic necessities to discretionary items. This obviously is a good trend for branded packaged food products. Rural consumption growth will accelerate now in the next 20 years, when the consumption in the rural household will reach urban levels of 2017. According to estimates of McKinsey (2007), food, beverages and tobacco with grow at a compounded annual growth rate of 4.5%, the details are given in the Table 1.

Table 1: A Snapshot of Consumption in Food & Beverages

(Source : The "Bird of Gold": The Rise of India's Consumer Market, McKinsey Global Institute, May 2007)

Category	2005 consumption billion, Indian rupees, 2000	2025 consumption billion, Indian rupees, 2000	Compound annual growth rate %
Food, beverages, and tobacco	7,147	17,296	4.5
· Food	6,565	14,598	4.1
· Non-alcoholic beverages	346	1,877	8.8
· Alcoholic beverages	115	712	9.6
· Tobacco	121	109	-0.6

India is amongst the most under-nourished country in peer group of nations and faces a challenge of feeding and providing nutrition to over a billion plus people. Mahatma Gandhi said "There are people in the world so hungry that God can not appear to them except in the form of bread". With reference to food nutrition, India's challenges are food availability, awareness, affordability, quality and safety.

According to an analysis by Kearney et al (The AT Kearney Report), the access to food can be improved by improving availability, ensuring quality and safety, increasing awareness and providing access as well as improving affordability (Fig. 2)

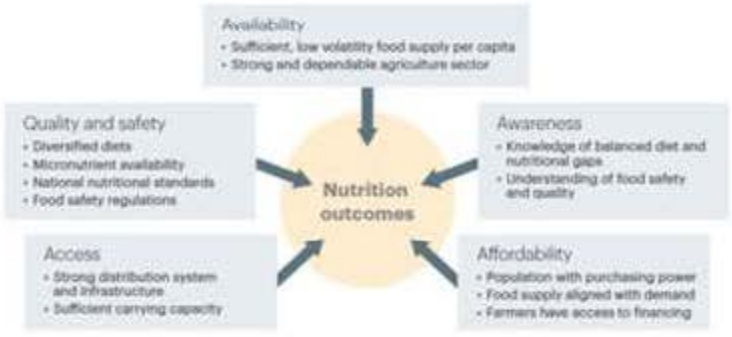


Fig. 2: Framework for improving access to nutritional food:
The AT Kearney Report

India's food requirements are expected to shift to more rich protein diet (from 2140 kilocalories now to 2568 kilocalories in 2020) (National sample survey office 66th round 2009) (Fig. 3).

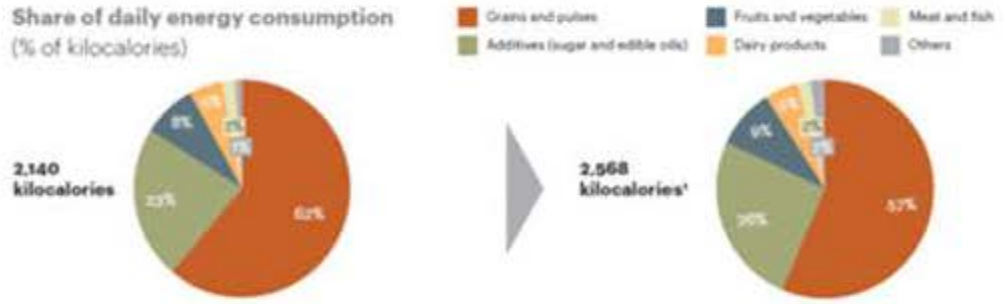


Fig. 3: Expected shift in India's food consumption pattern

The expected demand for grain & pulses & other food essentials is given in Table 1.

Table 1: Expected demand for grain, pulses and other food essentials

(Source: Feeding a Billion People- The role of the food processing industry, AT Kearney, 2013)

Supply (in million ton) : Demand & Availability			
Category	Domestic Availability 2010	Domestic Demand 2010	Domestic Demand 2025
Grains & pulses	186	191	240-260
Additives (Sugar, Edibil Oil)	188	189	300-330
Fruits & vegetables	87	87	130-140
Dairy Products	37	48	76-82
Meat & Fish	15	15	20-25
Others	3	3	9
Total	516 mn ton	534 mn ton	775-850 mn ton

In the year 2025, the demand may fax exceed the total domestic availability.

There are enormous opportunities in the sector in India, because India's per capita consumption / spending are much below than the Wolds's average and far behind advanced countries (Table 2). With increasing incomes, India's average is bound to increase much more than the present levels.

Table 2: Per capita food consumption for selected items: India and world

		Per capita consumption/spending 2008-09		Per capita spending
S.No.	Products	India	World	Largest Consumer
1	Milk	250g/day	1315g/day	5504 g/day (Finland)
2	Sugar	19kg	24kg	47 Kgs (USA)
3	Tea	.5kg/annum	.75kg/annum	2.7 kg/annum (Australia)
4	Coffee	.85kg	5kg	12kg (Finland)
5	Edible Oil	12 Kgs	20 kgs	30 Kgs (USA)
6	Household goods	US $ 19	US $ 1523	US $ 1523
7	Retail spending	US $ 701	US $ 13,259 (US)	US $ 13,259 (US)
8	Bottled water	3-4 lts	25 lts	111 lts(Europe) 45 lts(US)

2. India's Food Processing Industry

Food processing can transform the lives in Rural India in analogy with IT sector transformation to the Indian economy. Presently, food and food processing sector accounts for only 15% of the GDP. However, food processing in India needs to be agriculture plus. Presently the food processing contributes about $ 180 billion (INR 8 lakh crore) or only 1.3 to 1.5% to India's GDP. This is bound to grow and grow at a much faster rate.

There are three segments to the food processing namely, primary processing, secondary processing and tertiary processing. Various steps in all the three segments are given in Table 3. India's food processing is however dominated by the un-organized sector.

Table 3: Three segments of India's food processing industry

	Primary processing	Secondary processing	Tertiary processing
Fruits and vegetables	• Cleaning, cutting, and sorting	• Pulps, pastes, and slices	• Jams, juices, and pickles
Grains and cereals	• Sorting and grading	• Flour, malt, and milling	• Biscuits, noodles, and cakes
Dairy products	• Grading and refrigeration	• Cottage cheese, cream, and dried milk	• Yogurts and spreadable fats
Meat and poultry	• Sorting and refrigeration	• Cut, fried, and frozen	• Ready-to-eat
Marine products	• Chilling and freezing	• Cut, fried, and frozen	• Ready-to-eat
Edible oils	• Sorting and grading	• Refined oils	• Fortified oils

Source: A.T. Kearney analysis

The quantum of processing in the organized and also is the und-organized sector is given in Table 4.

Table 4: Food processing in the organized and un-organized sectors in India

Item	Processing in Organized Sector	Processing in Un-organized Sector	Total Processing
Fruits& Vegetables	1.2 %	0.5 %	1.7 %
Dairy Products	13	22	35
Meat	21	--	21
Poultry	6	--	6
Marine Fisheries	1.7	9	10.7
Shrimps	0.4	1	1.4

Source: Report of the Task Force on Development of Cold Chain in India, Department of Agriculture & Cooperation

In spite of have a comparative advantage in terms of raw material and agro-production and growing demand for processed food, the level of food processing is not significant as compared to other countries. Food is the biggest expense of an urban and rural Indian household constituting share of 38.5% and 48.6% of the total expenditure of household in 2011-12 respectively. As far as fruit and vegetables are concerned only 2.2% are processed and this is much lower when compared to countries like USA (65%), Philippines (78%) and China 23%. More importantly is the huge wastage estimated to be around (35%), for lack of processing and storage of fruits and vegetables. In the monetary terms, this amounts to approximately Rs. 33,000 crores annually.

The food processing industry, in India employs 13 million people directly and 35 million persons indirectly. This industry is one of the major employment intensive segments contributing 13.04% of employment generated in all registered factory sector in 2012-13. Unemployment rate in rural India is 1.7% and in urban areas 3.4%. Total number of employed people in India as on 2014 was 47.4 crores, while the number of un-employed stood at 1.06 crores. About 33.7 crore people work in rural India and 13.7 crores in urban India. The corresponding unemployed figures are 0.92 crores and 0.44 crore respectively. It is also to be noted that the wages in rural area for men as well as women have grown substantially since 2004-05 (Table 5).

Table 5: Growth in wages of rural men and women between age 15-59

	2004–05 daily wage	2011–12 daily wage	Growth (%)
Agricultural casual (daily) wages			
Men	89	134	50
Women	62	91	47
Other casual (daily) work wages			
Men	124	171	38
Women	76	110	45
All non-MGNREGA earnings (including casual and regular work)			
Men	143	194	36
Women	78	116	48

Source: Mahatma Gandhi National Rural Employment Guarantee Act
A Catalyst for Rural Transformation, 2014-15

3. Four stories: Rural Transformation through Food Processing.

In this part-I, will illustrate four success stories that have transformed the economy of the village as well as considerably improve the production and supply of concerned product.

3.1 AMUL

First successful example is that of AMUL, which today is the largest milk cooperative with an annual turnover of Rs. 26000 crores. The daily milk collection from various villages was 232 lakh liters/day in the year 2014. In Gujarat, there are seventeen district unions having 17000 village dairy cooperatives (VDC). India has 22 states federations, 184 district unions and 1,44,500 village dairy cooperatives. Members supplying milk to the dairies are 15 million in India and 1.2 million only in Gujarat. .

Late Shri Lal Bahadur Shastri had identified the success factors of dairy farms as follows:

- Farmers own dairy: responsibility of ownership.
- Elected members mange village societies and district unions.
- Employment of professionals to operate dairy and mange its business.

Dr. Kurien had joined (1972 making dairying as an instrument of change:

- Dairying is an industry – but its development must also serve our rural and semi-rural population.
- Planned or unplanned – public private or cooperative - in its development, dairy must compete for investment funds and
- Our dairying must develop in such a way as to contribute to the solutions of the problem of rural poverty.

3.2 Lijjat Papad : Shri Mahila Griha Udyog Lijjat Papad.

Lijjat is an organization of women, by the women and for the women. It was started in the year 1959 with 7 lady members and with a borrowed sum of Rs.80/- at Girgaum in Mumbai. Today in the year 2015, the sales of Lijjat have reached Rs. 1200 crores and out of this Rs.1000 crore was from papad and the balance from miscellaneous products like ATTA, Pickles etc.

By 2014, Lijjat had 82 branches and 27 divisions in the country and employed more than 43000 sister members. The minimum earnings were Rs.145 per day (2014) at the rate of Rs.35 x 5 Kg for rolling 5 Kg for papad. Payment is made for a minimum of 5 kg of finished product.

Productivity for two sizes of papad 7" x 5" was 1 Kg in half an hour for expert and one hour for an average performer. For 5" papad, the raw material Atta of 800 gms will give 120 papads and 7" will give 65 papads. The social impact of this cooperative is:

- Employment and self respect.
- Empowerment and leadership at all levels
- Education of self and family members.

The cooperative had organized 50th annual general meeting recently. It was resolved that if the branches can be opened in every district one can increase the membership from 45 thousands presently to 45 lakhs as self employed women.

3.3 Ramdev's Patanjali

Patanjali is a mass volunteerism for creating new India based on three principles:

- Healthy mind in healthy body
- Issues of sustainability
- Communal harmony

The priorities of change in Ramdev's movement are:

- Equal access to quality education to all children irrespective of class, caste and creed.
- Generate employment: Every hand should have work.
- Appropriate use of natural resources namely, water, land and forest.
- Corruption free administration.

Ramdev's products, of food and personal care have reached a business of Rs.2000 crore in 2014-15 as compared to Rs.50 crores in 2006-07. There are 15000 exclusive Patanjali outlets across the country till May 2015. In 6000 villages, Swadeshi Kendra are operating and one lakh stores sell Patanjali products.

3.4 Krishi Gram Vikas Kendra (KGVK), Rukka-Ranchi.

KGVK is an NGO of Usha-Martin group that began in 1972 but stared with Total Village Management (TVM) in 2007. TVM is a seven years journey from 5 villages to 415 villages in nine districts in Jharkhand that reached 45000 households in the year 2015. TVM is a model of sustainable development – a 360 degree approach to rural development.

The eight pillars of TVM are:

- Natural Resources Management.
- Health, nutrition and sanitation.
- Resources mobilization and infrastructure development.
- Women empowerment.
- Education
- Capacity Building and Market Linkage.
- Livelihood and Financial inclusion
- Energy inclusion.

The impacts of the TVM have been felt in the following:

- Rs.3.76 crores worth additional income for 11,198 farmers through SRI (System of Root Intervention)
- Rs.4.14 crores generated through vegetable cultivation by 6705 farmers.
- Rs.9.96 crores generated through off farm activities.
- Manages the school that developed the first girl's football team that participated in European Football league.

4. Conclusions

India is re-gearing for major transformation. The government, NGOs, business organizations

and media (TV, social & others) are playing a major role in this transformation. Aspirations, imaginations and innovations can do wonders. Food processing holds a big promise to generate employment and improve educational levels of millions.

"The enigma of India is that our progress in higher education, science and technology has not been sufficient to take out 350 million Indians out of literacy. It is difficult to imagine that 318 million people in the country don't have access to safe drinking water and 250 million people do not have access to basic medical care. Why should 630 million people not have access to acceptable sanitation facilities even in 2009?. When one sees world class supermarkets, and food chains in our towns and when our urban youngsters float over the choice of toppings on their pizzas, why should 51% of the children in the country be under-nourished". Narayan Murthy " A Better India; A Better World"

Innovative Thought Forum

INDIAN FOOD INDUSTRY : MY EXPERIENCE

Dinesh Oza.

1. Introduction

India has immense potential in agriculture, horticulture and food processing to contribute to the country's economy substantially. India holds second largest arable land in the world. With 20 agri-climatic regions, all 15 major climates of the world exist in India. The country also possesses 46 of 60 soil types in the world. India is the largest producer of milk, tea, cashew and mangoes, buffalo meat and second largest producer of tea, wheat, sugar cane and rice. The total value of Indian food processing industry is expected to touch US $ 194 billion in 2015 from a value US$ 121 billion in 2012.

Annual horticulture production is estimated at 100 million tonnes, which is over 18% of India's annual agricultural output; India being the largest producer of fruits and vegetables. Country's current food grain production (rice, jowar, bajra, maize, ragi, wheat, barley, gram and pulses) has been put at 225 million tons per year. India has the largest livestock population with milk cows and buffaloes being the main constituents. India at 172 million tons annually is also the largest milk producer

FAO has estimated the existing production of meat and poultry products and 4.42 million tons. Only 11% of buffalo population, 6% cattle, 33% sheep and 33% goat population is culled for meat. India boasts of the seventh largest marine landing base in the world with an extensive 7500 km coasted line and an Exclusive Economic Zone (EEZ) of 2 million Sq. km., largely untapped and also has a 29000 km stretch of rivers & canals. The country also has 145 million hectares of reservoirs and 0.75 million hectares of tanks and ponds. According to McKinsey, India will be an agriculture and high value food powerhouses by 2030.

2. The Beginners

Kantilal Chauhan set up a small confectionary unit named as "Parle Products" in 1920. Parle Industry today has more than Rs. 10000 crores annual turnover. Dr. Kurien's Amul today is a Rs.20000 crore industry, Nestle, an MNC, who set up their first unit in 1961 in Moga, Punjab, is today Rs.9853 crores Industry. One thing that is common to all these success stories is to grab opportunity while understanding the risk and results, so important to the growth.

3. Going Ahead

The industry can't grow by blaming the government for poor policy or poor infrastructure. Blaming lack of skilled power will also not help the industry and also blaming the economy or poor purchasing power will not be of any help. We or the industry have to go ahead. A forum like this, i.e. ITF may do the following:

- Launching a website providing data on food sector in nutshell.
- Convince farmers for minimal processing at farm level with financial support from the respective industry.
- Inspire the farmers of a specific agro-commodity area to set up a cluster for value added processing with possible support of sale.
- Provide required information to an entrepreneur for setting up a food processing unit at minimal or no cost.

- Show the experience with the government for necessary reforms in policy, infrastructure etc.

For facilitating an entrepreneur for setting up a food unit requires the following:

- Carrying out a SWOT analysis himself of the product segment in which he wishes to venture.
- Guidance for marketable product possibilities, if possible provision of guidance for innovation, in shape, size and taste and product presentation.
- Analysis of market probability and market competitiveness.
- Set up a small viable unit in the available infrastructure
- May grow in 2-3 years.

Besides market and financial availability, other major issues in a startup are :

- Land availability and affordability
- Data on raw material like varieties, growing centers, availability & trade practices.
- Appropriate machinery; Indigenous v/s Imported.
- Solid / liquid waste disposal and possibly utilization.
- Availability of food additives
- Availability of food certificates.

4. DISAN: Company profile

DISAN has 30 years of experience in the food processing sector and associated with more than 150 food projects across the country. The company has set up food projects in segments like F&V, cereals, spices edible oil, confectionary and food ingredients etc. The company is acquainted with all existing and new food processing technologies for dehydration, extrusion, baking, frying, freezing, extraction, concentration, microwave drying, size reduction etc. DISAN personnel are either on advising panel or visiting faculty to GITCO, GAICL, GCCI, EDI and also on board of directors of many companies.

Various issues related to food industries have been resolved like:

- Bajaj Wafers (1087): Avoiding potato chips from browning on frying.
- Janak Dehydration (1992): Dehydration of colored vegetables & waste utilization.
- Jain Irrigation (1997): Problems of oversize & under size onion bulb utilization.
- L & T Niro, Vadodara (2002): Affordable hydration machinery fabrication.
- Micro Industries (2006): Compatibility of defatted soy flour with besan/rice flour to product dal/rice analogues suit to Indian taste and getting right cooking properties.
- Freshtrop Fruits Ltd , Nasik (2009) : Making pomegranate juice plant viable.
- Patco Foods Ltd, Surat (2011) Setting up 10 different food units at one place.
- Cilantro Foods (2012) Making water, oil & sugar compatible N.I Flavours.
- Inbisco India (Indonesian Co.) (2014): Making Indian RM compatible with formulations.
- Ramdev Foods (2015) Water recycling starch recovery & peel utilization in PC Plant.

The scope of our services include project conceptualization, project planning and technology selection, DPR and estimated project cost, preparation of all lay units (BLD/MC/UTI), erection and commissioning of plant and trial runs. The trial runs help to setting up the technology parameters.

We also assert in commercial production, QC lab, getting quality certificates and implementing plant hygiene. We also partner in selection of technical manpower & provide training. Of course new product development remains our endeavor.

We work closely with the entrepreneur by providing product and segment understanding, making project portfolio wide depending upon product applications and suggestion of rough technology and cost. We endeavor to make plant versatile for using similar products and waste utilization. We do educate he prospective entrepreneur the critical aspects of the project. Some of the executed prestigious projects are :

- Inbisco India Ltd – Ahmedabad.
- Servottam Dairy – Bhavnagar.
- Freshtrop Fruits Ltd – Nasik.
- Ramdev Food Products Pvt. Ltd - Ahmedabad.
- Marico Ltd - Mumbai.
- Waves Foods Pvt Ltd (Rasna) - Ahmedabad.
- L & T Nitro Ltd – Vadodara (Now GEA)
- Jain Group of Industries – Jalgaon.
- Patco Foods Ltd – Surat.
- Gitco Ltd – Ahmedabad.

Some of the suggested projects for prospective entrepreneurs are :

Projects	Suggested Capacity (On Output Basis)	APPROX PROJECT COST Rs. Lakh	Approx Turnover Rs. Lakhs	1. Technology 2. Indigenous Mkt 3. Export Markets
Integrated Dehydration Plant: Ex Tomato Flakes/P	Hot Air Dried: 5 TPD Spray Drying: 4 TPD Drum Drying: 3 TPD	1500.00	4000.00	1. Imported + Indi. 2. Excellent 3. Excellent
Vacuum Fried F&V Chips: Mango, Carrot, Brinjal, etc.	2 TPD (Output)	500	900	1. Imported 2. Excellent 3. Excellent
Puffed/Roasted Cereals, Pulses, Nut	300 kg/hr	300.00	1000.00	1. Imported + Indi. 2. Existing 3. Excellent
Continuous Chikki, Cereal Bars & Fruit Bars	300 kg/hr (Chikki) Flavored Chikkies Good for Child Nutri.	1000.00	2500.00	1. Imported 2. Existing 3. High Potential
Roller Dried Potato Flakes and Powder	01 TPH (Output)	1000	4800	1. Imported 2. Growing 3. Excellent

PACKAGING SOLUTION FOR FRESH FLOWERS, FRUITS & BEVERAGES

Siva Sankaran

1. Introduction.

Fresh fruits and vegetables are living products with two important processes going on inside them, namely:

- Respiration – Conversion of starch to sugar and to energy.
- Transpiration – Loss of water by evaporation.

Respiration rate is determined by Temperature and it varies through the season. It is also different for different products and by also region for the same product. The increase in the shelf life of the agriculture and horticulture produce therefore need analysis, science and technology.

2. Extending the Shelf Life

Fresh produce of the farm needs oxygen to stay alive. Decreasing supply of oxygen improves the shelf life. Uflex provides controlled oxygen concentration in the package to ensure Aerobic Respiration. If no oxygen is supplied, than the anaerobic respiration will cause rapid spoilage. Our packing is optimized to maintain equilibrium atmosphere to enhance shelf life. Low level of O2 and high level of CO2 prevents oxidation responsible for deteriorating taste and flavor.

The equipment shown in Fig. 1, shows the respiration rate on line and concentrations of O2,

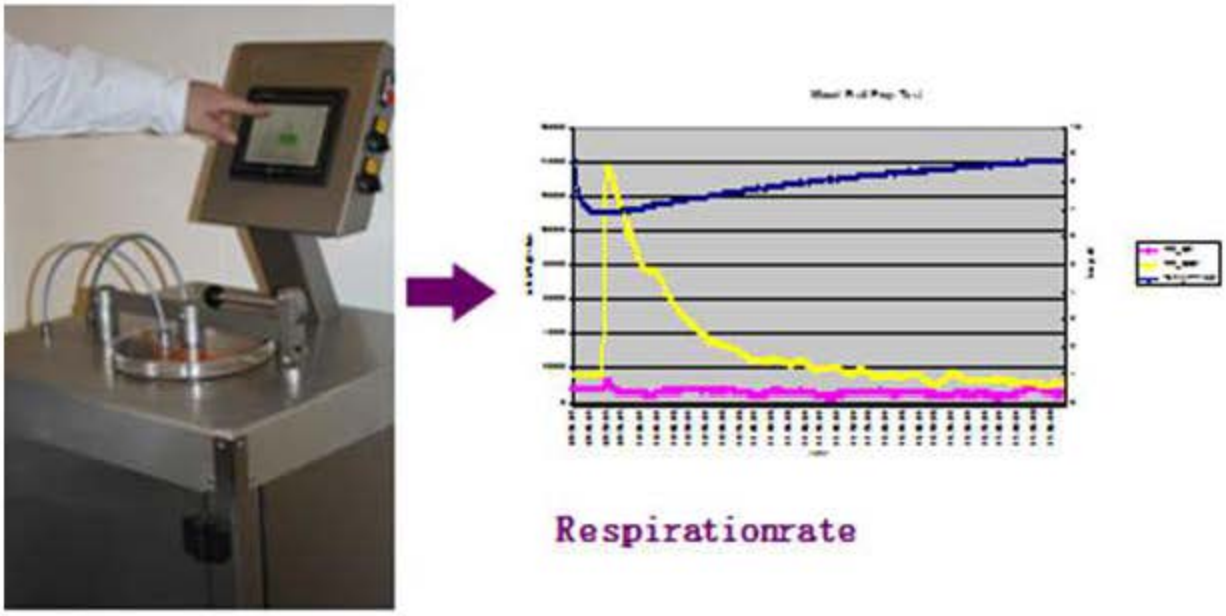


Fig.1: Respiration results

Co2 and the temperature variation over time . By keeping low levels of O2 and higher levels of Co2 , one is able to reduce waste and extends shelf life of the packaged produce. (Fig. 2)

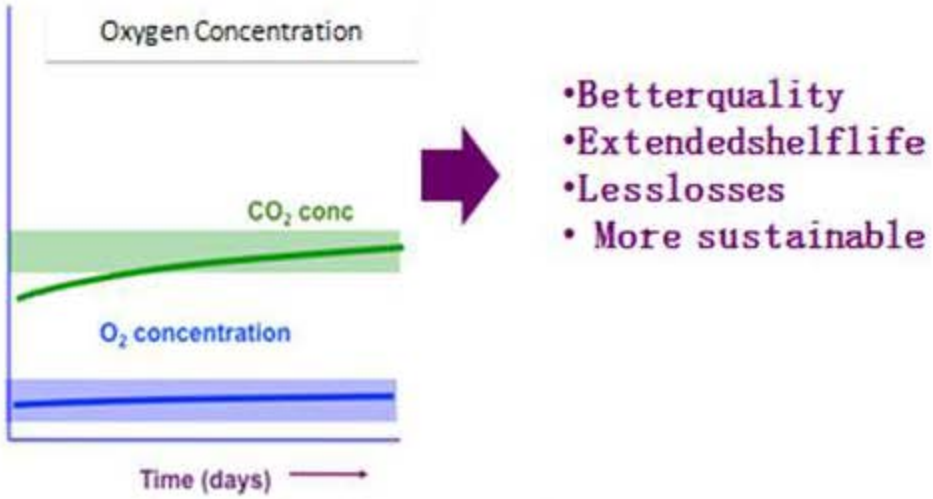
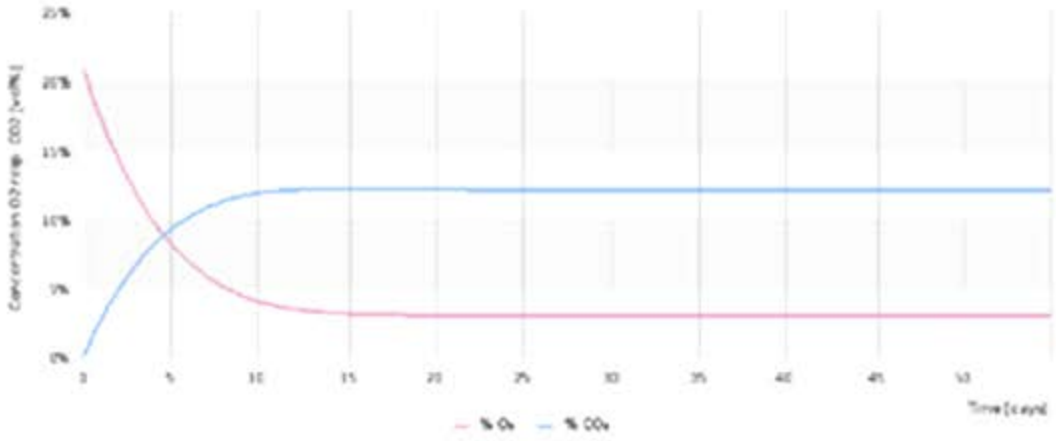


Fig. 2: The Solution

In the cases of green grapes the predicted O2 and CO2 levels are given in Fig. 3. Similar results were obtained for fresh okra



Examples of prolonged shelf life

We have developed a polymer that is biodegradable and keeps oxygen equilibrium inside the package. The product has a shelf life of 2 months. Cut pieces of vegetables in Domino Pizza are supplied. The other examples are prolonged shelf life of roses received by air freight. The results shown in Fig 4. After 22 days in storage the roses packed with the liner are just as good or even better than the fresh product. It is possible to shore roses up to 22 days for 31 days at the moment it is only possible with a couple of varieties.

Another example is the transport of hollandaise bell pepper overseas. It is possible now-a-days, using this packing, use sea route. Earlier it was only by air.

- 21/4 arrival by air freight
- Topical Amazone: Packed in the flex liner, after 7 days on the vase 89% of the roses are still good, in comparison with 50% with the current packaging. This is an improvements of 178%.

rozen goed na 7 dagen (%)			
	Trop Amazone	Akito	H&M
With	89	60	80
Without	50	50	40
Improvement	178	120	200

Fig.4 : Results showing prolonged life of fresh roses in a vase

3. Conclusions

Uflex Flex fresh liner provides the best shelf life extension of all available packaging solutions. This liner reduces weight loss during transportation. This packaging enables cheaper transportation methods and creates new export opportunities. The package is suitable for 5 to 15 kg fresh produce. Our claims are based on comparative studies under recommended respirations and temperature conditions performed by Uflex.

ORGANIC NUTRITION GARDEN: A PROJECT IN VIDARBHA

Dilnavaz Variava

(Presented by Dr. Shivang Swaminarayan)

1. Introduction

"When one's food is pure, one's being becomes pure" says Chandogya Upanishad 7.26.3. Indian is home to a quarter of all undernourished people worldwide ranking 135th in UNDP Human Development Index (2014) & 55th in Global Hunger Index. India is home of widespread anemia especially among women and children. As per Maharashtra survey (2012-13) 68% of children (6-14 years) and 65% women (15-49 years) suffer from anemia

We have initiated a Nutrition Garden Project in Seloo Taluka, Wardha District Maharashtra (August 2010 – May 2013). The project got started with only 5 villages and ended with 26 villages.

The objectives of the project were to improve household food availability with nutrition security and health especially for those most affect by anemia.

2. Methodology

We started with a meeting to create awareness followed by solution for beneficiaries based on willingness to develop kitchen garden. This was followed by training and supply of seed of 16 varieties of vegetables. We kept monitoring, guidance and required support. Simultaneous classes were held on nutritious food and demonstration to prepare the same. A house to house survey used to be conducted twice a year to collect information and quantity of vegetables grown in monsoon & winter. Health camps were organized to check up general health parameters and to estimate hemoglobin.

3. Results and observations

In the first year, total of 64 nutrition gardens were developed in 6 villages. In the 2nd year, 301 nutrition gardens were developed by women in 12 villages and 101 by students of two schools. In the 3rd year it was possible to have 833 nutrition gardens in 26 villages.

It was observed that hemoglobin in women has improved remarkably. There were no anemic pregnant women with kitchen garden. The women prefer to consume fresh vegetables over IFA tables. In the two villages out of five, 100% women attained normal Hb. In villages, where women reduced their Hb even after the nutrition garden in their farm, study is required to identify factors responsible for adversity.

4. Conclusions

Nutrition garden is a home based approach that answers cost effective availability of fresh vegetables. Vegetables improve health & nutrition in a sustainable manner. The model is easily replicable and it is scalable. The project has been a step forward in reducing anemia and malnutrition improving health index with better productivity.

Innovative Thought Forum

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