Training Programme

On

"Value Chain Analysis for Agricultural Commodities "

CCS National Institute of Agricultural Marketing

(An autonomous organization under Ministry of Agriculture and Farmers' Welfare Government of India)

Kota Road, Bambala, Pratap Nagar, Sanganer

Jaipur.

TRAINING PROGRAMME

ON

"VALUE CHAIN FOR AGRICULTURAL COMMODITIES"

READING MATERIAL

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Content Sheet

Value chain Analysis of Agricultural Commodities – An overview

Background:

A value chain is a set of linked activities that work to add value to a product; it consists of actors and actions that improve a product while linking commodity producers to processors and markets.

Value chains work best when their actors cooperate to produce higher-quality products and generate more income for all participants along the chain, as opposed to the simplest kinds of value chains, in which producers and buyers exchange only price information — often in an adversarial mode. Value chains differ from supply chains, which refer to logistics: the transport, storage and procedural steps for getting a product from its production site to the consumer.

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Value chain analysis:

A value chain approach in agricultural development helps identify weak points in the chain and actions to add more value.

In Rwanda, for example, analysis of the dairy value chain identified critical needs for more local milk cooling points, more collaboration between dairy plants and farmers and greater diversification of final products. In Guatemala, the world's largest producer of cardamom, reviews by Heifer International and the Norman Borlaug Institute for International Agriculture revealed that critical value chain weaknesses are total lack of varietal development over 100 years and lack of development of more diversified markets for cardamom as an input to processed foods, cosmetics and health products. In the Philippines, the analysis found a need for fishermen to deliver more uniform-sized fish to processors, for government to enforce corresponding regulations and for processors to offer fishermen contracts that contain credit. And in Vietnam, a value chain analysis of a cassava industry driven by growing demand inside the country and from China identified issues regarding depletion of soil fertility (unsustainable farming methods), management of wastewater from starch plants, and the need for better direct links between small farmers and processors.

Another example is sorghum in Africa. It has multiple end uses, including as porridge, flour, snacks, couscous and other products for human consumption; inputs for beer production; and feed for poultry and animals. However, yields of these grains have increased only slightly, and the sales of the grains to markets other than animal feed face obstacles in the value chains. Farmers could expand their profits from these multiple potential markets if solutions were found for value chain issues such as:

1. Poor quality of seeds and varieties inappropriate for the various uses.
2. Poor quality of product at harvest, with grains of inconsistent size and coloration.
3. Inadequate threshing techniques and post-harvest drying and storage, which reduce quantity and market quality.
4. Inadequate grading.
5. Insufficient market development and communication with markets regarding varieties and quality of sorghum desired.
6. Insufficient training and finance for improved post-harvest management.

This analysis underscores the importance of sorghum growers and breeders recognizing that managing for food quality can increase their access to more markets. In Uganda, a brewery

strengthened the sorghum value chain by offering farmers production contracts with guaranteed prices along with quality requirements, which led many more farmers to grow the grain.

As these examples illustrate, finding ways to improve value chains can be very important for raising small holders' incomes. Without being linked into markets they are condemned to produce only for subsistence — better markets can lift them out of poverty. But making this leap requires more knowledge, and many actors along the value chain can help supply this crucial ingredient.

Value Chain Analysis for Agricultural Commodities:

The agricultural value chain concept has been used since the beginning of the millennium, primarily by those working in agricultural development in developing countries. Although there is no universally accepted definition of the term, it normally refers to the whole range of goods and services necessary for an agricultural product to move from the farm to the final customer or consumer.

The term value chain was first popularized in a book published in 1985 by Michael Porter, who used it to illustrate how companies could achieve what he called "competitive advantage" by adding value within their organization. Subsequently, the term was adopted for agricultural development purposes and has now become very much in vogue among those working in this field, with an increasing number of bilateral and multilateral aid organisations using it to guide their development interventions.

At the heart of the agricultural value chain concept is the idea of actors connected along a chain producing and delivering goods to consumers through a sequence of activities. However, this "vertical" chain cannot function in isolation and an important aspect of the value chain approach is that it also considers "horizontal" impacts on the chain, such as input and finance provision, extension support and the general enabling environment. The approach has been found useful, particularly by donors, in that it has resulted in a consideration of all those factors impacting on the ability of farmers to access markets profitably, leading to a broader range of chain interventions. It is used both for upgrading existing chains and for donors to identify market opportunities for small farmers.

There is no commonly agreed definition of what is actually meant by agricultural value chains. Indeed, some agencies are using the term without having a workable definition or definitions

and simply redefined ongoing activities as “value chain” work when the term came into vogue. Published definitions include the World Bank’s “the term ‘’value chain’’ describes the full range of value adding activities required to bring a product or service through the different phases of production, including procurement of raw materials and other inputs”, UNIDO’s “actors connected along a chain producing, transforming and bringing goods and services to end-consumers through a sequenced set of activities”, and CIAT’s “a strategic network among a number of business organizations”.

Without a universal definition the term “value chain” is now being used to refer to a range of types of chain, including:

1. An international, or regional commodity market. Examples could include “the global cotton value chain”, “the southern African maize value chain” or “the Brazilian coffee value chain”;
2. A national or local commodity market or marketing system such as “the Ghanaian tomato value chain” or “”the Accra tomato value chain”;
3. A supply chain, which can cover both of the above;
4. An extended supply chain or marketing channel, which embraces all activities needed to produce the product, including information/extension, planning, input supply and finance. It is probably the most common usage of the value chain term;
5. A dedicated chain designed to meet the needs of one or a limited number of buyers. This usage, which is arguably most faithful to Porter’s concept, stresses that a value chain is designed to capture value for all actors by carrying out activities to meet the demand of consumers or of a particular retailer, processor or food service company supplying those consumers. Emphasis is firmly placed on demand as the source of the value.

Value Chain Methodologies:

Donors and others supporting agricultural development, such as GIZ, DFID, ILO, IIED and UNIDO, have produced a range of documents designed to assist their staff and others to evaluate value chains in order to decide on the most appropriate interventions to either update existing chains or promote new ones. However, the application of value chain analysis is being interpreted differently by different organisations, with possible repercussions for their development impact. The proliferation of guides has taken place in an environment where key conceptual and methodological elements of value chain analysis and development are still evolving. Many of these guides include not only detailed procedures that require experts to carry out the analysis but also use detailed quasi-academic methodologies.

One such methodology is to compare the same value chain over time (a comparative or panel study) to assess changes in rents, governance, systemic efficiency and the institutional framework.

Linking Farmer to market:

A major subset of value chain development work is concerned with ways of linking producers to companies, and hence into the value chains. While there are examples of fully integrated value chains that do not involve smallholders (e.g. Unilever operates tea estates and tea processing facilities in Kenya and then blends and packs the tea in Europe before selling it as Lipton, Brooke Bond or PG Tips brands), the great bulk of agricultural value chains involve sales to companies from independent farmers. Such arrangements frequently involve contract farming in which the farmer undertakes to supply agreed quantities of a crop or livestock product, based on the quality standards and delivery requirements of the purchaser, often at a price that is established in advance. Companies often also agree to support the farmer through input supply, land preparation, extension advice and transporting produce to their premises.

Inclusive Value Chain:

Work to promote market linkages in developing countries is often based on the concept of "inclusive value chains", which usually places emphasis on identifying possible ways in which small-scale farmers can be incorporated into existing or new value chains or can extract greater value from the chain, either by increasing efficiency or by also carrying out activities further along the chain. In the various publications on the topic the definition of "inclusion" is often imprecise as it is often unclear whether the development aim is to include all farmers or only those best able to take advantage of the opportunities.

Agricultural Value Chain Finance:

Agricultural value chain finance is concerned with the flows of funds to and within a value chain to meet the needs of chain actors for finance, to secure sales, to buy inputs or produce, or to improve efficiency. Examining the potential for value chain finance involves a holistic approach to analyze the chain, those working in it, and their inter-linkages. These linkages allow financing to flow through the chain. For example, inputs can be provided to farmers and the cost can be repaid directly when the product is delivered, without need for farmers taking a loan from a bank or similar institution. This is common under contract farming arrangements. Types of value chain finance include product financing through trader and input

supplier credit or credit supplied by a marketing company or a lead firm. Other trade finance instruments include receivables financing where the bank advances funds against an assignment of future receivables from the buyer, and factoring in which a business sells its accounts receivable at a discount. Also falling under value chain finance are asset collateralization, such as on the basis of warehouse receipts, and risk mitigation, such as forward contracting, futures and insurance.

The use of ICT in Value Chain:

Information and Communication Technologies, or ICTs, have become an important tool in promoting agricultural value chain efficiency. There has been a rapid expansion in the use of mobile technologies, in particular. The price of ICT services is falling and the technologies are becoming more affordable to many in developing countries. Applications can support farmers directly through SMS messages. Examples include iCow, developed in Kenya, which provides information on the gestation period, on artifi can support access to mobile payment services for a large percentage of those without banks, thereby facilitating transactions in the value chain. Other applications have been developed to promote provision of crop insurance through input dealers, for example.

ICTs are also being used to strengthen the capacity of extension officers and NGO field staff to reach farmers with timely and accurate information and, at the same time, help capture data from the field. The Grameen Foundation's Community Knowledge Worker (CKW) programme is an example. Farmer representatives are trained to use ICT applications on a smartphone to provide agricultural information and extension support. Most market price information is now delivered to farmers via SMS. Further along the chain, technologies offer considerable possibilities to enhance traceability, which is particularly relevant as certification grows in importance. Where necessary many exporters can now trace consignments back to individual farmers and take necessary measures to address problems. Finally, systems such as FARA's eRails are also supporting agricultural researchers through data collection and analysis and access to up-to-date research publications.

Enabling Environments:

As with all agricultural growth, two things appear essential for successful value chain development: creating the right environment for agriculture and investing in rural public goods. An enabling environment implies peace and public order, macro-economic stability, inflation

under control, exchange rates based on market fundamentals rather than government allocation of foreign currency, predictable taxation that is reinvested in public goods and property rights. There is a positive correlation of agricultural growth with investment in irrigation, transport infrastructure and other technologies. Governments have a responsibility to provide essential goods and services, infrastructure, such as rural roads, and agricultural research and extension. Value chain development is often constrained by corruption, both at a high level and at the ubiquitous road blocks found in many countries, particularly in Africa. Many measures to improve value chains require collaboration between a wide range of different ministries, and this can be difficult to achieve.

Post-Harvest Technology Management for Agricultural Commodities.

Introduction

India is the world's 2nd largest producer of food next to China, and has the potential of being the largest with the potential of being the largest with the food and agricultural sector. There is an opportunity for large investments in food and food processing technologies, skills and infrastructure, especially in areas of canning, dairy packaging, frozen food / refrigeration and thermo processing. Fruits and vegetables, milk and milk products, meat and poultry, packaged / convenience foods, alcoholic beverages, soft drinks, and grains are important sub - sectors of the food processing industry. Health food and supplements are other rapidly rising segments of this industry.

India is the 2nd largest vegetable and 3rd largest fruit producer in the world. India is poised to register the highest increase in rice production in the world over the next 10 years. India ranks second only to Japan in inland fish production.

India's food processing sector covers fruit and vegetables, meat and poultry, milk and milk products, alcoholic beverages, fisheries, plantation, grain processing and other consumer product groups like confectionery, chocolates and cocoa products, soya- based products, mineral water, high protein foods etc.

After harvest, foods (e.g. fruits, vegetables, milk, meat, fish,) are liable to accelerated physiological, chemical, and microbial processes that invariably lead to deterioration and loss of wholesomeness. It is then necessary to institute some measure of processing such as reduction in moisture content, denaturation of endogenous enzymes and microorganisms, or packaging in order to curtail perishability. In the absence of such processing, massive post-harvest losses can ensue. It is the responsibility of the food scientist or technologist to understand the underlying processes contributing to food deterioration and spoilage and, to device appropriate measures and methods of preservation in order to ensure availability, acceptability, and safety of foods.

Value addition to food products has assumed vital importance in our country due to diversity in socio-economic conditions, industrial growth, urbanization and globalization. It is not merely to satisfy producers and processors by way of higher monitory return but also with

better taste and nutrition. Value is added by changing their form, colour and other such methods to increase the shelf life of perishables. Though, with the effort of Ministry of Food Processing Industry the growth of this sector is accelerated, however, there is need to discuss and sort out various related issues amongst people of various categories to increase level of value addition and improve the quality of value added food products for domestic market as well as export.

Post Harvest Technology- Importance and Role

Post-harvest loss reduction technology encompasses the usage of optimum harvest factors, reduction of losses in handling, packaging, transportation and storage with modern infrastructure machinery, processing into a wide variety of products, home scale preservation with low cost technology. Use of thermal processing, low temperature, drying, chemical and biological reactions coupled with other preservation techniques are applied to enhance the storability. Containers and packaging materials confer portability as well as extend the shelf-life. Adoption of these techniques could make available a large quantity of food by avoiding losses and provide better quality food and nutrition, more raw materials for processing, thus ensuring better returns to the farmers.

Importance of Post-harvest technology lies in the fact that it has the capability to meet food requirement of growing population by eliminating losses making more nutritive food items from raw commodities by proper processing and fortification.

Post-harvest technology has potential to create rural industries. India, where 80 percent people live in the villages and 70 percent of them depend on agriculture has experienced that the process of industrialization has shifted the food, feed and fibre industries to urban areas. This process has resulted in capital drain from rural to urban areas, decreased employment opportunities in the rural areas balance trade in favour of urban sector and mismatched growth in economy and standard of living between rural and urban people. It is possible to evolve appropriate technologies, which can establish agricultural based rural industries. The farmer whose role has been reduced to producer can be transformed into producer cum processor and thus getting more dividends for hard labour, input, kind of risk taken and generating resource for socio-economic advancement keeping pace with the modern times.

Status of food processing Industry

Important sectors in agro processing industries are: fruit and vegetable processing, grain processing, fish processing, milk processing, meat and poultry processing, packaged/ convenience foods, alcoholic beverages and soft drinks etc.

Agricultural processing may be defined as an activity, which is performed to maintain or improve the quality or to change the form or characteristics of the agricultural product. Processing operations are undertaken to add value to agricultural materials after their production. The main purpose of agricultural processing is to minimize the qualitative and quantitative deterioration of the material after harvest.

Primary processing: Purification of raw materials by removing foreign matter, immature grain and then making the raw material eligible for processing by grading in different lots or conversion of raw material into the form suitable for secondary processing.

Secondary processing: Processing of primary processed raw material into product which is suitable for food uses or consumption after cooking, roasting, frying etc.

Tertiary processing: Conversion of secondary processed material into ready to eat form.

Food items are marketed in different forms as raw, primary processed, secondary processed and tertiary processed. The farmers in general prefer to sell their agricultural produce immediately after harvest leaving a part for own consumption and seed purposes. It has estimated that the farmers retain 44 per cent of the total wheat and 48 per cent of the paddy. Mandies and grain traders procure the balance for processing and / or for marketing.

The food processing sector in India has gained importance due to consumers preferences for ready to cook (RTC) and ready to eat (RTE) foods, besides increased demand for snack foods and beverages. As much as 42 per cent of the food industry is in the organized sector and 33 per cent in the small scale, tiny and cottage sectors.

Sector wise food processing

Fruits and vegetable processing

India is the world's second largest producer of fruits and vegetables. It has potential to grow all types of temperate, sub - tropical and tropical fruits and vegetables because of varied agro - climatic diversity. The total production of fruits and vegetable is over 45 million tones

and 85 million tonnes respectively. The losses are estimated to the extent of 20 -30 per cent due to lack of proper harvesting, processing and storage facilities, which is valued at Rs. 230 billion. The processed products from fruits and vegetables are beverages, jams, jellies, candies, preserves, canned fruits and vegetables, dehydrated fruits and vegetables, pickles, soup mixes, sauces and ketchups. Products that have growing demand, especially in the Middle East countries include pickles, chutneys, fruit pulps, canned fruits and vegetables, concentrated pulps and juices, dehydrated vegetables and frozen fruits and vegetables.

People generally prefer fresh fruits and vegetables in India due to abundance of seasonal fruits throughout the year available at low price. The production of pickles and chutneys has traditionally been rural level cottage industrial activity. However, in the recent years, processed foods in the form of canned fruits such as pineapple, mango slices and pulps, grapes, apple, peaches etc have increased considerably. The uses of fruits in the form of concentrated juice, dry powder, jam and jelly have also increased. The percentage production of processed fruits and vegetables are fruit juice and fruit pulp - 27, jams and jellies - 10, pickles -12, ready to serve beverages -13, synthetic syrups - 8, squashes - 4, tomato products - 4, canned vegetables- 4 and others -18.

The main fruits that enter the export market are mangoes, grapes, apples, citrus but other fruits identified for export are bananas, sapota, litchis etc. The main destinations for export of fruits being Middle East, U.K., Europe and to some extent Singapore, Malaysia etc. The important vegetables exported are potatoes (28.0%), onions (7.1%), cauliflower and cabbage (4.0 % each), okra (3.0%), peas (3.0%) and others (50.0 %).The exports are limited to Middle East, Europe, U.K and Singapore etc. At rural level solar assisted dehydrators could be promoted for preparation of ethnic food products like raisins, onion flakes and powder, chips, vegetables etc.

Food grain sector

Grains could emerge as a major export earner for India in coming years. India's food grains include rice, jowar, bajra, maize, wheat, gram and pulses.

Rice milling: Conventional rice hullers with a population of 91287 are very popular for milling of rice in rural areas. In conventional rice hullers, bran and husk are produced together and cannot be separated. The by - product is generally burnt. The modern rice mills have separate processing mechanism for dehusking and polishing of the paddy. The husk can be utilized for

energy and for industrial products like furfural and the bran for extraction of edible and non edible grades oil. These mills also have better recovery and lower energy consumption compared to conventional hullers.

Wheat milling: Wheat production in the country has increased to more than 73.53 million tonnes. Burr mills (chakkis) are very common for milling of wheat in rural and urban areas. Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Bihar, West Bengal, Punjab, Haryana, Madhya Pradesh, Assam, Gujarat, Kerala have the largest number of roller flour mills. At present flours made by the roller mills are sold to institutional buyers like defence, hotels etc., and the household purchase is limited to only 1.0 per cent due to absence of open policy for sale of wheat flour through public distribution system. Sale of soy blended and branded wheat flour is likely to increase due to better quality flour and thus scope of organized wheat milling will increase in future.

Pulse milling: Pulses are the major sources for protein for the vegetarians in India. In a total world production of 60 million tonnes of pulses, India, China, Brazil, Turkey and Mexico account for 2 / 3 rd of the output. The pulses are made into dhal by dehusking and dehulling.

Oil extraction: The Technology Mission on oilseeds has helped in increasing the oilseeds production to 24.5 million tonnes. Oil extraction has been a cottage level activity in the country through Kolhus and Oil Ghanis. The introduction of high capacity mechanical expellers and solvent extraction technology has brought in modernization. Small capacity oil expellers have been developed which could be installed in rural areas for promoting agri - business and that might provide more employment. Soybean is not only a good source of oil but also rich in protein. India is now the fifth largest producer of soybean at a global level with production of more than 5.2 million tones. Soymilk analogues, nuggets and soy - blends are being marketed.

Processing of commercial crops

Sugarcane, tea and coffee are major commercial crops grown in India. Tea emerged as major foreign exchange earner. India is the largest producer and exporter of black tea. India exports between 150 -170 million kilograms of tea per annum. Of course, the scope of foreign investment in this sector is good and the multinational tea companies would either be trying for marketing joint ventures with the Indian producers or acquire stakes in Indian tea companies. The production of sugarcane has increased to more than 299 million tones. About

50 per cent sugarcane is estimated to be processed by sugar mills and the balance by small scale Gur and Khandsari units. Although, the efficiency of Gur and Khandsari sector is low compared to sugar mills, but these units provide more employment opportunities to rural work force and therefore, cannot be ignored and requires special attention. Improved sugarcane crushers and furnaces have been developed for producing hygienic gur for domestic and export market.

Packed and convenience food

Modern packed and convenience foods such as bread, biscuit, confectionery, chocolates, ready to eat foods like noodles, cereal flakes, etc have become popular in recent years especially in urban areas although traditional foods have been used in the country in the form of roasted, puffed, sweet meat and baked products. The extruded foods are largely produced in the unorganized sector. The traditional ethnic ready to eat foods prepared in hygienic conditions and marketed with better packaging has plenty of domestic and exports market.

Fishing and Fish Processing

One of the catchy investment sectors is fisheries. The marine fish include prawns, shrimps, tuna, cuttlefish, squids, octopus, red snappers, ribbon fish, mackerel, lobsters, cat fish etc. There is growing canned and processed fishes from India.

Meat and Poultry Processing

India ranks first in world cattle population, 50 per cent of buffalo population and one - sixth of total goat population of the world. There is vast scope to set up modern slaughter facilities and cold store chains in meat and poultry processing sector. Compared with meat, poultry industry has registered significant growth. India ranks fifth in the world and both poultry and egg processing units have come in a very big way in the country. India is exporting egg powder, frozen egg yolk and albumin powder to Europe, Japan and other countries. Poultry exports are mostly to Maldives and Oman. Indian poultry meat products have good markets in Japan, Malaysia, Indonesia and Singapore. Presently there are only five egg powder plants in India which is considered insufficient in view of growing export demand for different kind of powder - whole egg, yolk and albumin.

There is a large potential for setting up of modern slaughter facilities and development of cold chains in meat and poultry processing sector. The market has not been tapped for ready to eat and semi processed meat products in the domestic market as well as for exports to neighboring countries especially to the Middle East. Buffalo meat is surplus in the country and has good export potential.

Milk and Milk products

The total milk production is now around 100 million tones and the demand for milk is estimated at even higher level. Manufacture of casein and lactose, largely being imported presently, has good scope.

Alcoholic beverages and soft drinks

Alcoholic beverages are another area where India witnessed substantial foreign investment. The IMFL (Indian Made Foreign Liquor) primarily comprise wine, vodka, gin, whisky, rum and brandy. The Indian beer market is estimated at Rs. 7000 million a year. One of the major advantages for any investor eyeing the Indian liquor market is that India offers enough raw materials like molasses, barley, maize, potatoes, grapes, yeast and hops for the industry.

The aerated soft drinks industry in India comprises over 100 plants across all states. The soft drinks constitute the 3rd largest packaged foods regularly consumed after packed tea and packed biscuits.

Processing can always fetch an additional income to the growers and help in stabilizing the prices with economic returns. The best overall indicator of the economic contribution of food processing to the food system is the value addition. It represents the firm’s contribution to an industry’s value addition and the value addition is the indicator of the industry’s contribution to GDP

Processing units are a boon for the welfare of the orchardists as they can save their crop from wastage and at the same time their produce becomes more valuable, price fetching commodity with suitable post harvest treatment packaging and by processing into various products.

Agriculture Value Chains in India

The agriculture system in India has undergone rapid transformations over the past few decades particularly after the economic reforms of 1990s. The emergence of integrated agriculture and food supply and value chains is one of the most visible market phenomena in India. Increasing concentration on processing, marketing and export is being observed in all the segments of the chain. The traditional way of food production is being replaced by practices more similar to manufacturing processes, with greater co-ordination across farmers, processors, retailers, exporters and other stakeholders in the agriculture value chain (Kumar *et al.* 2011).

Agricultural Gross Domestic Product (GDP) increased at an annual rate of 3 percent between 1980 and 2012-13, making India the third largest agricultural producer by value after China and USA. However, this sector is yet to realise its full potential. The sector currently fulfils only 60 percent of yield for most crops, particularly fruits and vegetables. Yet for many crops India does not have global scale processing facilities. In India only 4 percent of the fruits are processed compared to China (23 percent), Indonesia (50 percent) and Brazil (70 percent) (Shivakumar 2016). Apart from these, another issue is loss of agricultural products. Post-harvest losses in India are too high (25-30 percent of total production) (Joshi *et al.* 2007).

Thus, fruits and vegetables are suitable areas for consideration to revive Indian agriculture. Fruits and vegetables can provide 2-4 times higher incomes to farmers and consume 40-80 percent less water per hectare in comparison to cereals. China‟s success in apple can be a meaningful lesson for India where China‟s export of processed apple increased from US$50 million to more than US$1.4bn in eight-nine years (Shivakumar 2016).

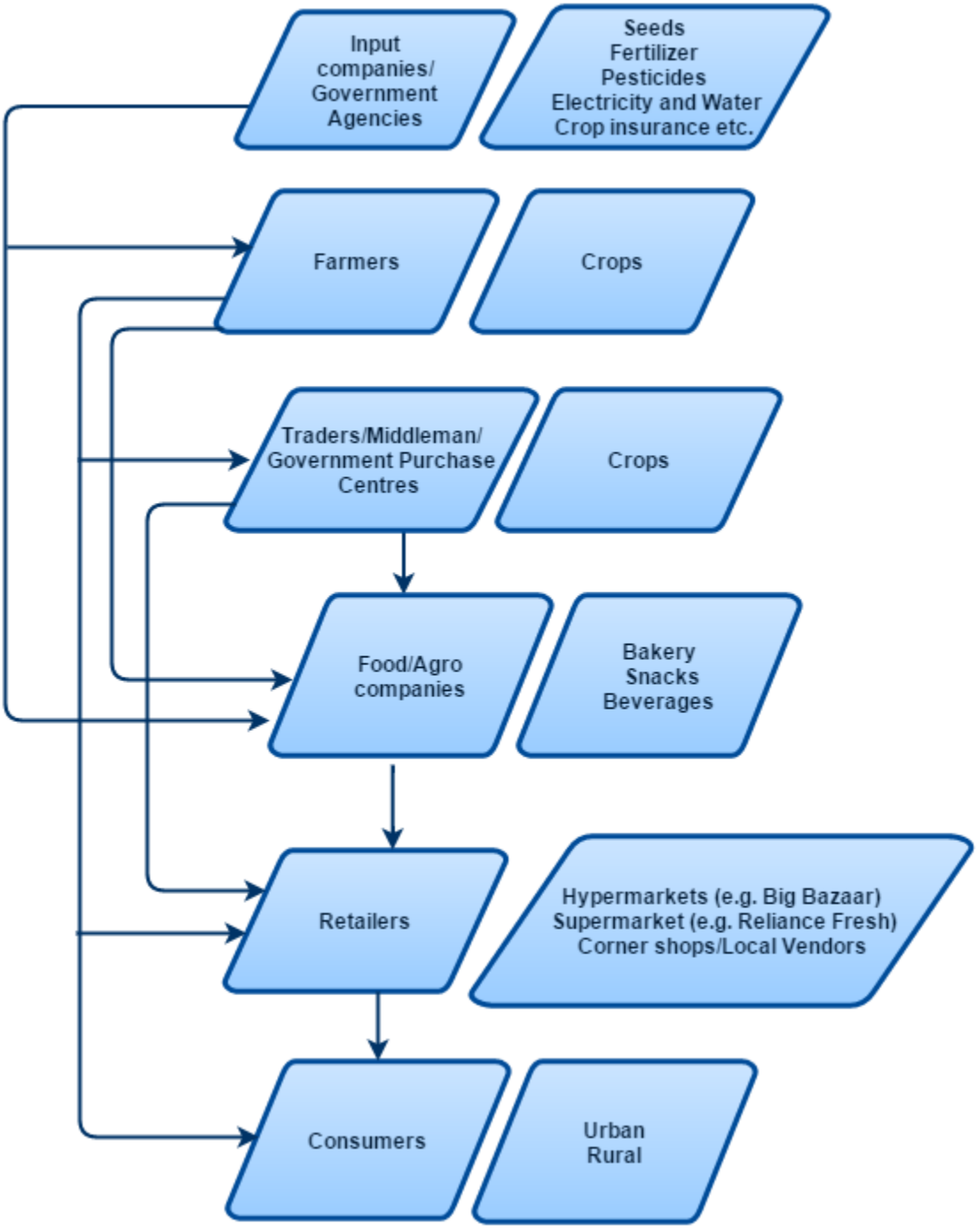
Apart from it, with steep rise in income of middle class, change in preferences and lifestyle, transformation in work profiles and demography has created a huge demand for high-value commodities and products, such as fruits, vegetables, livestock products etc. Other than these, changes in tastes, preferences and food-habit of Indian towards frozen and pre-cooked or ready-to-eat items have also increased particularly youth and working class and with the rising numbers of shopping malls and eating joints. This has also necessitated changes in quality and safety of products, production and processing process and distribution methods. Farmers have to grow and try to diversify their production systems accordingly and in some of the areas they

are trying to do this. This also opens a huge opportunity in the expansion of domestic market for non-conventional, crops, such as fruits and vegetables.

In India, agriculture system along with value chain framework has not been conceived as a main strategy to bring more efficiency, productivity and earnings. There has not been enough emphasis on the growth and development of efficient agricultural value chains in India. Through the development of modern agriculture value chains at national and regional-levels, farmers in India can gain from increased knowledge, data, and information and communication technologies. At the same time, modern and particularly urban consumers in India will get better quality and safe food products according to their choices and preferences. Costs, risks and losses to retailers and exporters will also go down with the better value-addition. Figure 1 shows the basic model of fruit and vegetable agriculture value chain in India.

Agriculture value chains in fruits and vegetables provide an alternative for the diversification of agriculture in view of high income, employment, foreign exchange earnings and a new method to combat challenges of food security. These products have high income elasticity of demand. Whenever and where-ever income of the population goes up, demand for these products also goes up mainly in the middle-income groups of developing countries. The rise in income and stress on quality has influenced the demand side while new technologies and trade agreements have the potential to influence the supply side.

But it is also noteworthy that in India, due to lack of technologies related to quality seeds, fertilisers, irrigation and good agricultural practices farmers find it very difficult to enhance their productivity. There is urgent need to develop innovative technologies related to agricultural inputs, such as quality seeds mainly climate-resilient varieties, fertilisers and improved irrigation equipment



A Model of Agriculture Value Chain of Fruits and Vegetables in India

There have been examples in India where successful agro-business models incorporated small and marginal farmers in their network and linked them with markets. The following cases briefly analyses such examples, which have been working very well in India for the development of agriculture value chains and linking the farmers to the domestic and external markets.

Case of PepsiCo

PepsiCo‟s agricultural operation in India is an example. At present, PepsiCo is earning 26 percent of its turnover from processed agricultural products (such as rice, potato, peanut butter, tomato, chilly, garlic and ginger pastes etc. The company has signed contracts with Punjab Agro Industries Corporation and Punjab Agricultural University for contract farming and research purposes. The company provides inputs and technology to the farmers. Returns to the farmers have also gone up as now farmers supply agricultural products to the company at an agreed price and for a fixed quantity. Direct involvement of company‟s agents with farmers ensures good quality for company as well as cover risks to farmers from crop infestation and bad weather etc. (Punjabi 2015).

Case of Mahagrapes

Mahagrapes is a cooperative and partnership firm of various cooperative societies spread all over Maharashtra state in India. It was established in Pune in January 1991 to export fresh grapes (mainly seedless grapes) from India. It was established by the support from National Cooperative Development Corporation (NCDC), Government of Maharashtra and other related government agencies involved in agricultural product export. Mahagrapes has established itself as a reputed brand in European, Sri Lankan and Middle Eastern markets.

Currently, it comprises 16 grape growers‟ cooperative societies having strength of more than 2500 grape growers with 6000 ha of land under grapes from Sangli, Solapur, Latur, Pune and Nasik. Mahagrapes also provides support to small farmers by bulk-buying/in house production of inputs. Apart from it, farmers receive price based on the quality of their output. To maintain standard, quality and safety it also provides materials, technical help and infrastructure support, such as cold storage to the farmers (Mahagrapes 2015). Mithofer and Waibel (2011) argued that farmers do earn significantly higher profits compared with those outside the Mahagrapes scheme. The success of Mahagrapes demonstrates that multi-specialised intermediaries can play in linking small farmers to overseas export markets.

Case of PRAN group

The PRAN (Programme for Rural Advancement Nationally) group started in 1981 in Bangladesh. It has now become Bangladesh‟s largest grower and processor of fruits, beverages and vegetables. Other than Bangladesh it supplies processed products of fruits and vegetables to more than 75 countries, including India. The PRAN group has also set up a processing plant in Tripura state of India.

The Tripura government has allotted land to the PRAN group in Bodhjungnagar to set up the unit, where already 500 people, mostly local residents and women, have been employed. It is expected to reach 1,000 workers by 2017 after the expansion of the unit. The group is also setting a processing unit at Kalyani in West Bengal‟s Nadia district. It also plans to set up units in Odisha and Siliguri in West Bengal to receive other agricultural products from North Eastern parts of India (PRAN 2016; Business Standard 2015).

Comparison of PepsiCo, Mahagrapes and PRAN on Select Parameters

Agri-business model	**Reaching small farmers**	**Adoption of new technology by farmers**	**Investment in modern technologies**	**Delivering strong marketing**	**Sharing benefits**
Pepsico	Limited	Strong	Strong	Strong	Limited
Mahagrapes	Strong	Limited	Strong	Strong	Limited
PRAN	Strong	Limited	Strong	Strong	Limited

Note: Comparison based on model developed by Gandhi (2015)

Table demonstrates that agribusiness models of PepsiCo, PRAN and Mahagrapes have both positive and negative traits. While the outreach of PepsiCo to small and marginal has been limited the reach of PRAN and Mahagrapes is comparatively strong and wider. With its strong dissemination activities PepsiCo has been able to provide new and modern technologies to the farmer's linked with its programme while this is limited in case of Mahagrapes and PRAN. But these organisations have failed in sharing the benefits and profits equally with their farmers, this need to be corrected as the long-term objective of these agri-business models should be connecting the farmers to the market and provide the equal share of benefits to them.

Despite these drawbacks these models demonstrates that agri-business models can work in South Asian countries, such as in India and Bangladesh and have potential to connect small and marginal farmers to the market and export community. Need of the hour is to develop national and regional-level policy framework to support the private companies and business houses to design innovative ideas to develop the agriculture value chains in India and link the farmers to the market and wider export community.

Post-harvest Technology of Fruits and Vegetables

Status of fruits and vegetable Industry

India has a wide variety of climate and soil on which a wide range of fruit and vegetable crops can be grown. During the last two decades, considerable emphasis has been laid on production of these crops in the country. As a result, area in fruits has risen from 3.75m ha. in 1998-1999 to 6.38m ha. in 2010-2011 accounting for an increase of about hundred percent. There has also been phenomenal increase in production of fruits from 44.113 million tonnes in 1998-99 to 74.878 million tonnes in 2010-2011. India accounts for more than 10% of total production of fruit crops. It leads the world in the production of mango, banana, sapota and acid limes. In vegetable production, India is next to China with an annual production 146.60 million tonnes from 8.49 million hectares (2010-2011). As a result India accounts for more than 14% of the world production of vegetables. The average productivity of vegetables is 17.3 tonnes per hectare which is almost half of USA and other developed countries (2010-2011).

Post harvest losses

While area and production of fruits and vegetables has increased manifolds, there is a considerable gap between their production and net availability due to heavy post harvest losses. Due to lack of elaborate harvesting equipment's, collection and packing centers in major producing areas, suitable containers, commercial storage facility and processing industries, lack of cold chain and rapid transport facilities, good packing material and poor availability of varieties have good quality and longer self life. The total loss in fruit and vegetables are estimated to be 20-30% accounting to nearly 44000 crores annually (2010-2011). These losses have been estimated between 13.7-17.1% in mango, 12 to 19% in banana, 8.3-30.7% in orange, 10-25% in apple, 23-30% in grapes, 6.1-40% in onion, 30-40% in potato, 6.7-33.5% in tomato and 4 to 35% in chillies/capsicum. Minimising these losses have therefore, been recognized as an effective means of increasing fruit and vegetable availability without bringing additional area under these crops

Factors affecting post harvest losses

A number of factors (pre harvest and post harvest) adversely affect the post harvest losses of fruits and vegetables. These include varieties selected for cultivation, irrigation and fertilizer applications and frequencies, method and stage of harvest, improper grading, packing

and absence of other post harvest operations, storage, transport and marketing which result in physical damage due to breakdown of tissues. Mechanical losses during handling and transport results in bruising, cracking, cuts, microbial spoilage by fungi and bacteria. Physiological changes cover respiration leading to ripening, transpiration resulting in shriveling and change in pigments, organic acids and flavour etc.

Control of post harvest losses

Control measure can be classified in two main groups

- Pre-harvest control measures
- Post-harvest control measures

Pre-harvest control measures

Some of the pre harvest treatments have profound effect on the post-harvest life of various fruits and vegetable crops. Some of these technologies developed are mentioned below:

Fruit crops:

1. Pre harvest application of 20ppm GA at fruit market stage delays ripening and improves storage life in mango and guava and color development in citrus.

2. Pre- harvest spray of Topsin-M (0.1%) or Bavistin 0.1% at 15 days before harvest can control anthracnose and stem-end rot of mango.

3. Application of Topsin-M (0.05%) effectively controls post- harvest losses in Dashehari mango by controlling maturity and delayed ripening.

4. Post harvest losses vary with varieties. Totapari mango showed 36% losses, Neelam 22%, Deshari 17% and Bavgana palli 20% in storage.

5. Pre harvest spray of 0.6% calcium chloride 10-20 days prior to harvest improved shelf-life and reduce physiological losses in weight in Thompson seed less grapes.

Vegetable crops

1. Tomato cultivar PKM-1, developed at TNAU is very popular among tomato growers of Tamilnadu and Andhra Pradesh for its slow ripening as well as strong skin with green shoulder.

2. Withholding of irrigation 10-15 days before harvesting in onion results in enhanced storage life. ·
3. Red color and thin neck onion cultivar have better keeping quality and storage life.

4. Pear shape tomato varieties have longer shelf life as compared to round fruited varieties.

5. Pre-harvest application of maleic hydrazide (MH) 1500-2000 ppm sprayed at 90 days of transplanting reduces sprouting of onion and potato during storage.

6. Higher dose of nitrogen (more than optimum) enhances post harvest losses in several vegetable crops.

Post harvest control measures

1. **Strengthen the post harvest facilities**: Efforts are now on for creation of suitable infrastructures for post harvest management. In public sector, three organizations, namely The National Horticulture Board (NHB), Gurgaon, Haryana, National Cooperative Development Corporation (NCDC), Delhi and Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi, have been entrusted with creating infrastructure facilities in the country. Various infrastructures like packing stations, primary processing centers, palletization, containerization, pilot scale grading and post treatment plants, mechanical washing, grading and waxing units have been installed by the above organizations in many parts of the country. They are also establishing cold storages, specialized refrigerated vans for transport, retail outlets and auction platforms in different parts of the country.

2. **Protective treatments and disinfection:**
    a. Post harvest losses can also be reduced by use of chemicals, fungicides and waxing etc.

b. Post harvest application of Bavistin (0.1%) and Topsin (0.1%) controls storage diseases in mango.
c. Hot water treatment with Bavistin (0.1%) and Imazlil (0.1%) reduces storage losses of Nagpur mandarins.
d. Spraying with aqueous emulsion of CIPC @ 50 mg/kg of tubers resulted in complete inhibition of sprouting in potatoes stored in evaporative cool chamber for 4-5 months.
e. In places where refrigerated storage facilities are not available, protective skin coating with wax increases storage life of fruits and vegetables at ambient temperatures.

3. **Irradiation:** Irradiation is not only used to kill various germs in meat and meat products but also to reduce post harvest losses and increase shelf life of horticultural products. Scientist at Babha Atomic Research Centre (BARC) have shown that small doses of irradiation can inhibit sprouting in onion, potato and garlic. The ripening of mango, banana and other fruits and vegetables can also be delayed. Insect and their eggs which infest grains, pulses, vegetables and fruits can be killed.
   a. The first of these facilities is for spices irradiation and is functional at VASHI on the outskirts of Bombay.
   b. The department of Atomic energy has also established a food irradiator, which is named as POTON (for potato and onion) at Nasik in Maharastra
   c. Sprouting of onion can be checked by gamma irradiation at a dose of 0.06 to 0.1 kgy. In potato, gamma irradiation at 0.1kgy can inhibit sprouting completely and also inhibit the light induced synthesis of chlorophyll and toxic alkaloid solanin.
   d. Laboratory studies have indicated that irradiated potatoes could be stored successfully for 6 months at 15°C with 10% loss.
   e. Fruits of climactric class such as banana, guava, mango and papaya where irradiation in the mature but unripe preclimactric stage is given in a close range of 0.25 to 0.75 kgy showed improved shelf life due to delay in the rate of ripening and senescence.

Curing, grading, packing and transport

Curing: Some vegetables like potato, sweet potato, yam, cassava, onion and garlic are stored better and for long duration when they are cured before storage. Curing is most simple and effective way of reducing water loss and decay during post-harvest storage. In curing

bruised and injured surface are allowed to heal. During the process of curing, wounds are healed by producing a new cork cambium, thus preventing infection by pathogenic organism.

Grading: Considerable variation occurs in quality of harvested fruits due to their stage of maturity, size, appearance or some environmental and agronomic factors. Systematic grading is therefore, a pre-requisite for efficient marketing system, results in quality consumption and enables the producer to get a competitive price. Most countries have their own set of standards for domestic trade and international trade. In India, fruits and vegetables are graded on compulsory basis for export and voluntary basis for internal marketing. The grading standards are developed by the directorate of marketing and inspection Ministry of Rural Development under the Agriculture Produce Grading and Marketing act.

a. In case of apple, mechanical grading has already been introduced in H.P., J&K and U.P. through packing centers equipped with mechanical graders

b. Size grading for Nagpur mandarin is in use based on weight or dimension of fruits. The size grader can be adjusted according to size as per demand for a particular size.

c. The HOPCOM at Bangalore has also installed washing, waxing and grading units for roundish fruits.

Packing

Packaging is a basic tool in post-harvest management of highly perishable commodities like fruits and vegetables. The present packaging systems for fresh fruits and vegetables in our country are unsuitable and unscientific. The use of traditional forms of packages like bamboo baskets is still prevalent. The other types of packages generally used are wooden boxes and gunny bags. The use of baskets besides being unhygienic also does not allow adequate aeration and prevents convenient handling and stacking. Wooden packages are also not conducive for packaging of fresh fruits. They occupy unnecessary additional volume and contribute to additional weight.

Considering the long term ecosystems and to achieve an overall economy, other available alternatives like corrugated fibre board boxes, corrugated polypropylene board boxes, plastic

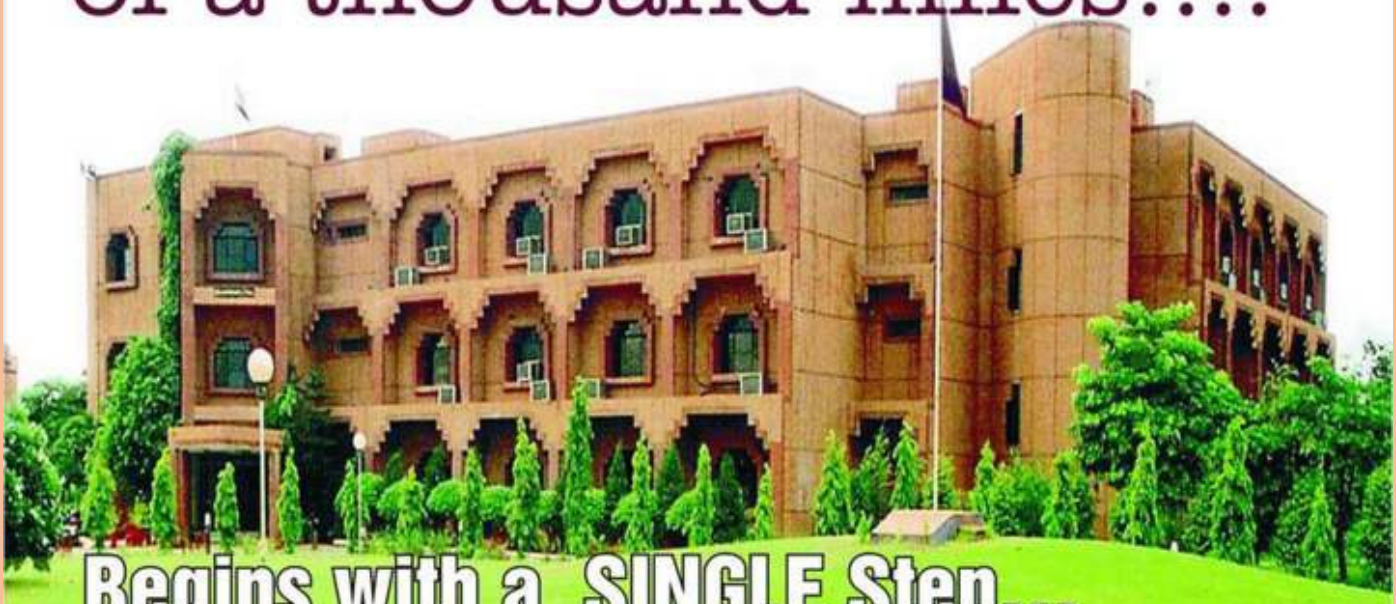
trays/crates/woven sacks, moulded pulp trays/thermoformed plastic trays, stretch films and shrink wrapping would have to be considered.

Fresh fruits and vegetables can also be packed in modified atmosphere where recommended levels of Oxygen, carbon dioxide, humidity, temperature are maintained. The recent developments of selectivity permeable plastic films have widened the scope of modified atmosphere packaging systems for storage of fruits.

Zero Energy Cool Chamber

A zero energy cool chamber for short-term storage of fruits and vegetables has been developed at Indian Agriculture Research Institute, New Delhi. It is based on evaporative cooling system. It is a double walled structure with sand in between. During summer when the outside temperature goes beyond 44°C the temperature inside the chamber never goes beyond 28°C. The relative humidity is maintained at 90% in the structure. A commercial size structure of 12x12x12m with double brick wall filled with sand has been successfully tried.

The Journey
of a thousand miles....



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