Indian Journal of Agricultural Sciences **89** (1): 3–8, January 2019/Review Article
https://doi.org/10.56093/ijas.v89i1.86090

Research Review Article

Potential and prospects of value chain development for fruits and vegetables in India

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Received: 17 April 2018; Accepted: 25 July 2018

ABSTRACT

Globally, India is second largest producer of horticultural produce, however, the postharvest loss estimated to be high (30-40%) and the insignificant proportion of vegetable (2%) and fruit (4%) produce are being processed. Therefore, for increasing the farmers' income, the need of the hour is to focus on beyond farm production, developing farmers' capacity for processing and linking them with market and other supporting institutions to promote efficient value chain. However, the value chain in fruits and vegetable is complex due to its perishability, high fluctuations in demand and prices and dependence on climate conditions. Hence, the need to stress on commodity and community based processing centres, developing partnership between local processors and marketing institutions, improving competency of development officers and infrastructure development for efficient value chain promotion. The paper attempt to document the need and potential of value addition; status of actors, activities and strategic network of value chain in present scenario, the challenges of value chain at recent and strategies to improve it.

Key words: Challenges, Farmers' share, Horticulture, Intermediaries, Value chain

Globally, our country ranks second in production of horticultural produce. The percentage share of horticulture output in agriculture has become more than 33% (Horticultural Statistics at A Glance 2015).The horticultural sector significantly helps in improving land productivity, generating employment, improving economic status of the farmers and entrepreneurs, enhancing exports and, above all, providing nutritional security to the people.This sector comprised vegetables, fruits, spices, flowers, plantation crops, aromatic crops etc. and the major share of horticultural crop production is contributed by vegetables (60.76%) and fruits (29.70%). Around 76% of the total fruits and vegetable production is consumed in fresh form, while 20 to 22% accounts for wastage and only insignificant proportion of vegetable production (2%) as well as fruit production (4%) are being processed (MoFPI 2016). The scenario of fruit and vegetable processing of India is in sharp contrast compared to other developing countries such as Brazil (70%), Malaysia (83%), Philippines (78%) and Thailand (30%). The share of our country in the global market is insignificant – it accounts for 1.7% of the global trade in vegetables and 0.5% in fruits (APEDA 2016). Further, the horticultural sector faces many challenges because of low productivity, huge wastage and post-harvest losses due to inadequate storage facility and transport bottleneck and inefficient supply chain management (SCM). Therefore, there is acute need to promote of efficient value chain for the growth of the sector and for ensuring sharing of significant gains among the value chain actors. Moreover, there is need to strengthen forward-backward linkages of horticulture with technology, supporting food processing industry to match soil to seed and product to market. Thus, high productivity and better value addition by agro-processing are its key parameters.

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Value chain development: Meaning and concept

Several authors have given the value chain definitions based on activities, actors and strategic network.

Value chain as a set of activities: Based on activities World Bank (2010) defined "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". The similar definitions were offered by FAO, IIED, GTZ and ILO.

Value chain as a set of actors: Some authors based their definition on actors. Like UNIDO (2011) defined a value chain as "actors connected along a chain producing, transforming, and bringing goods and services to end consumers through a sequenced set of activities". CIP (2006) defined a value chain as "all the actors, and the entirety of their productive activities, involved in the process of adding value to a specific crop or product".

Value chain as a strategic network: In this case, value chains do not simply exist in a particular space but are built for the purpose of better responding to consumer demand. Borrowing from Hobbs *et al*. (2000), CIAT (2007) defined value chains as a strategic network among a number of independent business organizations, where network members engage in extensive collaboration. DFID's (2008) defined a market system as a "multi-player, multi-function arrangement comprising three main sets of functions (core, rules, and supporting) undertaken by different players… through which exchange takes place, develops, adapts, and grows".

These three categories of definitions are complementary to some degree: activities are carried out by actors, and actors of different types comprise a strategic network.

Need of processing in fruits and vegetables

Fruits and vegetables are important element of Indian agriculture and nutritional security due to their perishability, high production, nutritional value, economic viability and generating employment on-farm and off-farm. India accounts for 12.5% (92 million tonnes) and 14% (168.6 million tonnes) of world's fruits and vegetables (Vegetable statistics 2016) respectively. However, only an insignificant proportion of horticultural produce (2-3%) is being processed, and the postharvest losses across horticultural commodities are alarming (30-40%) (CIPHET 2015). Thus, there is need of processing and adding value to fruits and vegetables to increase its shelf-life, diversification of products and attracting people with quality assurance. In India, there is immense potential for value addition in fruits and vegetables (Joshi *et al.* 2004, World Bank 2008); some of the literatures in its support are mentioned.

Potential for value added products in different fruits

There are mainly three types of value addition, i.e. according to form, time and place. Here mainly focussed is given to value addition according to form among different fruits. For example, aonla fruit is good source of vitamin C and having medicinal value but it is not popular as table fruit due to its sour and biting in taste. However, it can be processed into a number of food products like preserve jam, jelly, juice, laddu, burfi, dried powder, candy, toffee, pickle, sauce, squash, RTS beverage, cider, shreds etc. (Goyal *et al.* 2008, Bhattacherjee *et al.* 2011).

Similarly from guava number of processed products can be obtained; the fruit is famous especially for preparing a high quality natural jelly due to rich amount of pectin presence. The another guava products such as candy, toffee nectars, beverages, cheese, ice cream topping etc. are made through processed guava pulp.The other products not generally popular in India are guava powder, canned guavas with sugar syrup (40^{o} Brix) and dehydrated guavas (Rao 2012).

Another fruit, i.e. mango, the king of fruit, at almost every stage of growth, development, maturity and ripening can be processed into the products like mango powder, pickle, chutney etc. obtained from raw mango. Green mango is a source of an excellent drink. Ripe mangoes are utilized for making juice, shake, papad, toffee, squash etc. After drying it, mango slices and powder are prepared. In modern time technology has been standardized to obtain frozen mango slices (Rao 2012). Likewise, there are immense potential for value addition in other fruits also like orange, apple, banana, grapes etc.

Potential for value addition in vegetables

Like fruits, there are several vegetables like tomato, potato, mushroom, onion, cabbage, cauliflower, carrot, chilli etc. that can be processed into various value added products. Some are mentioned below.

Potato, the most widely grown vegetable in India, facing much fluctuation in prices of raw potato as compared to processed one.There is great potential for processing of potatoes into several products like chips, French fries, cubes, granules and canned products (Pandey *et al*. 2014).

Another vegetable, i.e. tomato, the second largely grown vegetable, but facing huge post-harvest challenges due to its high perishability. Only 1% of total tomato production is processed against 14% in China and around 1-2% of Indian tomatoes were exported in 2011, but interstate trade within India is significant (FAOSTAT 2013). Commercially, the vegetable is used in the preparation of tomato puree or ketchup, but the local varieties were not found to be suitable due to lower total soluble solids (Balaswamy *et al.* 2015). The other value-added tomato-based products are puree, paste, salsa, pizza, sauce, ketchup, juice, chutney, powder, instant tomato soup etc.

Mushroom is a commercial vegetable and rich source of good quality protein, minerals and vitamins but due to perishable in nature; the processing is the only alternative in order to utilize excess production in the season and to make it available during off season. There are a number of value-added mushroom based products that can be prepared such as canned mushroom, ketch-up, murabba, candy, chips, pickles, mushroom soup, powder, biscuit, nuggets etc.

Players/intermediaries/ actors in value chain

Due to the high perishability and short duration of the fruits and vegetables (F&V) produce, high fluctuations in price, demand and supply, increasing consumer alarms for food nutritional security and quality (Vorst and Beulens 2002), and dependence on climate situations (Salin 1998) the value chain found to be complex. Moreover, the intermediaries share around 75 percent of the total net profit of the entire chain (Modi *et al.* 2009). There are ample of studies conducted on various actors involve in value chain in both the cases of fruits and vegetables.

Firstly, considering the value chain in fruits; the study found that the net profit made among intermediaries, i.e. Producer (₹ 1.50), Commission agent (₹ 8.50), Processor (₹ 8.00), Wholesaler (₹ 10) and Retailer (₹ 8.50) when 2 kg of aonla fruit is processed into 1 kg of dried candy along the value chain (Kumbhar *et al*. 2014). Another similar study

conducted in Prayagraj district of UP on guava found that channel 1 (Producer-Wholesaler-Retailer-Consumer) was more advantageous than channel 2 (Producer-Commission agent-Wholesaler-Retailer-Consumer) (Manna 2016). The net profit of the producer declined significantly with the increase in number of intermediaries in the marketing supply chain and the producer's share in consumer's rupee is more in direct sale as compared to contract sale. Some of the studies suggested that the more the intermediaries the greater the chance of postharvest losses. As the study on grapes revealed that postharvest losses in grapes was found to be higher at retail level (4.56%) compared to field level (3.40%) (Murthy *et al*. 2014).

Several studies have been conducted on major actors involved in value chain of vegetables; however, the notable finding of few studies has been mentioned here. The study conducted in Ranchi district of Jharkhand found that for disposing perishable vegetables like tomato, cauliflower and okra etc. the farmers mainly preferred a short marketing channel (producer—consumer/or producer—retailer– –consumer); and for semi-perishable vegetables like potato and onion, a relatively long marketing channel (producer—wholesaler/commission agents—retailer—consumer) was preferred (Saha *et al.* 2010). In short marketing channels, the producer's share in consumer's rupees was higher compared to long one. Similar observation has been seen by the other study that with the increase in number of intermediaries in marketing supply chains; there was significant decreased in net profit of the producer, marketing efficiency and producers' share in consumer price; whereas marketing cost, marketing loss and consumer purchase price increased significantly. The suggestions has been given by several studies that to provide higher net profit to producer and competitive price to consumer for tomato, cabbage and cauliflower, it is important to introduce single window marketing system as well as provide better facilities for storage, transportation and marketing of tomato, cabbage and cauliflower (Imtiyaz and Soni 2010, Radha and Prasad 2001).

Set of activities in value chain

There are number of intermediaries who are involved in value chain of Fruits and Vegetables, from the farmer's field to the end consumer, who carries out several functions, such as transfer of ownership of commodities, its movement, maintenance and preservation of quantity and quality, payment to the seller and commodity delivery to the buyer (Halder and Pati 2011). A cold chain is a logistic system that protects a wide variety of horticultural produce from spoilage by providing a series of controlled temperature, storage and transport facilities from farm to fork. Presently, there is huge cold storage gap of about 3.28 million MT (MoFPI 2017) and moreover, the cold storage facilities were available mainly in the wholesale market or nearby. There is need of proper conditioned temperature for maintaining and sustaining the perishable goods for longer period of time as well as ensuring its quality to consumers but the weak and ill equipped cold chain infrastructure (Rathore *et al.* 2010), improper marketing systems and facilities (Singh *et al.* 2008) of the country has become the major impediments in the growth of the sector. Apart from cold storage problem, there are several other factors/issues affecting the activities involve in value chain. The following literatures will reflect the same.

The study on supply chain analysis in raisin making in western Maharashtra, has exposed that insignificant amount (3-4%) of the total grape yield was used for preparing raisins, and rest (96%) was sold as a fresh fruit in the market. However, the net profit per kg of raisin (₹ 15.92) was more than double compare to grapes (₹ 7.19) and the producer's share in consumer rupee was also higher in marketing raisin (64%) than grapes (50%) reported by Jadhav *et al*. (2010). However, because of limited marketing opportunities and risk taking ability, farmers preferred selling grapes. Another study observed the adoption of postharvest techniques (PHT) and revealed that the adoption of cleaning and washing, and sorting and grading was found quite high (50%), while the adoption of other practices like preserving and cooling, dehydrating/drying, packaging, labelling, and storage etc. was lower (3-25%) reported by Ali and Nath (2010). Thorat and Bhujbal (2010) conducted a study in Junnar tehsil of Pune district on marketing of selected vegetables and reported several problems faced by the vegetable growers such as, lack of cold storage facility, costly packing material, no return of packaging material back to the growers, high commission charges, high transport cost, unauthorized deductions and low prices to the produce etc.

Strategic network as a value chain in fruits and vegetables

There is great challenge of marketing of fruits and vegetables due to perishability, seasonality, bulkiness and consumption habits of the Indian consumers. Moreover, poor infrastructure status, inefficient supply chain and conventional small scale unorganized retailers makes it more challenging in the present scenario. Further, it was observed that poor forward and backward linkages in the marketing channels and poor marketing infrastructure are leading to high and fluctuating consumer prices and only a small proportion of the consumer rupee reaching the farmers (Kaul 1997). Analysis of prices at different levels indicated that the average producers' share in the consumer price is only around 48% for vegetables and 37% for fruits (Gandhi and Namboodiri 2002). In addition, Kumar *et al.* (2004) observed that the farm gate prices for vegetables and fruits range between 20-30% of the eventual retail prices in India as against developed countries such as USA, UK and Japan, the farm gate prices between 40-55% of retail prices. There is substantial wastage, deterioration in quality, and frequent mis-match between demand and supply spatially and over time (Subbanarasiah 1991, Singh *et al*. 1985). Several studies have been conducted reflecting the need of producers' cooperative and organized marketing infrastructure.

Since, the market (mandi) system has number of inefficiencies like non-transparent price setting where seller and buyer were often cheated, huge losses due to non-scientific handling and storage. Instead of direct selling, farmers preferred to sell their produce to local agents or trader. Sidhu *et al.* (2010) in the study reported that majority of produce disposed through commission agents/ wholesalers (90%) and a small proportion is sold through retailers and directly to consumers. Therefore, there is need of cooperative or producer organization to collect the raw material directly from producers and save them from the clutches of commission agents.

Several IFPRI studies in India confirmed that higher profit earned by contract farmers against non-contract farmers mainly due to lowering marketing and transaction costs and, in some cases, offering better prices. An IFPRI study of Mother Dairy, Nestle and Venkateshwara Hatcheries showed that contracting was beneficial because it helped contracted farmers to reduced cultivation cost and earned better price compared to non-contract farmers (Birthal *et al.* 2006). The summary results from the study showed that the net profit for the contract dairy farmers was more than double that of non-contract farmers, higher for vegetable farmers (78%) and poultry farmers (13%). Production costs reduced to approximately 21% for contracted farmers in case of vegetables owing to lower share of transaction and marketing costs. Therefore, several studies emphasized on organized retail and confirmed the relative advantages for farmers connected with organised retail on fresh fruit and vegetable retail chains in India. For instance, retail chain□contracted farmers received comparatively higher prices (Alam and Verma 2007), higher net profits (Birthal *et al.* 2005) and also had lower transaction costs (Singh and Singla 2010, Alam and Verma 2007). Presently, HaryaliKisan Bazaars, Mahindra and Mahindra's ShubhLabh Stores, Tata/ Rallis's KisanKendras, Escort's rural stores, and ITC-led ChoupalSagars are similar business hubs that provide value-added services like soil-testing facilities, education services, credit services, and agri-input supply to village farmers.

Major constraints in value chain development

The basic purpose of an efficient value chain is to provide value addition at every stage from farm to fork through proper utilization of inputs/resources and availing facilities of infrastructure within the opportunities and constraints of its institutional and/or entrepreneurial environment. Therefore, following constraints for value chain development are considered.

Access to market facility: Access to market depends on integrated concept of producers' competency, infrastructures facility and market intelligence. However, the involvement of large number of intermediaries in value chain leads to low producers' share in consumer prices as well as more post-harvest losses due to increase in number of stages. The direct selling of produce fetches more income but most of the producers do not prefer because of different reasons. Further, the lack of market information to producers, high commission charges, high transport cost, unauthorized deductions, low storage facility etc. constraint the value chain development.

Availability of resources and infrastructures (physical): For successful value chain, the supporting infrastructures and availability of resources/inputs are critical. The major limitation of resources and infrastructure for value chain development are: limited resources availability and inadequate infrastructure such as the geographic location of an enterprise; skilled labour availability and timely information (production, distribution, and marketing); cold storage facility at nearby location etc. are an important condition for innovative behaviour of value chain actors and finally, the level and availability of technology that can be used for production and distribution activities in the value chain.

Institutional voids: In India, institutional voids defined as "situations where institutional arrangements that support markets are absent, weak or fail to accomplish the role expected from them" (Mair and Marti 2008). In India the lack of one stop centre to provide theagri-start up facility, lack of block and/or district level processing units, lengthy procedure of registration and issuing certificate, poor awareness of quality testing and food standards, insufficient training institutions in post-harvest management and value chain promotion especially nearby regions etc. affect the value chain.The inadequate provision of forward and backward linkages, low support and guidance facilities, lack of credit and insurance facilities etc. limit the value chain development.

Strategies for promoting value chain in agriculture

Although India is second largest producer of horticultural crop globally but due to high post harvest losses and insignificant processing of fruits and vegetables there is need to focus on efficient value chain development. Again value chain development in horticultural sector is complex due to its perishability, high fluctuation in demand and price, seasonality, and climate dependence. The other factors which are critical for success of value chain like infrastructure, market information, forward-backward linkage, institutional support etc. are questionable. So, the following strategies are suggested for improvement of value chain.

There is need to focus on commodity and community based processing centre for instance Allahabad is red colour guava belt so if commodity based processing centre is established at block or district level then jelly can be easily prepared without adding edible colour to it. Similarly, there is need to start commodity based processing at different region like Malihabad region of Lucknow for mango, Pratapgarh for aonla, Sonipat for mushroom etc.

Emphasis should be given on partnership between local processors and institution; so that local processors can produce desire quality of value added products and supporting institution will help in marketing of the products through ensuring quality, branding, packaging and exporting. Most of the processors are working sporadically, thus

immense need to integrate them also.

Most of the projects started by government are limited to progressive farmers or adopted villages rather than reaching to resource poor farmers. Thus, vibrant programme should be undertaken, mass awareness should be created regarding programme objectives and ensuring active participation of farmers or target group.

Competency of development officer at district and block level should be improve, they should be sensitize with problems and issues of society.

Stress should be given on infrastructure and storage facility, availability of timely marketing information, institutional support and credit facilities etc. for efficient value chain development.

REFERENCES

Alam G and Verma D. 2007. Connecting small-scale farmers with dynamic markets: A case study of a successful supply chain in Uttarakhand. Centre for Sustainable Development, Dehradun, India.

Ali J and Nath T. 2010. Factor affecting adoption of post-harvest techniques in vegetable value chain. *Agricultural Economics Research Review* **23**: 554.

Agricultural and Processed Food Products Export Development Authority. 2016. https://www.apeda.gov.in

Balaswamy K, Rao P, Yadav P, Rao N and Satyanarayana S. 2015. Antioxidant activity of tomato (*Lycopersicon esculentum* L.) of low soluble solids and development of a shelf stable spread. *International Journal of Food Science, Nutrition and Dietetics* (IJFS).

Bernet T, Thiele G and Zschocke T. 2006. Participatory market chain approach (PMCA): User Guide. International Potato Center (CIP), Lima, Peru: http://cipotato.org/publications/pdf/003296.pdf

Bhattacharyya B K and Bhattacharjee D. 2007. Bactriocin: A biological food preservative. *Journal of Food Science and Technology* **44**(5): 459–64.

Birthal P S, Joshi P K and Gulati A. 2006.Vertical coordination in high value commodities. (*In*) From plate to plough: Agricultural diversification and its implications for the smallholders in India. Ford Foundation, New Delhi.

Birthal P S, Joshi P K and Gulati A. 2005. Vertical co-ordination in high-value food commodities: Implications for smallholders. MTID discussion paper no. 85, IFPRI, Washington.

Da Silva C A and de Souza Filho H M. 2007. Guidelines for rapid appraisals of agrifood chain performance in developing countries. Food and Agriculture Organization of the United Nations, Rome: http://www.fao.org/docrep/010/a1475e/a1475e00.htm

DFID. 2008. The operational guide for the making markets work for the poor (M4P) approach. Department for International Development, London http://www.setoolbelt.org/resources/1836.

FAOSTAT, 2013. Production output derived from FAOSTAT, accessed in November 2013; Processed output derived from "WPTC World production estimate of tomatoes for processing as of 6 September 2013", World Processing Tomato Council. http://faostat.fao.org/DesktopModules/Faostat/WATFDetailed2/watf.aspx?PageID=536, accessed on 2 December 2013.

Gandhi V P and Namboodiri N V. 2002. Fruit and vegetable marketing and its efficiency in India: A study of wholesale markets in the Ahmedabad area. Indian Institute of Management, Ahmedabad, India.

Goyal R K, Patil R T, Kingsly A R P, Walia H and Kumar P. 2008. Status of postharvest technology of aonla in India- A review. *American Journal of Food Technology* **3**(1): 13–23.

Halder P and Pati S. 2011. A need for paradigm shift to improve supply chain management of fruits and vegetables in India. *Asian Journal of Agriculture and Rural Development* **1**(1): 1–20.

Herr M L and Muzira T J. 2009. Value chain development for decent work. International Labour Office, Geneva: http://www.ilo.org/empent/areas/value-chain-development-vcd/WCMS_115490/lang-en/index.htm

Hobbs J, Cooney A and Fulton M. 2000. Value chains in the agri-food sector: What are they? How do they work? Are they for me? Department of Agricultural Economics, University of Saskatchewan, Saskatoon, Canada.

Imtiyaz H and Soni P. 2014. Evaluation of marketing supply chain performance of fresh vegetables in allahabad district, India. *International Journal of Management Sciences and Business Research* **3**(1): 72–83.

Jadhav M S, Pagire B V and Gavali A V. 2010. A supply chain analysis of raisins in western Maharashtra. *Agricultural Economics Research Review* **23**: 557.

Joshi P K, Gulati A Birthal P S and Tewari L. 2004. Agriculture diversification in south Asia: Patterns, determinants and policy implications. *Economic and Political Weekly* **39**(24): 2457–67.

Kaul G L. 1997. Horticulture in India: Production, marketing and processing. *Indian Journal of Agricultural Economics* **52**(3).

Kumar, S, Joshi P K and Pal S. 2004. Impact of Vegetable Research in India. NCAP Workshop Proceedings No. 13, National Centre for Agricultural Economics and Policy Research, ICAR, New Delhi.

Kumbhar J S, Pawar P P, Patole S D and Gavali A S. 2014. Economics of production and marketing of guava in Maharashtra. *International Journal of Agricultural Sciences* **10**(2): 592–9.

Lundy M, Gottret M V, Ostertag C, Best R and Ferris S. 2007. Participatory market chain analysis for smallholder producers. CIAT, Cali, Colombia: http://webapp.ciat.cgiar.org/agroempresas/ingles/good_practice_guide_4.htm

Mangala K P and Chengappa P G. 2008. A novel agribusiness model for backward linkages with farmers: A case of Food Retail Chain. *Agricultural Economics Research Review* **21:** 363–70.

Manna P, Mishra A A and Shukla R N. 2016. Production, marketing and value chain analysis of guava in Allahabad district of Uttar Pradesh, India. *International Journal of Environment, Agriculture and Biotechnology* **1**(2): 119–21.

Marti I and Mair J. 2008. Bringing change into the lives of the poor: Entrepreneurship outside traditional boundaries. (*In*) Institutional Work. Cambridge University Press.

Ministry of Food Processing Industries. 2017. https://www.mofpi.nic.in

Modi P, Mishra D, Gulati H and Murugesan K. 2009.Uttarakhand State Cooperative Federation: Can it help the horticulture farmers? *Vision—The Journal of Business Perspective* **13**(2): 53–61.

Murthy M R K, Reddy G P and Rao K H. 2014. Retail marketing of fruits and vegetables in India: A case study on export of grapes from Andhra Pradesh, India. *European Journal of Logistics Purchasing and Supply Chain Management* **2**(1): 62–70.

National Horticultural Board. 2016. Horticultural Statistics At A Glance 2015.https://wwwnhb.gov.in

Pandey N K, Dhiraj K and Singh R K. 2014. Current trends in quality potato production, processing and marketing. Summer School on Current Trends in Quality Potato Production, Processing and Marketing. CPRI, Shimla.

Radha Y and Prasad Y 2001. Economics of production and marketing of vegetables in Karimnagar district, Andhra Pradesh. *Indian Journal of Agricultural Marketing* **15**: 55–61.

Rao V S. 2012. Post Harvest Technology and Value Addition in Fruits. Central Research Institute for Dryland Agriculture, Hyderabad http://www.crida.in/DRM1-Winter%20School/VSR.pdf

Rathore J, Sharma A and Saxena K. 2010. Cold chain infrastructure for frozen food: A weak link in Indian retail sector. *IUP Journal of Supply Chain Management* **8**(1 & 2): 90–103.

Saha K P , Singh R P and Prakash J. 2015. A study of existing supply chain in vegetable crops in Ranchi, Jharkhand. *Agricultural Economics Research Review* **23** (Conference Number): 553.

Salin V. 1998. Information technology in agri-food supply chains. *International Food and Agribusiness Management Review* **1**(3): 329–34.

Sidhu R S, Kumar S, Vatta K and Singh P. 2010. Supply chain analysis of onion and cauliflower in Punjab. *Agricultural Economics Review* **23**: 445–53.

Singh M K. 1985. Price spread of vegetables marketing. *Indian Journal of Agricultural Economics* **40**(3).

Singh R, Kushwaha R, and Verma S K. 2008.An economic appraisal of post-harvest losses in vegetable in Uttar Pradesh. *Indian Journal of Agricultural Economics* **63**(3): 378.

Singh S and Singla N. 2010. Fresh Food Retail Chains in India: Impacts on Small Primary Vegetable Producers and Traditional F & V Retailers. Indian Institute of Management, Ahmedabad.

Springer-Heinze A. 2008. Value links: The methodology of value chain promotion. GTZ, Eschborn, Germany: http://www2.gtz.de/wbf/lred/library/detail.asp?number=3721

Thorat S N and Bhujbal B G. 2010. Marketing of selected vegetables in Junnar tahsil of Pune district. *Journal of Maharashtra Agricultural Universities* **35**: 265–8.

UNIDO. 2011. Pro-poor value chain development: 25 guiding questions for designing and implementing agroindustry projects. United Nations Industrial Development Organisation, Vienna: http://www.unido.org/fileadmin/user_media/Services/Agro-Industries/Pro-poor_value_chain_development_2011.pdf

Vegetable Statistics. 2016. Vegetable production in India (2000-2001 to 2010-2011). Technical Bulletin no 11, Indian Institute of Vegetable Research, ICAR, Varanasi.

Vermeulen S, J Woodhill F, Proctor and Delnoye R. 2008. Chain-wide learning for inclusive agrifood market development: A guide to multi-stakeholder processes for linking small-scale producers to modern markets. International Institute for Environment and Development, London and Wageningen University and Research Centre, Wageningen, the Netherlands: http://www.regoverningmarkets.org/en/articles/global/chain_wide_learning_guide_for_ inclusive_agrifood_market_development_a_guide.html

Vorst J V and Beulens A. 2002. Identifying sources of uncertainty to generate supply chain redesign strategies. *International Journal of Physical Distribution and Logistics Management* **32**(6): 409–30.

Weinberger K and Lumpkin T. 2005. Horticulture for Poverty Alleviation: The Unfunded Revolution: AVRDC- The World Vegetable Center. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=781784

World Bank. 2010. Building competitiveness in Africa's agriculture: A guide to value chain concepts and applications. World Bank, Washington DC: http://siteresources.worldbank.org/INTARD/Resources/Building_Competitiveness_in_ Africa_Ag.pdf.

World Bank. 2008. Horticulture Export Promotion and Technology Transfer Project (No. ICR0000679 h): The World Bank. July 28, 2008 http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/08/27/000333038_20080.