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Value Chain Assessment of Horticultural Crops in the Vidarbha Region of Maharashtra

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ABSTRACT

Background: This paper investigates the horticulture crop value chain in the Vidarbha region of Maharashtra. It focuses on the different approaches to marketing used in Vidarbha and makes note of the fact that just 1 out of 10 farmers choose the farm-to-table model.

Methods: A survey was conducted in order to gather the primary data employing a simple random sampling method. The survey was undertaken in four districts *viz*., Nagpur, Amravati, Bhandara and Wardha. The crops under investigation were banana, mango, lemon, orange/mandarin, tomato, potato and onion.

Result: It was recorded that the projected amount of produce wasted was the highest at the retail level for tomato, potato, banana and mango crops, at the farm level for lemon and orange and at the wholesale level for onion. Moreover, the harvested crops are not properly stored until delivered due to lack of storage facilities. Farmers received less price due to low quality of produce and exploitation by the middlemen. At the farm level, it was recorded that 15-36% of the yield is lost due to pests/predators, unprecedented weather conditions and improper management. The supply chain faces several issues, including the scarcity of high-quality seeds, a lack of irrigation resources, unfavourable weather that ruins the produce, post-harvest losses, lack of storage facilities, price seasonality and market volatility. Numerous vertical coordination problems in the value chain could be resolved by the adoption of horticulture cooperatives and the creation of FPOs (Farmer Producer Organisations).

Key words: Farmer producer organisation, Horticulture cooperatives, Lack of storage facilities, Post-harvest loss, Value chain.

INTRODUCTION

Horticulture in the Vidarbha region is characterised by high food losses often over 50% for highly perishable products (Apte, 2020). Value chain assessment for horticulture crops needs to pay special attention to food loss both pre-and post-harvest. It is important to assess and study the different components and challenges of the value chain as it will provide a clear picture and description which is necessary to boost Vidarbha's economic output. Horticulture is far more labour-intensive since it requires a farmer, wholesaler and retailer to take care of each crop on and off the farm (Nolan, 2004). A novel approach to market dynamics through value chain mapping was demonstrated (Dubey *et al*., 2020a). Thus a horticultural value chain involves producers which are farmers, collectors or traders, marketing agents or firms, processors, transporting individuals or agencies, wholesalers and finally retailers and consumers (Hassan *et al*., 2020). The economic system connects upstream agents such as farmers and processors, to downstream groups of consumers at each stage by technical, financial, territorial and social organisation and social relationships (Aboah *et al*., 2021). Vidarbha region has remained backwards and less developed as compared to other regions of Maharashtra due mainly to the repeated deployment of administrative machinery that was unable to implement the development program effectively (Apte, 2020). The problem in the Vidarbha region is repeated crop failures, the rising cost of cultivation and debts that have created a situation leading to farmers' frustration and reduced cash income (Dongre and Deshmukh, 2012). Lack of marketing opportunities and inadequate processing centres at the primary and secondary stages impact the value of the product (Apte, 2020). This lowers the total remuneration accrued to the farmers in the Vidarbha region of Maharashtra. This paper assesses the horticultural value chain development process in a few districts of Vidarbha and the probable constraints faced in each stage of its development. It also describes the different qualitative and quantitative methods for the value chain assessment and the role of market systems in the value chain development process and suggests mitigation strategies.

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MATERIALS AND METHODS

The laboratory used in this study was the Centre of Sericulture and Bioresource Management Research, RTM, Nagpur University, Maharashtra. A survey was undertaken with the

value chain actors in the towns and villages of Nagpur, Amravati, Wardha and Bhandara districts of Vidarbha from May-September 2023 to assess the value chains of horticultural crops from sowing to the harvest (Fig 1, a-d).

The assessment was carried out by evaluating the detailed procedure involved in each step of its activity and each actor's contribution to increasing production efficiency. These actors are grouped into three categories: primary, secondary and value-addition modifiers. The chain identified each step in the process of product development at which value is added including the manufacturing and marketing stages of its production (Table 1). A few notable and essential horticultural crops such as tomato, potato, onion, lemon, mandarin/orange, banana and mango were assessed in the small and medium-scale farmer's fields and other factors. The primary and secondary data were collected through a survey carried out in adjoining towns/ villages namely Nagpur (Saoner, Hatla, Ghogali, Chargaon-Dorli, Kondhali, Kalmeshwar (Dahegoan), Umred, Kahnolibara, Kohli, Satnavari, Koradi, Tekdi and Kahandevi), Amravati (Dhanla, Warud) Wardha (Seloo) and Bhandara (Mouda) (Fig 1). For primary quantitative research, a simple random sampling method was adopted in the above-mentioned sites. A total of 54 individuals of the horticultural value chain including small and medium-scale farmers, retailers, traders and wholesalers were randomly interviewed over a period of 32 days. All individuals were interviewed by supplying a questionnaire in a vernacular that incorporates queries ranging from age, family size, crop type, price charged, expenditure incurred, land size, brokerage paid and charged, subsidy received, location, constraints faced, such as diseases and pests, total production and production losses and source of income and their current role in various activities in the value chain. Primary data for the estimated wastage of each crop at each level was analysed and calculated using the following equation:

$$\text{Per cent wastage in the value chain of selected crops} = \frac{\Sigma \text{ Loss of each actor of specific crop at represented level}}{\text{Total no. of actors related to that loss level of specific crop}}$$

The average was calculated by taking the sum of each actor's loss of a specified crop divided by the number of actors related to that loss level.

RESULTS AND DISCUSSION

The data consisted of prices charged by each actor in the value chain for their respective product, per cent of brokerage paid and charged, expenditure incurred, amount of wastage and loss at each significant level and additional information such as problems faced, price fluctuations, land size *etc*. The primary data has revealed that farmers from these districts in the Vidarbha region have a common behavioural pattern. When trade and return in a specific year are extremely profitable in the horticulture sector, consequently, additional growers plant the crops in the following season. The farmer stated that if the crop is readily available in large quantities it will never be in demand and the farmer will not be rewarded for it. Moreover, farmers improperly package their products, damaging the goods. Many farmers lack the financial resources needed to carry out the process required to avert losses because of their poverty. Unfortunately, due to a lack of skill, planning and limitations in cultivation, the plantation suffers.

Surveys of potato growers in Kondhali village revealed that there is just one multipurpose storage facility in Kondhali, which was constructed in 2021. The vast majority of farmers in the districts surveyed favour selling their harvest

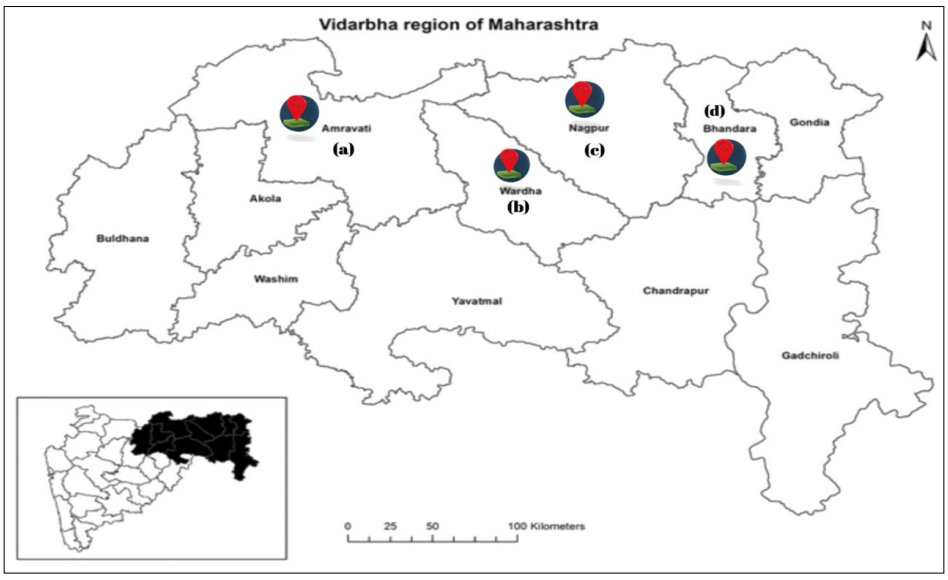


Fig 1: Map of Vidarbha region of Maharashtra with highlighted districts surveyed.

immediately rather than storing it. If additional cold storage facilities are made available, a farmer can store harvested crops for 2-4 months in Kondhali. With the existing storage facilities, farmers are paying a minimal fee for its use. Kalamna Market's wholesalers in Nagpur keep their produce in the warehouses and Godowns provided by the Agricultural Produce Market Committee (APMC). This Market offers mortgage services to eliminate the exploitation of the farmers by intermediaries, where they are forced to sell their produce at extremely low prices. By presenting his 7/12 (land) extract document, a farmer can keep his produce in the APMC Godown and obtain a loan against it. As a result, the farmer is able to store his produce if market prices are low. In the Vidarbha region, eleven APMCs (Nagpur, Wardha, Yavatmal, Buldana (2), Amravati (2), Akola, Washim, Bhandara and Chandrapur), offer this crucial facility to the farmers.

Farmer's preference

The farm-to-table methodology contributes to decreasing post-harvest losses, shortening the marketing chain and boosting infrastructure development. Our data revealed that 1 out of 10 farmers opt for the marketing channel 'Farmer' → Consumer' over Farmer → Wholesaler through middleman because farmers are not well informed about the technical know-how required to sell their produce. The majority of small and medium-scale farmers prefer involving a middleman to sell their produce due to time constraints offering a fixed rate to the broker. APMC limits the occurrence of distress sales by the farmers under the pressure and exploitation of creditors and other intermediaries. APMCs aided in price stabilisation and farmers are given storage facilities. It is inevitable that wholesalers' business will fluctuate by 10-20%. Wholesalers at the Kalamna market in Nagpur pay the APMC a cess of 1.05%.

Constraints faced by vidarbha farmers

The varied interconnected problems and challenges faced by the supply chain actors are; unavailability of good quality seeds, lack of irrigation sources, un-suitable weather conditions which damage the produce, excess use of fertiliser and pesticides that affect human and pollinators' life quality along with the environment, post-harvest losses, lack of storage infrastructure, price seasonality and market volatility. Increased temperatures in these districts result in lower agricultural yields and more insect infestations. The perishable nature of the crops adds distortion to the challenges faced. Heavy rains in August 2022 and a hailstorm in April 2023 in Vidarbha, led to major losses of crops. This has spiralled the value chain actors into huge debts. Moreover, the drought in July-August 2023 in Vidarbha has affected the horticultural crops.

Value chain mapping

Wastage of produce at each level

Food losses in the districts are illustrated into three stages, *viz*., Farm level, Wholesale and Retail. Farmers have resorted to distress sales because of crop fragmentation, severe volatility in prices (*e.g*., Tomato price fluctuation), substantial yield losses and harvest-dumping on roads due to lack of storage infrastructure and market. The amount of crop wasted has increased, which has a negative impact on retailers' income levels. The average is calculated by taking the sum of each actor's loss of a specified crop divided by the number of actors related to that loss level. Average per cent of loss of specified produce at each respective level (Table 2).

No. of storage units

In districts surveyed, the shortage of cold storage facilities contributes to post-harvest losses since produce is not properly preserved until it is delivered to retail consumer markets. Table 3 provides the number of cold storage for fruits and vegetables in Vidarbha and Table 4 provides the details of export facility centres in Vidarbha, especially for orange crops with various capacities facilitating pre-cooling and cold storage in facility centres.

Value chain prioritisation

Our assessment suggests that in horticultural crops Potato, Onion, Tomato, Banana, Mandarin/Orange, Mango and Lemon are considered as 'priority' value chain because these are the most common commodities for all consumers and are most effective at achieving multiple policy objectives. The retailers surveyed in Cotton Market, Nagpur revealed the prices of wholesale and retail for potatoes and onions (Table 5). A similar survey was carried out for other horticultural crops under study.

Opportunities for value addition in Vidarbha

Drying and dehydration of fruits and vegetables

Fruits and vegetables that are dried where they are produced may reduce food losses and increase the profitability of small

Table 1: Conceptual structure of the activities in the value chain and value addition for a better price.

Primary activities	Secondary or support activities	Value added/price
• Supply of seeds/plants	• Procurement of raw materials, services *etc.*	• The discrepancy between the value of the activities and their expense
• Input suppliers		
• Production, collection, grading and transportation	• Technology and skill development	
• Wholesaling and retailing	• Human resource management	
	• Infrastructure	
• Marketing and sale		

Table 2: The per cent losses of selected fruits and vegetables in the supply chain in 4 districts of Vidarbha (Average of the primary data collected).

Crop	Seed/Tuber/Nursey plant loss (mortality loss over the initial 30 day period after plantation) (Farm level loss)	Farm level loss	Wholesale level loss (Including transport loss)	Retail level loss (Including transport loss)	Total loss (Σ of columns)
Tomato	13%	12.75%	5%	19.4%	50.15%
Potato	2.25%	12.25%	15%	19.4%	48.9%
Onion	8.75%	12.5%	25%	18.66%	64.91%
Orange	2.25%	21%	13.5%	20%	56.75%
Banana	3.5%	12.5%	7.5%	20%	43.5%
Mango	5.25%	15%	7.5%	20%	47.75%
Lemon	8.75%	23.75%	15%	13.33%	60.83%
Horticultural crop loss range	2.25-13.00%	12.25-23.75%	5.00-25.00%	13.00-20.00%	43.50-64.91%

Source: Primary data of crop losses collected during survey from farm level to retailers in the horticultural value chain (2023).
(Note: For oranges 5 farmers have been surveyed whereas for other crops 4 farmers were surveyed; Similar quantitative methods were adopted for calculating the per cent losses at the wholesalers and retailers levels).

Table 3: Cold storage units in the districts of Vidarbha Region of Maharashtra.

Location	No. of storage	Capacity in metric tons	Sector	Products stored
Akola	2	789	Private	Potatoes; Fruits and vegetables
Amravati	3	5789	Private	Potatoes; Multipurpose
Bhandara	3	2335	Private	Potatoes; Multipurpose
Nagpur	8	44844	Private	Multipurpose
Wardha*	1	460	Private	Multipurpose
Yavatmal	1	468	Private	Multipurpose

Source: Agmarket.
*As per the survey conducted, there were nine ripening chambers for Banana crops within a 15-16 km radius of Seloo, District Wardha four of which were closed due to technical snag.

Table 4: Export facility centers.

Export facility centre	Particulars	Capacity	Additional information
Orange Export Facility Centre, Ashti, Dist. Wardha	(a) Precooling	(a) 5 M.T/6Hr.	Operational
	(b) Cold storage	(b) 25 M.T.	
	(c) Material handling system	(c) 1.5 M.T./Hr.	
Orange Export Facility Centre, Warud, Dist. Amravati	(a) Precooling	(a) 5 M.T/6Hr.	Proposed
	(b) Cold storage	(b) 50 M.T.	
	(c) Pack house	(c) 2000 Sq. Ft	

Source: https://www.msamb.com/Documents/list.pdf.

Table 5: Prices for onion and potato of a retailer in cotton market, Nagpur.

Particular	Amount (In Rs.)
Potato wholesale price	Rs. 550 for 40 kg (Jute bag)
Potato retail price	Rs. 20 per kg
Onion wholesale price	Rs. 700 for 40 kg (Gunny bag)
Onion retail price	Rs. 22-24 per kg
Transport costs	
Auto driver charges	Rs. 15 per jute/gunny bag
Labour cost for material handling	Rs. 6
Cost to weight handler (weighbridge)	Rs. 7

Source: Primary survey of retailers and wholesalers.

farmers. Fruits are susceptible to deterioration if harvested prior to maturation and results in poor quality. Produce is best protected by plastic crates and corrugated fibre board (CFB) boxes during handling, shipping and storage. Different techniques, such as cold storage, controlled environment storage, hypobaric storage, *etc*., can extend the shelf life of fresh fruits. Top companies of dehydration of fruits and vegetables are readily available in Maharashtra.

Value chains are crucial for the effective and systematic management of food production systems (Dubey *et al*., 2020a). It has been estimated that 30% of the food produced is frittered away while travelling from the farm to the consumer (Rezaei and Liu, 2017). This may be both in either quality or quantity (Ghamrawy, 2019). This quantity can feed the food-deprived population of the world. Therefore, a well-organised value chain can efficiently use natural and financial resources to minimise post-harvest losses (Dubey *et al*., 2020a). Value chain analysis of horticultural crops and their regional analysis in the Indian horticultural scenario was demonstrated by (Hassan *et al*., 2020). This enabled us to understand the various players involved, various activities which add value to the product and also the efficacy of the chain. In the districts of Vidarbha surveyed it has been assessed that, because of their perishable nature, fruits and vegetables must be sent to markets promptly to avoid quality degradation. However, Vidarbha does not have many such facilities. If more APMCs in the area develop resources at par with Nagpur Kalamna's market which is equipped with a lot of necessary facilities it would significantly boost farmers' income. Presently, produce from farms is still weighed in the traditional manner and farmers are defrauded in these districts. Moreover, the farmers use small vehicles and loosely transport their produce. Due to this practice fruits and vegetables are compressed and at the bottom harmed. This wasteful loss can be avoided if the produce is transported from the farm through big vehicles or rail efficiently, this will guarantee the quality of fruits and reduce the percentage of losses (Chhabrani, 2013).

Farmer connect is an initiative undertaken by APEDA (Agricultural and Processed Food Products Export Development Authority) to provide a 24/7 Online visibility digital platform in the form of a portal and mobile application. It is helping to bridge the gap between FPO (Farmer Producer Organisation)/FPC (Farmer Producer Company)/ Cooperatives and Exporters, who can make their profile and post sell offers. Agri Marketplace is a digital B2B (Business-to-Business) solution that brings together farmers and industrial buyers. They drive agricultural transactions through their digital platform in combination with their service partnership network. This process involves assembling storage, processing, transportation, packaging, grading and distribution of different agricultural commodities across the region/country. It is a link between the farm and non-farm sectors (Subrahmanyam, 2000). Our survey has revealed that recently the new farm technology introduced by the Govt. and accepted by a few farmers (13%) in 4 surveyed districts has proven to be helpful because it enables farmers and sellers to connect through online platforms, saving time and money on travel. It enabled speed up the process by allowing farmers and sellers to speak directly about the produce. In the aforesaid districts, over 80% of horticultural crops are mostly transported *via* buses, mini trucks and Jeeps, which raises the cost of transportation. The farmers are paid for higher-quality goods because there is an estimated 15-20% transportation loss from the production zone to distant markets. The most important restrictions noted in our study are probably the transportation of perishable goods. Therefore, most farmers in these districts sell their produce to middlemen at a throwaway price because of weak marketing infrastructure and the perishable nature of their crops. The farmers did not get a chance to put their horticultural produce to exhibit in the open market. Producers utilise bamboo baskets and gunny/ jute sacks instead of plastic boxes, which results in post-harvest losses. Our study revealed that farmers receive between 50 and 60 per cent of the retail price for high-quality produce and food. For a farmer in Vidarbha, the actual returns per unit area are relatively poor. At the farm level, output is wasted at a rate of 15-36% with no compensation to the producers.

Several studies highlighted and documented scientific evidence on waste to reduce food losses along the production and supply chain (Mohan *et al*., 2023; Braun *et al*., 2023). They recommended that it is possible to minimise losses with some safety measures adopted to add value to each level and reduce wastage. Cold storage forms the heart of the post-harvest business. Unfortunately, most of the perishable horticultural products do not go through the cold chain cycle before reaching the end consumer due to inadequate cold storage facilities and improper utilisation of the existing ones (Chakraborty, 2020). Our study has brought to light the per cent losses of selected fruits and vegetables in the supply chain in 4 districts of Vidarbha ranging from 43.50 to 64.91% for the crops understudy. The per cent losses shown are the average of the primary data collected from actors at every level of the value chain. These losses occur from the seed level to the farm level to wholesalers and retailers. There is a need for coordinated streamlined operation of economic centres (Rajapaksha *et al*., 2021) that handle the fruits and vegetable produce in bulk. For fruits, the schedule of harvesting should be based on market demand. It is necessary to promote the basic sorting, grading and pre-cooling techniques at the farm level. Instead of bamboo baskets, plastic crates should be used for storage and transportation (Kitinoja, 2013). For Vegetables, farmers should receive instruction in harvesting procedures and organised cultivation methods. Off-season vegetable harvesting should be coordinated with the demand in the states where it will be delivered. Long-distance shipping should be done in rigid containers with breathable space to prevent crushing of produce. The construction of a vegetable packhouse is imperative. In wholesale markets, basic amenities including offices, sheds, hygiene facilities, scales and grading should be available (Kitinoja, 2013). The advantages

of Vidarbha Cooperative Marketing include increased farmer profits, better quality goods and services, more markets, greater competition and a role in rural development. Additionally, it enhances local inhabitants' social security and provides employment opportunities. The bulk of farmers in 4 districts under study are small and marginal and they need to be organised for more effective value chain activities. Gedam *et al.* (2023) conducted their study on the economics of tomato production in the Nagpur district of Vidarbha and discovered that the gross returns from tomatoes were very high, indicating that tomato cultivation is economically viable in Nagpur. These are the opportunities along the value chain, beginning with the establishment of Postharvest Training and Service Centres (PTSC) in Vidarbha following which protection and efficient allocation of resources could be put into place for beneficial value addition.

CONCLUSION

The supply chain faces a few challenges that include a lack of high-quality seeds, a lack of irrigation resources, unfavourable weather that ruins the produce, post-harvest losses, a lack of storage facilities, price seasonality and market volatility. Numerous vertical coordination problems in the value chain may be resolved by the adoption of horticulture cooperatives and the creation of FPOs (Farmer Producer Organisations). This kind of value chain development will significantly contribute to Vidarbha's economic growth by enhancing product quality and market effectiveness through proper training and capacity building at the farm level.

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Conflict of interest

All authors declare that they have no conflicts of interest.

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