Value Chain Integration in Horticulture and Allied Sectors: Pathways to Farmer Prosperity in Telangana

Dr. P. Krishna Murthy

Deputy General Manager (DGM)
With 6 vertical Inter & Degree Tapasya Education Institutions,
Hyderabad. Telangana.

Abstract:
Horticulture is a small land use area in Telangana, but contributes an unusual amount of agricultural production, and thus is a strategic avenue to improved farm incomes. This paper reviews the concept of value chain integration, which involves coordinating input supply, production, aggregation, post-harvest handling and processing, and marketing, to turn that output into farmer prosperity. The study gives a baseline profile of the sector based on secondary information from the State and National data using primary evidence till October 2026, identifies gaps stage-wise, and examines three commodity pathways: oil palm, turmeric and spices, and mango and vegetables. Horticulture reportedly has a 7 percent share of the agricultural land and 34 percent share of the gross value of output, but Telangana has a significant dependency on vegetables from other states and limited cold-chain/processing facilities and capacities that can be directly attributed to smallholders. Oil palm demonstrates the effectiveness of institutional and collective marketing arrangements, and mill-led procurement and assured pricing to further integrate. Oil palm demonstrates the effectiveness of assured pricing by milling companies and mill-led procurement, and institutional and collective marketing arrangements in turmeric and mango. The paper introduces a four-pillar integration model, based on farmer producer organisations, post-harvest infrastructure, processing clusters and market risk institutions, and an illustrative loss-reduction scenario. Policy implications and a research programme are outlined.

Keywords: value chain integration, horticulture, farmer producer organisations, post-harvest management, oil palm, Telangana and farmer income.

1. Introduction

Diversification of Indian agriculture is a relentless process that has been in progress from cereal crops to fruits and vegetables, spices, plantation crops, and flowers with higher returns per acre and per unit of water. According to official estimates, India is expected to harvest 369.06 million tonnes of horticulture crops in 2024–25, which is approximately 4% higher than the previous year, with fruits production at 118.8 million tonnes and vegetables at 215.7 million tonnes (Global Agriculture, 2025; News Arena India, 2025). This sort of supply growth is essential for farmer prosperity, but is not enough. Perishable produce loses quantity and quality at every handoff, and farmers who sell raw produce at harvest into thin and volatile markets capture only a modest share of what consumers eventually pay.

Telangana illustrates both the promise and the problem. Horticulture occupies only about 7% of the state's agricultural area yet contributes about 34% of the agricultural gross value of output, and the state ranks among the national leaders in chilli, turmeric and mango (The Hans India, 2024). It has a large and growing urban market in Hyderabad and an international airport that the state's own planning documents identify as the basis

for an export hub in mango, banana, vegetables and flowers (Telangana Horticulture Department, 2018). More recently, the Sri Konda Laxman Telangana Horticultural University (SKLTGHU, 2025) has released a perspective plan for the sector to 2035, and the state has invested in oil palm, food processing zones and farmer collectives.

Yet performance has been uneven. The perspective plan reports that over the last decade fruit crops grew at only 1.6% while vegetable crops contracted by 8.4% (Siasat Daily, 2025). Estimates show that almost 40 lakh tonnes of vegetables are required annually in Telangana; but, production of about 19 lakh tonnes means that the state is dependent on neighboring regions for vegetables and is vulnerable to price hikes in the event of floods or droughts in those areas (Deccan Chronicle, 2023). Meanwhile, the University has warned against any further expansion in the mango and sweet orange area, as there is already a surplus in the state from the production of these fruits (Siasat Daily, 2025). If there's a deficiency of vegetables and an excess of some fruits, it's a sign of a failure in the chain of supply, not just in vegetable production.

This paper explores how greater value chain integration can increase the prosperity of farmers in Telangana. Integration here is defined as the intentional synchronisation of the supply of inputs, production, aggregation, post-harvest handling, processing and marketing, from the contracts, collective organisations, common infrastructure and supportive institutions, to maximise the benefits to the grower and minimise losses in the process. The study aims at three things – to profile the status of horticulture and allied agriculture in Telangana using the latest available data; to identify gaps at various stages that affect farmer returns; and to chart out pathways, based on commodity cases, for the path to follow by the policy makers, farmer organisations and agribusinesses.

The remainder of the paper is organised as follows. Section 2 sets out the conceptual framework, Section 3 describes data and method, Section 4 profiles the sector, Section 5 diagnoses the chain stage by stage, Section 6 examines commodity pathways, Section 7 reviews the policy architecture, Section 8 proposes an integration framework, Section 9 sets out limitations and a research agenda, and Section 10 concludes.

2. Conceptual Framework and Review of Literature

2.1 Value chains, governance and upgrading

The value chain idea originates in Porter's (1985) account of the sequence of activities through which a firm creates value. Kaplinsky and Morris (2001) extended the concept across firms, treating a chain as the full range of activities from production through processing and distribution to the final consumer, and highlighting two analytical questions: who governs the chain, and how participants can upgrade. Processes (Doing things more efficiently), Products (Moving to higher value varieties or forms), Functions (Entering new activities, grading or processing), and across chains. Collective functional upgrading, like primary processing and aggregation, can be the path of shortest route to added value for smallholder farmers. Gereffi, Humphrey and Sturgeon (2005) identified five types of governance ranging from arm's-length markets, to modular, relational and captive networks, to hierarchy based on the complexity of transactions, the codifiability of information, and supplier capabilities. It is important to differentiate because of horticulture. In spot markets, farmers are vulnerable to price fluctuations, while captive markets can give them confidence in the price received by the buyer but can also give the lead firm all the power to negotiate. In this paper, the same argument is followed by viewing policy and institutions as part of the chain, rather than background; in doing so, the paper builds on Trienekens (2011), who proposed a framework for the development of agricultural chains in developing countries, which integrates the chain structure with governance and the institutional environment.

2.2 Inclusion of smallholders into modern retail systems

In developing regions, the diffusion of supermarkets was changing procurement to focus more on consolidated suppliers, quality, and logistics, as demonstrated by Reardon, Timmer, Barrett and Berdegué (2003). Vertical

coordination in food chains was also noted by Swinnen and Maertens (2007), who presented how vertical coordination was affected through privatisation and globalisation. Birthal, Joshi and Gulati (2005) studied vertical coordination in high-value crops for India and found that smallholders can join when collective action and suitable institutions are able to bring down transaction costs, but can be excluded when buyers have a preference for fewer but larger suppliers. This relates to the role of farmer producer organisations (FPOs): They are one way of aggregating volumes to satisfy the requirements of organised buyers for scale and regularity.

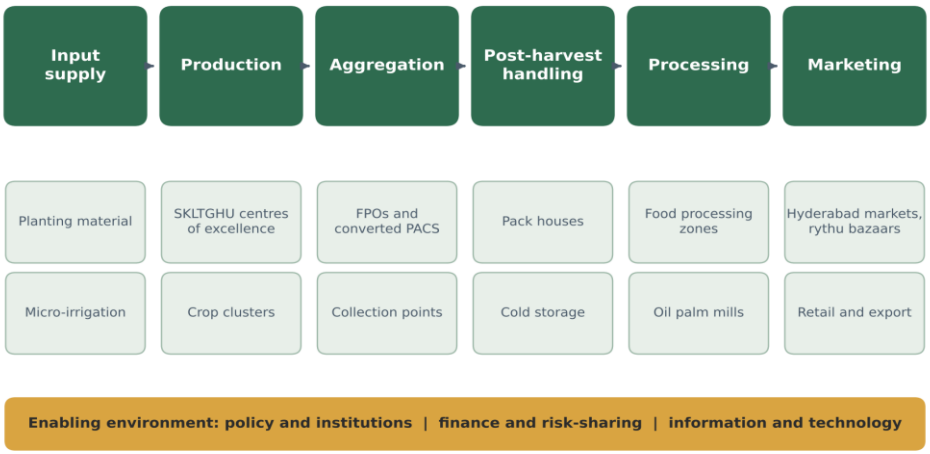
2.3 Diversification, post-harvest losses and infrastructure

While production technology was not the only determinant for diversification toward high value crops in South Asia, Joshi, Gulati, Birthal and Tewari (2004) were able to highlight the significant role that market access, infrastructure and institutional support played. Post-harvest handling is a constant weakness. According to a national assessment, the losses incurred in the harvest and post-harvest stage for fruits and vegetables ranged from 5-16% depending on the crop and stage of post-harvest (Jha, Vishwakarma, Ahmad, Rai & Dixit, 2015), and Kitinoja, Saran, Roy & Kader (2011) suggested that low-cost handling and cooling technologies for smallholders need to be given equal importance to high-cost, capital-intensive technologies. These studies together indicate that increased production is easily offset by the lack of investment in handling and storage facilities and market linkages.

2.4 Analytical framework

Here, we outline the framework in this figure. There is a policy, finance, and information enabling environment to support six functional stages from input supply to marketing. The paper poses the following questions for every stage: What does the evidence suggest is the binding constraint in Telangana? What instrument can loosen this constraint? When assessing integration, the impact on farmer outcomes (the selling price, loss reduction, income stability, and farmer value addition) is evaluated. The value chain stages and the enabling environment for the horticulture value chain in Telangana are shown in Figure 1.

Figure 1: The value chain stages and the enabling environment for the horticulture value chain in Telangana.



Note. Stage examples drawn from the institutions and schemes discussed in Sections 5 to 7. Prepared by the author.

3. Data and Method

This study is a desk-based secondary analysis study. The four types of material used were: (a) sector statistics reported by the Telangana horticulture department and national estimates of horticulture released by the Union agriculture ministry; (b) the Indian Parliament's responses to questions about the FPOs, cold storage, food processing and the National Turmeric Board; (c) policy documents like the Rashtriya Krishi Vikas Yojana project report, the Telangana food processing policy and the horticulture perspective plan to 2035; and (d) the press and institutional reports on oil palm, vegetable supply and farmer organisations. Searches were made in October and November 2026, and the latest available data were utilized where possible.

Three cautions apply. First, many of the reports pertaining to Telangana have been relayed in statements by departments and newspaper reports, and years and definitions vary between reports, with the paper detailing the year that each figure is from and indicating inconsistencies. Second, the figures cited in this paper are used to calculate derived quantities (such as sector shares, implied yields, etc.), which are the authors' calculations. Third, the story in section 8 is an illustration of the arithmetic, rather than a prediction. A primary survey was not conducted, so reported prices were used to derive premiums and reported premiums to draw conclusions about farmer incomes, which are not estimates of net return.

4. Horticulture and allied sectors profile of Telangana

4.1 Area, production and implied productivity

The horticulture profile of the sector reported by the state horticulture department is given in Table 1.

Horticulture and agroforestry together cover about 12.9 lakh acres and produce about 61.6 lakh tonnes (The Hans India, 2024). Fruits and spices each account for roughly a third of the area, but fruits supply about 40% of tonnage while spices supply only 15%. Vegetables occupy 14% of the area and deliver about 27% of production, making them the most intensive component. Flowers, plantation crops and agroforestry are smaller but, as Section 6 shows, plantation crops include oil palm, which is now a strategic focus.

Table 1

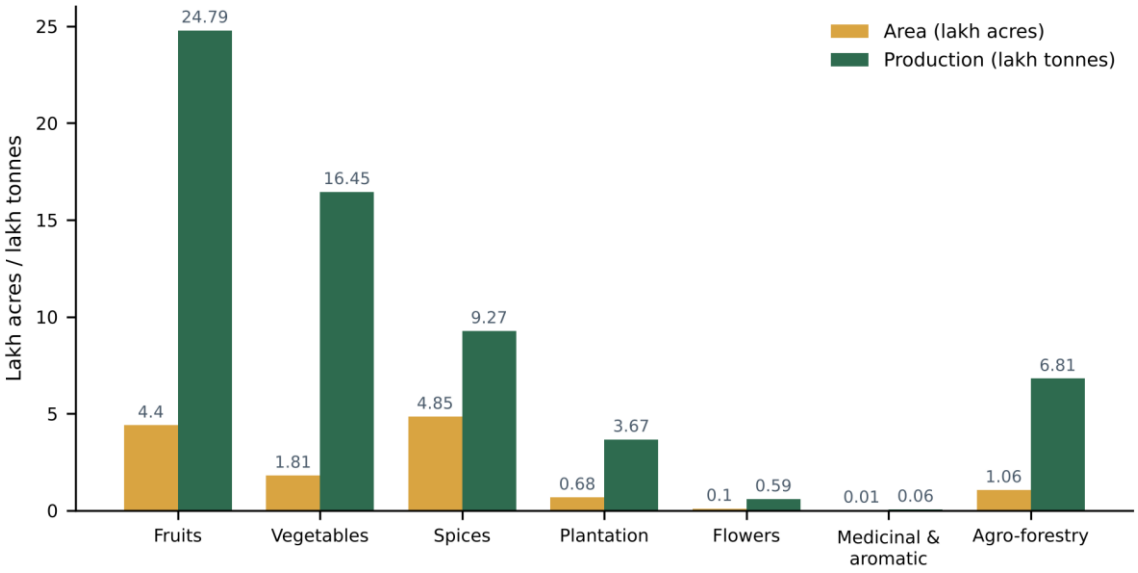
Area, Production and Implied Yield of Horticulture and Allied Sectors in Telangana

Sector	Area (lakh acres)	Share of area (%)	Production (lakh tonnes)	Share of production (%)	Implied yield (t/acre)
Fruits	4.40	34.1	24.79	40.2	5.63
Vegetables	1.81	14.0	16.45	26.7	9.09
Spices	4.85	37.6	9.27	15.0	1.91
Plantation crops	0.68	5.3	3.67	6.0	5.40
Flowers	0.10	0.8	0.59	1.0	5.90
Medicinal and aromatic crops	0.01	0.1	0.06	0.1	6.00
Agroforestry	1.06	8.2	6.81	11.0	6.42
Total	12.91	100.0	61.64	100.0	4.77

Note. Area and production from The Hans India (2024). Shares and implied yields are the author's calculations. Spice production is reported on a dried basis, so yields are not strictly comparable across sectors.

Figure 2

Area and production by horticulture sector in Telangana

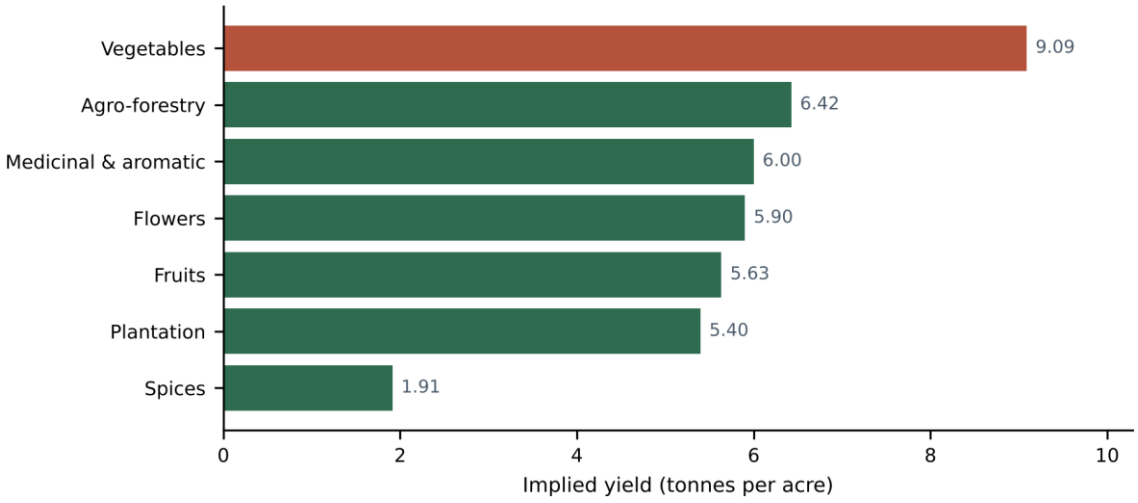


Note. Based on The Hans India (2024). Area in lakh acres; production in lakh tonnes (1 lakh = 100,000).

The contrast between area and output profiles is illustrated in Figure 2, and the implication of yield per acre is isolated in Figure 3. The vegetables are particularly outstanding with approximately 9.1 tonnes per acre, while the spices are the least healthy, as the measurement is for dried spices. It is important to note that the comparison is not intended to indicate the profitability ranking of the different lands, but merely the degree of intensive use. The same structure was evident in the past also; in 2016-17, the area under vegetables accounted for 25.15% and under spices accounted for 37.73% in the horticulture area in Telangana Horticulture Department (2018).

Figure 3

Implied yield per acre by sector (vegetables highlighted)



Note. Author's calculation from The Hans India (2024). Spice yields are on a dried-weight basis.

4.2 Competitive position and institutional base

The data also reveals that the national ranking of the department varies from crop to crop in terms of Telangana. As mentioned, the State is the leading State in the area of chilli and second in chilli production, third in turmeric area and production, and 2nd in mango production and around 9th in total horticulture area and 11th in production; the vegetables are at 12th place by area and 11th by production (The Hans India, 2024). The pattern appears to indicate a state that is specialised in crops and has an economy that is not strong in horticulture. A technology base exists at two centres of excellence – in Jeedimetla in Medchal district for vegetables and flowers and in Mulugu in Siddipet district for fruits (The Hans India, 2024). The oil extraction rate in the state is also the best in India for oil palm, 19.32% (The Hans India, 2024), providing a better commercial basis for the crop.

4.3 Scope of the allied sector

In this paper, the allied sector refers to plantation crops including oil palm, flowers, medicinal and aromatic crops, agroforestry, sericulture and the agro-processing industry that handles horticultural raw material. These activities are administered through the horticulture and sericulture departments, the Telangana Food Processing Society, and national bodies such as the National Turmeric Board. Livestock and fisheries are not part of the quantitative profile above and are integrated into the household at the farm level in many households and supported by the state's food processing policy (Telangana Food Processing Society, n.d).

The national scene is positive. As can be seen from Table 2, India's production of horticulture increased by almost 4% during 2024-25, of which onion production increased by nearly 27% and fruit production increased by almost 5%. When supply increases more rapidly than storage and grading/processing capacity, there is a greater need for supply-side integration, as the consequences are likely to be price volatility, not higher farm income (Global Agriculture, 2025).

Table 2- *India Horticulture Area and Production, 2023–24 and 2024–25 (Third Advance Estimates)*

Indicator	2023–24	2024–25	Change (%)
Total area (million ha)	29.09	29.49	+1.4
Total production (million tonnes)	354.74	369.06	+4.0
Fruits (million tonnes)	112.98	118.76	+5.1
Vegetables (million tonnes)	207.21	215.68	+4.1
Onion (million tonnes)	24.27	30.79	+26.9
Potato (million tonnes)	57.05	58.11	+1.9

Note. Source: Global Agriculture (2025) and News Arena India (2025). Fruit and vegetable values for 2023–24 are back-calculated from reported growth rates and rounded; percentage changes are the author's calculations.

5. Stage-wise Diagnosis of the Value Chain

5.1 Inputs and production

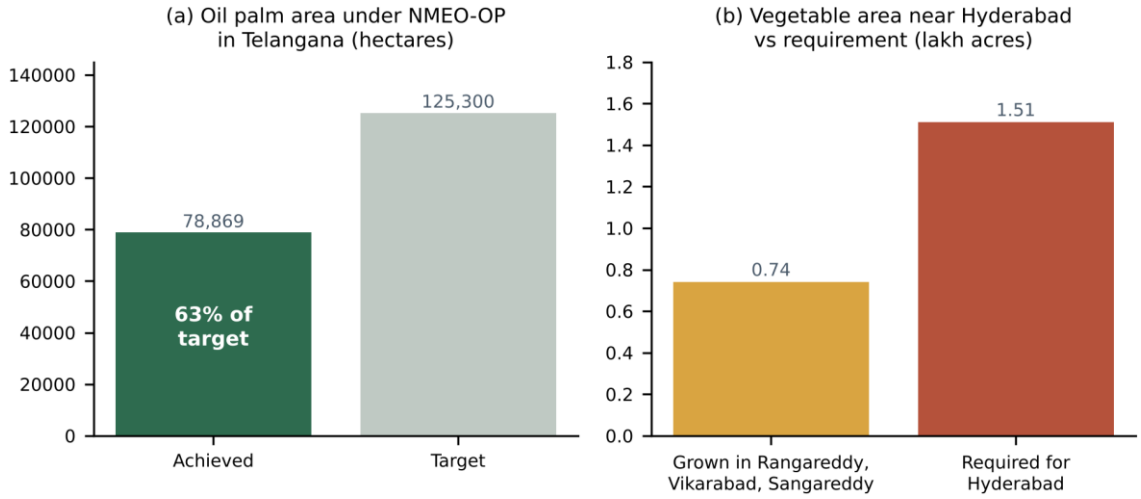
The evidence at the production stage suggests that rebalancing is needed, not overall growth. It is proposed to add an additional 1.32 lakh acres under fruit crops and 2.45 lakh acres under vegetables, where input investment of Rs 920.90 crore and an anticipated return of around four rupees for each rupee invested is estimated (SKLTGHU, 2025). It further suggests refraining from enlarging mango and sweet orange and recommends crops like guava, papaya, banana, sapota, pomegranate, dragon fruit, grapes and custard apple,

which are encouraged via subsidy schemes (Siasat Daily, 2025). The vegetable gap is even more pronounced – Rangareddy, Vikarabad and Sangareddy have 74,000 acres under vegetable cultivation while an estimated 1.51 lakh acres are needed to meet the demand in Hyderabad (The Hans India, n.d.-a).

The other limitation is water. Based on Telangana Today 2022, in the case of Oil Palm planting, authorities have fixed conditions that the farmers have to follow, such as micro-irrigation, which involves tying input support to resource efficiency. Drought is a problem for borewells, and during a drought, a state report has pointed out that vegetable cultivation was restricted due to the depletion of groundwater (Deccan Chronicle, 2017). A value chain to assure buyers should also enable the reliability of production, including irrigation, advisories, and assured planting material.

Figure 4

Selected indicators: (a) oil palm progress in Telangana; (b) vegetable area near Hyderabad versus requirement



Note. Panel (a) from ETV Bharat (2025), as of September 2025. Panel (b) from The Hans India (n.d.-a).

5.2 Aggregation and farmer organisations

Aggregation is where small farms gain bargaining power. The Union government's scheme for 10,000 new FPOs, to run to 2027–28, provides management support of up to Rs 18 lakh per FPO over three years (Global Agriculture, 2021), together with matching equity grants of up to Rs 2,000 per member within a cap of Rs 15 lakh per FPO and credit guarantees (Lok Sabha, n.d.). In Telangana, NABARD has promoted FPOs since 2015 (NABARD, 2026), and the state has taken a distinctive step by converting 311 primary agricultural cooperative societies into FPOs (The Hans India, n.d.-b). An earlier mango initiative organised 25 FPOs across 21 districts, each with 800 to 1,200 members, supplying organised retailers and aiming at a turnover of Rs 20 crore in 2021–22 (Telangana Today, 2021).

These examples show the potential of aggregation, but weaknesses remain. FPOs converted from cooperatives may inherit input-retail or credit orientation rather than market-facing marketing skills. In a December 2025 reply, the food processing ministry stated that no project in the FPO category had been supported in Telangana under its PMKSY scheme (Ministry of Food Processing Industries, 2025), indicating that FPOs have not yet accessed processing finance from this channel. Without working capital, grading sheds and market intelligence, aggregation alone will not change farmer returns. Aggregation therefore needs to be sequenced with the post-harvest and processing investments described below.

5.3 Post-harvest handling and cold chain

The biggest infrastructure deficit is cold-chain capacity, though similar state-level data is limited. According to the Union government as of March 2023 (Ministry of Agriculture and Farmers Welfare, 2023), there were 8,457 cold storage facilities in the country, while a government cold storage facility dataset contained 467 such facilities for Andhra Pradesh and Telangana combined as of January 2024 (Dataful, 2024). This is another data gap for Telangana planning, as both states are reported together. There are also differences between capacity and usable capacity for horticulture: many cold stores are constructed for potatoes; fruit and vegetable growers require pre-cooling, grading, and packhouse facilities in close proximity to the farm (Kitinoja et al., 2011).

The Telangana RKVY project report envisaged upgrading an integrated packhouse at the Post Harvest Technology Research Station in Rajendranagar to promote exports of fruits, vegetables and cut flowers (Telangana Horticulture Department, 2018). Given estimated losses of roughly 5–16% for fruits and vegetables nationally (Jha et al., 2015), investments in sorting, grading, ventilated packaging and small-scale cooling near production clusters may offer higher returns per rupee than large central stores, and FPOs are natural owners of such assets.

5.4 Processing and value addition

The 2021 Telangana food processing policy aimed to establish special food processing zones of 500 to 1,000 acres, totalling 10,000 acres by 2024–25 (Telangana Today, 2021b), with 30% of zone area reserved for warehousing, logistics, marketing and export functions (Telangana Food Processing Society, n.d.). By early 2023, the state reported 21 special zones across 7,150 acres, and investments of Rs 2,396 crore in 2022–23 (Deccan Chronicle, 2023b). These are significant steps, but two issues deserve attention. First, the 10,000-acre target had not yet been reached at that stage, and the share of processing capacity dedicated to fruit and vegetable pulp, dehydration and spice processing, as against grain and oilseed, is not disclosed. Second, the link between zone-based processors and smallholder suppliers is not specified: zones attract capital, but farmers benefit only if procurement is contractual and price-transparent.

5.5 Marketing, price formation and market dependence

Hyderabad is both Telangana's greatest horticultural opportunity and its greatest source of fragility. A state report during a dry spell recorded that over 80% of the city's vegetable demand was met by imports from neighbouring states (Deccan Chronicle, 2017). Potato dependence is high at about 79%, with annual demand of 1.79 lakh tonnes against local production of 38,000 tonnes, and onions worth roughly Rs 500 crore are imported each year from Maharashtra, Andhra Pradesh and Karnataka (Hyderabad News Hunt, n.d.). Floods in neighbouring states have repeatedly pushed up onion and vegetable prices in the city (Siasat Daily, n.d.).

This is the opportunity on the reverse side of this dependence. Proximity to a deficit market should give nearby growers a transport and freshness advantage, and rythu bazaars (farmers' markets) provide a direct-sale channel. But the opportunity is realised only when growers have reliable volumes, quality and information to supply the market consistently. Where cluster-based vegetable production was promoted, early reports noted that clusters in Mahabubnagar, Medak, Ranga Reddy and Nalgonda would take time to begin supplying Hyderabad (FreshPlaza, 2014), and the state's 2016 announcement of vegetable colonies around Hyderabad and tier-two cities had still not closed the supply gap by 2023 (Deccan Chronicle, 2023a). Table 3 summarises the stage-wise constraints and the corresponding interventions.

Table 3

Stage-wise Constraints and Integration Interventions in Telangana Horticulture

Stage	Principal constraint (evidence)	Integration intervention
Inputs and production	Vegetable area near Hyderabad about half of requirement; groundwater stress; surplus in mango and sweet orange	Crop rebalancing under the 2035 plan; micro-irrigation linked subsidies; certified planting material
Aggregation	Few market-facing FPOs; converted PACS lack marketing skills; no PMKSY FPO project in Telangana	Commodity-specific FPOs; working-capital and equity access; shared market intelligence
Post-harvest handling	Losses of about 5–16%; cold-store data not available separately for Telangana	Farm-gate pack houses, pre-cooling and grading; FPO-owned assets; state-wise cold-chain mapping
Processing	Zone acreage below target; weak linkage of zone processors with smallholders	Contract procurement; pulp, dehydration and spice-processing units in zones; price-sharing rules
Marketing	Heavy import dependence for vegetables; price spikes from weather shocks elsewhere	Cluster supply to Hyderabad; rythu bazaar linkages; retail and export contracts; storage buffers

Note. Prepared by the author from evidence cited in Section 5.

6. Commodity Pathways to Integration

6.1 Oil palm: mill-linked integration

Oil palm is the most explicit example of an integrated chain in Telangana because the perennial crop must be processed within hours of harvest, binding growers to mills. Under the National Mission on Edible Oils–Oil Palm (NMEO-OP), Telangana had achieved 78,869 hectares by September 2025, which is 63% of its target of 1,25,300 hectares and the best performance among participating states (ETV Bharat, 2025). In 2025–26, up to 22 October, the country added 52,113 hectares, of which Andhra Pradesh contributed 13,286 and Telangana 12,005 hectares (Millennium Post, 2025). By mid-2026 the state's oil palm area was reported at 2.93 lakh acres, up from about 35,000 acres in Khammam in 2020–21, and the price of fresh fruit bunches stood at Rs 23,852 per tonne (Telangana Today, 2026). Figure 4(a) shows the state's progress against its NMEO-OP target.

Processing capacity is being expanded in step with planting. The agriculture minister reviewed new mills at Narmetta, Peddapalli, Khammam, Wanaparthy, Kallur Gudem, Beechupalli and Mulugu that were scheduled to begin operations between November 2025 and August 2026 (Hyderabad News Hunt, 2025). Together with micro-irrigation conditions and company-allocated factory zones, this creates a chain in which input support, assured offtake and processing are coordinated. Table 4 summarises the main indicators.

Table 4

Oil Palm Integration Indicators for Telangana

Indicator	Reported value	Source
Area achieved under NMEO-OP (September 2025)	78,869 ha (63% of 1,25,300 ha target)	ETV Bharat (2025)

Indicator	Reported value	Source
Area added in 2025–26 to 22 October	12,005 ha (Telangana); 13,286 ha (Andhra Pradesh); 52,113 ha (India)	Millennium Post (2025)
Total state oil palm area (2026)	2.93 lakh acres	Telangana Today (2026)
Fresh fruit bunch price (2026)	Rs 23,852 per tonne	Telangana Today (2026)
Oil extraction rate	19.32% (highest in India, as reported)	The Hans India (2024)
New mills scheduled	Seven (Nov 2025 to Aug 2026)	Hyderabad News Hunt (2025)

Note. Scheme-supported area (NMEO-OP) and total cultivated area are measured on different bases and should not be added or directly compared.

Oil palm also poses risks of captive chains. The farmers now have a commitment of decades, a limited number of buyers in every price zone of the factories, and are facing price risk if international edible oil prices are declining. The 29% drop in India's vegetable oil imports in June 2026, despite imports increasing 6% Y-O-Y over the last 6 months from Nov 25 to June 26 (OfBusiness, 2026), is a reminder that import policy and global markets have an impact on domestic prices. Thus, transparent formula pricing based on oil prices, farmer participation in price-setting, and verifiable payment deadlines are key to the success of the model (Gereffi et al., 2005).

6.2 Turmeric and spices: institutional integration

Telangana's turmeric belt in Nizamabad, Karimnagar, Warangal and Adilabad covers more than 50,000 hectares (Deccan Herald, 2025). A study by the Centre for Good Governance for the Directorate of Arecanut and Spices Development examined value addition across the turmeric chain in these districts (Centre for Good Governance, 2017). In January 2025, the National Turmeric Board was inaugurated, with its headquarters in Nizamabad, to promote research, value addition, exports, quality, and supply chain strengthening (Ministry of Commerce and Industry, 2025). Its physical office was opened in June 2025 with an allocation reported at Rs 200 crore, and national turmeric production of 10.74 lakh tonnes, exports of 1.62 lakh tonnes worth USD 226.5 million and farmer prices of Rs 18,000–19,000 per quintal were reported for 2025 (Menon, 2025).

The Board is an institutional innovation for functional upgrading: it can coordinate varietal research, curcumin-content testing, processing and branding that individual farmers and traders cannot. The test of integration will be whether it moves more of the chain into the producing districts, through drying, polishing, grading and powdering units owned by farmer groups, rather than only increasing raw turmeric exports. The same is the case with chilli, too, with Guntur, Andhra Pradesh, rather than Telangana, having the Spices Board's regional office, laboratory and spice park (Ministry of Commerce and Industry, 2025), which could warrant the creation of a quality-testing and processing node closer to the chilli production zones in Telangana.

6.3 Mango and vegetables:

Market-proximity integration is the integration that places the mangoes and vegetables closer to the market.

The mango and vegetable market goes by a pathway close to the market. Telangana ranks second in the production of mangoes, which is not in sync with the recommendations made by the University to control the area, so the growth should be achieved by better realisation, not by increasing the area (The Hans India, 2024;

Siasat Daily, 2025). The concept of direct contracts is possible with the farmer organisations grading their mangoes and supplying them to organised retailers and online platforms (Telangana Today, 2021a). The above contracts should also be extended to pulp, dehydrated, and export-quality markets to absorb the surplus in the peak season.

In the case of vegetables, it is for production near Hyderabad, controlled and protected cultivation under scarcity of land, farm-level cooling, and regular supply contracts with the retail's chains/ rythu bazaars. The 10-year price increases over the past decade will prove that reliability will be the key to success.

Figure 4(b) summarises the scale of the opportunity: bringing the three nearest districts' vegetable acreage anywhere near the 1.51 lakh acres needed would roughly double current local supply to the city, if water and labour permit.

6.4 Flowers, plantation crops and agroforestry

The smaller allied chains offer diversification rather than scale. Flowers occupy only about 0.10 lakh acres but show an implied yield of 5.9 tonnes per acre, and the state's planning documents see Hyderabad's airport as a base for cut-flower exports, which depend on pre-cooling and reliable air-freight connections (The Hans India, 2024; Telangana Horticulture Department, 2018). Agroforestry accounts for 1.06 lakh acres and 6.81 lakh tonnes of production and can provide the farmers with an alternate source of income apart from their seasonal crop (The Hans India, 2024). These chains are thin in nature, and hence it is more feasible to have shared packhouses or common branding as well as aggregation through FPOs, as opposed to separate infrastructure for each product. They are primarily useful to the farmer in diversifying income.

7. The policy and institutional architecture in the agricultural sector

The horticulture chain in Telangana is characterised by multiple layers of central and state tools/initiatives which are consolidated here in Table 5. The Mission for Integrated Development of Horticulture (MIDH), Rashtriya Krishi Vikas Yojana (RKVY) provide support for the area expansion and post-harvest infrastructure, while the National Turmeric Board supports the oil palm industry, through the FPO scheme, there is support for aggregation, and the 2021 food processing policy provides incentives for zone based processing (Telangana Horticulture Department, 2018; Global Agriculture, 2021; Ministry of Commerce and Industry, 2025; Telangana Food Processing Society, n.d.).

Table 5

Selected Policy Instruments Relevant to Horticulture Value Chain Integration in Telangana

Instrument	Chain stage addressed	Key feature reported
MIDH and RKVY	Production, post-harvest	Area expansion, pack houses, value addition projects (Telangana Horticulture Department, 2018)
NMEO-OP (since 2021–22)	Production, processing	Planting support, factory zones, micro-irrigation condition (ETV Bharat, 2025; Telangana Today, 2022)
Central FPO scheme	Aggregation	10,000 FPOs to 2027–28; management support up to Rs 18 lakh over three years (Global Agriculture, 2021)

Instrument	Chain stage addressed	Key feature reported
PACS-to-FPO conversion	Aggregation	311 societies converted in Telangana (The Hans India, n.d.-b)
Telangana food processing policy (2021)	Processing, logistics	Special zones of 500–1,000 acres; 30% for warehousing and logistics (Telangana Food Processing Society, n.d.)
National Turmeric Board (2025)	Research, processing, exports	Headquartered in Nizamabad; value addition and export mandate (Ministry of Commerce and Industry, 2025)

Note. Compiled by the author from the sources cited in the table.

There are two aspects of this architecture that should be highlighted. First, schemes are structured on the basis of crops and stages, while farmers go through a chain of production credit, packhouse, processing contract, and market access simultaneously. Transaction costs would be reduced if there were convergence at the district level, such as a single nodal plan for each commodity cluster. Secondly, there is limited monitoring data. The lack of any Telangana-specific cold-chain count, FPO performance information, and farmer-level price-share information makes it challenging to determine the impact of integration on increasing incomes. This may be remedied by a state value chain observatory.

A third cross-cutting issue is finance. The central FPO scheme includes management grants, matching equity, and credit guarantees (Lok Sabha, n.d.; Global Agriculture, 2021), and the promotion of FPOs is tied to the Agri-Infra Fund in briefings for officers at NABARD's Telangana office (NABARD, 2026). Despite this, FPOs do need infrastructure like packhouses and cold rooms that require more capital investment than they are able to raise from their own balance sheets. A combination of grants for shared assets, advance contracts by processors, and bank lending based on warehouse receipts can introduce private capital without affecting the ownership of the chain with farmers.

8. Pathways to Farmer Prosperity: An Integration Framework.

8.1 Four pillars

The paper suggests four interdependent pillars, based on the diagnosis. One way is market-facing aggregation, where FPOs are commodity-based, with professional management, working capital, and clear grading and price-sharing rules, as opposed to generalist societies. The second relates to pre-cooling systems, grading lines, ventilated packaging, ripening chambers and small cold rooms, which are also funded through blended grants and credit and owned or operated by the FPOs. The third is contract-based processing clusters with suppliers: Pulp Dehydration (mango & tomato); Dehydration (spice processing – turmeric and chilli); Mill-linked procurement (oil palm). The fourth is market-risk institutions: price information, forward contracts, minimum-price in captive chains, crop insurance and buffer storage for onion and potato.

8.2 Sequencing and governance

Sequencing matters. Prior to processing capacity, however, the raw material would have to be imported from outside the state, while the aggregation without post-harvest infrastructure will only focus on losses. A good approach is to process first, get offtake contracts, and then build processing facilities for farmers based on a commodity. Governance should not be reliant on a single buyer. If not, a scheme that incorporates the use of formula pricing and farmer representation should be included in the contract, such as in the case of oil palm (Gereffi et al., 2005). Deliberate attention is required for the inclusion of smallholders: Birthal et al. (2005)

identified that smallholders are most likely excluded if buyers favour fewer, larger suppliers; therefore, membership of FPOs must allow small, tenant, and women farmers. Lastly, there is a need for patient timelines, with perennial crops like the oil palm taking a number of years to become fully productive and FPOs requiring a few seasons to establish trust with buyers, so that scheme evaluations could be conducted over cohorts of farmers, over time, rather than within a single season.

8.3 An example of loss-reduction is provided below.

For a sense of scale, Table 6 shows that, according to The Hans India 2024, post-harvest loss of the fruits and vegetables grown in the state of Telangana is estimated at 24.79 lakh tonnes and 16.45 lakh tonnes, respectively, of a total production of 41.24 lakh tonnes. The loss estimated by Jha et al. (2015) across the nation is in the range of 5 percentage points, which would mean that approximately 2.06 lakh tonnes would remain. In the case of vegetables, a five-point reduction leaves around 0.82 lakh tonnes, or about 4% of the gap between estimated demand (about 40 lakh tonnes) and production (around 19 lakh tonnes) reported earlier (Deccan Chronicle, 2023a). The figures have been provided in various terms and years because the figure of 16.45 lakh tonnes in Table 1 is different from the estimate of 19 lakh tonnes from 2006, so the percentage is indicative only.

Table 6

Output Retained Through Reduced Post-Harvest Losses (Fruits and Vegetables)

Loss reduction (percentage points)	Fruits (lakh tonnes)	Vegetables (lakh tonnes)	Total (lakh tonnes)
3	0.74	0.49	1.24
5	1.24	0.82	2.06
8	1.98	1.32	3.30

Note. Author's arithmetic on output of 24.79 lakh tonnes (fruits) and 16.45 lakh tonnes (vegetables) from The Hans India (2024). Illustrative only; not a forecast.

Retained output is only of benefit to the farmer when it is sold in the market as a product; its value is dependent upon the market price. Additional volume can affect prices when markets are thin, so loss reduction should be complemented with market development, such as processing the surplus. This scenario does indicate, however, that a modest improvement in handling is similar in magnitude to an area expansion.

8.4 Indicators for monitoring integration

The targets of integration should be evaluated based on farmer-based results rather than infrastructure only. Some of the indicators that could prove useful include the percentage of produce sold in FPOs/under contracts, the farm-gate price as a percentage of the retail price, post-harvest loss at the aggregator and farm levels, timeliness of payments, proportion of small female farmers in the FPOs, and stability of net income by season. These indicators may be mandatorily required by the state for any scheme assistance to FPOs and processing zones.

9. Limitations and Research Agenda

The data used in this study is secondary data, some of which is reported through the press; the year, and definitions of the figures vary. Telangana-specific cold-chain, FPO turnover and farm-gate price data were not available in consistent form. The scenario in Section 8 is an arithmetic illustration and ignores price effects. Future work should combine district-level primary surveys of growers in oil palm, turmeric, mango

and vegetable clusters, estimates of the farmer's share in the consumer rupee for each commodity, cost–benefit appraisal of cluster-level packhouses, and an evaluation of the performance of converted PACS-based FPOs.

10. Conclusion

Horticulture is among Telangana's most promising routes to higher farm incomes: it uses about 7% of agricultural land yet contributes about 34% of agricultural output value (The Hans India, 2024). The analysis in this paper shows that the constraint on farmer prosperity is increasingly not production but the chain that connects production to markets. There is a large import of vegetables and some fruit crops are in surplus, a limited amount of information is available on cold chain, increasing number of FPOs, but not yet processing links, and processing zones propose investments without guaranteed links with smallholders.

Three commodity cases explain the path ways. Mill-linked integration is seen in oil palm as a quick way of increasing area when input support and irrigation conditions and processing capacity are aligned, but requires clarity in pricing of the part of the mill that needs to be protected. The institutional anchor – the National Turmeric Board – has potential to facilitate functional upgrading in the producing districts through the use of turmeric and spices. The case of Mango and vegetables indicate that being close to Hyderabad is a latent advantage that relies on reliable aggregation, handling and contracting.

The intended policy program of market-facing aggregation, cluster-based post-harvest infrastructure and contract-based processing and market-risk institutions provides a coherent policy program. Success should be judged at the farmer's door, with increased price realisation, reduced losses, and a more stable income for farmers and greater inclusion of small and women farmers. By organizing schemes based on commodity clusters, strengthening data to track results and creating governance that fairly distributes value, the integration of value chains can transform Telangana horticulture from a production to a farmer prosperity story.

REFERENCES:

1. Birthal, P. S., Joshi, P. K., & Gulati, A. (2005). *Vertical coordination in high-value food commodities: Implications for smallholders* (MTID Discussion Paper No. 85). International Food Policy Research Institute.
2. Centre for Good Governance. (2017). *A study on turmeric with emphasis on value chain analysis in Telangana*. https://www.cgg.gov.in/?p=1557
3. Dataful. (2024). *State and year-wise cold storages and their capacity* [Data set; as on 31 January 2024]. https://dataful.in/datasets/1615/
4. Deccan Chronicle. (2017, August 1). Telangana: Dry spell spurs vegetable shortage, jacks up prices. https://www.deccanchronicle.com/nation/current-affairs/010817/telangana-dry-spell-spurs-vegetable-shortage-jacks-up-prices.html
5. Deccan Chronicle. (2023a, July 11). Telangana faces huge vegetable crunch. https://www.deccanchronicle.com/nation/in-other-news/110723/telangana-faces-huge-vegetable-crunch.html
6. Deccan Chronicle. (2023b, January 5). TS food processing industry doubles since state formation. https://www.deccanchronicle.com/business/economy/050123/ts-food-processing-industry-doubles-since-state-formation.html
7. Deccan Herald. (2025, January 14). Union minister Piyush Goyal launches National Turmeric Board in Telangana's Nizamabad.
8. https://www.deccanherald.com/amp/story/india%2Ftelangana%2Funion-minister-piyush-goyal-launches-national-turmeric-board-in-telanganas-nizamabad-3354446

9. ETV Bharat. (2025, September 22). Telangana leads nation in oil palm cultivation: 78,869 hectares added in four years under NMEO scheme. https://www.etvbharat.com/en/!state/telangana-leads-nation-in-oil-palm-cultivation-enn25092205453
10. FreshPlaza. (2014). Vegetable prices go through the roof. https://www.freshplaza.com/north-america/article/2130677/vegetable-prices-go-through-the-roof/
11. Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy, 12*(1), 78–104. https://doi.org/10.1080/09692290500049805
12. Global Agriculture. (2021, July 28). Farmer producer organisations (FPOs) formed in India up till 2020. https://www.global-agriculture.com/national-news/farmer-producer-organisations-fpos-formed-in-india-up-till-2020/
13. Global Agriculture. (2025, November 27). India's horticulture production rises to 369 million tonnes in 2024–25: Third advance estimates. https://www.global-agriculture.com/global-agriculture/indias-horticulture-production-rises-to-369-million-tonnes-in-2024-25-third-advance-estimates/
14. Hyderabad News Hunt. (n.d.). Telangana faces tuber crop shortage, 70% dependent on imports. https://hyderabadnewshunt.com/tuber-crop-shortage-70-percent-imports
15. Hyderabad News Hunt. (2025). Govt targets two lakh acres of oil palm cultivation per year: Minister Tummala. https://www.hyderabadnewshunt.com/telangana-oil-palm-cultivation-target-tummala
16. Jha, S. N., Vishwakarma, R. K., Ahmad, T., Rai, A., & Dixit, A. K. (2015). *Report on assessment of quantitative harvest and post-harvest losses of major crops and commodities in India*. ICAR–All India Coordinated Research Project on Post-Harvest Technology, ICAR–CIPHET.
17. Joshi, P. K., Gulati, A., Birthal, P. S., & Tewari, L. (2004). Agriculture diversification in South Asia: Patterns, determinants and policy implications. *Economic and Political Weekly, 39*(24), 2457–2467.
18. Kaplinsky, R., & Morris, M. (2001). *A handbook for value chain research*. International Development Research Centre.
19. Kitinoja, L., Saran, S., Roy, S. K., & Kader, A. A. (2011). Postharvest technology for developing countries: Challenges and opportunities in research, outreach and advocacy. *Journal of the Science of Food and Agriculture, 91*(4), 597–603. https://doi.org/10.1002/jsfa.4295
20. Lok Sabha. (n.d.). *Unstarred question on farmer producer organisations in Telangana* (Question AU1012) [Parliamentary reply, Ministry of Agriculture and Farmers Welfare]. https://eparlib.sansad.in/bitstream/123456789/1466701/1/AU1012.pdf
21. Menon, S. (2025). *National Turmeric Board (2025): Institutionalising India's dominance in the global spice trade* [Policy update]. IMPRI Impact and Policy Research Institute. https://www.impriindia.com/insights/policy-update/national-turmeric-board/
22. Millennium Post. (2025). India's oil palm area reaches 52,113 hectares. https://www.millenniumpost.in/business/indias-oil-palm-area-reaches-52113-hectares-632629
23. Ministry of Agriculture and Farmers Welfare. (2023, March 31). *Unstarred question no. 3400: Cold storage across the country* [Parliamentary reply]. https://rsdebate.nic.in/bitstream/123456789/739520/1/PQ_259_31032023_U3400_p138_p140.pdf
24. Ministry of Commerce and Industry. (2025, February 4). *Lok Sabha unstarred question no. 436: National Turmeric Board and Chilli Board*. https://www.commerce.gov.in/wp-content/uploads/2025/02/LS-USQ-No.436-dated.-04.02.2025.pdf
25. Ministry of Food Processing Industries. (2025, December 18). *Lok Sabha unstarred question no. 3015: Mega food parks in Telangana*. https://eparlib.sansad.in/bitstream/123456789/3018438/1/AU3015_qqxmeo.pdf

26. National Bank for Agriculture and Rural Development. (2026, February 13). *Farmer producer organization (FPOs) and Agri-Infra Fund scheme* [Presentation]. NABARD Telangana Regional Office. https://mcrhrdi.gov.in/2026/group1/week4/FPO%20Presentation.pdf
27. News Arena India. (2025). Horticulture production up 4 pc in 2024-25. https://newsarenaindia.com/economy/horticulture-production-up-4-pc-in-2024-25/64197
28. OfBusiness. (2026). Telangana government plans to boost palm oil production and cultivation. https://www.ofbusiness.com/blog/food-processing/telangana-government-plans-to-boost-palm-oil-production-and-cultivation-32056
29. Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. Free Press.
30. Reardon, T., Timmer, C. P., Barrett, C. B., & Berdegué, J. (2003). The rise of supermarkets in Africa, Asia, and Latin America. *American Journal of Agricultural Economics*, *85*(5), 1140–1146. https://doi.org/10.1111/j.0092-5853.2003.00520.x
31. Siasat Daily. (n.d.). Hyderabad: Vegetable prices soar due to floods, heavy rains in neighbouring states. https://www.siasat.com/hyderabad-vegetable-prices-soar-due-to-floods-heavy-rains-in-neighbouring-states-3094603/
32. Siasat Daily. (2025). Telangana horticultural university recommends raising cultivation of fruits, veggies. https://www.siasat.com/telangana-horticultural-university-recommends-raising-cultivation-of-fruits-veggies-3281536/
33. Sri Konda Laxman Telangana Horticultural University. (2025). *Perspective plan for horticulture in Telangana 2035* [Brief note]. https://www.siasat.com/wp-content/uploads/2025/10/Perspective-Planfor-Horticulture-in-Telangana-2035.pdf
34. Swinnen, J. F. M., & Maertens, M. (2007). Globalization, privatization, and vertical coordination in food value chains in developing and transition countries. *Agricultural Economics*, *37*(s1), 89–102. https://doi.org/10.1111/j.1574-0862.2007.00237.x
35. Telangana Food Processing Society. (n.d.). *Telangana food processing and preservation policy*. https://tgfps.telangana.gov.in/telangana-food-processing-and-preservation-policy
36. Telangana Horticulture Department. (2018). *RKVY DPR and implementation guidelines 2018–19*. https://horticulture.tg.nic.in/RKVY/Downloads/RKVY%20DPR%20and%20Implementaion%20guidelines%20-2018-19.pdf
37. Telangana Today. (2021a, April 7). FPOs aim at Rs 20 crore turnover through mango procurement: Errabelli. https://telanganatoday.com/fpos-aim-at-rs-20-crore-turnover-through-mango-procurement-errabelli
38. Telangana Today. (2021b, July 15). Telangana okays food processing policy. https://telanganatoday.com/telangana-okays-food-processing-policy
39. Telangana Today. (2022, November 24). Telangana government to ramp up oil palm cultivation. https://telanganatoday.com/telangana-government-to-ramp-up-oil-palm-cultivation
40. Telangana Today. (2026). Telangana oil palm push begins paying off as farmers report better returns. https://telanganatoday.com/telangana-oil-palm-push-begins-paying-off-as-farmers-report-better-returns
41. The Hans India. (n.d.-a). Farmers dump veggies, switch to other crops. https://assets.thehansindia.com/news/cities/hyderabad/farmers-dump-veggies-switch-to-other-crops-811555
42. The Hans India. (n.d.-b). Telangana has set national precedent by transforming PACS into FPOs: Tummala. https://assets.thehansindia.com/telangana/telangana-has-set-national-precedent-by-transforming-pacs-into-fpos-tummala-988380

43. The Hans India. (2024). Horticulture emerges as eco growth driver in TS. https://www.thehansindia.com/telangana/horticulture-emerges-as-eco-growth-driver-in-ts-800510
44. Trienekens, J. H. (2011). Agricultural value chains in developing countries: A framework for analysis. *International Food and Agribusiness Management Review*, *14*(2), 51–82.