

Agricultural Transformation in Telangana

Understanding Drivers of Growth and Planning Ahead

SHWETA SAINI
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Shweta Saini and Pulkit Khatri are with Arcus Policy Research (APR). Dr. R. Vijaya Kumari is with PJTSAU.

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Professor Jayashankar Telangana State Agricultural University (PJTSAU)

Rajendranagar, Hyderabad, India
www.pjtsau.edu.in

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Arcus Policy Research (APR)

B-2/1B, Ground Floor
Safdarjung Enclave, Africa Avenue
New Delhi-110029
admin@arcusresearch.in
www.arcusresearch.in

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Abbreviations

A&A	Agriculture and Allied Sectors
AHH	Agriculture Household
APEDA	Agricultural and Processed Food Products Export Development Authority
CAGR	Compound Annual Growth Rate
DES	Department of Economics & Statistics, Government of India
F&V	Fruits and Vegetables
FPO	Farmer Producer Organization
GCA	Gross Cropped Area
GIA	Gross Irrigated Area
GOI	Government of India
GOT	Government of Telangana
GVA	Gross Value Added
MMT	Million Metric Tonnes
NABARD	National Bank for Agriculture and Rural Development
NARMUL	Nalgonda-Ranga Reddy Milk Producers Mutually Aided Coop. Union Ltd
NSSO	National Sample Survey Office
OLS	Ordinary Least Squares
PLFS	Periodic Labour Force Survey
PM-KISAN	<i>Pradhan Mantri Kisan Samman Nidhi</i>
R&D	Research and Development
RBS	<i>Rythu Bandhu</i> Scheme
SLBC	State Level Bankers' Committee
TE	Triennium Ending
TSTPC	Telangana State Trade Promotion Council
VOO	Value of Output

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Executive Summary

What Telangana did in six years, India did in 28. When the state was created in 2014, less than half (47.6 per cent) of the state's cropped area had access to assured irrigation. In the next six years, the state expanded this coverage to about 65 per cent of total cropped area. The country as a whole took about 28 years to deliver a similar magnitude of increase in irrigation and yet, India's irrigation coverage stands only at 52 per cent (2018-19).

Both the increased coverage and the speed at which this increase was delivered in Telangana, coupled with 24 x 7 access to quality power, laid the foundation of one of the strongest growth stories witnessed by an Indian state's agricultural sector in recent years.

This report undertakes an exhaustive study of Telangana's agricultural sector. We study the sector's performance via qualitative and quantitative analysis. By understanding the composition of the state's agricultural sectors and estimating each of their contributions to the state's value of agricultural output (VOO), the study identifies sources or engines of this growth. Further, using mathematical modelling, the study identifies the statistically significant drivers of growth and their impact on the state's agricultural performance. A summary of the findings can be found below.

Sources/Engines of growth: Since 2015-16, the value of agricultural output in the state increased at an average annual rate of 7 per cent in real terms. Using the methodology from OECD 2022 and Gulati *et al.* 2018, we identify the sources of this growth. Livestock emerges as the biggest source with the state making aggressive strides in its milk and the meat sectors. Following livestock, is cotton. Higher acreage, supported by higher procurement and access to more lucrative markets, appears to have pulled up cotton's contribution to the state's agrarian performance. Cereals, mainly paddy and maize, rank third. High-value crops like the fruits and vegetables, with a contribution of about 13 per cent (about half that of cotton), emerge as the fourth largest contributor to the state's agricultural VOO growth.

Drivers of growth: Using econometric analysis, we identified the factors which triggered growth in the 'engines of growth' identified above. It emerges that (i) access to *irrigation*, (ii) access to timely and affordable *institutional credit*, (iii) regular receipt of *unconditional cash transfer*, and (iv) *access to remunerative markets* for crops drove the state's agricultural growth performance.

Challenges: Despite a spectacular performance, there emerge a few challenges that impede the state's ability to reach its full potential. Crop diversification is one such challenge. Instead of shifting to high-value crops like oilseeds, or even pulses, Telangana farmers shifted to crops like paddy and

cotton when their access to irrigation improved. The increased focus on paddy or cotton raises issues of environmental sustainability and exposes farmers to production risks. Cotton, for example, is particularly prone to pests. This, combined with the absence of a crop insurance mechanism in the state, leaves farmers highly vulnerable to yield risks. In addition to this, increased access to water aided by 24x7 supply of power is likely to raise issues in ground water management in the coming years. The state also lags in its road infrastructure. Less than 60 per cent of the state's rural roads are surfaced, hindering farmers' access to remunerative markets. Lastly, despite livestock being a major determinant of growth, the income realised by farmers from this sector is abysmally low. Although the state is the country's hub for eggs and poultry meat, the sector has not been able to generate enough incomes for its farmers.

Key recommendations for the way ahead

To sustain its high growth trajectory while increasing farmers' incomes, the state can deliberate on the following set of recommendations. These recommendations centre on five themes:

1. **Institutions**
2. **Sustainability**
3. **Diversification**
4. **Processing**
5. **Innovation in Policies**

1. Institutions

We recommend the state to consider setting-up three institutions centred on FPOs, Fruits and Vegetables and Exports.

Develop a FPO council

Telangana today ranks fourth in terms of number of registered farmer producer organisations (FPOs) in the country (PIB 2022). The sustainability of an FPO is determined by two core factors – financial viability and institutional sustainability. An FPO Council could pursue, inter alia, economic objectives through value-chain financing and social objectives like outcome-oriented capacity building for FPOs. An FPO Council can help farmer producer organisations to clearly understand the purposes they are supposed to fulfil and the means required to achieve these.

Telangana Horticulture Board

Diversification towards high-value agricultural crops like fruits and vegetables (F&V) is vital for a state with a focus on augmenting farmer incomes. The problem is that F&V are mostly subject to fierce price volatility between seasons and years. Therefore, despite their high profitability, farmers are averse to growing them at scale. There is therefore a need for greater focus on F&V since they have a higher

capacity for value generation and can benefit from a processing industry. Therefore, a horticulture board can play a pivotal role in the state.

Its key objectives may include, *inter alia*, developing an integrated, energy efficient cold chain infrastructure for fresh horticulture produce, improving efficiency of value chains through appropriate value additions and/or shortening of the chain, and promoting innovations such as the identification and production of new varieties and the adoption of improved technology in the pre-and-post-production value-chain.

Depending on the specific commodities to be promoted, the board can adopt three strategies: (i) undertake direct marketing; (ii) develop partnerships with F&V players like SAFAL, NAFED, etc., and (iii) bring the private sector into play.

The Board can either be a state-owned PSU like Himachal Pradesh's HPMC, or a corporation like the North-East Regional Agricultural Marketing Corporation Limited (NERAMAC). The Board can be registered as an independent society under the Societies Registration Act, 1860. A horticulture board would allow dedicated focus on long-term interventions and help develop ancillary markets and processing infrastructure, forge partnerships and support innovation.

Revive Telangana State Trade Promotion Council (TSTPC) with focus on agricultural exports

TSTPC was set up in 2014 after the formation of the state to increase and facilitate exports and imports. Considering the change in the state's agricultural landscape and increasing opportunities for exports, there should be amendments to the mandate of the TSTPC, with increased focus on agricultural and allied sector products, particularly mango, poultry meat, turmeric, and chillies (dry).

2. Sustainability

Water is critical and its use must be optimised. It is encouraging to see the state's focus on improving access to irrigation in the state. However, its policy of providing free electricity requires a rethink, particularly in light of its role in encouraging unhindered drilling of underground water in the future. Focus is now required on increasing the efficiency of water-use. Increased deployment and adoption of technologies like drip irrigation and sprinklers will not only rationalise water usage in cultivation but also improve yields of crops. The state can consider use of solar-powered phase-change enabled equipment for irrigation which can replace electric motors in selected parts of the state. This intervention will reduce the burden on discoms and will be very useful, particularly for small and marginal farmers in areas with poor or unstable electricity. Similarly, the state may do well to decentralise the sources of water. The government has to support farmers in accessing their own sources of irrigation (including dug wells) by providing technical and financial support. With the completion of most large/major irrigation projects, the state now must deliver last mile water to farmers on the tail of a project's command area.

Both crops and cattle are vulnerable to cyclones and floods in the state. With climate change, the magnitude and types of pest attacks have also increased. The state has to insure its farmers from such production risks. The objectives of the scheme should be to finance farmers who experience crop loss or damage due to unforeseeable events, stabilise farmers' incomes to secure their ability to continue farming, encourage them to use cutting-edge agricultural techniques, and ensure the flow of credit to the agriculture sector. It is also assumed that stand-alone incidents of calamity will be tended to through the availability of other funds in the state such as the Disaster Relief Fund.

3. Diversification

The state needs strategic crop planning to encourage crop diversification. With access to quality inputs, the state is rightly focusing on becoming the country's seed hub, but it also needs to focus on climate-resilient crops like millets, or high-value crops like sugar, F&V, and oilseeds like soybean. Market incentives are critical to change farmers' behaviour. Ensuring the existence of multiple avenues of sale for produce can bring about such a change. Districts that account for a high proportions of the state's gross cropped areas but have lower levels of crop incomes can be a start-point for a comprehensive diversification programme.

The promotion of flood tolerant varieties in flood-prone areas and drought-resistant varieties in dry lands should be undertaken. Considering the long-term variability in the monsoon pattern, efforts to adjust the sowing patterns of crops to coincide with the availability of rainwater may be encouraged. An R&D mission may be designed to deliver improvement of varieties, align cultivation practices, and manage pests and diseases.

The state has a large population of unproductive bovines. Intensive efforts are required to improve the genetic potential of the cattle and buffaloes to improve per animal milk output. Increased extension services to the livestock sector is critical. Telangana's NARMUL (one of leading dairy co-operatives in the state) suffers from operational and logistical challenges, which need to be addressed on a priority basis. The state could do well if a fodder development programme that allows growing fodder in public lands and fallow lands can be put in place. With maize being an important crop in the state, the possibility of converting maize crops into silage for cattle is another lucrative option for the state. With shrinking land nationally, scarcity of cattle fodder is already an alarming issue for the country. Telangana can explore becoming a silage exporter to fellow states.

4. Increased value addition

Sugarcane among agricultural products and fisheries and agro-forestry among the allied activities sectors have the greatest potential to improve farmers' income in the state. Improved access to assured irrigation can ensure a shift in focus to sugarcane in the state. With assured prices for cane, setting up cane processing units will yield sugar, ethanol and bagasse, all of which can deliver high value to everyone in the value-chain. The country's ambitious mandates on ethanol (for fuel blending) to be

achieved by 2025-26 can be used to attract investments in distilleries to produce ethanol not only to meet its domestic requirements but also for export to other deficit states. In addition, bagasse-based power hubs can be thought of.

Focus on fisheries: With expanded access to irrigation, the scope for leveraging in-land fisheries is huge in the state. The focus must be on multiple stocking and multiple harvesting of the right species. To deliver aggregation and value chain benefits, FPOs in fisheries can be created. Besides, the establishment of a sound network of brood banks can augment incomes of carp seed breeders and help farmers access quality seeds. There are several digitalization-based initiatives that can be leveraged to improve the state's aquaculture practices. App-based solutions, for instance for tracking capture production data or providing farm advisories, can be integrated while promoting aquaculture units at scale.

Increase Agro-Forestry: Timber imports are the second largest segment of imports into India. Therefore, there is immense potential to increase farmer incomes through agro forestry. To develop it, the state should map and identify species of wood to its different agro-climatic zones, ensure timely and affordable provision of seedlings, smoothen the policy environment and governance mechanisms to ensure predictable annual harvests, and free markets for wood cutting, transportation and processing from administrative bottlenecks.

5. Innovate on policies

Telangana was a pioneer in the country spearheading the unconditional direct benefit transfer programme for its farmers via its *Rythu Bandhu* Scheme. As next steps, the government can learn from global experience to use the programme to bring about a change in farmer behaviour. For example, under its Common Agricultural Policy (CAP), EU provides a benefit transfer to young farmers. This is a way to encourage younger farmers (below age of 40 years) to continue in farming. Similarly, payments are being made to encourage acreage under certain crops. China makes area-based payments to its maize and soybean farmers. The Brazilian government provides concessional loans to farmers to market their produce. By building on global experiences, the state can prepare for its next leap of progress.

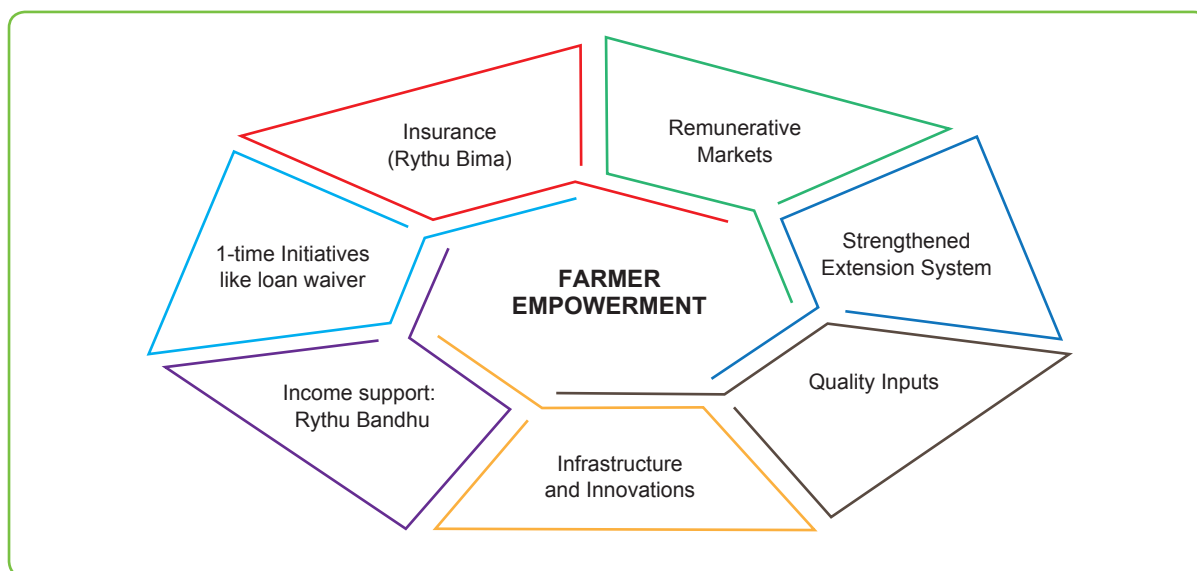


Introduction

Telegana is the youngest state in India, having separated from Andhra Pradesh in 2014. After separation, the state, like other parts of India, suffered from consecutive droughts in the years 2014 and 2015. In the 115 years of recorded monsoon history of the country, two consecutive drought years had only happened thrice before this: 1904/1905, 1965/1966 and 1986/1987 (Saini 2019). With more than half of Telegana’s gross cropped area (GCA) dependent on rains for irrigation, crop acreage and yields dwindled in those years. Learning an early lesson, Telegana focused on assuring irrigation to its farmers.

In the six-year period from 2014-15 to 2020-21, irrigation coverage in the state increased from 47.6 per cent irrigation to 65 per cent.² At the national level, India took about 28 year to achieve an increase in irrigation coverage of a similar magnitude and it still lags behind with an overall coverage of only 52 per cent according to the latest available data (2018-19). Both, the increased coverage, and the speed at which this increase was delivered, coupled with 24 x 7 access to quality power laid the foundation for one of the strongest growth stories witnessed by an Indian state’s agricultural sector in recent years.

FIGURE 1: Telegana’s 360° approach for empowering farmers



Source: Authors' Interpretation

2 As per Telegana’s latest Socio-Economic Outlook (SEO) 2022, Telegana’s irrigation coverage ratio in 2021-22 is about 69 percent. Interestingly, between 2020-21 and 2021-22, while the state’s gross irrigated area (GIA) has stayed the same (about 5.5 million hectares), its gross cropped area (GCA) fell (from about 8.5 million hectares in 2020-21 to about 8 million hectares in 2021-22). This pulled up the state’s irrigation coverage ratio. As there was no change in GIA, we have retained the data for 2020-21 as indicative of the state’s irrigation coverage

Not just this, the government has strategically delivered schemes focused around farmers' overall economic well-being since the state was created. This could be framed as their 360^o-approach (Figure 1). Starting with completing its medium- and major- irrigation projects, and strengthening the agricultural extension system, the state ensured access to quality inputs like credit, seeds, technology and innovations, and most importantly, to remunerative markets. The state also gave assured, unconditional annual income support to its farmers and insured them for accidents and loss of life. The state government even undertook two farm loan waivers (FLW), which were implemented in a phased-manner.

These efforts have supported the state's farmers at financial, psychological, and social levels. The results are visible in the state's robust agricultural performance, making it one of the fastest growing in the country.

In this report, we study Telangana's agricultural growth performance by assessing its sources or engines of growth. Using econometric analysis, the statistically significant drivers of growth are also identified and studied for their impact on state's agricultural performance.

This report is divided into six sections. Section I provides an overview of the agricultural sector in the state and discusses its performance over time. In Section II, using the value of output (VOO) data, we scope the sources of agricultural growth in the state. In Section III, a statistical modelling exercise had been used to identify the drivers of this growth. Additional analytics on selected agrarian metrics of the state are presented in Section IV. The synthesis of this study is presented in Section V, listing the key findings and conclusions. The last section identifies key policy recommendations to improve and strengthen the state's agricultural growth trajectory.



Section I: Overview of Agricultural Sector in Telangana

TElangana is globally known for Hyderabad, its IT hub. Around 61 per cent of the state's GVA came from the tertiary sector, comprising IT, financial services, transportation, and other services, in TE 2021-22. The secondary sector (comprising manufacturing, construction, and utility services) contributed about 21 per cent; about 3 per cent came from mining and the remaining 15.3 per cent came from the state's A&A sectors (Table 1).

TABLE 1: Growth and composition of A&A GVA in Telangana

TE 2021-22	Shares		Average annual growth rates	
Item	Current prices	Constant prices (2011-12)	Current prices	Constant prices (2011-12)
Agriculture, forestry, and fishing	19.0%	15.3%	20.0%	10.8%
<i>Crops</i>	47.7%	51.0%	24.6%	16.8%
<i>Livestock</i>	45.7%	43.6%	17.6%	6.8%
<i>Forestry and logging</i>	3.5%	2.4%	23.5%	3.6%
<i>Fishing and aquaculture</i>	3.0%	3.0%	13.3%	10.0%
Mining and quarrying	2.8%	3.1%	-8.4%	-5.0%
<i>Primary</i>			14.5%	6.7%
<i>Secondary</i>	17.3%	20.8%	6.9%	1.5%
<i>Tertiary</i>	61%	60.9%	10.3%	3.6%
TOTAL GSVA at basic prices	100.0%	100.0%	10.4%	3.6%

Source: MOSPI, GOI

Note: Composition of crops, livestock, forestry and logging, and fishing & aquaculture have been calculated only for A&A sector total

However, in terms of average annual growth rates, the state's agricultural sector (growing at 10.8 per cent in real terms) is outperforming both the secondary (1.5 per cent) and the tertiary (3.6 per cent) sectors in nominal and real terms (Table 1). Within the agricultural sector, most growth appears to be driven by the crop and the livestock sectors. Interestingly, since 2021-22, in both nominal and real terms, the growth of the livestock sector has surpassed that of the state's crop sector. Fisheries too has registered high double-digit growth in the state.

About 66.13 per cent of Telangana state's workers are employed in agricultural and allied (A&A) sectors (including crop, forestry, fishing, and livestock) (PLFS 2020-21); their contribution to the state's gross value added (GVA) was about 15 per cent in real terms and about 19 per cent in nominal terms in the triennium ending 2021-22 (MOSPI). The state has anywhere between 5.9 to 6.1 million farmers.³

The following features distinguish the state's agricultural sector compared to the sector at the all-India level:

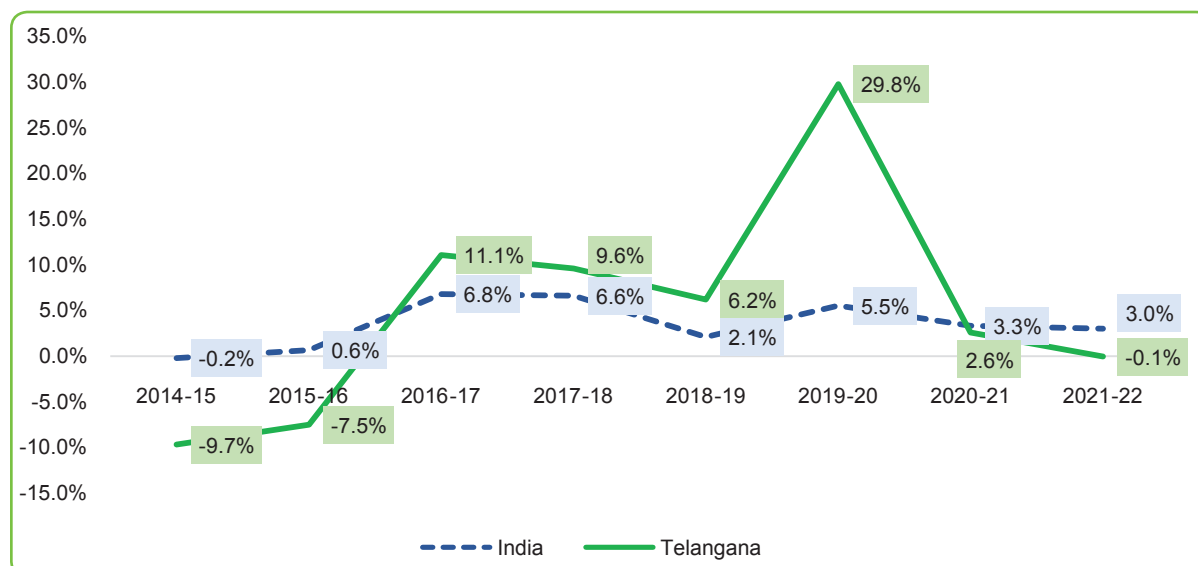
3 As per India's Agricultural Census (2015-16), the state has about 5.95 million agricultural landholdings and as per the state's Rythu Bandhu scheme that transfers direct benefits into farmer's bank accounts, there are about 6.1 million farmers in the state.

1. **More small farmers:** Telangana state has a larger number of small and marginal farmers (SMF or farmers with average landholding size below 2 hectares) who operate on a much larger area. About 88 per cent of Telangana's operational holdings consist of small and marginal farms compared to about 86 per cent at the all-India level. In terms of area, while 62 per cent of state's operated area is with SMF, the average for India as a whole is about 47 per cent (Agricultural Census 2015-16).
2. **Smaller Farms:** The average landholding size in Telangana is about 1 hectare while the all-India average is marginally higher at about 1.08 hectares.
3. **More women farmers:** In Telangana, about 23 per cent of landholdings covering about 22 per cent of operated area are with women. This compares with India's average of 14 per cent and 12 per cent respectively.
4. **Bigger marginal farmers:** The average landholding size of a marginal farmer in Telangana is 0.44 hectares while the all-India average is about 0.38 hectares.
5. **A richer large farmer:** About 0.16 per cent of state's farmers have average landholding sizes greater than 10 hectares. These farmers, on an average, make more money from crop farming (about Rs.78,482 per year) than large farmers even in Punjab (who makes about Rs.70,355 per year).

Agricultural sector performance over time

Between 2014-15 and 2021-22, Telangana's gross value added (GVA) from its A&A sectors grew at a cumulative annual growth rate (CAGR) of 6.9 per cent (at 2011-12 prices). In this period, India's average growth rate was a little above half of this at 3.98 per cent (Figure 2).

FIGURE 2: India and Telangana's A&A GVA growth rates (2011-12 constant prices)



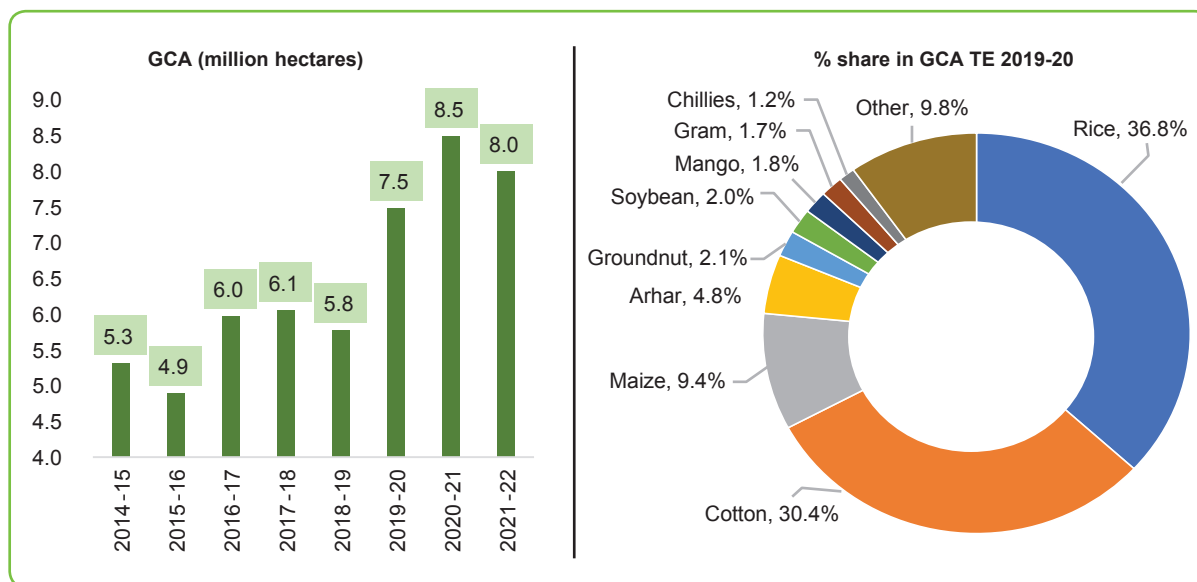
Source: MOSPI

In the triennium ending (TE) 2020-21, Arunachal Pradesh’s A&A sector registered the fastest growth rate of 15.9 per cent. Telangana’s growth rate too was high at 12.9 per cent. Growth rates were much lower in other important agricultural states like Andhra Pradesh (4.9 per cent), Maharashtra (about 8.1 per cent), Punjab (about 2.4 per cent) and Uttar Pradesh (about 2.1 per cent).

Agricultural land and its use

Telangana has about 11.2 million hectares of land (which is about 3.4 per cent of the country’s geographic area) (LUS, GOI) and about one quarter of it is under forest cover. The state’s gross cropped area (GCA) is about 8.5 million hectares (2020-21) (Figure 4) and it has been increasing since 2014-15 (it increased by about 60 per cent between 2014-15 and 2020-21). Approximately 36 per cent of the state’s land is double cropped and, over time, the state has recovered about 3.9 lakh hectares of fallow land. In 2021-22, 69 per cent of GCA in the state was irrigated (SEO 2023).

FIGURE 4: Gross cropped area (GCA) and its composition in Telangana



Source: DES India, Telangana’s Statistical Yearbook 2015, and Socio-Economic Outlook, various issues

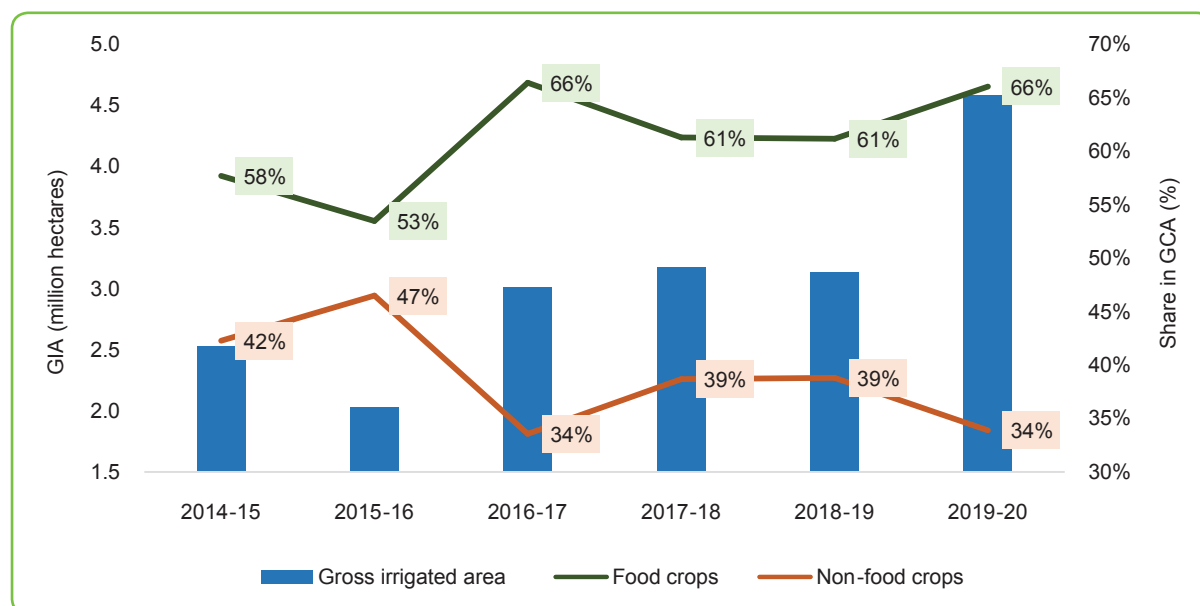
Note: Latest data on crop-wise GCA is available until 2019-20 on DES, India

Close to two-thirds of the state’s GCA is under only two crops: rice and cotton (Figure 4). This is followed by maize (9.4 per cent), *arhar/tur* (pigeon pea) (4.8 per cent), groundnut (2.1 per cent), soybean (2 per cent), mango (1.8 per cent), gram (1.7 per cent) and chillies (1.2 per cent). Other crops such as *jowar*, sugarcane, coconut, turmeric, accounted for about 9.8 per cent of GCA. In recent years, as part of crop diversification initiatives, the state has seen an increase in the area under oil palm cultivation. As per SEO 2023, the state ranks sixth in the country with about 27,696 hectares (0.35 per cent of GCA⁴) under oil palm cultivation.

4 GCA (8 million hectares) in 2021-22 used

Reddy (2020) highlights that farmers in Telangana prefer cultivating paddy when irrigation facilities improve. Between 2014-15 and 2019-20, state's gross irrigated area nearly doubled, from 2.5 million hectares to 4.6 million hectares (Figure 5). During the same time, higher acreages diverted towards food crops. From 58 per cent in 2014-15, the share of food crops in state's GCA expanded to 66 per cent by 2019-20.

FIGURE 5: Telangana's GIA and per cent GCA under food/non-food crops



Source: DES, India

Note: Food Crops include cereals, pulses, fruits and vegetables, sugarcane and spices; non-food crops include oilseeds, fibres, drugs and narcotics (tea, coffee, others) and plantation crops.

In TE 2016-17, about 26.2 per cent of GCA was under paddy; this increased to about 37 per cent by TE 2019-20. While crops like paddy, gram, turmeric, and mango reported increased acreage, acreage under crops like soybean and groundnut fell.

Yield of major crops

Most of the state's GCA, as observed in Figure 5, is under seven crops: rice, cotton, maize, chillies, *tur*, mango, and groundnut. Barring mango and *tur*, the average yield of the other five crops in the state is higher than the all-India average (Table 2).

TABLE 2: Yield for major crops in Telangana (kg/hectare) (TE 2020-21)

S. No	Commodity	Telangana	India	Largest producer
1	Rice	3473*	2691	2934 (WB)
2	Cotton#	445	432	499 (GJ)
3	Chillies (Green)	12153	11077	23000 (AP)
4	Maize	5958*	3090	2962 (KA)
5	Mango	7567	8967	16903 (UP)
6	Groundnut	2310*	1720	2014 (GJ)
7	Arhar/Tur #	776	827	868 (MH)

Source: *Agricultural Statistics at a Glance, various issues, Horticultural Statistics at a Glance, various issues (chillies) and Telangana State Statistical Abstract for data on groundnut, rice and maize.*

Note: Text in parenthesis is the largest producing state for the crop. WB is West Bengal, GJ is Gujarat, AP is Andhra Pradesh, KA is Karnataka, UP is Uttar Pradesh, MH is Maharashtra. '#' Telangana ranked third in production in 2020-21. '*' Data is averaged for 2019-20, 2020-21 and 2021-22.

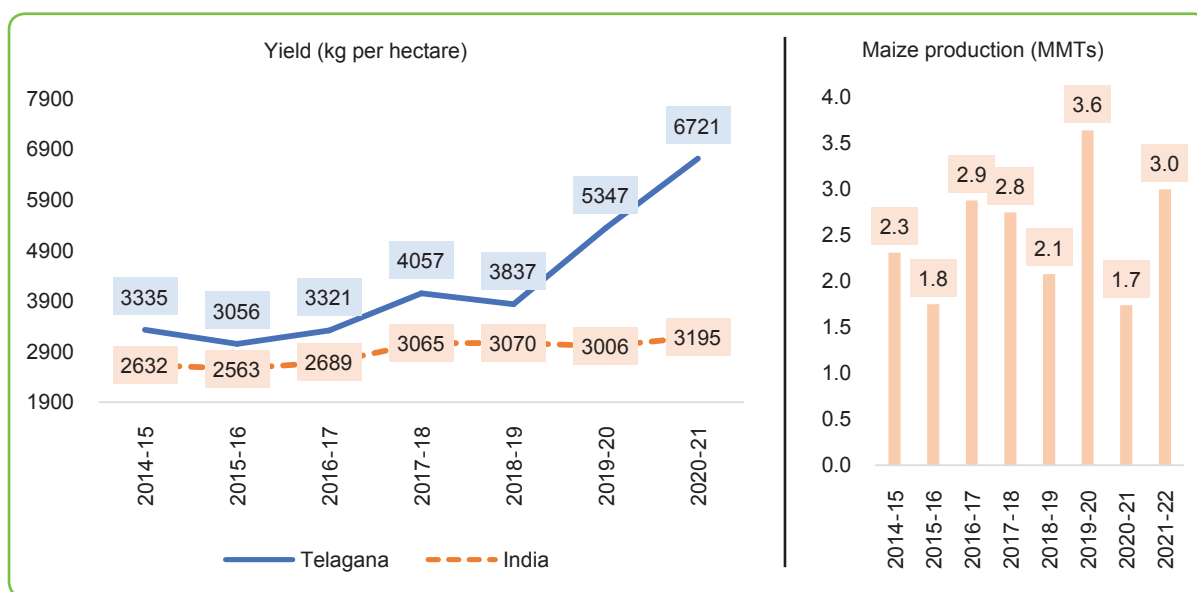
In the case of rice, Telangana's yield is higher than even the largest rice producing state in the country i.e., West Bengal. In comparison to Punjab's yield of 4.4 tonnes per hectare (Punjab Agricultural University), however, the state's yield of 3.5 tonnes per hectare trails.

In the case of maize too, Telangana's yield of 5.6 tonnes/ha is higher than the all-India average of 3.1 tonnes/ha and that of the largest maize producing state, Karnataka. However, it is far below Tamil Nadu's yield of about 7.16 tonnes/ha (TE 2020-21). The yield of groundnut in Telangana's is above the all-India average and that of Gujarat, but below that of other large producers like Tamil Nadu.

Even though higher than the all-India average, cotton and chilli yields in Telangana are lower than that of the largest producing states. The yield of *tur/arhar* (pigeon pea) is lower than both the all-India average and that of other major *tur* producers like Maharashtra and Madhya Pradesh.

Maize is an interesting story. With a change in farming practices such as cultivating green manure crops before maize sowing to increase soil fertility, combined with an increase in extension services, there has been a sharp increase in maize yields (Chandrashekar 2021) (Figure 6). Despite this and a vibrant poultry sector that uses maize as a core feed-crop, the Government of Telangana is encouraging a shift in acreage away from maize (Vadlapatla 2022). Between 2019-20 and 2020-21, acreage under maize decreased by 77.9 per cent; although it recovered in the subsequent year, it stayed below the 2019-20 level.

FIGURE 6: Maize yield (kg per hectare) and production (MMTs) in Telangana

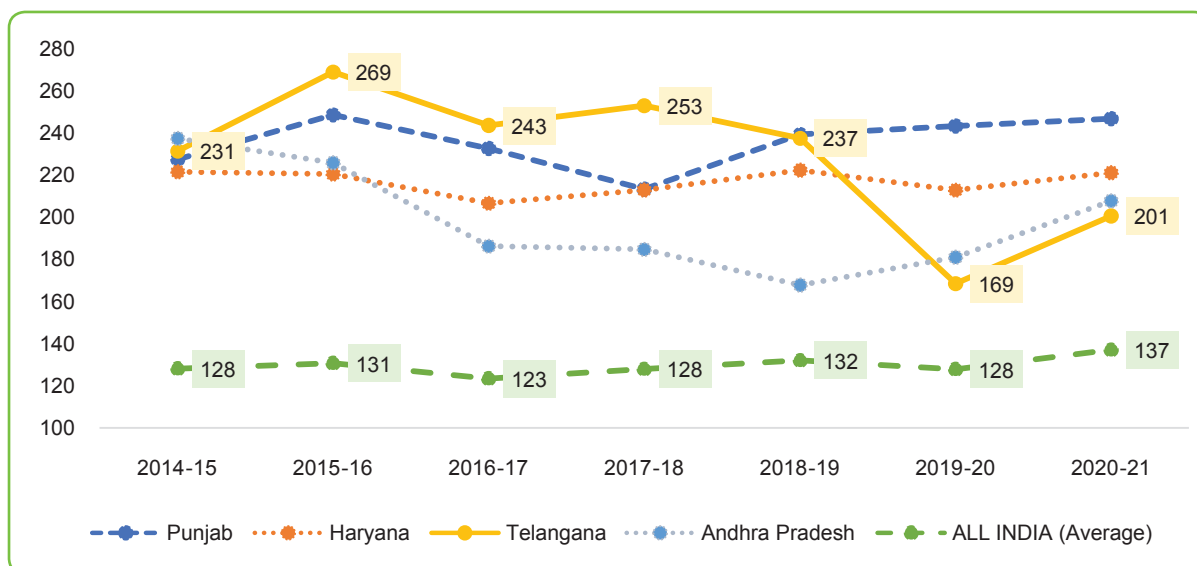


Source: Agricultural Statistics at a Glance, various issues and Telangana State Statistical Abstract

Fertiliser consumption in Telangana

Government of India (GOI) data on fertiliser consumption shows that Telangana had amongst the highest levels of fertiliser consumption per hectare of GCA between 2015-16 and 2017-18 in the country, even higher than Punjab and Haryana (Figure 7). However, since 2017-18, that has been falling. Sharp increases in state's GCA (Figure 4) can explain some moderation in these fertilizer consumption data.

FIGURE 7: Fertiliser consumption from 2014-15 to 2020-21 (kg per hectare of GCA)



Source: Agricultural Statistics at a Glance, Ministry of Agriculture and Farmers Welfare, Government of India

Clearly, decreased fertiliser consumption has not resulted in lower crop yields in the state. Possibly, yield improvements have been supported by increased irrigation, availability of quality inputs such as seeds and a carefully planned shift to more eco-friendly farming practices (Telangana Government 2018). The state has high seed-replacement ratios for major crops and has invested in ensuring availability of quality seeds to its farmers.

Trends in incomes of Telangana farmer households

Sample surveys of agricultural households – the GOI’s NSSO (National Sample Survey Office) and National Bank for Agriculture and Rural Development’s (NABARD) All-India Financial Inclusion Survey (NAFIS) – have been used to estimate incomes earned by farming households in Indian states and union territories (UTs). After Telangana was created in 2014, there are two estimates for the state’s farmer incomes: (i) for the year 2015-16 from NAFIS and (ii) for the year 2018-19 from NSSO. There are definitional issues between the estimates of these two surveys (Saini and Gulati 2018); however due to paucity of data on farmer incomes, we use these numbers for our analysis.

The impact of unconditional cash transfers received under the state’s *Rythu Bandhu* Scheme (RBS) and the central government’s *Pradhan Mantri Kisan Samman Nidhi* (PM-KISAN) on farmers’ incomes is not included in these estimates, because (i) farmers’ income estimates are older (2018-19 is the latest available estimate), and (ii) a cash transfer is not counted as income of the household. Nevertheless, it needs to be remembered that since 2018-19, an average Telangana farmer, whose landholding size is about 1 acre, receives Rs.10,000 under RBS and Rs.6000 under PM-KISAN, making a total of an additional income of Rs.16,000 per year.

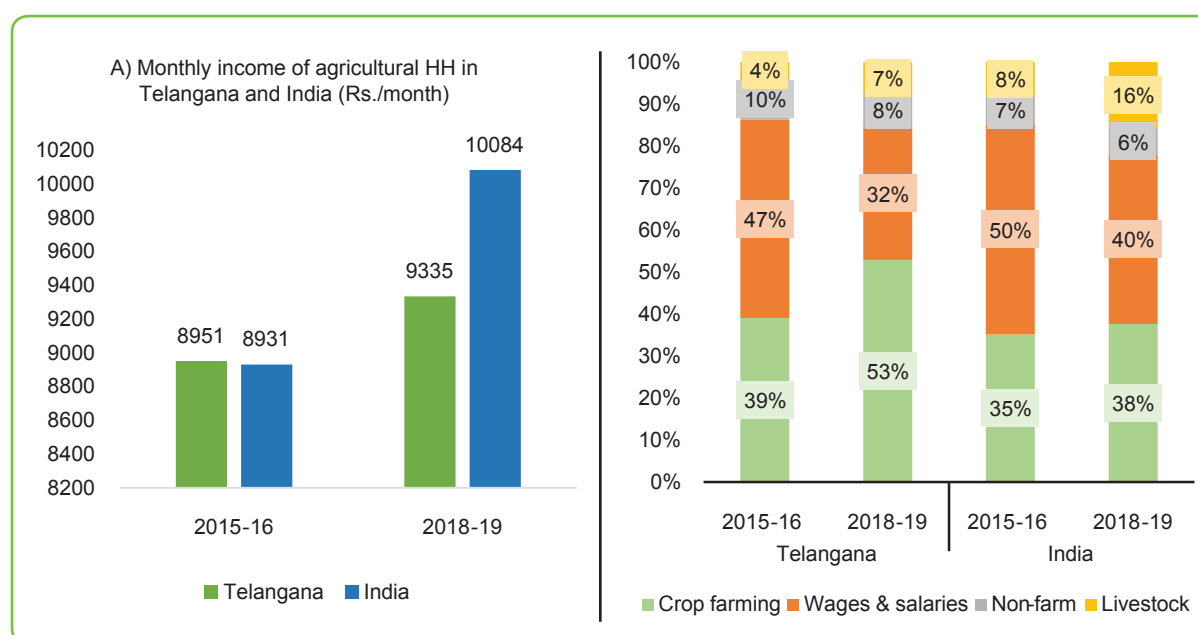
There are interesting insights from the NSSO and NAFIS data that are presented below.

Average level of farmer’s income

An average agricultural household (AHH) in Telangana earned about Rs.8,951 per month (about Rs.1,07,412 per year) in 2015-16; this increased to Rs.9,335⁵ (i.e., about Rs.1,12,020 per year) in 2018-19 (Figure 8). In 2015-16, a farmer’s income in Telangana was marginally above India’s average of Rs.8,931 per month; however, by 2018-19, it trailed the all-India average of Rs.10,084.

5 Upon adding income from leasing out land, this becomes Rs.9403. As this head was not part of the 2015-16 estimates, they have not been added here.

FIGURE 8: Farmer Income in Telangana and India (Rs./Month and percentage)



Source: NAFIS 2015-16 and NSS 2018-19

Note: In 2018-19, income from leased-out land is not included. For 2015-16, other sources of income have been added to non-farm incomes and incomes from private and government sources have been added to the wages and salaries segment

Incomes from crops were the most important source of income for an average agricultural household in Telangana in 2018-19. In case of India, it was wages and salaries. Livestock does not emerge to be as important income source either for Telangana or an average Indian farmer.

Between 2015-16 and 2018-19, the importance of crop incomes increased for Telangana farmers. From 39 per cent in 2015-16, income coming from crops formed 53 per cent of the agricultural household's income by 2018-19. Although not as high, the contribution from livestock activities too rose between these years. The share of wages and salaries fell although it still accounted for about one-third of total AHH income in 2018-19.

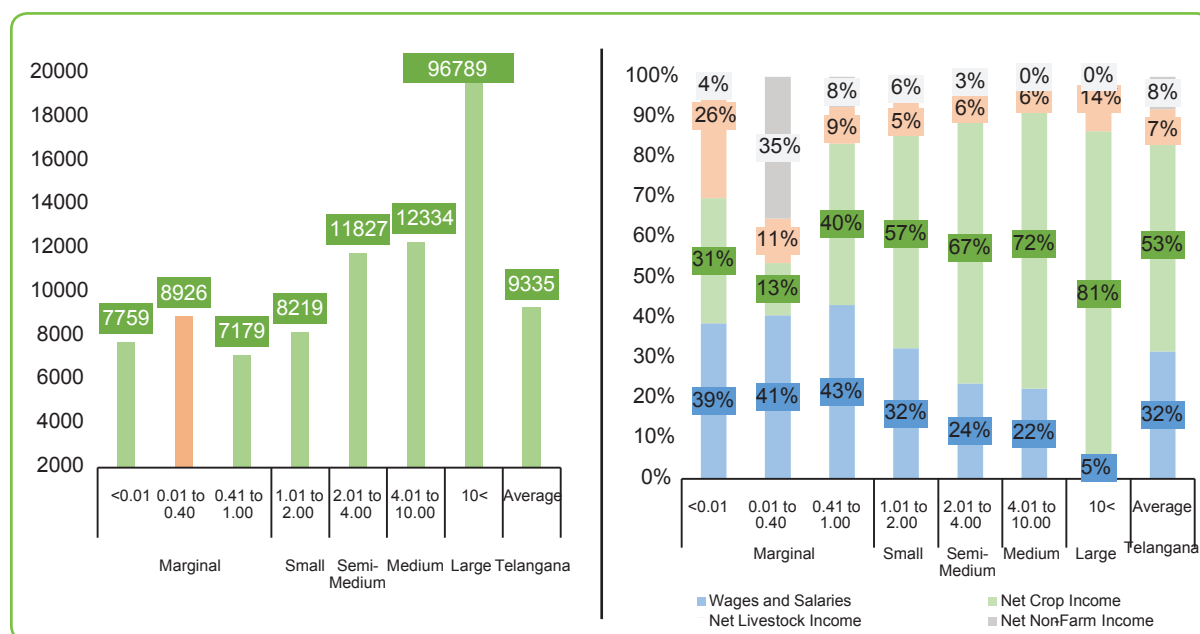
Landholding size-wise farmer incomes

Three interesting aspects emerge from data on incomes according to landholding size (Figure 9):

First, with landholding sizes, the contribution of crops in farmer's household income increased and that of livestock income fell, except in the case of large farmers, for whom livestock contributed to about 14 per cent of income.

Second, large farmers (about 0.16 per cent of the total farmers) in the state made more crop income than Punjab's large farmers. Compared to the average monthly income of Rs.70,335 in Punjab, large farmers in Telangana earned Rs.78,399 per month from crop farming.

FIGURE 9: Average farmer income by landholding size: Level (Rs./month) and composition (%)



Source: NSS 2018-19 SAS

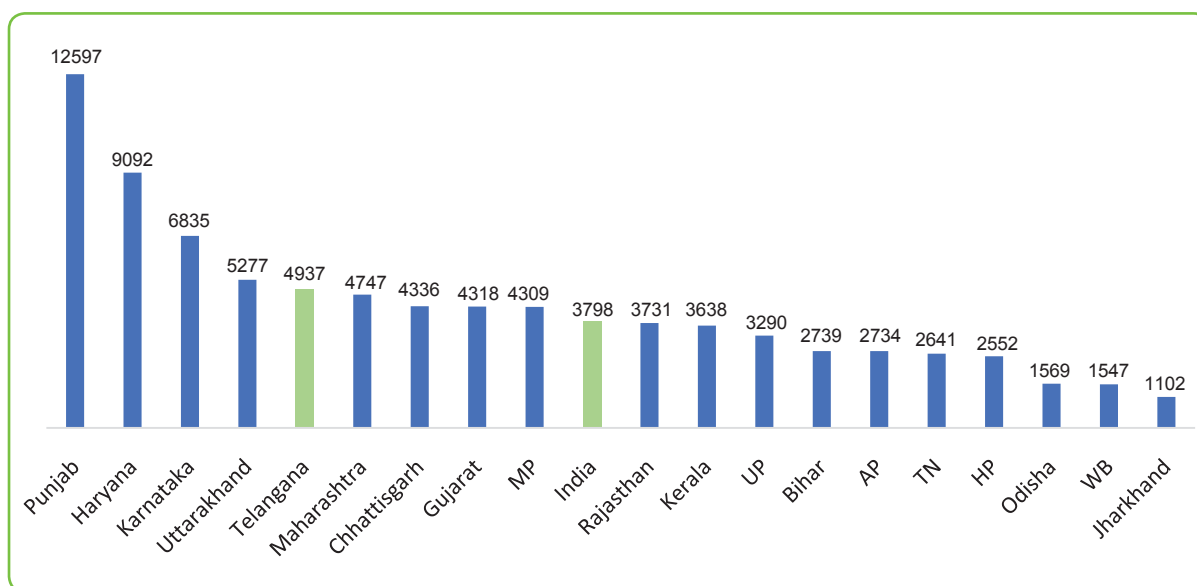
Note: Income estimates do not include estimates of income/rent from leased-out land

Third, one category of marginal farmers in Telangana (orange coloured bar in Figure 9) made more money than other marginal and small farmers (with a little larger landholding size, but still below 2 hectares) in the state. This category earned about a third of its income from non-farm activities such as household enterprises in mining, construction, hotel/restaurant, etc. Interestingly, no other land category of farmers made much income from this source (Figure 9). As per Agriculture Census 2015-16, almost two-thirds (64.6 per cent) of the farmers in the state were marginal and about 23.7 per cent were small.

State-wise crop incomes

Looking exclusively at incomes from crops and comparing them across states/UTs in the country, farmers in Telangana appear to be earning more than farmers in most agrarian states. Income from crops in Telangana is nearly double that in Andhra Pradesh and triple that in West Bengal.

FIGURE 10: Average household income from crops (2018-19) (Rs. /Month)



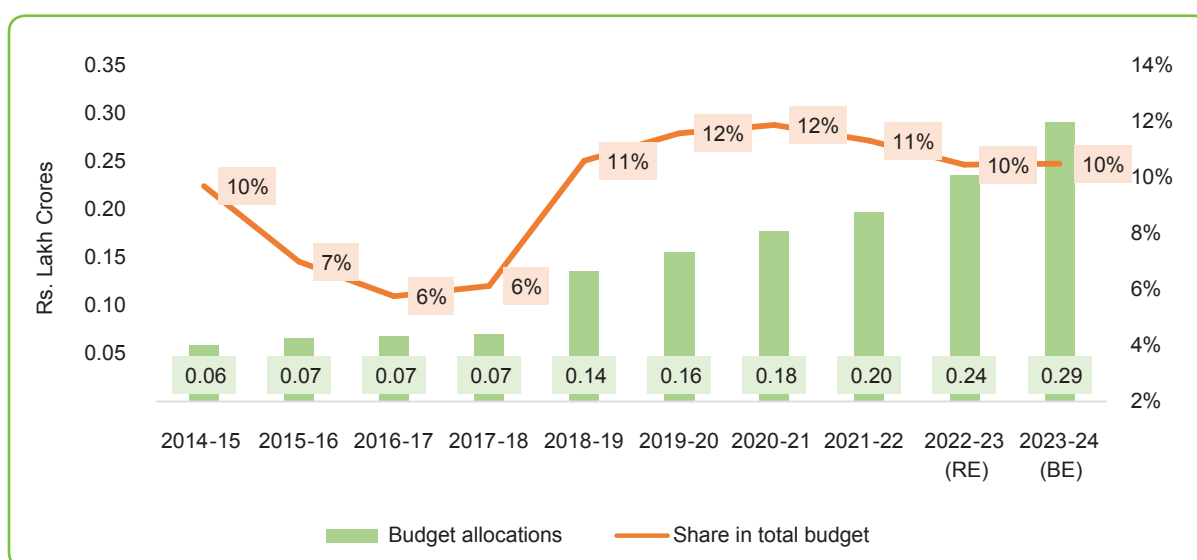
Source: NSS 2018-19

Note: MP is Madhya Pradesh, UP is Uttar Pradesh, AP is Andhra Pradesh, TN is Tamil Nadu, HP is Himachal Pradesh, WB is West Bengal

Budgetary support to A&A sectors

The central government’s agriculture and allied budget is about 3 per cent of the total union budget (2023-24, GOI). For Telangana, this share is about 10 per cent (Figure 11). The increase has been particularly sharp since the year 2018-19.

FIGURE 11: Budgetary allocations to A&A sectors in Telangana

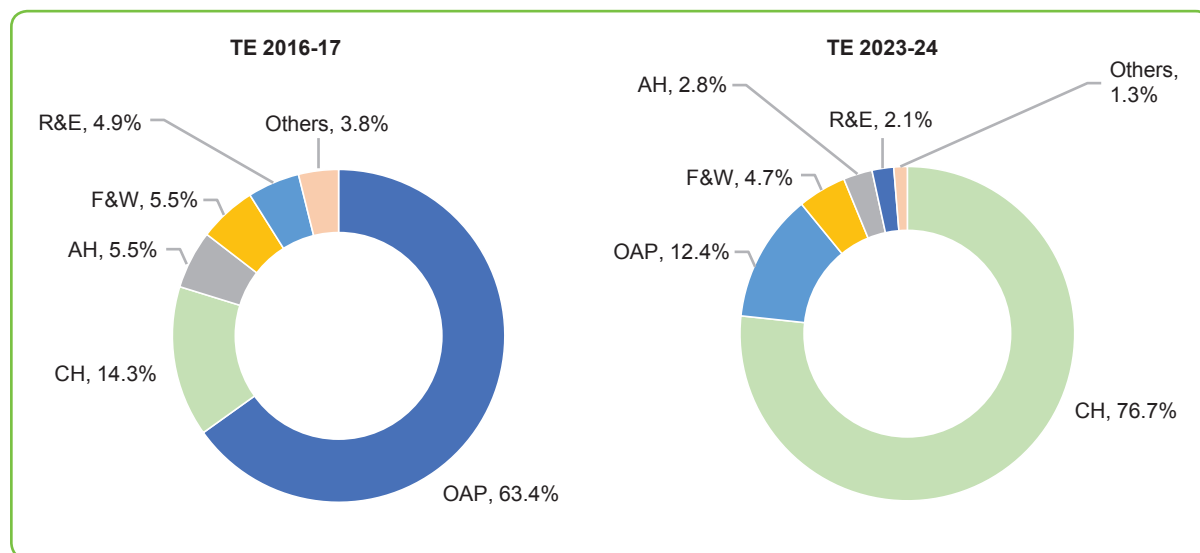


Source: Telangana state budget documents. Accessed on 09.02.2023

Note: Total budget is the summation of revenue expenditure, capital expenditure and loans and advances. BE is budget estimate and RE is revised estimate.

Over the years, the composition of Telangana’s A&A budget has changed (Figure 12). Overtime, higher allocations have been made to the department of crop husbandry (76.7 per cent of total A&A budget in TE 2023-24) and most of this increase can be attributed to the higher allocation to the state’s direct cash transfer scheme of *Rythu Bandhu*. Consequently, the share of budgetary allocations decreased for other sub-heads, including other agricultural programmes and research and education.

FIGURE 12: Components of A&A sectors budget (per cent of total)



Source: Telangana state budget documents. Accessed on 09.02.2023.

Note: OAP is Other Agricultural Programmes, CH is Crop Husbandry, AH is Animal Husbandry, F&W is Forestry and Wildlife, R&E is Research and Education, Others includes Co-operation, Soil and Water Conservation, Fisheries, Food Storage and Warehousing, and Dairy Development.

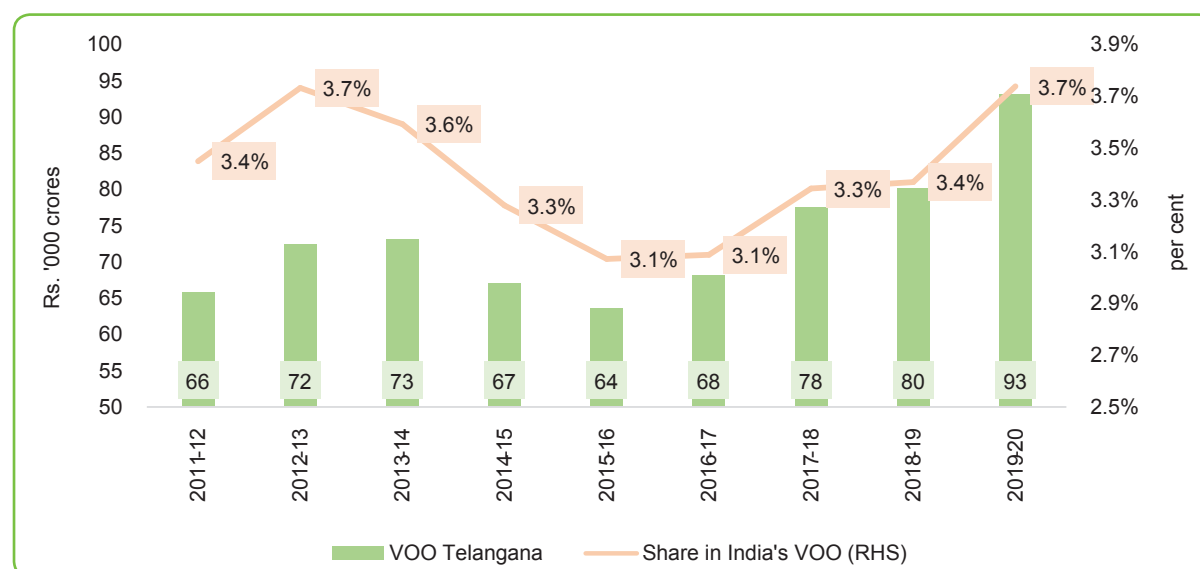


Section II: Sources of Telangana's Agricultural Growth

In this section, we decompose Telangana's A&A sector to identify sub-sectors which pulled up the A&A growth in the state. The data on state's value of output (VOO) is used for this purpose. VOO of any commodity/crop is estimated by multiplying the production of the commodity/crop with the average price received by its producer/farmer. This data is available with GOI's Ministry of Statistics & Programme Implementation (MOSPI), which gives VOO data both in real and nominal terms. To understand real trends over time, we use the data in real terms or in constant prices with a base of 2011-12. Even though the state was formed in 2014-15, the VOO data for Telangana is available from 2011-12. The latest data available is for the year 2019-20.

In 2019-20, Telangana produced about Rs.93,000 crore worth of agricultural output. This was about 4 per cent of India's agricultural VOO that year. Over time, Telangana's VOO has increased at a 4.4 per cent CAGR (Figure 13).

FIGURE 13: VOO from the A&A sector in Telangana (Constant prices)

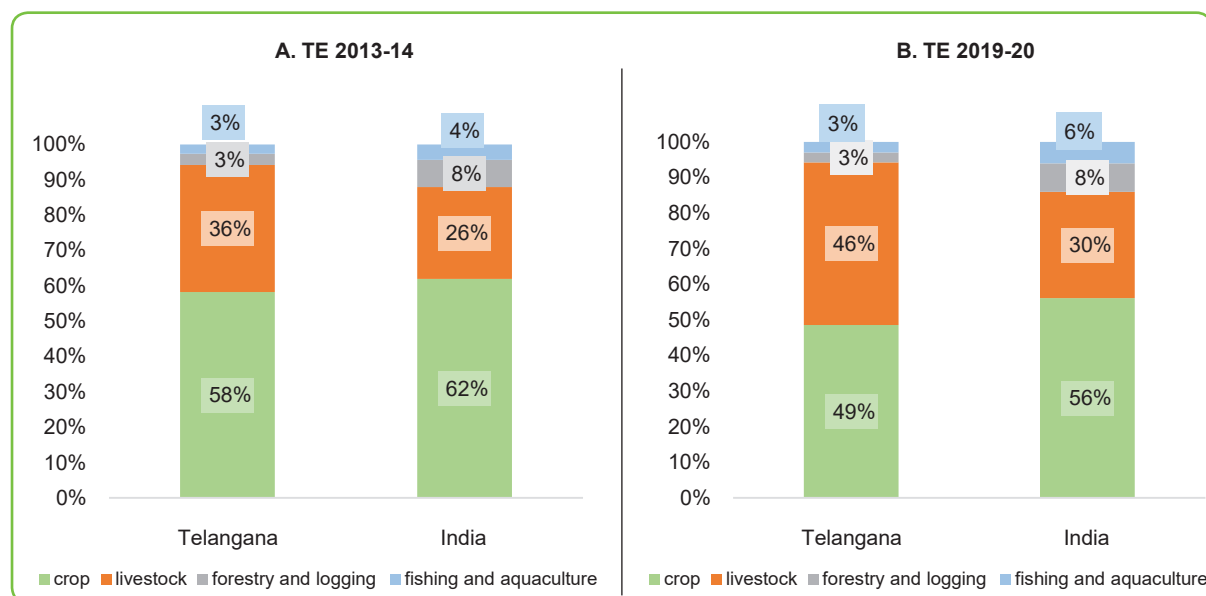


Source: MOSPI, GOI

The composition of sub-sectors within A&A has changed over time in the state (Figure 14). Some salient features:

- 1. Centrality of crops:** Despite the growth in other sectors like livestock, the crop sector continues to be the main anchor of the state's A&A sectors. Despite a fall in its share (from 58 per cent in TE 2013-14 to 49 per cent in TE 2019-20), close to half of the state's VOO from A&A comes from crops.
- 2. Livestock's growth is steep:** In the six years between 2013-14 and 2019-20, the share of livestock in the state's agricultural VOO increased by 10 per cent. Livestock appears to be more important in the state as compared to overall India. Its contribution is now at 46 per cent, which is very close to the contribution of crops with 49 per cent.

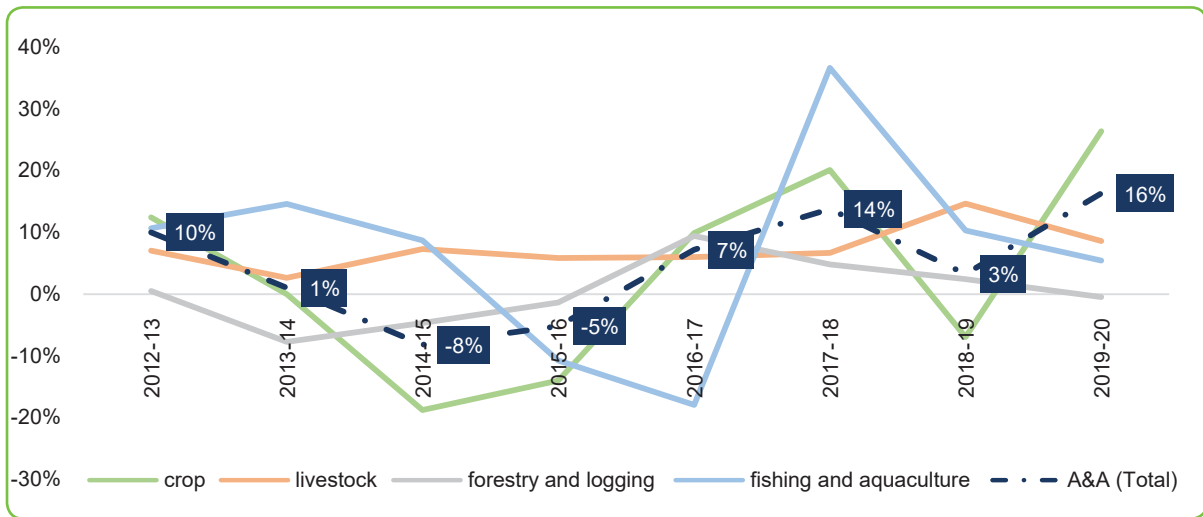
FIGURE 14: Composition of VOO for A&A in Telangana and India



Source: MOSPI, GOI

3. Not much has changed in the case of forestry and fishery for either India or Telangana.
4. In terms of annual growth rate in VOO (Figure 15), the following features in Telangana are noteworthy:
 - i. The value of output from crops shows high volatility in Telangana. As we will see in the upcoming section, this volatility is mapped closely with volatility in annual rainfall. In the twin drought years of 2014-15 and 2015-16, annual VOO growth rate in crops fell to (-)8 per cent and (-)5 per cent respectively.
 - ii. There has been steady average annual growth rate of about 8.2 per cent between 2014-15 and 2019-20 in the livestock sector.

FIGURE 15: VOO growth of A&A sectors in Telangana



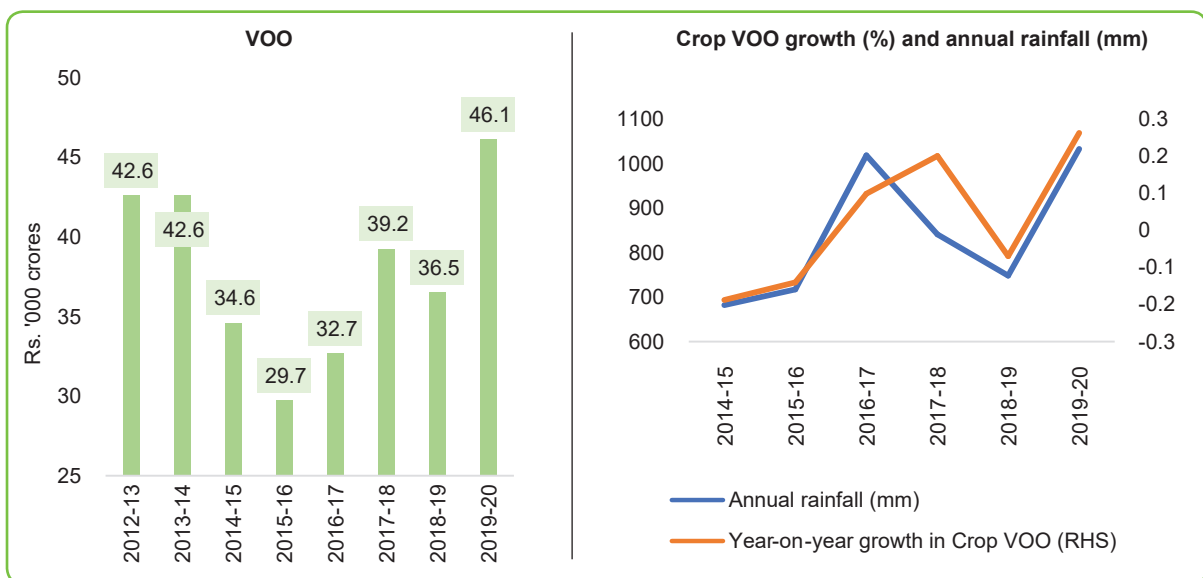
Source: MOSPI, GOI

Before estimating the sources of growth, in this section we will study individual elements of A&A VOO.

Crop sector

Less than half the state’s gross cropped area (GCA) had assured irrigation when the state was created in year 2014-15. By 2021-22, this coverage increased to about 69 per cent of the total GCA. Although the state’s dependence on rains reduced over time, it is still important. Therefore, its crop output emerges to be moving in line with rainfall level in the state (Figure 16 RHS). The years 2014-15 and 2015-16

FIGURE 16: Crop VOO (2011-12 constant prices) and co-movement with rainfall

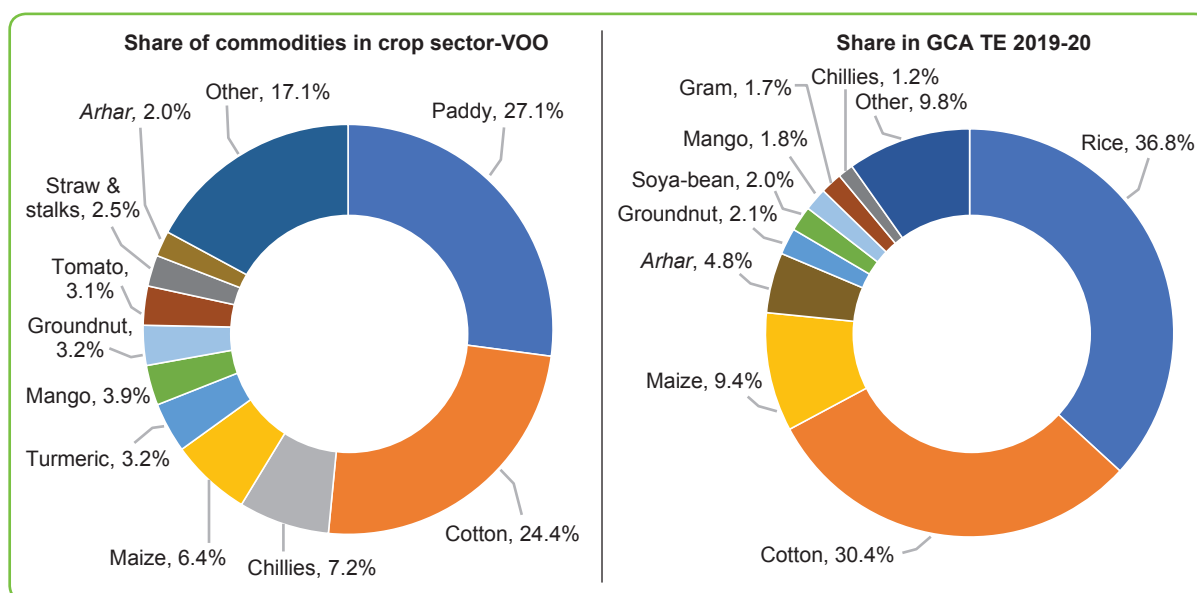


Source: MOSPI, GOI for data on VOO and SEO 2022 for data on annual rainfall

were drought years (and 2018-19 saw deficit rainfall); these rain deficits map almost identically with the movements in crop output.

Telangana's crop output is paddy and cotton centric. Close to 52 per cent of the state's crop VOO in TE 2019-20 came from these two crops (Figure 17). Other important crops included chillies (7.2 per cent), maize (6.4 per cent), mango (3.9 per cent), turmeric (3.2 per cent), groundnut (3.2 per cent), tomato (3.1 per cent), and *arhar/tur* (2 per cent).

FIGURE 17: Share of commodities in crop sector VOO and GCA (TE 2019-20) (% of total)



Source: MOSPI, GOI

Comparing the GCA under different crops with the crop's contribution to the state's value of agricultural output (proportionate share of the crop in total crop VOO), we find the following:

1. In TE 2019-20, 77.8 per cent of GCA was under paddy, maize, chillies, and cotton cultivation but their combined contribution to the value of crop output was only 65.1 per cent.
2. Crops like mango, groundnut and turmeric contributed 10.3 per cent to crop VOO but accounted for less than 5 per cent of state's GCA.
3. Oilseeds such as groundnut generated more value than *tur*, for example, but accounted for a lower GCA share.

Telangana stands out in particularly for these crops:

1. **Cotton:** Telangana is the third largest cotton producer in the country after Gujarat and Maharashtra. However, Telangana had the fastest CAGR in VOO between 2015-16 and 2019-20 at 16.3 per cent compared to Gujarat ((-) 2.9 per cent) and Maharashtra (0.5 per cent).

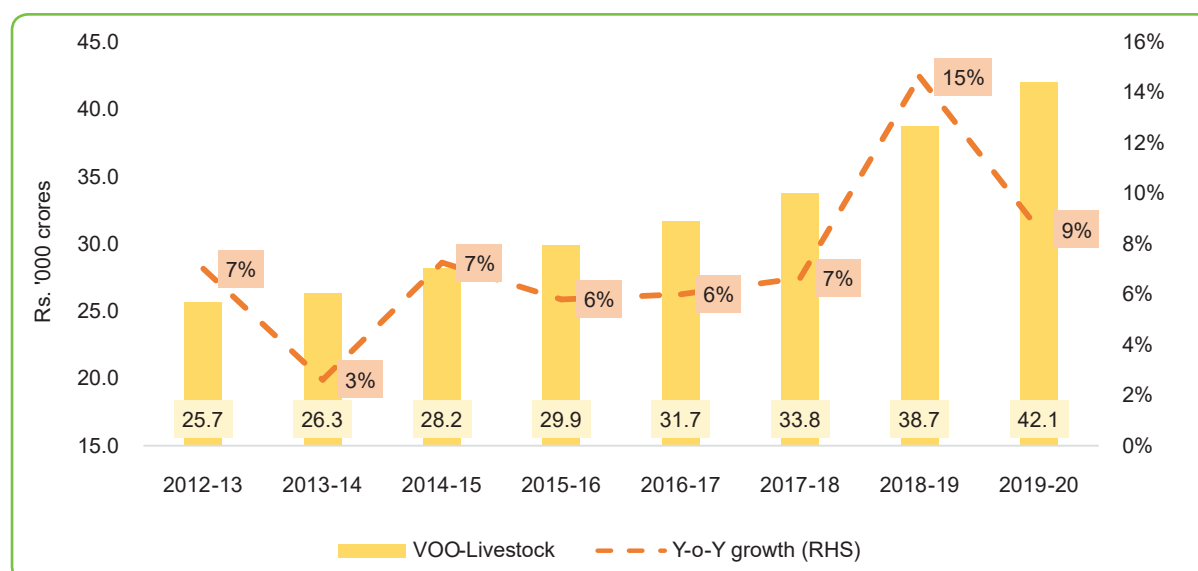
2. **Turmeric:** Maharashtra and Telangana are the most important states for turmeric in India. In terms of CAGR (2015-16 and 2019-20), Telangana registered an average annual growth rate of 20.3 per cent against Maharashtra's 12.5 per cent.
3. **Chillies:** Telangana contributes the second largest share in the country's VOO of chillies but the VOO growth rate in Telangana at 17.7 per cent was twice as much as the largest contributor, Andhra Pradesh, which registered a CAGR of 6.8 per cent between 2015-16 and 2019-20.
4. **Maize:** The VOO of maize in Telangana is the fourth largest in the country (Karnataka, Madhya Pradesh and Tamil Nadu are top three). However, the CAGR of the VOO from maize between 2015-16 and 2019-20 in Telangana was 14.4 per cent against Karnataka's 6.5 per cent, Tamil Nadu's (-) 0.1 per cent and Madhya Pradesh's 12.1 per cent.

Livestock at par with crops

Livestock is more important in Telangana than in an average Indian state. About 30 per cent of India's agricultural value came from livestock; in the case of Telangana, this contribution was about 46 per cent. Nationally, livestock is touted to play a critical role in augmenting farmers' incomes and concerted efforts are being designed to promote the livestock sector (PIB 2020). In Telangana, at least at the macro level, this diversification appears to be already delivering.

In TE 2019-20, VOO from livestock sector grew at an annual average rate of about 10.3 per cent in real terms (Figure 18). This growth is driven by the milk and meat sub-sectors. The two sub-sectors

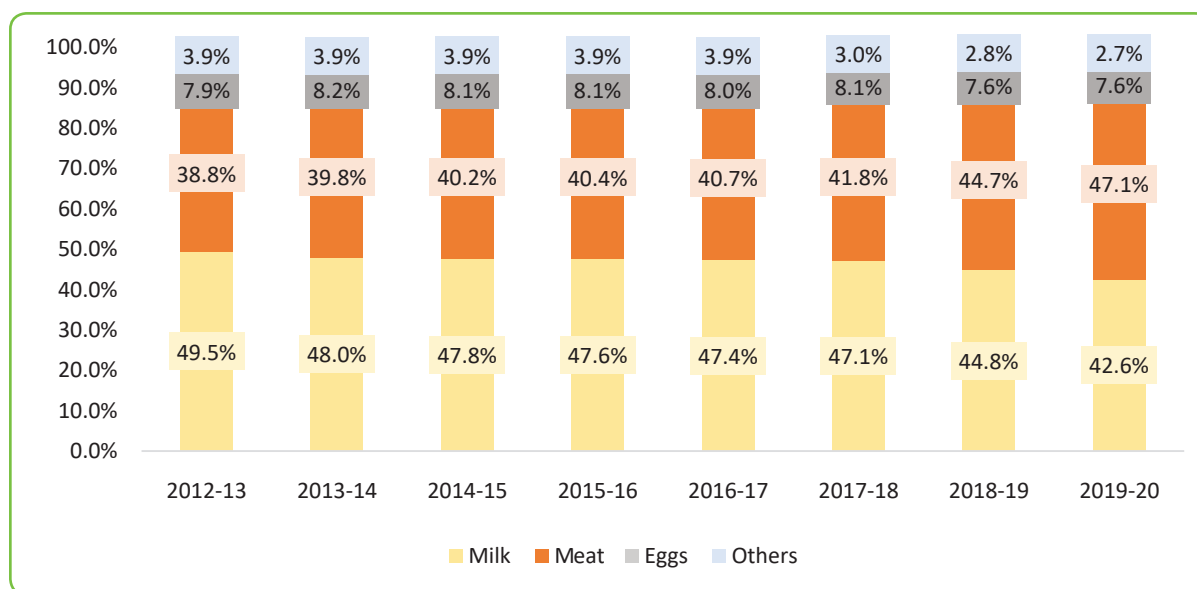
FIGURE 18: VOO from livestock sector (Constant prices)



Source: MOSPI, GOI

accounted for about 89 per cent of Telangana’s total livestock VOO between 2012-13 and 2019-20. However, the relative contribution of milk has been falling and that of meat has been rising (Figure 19).

FIGURE 19: Composition of VOO from livestock sector (per cent share in livestock VOO)



Source: MOSPI, GOI

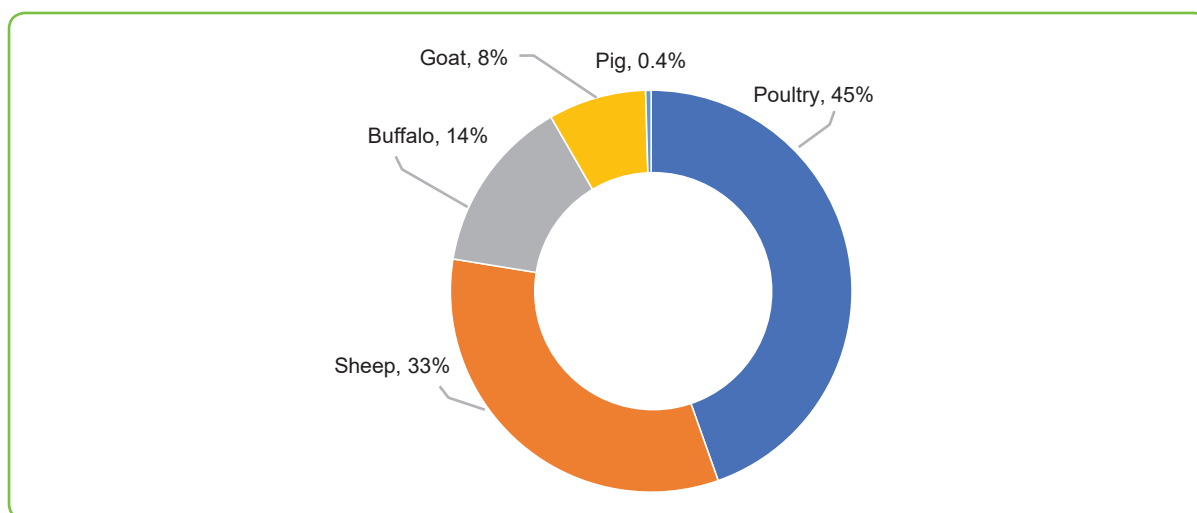
Note: Others include wool & hair, dung, silkworm cocoons & honey and increments to livestock.

Given the state government’s programmes of distributing sheep to tribals and the private sector’s thrust in the poultry sector, mainly broiler, the rise in the VOO from meat has been exceptional. Under its sheep distribution programme, the state distributed about 82.64 lakh sheep to about 3.93 lakh beneficiaries between 2017 and 2022 (SEO 2023).

About 45 per cent of meat produced in the state is from poultry, followed by 33 per cent from sheep, 14 per cent from buffalo, 8 per cent from goats and 0.4 per cent from pigs (Figure 20). High poultry meat production is supported by an increase in the number of broiler farms in the state. In 2021-22, there were 3732 broiler farmers in the state, increasing from 3452 in 2019-20 (DAH).

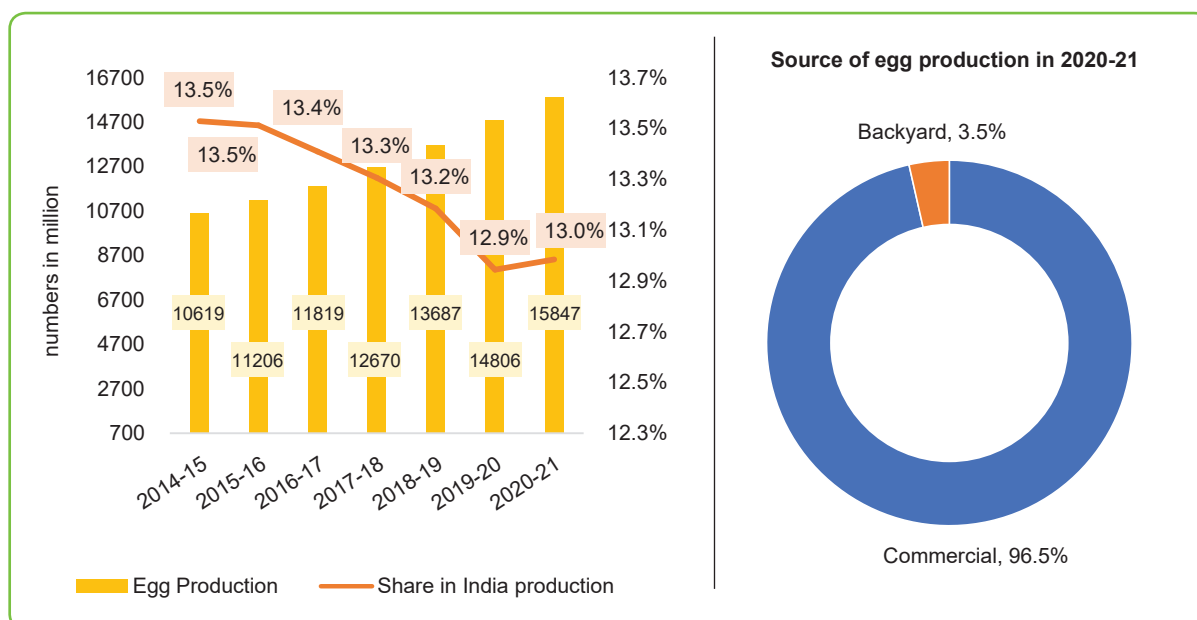
The state is the third largest producer of eggs in the country, behind Andhra Pradesh and Tamil Nadu (BAHS 2020-21). Between 2014-15 and 2020-21, egg production in the state increased from 10.6 billion to 15.9 billion eggs (Figure 21). Despite this growth, Telangana accounts for a smaller share in Indian egg supplies today, possibly due to the sharper growth of the poultry sector in states like Haryana, and Andhra Pradesh. The state produced about 13 per cent of total eggs produced in the country in 2020-21 (this was about 13.5 per cent in 2014-15). About 96.5 per cent of the state’s eggs were produced in commercial farms; the remaining came from backyard poultry farms.

FIGURE 20: Composition of meat production in Telangana (2020-21)



Source: BAHS 2021

FIGURE 21: Production of eggs in Telangana (million) and sources of production

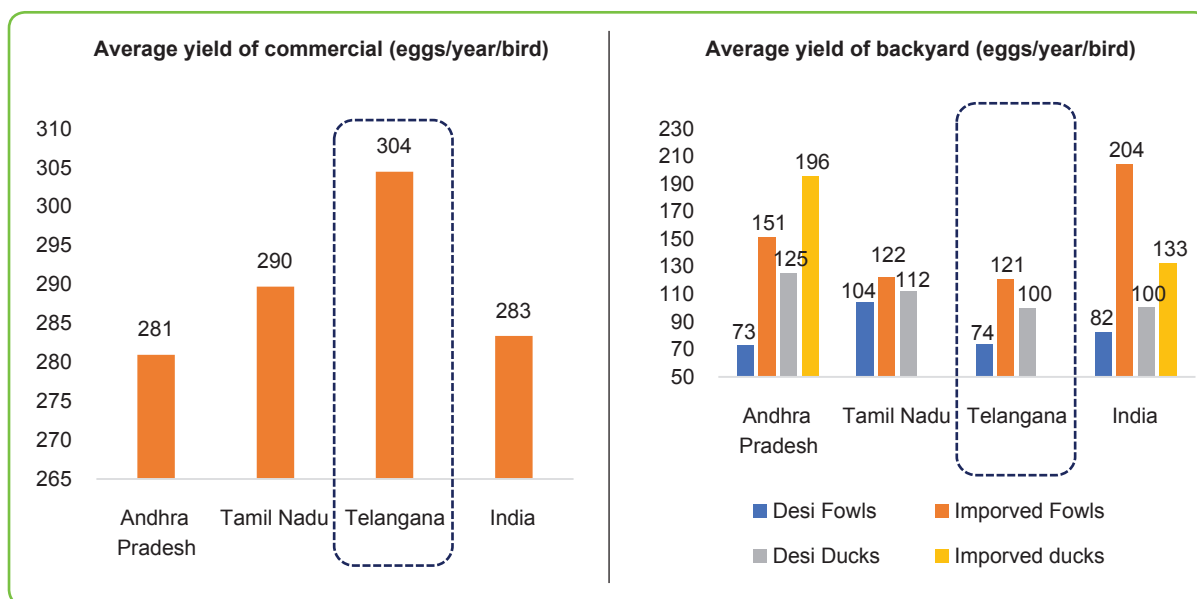


Source: BAHS 2021

The commercial poultry farms in Telangana had the highest egg yields (304 eggs/year/bird) among major producing states (Andhra Pradesh and Tamil Nadu) (see Figure 22). Only Odisha and Rajasthan reported higher egg yields from commercial poultry than Telangana.

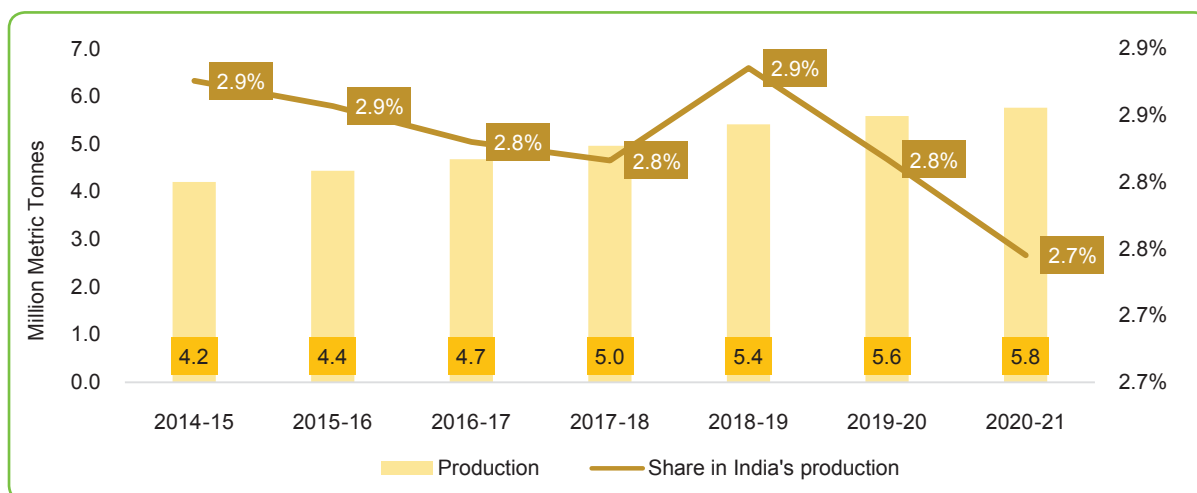
Telangana's milk production and the value of milk output have been increasing (Figure 23). About 2.8 per cent of India's milk comes from the state (between 2014-15 and 2020-21). Milk production in the state increased at a CAGR of about 5.8 per cent between 2014-15 and 2020-21, almost the same as the average growth rate of milk production in the country at large.

FIGURE 22: Yield per layer per year for commercial and backyard poultry farms (2020-21)



Source: BAHS 2021

FIGURE 23: Milk production in Telangana (MMTs and share in India's milk production)

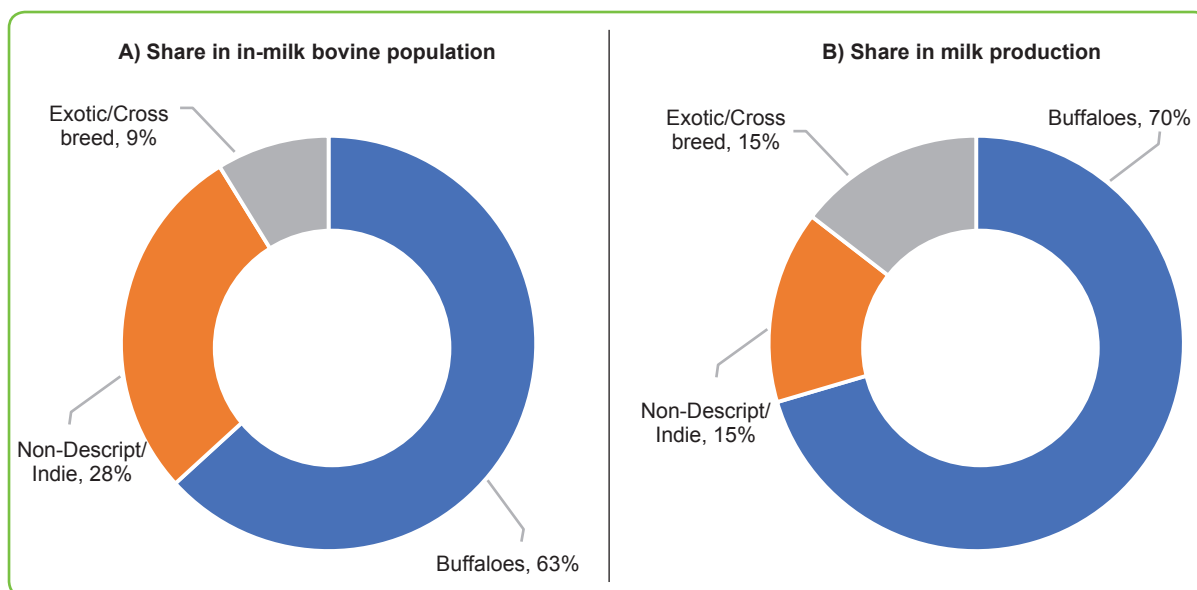


Source: 20th Livestock Census and BAHS 2020-21

Like other Indian states, Telangana too has problems with its bovine breed composition and yield. As per the 20th Livestock Census conducted in 2018-19, Telangana had a total bovine population of 8.4 million, of which 77 per cent were females.⁶ Of these females, only 36.4 per cent were in-milk and of these, 63 per cent were buffaloes, 28 per cent were non-descript/indie breeds and only 9 per cent were exotic/cross breeds (Figure 24).

⁶ Department of Animal Husbandry and Dairying, GOI conducts livestock census and the Integrated Sample Survey (ISS). The latest livestock census (20th Livestock census) estimates are for 2018-19. Data from ISS is published in the yearly Basic Animal Husbandry Statistics (BAHS).

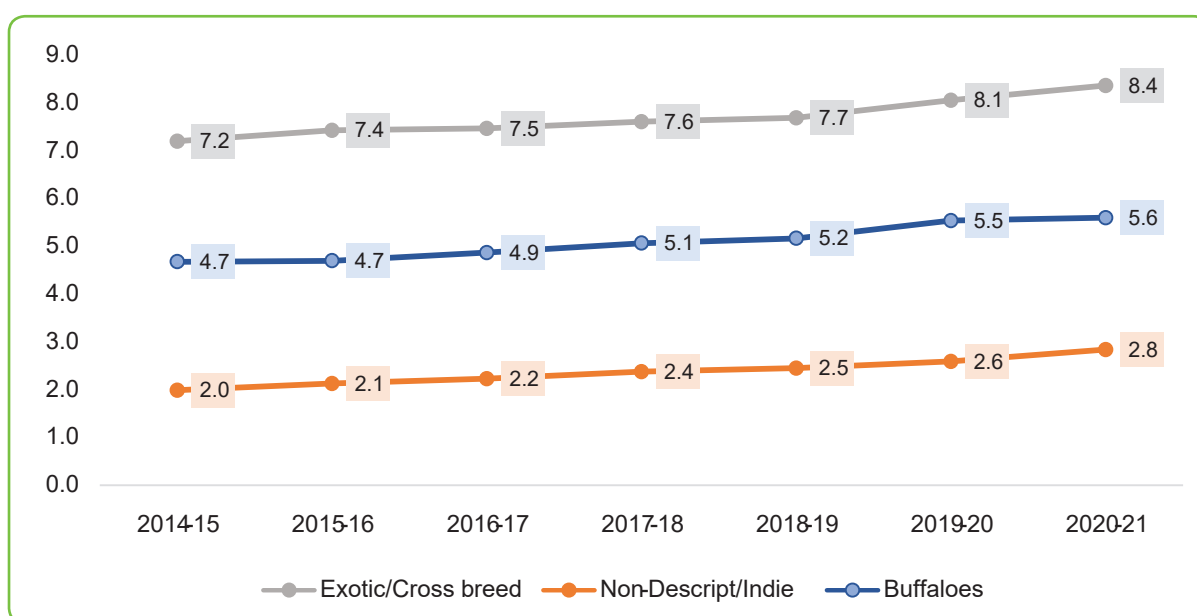
FIGURE 24: Breed-wise milk production and share in in-milk bovine population (TE 2020-21)



Source: BAHS 2021

As per BAHS, yields of non-descript/indie breeds are the lowest at 2.8 kg/day (2020-21) and that of exotic/crossbreeds the highest at 8.4 kg/day (Figure 25). This implies that 28 per cent of the cattle (non-descript variety) gives the same amount of milk as 9 per cent of the exotic breeds. Apart from the implications on emissions from cattle, this also has a huge bearing on the limited feed that is available for these animals.

FIGURE 25: Milk yields per animal (Kilograms per day)



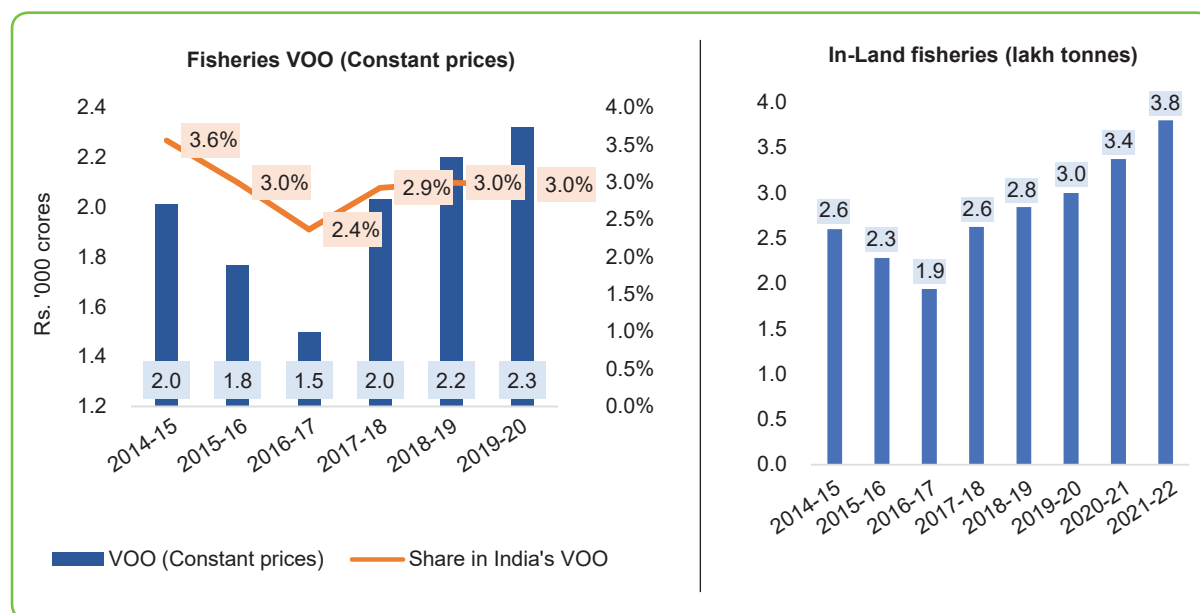
Source: BAHS 2021

In recent years, sex-sorted semen availability and artificial inseminations have increased in the state (Telangana State Livestock Development Agency). With the development of breeding laboratories, the state is now self-reliant in frozen semen doses and exports to other states as well (Telangana State Livestock Development Agency). In 2017, the state started the Milk Incentive Scheme, which subsidised buffalo and cattle purchase for schedule castes and schedule tribes in the state (Lasania 2017). The state government, co-operative dairies such as Amul and other private sector dairies have also increased milk processing capacity by investing in processing plants (TH 2021 and HBL 2021, Raj 2020).

Fisheries and aquaculture

In TE 2019-20, fisheries and aquaculture accounted for 3 per cent of the state’s agricultural VOO. Data on fisheries is reported under two sub-heads. These are inland fisheries and marine fisheries. In TE 2019-20, 89 per cent of VOO from fisheries were from the inland fisheries sector (Figure 26).

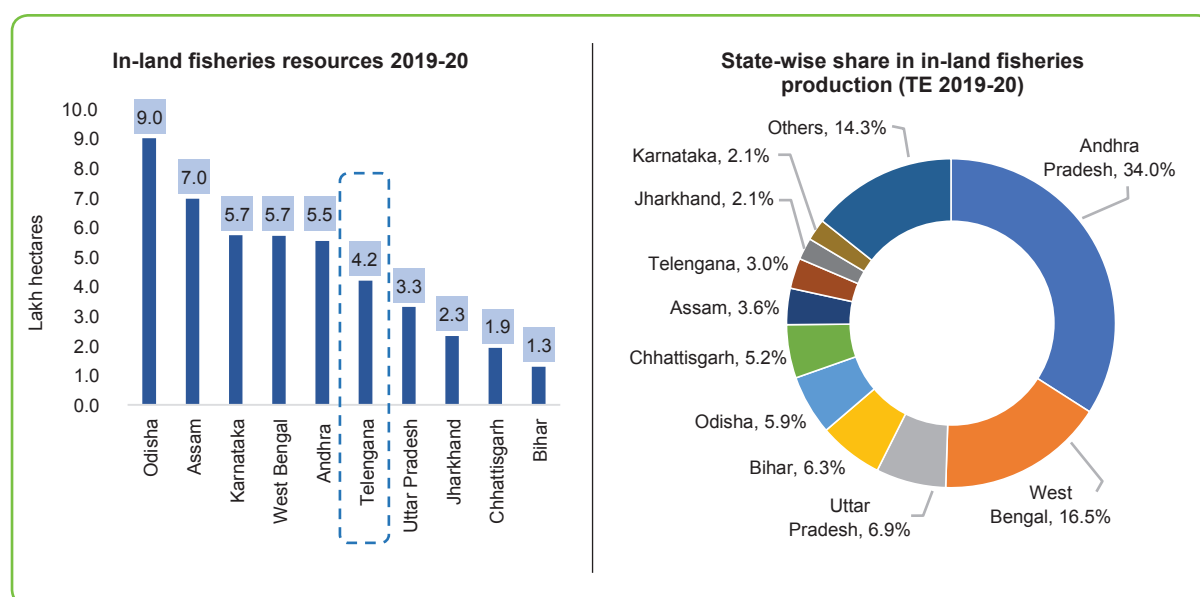
FIGURE 26: VOO and production of inland fisheries in Telangana



Source: MOSPI, GOI and Handbook on Fisheries Statistics (2020), Statistical Abstract of Telangana. Data for VOO was available till 2019-20.

The state has the fifth largest inland water resource base and ranks 8th in terms on total inland fishery production in the country (Figure 27). Uttar Pradesh, Bihar, and Chhattisgarh produced more with lower inland water resources. In Telangana, 94 per cent of inland water resources are medium and large reservoirs and 6 per cent small reservoirs. With the development of irrigation infrastructure in the state in recent years, opportunities to expand inland fisheries in the state have grown.

FIGURE 27: Inland fisheries production in Telangana and state-wise share in total production



Source: Handbook on Fisheries Statistics (2020)

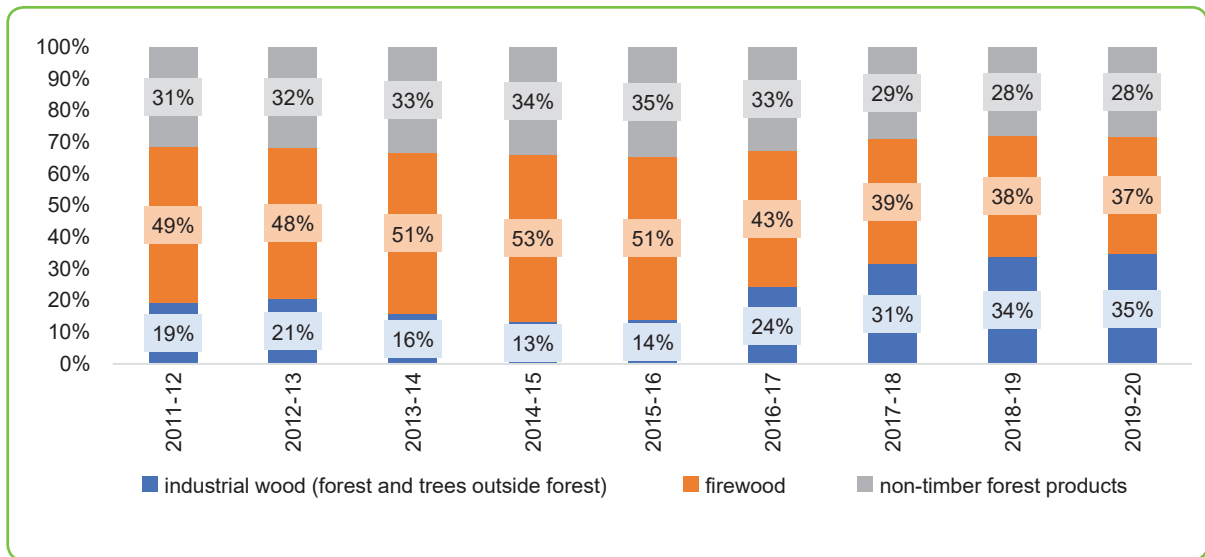
The state’s Integrated Fisheries Development Scheme (IFDS) has multiple objectives which includes supply of fish seeds, providing financial assistance to fishermen for livelihood support, construction of community halls for fishermen co-operative societies, and construction of fish markets (Government of Telangana). The scheme also aims to improve productivity, reduce losses, and increase livelihood support for the welfare of fishermen. The average share of the scheme’s budget in the fisheries department budget since 2019-20 is 15 per cent.

Forestry and logging

In TE 2019-20, forestry, and logging (F&L) accounted for 3 per cent of the value of agricultural output in Telangana. Between 2012-13 and 2019-20, VOO from forestry and logging remained constant at about Rs.2300 crore. The composition of F&L VOO does, however, appear to have changed over the years. The share of firewood and non-timber forest produce (NTFP) has been falling in the state. At the same time, the share of agro-forestry or trees outside forest (TOF) has been increasing (Figure 28).

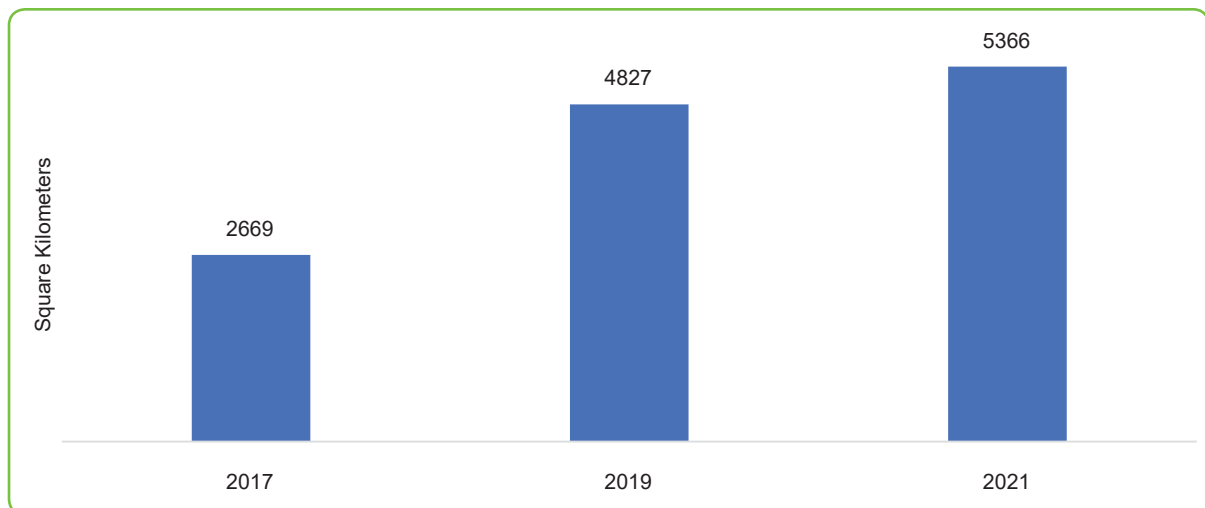
The State of India’s Forest report provides data on the extent of trees outside forests (TOF) in the country. TOF refer to all trees grown outside the recorded forest area. In 2021, Telangana reported a TOF cover of 5366 sq. kilometres (4.8 per cent of total geographic area of the state). Over the years, TOF in the state has been increasing (Figure 29), coinciding with the increase in VOO from industrial wood.

FIGURE 28: Composition of forestry VOO (Per cent share in total)



Source: MOSPI, GOI

FIGURE 29: Tree cover outside reserved forests in Telangana



Source: State of India's Forest reports (various issues), Forest Survey of India

Under various central and state schemes, the state government is promoting agro-forestry (forestry on agricultural lands) near areas with paper mills and promoting cultivation of eucalyptus clones, casuarina and *subabul* plantations (Bansal 2021). Telangana also initiated a pilot project for cotton-based agro forestry in Karimnagar and Mulugu districts (WWF 2023). The state government has tried to increase agro forestry through increased awareness and technology (PJ TSAU and USAID 2022). However, challenges such as farmer's monocropping preferences, survival rates of trees, and high maintenance costs still remain.

Putting the pieces together to identify ‘Sources of Growth’

So, is it the crop sector or fisheries or livestock that has pulled up state’s agricultural growth rate in the recent years? In this section, we combine each of their individual growth contributions and assess how they add up to explaining Telangana’s A&A VOO growth.

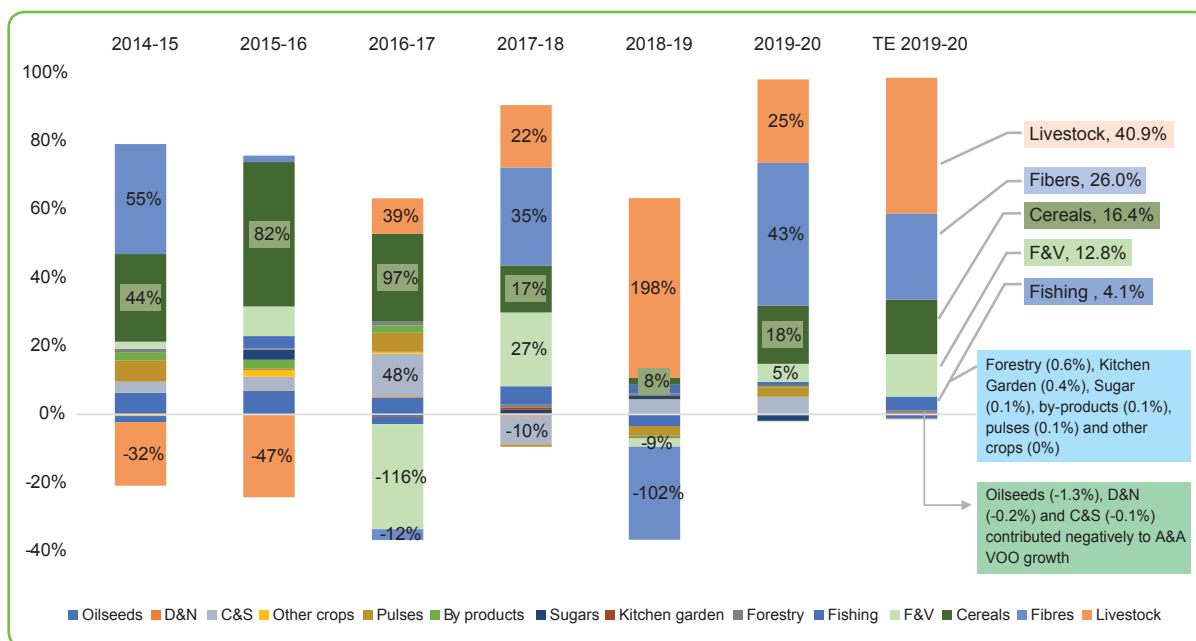
Methodology for calculating contributions to VOO A&A growth

The methodology for estimating contributions of different components is adopted from Gulati, Roy and Saini 2018 and OECD 2022. For estimating the contributions of components to overall A&A growth, the following steps have been followed:

1. *Estimating component specific growth rates:* The year-on-year growth rates between 2011-12 and 2019-20 are calculated separately for cereals, pulses, oilseeds, sugars, fibres, drugs and narcotics, condiments and spices, fruits and vegetables, other crops, by-products, kitchen garden, livestock, forestry and logging, and fisheries segments.
2. *Estimating weight for different components:* Weights are estimated by calculating the share of each component in the total VOO from A&A. Separate weights are calculated for different years between 2011-12 and 2019-20.
3. *Estimating weighted sum corresponding to total A&A growth:* Here the component specific growth rates are multiplied with their respective weights from previous year. The weighted sum of different components is equal to the growth rate of A&A sector as a whole in that year.
4. *Estimating per cent share of each component in total A&A growth:* The weighted value of each component (calculated in point 3 above) is expressed as percentage share of the overall A&A growth rate. This percentage share is the contribution of the component in overall A&A growth.

The annual contributions since 2014-15 to 2019-20 (*latest available data*) have been presented below in Figure 30.

FIGURE 30: Contribution of components in A&A VOO growth



Source: Estimated by authors using MOSPI data

From the analysis, the following observations emerge:

- Livestock** is biggest source of growth in Telangana’s agricultural sector. This finding echoes with the basic analytics we presented in Table 1 earlier. Barring 2014-15 and 2015-16, the livestock sector has contributed significantly to overall A&A VOO growth in the state. In TE 2019-20, about 41 per cent of state’s agricultural VOO growth came from livestock.
- The second major driver of growth is **cotton/fibre**. Over the years, cotton’s contribution to A&A VOO has been volatile, with negative contributions in 2016-17 and 2018-19. Nevertheless, there has been a large shift in acreage towards cotton in the state. Bolstered by higher procurement and lucrative open market prices, cotton appears to have pulled up the state’s agricultural growth. In TE 2019-20, cotton contributed about 26 per cent to the state’s agricultural VOO growth.
- Cereals** rank third in their contribution to the state’s agricultural VOO growth in TE 2019-20, even though their contribution over the years has been falling. In 2014-15, cereals contributed, on average, 44 per cent to A&A VOO growth; this has shrunk to about 18 per cent in 2019-20. Within cereals, the highest contributions came from paddy and maize. In TE 2019-20, VOO paddy and maize grew at an annual average rate of 13 per cent and 7 per cent, respectively.
- The contribution of the **Fruits and Vegetables (F&V)** sector has been volatile. Its contribution declined from 4 per cent in 2014-15 to (-) 116 per cent in 2016-17. It again picked up the following year and reported highest ever contribution in 2017-18. In TE 2019-20, F&V ranked fourth with

a contribution of about 12.8 per cent in total A&A growth. Fruits such as mango and lemons, and vegetables such as brinjal and tomato lead in terms of annual growth in VOO in TE 2019-20. Floriculture is also picking up pace, reporting an annual average VOO growth of 81 per cent in TE 2019-20.

5. After 2016-17, the contribution from **fisheries** have turned positive. With more irrigation sources, the opportunities to develop it are abundant. In TE 2019-20, fisheries contributed about 4.1 per cent to state's agricultural VOO growth.
6. Unlike fisheries, the contribution after 2016-17 from **pulses and oilseeds** to A&A VOO growth has declined significantly. This can be attributed to the increasing acreage being shifted to paddy and cotton over the years.
7. Contribution from **sugarcane** has been low since 2014-15 and was at 0.1 per cent in TE 2019-20.
8. **Forestry** contributes only marginally to the agricultural landscape of the state.



Section III: Drivers of Telangana's Agricultural Growth

From the previous section, it is apparent that cereal crops like paddy and maize, cash crops like cotton and allied activities like livestock were the major sources of agricultural growth in Telangana. In this section, we examine the determinants of growth in these sub-sectors. A brief discussion of the possible determinants of growth is followed by an econometric analysis to test the statistical significance of these growth factors in explaining variations in the GVA in agriculture and allied activities in the state. We start with the state's initiatives in irrigation. Apart from being a key input in the cultivation process, irrigation has been a pivotal policy focus on which the state government undertook concerted efforts.

Expansion of area under irrigation

As mentioned before, immediately after the creation of Telangana, there were two consecutive years of droughts. With more than half its GCA dependent on rains to meet irrigation needs, these droughts pulled down the state's GCA, crop yields and production (NABARD, Telangana State Development Planning Authority 2014, SANDRP 2016). Consequently, on priority, the state worked on increasing its irrigation coverage.

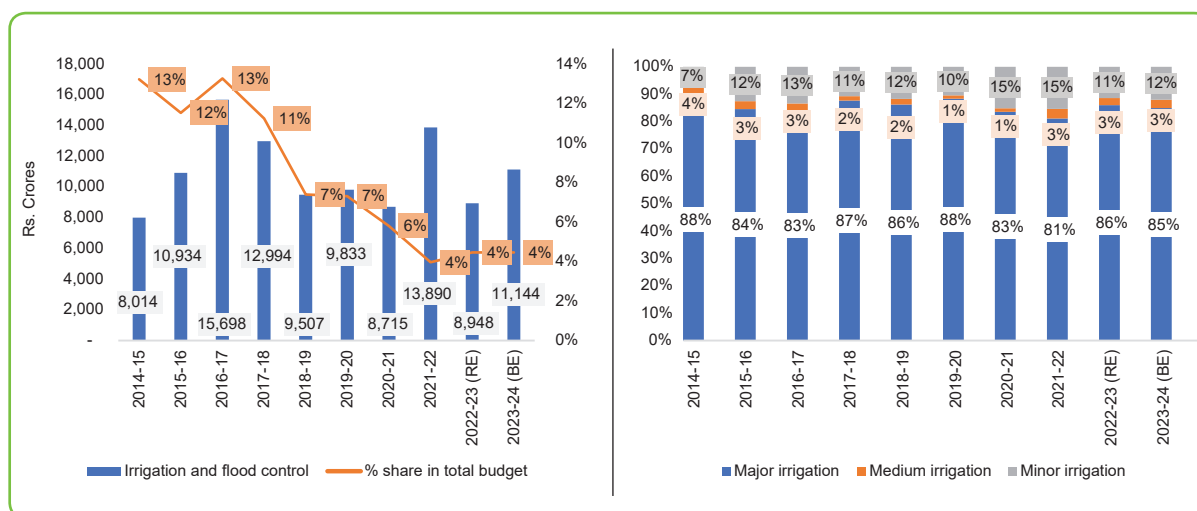
Figure 31 shows the budget for the Irrigation and Flood Department (IFD) and its share in the total budget of the state. During the initial years, about 10 to 11 per cent of the state's total budget was assigned to IFD. Between 2014-15 and 2023-24, on average, 85 per cent of the department's budget was assigned to the major irrigation projects, followed by minor and then medium irrigation projects.⁷

The state's flagship project, Mission Kakatiya (tank rejuvenation programme), started in 2015. It focused on the state's SMF (about 88 per cent of state's farmers are SMF). Under the mission, infrastructure for the development of minor irrigation was enhanced, tanks were restored, and community-based irrigation was strengthened.

Another key irrigation project was the Kaleswaram project. Initiated in 2019, the project aimed to supply water for drinking, irrigation, and industrial use. The overall estimated cost of the Project was Rs.80,190 crore (Government of Telangana).

⁷ As per ICAR, command area is the area which benefits from an irrigation project. Major irrigation projects are those which have a command area of more than 10,000 hectares, medium projects are those which have a command area between 2,000 hectares and 10,000 hectares, and minor irrigation projects are those designed to irrigate an area of 2,000 hectares or less (ICAR).

FIGURE 31: Level and composition of irrigation and flood control department budget



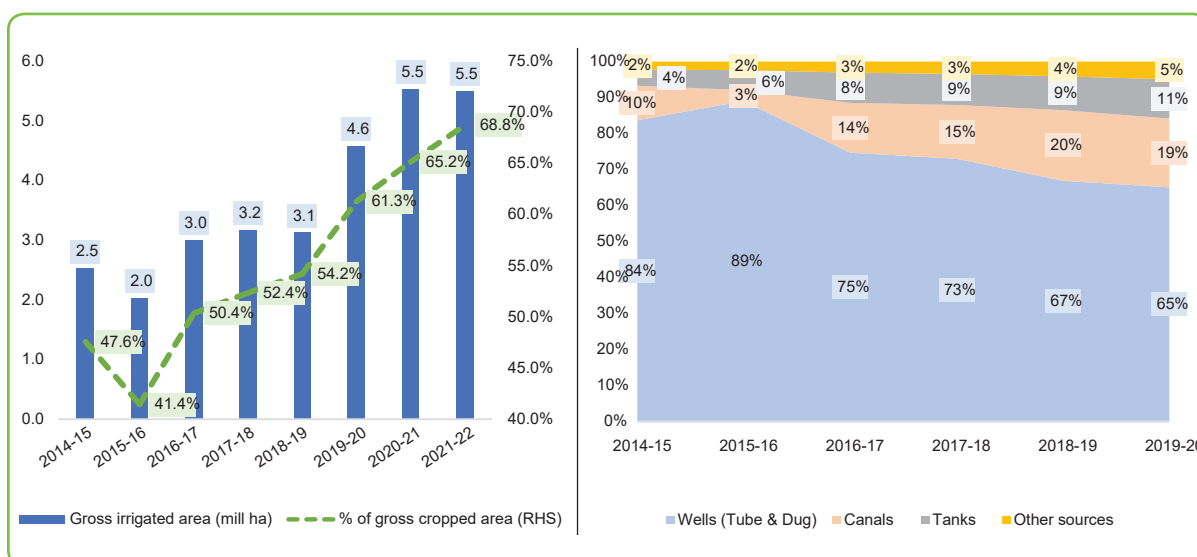
Source: *Telangana state budget documents. Accessed on January 5, 2023*

Note: BE is budget estimate and RE is revised estimate

The results of the state government’s efforts are visible in the state’s irrigation coverage ratio (Figure 32). In 2014-15, Telangana’s irrigation coverage was 48 per cent of the GCA; in seven years, it increased to 68.8 per cent in 2021-22.

Canals and tanks emerge to have become critical sources of irrigation in the state, particularly since 2016-17. Major revival work on tanks was undertaken under the state’s Mission Kakatiya (Figure 32).

FIGURE 32: Gross irrigated area (million hectares) and its composition in Telangana



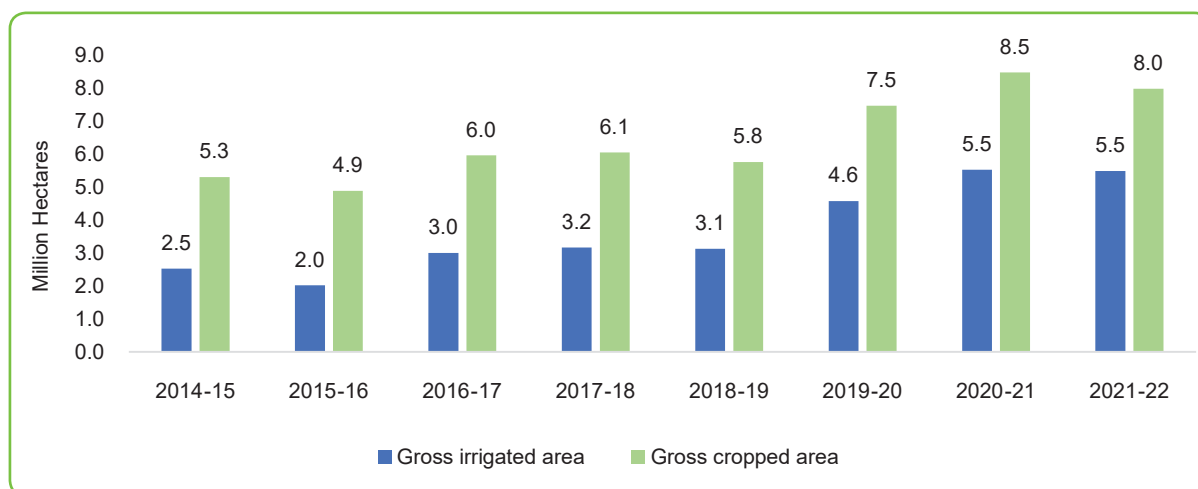
Source: *DES India and SEO 2023*

Note: In 2020-21 and 2021-22, gross irrigated area in the state was at 5.5 million hectares. Due to decrease in GCA between 2020-21 and 2021-22, as percentage of GCA, gross irrigated area reported increase from 65.2 per cent to 68.8 per cent.

With the focus on major irrigation projects and their completion, the share of canals also increased. By 2019-20, 65 per cent of the state’s irrigation needs were met through wells, 19 per cent through canals, and 11 per cent through tanks.

Irrigation is one of the most critical inputs to boost the growth of the agriculture and allied sector (Gulati *et al.* 2021). It not only improves farmers’ income but also reduces their exposure to production risks (Birthal *et al.* 2022).

FIGURE 33: Telangana’s irrigated and cropped areas (million hectares)

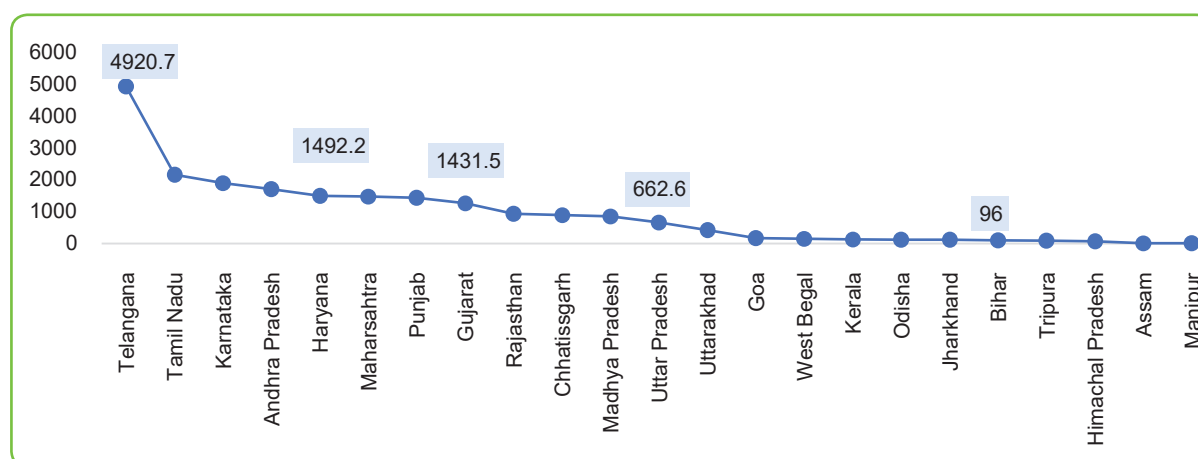


Source: DES India and SEO Telangana

Free Power to Agriculture Sector

Access to quality power is critical for a farmer (Gulati *et al.* 2021 and SEO 2022). In 2017-18, the Telangana government announced free power supply to its agricultural sector. As a result, by 2020-21, the state reported a per hectare (*of net sown area*) electricity consumption of 4920 kwh (Figure 34), which was the highest in the country, much higher than in Tamil Nadu, Karnataka, Punjab, and other major agricultural states.

FIGURE 34: Electricity consumption (kwh/ha of net sown area) 2020-21



Source: Satyasai *et al.* 2021

Although high electricity consumption improves farmers' access to irrigation, it entails costs such as increased capital expenditures for digging bore-wells, over exploitation and lowering of the groundwater table, and increased cost to the state exchequer (Fosli *et al.* 2021). Research suggests that water intensive cropping patterns combined with free electricity supply have led to indiscriminate water use, leading to depleting ground water levels in Punjab (Gupta 2011).

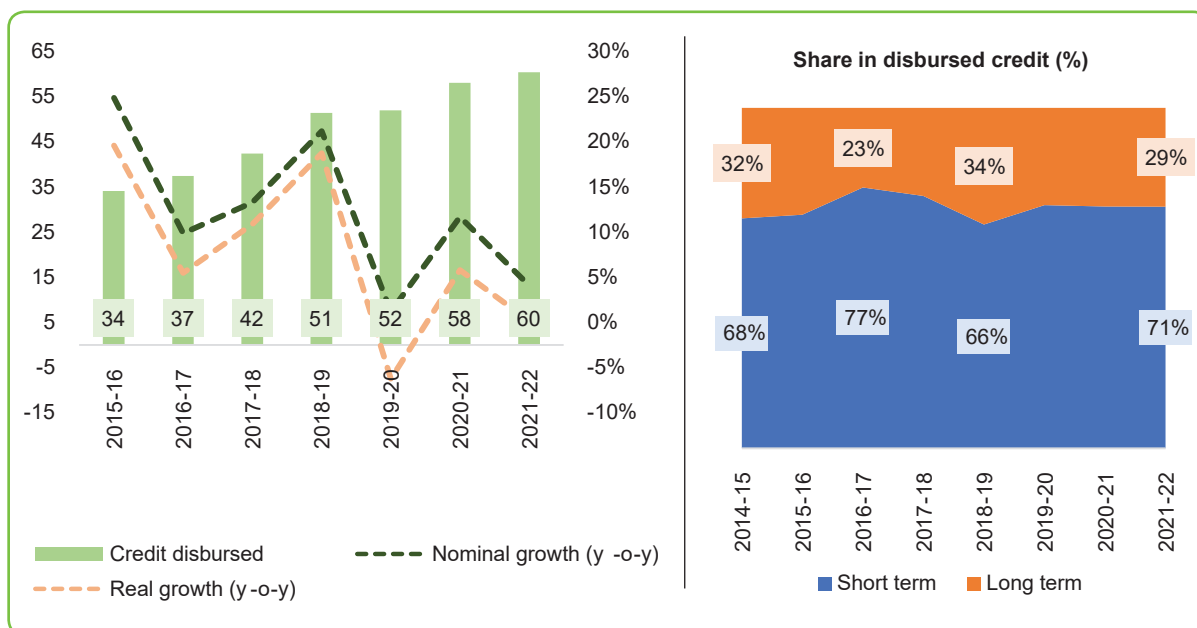
Access to credit

In 2021-22, a total of Rs.16.5 lakh crore of agricultural credit was disbursed in the country. Out of this, about 3.7 per cent was distributed in Telangana.

Overtime there has been a sharp increase in the amount of institutional credit disbursed in the state. Compared to India's average of 10 per cent (nominal terms) and 5 per cent (real terms, deflated using CPI-AL), credit disbursement in the state grew at 13 per cent and 7 per cent, respectively between 2014-15 and 2021-22.

Within the disbursed credit of Rs.60,389 crore (2021-22), close to 71 per cent was short-term crop loans and the remaining about 29 per cent went as longer-term fixed capital loans (State Level Bankers' Committee, Telangana (SLBC-T) (Figure 35). It is interesting to note that the share of credit disbursed as term loans has decreased overtime.

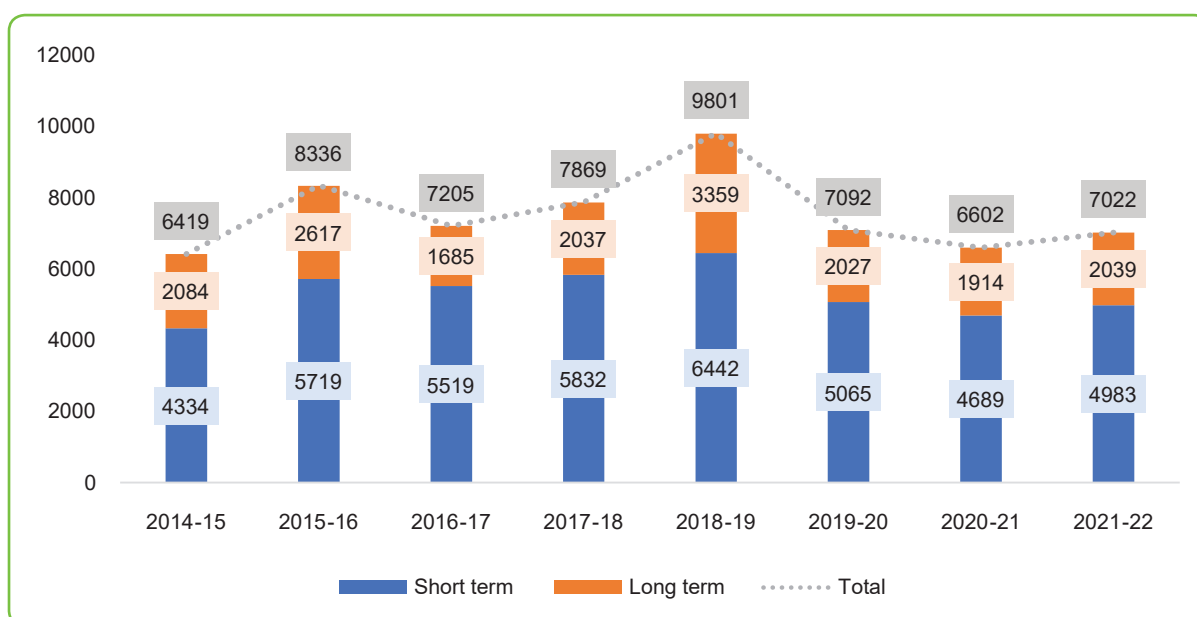
FIGURE 35: Credit to A&A sectors (Rs. Th crores) and its composition (per cent)



Source: SLBC Telangana meeting minutes, various issues

Note: Credit is inflation adjusted using CPI-AL with 1985-86 base.

FIGURE 36: Credit disbursed in Telangana per hectare of GCA (real terms) (Rs. /hectare)



Source: SLBC Telangana meeting minutes, various issues

Note: Credit is inflation adjusted using CPI-AL with 1985-86 base.

As the state's GCA grew fast in the last few years, despite a sharp increase in credit disbursal in the state, credit (in real terms) on a per hectare basis appears to have fallen in the recent years (Figure 36).

Every hectare of state's GCA today, on average, gets lower crop loans than they did back in 2015-16. In terms of the total disbursed credit, the 2021-22 levels were below the 2016-17 levels.

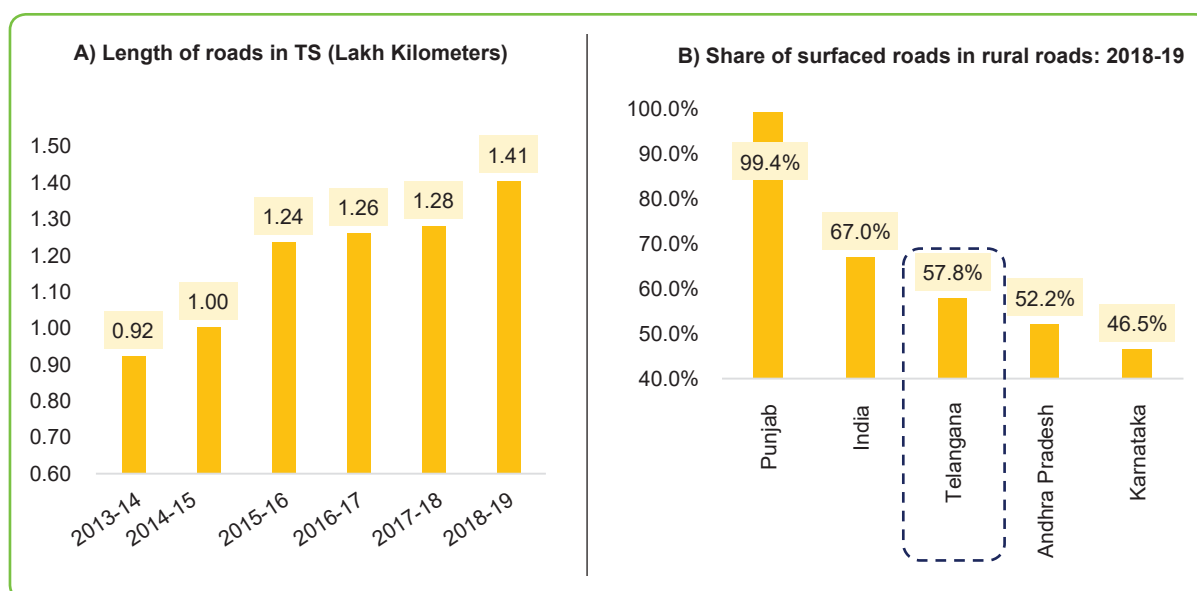
Studies find that access to affordable and timely credit is an important determinant of agricultural sector growth (Saini *et al.* 2022, Gulati *et al.* 2021 and Rizwan *et al.* 2019). We check for its role in Telangana's agricultural performance in our modelling exercise.

Investments in roads

Roads are critical for farmer empowerment (Dalwai 2018, Gulati *et al.* 2021). Improved road infrastructure is found to have positively contributed to agricultural growth in Madhya Pradesh, Uttar Pradesh, Bihar, and Odisha (Gulati *et al.* 2021). Over the years, the Telangana government has also invested in road infrastructure. Although the share of Road and Bridges' (R&B) department in the state's total budget is low, budgetary allocations have been increasing. Complemented by the Union Government's *Pradhan Mantri Gram Sadak Yojana* (PMGSY), the state has been expanding its road connectivity (Figure 37A). According to data from the RBI, Telangana had 1.41 lakh kilometres (km.) of roads in 2019. Between 2014 and 2019, road length in Telangana increased at a CAGR of 9 per cent compared to the all-India average of about 4 per cent.

However, as per Basic Roads Statistics of India Report for 2018-19, Telangana ranks low in terms of the share of surfaced roads in total rural roads compared to other states. Compared to about 99 per cent coverage in states like Punjab, Telangana, with about 58 per cent coverage, trailed even the all-India average of 67 per cent (Figure 37 B).

FIGURE 37: Length of roads and share of surface roads in rural roads in Telangana



Source: RBI and Basic Road Statistics Report.

Welfare delivery through *Rythu Bandhu* scheme

When the Telangana government announced the *Rythu Bandhu* Scheme (RBS) in 2018-19, the country as a whole had only undertaken pilot studies to examine the benefits of unconditional cash transfers on the beneficiaries (Davalá *et al.* 2019). Telangana not only spearheaded the scheme but guided the country and other states to replicate it with its various modifications. With it, the state also mainstreamed the focus on farmer welfare. As per the scheme document, the cash transfer was designed to provide beneficiary farmers with initial investment needs and help reduce their debt burden (Government of Telangana).

The scheme provides, in two instalments Rs.10,000 per acre annually to landowning farmers at the beginning of the *kharif* and *rabi* seasons. Locally, the *kharif* season is referred to as *Vanakalam* and *rabi* as *Yasangi*. These payments are unconnected to the actual ploughing decisions of the farmer. As per SEO 2023, the state's cropping intensity is about 43 per cent, which implies that about 57 per cent of the land only takes one crop in a year. Irrespective of the actual sowing, a farmer receives her instalments. In addition to this, the central government under its PM-KISAN scheme, also pays every landowning farmer an unconditional cash amount of Rs. 6,000 annually, paid in three instalments. Therefore, an average Telangana farmer with landholding size of 1 acre, annually received about Rs.16,000 per year (Rs.10,000 from the state government and Rs. 6,000 from the central government). The amount is directly transferred into the bank accounts of beneficiaries and farmers are free to decide about its usage. As per NSSO, a farmer's household income was about Rs.9,335 in Telangana in 2018-19, the year in which the scheme was launched.

As per data from Telangana's statistical abstract, over 6 million farmers in both *kharif* and *rabi* seasons received the cash transfer under RBS, costing the exchequer Rs.14.8 thousand crore (Table 3).

TABLE 3: Number of beneficiaries and transfers made under *Rythu Bandhu* scheme

Year	No. of beneficiaries (Lakhs)		Amount transferred (Rs. Cr)		
	<i>Kharif</i>	<i>Rabi</i>	<i>Kharif</i>	<i>Rabi</i>	Total
2018-19	50.25	49.13	5236	5251	10487
2019-20	51.61	42.42	6125	4406	10531
2020-21	58.02	59.33	7288	7367	14655
2021-22	61.08	63.00	7377	7412	14789
2022-23*	65.00	-	7434	-	7434

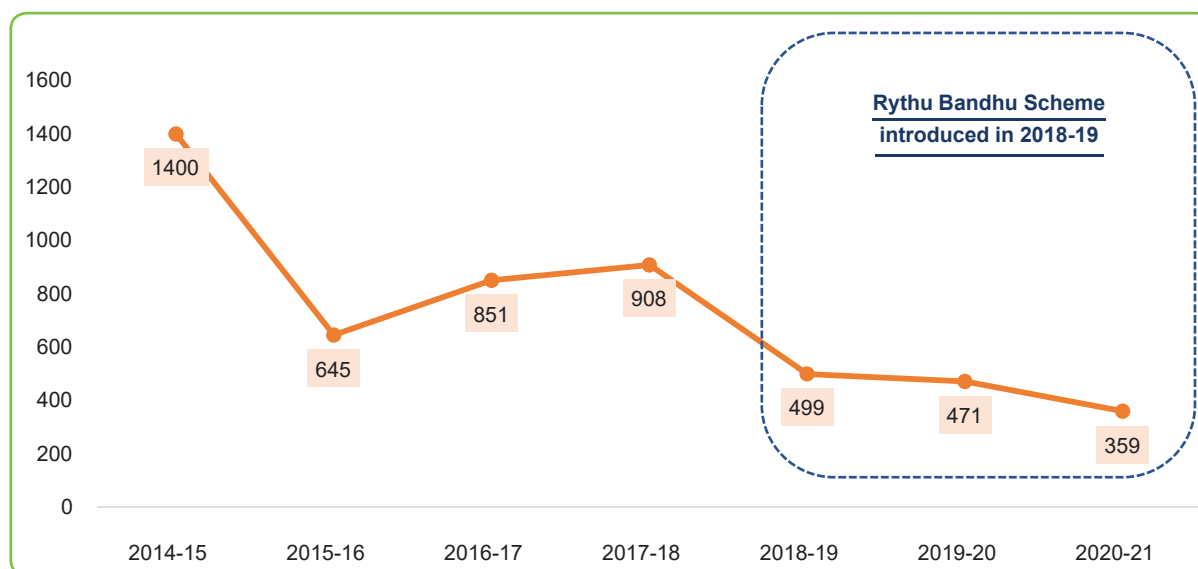
Source: Telangana Statistical Abstract 2022

Note: * until September 15, 2022

RBS improved the welfare of beneficiary farmers. Thomas, Uday and Zaveri (2020) find instances of an inverse relationship between farmer suicides in the state and RBS. A quick look at the data on farmer suicides in the state (sourced from National Crime Records Bureau) together with the period of RBS

reveals that suicides have reduced significantly since 2018-19 (Figure 38). The correlation between RBS and the number of farmer suicides in the state comes to about (-) 0.77. Even though we can infer their co-movement, more research is needed to establish a causal relationship between the two, which is beyond the purview of the current work. Nevertheless, RBS undoubtedly empowered farmers in Telangana. But whether it directly catapulted A&A GVA is tested in the modelling section.

FIGURE 38: Farmer suicides in Telangana and Rythu Bandhu scheme



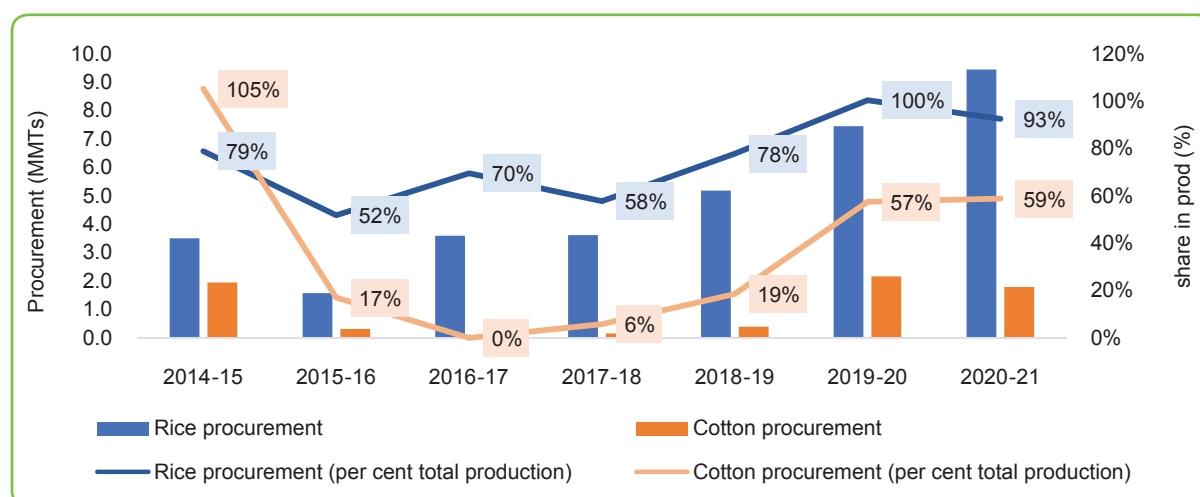
Source: NCRB various issues

Improved access to markets and remunerative prices

Lucrative markets and access to remunerative prices for agricultural produce are undisputed levers of agricultural growth (Dalwai 2019, Gulati *et al.* 2021, Landes & Burfisher 2009, FAO). The state undertook concerted efforts to improve them both (Nair 2022, Government of Telangana 2022). In the crop sector, efforts to increase procurement were aggressive. The state opened 11,000 procurement centres in the state (SEO 2022). In 2020-21, 60 per cent of cotton output and 93 per cent of rice output were procured in the state (Figure 39).

For the dairy sector, the state government provided incentives to promote milk production. The state government provides Rs.4 per litre to every milk producer who supplied milk to the co-operative dairies. In the 2023-24 budget, 6 per cent of the total animal husbandry department's budget has been allocated towards this incentive scheme. For supporting value addition in crops, the state implemented the Food Processing and Preservation Policy in 2020-21.

FIGURE 39: Procurement of rice and cotton in Telangana (MMTs and per cent production)



Source: Food Grain Bulletin, various issues (DFPD)

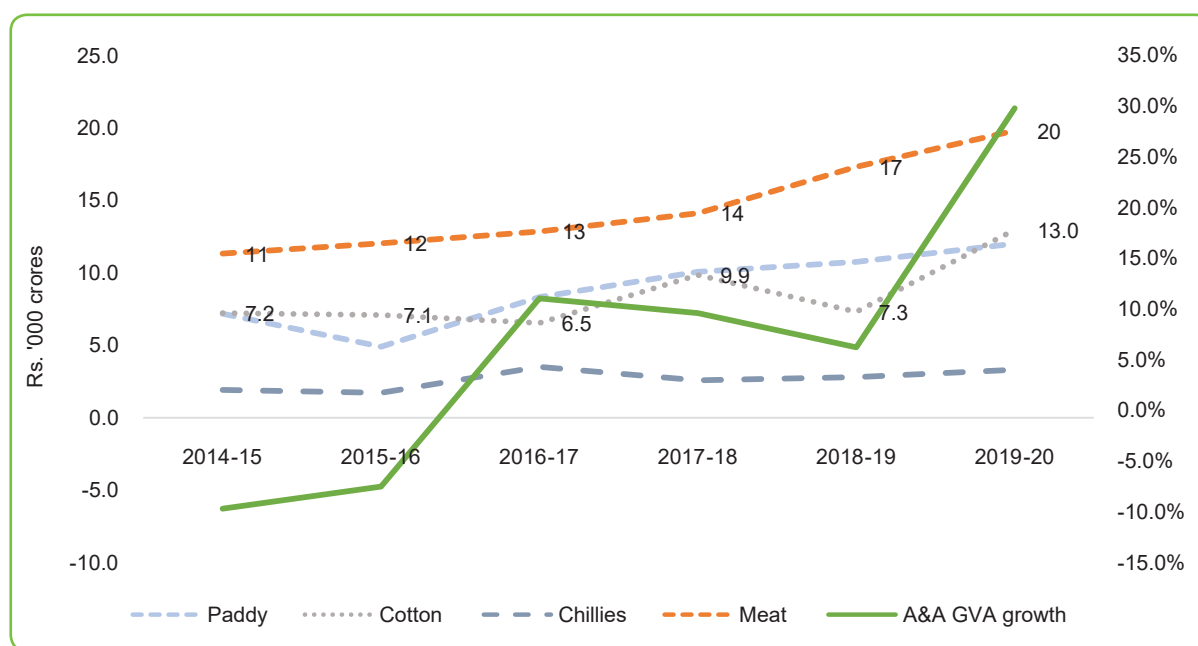
Farmers respond positively to price incentives (Gulati *et al.* 2013, Pineiro *et al.* 2020, Negi *et al.* 2020). Therefore, the role of better prices in explaining the growth in the state’s A&A GVA is undisputed. As a proxy for the farmer prices for various crops and allied activities in the state, we use the data on value of output (VOO). As mentioned before, VOO is estimated by multiplying the prices received on average by farmers with the quantity produced by them. This variable will help represent agricultural market dynamics in the state.

While the detailed macro trends in state’s A&A VOO have already been presented in Section II, we present below the trends in VOO of specific important commodities (Figure 40). Based on the sources of growth analysis, four commodities i.e., paddy, cotton, chillies, and meat appear to be crucial for state’s A&A VOO growth. Between 2014-15 and 2019-20, VOO for cotton reported the highest CAGR (12.5 per cent), followed by meat at 11.8 per cent, chillies at 11.5 per cent and paddy at 10.9 per cent. It is important to note that other identified determinants of A&A growth such as irrigation and *Rythu Bandhu* scheme might have also impacted VOO for these commodities. We check for this in our modelling exercise.

Other initiatives by the state

Other initiatives taken by the state may not be quantifiable for our model; nonetheless, these are critical for the support they provided to producers and, therefore, we list some of these innovations and interventions here.

FIGURE 40: Trends in VOO of major commodities (Constant prices)



Source: MOSPI

Life and Accidental Insurance: Insurance affects the welfare of farming households (Delay *et al.* 2022, Bhuiyan *et al.* 2022). Under the *Rythu Bandhu* scheme, the Government of Telangana (GoT) introduced a farmer insurance scheme in 2018, which is commonly known as ‘*Rythu Bima*’. Its main objective is to provide financial relief on a farmer’s death, irrespective of the reason. Farmers in the age group of 18 to 59 years are eligible for the scheme and if a farmer dies, the nominee receives Rs.5 lakh within ten days. In 2018-19, the actual expenditure on the scheme was Rs.899 crore. It increased to Rs.945 crore in 2019-20 and Rs.1718 crore in 2021-22 (Statistical Abstract 2022). In 2021-22, 35.64 lakh farmers were covered under the scheme.

Seed-Hub: Due to favourable weather conditions, Telangana has emerged as a seed-hub not just for the country but also for many global players (GOT 2018). The state has over 35000 seed growers growing seeds for more than 15 crops such as maize, paddy, gram, soybean, chillies, okra, tomato, etc. (TSSDCL).

Extension System: The agriculture extension system is a driver for increasing farmers’ incomes (DFI 2018). In India, there is a severe shortage of extension officers. Only 91,288 of the 143,863 available positions in the Department of Agriculture are filled (Gulati *et al.* 2018). Telangana is investing in its extension services and data from Department of Agriculture & Co-operation, Telangana, suggests that there are 2858 extension officers in the state, which implies that for the state’s net sown area of around 146 lakh acres, there is one extension officer every 5124 acres. In the dairy sector, *gopalmitras* support dairy farmers with artificial insemination. Currently, 1365 *gopalmitras* operate in the state (Telangana State Livestock Development Agency).

Farm Loan Waivers: To relieve farmers of their outstanding debts due to crop failures in drought or deficient rainfall years, Telangana has so far implemented two crop loan waivers – in 2014 and 2018. However, Saini *et al.* (2022) find that, among other things, farm loan waivers negatively impact the credit culture in the implementing state, affecting state finances adversely and discouraging banks from lending to farmers.

Hub for technological innovations: Telangana is leveraging its strength in the IT sector. The state is focusing on implementing projects using emerging technologies like artificial intelligence (AI), blockchain and internet of things (IoT). The state launched the Artificial Intelligence for Agricultural Innovation programme in 2020 to benefit both farmers and policy makers. As a part of this initiative, the state came up with the Agriculture Advancement Project in order to accelerate growth in the agricultural sector using emerging technologies in a sustainable and inclusive way. Using the Internet of Things (IOT) technology, the state came up with a smart irrigation and nutrient management project. Based on the weather, soil moisture and other parameters, the smart irrigation project recommends to the farmer the level of water a field requires. Additionally, a Seed Traceability project using blockchain technology is under implementation (Department of Agriculture & Cooperation, GOT). An agricultural innovation hub was also opened in 2021 to encourage innovative thinking among farmers. It makes technology available to farmers in local languages so that they can adopt advances in agricultural technology. The state also has an agency – Telangana State Development Planning Society – that disseminates real-time weather information. The state has also focused on the development of *Rythu Vedikas* through which training and awareness programmes are organised to encourage farmers to take up modern and innovative agricultural practices. As per the data from the Department of Agriculture & Co-operation, Telangana, there are 2601 *Rythu Vedikas* in the state. While the results of these interventions will show over time, the policy focus on innovations is bound to deliver efficiency gains in the system.

Modelling for identifying drivers of Telangana state's agricultural growth

The factors that have been detailed in the above section will be tested for their statistical significance in explaining trends the performance of Telangana's agricultural sector.

Source of data

A time series data set from 2014-15 to 2020-21 has been created for this purpose. The data has been taken from the following sources:

1. Ministry of Statistics & Programme Implementation (MOSPI)
2. Department of Economics and Statistics (Government of India),
3. Statistical Year Books and Socio-Economic Outlook reports (Government of Telangana)

4. Budget documents for the union and Telangana government
5. Reserve Bank of India (RBI)
6. State Level Bankers' Committee (SLBC), Telangana

The model

For our analysis, we used the following simultaneous equation model:

$$Y_1 = \beta_0 + \beta_1 Y_2 + \beta_2 X_1 + \varepsilon_i \quad (1)$$

$$Y_2 = \gamma_0 + \gamma_1 X_2 + \gamma_2 X_3 + \varepsilon_j \quad (2)$$

A simultaneous equation model was used because of the endogeneity of the two dependent variables. Since applying OLS to estimate the parameters of a simultaneous equation model results in a correlation between the independent variable and the disturbance term, leading to biased estimates, a 3-SLS simultaneous regression model has been used for the analysis.

The 3-SLS method of estimation is also known as seemingly unrelated regression (SUR), with two-stage least squares estimation. It is a form of instrumental variable estimation that permits correlations of the unobserved disturbances across several equations, as well as restrictions among coefficients of different equations, and improves the efficiency of equation-by-equation estimation by considering such correlations across equations (Zellner & Theil, 1962). 3SLS estimates all coefficients simultaneously and it is assumed that each equation of the system is at least just identified. Equations that are under-identified (identification problem) are disregarded in the 3SLS estimation. The assumptions are the same as in the classical linear regression model, i.e., within each structural equation, the disturbances are both homoscedastic and serially uncorrelated (Zellner & Theil, 1962).

Variable treatment for stationarity

The variables used for the modelling analysis were checked for stationarity using the Augmented Dicky-Fuller test. Non-stationary variables were made stationary using the first differences. For model best fit conditions, multiple iterations with different transformations of variables were performed.

Model result

The following two simultaneous equation regression models were identified:

MODEL I

$$\ln_aa_gva = -1.21 + 0.89^{***} (\ln_gca) + 0.72^{**} (\ln_meat_voo) + 0.18^* (\ln_per_hc_crop_loans) + \varepsilon_i \quad (1)$$

$$(\ln_gca) = -0.002 + 0.51^{***} (\ln_gia) + 0.02^{***} (L.rbs) + \varepsilon_j \quad (2)$$

$$\ln_aa_gva = -0.23 + 0.7^{***} (\ln_gca) + 0.69^{**} (\ln_meat_voo) + \varepsilon_i \quad (1)$$

$$(\ln_gca) = 0.002 + 0.51^{***} (\ln_gia) + 0.08^{***} (\ln_cotton_voo) + \varepsilon_j \quad (2)$$

MODEL II

Note: *** Significant at 1%; ** Significant at 5%. Both the constant terms were not significant.

where

ln = natural log

ln_aa_gva = natural log of A&A GVA at constant prices

ln_gca = natural log of gross cropped area

ln_meat_voo = natural log of VOO from meat sector at constant prices

ln_per_hc_crop loans = natural log of per hectare crop loans

ln_gia = natural log of gross irrigated area

L.rbs = one time period lag for binary (0 and 1) variable for *Rythu Bandhu* scheme

ln_cotton_voo = natural log of VOO from cotton at constant prices

The results suggest that 83.6 and 75.3 per cent of the variations in Telangana's A&A GVA are explained by Model I and Model II respectively.

They also show that the expansion in the state's cropped area, improved allocation of agricultural credit, and the sharp growth in the livestock sector were the three most important determinants of Telangana's agricultural growth. Using the simultaneous equation model, we can also explain the factors that led to expansion of area in the state. It appears that access to irrigation and the (lagged) impact of the *Rythu Bandhu* scheme (model I) explained most of that increase. Increments in cotton VOO were also found to be significant under Model II.

Corroborating this with findings from our earlier sections, it appears that the increased area under paddy and cotton and the contribution of the meat industry appears to have boosted the state's agricultural performance. Expanded irrigation coverage, access to credit, support from unconditional cash transfers and higher value realisations for crops like cotton encouraged farmers to expand cropped areas.

Model validation and credibility

Since the data was only available from 2014-15, there were data limitations impacting the degrees of freedom, i.e., the number of parameters that can be studied for explaining variations in dependent variables. The selected model followed the Gauss-Markov assumptions of errors being homoscedastic and uncorrelated. The regression model results have been checked for normality of errors.

Before we proceed to policy recommendations, in the next section we present some analytical and qualitative insights into the state's agricultural sector.



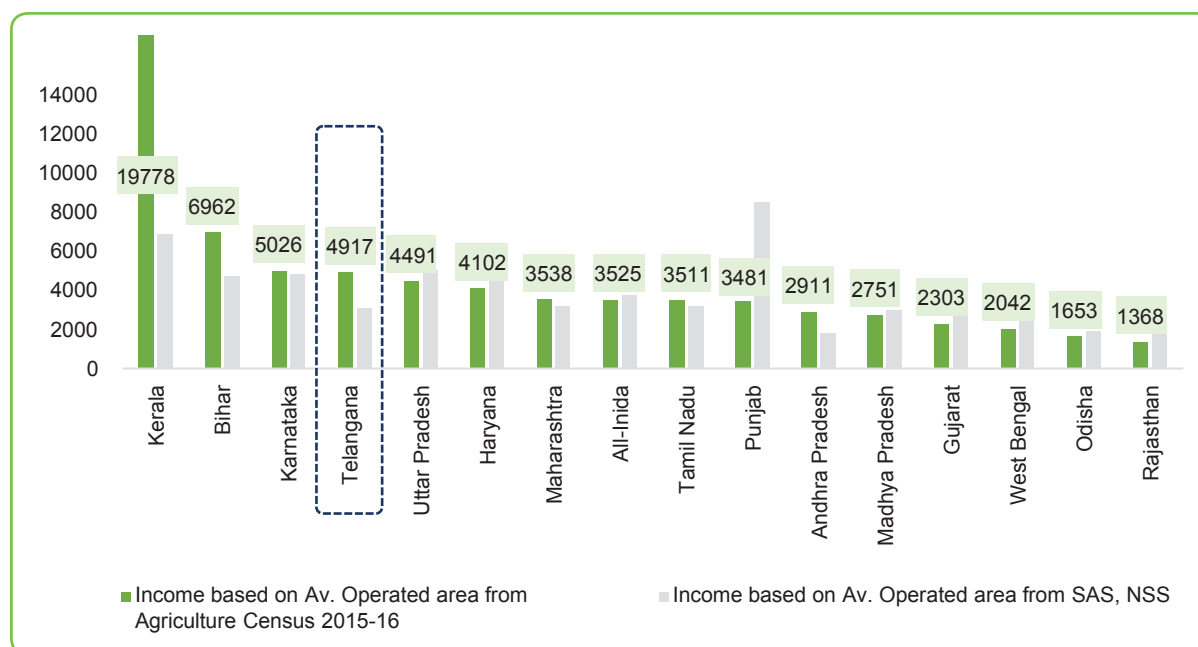
Section IV: Some micro insights on Telangana's agriculture

There is no dispute that the Telangana’s agricultural sector has progressed exceptionally well, and the factors identified above propelled the sector’s performance. However, there are some gaps and challenges too. We present some in this section.

Per hectare value generation

Upon dividing crop incomes earned by different Indian states with the average size of each of their landholdings, one can estimate the level of crop incomes per hectare generated by each state. The most recent data on the average size of operational holding is available from Agricultural Census 2015-16 and NSS’s 2018-19 farmer income survey. But there are huge variations in the two datasets. For example, in case of Punjab, while the Agriculture Census claims the average landholding size to be about 3.62 hectares, the size is about 1.7 hectares according to the NSSO. We present results based on both the landholding sizes in Figure 41. However, as the Agriculture Census is a census survey and is the official document on landholdings in the country, we mainly refer to findings based on them.

FIGURE 41: Per hectare farmer income in Indian states (2018-19)



Source: NSS 2018-19, Agriculture Census 2015-16

In 2018-19, Telangana agricultural households earned about Rs.4,917 from crops every month. As per Agriculture Census 2015-16, the state’s average landholding size is about 1.004 hectares, which implies that on average, Telangana farmers generated crop income of about Rs.4,937 per hectare. Let us compare this with Punjab’s crop income of Rs.12,597 per month. As per Agricultural Census,

average landholding size in Punjab is about 3.62 hectares. This implies that on average, a Punjab farmer generated a crop income per hectare of about Rs.3,481.

Overall, it appears that in 2018-19, Telangana farmers made higher incomes per hectare as compared to farmers in Punjab, Maharashtra, Haryana, Andhra Pradesh, Gujarat and Uttar Pradesh. But the state can surely learn lessons for example from Karnataka.

Low incomes from livestock activities compared to neighbouring states

Compared to a few neighbouring and important agrarian states, although Telangana's overall agricultural household incomes were lower, the incomes they generated from just crops were on average higher than those in Andhra Pradesh and Tamil Nadu, for example (Table 4).

TABLE 4: Farmer incomes: Levels and composition for selected states (2018-19) Rs./Month

State	Farming	Livestock	Wages & Salaries	Non-farm business	Leasing out of land	Total farmer income
Andhra Pradesh	2734	2046	4849	662	189	10480
Tamil Nadu	2641	2000	6497	715	72	11924
Telangana	4937	689	2961	748	67	9403
Karnataka	6835	1663	4576	264	104	13441
Punjab	12597	4457	5981	1014	2652	26701

Source: NAFIS 2015-16, NSS 2018-19

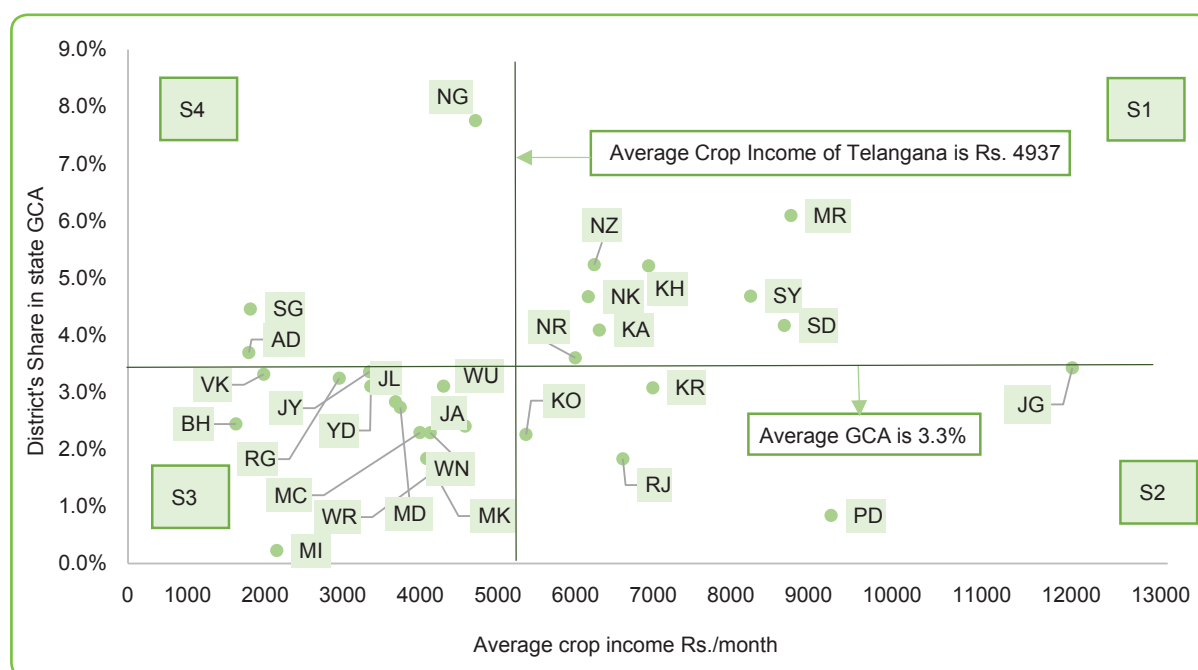
However, it appears that farmers in Telangana earned the least income both from livestock and from wages and salaries among this group of states. This is despite the state being among the leaders in the country in at least the poultry sector.

High GCA in districts but low crop incomes

Ideally, access to more arable land is associated with a greater potential to generate crop incomes (Satyasai and Mehrotra 2016). This may not hold true in many cases say like in Kerala where from smaller pieces of land, the farmers are able to generate higher incomes due to the high-value crops sown by them. However, usually, higher area under cultivation is studied to pull up farmer incomes. We study this for the 30 districts⁸ of Telangana, where we map a district's share in the state's GCA with its average level of crop incomes.

⁸ Telangana has 32 districts, but data was only available for 30. Data for Hyderabad district was not available. Mulugu and Narayanpet were formed in 2018 and their area has been added to Jayashankar and Mahbubnagar districts, respectively.

FIGURE 42: District wise monthly crop income (Rs/month) and GCA (%)



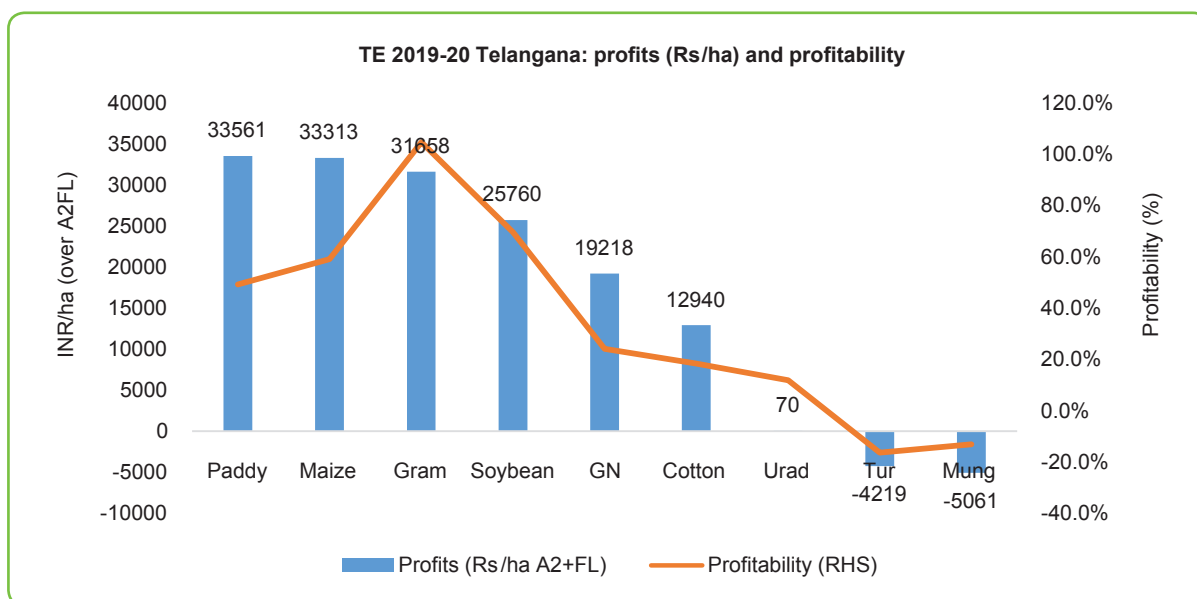
1. Segment 1: Comprises eight districts namely *Kamareddy, Khammam, Mahbubnagar, Nagarkurnool, Nizamabad, Nirmal, Siddipet* and *Suryapet*. These are relatively well performing districts that account for a high share of the state's GCA and earn high incomes from their crops.
2. Segment 2: This is a rather interesting segment where despite a smaller share in the state's GCA, the districts report high crop incomes. Five districts – *Karimnagar, Rajanna, Jagital, Komaram Bheem* and *Peddapalli* – are part of this segment.
3. Segment 3: This segment has districts that account for a low share of the state's GCA and earn lower crop incomes relative to the state average. This segment has 14 districts: *Bhadradri, Jangaon, Jogulamba, Jayshankar, Mahabubabad, Mancherial, Medak, Medchal-Malkajgiri, Rangareddy, Vikrabad, Wanaparthy, Warangal Rural, Warangal Urban* and *Yadadri*.
4. Segment 4: These are the three districts which despite accounting for a greater share of state's GCA do not earn enough crop incomes. These districts are *Adilabad, Nalgonda, and Sangareddy*.

As per Indian Council of Agriculture Research's (ICAR) Climate Vulnerability Atlas 2019, two districts of Telangana, namely Adilabad and Mahbubnagar, are prone to high climate risk in coming years. The threat is likely from a higher frequency of floods and cyclones and from the possibility of higher temperatures. With increasing instances and probability of yield losses due to changing climatic conditions (Kumar *et al.* 2022, PIB 2021, Hussain & Khatri 2022), it is necessary to focus on climate resilient agricultural practices to ensure sustainability of farmer incomes.

Low acreage under profitable crops

The Government of India's Directorate of Economics and Statistics (DES) collects data on the cost of cultivation of major crops for major Indian states. This data is available for Telangana for nine crops: paddy, maize, soybean, groundnut, gram, *tur* or pigeon pea, *urad* and *mung* (green gram). DES also collects information on the average value realised on a per hectare basis by the crop in the state. The latest data in this regard is available until 2019-20. By combining the data on costs (actual paid out cost plus the imputed value of family labour) and value, we compute the level of profits earned on a per hectare basis for each crop in the state (Figure 43).

FIGURE 43: Profits earned from major crops in Telangana (Rs./hectare) TE 2019-20



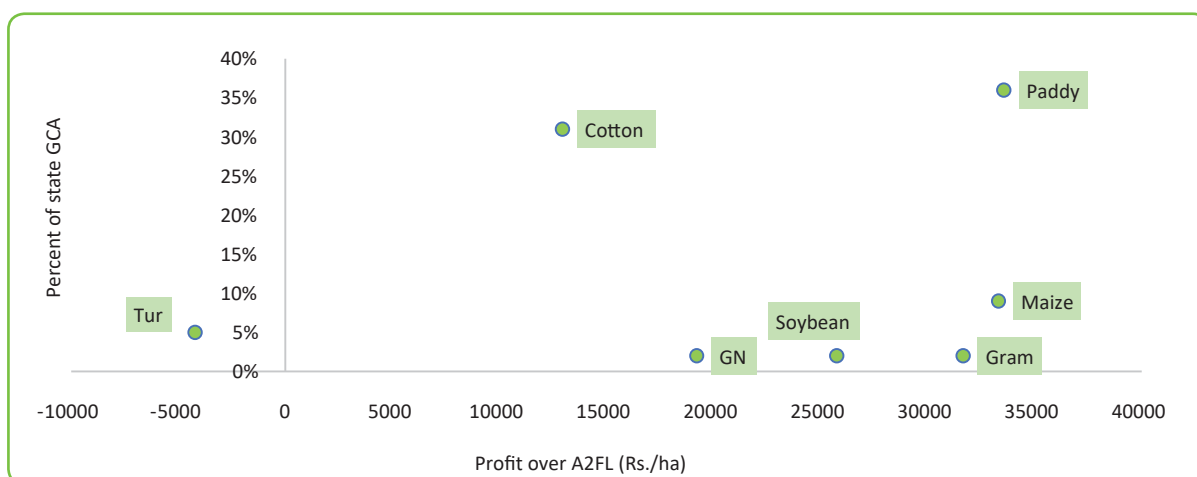
Source: DES, GOI.

Note: Cost is A2 plus cost of family labour and value is the sum of the value generated from the main crop and its by-products.

It appears that for Telangana, paddy and maize are the most profitable on a per hectare basis. Farmers generated about Rs.33,000 as profits on every hectare under paddy and maize. Apart from gram, pulses do not appear to be profitable for Telangana farmers; not surprisingly, acreage under pulses is being diverted to more profitable crops like paddy.

One would normally expect acreage in state to be under the most profitable crop. Figure 44 plots profits from different crops and the share of that crop in the state's GCA.

FIGURE 44: Profits and GCA for major crops (TE 2019-20)



Source: DES, India

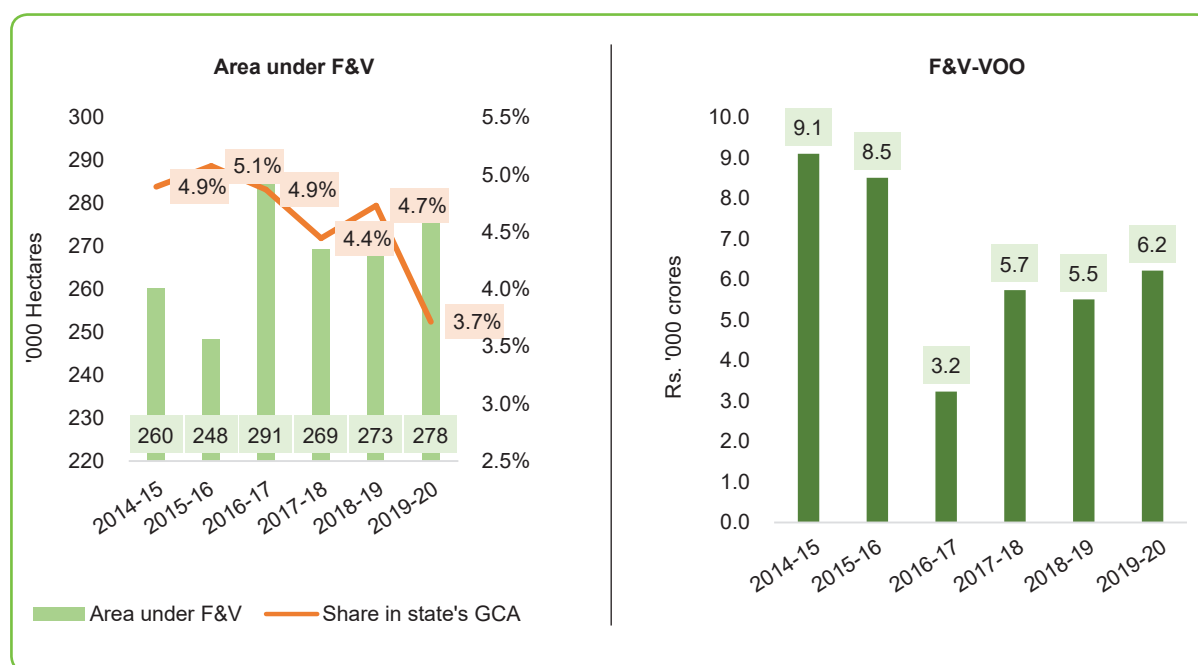
Note: GN is groundnut. A2+Fl means paid-out cost plus imputed cost of family labour

Paddy is highly profitable and is cultivated on a fairly large proportion of the state's GCA. However, despite having high profits, acreage under maize is low but that under cotton, which is far less profitable, is higher. Crops like gram, soybean and groundnut reported high profits but the acreage under these crops are relatively lower. Telangana's *Tandur* red gram was recently awarded the GI-Tag in 2022. This is likely to boost profitability of the *tur* pulse, which otherwise was plummeting to abysmally low levels, as per Figure 44.

F&V losing steam in the state

In the section on sources of growth, we estimated that the fruits and vegetables (F&V) sector's contribution to state's agricultural VOO performance was 12.8 per cent. From data, we see that even though the acreage under F&V has been rising since the state was created, the value generated from the segment has fallen (Figure 45).

FIGURE 45: Area and VOO of F&V segment in Telangana



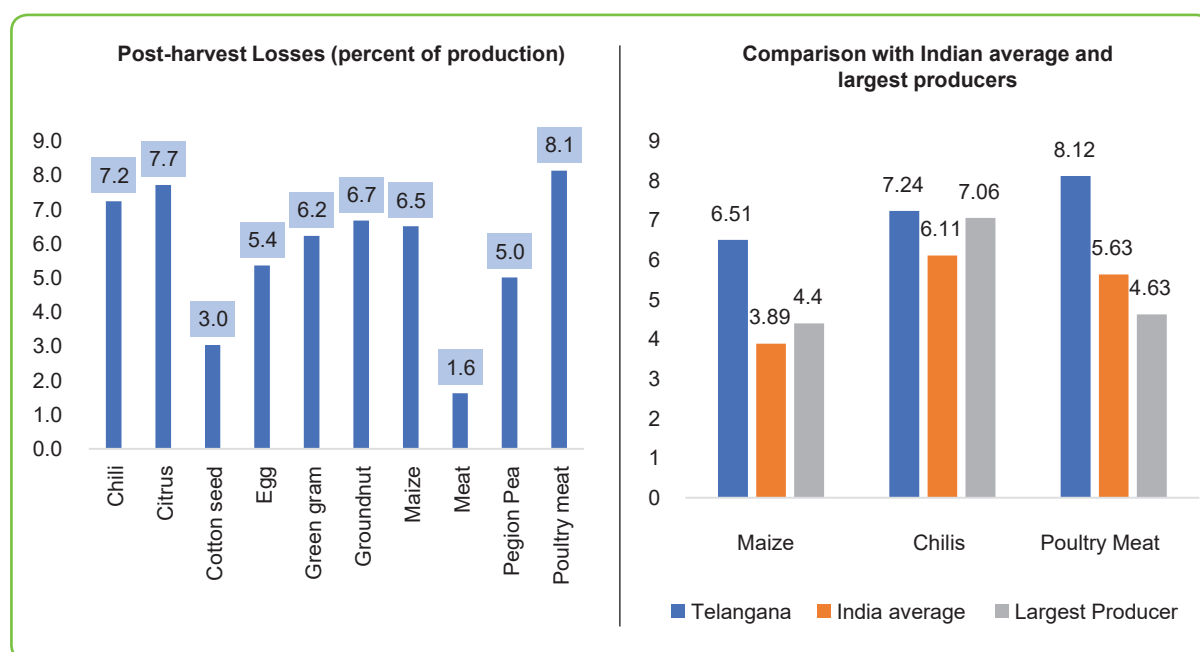
Source: DES India and SEO, 2022

It is ironical that despite expanding acreage, the F&V sector is unable to generate enough value. As a percentage of crop VOO, the share of F&V fell from 26 per cent in 2014-15 to 13 per cent in 2019-20. Over the years, the decrease in VOO shares has been reported by crops including okra, orange (citrus) and onion. The area under cultivation for these crops, especially citrus fruits has fallen over the years. Could this lower value be related to inefficiencies of the F&V value chains in the state? We check in the next sub-section

High post-harvest losses in important commodities

In December 2022, the GOI’s Ministry of Food Processing Industries released a report titled “Study to Determine Post Harvest Losses (PHL) of Agri Produces in India-2022”. Using a primary survey of crops in Indian states, the report assesses the level of losses the crop suffers along its value-chain after harvest and before it reaches the end consumer. This measures losses in terms of both quality and quantity. In the case of Telangana, this study was undertaken for 10 crops (Figure 46). Compared to other Indian states, Telangana reported the highest level of losses in green gram, cottonseed, and poultry meat. The losses reported in the state were the lowest in the case of meat (poultry, sheep, and others) and eggs.

FIGURE 46: Estimates of post-harvest losses in Telangana



Source: NABCONS 2022

Note: reference period of the study is August 2020 to May 2022. Karnataka is the largest producer of maize, Andhra Pradesh is the largest producer of chillies and Haryana is the largest producer of poultry meat.

This PHL study throws up the following observations:

1. Chilli – Overall level of losses are at 7.2 per cent of total production. Seventy-five per cent of these losses are reported at the farm level during harvesting (1.29 per cent production loss at harvesting stage).
2. Citrus – Overall losses were reported to be 7.73 per cent of total production. In case of citrus, higher losses were reported at the farm level (70 per cent of total losses).

3. Cotton seed – overall only 3 per cent of the production is wasted, but 86 per cent of the losses are at the farm level. Haryana has reported the lowest post-harvest losses (2.55 per cent). Cautious removal of cotton bolls and prompt collection on the field to prevent spilled losses were the main reasons for the low level of loss in Haryana (NABCONS 2022). In Telangana, high losses were reported at the harvesting stage (2.03 per cent).
4. Meat and poultry - As a result of the availability of post-harvest infrastructure, including cold storage facilities and contemporary retail outlets with covered display units, Telangana reported the lowest level of losses in the meat sector (NABCONS 2022). But in case of poultry meat, the state had the highest level of losses (8.1 per cent) among states. In case of poultry meat, most losses were reported at wholesale level (3.05 per cent).
5. Maize – Overall losses in the case of maize was 6.5 per cent. Losses at the wholesaler and retailer levels were the highest (1.91 per cent and 1.62 per cent of total production respectively)

It is important to note that it is not possible to completely eradicate such losses as these occur even along sophisticated value-chains in more developed nations. However, steps are needed to minimise wastage in the supply chain to maximise returns for farmers and other stakeholders.

Absence of crop insurance

Farmers in Telangana suffer from multiple production risks. These include the following:

1. **Prone to floods and cyclones:** Since 2019, Telangana has reported floods every year (Floodlist). The state is ranked third among states that are prone to floods (BMTPC 2019). According to the Centre on Energy, Environment, and Water (CEEW) 2021 report, a district-wise climate vulnerability index finds *Mahabubnagar* to be prone to floods, and Hyderabad as being prone to floods, cyclones and droughts. Adilabad, Khammam, Karimnagar and Nizamabad districts were identified by the Vulnerability Atlas of India (2019) as flood prone. The districts account for about 1.5 million hectares of the state's GCA (TE 2019-20).
2. **Pest Attacks:** Cotton and chilli are among the crops vulnerable to pest attacks. Cotton, one of the most critical crops in the state, are vulnerable to pink bollworm infestation. According to research, pink bollworm infestation can inflict locule damage to the extent of 55 per cent, reduce seed cotton yield by 35-90 per cent and affect lint quality (SABC). Similarly, pest attacks on chillies that affect yields has been a cause of worry in a few districts in Telangana.
3. Encroachment by **wild animals:** In Telangana, districts like *Jangaon* face threat from wild animals destroying crops (NIE 2022).

Despite being prone to flooding and pest attacks, Telangana state has not had a crop insurance scheme, at least since 2020. Without a comprehensive crop insurance scheme, with flooding and cyclonic weather conditions practically every year, farmers are over-exposed to production risks. Crop insurance for farmers help reduce these risks as well as their debt burden (Delay *et al.* 2022).

Parallels with Chinese agrarian reforms

Telangana's agrarian performance, backed by specific policy initiatives targeted at the most vulnerable sections of the population (IHDS 2020) appears to have a lot in common with the Chinese agrarian reforms of the 1970s and 1980s. During the reform period, the Chinese government provided free electricity to rural households, and invested heavily in irrigation infrastructure, agricultural research and infrastructure. Availability of inputs such as seeds and fertilisers increased substantially in China during the reforms. Relaxation in marketing policies helped in the diversification of and subsequent increase in China's agricultural output, which increased at an average annual rate of 7.1 per cent between 1979 and 1984 (Huang and Rozelle 2010, Lin 1992, Gulati Fan & Dalafi 2005). This growth had a multiplier effect in the economy, increasing the demand for manufactured items and services and pulling up the economy's overall growth rate (Gulati *et al.* 2021). Telangana appears to be on a similar growth trajectory. However, some lessons from China are warranted. One typical change in the country was its diversification towards commercialised crops and high value agriculture. Telangana's over concentration on paddy and cotton, and reduced value from F&V point to the need for diversification.



Key Findings and Conclusions

Telangana is the youngest state in the country and its agricultural (including livestock, fisheries, and forestry) sector has been growing at an unprecedented rate. It is among the fastest growing in the country.

From our analysis, it appears that Telangana followed a three-fold approach to establish its fast-paced growth trajectory for agricultural sector. The state focused on inputs, markets, and farmers' welfare.

Telangana improved access to quality inputs for its farmers. The state ensured that water reached the farms; it gave farmers unrestricted access to power so water could be lifted to irrigate fields, provided access to affordable institutional credit, and provided high yielding seeds to its farmers. The state invested in improved techniques of production and took these learnings from *lab to land* via its strengthened extension system.

The state government also worked on improving market access for its farmers. With an increase in the area under cotton and paddy, procurement operations were scaled up. Higher levels of procurement, *inter alia*, assured remunerative returns to their farmers.

The state also emerged as a pioneer in mainstreaming focus on farmers' welfare. Via its unconditional cash transfer scheme, the state transferred Rs.10,000 per acre in two equal instalments directly into the bank accounts of the farmers. For an average Telangana farmer, this was more than their one month's household income. The farmers were free to decide the use of this money. This cash transfer empowered farmers socially and economically.

Telangana's holistic approach to agrarian reform has many global parallels. For example, in the 1970s, China too triggered its economic growth with aggressive reforms and empowerment of its agricultural sector. There are many similarities in the agricultural reforms introduced in China and Telangana.

Not surprisingly, the state, known primarily for the IT-hub in Hyderabad, is also the centre for innovations in agriculture. There are exceptional success stories, be it in increases in maize yields, or becoming a global seed hub, supplying certified high-quality seeds not just to other states within the country but also to 18 countries globally.

In these successes, there were some misses too. With increased irrigation, the acreage under paddy and cotton increased while the area under crops like soybean, pulses, and groundnut fell. Cotton is particularly prone to pests. In the absence of a crop insurance mechanism, this leaves farmers highly vulnerable to yield risks. Besides, increased access to water aided by 24 x 7 power supply is likely to raise issues related to ground water management in the coming years. With near 100 per cent irrigation coverage in Punjab, the rapid depletion of its aquifers has been one

of the most noticeable effects of its free electricity policy. Telangana needs to learn lessons from other states.

Besides, climate change threats are palpable and that too in two of the most important agricultural districts of the state, namely Adilabad and Mahbubnagar. Threats from floods and cyclones will now be coupled with the challenge of higher temperatures. Thus, ensuring climate resilience is critical.

The state also lags in its road infrastructure. Less than 60 per cent of the state's rural roads are surfaced, which is likely to be one of the biggest hindrances for farmers in accessing remunerative markets.

Farmers' income from the livestock sector is abysmally low compared to other states, particularly the southern states. Despite being a hub for eggs and poultry meat, the state's livestock activities have not been able to generate enough income for its farmers. This is notwithstanding the fact that, unlike other Indian states, livestock and crops in Telangana contribute equally to its agricultural gross value added with livestock being the biggest contributor to the state's GVA growth rate in recent years.



Policy Recommendations

Notwithstanding the gaps and challenges, Telangana's agricultural sector is poised to witness significant growth in the coming years. As stated in the above sections, the high agricultural growth rate in Telangana agricultural has not translated into high income levels for farmers. Building on the analysis presented in this paper, we suggest measures that are likely to sustain the high levels of growth in the state's agricultural sectors while ensuring higher incomes for farmers.

They are centred on the following five themes:

1. **Institutions**
2. **Sustainability**
3. **Diversification**
4. **Processing**
5. **Policy Innovation**

1. Institutions

The state should consider setting up three institutions centred on farmer producer organisations (FPOs), F&V and exports.

Develop an FPO Council

FPOs are particularly critical when the average landholding of farmers is small. FPOs are critical not just for the benefits from aggregation of produce and negotiation in access to quality inputs, but also for the improvement of social and economic capital of its members.

The sustainability of any FPO is determined by two factors, namely, financial viability and institutional sustainability. The FPO Council should pursue economic objectives through value chain financing and social objectives like outcome-oriented capacity building for FPOs. A FPO Council can help farmer producer organisations to clearly understand the purposes they are supposed to fulfil and the means for their attainment. It can help FPOs to structure themselves better to ensure a better fit between organisations and their environments, and hence to improve organisational performance. It can guide FPOs to manage their human resources in the interests of performance as well as the well-being of farmers.

While Telangana today ranks fourth in terms of the number of registered FPOs in the country (PIB 2022), it is necessary to take measures to ensure the financial viability and sustainability of these FPOs. Effective institutional support in this regard can go a long way.

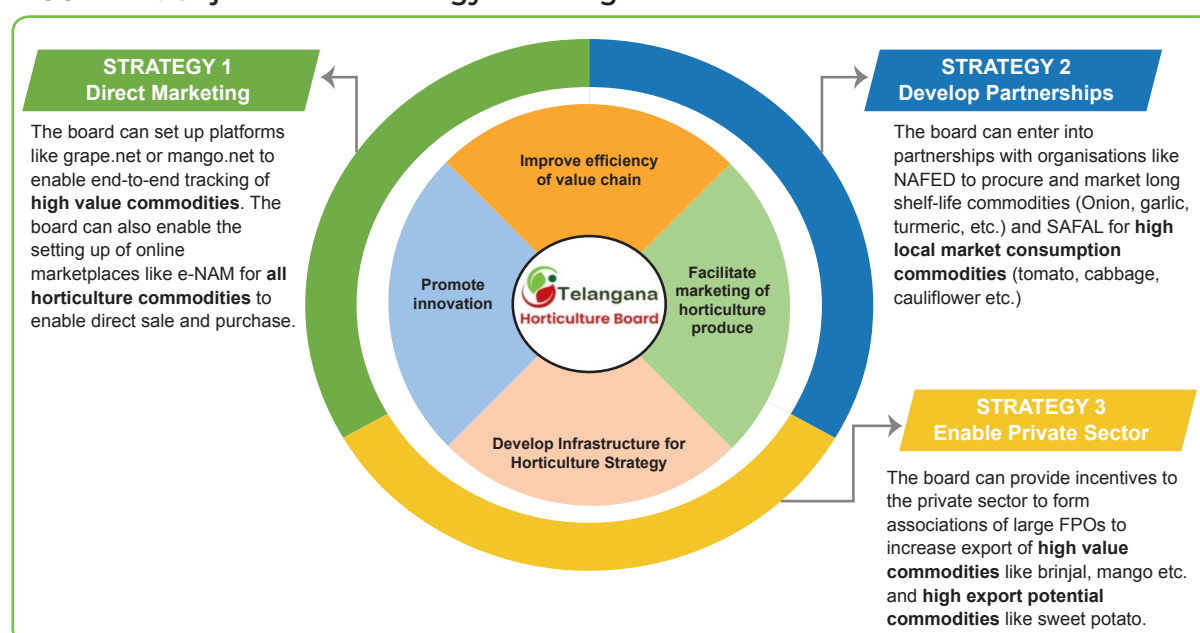
Setting up of Telangana Horticulture Board

Fruits and vegetables (F&Vs) are subject to fierce price volatility inter- and intra-year. Therefore, despite high probability of profits, farmers in the state are averse to growing them at scale. As these generate higher value and can benefit from processing, there should be greater focus on F&Vs in the state. Therefore, a Horticulture Board can play a pivotal role in the state. Its key objectives may include the following:

1. Develop infrastructure for horticulture: Developing an integrated, energy efficient cold chain infrastructure for fresh horticulture produce, for example, will lead to longer shelf life of the products.
2. Improve efficiency of value chains: Improvement in the efficiency of value chains through appropriate value additions and/or shortening of the chain can lead to an increase in farmers' income.
3. Facilitate marketing of horticulture produce: Promotion and market development of fresh horticultural produce will lead to increase in consumption, enabling higher production and better value for farmers.
4. Promote horticulture innovation: Identification and production of new varieties and technology-based innovations in the entire pre-and-post-production value chain will improve income generation through horticulture.

Depending upon the specific commodities to be promoted, the board can adopt, *inter alia*, three strategies: (i) undertake direct marketing (ii) develop partnerships with F&V players like SAFAL, NAFED etc., and (iii) ensure greater private sector participation. We present our strategies in Figure 47 below.

FIGURE 47: Objective and strategy of Telangana Horticulture Board



Source: Created by Authors

The board can either be a state-owned PSU like Himachal Pradesh's HPMC, or a corporation like the North-East Regional Agricultural Marketing Corporation Limited (NERAMAC). The board can even be registered as an independent society under the Societies Registration Act, 1860.

A Horticulture Board would allow dedicated focus on long-term interventions, develop ancillary markets and processing infrastructure, forge partnerships and support innovations.

Revive Telangana State Trade Promotion Council with focus on agricultural exports

The Telangana State Trade Promotion Council (TSTPC) was set up in 2014 after the incorporation of the state to increase and facilitate export and import in the state. Considering the dramatic change in the state's agricultural and the increasing opportunities for export, there should be amendments to the mandate of TSTPC. TSTPC should increase its focus on agricultural commodities. The draft export policy for Telangana identifies mango, poultry meat, turmeric, and chillies (dry) as commodities with high export potential. These commodities are also endorsed by India's agricultural export policy, which was introduced in 2018. However, there are gaps in the value chain for these commodities such as the high losses/wastages in poultry meat value chains, the lack of pack houses in the state that pose a challenge to mango exports, unavailability of processing facilities for turmeric, etc. Among other things, TSTPC should facilitate registration of farmers on APEDA's portals such as mango.net, facilitate the creation of key infrastructure such as pack houses, integrate the efforts of different departments to increase exports of agricultural products and ensure agriculture trade logistics.

2. Sustainability

Under this theme, the recommendations are two-fold: (i) ones which suggests ways to strengthen the state's resilience to the impact of climate change, and (ii) ones which suggest ways to improve the efficiency of its resource use.

Rationalising water use

Water is critical and its use must be optimal. It is encouraging to see the state's focus on improving access to irrigation in the state. However, there has to be focus on delivering efficiency. Water-use efficiency in the state can be enhanced by the adoption of technologies like drip irrigation and sprinklers. These technologies are known to not only rationalise water usage in cultivation but also improve crop yields.

Another initiative can be to replace electric motors with solar-powered phase-change enabled equipment for irrigation in selected parts of the state. This will reduce the burden on discoms and will be particularly useful for small and marginal farmers in areas with poor or unstable electricity. Similarly, the state may do well to decentralise sources of water. The government has to support farmers in accessing their own sources of irrigation (including dug wells) by providing technical and financial support. With the

completion of most large major irrigation projects, the state now must deliver last mile water to farmers on the tail of the project's command area.

Crop insurance

Both crops and cattle are vulnerable to cyclones and floods in the state. With climate change, there has also been an increase in the magnitude and types of pest attacks. The state has to insure its farmers from such production risks. The objectives of the scheme should be financing farmers who experience crop loss or damage due to unforeseeable events, stabilising farmers' incomes to secure their ability to continue farming, encouraging them to use cutting-edge agricultural techniques, and ensuring the flow of credit to the agriculture sector. It is also assumed that stand-alone incidents of calamity will be tended to through the availability of other funds in the state such as the Disaster Relief Fund.

Create farmer distress index

Farmer's distress is often the result of a complex interplay of myriad issues and risks including but not limited to high level of formal or informal debt, natural calamities resulting in crop loss or serious reduction in yields, heavy dependence on agriculture for sustenance, market failures, excessive dependence on commercial crops, falling water tables, stressful social and religious practices involving avoidable expenses, expensive medical treatment and loss of a family member; these may affect farmers simultaneously. It may be prudent for the state to possibly track the level of distress/welfare of farmers, say at the district-level. Building such a tool will provide opportunities for corrective action through timely and adequate policy support to the neediest farmers of the state.

3. Diversification

The state needs strategic crop planning to encourage crop diversification. Among the crops that need to be focused on are millets, sugar, F&V, and oilseeds like soybean. Market incentives are critical to bring about behavioural change. This can be brought about by ensuring the existence of multiple avenues for the sale of produce. Districts with a higher share in the overall acreage but low levels of farmers' income can be a starting point for a comprehensive diversification programme.

Threats from climate change are particularly pronounced for Telangana. It is already one of the most vulnerable states to weather vagaries; its vulnerability is likely to intensify with climate change. Floods, cyclones, and effects of higher minimum temperatures are among the major threats the state is likely to face. The promotion of flood tolerant varieties in flood prone areas and drought resistant varieties in dry lands should be undertaken. Considering the long-term variability in the monsoon pattern, efforts to adjust the crops and their sowing patterns to coincide with the availability of rainwater may be encouraged. An R&D mission may be designed to deliver improvement of varieties, cultivation practices, and management of pests and diseases.

Climate change not only affects agriculture but is also affected by agricultural activities. Stubble burning, the flooding method of rice cultivation, and livestock are amongst the biggest emitters of greenhouse gases within agriculture. In the case of India, livestock accounts for about 63 per cent of all emissions from the agricultural sector. As shown in the paper, the state has a large population of unproductive bovines. Concerted efforts are required to improve the genetic potential of cattle and buffaloes to improve per animal milk output. Cross breeding with Indian and foreign breeds of bulls of high genetic merit should be promoted. The infrastructure for artificial insemination will need to be expanded and sex-sorted semen may be subsidised to improve the productivity and profitability of the sector. Extension services in livestock is critical. In the milk sector, NARMUL is one of Telangana's leading dairy co-operatives. The main challenges faced by its members are low procurement price, lack of disease control programmes, lack of milk testing and animal screening facilities, irregular visits by veterinary staff, unavailability of first aid services and lack of sufficient supply of vaccines. The availability of veterinary services will need to be expanded and a fodder development programme for growing fodder in public and fallow lands will need to be put in place. Maize being an important crop in the state, the possibility of converting maize crops into silage for cattle is another lucrative option that the state needs to explore. With shrinking land nationally, the scarcity of cattle fodder is already an alarming issue for the country. Telangana can explore becoming a silage exporter to fellow states.

Central to a value-focused policy is one that realises the need to promote standardised integrated farming systems involving agriculture-horticulture-livestock-fishery. A composite farm is at a low risk and is a high profit model. Effective and sustained income improvement may be garnered for more and more farm families through the convergence of various ongoing schemes/ programmes of the union and the state government.

4. Increased value addition

After ensuring sustainable production, the next step in the value-chain is processing. Can the state leverage the food or commodity processing markets?

Energy-Hub: With improved access to assured irrigation, the state can direct focus on its sugarcane crop. This crop will produce, among other things, sugar, ethanol, and bagasse. With assured remunerative prices for cane, the crop can deliver high value to everyone in the value-chain. Besides, the country has ambitious mandates on ethanol (for fuel blending) to be achieved by 2025-26. If there are enough investments in distilleries, the state can build on the ethanol blending targets and produce enough ethanol for even exporting to other deficit states. In addition, bagasse-based power hubs can be thought of.

Reduce wastage/losses in the value chains: The state needs to work on reducing food losses across the value chains, especially in the case of poultry meat, maize and chillies and cottonseed. Investments should be made in both on-farm and marketing infrastructure. For on-farm losses, better techniques for

harvesting and increased mechanisation can be used to reduce losses at the farm level. For losses at the market level, adequate infrastructure is required to increase the shelf life of products, especially maize and poultry meat. A policy to improve the quality of rice milling in the state will go a long way to ensure better value capture, including for by-products like bran, husk etc.

Focus on allied activities: To increase value addition, increased focus should be made on allied activities in the state. We list these below.

Focus on Poultry and Poultry Feed: With rising per capita income and the diversified food basket of the average Indian, the demand for poultry products like egg and meat are likely to increase at double digit rates in the coming years. While the state will do well by ensuring higher value realisation by the poultry farmers, the implication on the poultry feed requirement of the country is huge. The state has fallow lands and feedstock for poultry feed. As per the Indian Poultry Feed Market Report and Forecast 2023-28, the Indian poultry feed industry, which was valued at about US\$20,867 million in 2022, is likely to grow at a CAGR of about 7.3 per cent between 2023 and 2028, to reach a level of about US\$31,489 million by 2028. With the country's shrinking GCA, the ability of farmers to supply enough feedstock for the feed industry is already under question, particularly so in the light of climate change. Telangana can become the feed hub of the country, particularly if measures are taken to boost the production of maize, which can double up as feed for cattle (in the form of silage) as well as protein for poultry.

Focus on fisheries: With expanded access to irrigation, the scope for leveraging inland fisheries is huge in the state. The focus must be on multiple stocking and multiple harvesting of the right species. To deliver the benefits of aggregation and value-chains, FPOs in fisheries can be created. Besides, the establishment of a sound network of brood banks can augment incomes of carp seed breeders and help farmers access quality seeds. There are also several digitalization-based initiatives that can be leveraged to improve the state's aquaculture practices. App-based solutions for example, for tracking production data, or providing farm advisories can be integrated while promoting aquaculture units at scale.

Increase Agro-Forestry: Timber products are the second largest imported segment in the country's agro-import basket. Therefore, there is immense potential for increasing farmer incomes via agro forestry. To develop it, the state should map and identify species of wood to its different agro-climatic zones, ensure timely and affordable provision of seedlings, smoothen the policy environment and governance mechanisms to ensure predictable annual harvests, and liberate the markets of wood cutting, transportation and processing from administrative bottlenecks.

5. Innovation in policies

Telangana was the pioneer state that spearheaded the unconditional direct benefit transfer programme for its farmers via its *Rythu Bandhu* scheme. As the next step, the government needs to learn from global

experience to introduce changes in the benefit transfer programme to bring about behavioural change. For example, under its Common Agricultural Policy (CAP), EU provides a benefit transfer to its young farmers (below age of 40 years) to encourage them to continue in farming. Similarly, payments are being made to encouraging farmers to shift acreage towards certain crops. China makes area-based payments to its maize and soybean farmers. The Brazilian government gives out concessional loans to farmers for marketing their produce. They cover the following crops - wheat, maize, rice, soybeans, sugar cane, cotton, coffee, milk, beef and veal, pig meat, poultry. By building on global experiences, the state can prepare for its next leap of progress.



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Arcus Policy Research

B-2/1B, Ground Floor
Safdarjung Enclave, Delhi-110029
admin@arcusresearch.in
www.arcusresearch.in

