AGRICULTURE IN TELANGANA

FROM PLIGHT TO PRIDE

CDPP CENTRE FOR DEVELOPMENT POLICY AND PRACTICE

SAHAYATA TRUST

AGRICULTURE IN TELANGANA: FROM PLIGHT TO PRIDE

About the Project: The research report titled "Agriculture in Telangana: from Plight to Pride"sheds light on various dimensions of Telangana's agricultural domain.

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ABBREVIATIONS

ADEx	:	Agriculture Data Exchange
AI	:	Artificial Intelligence
AI4AI	:	AI for Agricultural Innovation
AISS	:	Agriculture Investment Support Scheme
ANGRAU	:	Acharya N. G. Ranga Agricultural University
AP	:	Andhra Pradesh
APLM	:	Agricultural Produce & Livestock Market Committee
APMC	:	Agricultural Produce & Livestock Market Committee
ATMA	:	Agricultural Technology Management Agency
BC	:	Backward Classes
CAGR	:	Compound Annual Growth Rate
CBO	:	Community Based Organisation
CBT	:	Community Based Trainings
CC	:	Collection Centre
CD	:	Crops with Dairy
CEO	:	Chief Executive Officer
CGIAR	:	Group on International Agricultural Research
CROP	:	Cooperative Research Programme on Poverty
CSA	:	Community Supported Agriculture
CSC	:	Centre for Sustainable Cooling
CSR	:	Corporate Social Responsibility
CSR	:	Crops with small ruminants
CTI	:	Cooperative Training Institute
CTO	:	Chief Technology Officer
CWDL	:	Crops with diverse livestock
CWL	:	Crops Without Livestock
DAP	:	Di-ammonium Phosphate
DBT	:	Direct Benefit Transfer
DC	:	Distribution Center
DCCBs	:	District Central Co-operative Banks
ENAM	:	Electronic National Agricultural Market
ESTP	:	Employment through Skill Training and Placement
FAAS	:	Farming as a Service
FAO	:	Food and Agriculture Organisation
FFBs	:	Fresh Fruit Bunches
FIGs	:	Farmer Interest Groups
FPCs	:	Farmer Producer Companies
FPCs	:	Farmer Producer Companies

FPO	:	Farmer Producer Organisation
GCA	:	Gross Cropped Area
GrAMs	:	Gramin Agricultural Markets
GSVAA	:	Gross Value Added Agriculture and Allied Activities
GVA	:	Gross Value Added
GVO	:	Gross Value of Output
GVOA	:	Gross Value of Output from Agriculture and Allied Activities
Ha	:	Hectares
IAS	:	Indian Administrative Service
ICRISAT	:	International Crops Research Institution for the Semi-Arid Tropics
ICT	:	Information and Communication Technology
IoT	:	Internet of Things
IPM	:	Integrated Pest Management
IRDP	:	Rural Development Programme
IT	:	Information Technology
KDCCB	:	Karimnagar District Co-operative Central Bank
KPO	:	Keshavapally Procurement Office
KWH	:	Kilo Watt Hour
LIC	:	Life Insurance Corporation of India
LRUP	:	Land Records Updation Program
LWL	:	Landless with Livestock
MACS	:	Mutually Aided Cooperative Societies
MEPMA	:	Mission for Elimination of Poverty in Municipal Areas
MNREGA	:	Mahatma Gandhi National Rural Employment Guarantee Act
MNREGS	:	Mahatma Gandhi National Rural Employment Guarantee Scheme
MoSPI	:	Ministry of Statistics and Programme Implementation
MRIDA	:	Managing Resources for Integrated Development of Agriculture
MS	:	Micro-enterprises
MSP	:	Minimum Support Price
MT	:	Metric Tonnes
NAARM	:	National Academy of Agricultural Research Management
NABARD	:	National Bank for Agriculture and Rural Development
NAFSCOB	:	National Federation of State Cooperative Banks
NCDC	:	National Cooperative Development Corporation
NCDC	:	National Cooperative Development Corporation
NDDB	:	National Dairy Development Board
NFSM	:	National Food Security Mission
NGO	:	Non-Governmental Organisation
NIC	:	National Informatics Centre
NPAs	:	Non-Performing Assets

NRLM	:	National Rural Livelihood Mission
NSA	:	Net Sown Area
NSSO	:	National Sample Survey Organisation
OBC	:	Other Backward Classes
PACS	:	Primary Agricultural Co-Operative Societies
PIB	:	Press Information Bureau
PJTSAU	:	Professor Jayashankar Telangana State Agricultural University
PLFS	:	Periodic Labour Force Survey
PM-KMY	:	Pradhan Mantri Kisan Maan Dhan Yojana
PO	:	Producer Organisation
PPP	:	Public Private Partnership
RAD	:	Rainfed Area Development Scheme
RB	:	Rythu Bandhu (Scheme)
RBI	:	Reserve Bank of India
RKBY	:	Rashtriya Krishi Bima Yojana
RKVY	:	Rastriya Krishi Vikas Yojana
RSV	:	Rythu Swarajya Vedika
RTGS	:	Real Time Gross Settlement
SAP	:	Specially Abled Persons
SC	:	Scheduled Castes
SEP	:	Self Employment Programme
SERP	:	Society for Elimination of Rural Poverty
SFAC	:	Small Farmer’s Agri-business Consortium
SGST	:	State Goods and Service Tax
SHC	:	Soil Health Card Scheme
SHGs	:	Help Groups
SLBC	:	State Level Bankers Committee
SLFs	:	Slum Level Federations
SM&ID	:	Social Mobilisation and Institution Development
SRDP	:	Sheep Rearing and Development Programme
ST	:	Scheduled Tribes
SUSV	:	Support to Urban Street Vendors
T-IDEA	:	Telangana State Innovation in Digital Entrepreneurship and Acceleration
TLFs	:	Town Level Federations
TMC	:	Million Cubic Feet
TSCAB	:	Telangana State Cooperative Apex Bank
TSFPS	:	Telangana State Food Processing Society
TSIRD	:	Telangana State Institution for Rural Development
TSSDC	:	Telangana State Seed Development Corporation
UNEP	:	United Nations Environment Programme

VO	:	Village Organisations
VOO	:	Value of Output
VRO	:	Village Revenue Officer
WEF	:	World Economic Forum

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First, we extend our appreciation to the members of the advisory board for their invaluable counsel and insights throughout the project.

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Research Director
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FOREWORD

Brown to green – the story of the Telangana landscape

Amir Ullah Khan is a Professor of Public Policy at MCRHRDI

For those of us who grew up in Hyderabad in the seventies and the eighties, the monsoons were delightful. The clouds would burst, and rains would come down most definitely by the end of the first week of June, and the atmosphere would change magically. Small ponds would fill up, wild ducks would appear out of thin air, and the brown, dusty solid would turn lush green. The next six months would be simply gorgeous. Paddy fields with dark green shoots almost submerged in water would come up in the same dusty fields that were barren till a few days ago. The rice bushes would turn a lighter shade of green as the stalks grew and, in a few months, turn a golden brown to be harvested soon after. The cotton fields would stand out in the horizons, and the lovely woolly flowers would turn the hinterland into a sea of pristine white.

Early next year, the hot sun would come back furiously, with temperatures soaring to the mid-40s. The earth would go brown and dusty again, and most ponds and lakes would dry up completely, showing a cracked surface where cars would actually drive in and park, exactly where there would have been 20 feet of water a couple of months ago. And while the water would stop flowing and the taps went dry, electricity also would play truant. The summer was tough; the only respite came with mangoes that appeared in plenty even as the summer sun scorched the earth.

Something has changed completely now. This new generation sees a green surface throughout the year across the state. Those rain-fed reservoirs now rarely allow water levels to come down, forget getting parched and bone dry. Farmers who grew one crop during the rains grow three or even four crops a year. All 10000 villages have water and get electricity, often uninterrupted. The state, known more for its contribution to Information Technology, Higher education and Pharmaceuticals, has quietly become the rice bowl of the country while recording the highest yield among all states. Telangana produces nearly 3400 kgs of paddy per hectare, while the Indian average stands at 2700 kgs/hectare.

The transformation is indeed spectacular. In a state that valued higher education, a software job and a foreign visa, the farmer was often at the periphery. In the erstwhile state, it was the Andhra region that produced rice and sent it to Hyderabad and its neighbourhood. Within six years, the production has flipped, and Telangana produces at least 2500 thousand tonnes more paddy than the coastal Andhra, with the

traditional advantage of being irrigated by perennial rivers. What has changed since the state got bifurcated, and today has emerged as one of the top producers of Maize, Cotton and Paddy in the country?

There are the rain gods that need to be acknowledged. Over the last few years, the monsoon has been consistently good and spread across a larger period of June to October than earlier. However, what has changed the scenario completely is the policy emphasis on agriculture. Telangana announced the Rythu Bandhu scheme five years ago, a brave step towards providing investment support to farmers across the state. Much derided at first as yet another subsidy; this scheme quickly became the talk of the town. The government at the centre replicated it almost entirely as the PM Kisan scheme and extended it across the country. The Rythu Bandhu scheme gave farmers the bandwidth to buy better seeds, fertilisers, and labour, leading to increases in productivity.

The Rythu Bima scheme followed, where farmer families are given five lakh rupees within ten days of a farmer's death, including due to natural causes. The farmer does not even pay the insurance premium; the state does. The Rythu Vedika initiative ensures that agriculture extension work is carefully coordinated, and farmers get price information and input advice from a network of extension workers. On top of this are the much-talked-about and often criticised large irrigation projects that were launched and executed in record time. To add to these is something at a micro level that has yet to be talked about much, and that is the renovation work done on the 50000 ponds and canals that were cleaned and de-silted.

The story is, therefore, of a new state that continues to attract talent and investment in the hi-tech sectors but also addresses the plight of the farmer. Agriculture continues to play a significant role, contributing more than 21 per cent to the economy, with nearly 60 per cent of the population living in rural areas and dependent on farming. To restore pride in the sector, it is important, therefore, to work on all concerns together – farm loans, investment support, irrigation, extension, procurement and price discovery. While the progress has been significant over the last few years, there are formidable challenges that lie ahead.

The foremost challenge to agriculture comes with climate change. Recent studies show that nearly 80 per cent of farming households in Telangana are vulnerable to climate change. The changes in temperature, along with unexpected rain and frost, play havoc as far as crop production and harvest are concerned. The other major challenge is the incentive structure that is skewed towards paddy and cotton. Even now, the overproduction of these two crops is posing a huge threat to the precarious procurement infrastructure in the state. Minimum support prices cannot be reduced, and this issue could lead to friction between the farmer and the state and between the centre and the state.

Crop diversification would help, but it is not easy to bring such a change in farming practices where there is added risk and uncertainty. Price guarantees are required to steer farmers away from traditional crops,

and these are not easy to add to the ever-expanding basket of MSPs. Palm oil production is going up, and while this will definitely help the import-dependent edible oil industry, the costs to the environment are considerable due to depleting water resources. This will also imply a continuation of high subsidies and support required for palm oil farm economics. The road ahead will have even more speed breakers and roadblocks. Given the importance of agriculture in the state economy, there is a constant need for innovation and creativity in policy and practice. Telangana has indeed taken some bold steps and reaped a green cover for the state. As the dust settles, will the state be able to continue its unique measure of providing 24 X7 power and irrigation to all its villages and provide a working model to the large agrarian states in the north, where the farm sector continues to struggle?

OVERVIEW

The research report titled "Agriculture in Telangana: from Plight to Pride" sheds light on various dimensions of Telangana's agricultural domain.

Historical Outline

Commencing with an overview of initiatives during the Kakatiya Dynasty, it traces the evolution of measures by the Nizam's rule in Hyderabad to the united Andhra Pradesh, culminating in the present-day state of Telangana.

The Kakatiya dynasty, ruling 12th-14th century Deccan, focused on agriculture, constructing numerous reservoirs for irrigation. This benefitted arid regions, with tanks like Pakala and Ramappa still in use. Nizam rulers furthered irrigation projects in the 19th century, building significant dams and canals. Post-1956, Andhra Pradesh initiated land reforms, witnessed the Green Revolution, and introduced schemes like IRDP. Telangana faced challenges pre-bifurcation. After forming Telangana, schemes like Rythu Bandhu and Rythu Bima aided farmers, alongside initiatives like Soil Health Card and Seed Village Programme. The Rythu Vedika platform was also initiated to empower farmers by addressing their issues and implementing effective selling strategies.

Contemporary State Policies

The study then delves into the contemporary agricultural policies of Telangana and their impacts, drawing from interviews conducted between May and September 2023. It encompasses insights from conversations with 15 experts and 50 farmers across the region. Through these interviews, the study offers a profound insight into how these policies have influenced farmers and their means of livelihood, providing a human-centric perspective on their real-world implications. Key policies such as tank rejuvenation, Rythu Bandhu, Rythu Bima, Rythu Vedika, promotion of palm oil cultivation, and the implementation of the Dharani portal are explored, underscoring their transformative influence on the agricultural landscape and addressing related concerns.

Data Insights into the Agriculture Sector

The research then transitions into a pivotal section that provides essential statistics, offering valuable insights into the current state of the agriculture sector. This section examines various parameters related to the agriculture sector, including budgets, gross values added by agriculture and allied activities, land use, sown area, farmer suicides, farmer income, agricultural inputs, major crops grown, profitability of crops, and cropping patterns. This analysis covers the period from 2014 to 2022 and assesses Telangana's specific position within these parameters.

Data Insights into the Allied Sectors

The report proceeds to assess the performance of the allied sectors, focusing on the growth of various subsectors such as milk, meat, wool, eggs, and fish from 2014 to 2022. Furthermore, the report examines Telangana's position within the country regarding the performance of these specific subsectors. This analysis provides insights into the evolution and standing of these allied sectors.

Sources of Agricultural Growth in Telangana

The report proceeds with an attempt to identify the agricultural and allied subsectors that have made the most significant contributions to the growth of the agriculture sector in Telangana. This analysis is carried out through a decomposition and regression analysis. By employing these methodologies, the report aims to pinpoint the specific items or factors that have played a pivotal role in driving the growth of the agricultural sector in Telangana.

Addressing Sustainability

The report then grapples with broader ecological and environmental concerns arising from agricultural practices, emphasising current government policies to ensure the enduring sustainability of agricultural activities. The government's initiatives, like the Crop Diversification Index, show promising results. The Giri Vikasam scheme empowers tribal farmers while organic farming gains traction. The Telangana Centre of Excellence for Sustainable Cooling and Cold Chain aims to reduce emissions and food losses. Integrating agritech and strategic partnerships further demonstrates the state's commitment to sustainable rural development. At the grassroots level, community-supported agriculture programs and individual farmers adopting agro ecological methods are pivotal and mentioned in this section. These efforts should inform and shape government policies, ensuring a sustainable agricultural future for Telangana.

Revolutionising Agribusiness: Agritech, Startups, and FPOs

In the following section, an evaluation is conducted on the support provided to agricultural businesses, along with an analysis of governmental initiatives designed to cultivate an environment conducive to the growth of agri-businesses. This portion commences by highlighting the pivotal role of technology in propelling agriculture forward, followed by an exploration of the contributions made by Farmer Producer Organisations. Additionally, attention is turned towards the rising agri-based startup ecosystem in Telangana.

Expanding Opportunities through Livelihood Diversification

Diversifying rural livelihoods is also examined, spotlighting government initiatives and recommendations for further progress. The state government implements diverse schemes for livelihood diversification. Initiatives under the allied sectors have been introduced. A debt remission scheme aids farmers with loans below Rs. 1 lakh. Cooperative societies, like PACS and KDCCB, also play vital roles. Women empowerment through SHGs and agro-related strategies further enhances livelihoods and economic development in Telangana.

Synergies between Different State Government Departments

The project also underscores the collaborative efforts of different state government departments driving the agriculture sector in Telangana. The Agriculture and Co-operation Department and Animal Husbandry, Fisheries, Irrigation, Energy, and more collaborate for rural development. The Department of Agricultural Marketing modernises operations, empowering farmers and eliminating middlemen. The Forest Department aims to increase tree cover. Professor Jayashankar Telangana State Agricultural University focuses on education, research, and extension. The Telangana State Seed Development Corporation advances seed production. In addition, various other state departments join hands in the collective pursuit

of raising minimum wages, bolstering infrastructure, and championing inclusive policies, all of which contribute significantly to the thriving growth of the agricultural sector.

Addressing Concerns and Seizing Improvement Opportunities

Finally, the research report concludes by addressing potential concerns and offering recommendations. It highlights labour scarcity due to job diversification, impacting farm tasks and costs. Post-harvest losses are also identified across crops, highlighting the need for efficient management. Engaging youth in agriculture is crucial, but they face challenges accessing knowledge, land, and finances. Policy interventions, including tailored education and mentorship, are proposed. This section also mentions the effectiveness of certain subsidies and extension services, advocating for increased focus on Research and Development. Allocating resources to international research centres, national systems, innovation, and the private sector is suggested to benefit global agriculture.

Conclusion

By synthesising this diverse array of subjects, we aim to produce a comprehensive and well-informed report that not only confronts potential challenges faced by the agricultural sector in Telangana but also presents innovative solutions. Ultimately, our objective is to promote sustainable and robust agricultural practices that enhance productivity, elevate farmers' livelihoods, and contribute to the overall advancement of the region.

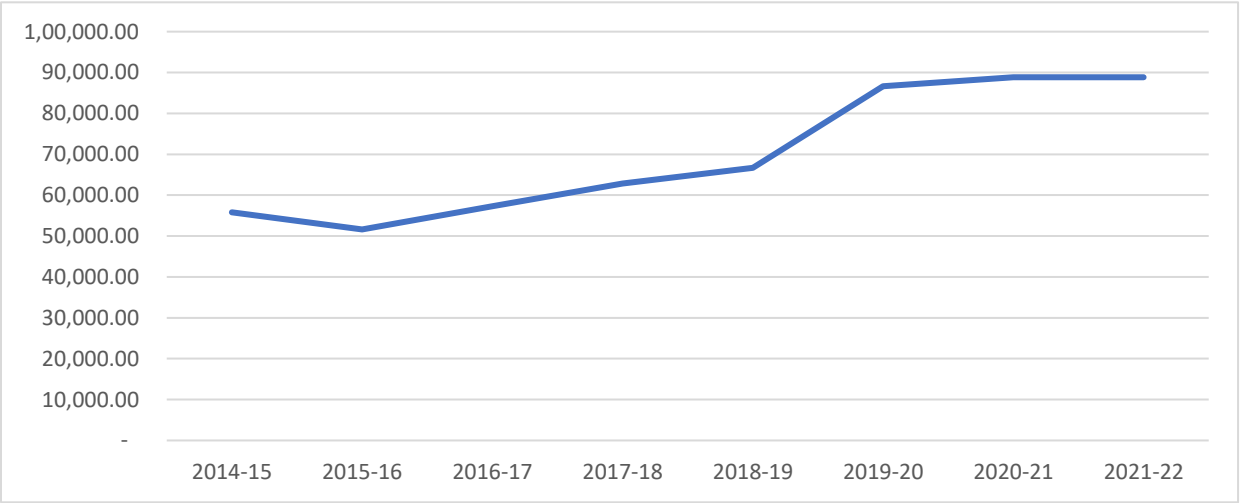
INTRODUCTION

In the Telangana region in 1968, 14 per cent of the total geographical area consisted of fallow land, which refers to cultivable land not cultivated during the reported year (Reddy et al., 2014). By 2011, this percentage had increased to 23 percent. This high proportion of fallow land reflects the neglect of the agriculture sector and the lack of investment in land development over five decades (Reddy et al., 2014). The agriculture sector in Telangana faced numerous challenges, including water shortages, declining land productivity, unremunerative prices, high cultivation costs, and the impacts of climate change (Government of Telangana Planning Department, 2015). Various initiatives were undertaken in the new state of Telangana, such as farm loan waivers, the Mission Kakatiya program, and the promotion of farm mechanisation to reduce cultivation costs to address the various issues in the agriculture sector.

In just under a decade, the agricultural sector in Telangana has made significant progress. The once-barren lands of Telangana have now turned green. The growth in the Gross Value Added (GVA) from agriculture, at constant prices, between 2015-16 and 2021-22 stands at an impressive 7.4 per cent, starkly contrasting India's overall growth rate of 4 per cent (Sri Harish, 2023). In 2021-22, the Gross Value Added from Agriculture and Allied Activities (GVOA) at constant prices amounted to Rs. 88,803.53 crores. The contribution of agriculture to the gross value added has experienced a remarkable growth of 59.12 per cent since 2014-15 (Figure 1).

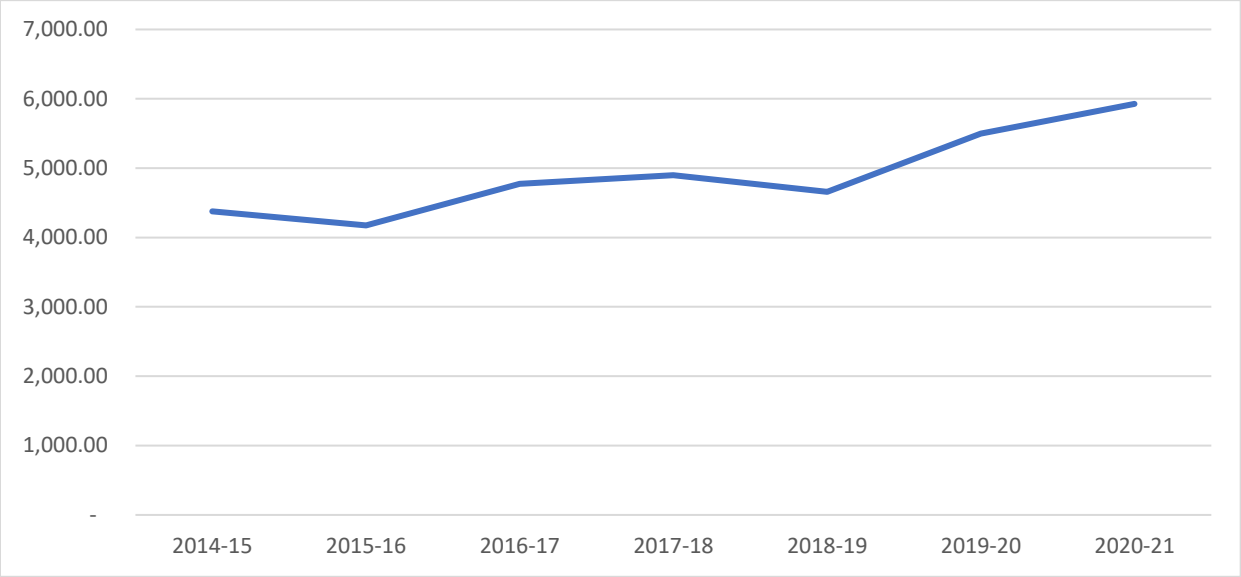
Moreover, the net sown area has grown from 4,377 thousand hectares in 2014-15 to 5,926 thousand hectares in 2020-21 (Figure 2). Additionally, the proportion of net irrigated areas concerning the net sown area has risen from 39.44 per cent in 2014-15 to 56.7 per cent in 2020-21. Regarding the gross irrigated area, in 2018-19, Telangana achieved an irrigation coverage of 58.1 per cent of the gross cropped area, surpassing India's average coverage of 52.03 per cent.

Figure 1: *Gross Value Added from Agriculture and Allied Activities from 2014-15 to 2021-22 (constant prices, in Rs. Crores)*



Source: Agriculture Statistics at a Glance 2022

Figure 2: *Net Sown Area from 2014-15 to 2020-21 (000' hectares)*

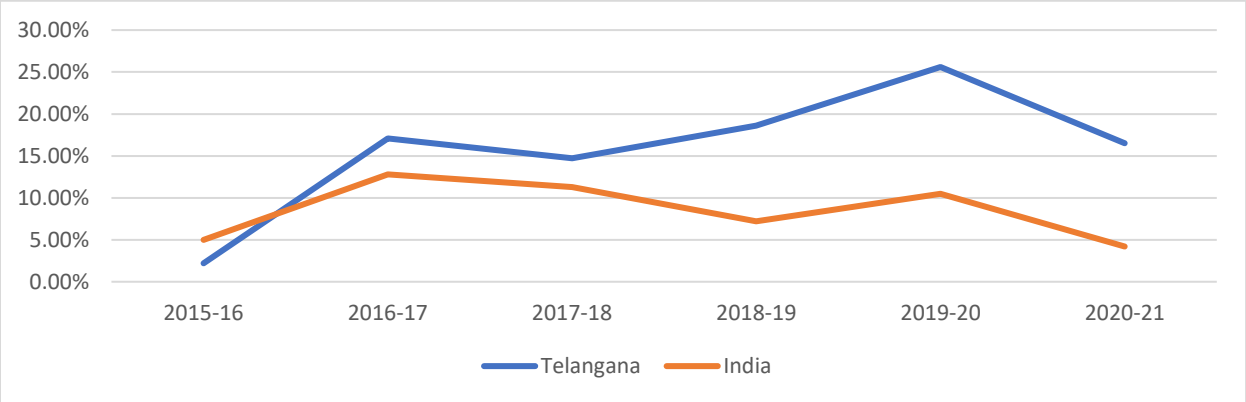


Source: Agriculture Statistics at a Glance 2022

In 2014-15, the primary sector accounted for 19.5 per cent, the secondary sector accounted for 19.2 per cent, and the tertiary sector held the majority share of 61.3 per cent. However, noticeable changes occurred by 2020-21 in these sectoral contributions. The primary sector experienced a significant increase of 4.6 per cent, reaching a share of 24.1 per cent. Telangana exhibited an impressive annual average growth rate of 15.8 per cent in the primary sector from 2015-16 to 2020-21, surpassing India's average growth rate of 8.5 per cent. Furthermore, this growth rate was the highest among the South Indian states.

On the other hand, the secondary sector witnessed a decline of 2.7 per cent, and the tertiary sector saw a decrease of 1.9 per cent in their respective contributions.

Figure 3: *Annual Growth Rate of Primary Sector of Telangana and India from 2015-16 to 2020-21*



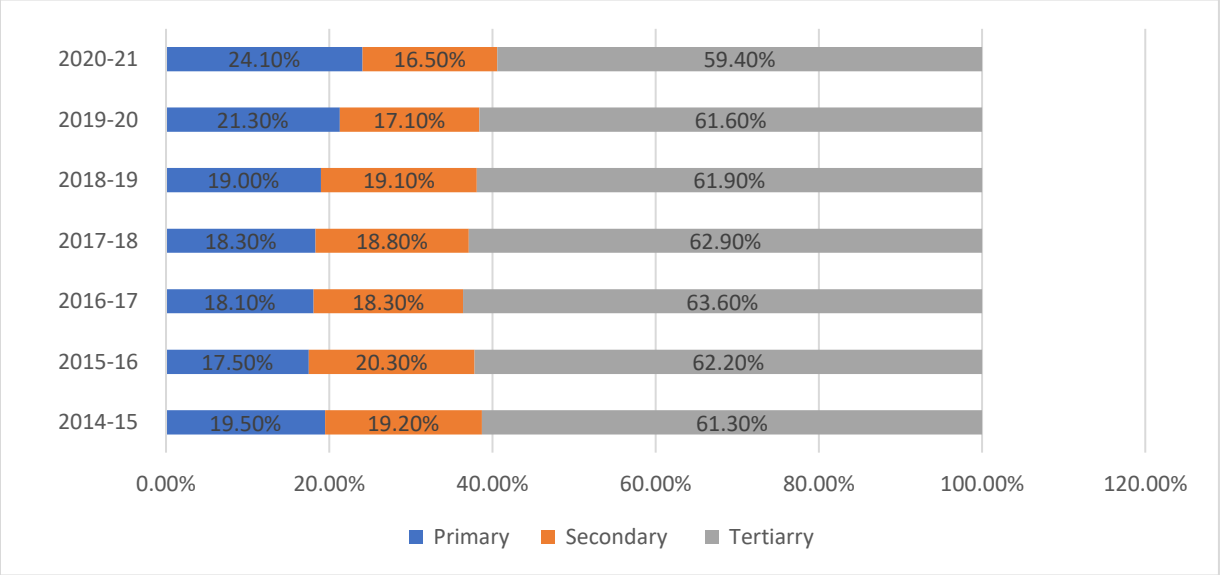
Source: Directorate of Economics and Statistics, Government of Telangana

Table 1: *Annual Growth Rate (%) of the Primary Sector*

State	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Annual Average
Telangana	2.2	17.1	14.7	18.6	25.6	16.5	15.8
Andhra Pradesh	18	21	22.4	6.5	11.2	8.6	14.6
Karnataka	0.9	6.2	26.4	2.2	15.6	8.8	10
Tamil Nadu	3.8	3.8	18	7.9	12.5	10.1	9.4
Kerala	-2	9.3	8.9	-0.7	-1.6	NA	2.8
India	5	12.8	11.3	7.2	10.5	4.2	8.5

Source: Directorate of Economics and Statistics, Government of Telangana

Figure 4: *Sector Contribution to Gross State Value Added from 2014-15 to 2021-22*



Source: Directorate of Economics and Statistics, Government of Telangana

The incredible growth observed in the sector naturally led to questions about the reasons behind its impressive performance and how it reached this stage.

The report attempts to explore different facets of Telangana's agriculture sector. The report is divided into ten sections. They are historical outline, contemporary state policies, data insights into the agriculture sector, data insights into allied sectors, sources of growth in agriculture, addressing sustainability, revolutionising agribusiness, addressing livelihood diversification, synergies between different state government departments, and addressing concerns and finally seizing improvement opportunities.

SECTION - I
HISTORICAL OUTLINE

An Overview of Historical Agricultural Developments

Though Telangana as a state was formed in 2014, the agricultural policies and schemes elaborated here begin from the Kakatiya and Nizam periods. First, we will look at the initiatives of Kakatiya Dynasty, followed by policies in the Hyderabad state during the Nizam rule, later in united Andhra Pradesh, and finally, the newly formed state of Telangana.

Table 2: *Agricultural Policy Timeline of Telangana, India*

Year	Some Agriculture Policies / Schemes
12th - 14th Centuries	Construction of Reservoirs for Irrigation in the Uplands by the Kakatiya Dynasty
1923	Construction of Nizam Sagar dam by Mir Osman Ali Khan
1970s	Green Revolution
1978	Integrated Rural Development Program (IRDP)
2003	Andhra Pradesh Micro Irrigation Project (APMIP)
2005	Agricultural Technology Management Agency (ATMA)
2007	Rashtriya Krishi Vikas Yojana (RKVY)
2015	Mission Kakatiya
2015	Soil Health Card Scheme
2015	Integrated Fisheries Development Scheme
2015	Free power (up to 200 units) to poultry farms
2018	Rythu Bandhu
2018	Rythu Bima
2018	Crop Loan Waiver Scheme
2018	Free Power to Farmers
2018	Sheep Rearing & Development Programme
2019	Kaleshwaram Lift Irrigation Project
2020	Rythu Vedika
2020	Dharani Portal
2022	Project Saagu Baagu

Pre-independence Efforts

The Kakatiya dynasty dominated most of the eastern Deccan region in present-day India from the 12th to the 14th centuries. Their realm encompassed much of modern-day Telangana and Andhra Pradesh, along with portions of eastern Karnataka, northern Tamil Nadu, and southern Odisha. Orugallu, presently known as Warangal, served as their capital (Ventakaramanayya, 1942).

Sastry (1978), in the book Kakatiyas of Warangal, mentioned the Kakatiyas found the need to establish numerous villages near water resources than the prior empires. It was because they were indigenous rulers

and fought for development by utilising natural resources and creating more arable land. The Deccan region was not densely populated, and large portions of the land were covered by hills, forests, and rocky soil, making it unsuitable for cultivation. (Sastry,1978)

During this era, much of the population relied on agriculture, which served as the primary foundation of the Kakatiya economy and the main source of income. As a result, the Kakatiya rulers, along with their subordinate leaders and affluent individuals of the time, displayed a strong interest in facilitating irrigation and promoting agriculture on a large scale (Devi, 2021).

This interest led to the extensive construction of reservoirs for irrigation in the highlands. Approximately 5,000 of these structures were erected by warrior clans under the authority of the Kakatiyas, significantly transforming the potential for development in sparsely populated arid regions. Many of these architectural feats, commonly referred to as "tanks," including notable examples such as those at Pakala and Ramappa, continue to serve their purpose today (Eaton, 2005).

They were the first to recognise the high fertility of the red and sandy soils in Telangana, which were exceptionally suitable for wet cultivation. However, due to their porous nature, they required a generous supply of water to be productive and yield enough crops to sustain the population. They pursued the construction of these irrigation systems through three key avenues. First was to reclaim unproductive land, second was to establish extensive networks of irrigation tanks, and third was to allocate them as agraharas to temples and Brahmanas, among others.

Although a few tanks existed before them, they were small, and the irrigated area was limited. The Kakatiyas constructed huge dams at different points of the rivers or streams to create large reservoirs which could store large amounts of water. Several large notable tanks were constructed to irrigate the lands during their period. One among the many is the Pakhala Lake in Pakhalashoknagar Village in the Warangal district. As per the inscription at the bund, it was constructed during the time of Ganapatideva by Jagadalu Mummadi, son of the minister Bayyana Nayaka and Bachamambe. (Sastry,1978)

The Kakatiyas constructed tanks in all villages of Warangal, Khammam, Karimnagar, Nizamabad, and Nalgonda districts. These districts receive more rainfall than other districts in Telangana, making it more conducive to constructing tanks, storing water for agricultural purposes, promoting agriculture and, as a result, enhancing the economic condition of the kingdom. Apart from tanks, canals, also called uta-kalua, were another essential irrigation source. (Sastry,1978)

The kingdom ensured that they not only constructed the tanks and canals but also ensured to maintain them. Annual repair of the bunds, removal of silt deposits on the bed, and repairs of canals and sluices were conducted. (Sastry,1978)

While building tanks was seen as an act of benevolence leading to the acquisition of significant religious merit, it also held economic significance. It was regarded as one of the seven commendable acts known as the 'sapta santanas' or seven deeds of enduring virtues (Devi, 2021).

The Nizam period saw many efforts for the development and welfare of farmers, mainly in irrigation. The Nizam rulers undertook various irrigation projects to improve agricultural productivity. In the late 19th century, the public works department initiated medium and major irrigation projects under Nizam's

government. A clear policy was in place to maintain and preserve tanks, wells, channels, and other minor irrigation works. During the rule of Mir Osman Ali Khan, particularly in the 1920s, several significant irrigation projects were constructed. Several dams, tanks, and canals were constructed to store and distribute water for irrigation purposes. The Nizam Sagar Dam, Singur Dam, and Osman Sagar are examples of such projects. The Nizam Sagar project was the largest irrigation project in the former Hyderabad State. Originally designed to utilise 58 thousand million cubic feet (TMC) of water and irrigate 275,000 acres of land, this project spanned Banswada, Bodhan, Nizamabad, and Armoor taluks in Nizamabad districts. The Nizam Sagar project served as protection against famine and brought substantial income and profits to the farmers involved.

> Mr K.I. Shariff, a retired general manager of NABARD, mentioned the first thing the Nizams did to boost agriculture production in the state or create some livelihood for people was to revive all irrigation tanks constructed by Kakatiyas or other kingdoms in the state. They also took up major irrigation projects like Nizam Sagar, Hussain Sagar, and Gandipet. Additionally, minor irrigation projects were constructed for all big villages. The agriculture sector served as a source of revenue for the kingdom. Village heads called Deshmukhs' were appointed, each handling seven to eight villages. The role of a Deshmukh was to support the agriculture sector, collect taxes, and pay them to the kingdom. This system was like the Zamindari system.

Gautam Pingle (2011) notes that tank irrigation grew ninefold in the sixty-five-year period between 1875-1940 during the Nizam rule. Due to this, total irrigation also multiplied sevenfold. Thus, he states that the Nizam state can take pride in this tremendous endeavour and accomplishment. The restoration of non-functional tanks and wells held great potential for the state's future and farmers' welfare. Besides these, they also established a College of Agriculture, which is now a part of Professor Jayashankar Telangana State Agricultural University.

State Reorganisation and Agricultural Policies in United Andhra Pradesh

After the State Reorganisation Act of 1956, the Nizam State was merged with Andhra to form the state of Andhra Pradesh. From 1956 till 2014, when the state was bifurcated, the government implemented various policies and schemes to support the agricultural sector and improve farmers' livelihoods. Andhra Pradesh government initially implemented significant land reforms to address land inequality and provide land to landless farmers. The government implemented the abolition of the Zamindari system, tenancy reforms, and land redistribution to promote equitable land ownership. Like many other states in India, Andhra Pradesh witnessed the Green Revolution. The government introduced new high-yielding crop varieties, promoting the use of chemical fertilisers and pesticides. In 1978, they introduced the Integrated Rural Development Programme (IRDP), which aimed to uplift rural communities and reduce poverty by providing financial support and training to small and marginal farmers. It included various components such as credit, subsidy, and technology dissemination to promote agricultural and allied activities. The Andhra Pradesh (AP) government also launched other programmes like the Andhra Pradesh Micro Irrigation Project and implemented the National Agricultural Insurance Scheme and Rashtriya Krishi Vikas Yojana.

Though many schemes were launched, the state faced many challenges during this period. During the decade before the state bifurcation, there were many challenges, including declining crop yields, with the gaps between their yields and the country's best yields growing wider. Furthermore, the prices of agricultural inputs rose, leading to higher cultivation costs. The changing patterns associated with climate variability further added to the farmers' woes. Major problems faced during this period were increasing costs of cultivation, inflation, low and stagnant productivity, land degradation due to poor soil health management, and an increase in farmer suicides.

> An Indian Academic and Professional development worker during the interview mentioned that a significant change occurred during the first five-year plan when former PM Jawaharlal Nehru emphasised investment in the "temples of modern India." This meant a substantial investment in irrigation infrastructure. However, the approach centred on constructing dams and reservoirs to divert water from major rivers for agricultural purposes. The Bhakra Nangal, Mahanadi, Nagarjuna Sagar, Sriram Sagar, and Srisailam projects were examples of such initiatives.
>
> An eminent agriculture scholar raised the point that after independence, policies were introduced to revive the agriculture industry. However, Telangana was considered relatively backwards regarding irrigation facilities compared to Andhra Pradesh. Coastal Andhra Pradesh had more advanced irrigation projects, while disparities existed within Telangana itself, with North Telangana being more backward than the southern regions.

The final report of the Commission on Farmer's Welfare highlighted that the shortage of water supply was a significant issue that most farmers in undivided Andhra Pradesh faced. While there was a shortage of water supply, the access to irrigation facilities varied across the districts. Anantapur had the lowest rainfall and the lowest irrigation. Other districts with low rainfall and low irrigation facilities were Kurnool, Cuddapah, Mahbubnagar, and Rangareddy. Whereas Adilabad had relatively higher rainfall but still had poor irrigation facilities. The inadequate and unequal facilities led to the reliance on borewells, an expensive endeavour.

> An eminent agriculture scholar recalled a story about a farmer who had taken a loan of 2-3 lakhs to dig a borewell on his farm. Unfortunately, the borewell failed, forcing the farmer to relocate to another plot of land, requiring further financial investment. In cases where such situations persisted, farmers often resorted to suicide due to the mounting financial burden.

The report identified that the decline of surface water resources like tanks was attributed to the following reasons:

1. Neglect of medium or large tanks and traditional irrigation structures, especially in Telangana.
2. Neglect of particular districts like Anantapur, Cuddapah, Chittoor, Rangareddy, and Mahbubnagar.
3. Uneven spread of large irrigation schemes
4. Lack of incentives to save water

The decline of Tank Irrigation

In his paper, Pingle, G. (2011) discusses the significant push for tank irrigation in the Telangana region during 1875 – 1940. In 1875, the area irrigated by the tanks was 41,000 ha; in 1940, it increased to 3,73,684 ha; by 1957, it had reached 5,30,565 ha. However, when Telangana was part of Andhra Pradesh, tank irrigation decreased by 59 per cent from 1956-57 to 2008-09, and the total irrigation from all sources (tank, canal, and well) doubled. The decline in tank irrigation can be attributed to the following reasons. First, the deterioration of the tanks because of neglect and lack of funds allocated to the Panchayati Raj. Second, tank irrigation is dependent on rainfall. Hence, the irrigated area will also be impacted during periods of low rainfall.

Additionally, rainfall was also affected because of the loss of forest cover. Third, the government allowed specific communities to pursue fishing activities in the tanks. However, these communities demanded that the water from the tank not be released to maintain the fisheries. Hence, tank irrigation declined. (Pingle, 2011)

Concerning canal irrigation, in Telangana, from 1956 to 1990-92, the canal irrigated area increased from 1,16,619 ha to 3,38,276 ha. However, between 1990-92 and 2001-05, the irrigated area fell by 50 per cent to 1,62,315 ha. By 2005-09, because of new minor irrigation projects, the irrigated area increased to 259,629. Coming to wells, significant growth of good irrigation took place after the launch of the rural electrification program. Most of the investments were privately funded. Also, well irrigation provides farmers with more flexibility in the cropping pattern and the number of crops grown than other sources of irrigation. From 1956-57 to 2005-09, the well-irrigated area increased from 1,29,869 ha to 12,17,642 ha. (Pingle, 2011)

Mr. Ramanjaneyulu, Executive Director of the Centre for Sustainable Agriculture, recalled that by the 90s, the agriculture crisis had begun in Andhra Pradesh. Since the lands were rainfed, they were not suitable for high input usage, and due to the lack of water and groundwater depletion, farmers were panicking. Geologically, 300 feet below Telangana, there is a massive rock formation, so even with water harvesting measures, water will not be revived in the aquifers. Farmers relied on tanks during the Nizam and Kakatiya periods for surface irrigation. Once borewells were made available, farmers extracted groundwater from deep aquifers, and whatever recharge occurred did not return to the deep aquifers. Deep aquifers started drying up; therefore, crop failure began occurring in large areas. This was one of the reasons for the large number of suicides that occurred in Telangana after 1996. In 1997 and 1998, Telangana was the region with the most farmer suicides, and in 2004, 4000 farmers committed suicide.

During the fight for a separated Telangana, agriculture was one of the central demands. Since before the bifurcation, Telangana was neglected while Andhra was given all the attention regarding agriculture.

Newly Formed State of Telangana

After the formation of the Telangana state, the government launched multiple schemes to improve the conditions and promote the welfare of farmers and the agricultural sector. The government has launched the Rythu Bandhu Scheme (AISS) to provide investment support to farmers. Under this scheme, farmers receive a grant of Rs. 5,000 per acre per season to purchase agricultural inputs. Another scheme called Rythu Bima (Farmers Group Life Insurance Scheme) offers financial relief to the family members of deceased farmers by providing a sum assured of Rs. 5,00,000. The government also implemented the Soil Health Card Scheme (SHC) to promote sustainable agriculture practices and optimal utilisation of water resources. Subsidy Seed Distribution ensures the availability of crop seeds on subsidy, including paddy, jowar, maize, and others.

The Seed Village Programme focuses on improving the quality of farm-saved seeds and increasing the seed replacement rate. Farm mechanisation is encouraged through the distribution of farm machinery and implements on a subsidy basis. Other initiatives include the Rashtriya Krishi Vikas Yojana (RKVY) to incentivise states for agricultural investments, the Rainfed Area Development Scheme (RAD) for enhancing productivity in rainfed areas, and the National Food Security Mission (NFSM) to increase food grain production. The Agriculture Technology Management Agency (ATMA), although initiated in 2005, gained significant traction and impetus in 2021, which greatly contributes to an efficient extension system, and the Pradhan Mantri Kisan Maan Dhan Yojana (PM-KMY) provides a pension for small and marginal farmers.

Rythu Vedika, launched in 2020, is another initiative by the Telangana government to help farmers attain higher returns by bringing them together on one platform. The platform aims to enable farmers to gather regularly and address their issues while implementing their selling strategies effectively. Additionally, it will assist farmers in forming organised groups to safeguard their rights. It will provide valuable insights to the government regarding the challenges and obstacles faced by farmers at the grassroots level, allowing for the formulation of new strategies and improvements to the existing agricultural system. Moreover, the platforms will serve as centres for imparting skills by the agriculture and allied departments.

According to Mr. Ismail Shariff, retired General Manager of National Bank for Agriculture and Rural Development (NABARD), in Telangana, the government has diligently implemented various programs to support the agriculture sector. A State Level Bankers Committee (SLBC) has been established, where banks are responsible for developing comprehensive plans for different aspects of agriculture, including agriculture itself, allied sectors, irrigation, and crop loans. These plans are prepared annually and undergo review by NABARD, the Reserve Bank of India (RBI), and the district collector, who serves as the head at the district level. This ensures that the set targets are monitored and achieved.

Additionally, the agriculture department plays a crucial role by offering subsidies, supplying quality seeds, and providing support systems such as new technology and machinery. Other departments, such as the horticulture department and seed certification department, also contribute to the agricultural ecosystem. The agriculture department is responsible for issuing licenses to seed and pesticide sellers, ensuring quality and compliance.

To ensure effective coordination and collaboration, regular meetings are held at the district level, where all departments and banks come together to review subsidy schemes and government-sponsored initiatives. This allows for a comprehensive evaluation of ongoing schemes and promotes effective implementation of agricultural policies.

Policy Developments in the Allied Sectors

Regarding allied sectors, the Telangana government has implemented policies in animal husbandry, dairy, fodder production and development, poultry, and fisheries to incentivise farmers to increase production.

The government has launched the Sheep Rearing and Development Programme to increase rural development and provide sustainable livelihood to shepherds.

The government has also launched an Integrated Fisheries Development Scheme with the National Cooperative Development Corporation. Additionally, the government introduced a scheme to provide Rs 4/- per litre of milk collected to encourage farmers to take up dairy farming.

Since 2015, the Telangana government has also provided free power up to 200/units to poultry farms. In 2021-2022, the state ranked third in egg production in the country.

According to an Indian academic and professional development worker, India's poultry and fishery industries are predominantly dominated by Andhra Pradesh and Telangana. This can be observed in places like Guwahati, where consumers are presented with two options: local fish or fish sourced from Andhra Pradesh and Telangana. Remarkably, the fish from these two states is available at half the price of the local fish, thanks to their deep market penetration and impressive productivity levels. Interestingly, the government has adopted a decentralised open system to foster the growth of the fishery industry. Instead of establishing large government-led firms, it has provided support to every producer involved in the production chain.

SECTION - II
CONTEMPORARY STATE POLICIES

Irrigation Projects

The provision of water for irrigation is the foundation for a prosperous agriculture sector. In the history of the Telangana region, during the Kakatiya and Nizam periods, the importance of water availability was recognised, and various irrigation structures were constructed. However, post-independence, irrigation by tanks was reduced drastically for various reasons. Post the formation of Telangana, the government undertook various measures to ensure water availability for the farmers.

Mr K.I. Shariff, a retired general manager of NABARD, believed that the state government had played a proactive role in improving the agriculture sector. He mentioned that the first step taken by the government was to revive the irrigation tanks as there were many breaches, the bunds were in bad condition, and there were no sluice valves. A sluice is a type of valve where, whenever we want, we can take out the water, and whenever we want, we can block the water supply. So, a small hole will be there through which the water goes from the bund to the fields. Therefore, the main intention was to stabilise the command area, which would help to increase production.

He mentioned that irrigation projects are classified broadly into minor, medium, and major. Irrigation projects up to 2000 hectares of command area are categorised as minor irrigation tanks. They are classified as medium irrigation projects from 2,000 to 10,000 hectares of command area. And above 10,000 hectares of command area they are classified under major irrigation projects. Generally, the financial support for primary and medium irrigation projects comes mainly from the central government and partly from the state government. And for minor irrigation projects, the funding is solely from the state government. So, the state government avails loans from different agencies, including NABARD. Or they budget it from their resources and construct these structures mainly to provide irrigation to agriculture and boost the agriculture sector.

Mission Kakatiya

The rejuvenation of minor irrigation tanks in India, which were once essential water sources for irrigation and drinking purposes but had deteriorated due to lack of maintenance, has been addressed by the Telangana government through Mission Kakatiya. ***The government launched Mission Kakatiya in 2015, under which 46,531 minor irrigation structures were to be restored in a phased manner within five years.*** The restoration of the tanks included repairs of bunds, weirs, and sluice, silt removal and silt application, restoration of feeder channels to the tank, etc.

As per an article by Reddy (2020), over the past four years, this initiative has successfully restored and revitalised 46,000 out of the original 80,000 tanks in the region. The positive effects of this endeavour are evident through various improvements, including increased water tables, expanded cultivated areas, and greater cultivation of multiple and profitable crops like paddy.

The rejuvenation process has been executed in multiple phases, with 15,649 tanks already completed and work on the remaining 5,650 tanks underway in Phase IV. The socio-economic impact studies conducted so far indicate that not only have farmers experienced a significant increase in income, but the livelihoods of fishermen and washermen have also improved. The scheme has garnered recognition and praise from the Central government and Niti Aayog for its effective implementation, which has resulted in cost reduction, alleviation of agricultural distress, higher yields, increased profits, and enhanced water availability in neighbouring villages through improved water tables. Additionally, providing 24-hour free electricity has further facilitated farmers in utilising the benefits of the increased water table, enabling them to expand irrigation through borewells.

The study "Impacts of irrigation tank restoration on water bodies and croplands in the Telangana State of India using Landsat time series data and machine learning algorithms" focused on the impact of irrigation tank restoration on water bodies and croplands in Telangana, India. ***Using remote sensing imagery and machine learning algorithms, the researchers mapped the changes in cropland areas and water bodies over six years. They found a significant increase in cropped areas under irrigation and expansion of water bodies.*** The study validated the results with ground survey data, achieving an overall accuracy of 87 per cent. The researchers concluded that remote sensing is an effective method for monitoring land use changes and recommended using higher-resolution satellite data for improved accuracy (Gumma et al., 2023).

NABCONS conducted an impact evaluation study on Mission Kakatiya. The years for the study chosen were Kharif 2017 and Rabi 2017-18. The base year chosen for the study was 2013-14. The infrastructure status was classified as Poor, Not Satisfactory, Fair and Good. The study results showed that the percentage of tanks categorised as poor during the base year reduced from 24 per cent to 3 per cent in the impact year. Similarly, the percentage of tanks categorised as good increased from 7 per cent to 29 per cent. (NABCONS, 2018)

Between the baseline and impact situation, the yield has increased by 8.3 per cent for Kharif paddy, 3.6 per cent in Kharif Cotton, 16.9 per cent in Kharif Maize, and 5.4 per cent in Kharif Jowar. For gross incomes from agriculture, during the impact year, there is a difference of Rs.10,303 between project and control tanks, and the gross income of project tanks from baseline to impact year has increased by 20 per cent. In contrast, for the control tanks, the income increase is minimal. (NABCONS, 2018)

Restoration of water tanks also has impacts on other livelihoods of people. For instance, using minor irrigation tanks to develop fisheries is a traditional practice in Telangana. Fisherman Cooperative Societies (FCSs) are allotted tanks in an area, one or more based on the tank size. In 2017-18, among the sample projects, only 58 per cent of tanks undertook fishing. During 2016-17 and 2017-18, the state government distributed fish seed on a large scale. The FCSs claimed that this increased fish production by 31.3 per cent. (NABCONS, 2018)

> Mr K.I. Shariff remembered that 15 to 20 years back, there was no water in many of the tanks. However, every tank now holds much water, and the farmers can grow two or three crops in some areas. The third crop grown is vegetables or short-duration crops, pulses, etc.

Kaleshwaram Lift Irrigation Project

Kaleshwaram Irrigation project is the world's multi-stage lift irrigation project that was taken up to tackle the water challenges the state faced. The project aimed to divert 195 TMC of water to 13 districts in Telangana state. The project is divided into seven links, which cover a distance of 500 km through a canal network of more than 1800 km. The project aims to cover a new irrigation area of 18,25,700 acres. Besides providing irrigation water, 40 TMC of drinking water and 16 TMC of water for industrial use are created. An additional benefit of the project is shifting to surface water for groundwater irrigation and restoring the groundwater levels. The cost of the project was detailed to be Rs.80190.46 crore. The project was opened on 21st June 2019. The districts covered under this project are Kamareddy, Sangareddy, Medak, Medchal, Yadadri, Nalgonda, Rajanna Sircilla, Siddipet, Jagityal, Karimnagar, Pedapalli, Nirmal, Nizamabad.

Mr K. I. Shariff mentions that there are multiple benefits of irrigation projects. Our irrigation projects have benefitted the agriculture sector, fodder because of water moisture, soil moisture, and groundwater. The water spread area has increased and helped increase fish production. Otherwise, Telangana did not have many fish (mostly from Andhra). It was mainly coming from Andhra. However, now Telangana is supplying to other states.

An eminent agriculture scholar noted that the situation has gradually changed due to the government's efforts to improve irrigation infrastructure. These projects, including the construction of large dams, are undoubtedly costly but have been instrumental in addressing water scarcity and enhancing agricultural productivity. Nonetheless, it was acknowledged that the implementation of such projects has had a significant impact on the local population and their livelihoods.

Potential Concerns

Water availability will pose a significant challenge for India in the coming years due to various factors. One of these factors is the growing population, which will lead to a substantial increase in annual food demand, exceeding 250 million tons by 2050, consequently creating a heightened need for water resources. Another concern pertains to the excessive exploitation of groundwater. The provision of free electricity by state governments encourages farmers to pump water without regard for wastage, resulting in the depletion of groundwater levels. (Central Water Commission, 2019)

Additionally, there is inefficiency in water usage, particularly in open canals, flood irrigation practices, and the charging of water based on the irrigated area rather than the actual quantity of water supplied. Estimates suggest that around 70 percent of irrigation water in the country is wasted by depriving dry regions of the essential irrigation they need. Furthermore, farmers often employ flood irrigation techniques, which lead to water wastage, soil erosion, increased occurrences of pests, diseases, and weeds, ultimately reducing crop yields. Consequently, there is an urgent necessity to promote water-efficient irrigation methods. (Central Water Commission, 2019)

Mr K.I. Shariff, opined that efficient management of irrigation projects necessitates considerations such as incorporating IoT (Internet of Things) , particularly in lift irrigation systems. IoT solutions, such as calibrated scales and sensors, can optimize water usage by controlling the supply to specific tanks or households based on predetermined levels. This not only conserves water but also reduces power consumption.

Furthermore, the government may explore the implementation of piped irrigation systems, especially in areas that pose challenges for water distribution through conventional means. By utilizing advanced irrigation techniques and technologies, Telangana can enhance the overall command areas and improve water resource management.

Similarly, the application of sensors can be considered in households to monitor water levels during pumping from borewells to tanks. When the water level reaches a specified sensor point, the supply can be automatically halted. This proactive approach ensures that water is used optimally without unnecessary wastage.

The current water supply system involves a two-stage pumping process, sourcing water from the upper regions of Maharashtra's Godavari River. If substantial rainfall occurs in Maharashtra, resulting in increased water flow into the river, there might be no need to pump water from alternate sources. By employing sensor-based data collection in the upper catchment areas, it becomes possible to determine the expected water inflow and the timeframe for its arrival in the Kaleshwaram area. This information can guide decision-making regarding the necessity of pumping water from other sources, thus saving costs and resources.

Furthermore, the existing system, involving pumping water from lower levels to Kaleshwaram before initiating another round of pumping, can be revised. If sufficient water from the Godavari River is already entering Kaleshwaram, the additional pumping process may become unnecessary, leading to significant savings in pumping costs.

To transform the irrigation sector, the integration of IoT technology and the introduction of piped irrigation systems with IoT solutions are recommended. For instance, in a scenario where water needs to be supplied to 100 acres of land through a channel, an automated valve can be implemented to close once the designated area has been sufficiently irrigated. This approach optimizes water usage and power consumption, contributing to resource conservation and efficiency in the agricultural practices of Telangana.

Rythu Bandhu (Financial Aid for Farmers)

To address the challenges of rural indebtedness and improve farmers' agricultural productivity and income, the Agriculture Investment Support Scheme, also known as Rythu Bandhu, was introduced in the 2018-19 Kharif season. This scheme aims to fulfil the initial investment requirements of every farmer.

Under this program, financial assistance is provided to farmers for agricultural and horticultural crops. They receive a grant of Rs. 5,000 per acre per season, which can be used for purchasing inputs such as seeds,

fertilisers, pesticides, labour, and other necessary investments. This support is given twice a year, during the Rabi and Kharif seasons. ***It is worth noting that this scheme is the first of its kind in India, as it directly provides cash payments to farmers*** (Department of Economic and Social Affairs, n.d.).

Observations from the study 'Impact of Rythu Bandhu Scheme on Farmers: An Evolutionary Study in Telangana State' (2021) indicate that a significant number of farmers, totalling 53.57 lakhs, benefited from the RB scheme in both the Kharif and Rabi seasons. the number of beneficiaries under the Rythu Bandhu (RB) scheme in Telangana state, Nalgonda District ranked first with 4,19,723 farmers. The study also revealed that approximately 70 per cent of agricultural land in Telangana is registered under farmers above 40. Furthermore, it was noted that 87.6 per cent of farmers have an annual income of up to 3 lakhs, with a majority falling under the Other Backward Classes (OBC) category. Analysis revealed that 24 per cent of farmers used RB benefits to purchase seeds, followed by fertilisers, while 29.5% utilised the benefits for non-farming activities.

One key finding of the study is that the Rythu Bandhu scheme has had a positive impact on reducing farmers' debts, thereby safeguarding them from falling into a debt trap. Consequently, the scheme is considered a viable alternative to loan waiver schemes. To further enhance its effectiveness, it is recommended that the government increase the financial assistance from Rs. 4000 to Rs. 5000 per acre.

However, the study also indicated that the Rythu Bandhu scheme did not directly contribute to farmers' annual agricultural income growth. The scheme primarily addresses the initial investment challenges farmers face, while the growth of their income relies on favourable market conditions and effective marketing mechanisms. Thus, the study argued that the state government must focus on implementing Minimum Support Price (MSP) policies and improving market conditions to ensure profitable crop sales.

Additionally, it was found that there was a significant difference in the purposeful usage of the initial investment based on the number of acres owned. Farmers with agricultural land up to eight acres utilised the scheme's benefits for agricultural purposes, while those with more than eight acres showed less purposeful utilisation. Many farmers with more than ten acres opted to lease their land to tenant farmers. The disparity is pointed out and, the study suggests implementing a slab system for providing financial assistance under the Rythu Bandhu scheme and directing assistance solely to cultivating farmers who Agriculture Extension Officers register at the village level.

A 2019 Tata Institute of Social Sciences survey found that 78 per cent of landowning farmers received full cash transfers for both seasons under the Rythu Bandhu scheme. However, 22 per cent either received reduced amounts or did not receive any cash transfer. These farmers, mostly small-scale food producers, faced this issue due to not having the necessary Pattadar Passbook, a prerequisite for receiving cash transfers. The delay or absence of the Passbook hampers the effective implementation of the program (Department of Economic and Social Affairs, n.d.).

To address this, the State Government focuses on expediting the Land Records Updation Program (LRUP). Phone-based monitoring has been implemented to improve financial support delivery, benefiting small farmers. The National Informatics Centre (NIC) is developing a dedicated dashboard software for monitoring, and beneficiaries can check payment status via a designated weblink.

Potential Concerns

One notable criticism is the exclusion of tenant farmers from the Rythu Bandhu scheme. A field study by the Rythu Swarajya Vedika (RSV) revealed that 75 per cent of farmers who died by suicide in Telangana were tenants leasing land. Tenancy is increasing in the state, comprising about 14.8 per cent of the total operational area. Tenants face significant barriers in accessing credit, Minimum Support Price, warehousing, subsidies, and other benefits, rendering them the most marginalised farmers (The Wire, 2022).

Another article, "Pioneering Direct Cash Transfers in the Farm Sector in India: A Case Study of the Rythu Bandhu Scheme in Telangana" (2022), opined that it only benefits landowners, leaving out landless labourers and tenant farmers. Surprisingly, a significant number of landowner beneficiaries, about 87.5 per cent, do not share the benefits with their tenant farmers, which further isolates and alienates them. The government could target beneficiaries based on accurate and regularly updated land records to address this issue.

The 2020 study, 'Linking Welfare Distribution to Land Records: A Case Study of the Rythu Bandhu Scheme (RBS) in Telangana,' highlighted widespread farmer discontent over delayed entitlements for the ongoing Rabi 2019 season. Several reported similar delays in benefits for the Kharif 2019 season. Field interviews by CDPP further emphasised this issue of delayed payments within the scheme.

During our interviews with development workers, educationists, and business experts, the scholars stated that absentee landlordism in Telangana leads to tenants being denied their rights, including access to loans. It was suggested that tenants should be included in agricultural programs to ensure the inclusion of genuine farmers.

It was also specified that tenants face uncertainty about whether they will have land to cultivate in the following year. Therefore, the needs of tenants must also be considered in agricultural policies.

Additionally, it was mentioned that tenant farmers play a crucial role in the agricultural sector, and it is important to address their needs and concerns. Currently, there is a lack of a robust system to support them. Digitisation can be utilised to establish a connection between landowners and tenant farmers. Schemes and benefits should be directed directly to the tenant farmers to ensure their effective implementation.

Furthermore, it was opined that tenancy is not a specific problem in Telangana, it is a nationwide problem. There is not a single perfect answer to this dilemma. FPOs (Farmer Producer Organisations) are a possible way out since members in an FPO are not categorised by their land ownership. If the government lends a hand to these FPOs, it can guarantee that tenant farmers also receive aid.

On the other hand, the study also observed that non-farmers and wealthy landholders are also benefiting from the scheme, even though they are not actively engaged in agricultural activities. Moreover, the scheme disproportionately favours farmers with larger landholdings, exacerbating income inequalities. In contrast,

other forms of support, such as fertiliser, power, and irrigation subsidies, primarily benefit landless labourers who are directly involved in agricultural work.

Many farmers argue that in times of rising input costs and falling crop prices, minimum support prices (MSPs) are crucial to keep them afloat and help them overcome difficult situations. The findings also reveal that many farmers take crop loans intending to repay them using the Rythu Bandhu allowance. The accessibility and timeliness of crop loans play a vital role in boosting farm incomes.

In comparison to direct transfers, many farmers prefer fertiliser subsidies, crop loans, and loan waivers, raising concerns about the effectiveness of the developing scheme. This suggests that the existing support schemes for the agricultural sector should not be hastily discontinued. A significant proportion of beneficiaries, 41 per cent, believe that MSPs and subsidies cannot be substituted with this scheme, while 23.5 per cent remain undecided.

While the online transfer of benefits represents a new digitised approach that streamlines the process, it also presents its challenges. Farmers found receiving checks more empowering and convenient as they could choose which bank to encash the checks in. However, under the current scheme, the money is directly transferred to the Grameena Bank, leading to issues such as the bank withholding the funds to clear old debts that were promised to be waived off by the government. This causes unnecessary delays, and timeliness in these transfers is of utmost importance (Dhar et al., 2022).

On a positive note, it was noted that the transfers do encourage farmers to make expenditures for agricultural purposes. A majority, around 78 per cent of claimants, confirmed that they used the funds for agricultural activities. In comparison, 11 per cent utilised the allowance to clear old debts and support themselves until the next set of transfers. It is also encouraging to note that 62.5 per cent of the beneficiaries reported a positive impact on crop production due to the transfers. Most importantly, the cash transfers have provided farmers with a buffer, boosting their morale and confidence and positively influencing their mindset (Dhar et al., 2022).

Therefore, it is worth acknowledging the Rythu Bandhu Scheme's positive aspects. It provides farmers with a unique opportunity for further development, and many beneficiaries have attested to the psychological solace it has brought them. However, given that the scheme is still in its early stages, it is still early to draw firm conclusions regarding its effectiveness and implementation challenges. Nonetheless, this is an opportune moment to gather preliminary insights into the scheme's targeting, operational obstacles, and overall impact.

Dharani Portal (Integrated Land Records Management System)

The Dharani Portal has been operational since the year 2020. As of November 2022, it is stated that it has recorded significant achievements, including 2.81 lakh Gift Deeds, succession rights for 1.80 lakh individuals, and a total of 9.16 crore hits on the portal. Since its launch, the portal has facilitated an impressive 11.24 lakh transactions and addressed 3.16 lakh land dispute grievances (Reddy, 2020).

The success of the Dharani Portal has prompted several state governments to consider adopting similar services and exploring the possibility of replicating the portal. Before Dharani's launch, transactions were only conducted at the 141 Sub Registrar Offices throughout the state. However, since the implementation of Dharani, registrations can now be done at the 574 mandal headquarters, making registration services more accessible to citizens.

Previously, individuals had to go through a cumbersome process to update revenue records for land mutations after registration. However, with Dharani, mutations are now performed instantly, and e-Pattadar passbooks are shared with citizens via SMS within seconds. Physical passbooks with 18 security features are delivered by mail to landowners within a week. U ntil November 2022, the Dharani portal recorded 9.16 crore hits and completed over 26 lakh transactions. Notably, Dharani has also resolved numerous long-standing grievances, including 2.97 lakh cases where registrations were completed in the past, but mutations were not finalised.

The State government has successfully addressed 3.16 lakh land-related grievances, instilling new confidence among farmers and NRIs regarding the security of their lands. Dharani provides information on 1.54 crore acres of agricultural land belonging to 70 lakh pattadars. These individuals have been receiving Rythu Bandhu benefits smoothly, as all government lands, endowments lands, and wakf lands were automatically locked, preventing any unauthorised transactions related to these lands.

By leveraging these accurate and up-to-date land records, the state aims to eliminate fictitious land transactions and make informed decisions regarding investment support on actual land holdings. This initiative enhances transparency and efficiency in land transactions, ensuring that investments are directed towards legitimate and productive agricultural ventures.

In summary, the Telangana government's commendable land records updation and rectification program, praised for its importance in good governance, has successfully conducted a thorough land survey, rectified records, and established the user-friendly Dharani website for real-time registration of land transactions.

Potential Concerns

However, a report argues that the Dharani portal currently has approximately 10 lakh pending applications across various categories. The same report by the Indian Express dated September 2022 noticed that the portal lacks a window to address certain issues such as changes of passbook, Sadabinama registrations, boundary disputes, and corrections in the name, extent, and nature of the land. This absence of a facility to handle these matters has left many landowners unsure where to seek resolution for their problems. As a result, the number of pending applications continues to grow (Kartheek, 2022).

These issues arise because certain services can only be authorised by District Collectors. However, with thousands of applications awaiting approval or rejection, it becomes challenging for the Collectors to handle them all while juggling their other responsibilities. This situation forces farmers to rely on middlemen, data entry operators, and local political leaders, who sometimes demand some money to assist with their applications.

Another problem arises from the fact that in the old revenue records, the names of new land buyers were not immediately updated after registrations. Consequently, the names of previous owners remained in the records, causing conflicts between the parties involved.

Furthermore, mutation certificates are being issued with the digital signature of concerned Tahsildars. This raises concerns among Tahsildars and lower-ranking officials in the Revenue department, as they may be held liable in court cases related to these certificates. They suggest that the certificates should either bear the name of the Collector or authorise Tahsildars to issue them. Moreover, due to the abolishment of the Village Revenue Officer (VRO) system, the verification of land claims falls upon only a limited number of Tahsildars and Revenue Inspectors, making it difficult to handle the large volume of applications.

Additionally, some government lands that should be marked as prohibited are not categorised as such in the Dharani portal. This allows people to attempt to register government properties, and it is suggested that discretionary power and time should be given to decide whether to register such properties or not. Furthermore, it is stated that users of the Dharani portal face the problem of not refunding registration fees in the event of slot cancellations.

Addressal

The state government has changed the Dharani portal in response to criticism and allegations of land grabbing by opposition parties. One of the modifications is the introduction of the TM32 module, allowing collectors to correct errors in land mapping. Revenue conventions will also be held to address landowners' complaints. The portal initially aimed to streamline land registration but faced issues due to manual entry errors and the inclusion of certain deeds in the prohibitory list. As a result, landowners faced hardships, leading to petitions and protests. Collectors have been instructed to prioritise resolving claims and verify cases related to different land categories. The Nizamabad collector expressed confidence that genuine land issues would be resolved using the TM32 module.

In addition to this modification, other concerns related to the Dharani portal must be addressed in a manner that minimises the number of issues, particularly for farmers whose Rythu Bandhu status is affected. Hence, by addressing these concerns, the government can improve the overall experience for smallholder farmers and maintain the integrity of other connecting programs (Pulloor, 2022).

Promotion of Palm Oil Production

Oil palm is a productive oilseed crop, known for its high yields worldwide. It accounts for 33 per cent of global edible oil consumption and 60 per cent of India's consumption, making it the second-highest imported commodity after crude oil. India imports one crore MTs (metric tonnes) of crude palm oil worth Rs. 80,000 crores from Malaysia and Indonesia. **It is argued that oil palm requires only 25 per cent of the water compared to paddy. It offers five times the returns of paddy once the plantation reaches full maturity.**

Oil palm cultivation and processing in Telangana are regulated by The Telangana Oil Palm (Regulation of Productions and Processing) Act 1993. The act mandates that designated companies procure all harvests at prices determined by the state government. Currently, oil palm cultivation covers 45,000 acres in Khammam, Kothagudem, and Suryapet, with three operating companies in the state: TS Oil fed, Godrej, and Ruchi Soya (Telangana State Food Processing Society (TSFPS), 2021).

Potential Concerns and Addressal Mechanism

However, oil palm has a gestation period of four years. Additionally, oil palm must be crushed within 24 hours of harvest, requiring the cultivation to be clustered within a 50 km radius of the mill.

Both the state and central governments have agreed that cultivating palm oil is a viable alternative to importing edible oil. The government of Telangana has already begun promoting this concept, but further steps can be taken to enhance the palm oil industry, such as establishing processing centres near the cultivation areas. Regarding sustainability, it is crucial to conduct an initial assessment of the available resources to determine if the soil and weather conditions are suitable for palm oil cultivation. Additionally, intercropping techniques should be implemented to ensure that farmers have a sustainable source of income during the , palm trees' gestation period, which can supplement their earnings. By considering these factors and implementing appropriate measures, palm oil cultivation in Telangana can be economically and

environmentally optimised. Hence, to establish new oil palm plantations, it is essential to simultaneously develop the ecosystem of nurseries, plantations, and oil mills.

Another agriculture and dairy business expert from a renowned company stated that while palm oil cultivation is limited to certain lands, it continues to provide a consistent source of revenue, albeit with a gestation period of three years. To support palm oil farmers, processing units should be established near the farms due to the low shelf life of the fresh fruit bunches. It requires a good scheme and ecosystem support to ensure proper implementation.

Government's Planned Initiatives for Palm Oil

To promote oil palm, the Government of India has set a target of 8.24 lakh acres in 25 districts of Telangana. Nine companies have been allotted zones across the state. The goal is to bring over 20 lakh acres under oil palm cultivation within three years, with a subsidy of Rs. 36,000 per acre provided to farmers. The subsidy will be disbursed directly to farmers' accounts under the Direct Benefit Transfer (DBT) mode, like the Rythu Bandhu scheme (TSFPS, 2021).

The total funds required for the plan are estimated at Rs. 780 crores in 2022-23, Rs. 1,970 crores in 2023-2024, Rs. 3,100 crores in 2024-2025, Rs. 850 crores in 2025-2026, and Rs. 500 crores in 2026-2027. The government may levy a cess on oil palm companies to purchase fresh fruit bunches (FFBs), potentially earning an additional Rs. 200 crores per year. Collaboration with organisations like NABARD and NCDC (National Cooperative Development Corporation) can be explored to fund the subsidy portion of the plan.

It has been stated that banks will be encouraged to provide credit schemes for farmers to finance oil palm cultivation, while TS Oil fed will be supported in establishing more oil mills in a cluster approach. A joint venture with Costa Rican companies can help develop indigenous capabilities in seed production, nursery management, yield maximisation, intercropping, and oil processing (TSFPS, 2021).

To implement the Telangana State Oil Palm Mission, a Cabinet Sub-Committee headed by the Minister for Horticulture, along with Ministers for Finance and Industries, will decide the policy and implementation strategies. An inter-departmental committee of officials is set to ensure coordination between departments and drive the mission.

Promoting oil palm cultivation on 20 lakh acres over the next three years is expected to yield significant benefits. It will reduce the burden on paddy procurement by an estimated 25 lakh MTs, decrease annual electricity subsidy costs by approximately Rs. 1500 crores, increase the state's agriculture GVA (Gross Value Added) by 10 per cent, boost annual incomes for 4 to 5 lakh households by at least four times, generate annual SGST (State Goods and Service Tax) revenues of Rs. 2,000 crores and provide employment opportunities for 30,000 people directly and 200,000 at the farm level (TSFPS, 2021).

A few of our interviewees, with the sector experts, also voiced that the cultivation of palm oil, although considered water-intensive, is defended by some officials due to its suitability for areas with no water scarcity. Palm oil cultivation was seen as a means to reduce edible oil imports and provide higher incomes to farmers, despite the three-year waiting period for yields. However, further research on the economics and impact of palm oil cultivation was deemed necessary.

It was also suggested that from a health perspective, palm oil is not necessarily the best choice, considering the availability of highly nutritious oils like sunflower, mustard, coconut, and sesame oil in India.

In the past, different regions in India relied on specific oils like mustard oil in North India, sesame oil in Tamil Nadu, and coconut oil in Karnataka and Kerala, all of which have been proven to be healthy. Large-scale monoculture plantations are detrimental to biodiversity, which is crucial for mitigating climate change.

To promote the population's health and support local businesses, government policies should focus on encouraging the consumption and production of healthy oils such as coconut and mustard. Exploiting the international demand for coconut oil could also boost exports and revenue.

Therefore, it is imperative to establish a comprehensive policy roadmap that addresses the challenges and opportunities associated with palm oil cultivation and marketing.

Rythu Bima (Life Insurance for Farmers)

Rythu Bima is a scheme implemented in Telangana state that offers life insurance coverage to farmers. ***The scheme's primary objective is to provide financial relief and social security to the family members or dependents in the unfortunate event of the farmer's death, regardless of the cause.***

Farmers between 18 and 59 are eligible to enrol in the scheme. In the event of the enrolled farmer's death, an insured amount of 5.00 Lakhs is promptly deposited into the designated nominee's account within ten days.

The scheme is implemented using Information Technology and a Management Information System developed by the National Informatics Centre (NIC). It is stated that the nominees do not need to visit any office for claim settlement. Village-level outreach officers collect data from the revenue department in case of a farmer's demise and submit it to LIC (Life Insurance Corporation of India) on behalf of the designated nominee. The claimed amount is transferred to the nominee's account through Real-Time Gross Settlement (RTGS) using Direct Benefit Transfer (DBT).

The scheme enrolled 32.73 lakh farmers in 2020-21, with a total insurance premium paid by the state government amounting to 2917.39 crores. So far, claims have been settled for 40,273 farmers. Among the beneficiaries, 70.2 per cent are small and marginal farmers, highlighting the scheme's focus on supporting vulnerable farming communities.

The Rythu Bima scheme gained recognition internationally, as it was selected as one of the 20 innovative programs for agricultural development by the United Nations. It was showcased at the 'Innovations in Agricultural Development' conference held at the Food and Agriculture Organization (FAO) headquarters in Rome from November 20 to 23, 2018. The scheme and Rythu Bandhu received special appreciation, and the Chief Secretary of the Agriculture Department presented the measures taken for agricultural welfare in Telangana State (Lavanya, 2021).

Rythu Vedika (Agriculture Extension)

The Government of Telangana has taken an important step by initiating the construction of 2601 Rythu Vedika Work Sheds in clusters of Agriculture Extension Officers. These work sheds are being built with a construction cost of Rs. 22,00,000/- each, with a contribution of Rs. 12,00,000/- from the Department of Agriculture and Rs. 10,00,000/- from MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) funds, as specified in G.O. Rt. No: 264, Dt: 15-06-2020 of the A&C (Agri. II) Department.

Rythu Vedikas are unique platforms that aim to provide a space for farmers to come together, motivating and stabilising them in pursuing higher returns. The ultimate goal is to empower farmers to become Rythe Raju, exerting control over their agricultural practices.

These Rythu Vedikas serve a vital purpose in mobilising farmers and encouraging them to organise themselves into groups, aiming to achieve remunerative prices, access better marketing facilities, increase productivity, and make agriculture more profitable. By creating a platform for interaction, Rythu Vedikas allow farmers to share knowledge and experiences, fostering a sense of community.

Furthermore, Rythu Vedikas provide an opportunity for the government to gain insights into the ground-level challenges and difficulties farmers face. This knowledge enables formulating new strategies and improving existing systems, making agriculture more sustainable and profitable.

The significance of Rythu Vedikas goes beyond their physical structure. They serve as awareness hubs, informing farmers about various government welfare schemes and available subsidies. These platforms can also be utilised as skill-imparting centres, where agriculture and allied departments can train farmers. By disseminating information on institutional finance, Rythu Vedikas help stabilise farmers' income and ensure their continuity in farming.

Another crucial aspect of Rythu Vedikas is their role in encouraging farmers to adopt innovative and modern agricultural practices. By showcasing new techniques and technologies, these platforms promote adopting advanced methods that can enhance productivity and efficiency.

In addition, Rythu Vedikas provide venues for conducting training, awareness campaigns, and workshops on the latest advancements in agriculture. They serve as gathering places for farmers, enabling them to interact, share knowledge, and learn from each other's experiences (Lavanya, 2021).

Overall, the establishment of Rythu Vedikas reflects the Telangana government's commitment to supporting farmers and promoting sustainable agricultural development. These platforms empower farmers, improve their livelihoods, and foster a sense of unity and collaboration within the farming community.

Potential Concerns

One potential drawback of Rythu Vedikas is that the personnel has limited influence and ability to effectively communicate the concerns and needs of farmers to higher-level agriculture officers. It could hinder the flow of information and impede the farmers' ability to engage with senior officials in the department.

In another village we visited, we encountered a situation where the Rythu Vedika officer faced limitations in addressing the issues faced by the farmers. Despite their best intentions, the officer's role seemed confined to reporting the problems to senior officers rather than having the authority to resolve them directly.

Additionally, Rythu Vedikas may not be accessible to all farmers, particularly those in remote locations in rural areas. It is stated that one Rythu Vedika has been constructed for every 5000-acre cluster (Telangana State Finance Department, 2023). It could exclude certain farmers from benefiting from the resources and opportunities provided by these platforms.

Our research also took us to another village in the Vikarabad district in Telangana, where the villagers highlighted that while these agricultural service centres have proven beneficial to the nearby villages, they often neglect the ones located at a considerable distance. This discrepancy in accessibility became apparent during our interactions with the community.

SECTION - III
DATA INSIGHTS INTO THE AGRICULTURE SECTOR

Budget Allocations

Over the years, the government of Telangana has consistently allocated substantial funds to support agriculture and related sectors. Ten years before the formation of the state, Rs. 7,994 crore was spent on the agriculture sector. Whereas, post-formation of the state, the government has spent a cumulative of Rs.1,91,612 crore till January 2023 on the agriculture sector, which is a twentyfold increase compared to the pre-2014 period (Sri Harish, 2023). For 2023-24, a budget of Rs. 29,164 crores have been designated for agriculture. The budget allocation more than tripled in 2018-19 from 2017-18 (Table 3). From 2018-19 to 2022-23, approximately 13.8 per cent of the total expenditure has been directed towards agriculture and allied sectors, significantly higher than the average of other states, around 6.5 per cent.

Irrigation is an essential component of the agricultural sector, and the Telangana government recognised its significance by allocating substantial budgets during the initial years of the state's formation. These allocations were intended to support various irrigation projects, including initiatives like Mission Kakatiya and the Kaleshwaram lift irrigation project, indicating the government's commitment to enhancing irrigation facilities.

Table 3: *Telangana Budget Allocations for Agriculture and Allied Activities and Irrigation*

Years	Agriculture And Allied Activities (Crores)	Irrigation and Flood Control (Crores)
2016-17	6,611.00	24,132.00
2017-18	5,852.00	22,668.00
2018-19	17,252.00	24,969.00
2019-20	21,680.00	6,286.00
2020-21	25,305.00	4,704.00
2021-22	26,822.00	7,979.00
2022-23	27,228.00	10,946.00
2023-24	29,164.00	11,169.00

Source: Author Compilation (PRS Legislative Research, various years) | * From 2019-20, the budget allocation is for Irrigation and Flood Control

Telangana stands out as the sole state in India that has extended substantial investment support of Rs. 65,000 crores to benefit 65 lakh farmers through the Rythu Bandhu Scheme (Sri Harish, 2023). In the 2023-24 budget, a total of Rs. 11,704 crores have been allocated for the investment support scheme for the farmers. Another crucial area of focus for the government has been providing debt relief to farmers. From 2019-20 to 2022-23, they have allocated a cumulative of Rs. 19,978 crores for loan waivers and debt relief initiatives for the farmers (Table 4). Additionally, since 2018, the government has provided free power to farmers. From 2019 to 2020, they allocated Rs. 39,574 crores to fund this power subsidy for the farming community (Table 4).

Table 4: *Telangana Budget Allocations for Rythu Bandhu, Loan Waivers, and Free Power*

Years	Rythu Bandhu (crores)	Farmer Loan Waivers (crores)	Energy (crores)
2019-20	9,056.00	4,528.00	5,984.00
2020-21	14,000.00	6,225.00	10,000.00
2021-22	14,800.00	5,225.00	7,665.00
2022-23	14,800.00	4,000.00	7,665.00
2023-24	11,704.00		8,260.00

Source: Author Compilation (PRS Legislative Research, various years)

Land Use and Sown Area

The net sown area as a proportion of total land under survey increased by 13.83 per cent from 2014-15 to 2020-21. Looking at the land use data, an area that has come under cultivation is because of the conversion of fallow land to cultivable land. Fallow land in 2014-15 was 19.68 per cent of total land under survey, whereas in 2020-21, it has reduced to 5.26 per cent, a reduction of 14.42 per cent. Fallow land is classified into two types: Current fallows and fallow land other than current fallows. Current fallows are left uncultivated for one or less one agricultural year. Within the broader category of fallow land, the current fallows have decreased by 10.63 per cent from 2014-15 to 2020-21.

Interestingly, most fallow land reduction can be observed after 2018-19. In 2019-20, the fallow land accounted for 9.1 per cent of the total land under survey, marking a substantial reduction of 7.2 per cent compared to the figures from 2018-19. This reduction can be attributed to various factors, including introducing the Rythu Bandhu scheme, completing Mission Kakatiya, and opening the Kaleshwaram lift irrigation project. These initiatives have collectively contributed to the decrease in fallow land and the expansion of cultivated areas.

Table 5: *Land Use in Telangana*

Years	2014-15	2018-19	2019-20	2020-21	Change (2014-15 and 2020-21)
Forests	22.66%	24.07%	24.07%	24.70%	2.03%
Not Available for Cultivation	13.31%	12.88%	12.88%	12.88%	-0.43%
Uncultivated land other than fallow land	5.29%	5.27%	4.96%	4.29%	-1.01%
Fallow land	19.68%	16.20%	9.01%	5.26%	-14.42%
Fallow Lands Other Than Current Fallows	7.18%	6.70%	5.05%	3.39%	-3.80%
Current Fallow	12.50%	9.50%	3.96%	1.87%	-10.63%
Net Area Sown	39.05%	41.58%	49.08%	52.88%	13.83%

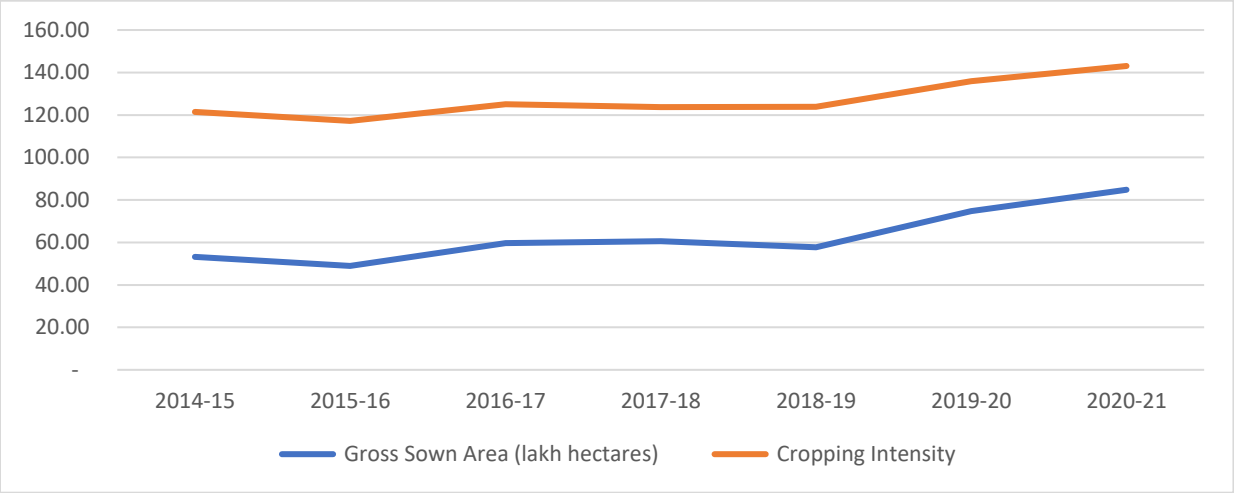
Source: Ministry of Agriculture and Farmer's Welfare

Gross Sown area and Cropping Intensity

The Gross sown area in Telangana has experienced a substantial growth of 59.53 per cent, expanding from 53.15 lakh hectares to 84.79 lakh hectares from 2014-15 to 2020-21. Consequently, the cropping intensity increased from 121.45 to 143.07 during the same period. This remarkable rise can be attributed to the state's efforts to enhance existing irrigation infrastructure and introduce new facilities, aiding increased agricultural activity and improved land utilisation.

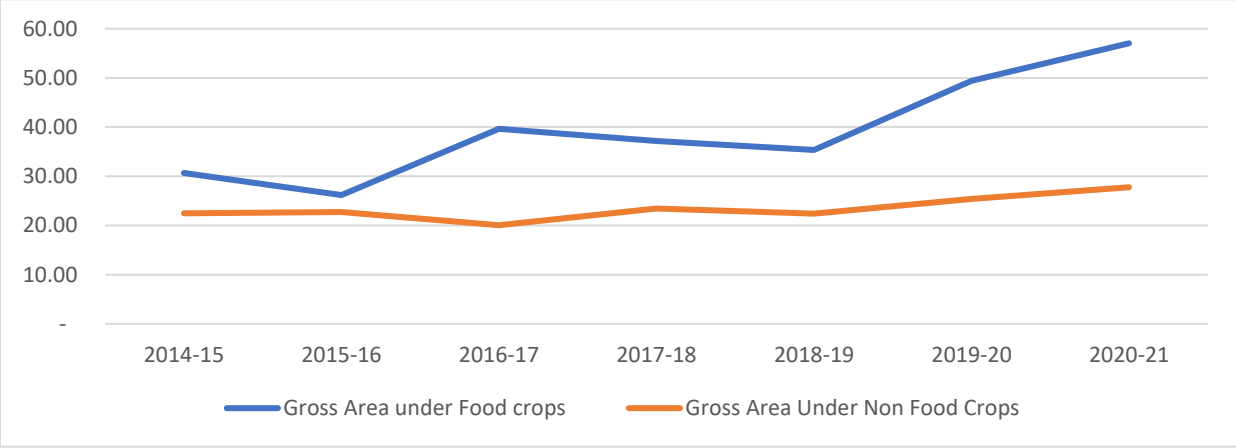
The Gross sown area under food crops has seen an impressive increase of 85.9 per cent from 30.68 lakh hectares in 2014-15 to 57.03 lakh hectares in 2020-21. Notably, a steep spike of 39.8 per cent in 2019-20. On the other hand, the Gross sown area allocated to non-food crops has seen a modest growth of 23.52 per cent from 2014-15 to 2020-21.

Figure 5: *Gross Sown Area (Lakh Hectares) and Cropping Intensity*



Source: Ministry of Agriculture and Farmer's Welfare

Figure 6: *Gross Sown Area (Lakh Hectares) under Food and Non-Food crops*



Source: Ministry of Agriculture and Farmer's Welfare

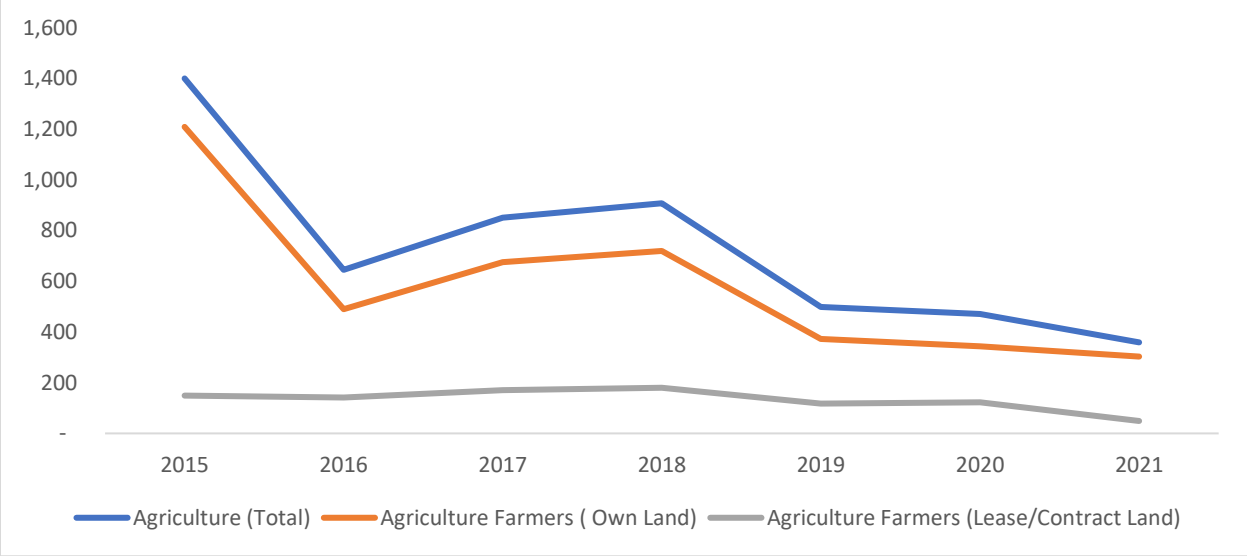
Farmer Suicides

The number of farmer suicides in Telangana has experienced a significant reduction of 74 per cent, decreasing from 1,400 in 2015 to 359 in 2021. This reduction can be further broken down by the categories of farmers who own land, those who contract/lease land, and agricultural labourers:

1. For farmers who own land, the suicides have reduced from 1,209 in 2015 to 303 in 2021.
2. Similarly, for farmers who contract/lease land, the suicides have reduced from 149 in 2015 to 49 in 2021.
3. Finally, for agriculture labourers, the suicides have reduced from 42 in 2015 to 7 in 2021.

Additionally, in 2019, a steep reduction in farmer suicides of 45.04 per cent was observed. This significant reduction can be attributed to various initiatives introduced by the government in 2018-19, such as the Rythu Bandhu direct benefit transfer scheme, the opening of the Kaleshwaram Lift Irrigation Project, and the completion of the Mission Kakatiya project. These initiatives likely played a crucial role in improving the overall well-being of farmers and reducing distress in the agricultural sector.

Figure 7: *Farmer Suicides in Telangana from 2015 to 2021*



Source: Accidental Deaths and Suicides in India (Different Issues)

Farmer Incomes

The average monthly income for small/marginal farmers in Telangana in 2022 was Rs. 23,845, and for organised farmers, Rs. 46,277. From 2015, the farmer incomes have grown at a compound annual growth rate (CAGR) of 10.15 per cent and 14.99 per cent for small/marginal and organised farmers, respectively. Adjusting for inflation, for small/marginal farmers, the income has increased by 50.79 per cent from 2015; for organised farmers, the income has increased by a whopping 103.33 per cent from 2015.

The government started Rythu Bandhu in 2018, so considering the income of farmer households without the government income, for small/marginal farmers, inflation-adjusted income increase is 38.53 per cent. Similarly, for organised farmers, it is 94.19 per cent. The feat of doubling a farmer's income is a reality for organised farmers. However, there is still a long way to go for small/marginal farmers.

Table 6: *Income in Telangana in 2015, 2018, and 2022*

Years	Small/Marginal Farmers	Organised Farmers	Average
2015	12,122.00	17,409.00	14,765.50
2018	17,702.70	30,684.58	24,193.64
2022	23,845.00	46,277.00	35,061.00
CAGR (2015 to 2022)	10.15%	14.99%	13.15%

Source: CMIE Households

Table 7: *Nominal and Inflation Adjusted Increase in Farmer Income from 2015 to 2022*

From 2015 to 2022	Inflation*	Nominal increase	Inflation Adjusted Increase	Nominal increase (without govt. income)	Inflation Adjusted Increase (without govt. income)
Small/Marginal Farmers	30.45%	96.71%	50.79%	80.72%	**38.53%**
Organised Farmers	30.45%	165.82%	103.77%	153.32%	**94.19%**
Average	30.45%	137.45%	82.02%	123.52%	**71.34%**

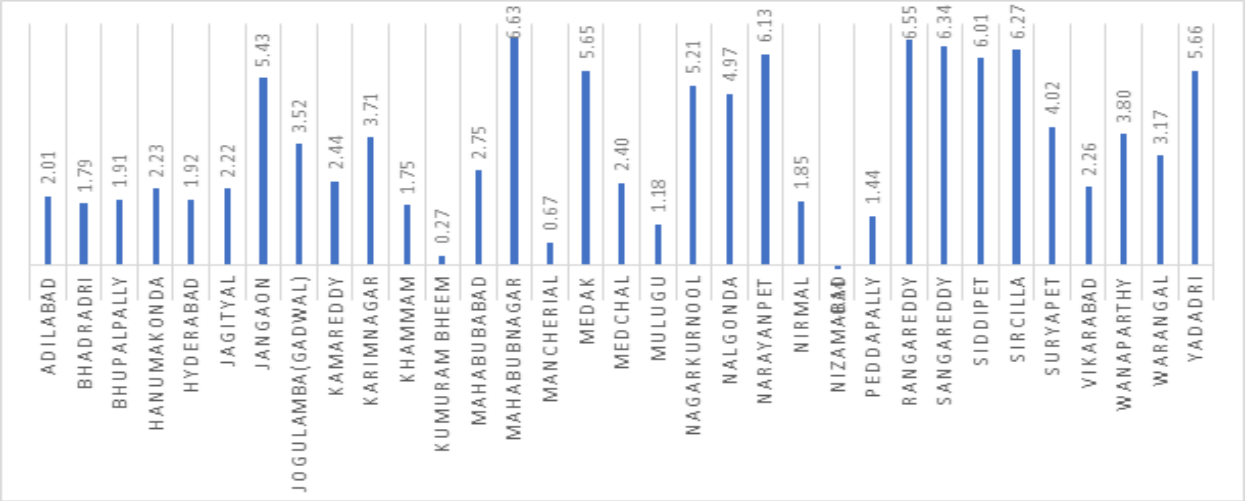
Source: Author Calculation | *CPI(Rural) in 2015 was 126.1, and in 2022 it was 164.5

Ground Water Levels

As of March 2022, the water level increased by 3.39m compared to March 2012. The maximum decadal increase in water level was 32.04m recorded at Khudabhakshpally village, Nalgonda district. Also, the maximum decadal water level fall of 7.3m was observed at Komatlagudem village, Mahabubabad district.

The rise in the water levels compared to the decadal average of March (2012-2021) was observed in 336 mandals out of 594 mandals. 39 mandals observed a rise of up to 0.5m, 27 mandals between 0.5-1.0m, 1-2m in 72 mandals and more than 2 in 198 mandals **(**Government of Telangana,2022**).**

Figure 8: *Rise in water levels compared to the decadal average (2012-2021)*



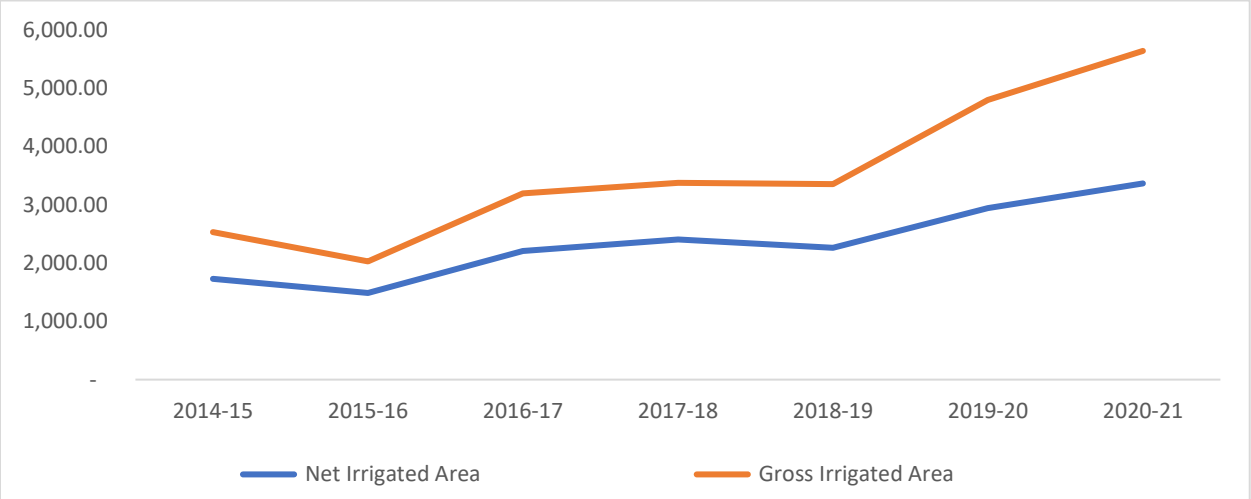
Source: Status of Groundwater Level Scenario (March 2022), Government of Telangana

AGRICULTURE INPUTS

Irrigation

The net irrigated and gross irrigated areas have seen a significant increase of 95 per cent and 123 per cent, respectively, compared to 2014-15 levels. As a proportion of gross sown area, the gross irrigated area has increased by 18.91 per cent from 2014-15 to 2020-21. Post-2018-19, a steep increase can be observed from the (figure 9). It can be attributed to the completion of Mission Kakatiya and the Kaleshwaram Irrigation Project. In 2019-20, the annual growth of gross irrigated area was 43.1 per cent; for 2020-21, it was 17.5 per cent.

Figure 9: *Net and Gross Irrigated Area (000' hectares)*

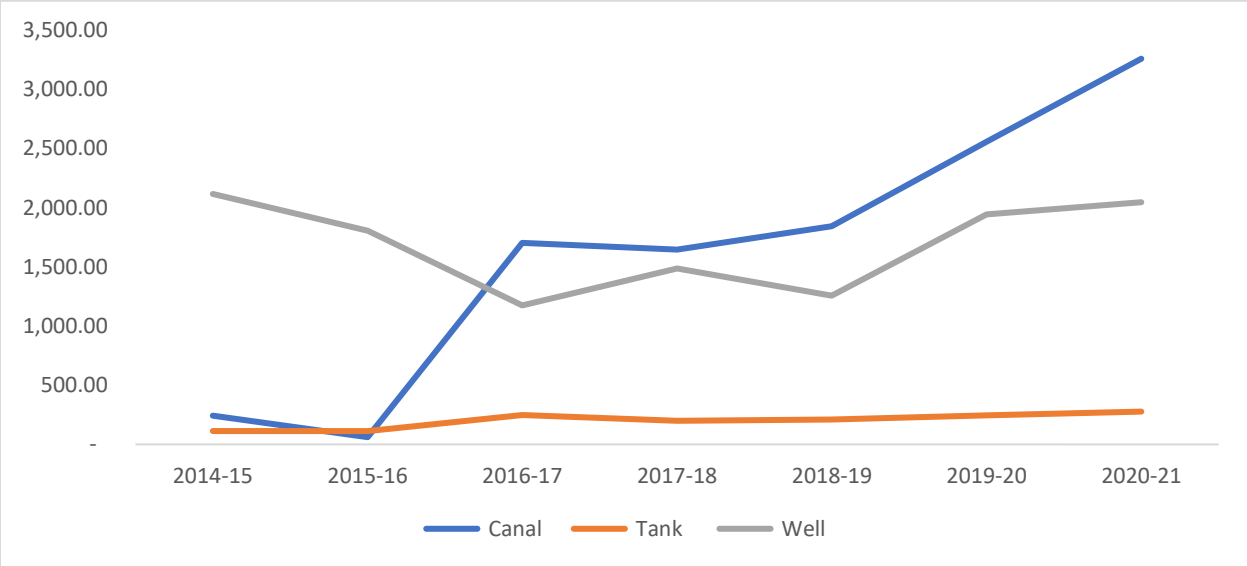


Source: Ministry of Agriculture and Farmer's Welfare

Gross Irrigated Area under Different Sources

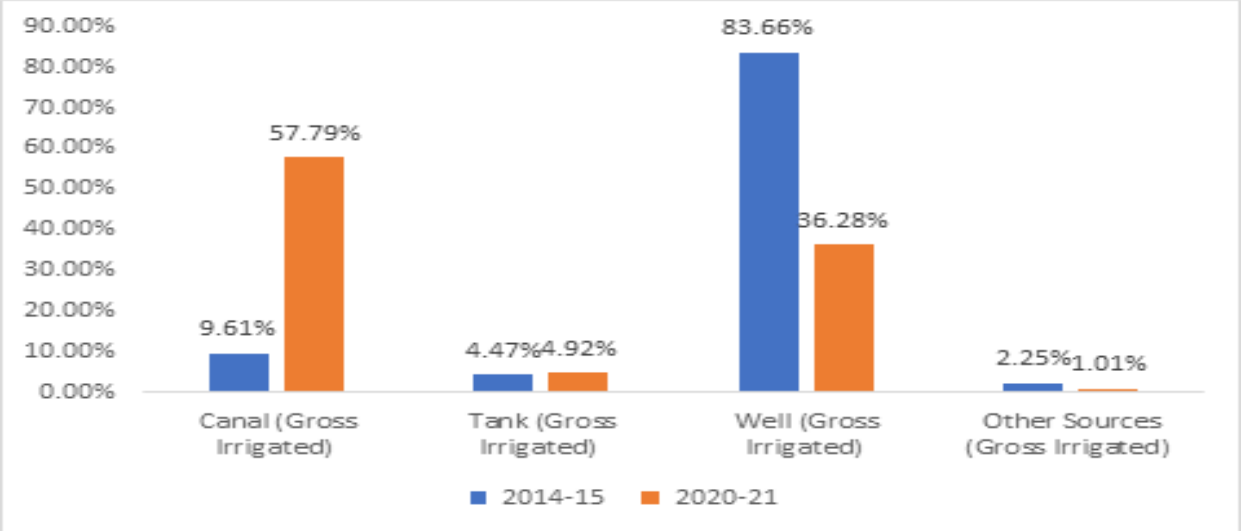
There are three primary sources of irrigation water: canals, tanks, and wells. Irrigation through wells made up 83.66 per cent of the total gross irrigated area in 2014-15, which has reduced to 36.28 per cent in 2020-21. Irrigation through canals has substantially increased from 9.61 per cent in 2014-15 to 57.79 per cent in 2020-21.

Figure 10: *Gross Irrigated Area under Different Sources (000' hectares)*



Source: Ministry of Agriculture and Farmer's Welfare

Figure 11: *Percentage of Gross Irrigated Area under Different Sources in 2014-15 and 2020-21*

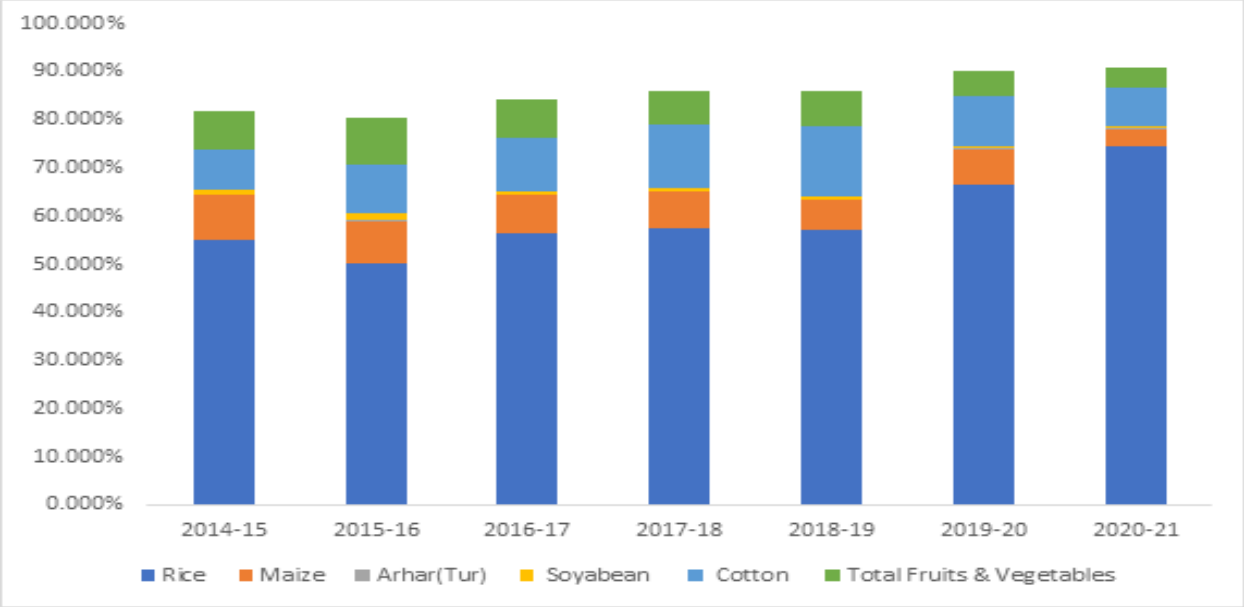


Source: Ministry of Agriculture and Farmer's Welfare

Gross Area Irrigated Under Different Crops

The gross irrigated under paddy has dominated the gross irrigated area since 2014-15. Gross irrigated area under paddy increased from 55 per cent in 2014-15 to 74.5 per cent in 2020-21. The gross irrigated area under maize and fruits and vegetables have reduced by 6.02 per cent and 4.17 per cent, respectively, from 2014-15 to 2020-21.

Figure 12: *Percentage of Gross Irrigated Area under different crops*



Source: Ministry of Agriculture and Farmer's Welfare

Seeds

It is globally recognised that seeds are a crucial component of agriculture. The quality of seeds stands at the core of ensuring the sustained development of the agricultural sector. In addition, quality seeds are important because they impact the effectiveness of other inputs in improving productivity, production levels, and, ultimately, farmers' income. A strong and reliable seed supply, accessible to farmers and offered at reasonable prices, can be considered the primary and essential step to the country's food security. In addition, it plays a pivotal role in driving agricultural growth.

Telangana is known as the seed bowl of India. In 2020, it had 450 seed companies with robust infrastructure like processing capabilities (850 tonnes per hour) and storage facilities. Additionally, the state boasts a skilled workforce, public and private research organisations and seed farmers who produce a variety of seeds for agencies (Raju et al., 2022).

In the state, cultivation of different categories of seeds is done by governmental and private institutions, including breeder seed, foundation seed, and certified seed. The certified and high-quality seeds are supplied to farmers through various central and state schemes. It is one of the effective ways to ensure increased production and productivity at the farm level. Providing seeds at a subsidised cost helps farmers access quality seeds, which is a critical input in farming. (Department of Agriculture, Government of

Telangana, 2021). The State Action Plan, 2021-22, proposed distributing 1.92 lakh quintals of green manure seed on subsidy through the Telangana State Seed Development Corporation (TSSSDC).

In 2021-22, Telangana SSDC produced seeds worth ₹6,500 crore. In the same year, it produced 1,60,441 quintals of seed for 18 food, commercial and fodder crops. The production met the needs of Telangana and other states like Andhra Pradesh, Chhattisgarh, Kerala, Tamil Nadu, Karnataka, Uttar Pradesh, Maharashtra, West Bengal and Odisha (The Hindu, 2022).

Karimnagar and Warangal in Telangana account for more than 80 per cent of the hybrid paddy production in India. Additionally, Khammam, in Telangana, specialises in hybrid maize production, and Gadwal district specialises in cotton production (NSAI report on seed industry submitted to NABARD, 2020).

The area under seed production has increased between 2020 and 2014 by 26.88 per cent. However, the portion of the total area under hybrid rice seed production has reduced from 23.3 in 2014 to 13.3 in 2020. Similarly, even the portion of the total area under cotton seed production has reduced from 8.0 per cent in 2014 to 4.7 per cent.

Overall, the share of Telangana in the Indian seed business has declined from 30 per cent in 2014 to 19 per cent in 2020. The reduction is because the seed industry has shifted to Chhattisgarh for hybrid rice production and Andhra Pradesh for hybrid maize seed production (Raju et al., 2022).

Assessing this trend, Raju et al. (2022) suggested a need for an incentive to create an environment beneficial for seed growers to prevent further shifting of hybrid rice and cotton growers.

One of our speakers, the executive director of a rural development society, mentioned that Telangana is known as the Seed Bowl of the country. Still, farmers in the state do not have much access to these seeds. The seed value chain is controlled by national and multinational companies: though they add value, the farmers do not have control over their seeds.

Hence, seed production by the FPOs is a much-needed intervention for Telangana: there are good seed co-operatives in FPOs like Karimnagar and Warangal exporting seeds to other states. Seeds like cotton, groundnut, some fruits and vegetables, soybean, red gram, onion, potato, Bengal gram, and millet can be produced. Since these crops are mostly self-pollinated and open-pollinated, companies are not interested in them due to low margins; however, they are very important for small farmers. Encouraging seed production, processing, and distribution by FPOs is one important initiative that can be taken up in this state.

Table 8: *Seed Statistics of Telangana*

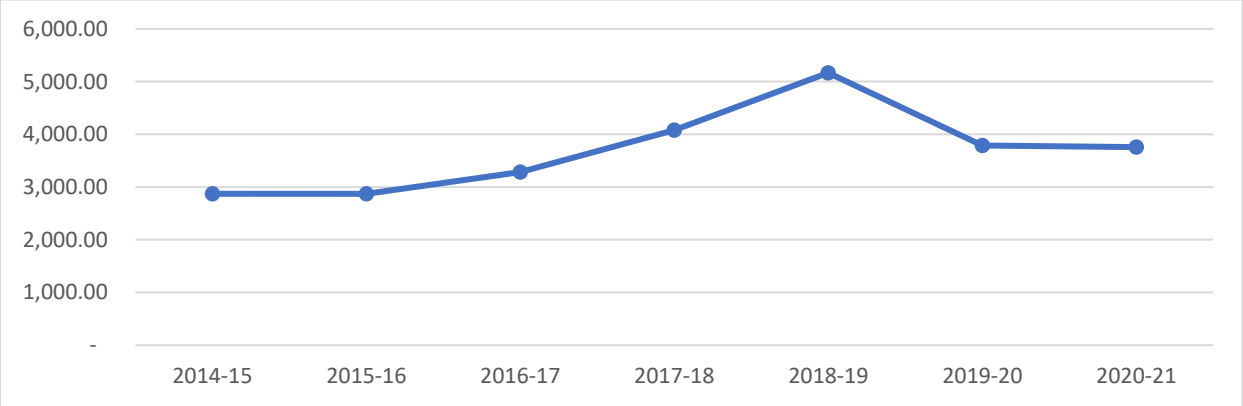
Indicators	2014	2020	Change (%)
Total area under seed production of all crops (acres)	4,72,400	5,99,400	26.88%
Number of registered seed companies	400	450	12.50
Total number of seed growers	3,00,000	3,20,000	6.67
Area under hybrid rice seed production (acres)	1,10,000 (23.3)	80,000 (13.3)	-27.27
Quantity of hybrid seed produced (tonnes)	51,750	41,160	-23.09
Number of hybrid seed growers	66,865	3,50,000	84.21
Area under inbred rice seed production (acres)	1,90,000 (40.2)	3,50,000 (58.4)	84.21
Quantity of inbred rice seed produced (tonnes)	3,86,000	7,00,000	81.35
Number of inbred rice seed growers	86,300	1,59,000	84.24
Area under cotton seed production (acres)	38,000 (8.0)	28,500 (4.7)	-25.00
Quantity of cotton seed production (tonnes)	10,450	7,500	-28.23
Number of cotton seed growers	58,000	40,600	-30.00
Area under hybrid maize seed production (acres)	18,000	13,000	-27.8

Source: (Raju et al., 2022).

Power

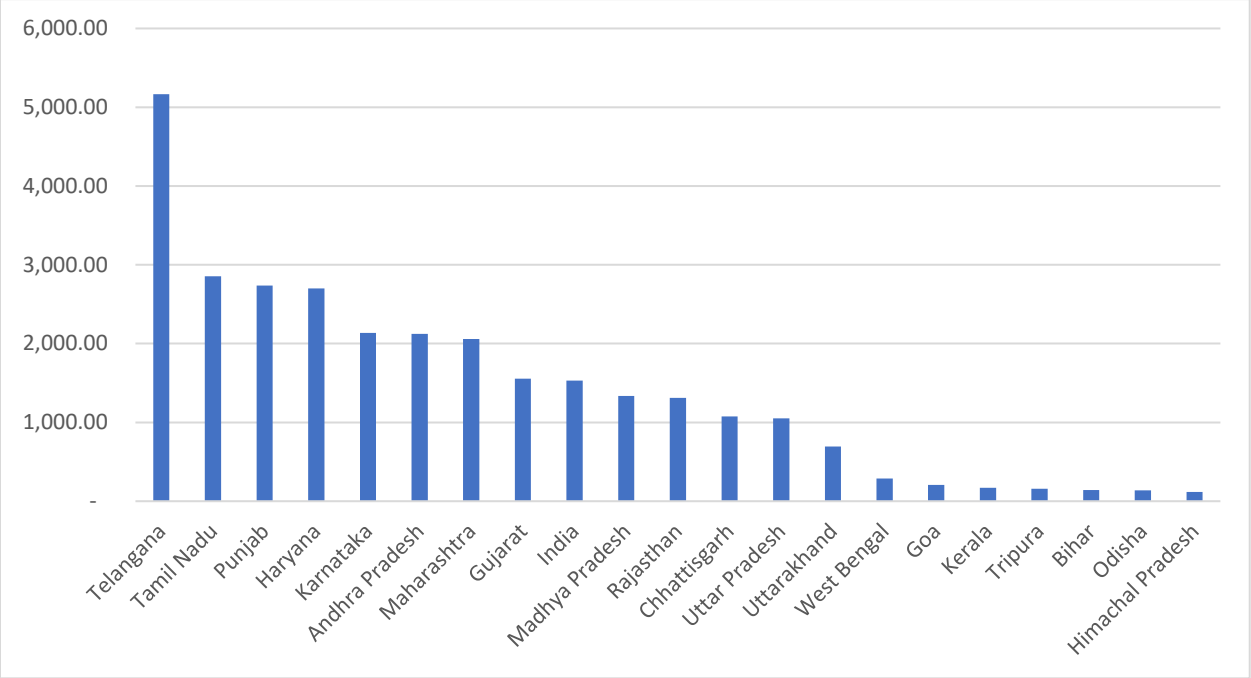
Telangana government has provided free power for the farmers since 2018. Power consumption per net sown area (kwh/nsa) has increased by 30.77 per cent from 2014-15 to 2020-21. It peaked in 2018-19 with 5,166 kwh/nsa, post which it has declined. In comparison to states, in 2018-19, Telangana had the highest consumption of 5,166 kwh/nsa, whereas the India average was 1,531 kWh/nsa.

Figure 13: *Power Consumption in Telangana per Net Sown Area (Kwh/NSA)*



Source: IndiaStat and Ministry of Agriculture and Farmer's Welfare

Figure 14: *Power consumption per Net Sown Area (kwh/nsa) in 2018-19 for a few Indian States*



Source: Agriculture Statistics 2021 and RBI Handbook of Indian States

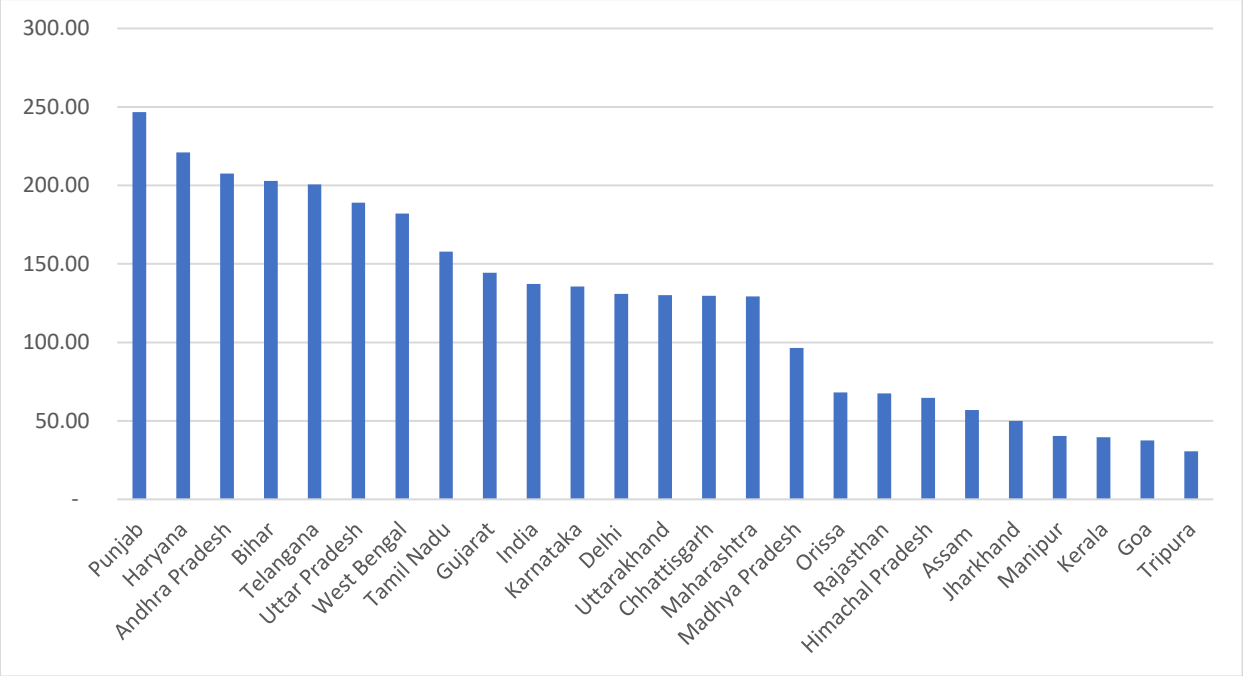
Farmer representatives argue in favour of free electricity because only a few regions have canal irrigation through public investment benefits. In areas where farmers do not receive canal irrigation, they have to make private investments in drilling borewells and purchasing pumping sets. The farmers have to bear the initial operation and maintenance costs. The provision of free electricity tries to address regional inequity in irrigation water (Fosli et al., 2021).

Fosli et al. (2021) highlight that the policy of offering free electricity might serve to support populist political objectives. However, it is often wrongly perceived as a solution to farmers' issues. A more effective approach for the government would be to concentrate on initiatives such as watershed management, rainwater harvesting, micro-irrigation, and ensuring farmers receive high-quality power supply with appropriate fees for resource utilisation.

Fertiliser

In 2020-21, Telangana's fertiliser consumption stood at 200.53 kg per hectare, making it the fifth-highest consumer of fertilisers among Indian states. However, when we examine previous years, there is a 25 per cent decline in fertiliser consumption since 2015-16. While Telangana still maintains a relatively high level of fertiliser usage, this gradual reduction can be attributed to a shift towards more sustainable farming practices.

Figure 15: *Fertiliser (N+P+K) consumption of different States in 2020-21 (kg/hectare)*



Source: Agricultural Statistics at a Glance 2021

Table 9: *Fertiliser (N+P+K) consumption in Telangana and India (kg/hectare)*

Years	Telangana	All India
2015-16	268.91	130.66
2016-17	252.56	124.41
2017-18	252.96	127.88
2018-19	237.48	132.14
2019-20	168.57	127.79
2020-21	200.53	137.15

Source: Agricultural Statistics at a Glance (Different Issues)

MAJOR CROPS

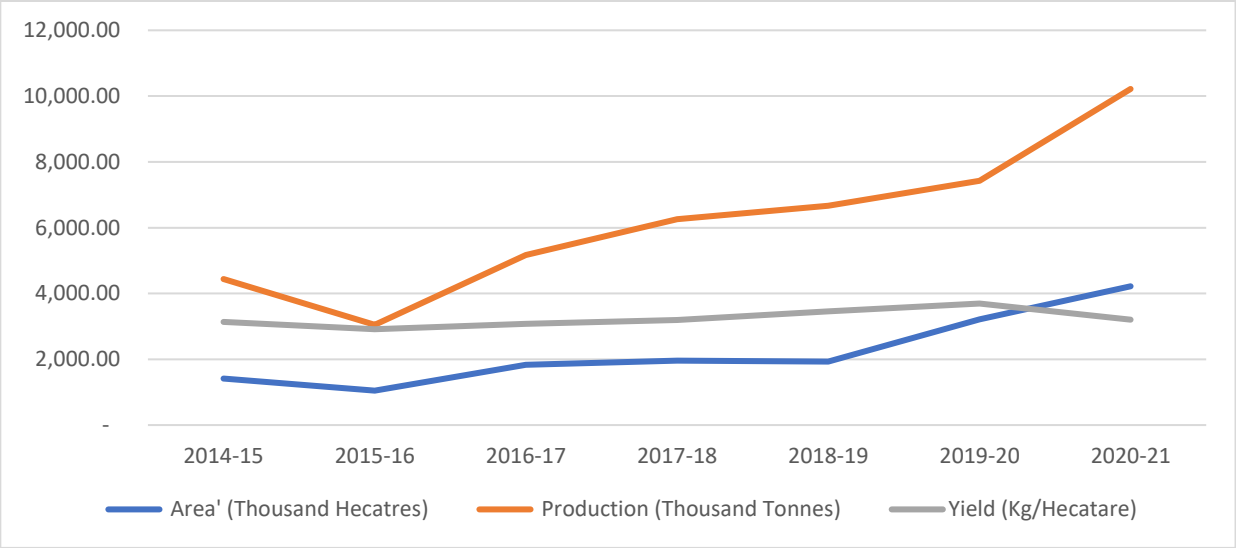
The major crops of Telangana are Paddy, Cotton, Maize, Tur, and Soyabean. In 2020-21, these five crops comprised 87.58 per cent of the total gross sown area. Crop-wise, paddy comprised 49.75 per cent, cotton was 27.81 per cent, tur was 5.05 per cent, maize was 3.05 per cent, and Soyabean was 1.91 per cent.

Paddy

Telangana has been hailed as the Annapurna (Sri Harish, 2023) or the nation's rice bowl. In 2020-21, it significantly contributed 8.2 per cent to total India production by producing 10217.1 thousand tonnes of paddy. According to the 2020-21 production figures, Telangana ranks India's fourth-largest paddy producer, trailing behind West Bengal, Uttar Pradesh, and Punjab.

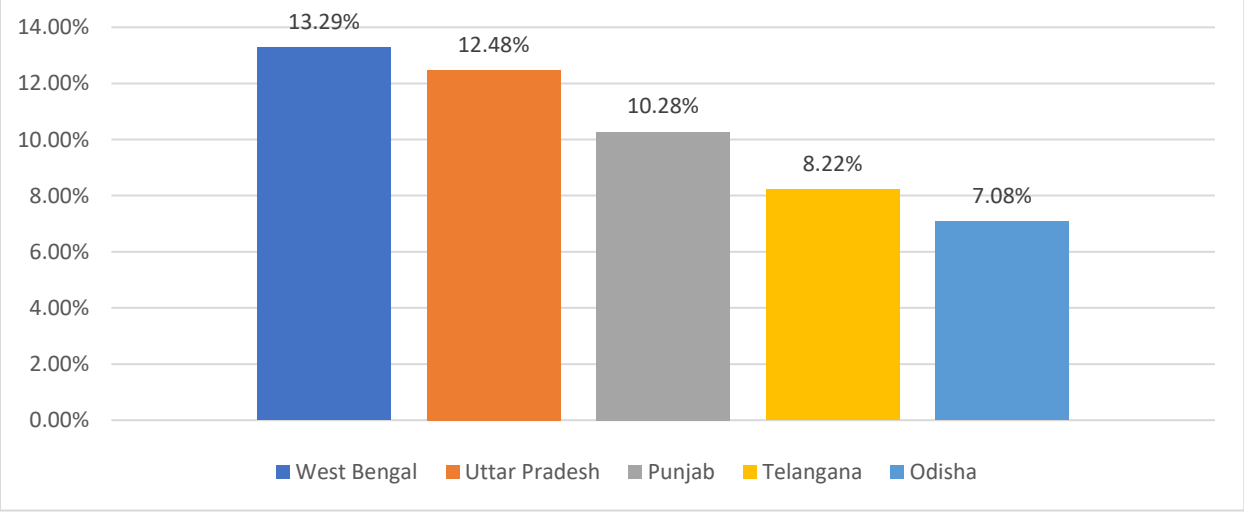
Telangana's gross area under paddy cultivation has increased by 198 per cent from 1415.42 thousand hectares in 2014-15 to 4218.11 thousand hectares in 2020-21. Similarly, the production saw a substantial rise of 130 per cent, from 4440.8 thousand tonnes in 2014-15 to 10217 thousand tonnes in 2020-21. Telangana's yield in 2020-21 was 3206 kg/hectare, higher than the Indian average of 2717 kg/hectare. Punjab (4366 kg/hectare), Andhra Pradesh (3393 kg/hectare), and Tamil Nadu (3379 kg/hectare) have higher yields than Telangana. Area under irrigation for paddy in Telangana since 2014-15 has been around 98-99 per cent.

Figure 16: *Gross Area Under Cultivation, Production, and Yield of Paddy in Telangana*



Source: RBI Handbook of Statistics and Ministry of Agriculture and Farmer's Welfare

Figure 17*: Proportion of Production of Paddy to Total India Production in 2020-21 - Top 5 States*



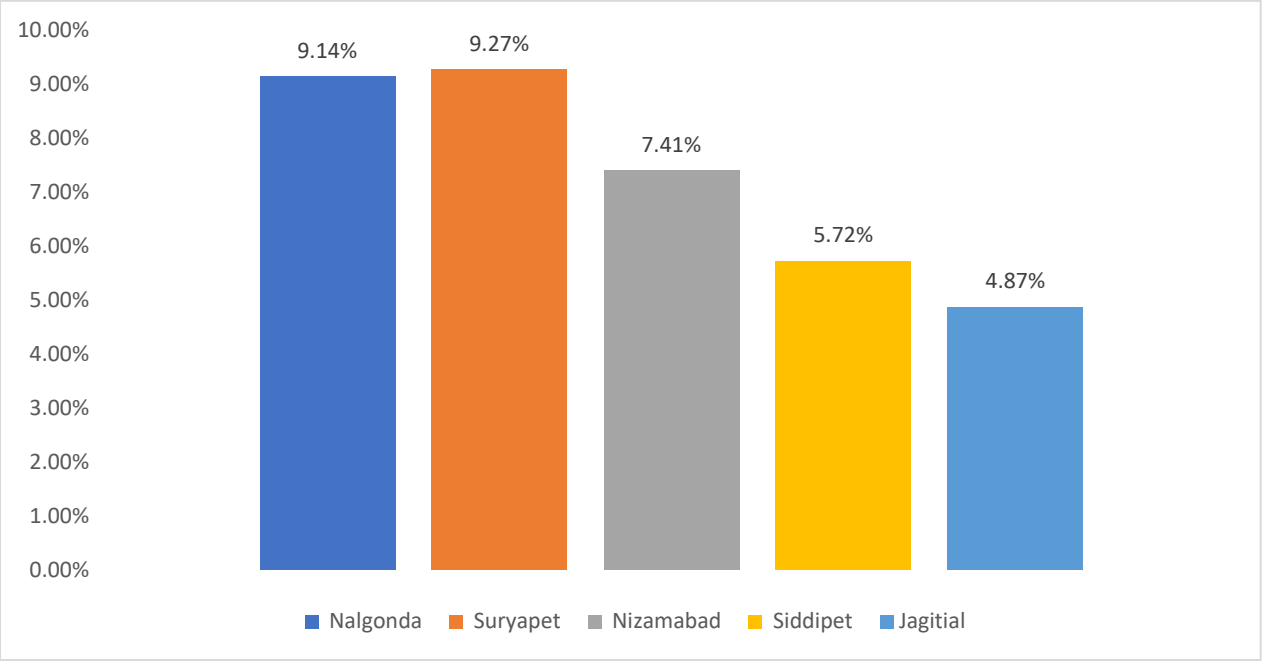
Source: RBI Handbook of Indian States

District

In 2021-22, the top 5 districts in producing paddy in Telangana were Nalgonda (9.14 per cent), Suryapet (9.27 per cent), Nizamabad (7.41 per cent), Siddipet (5.72 per cent), Jagitial (4.87 per cent).

Nalgonda produced 1220.3 thousand tonnes of paddy in 2020-21. 2019-20, a major increase in the area and production was observed. During this period, the area dedicated to paddy cultivation increased by 54.58 per cent, and production surged by 66.65 per cent (Table 10). It's worth mentioning that Nalgonda was one of the districts that received irrigation water from the Kaleshwaram project. Consequently, in 2019-20, canal irrigation in the district saw a remarkable increase of 58.67 per cent, contributing to the significant growth in paddy cultivation.

Figure 18: *Proportion of Production of Paddy to Total India Production in 2021-22 - Top 5 districts*



Source: Department of Agriculture and Farmer's Welfare

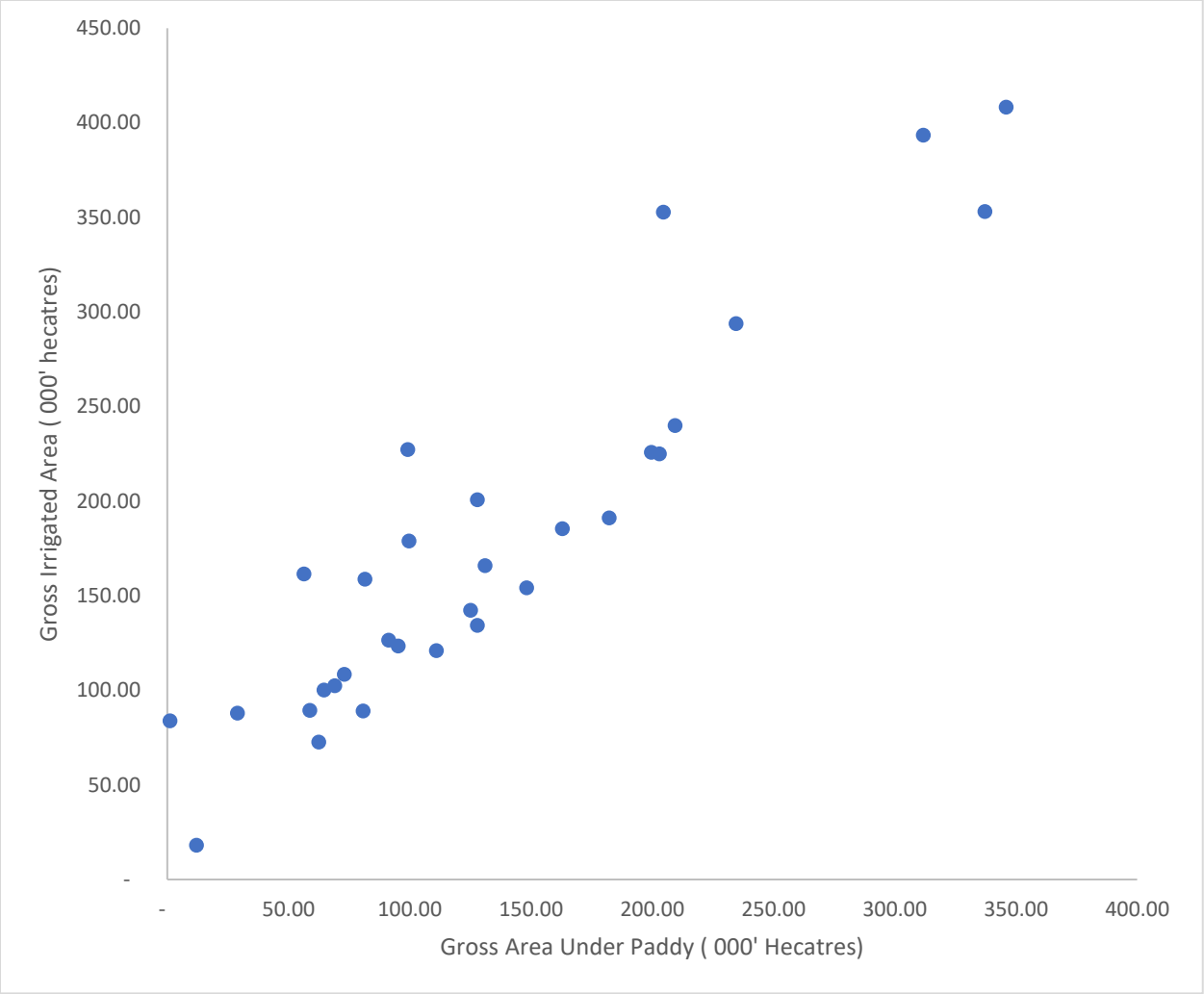
Table 10*: Area under Paddy Cultivation, Paddy Production, and Gross Canal Irrigation in Nalgonda District*

Years	Area (Hectares)	Production (Tonnes)	Gross Canal Irrigation (Hectares)
2018 - 2019	1,79,755.00	5,74,358.00	1,96,995.00
2019 - 2020	2,77,871.00	9,57,186.00	3,12,568.00
2020 - 2021	3,45,953.00	12,20,314.00	3,87,751.00

Source: Department of Agriculture and Farmer's Welfare

A positive relationship between the gross area under paddy cultivation and the gross irrigated area can be observed. Districts with a higher irrigated area have a higher area under paddy cultivation.

Figure 19: *Gross Area Under Paddy and Gross Irrigated Area for all Districts in Telangana in 2020-21*

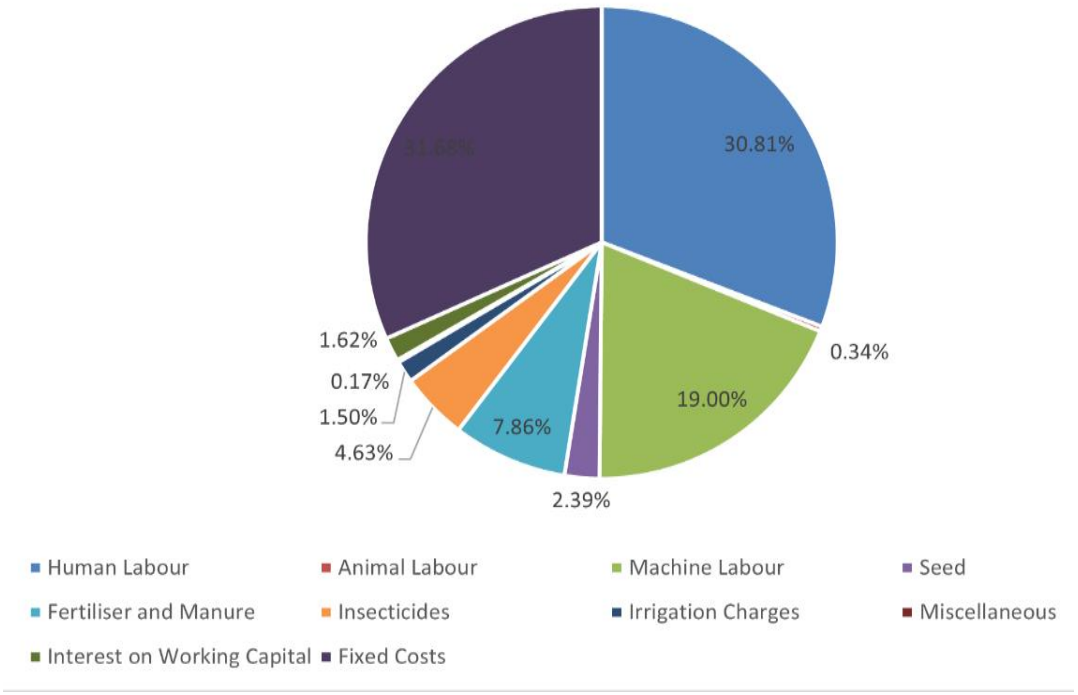


Source: Department of Agriculture and Farmer's Welfare

COST OF CULTIVATION AND PROFIT

The cost of cultivating paddy in Telangana is Rs. 1,13,266 / hectare, of which 68 per cent are operational costs. Major operational costs include labour, seeds, fertilisers, insecticides, and irrigation charges. ***In Telangana, almost 50 per cent of the cost is from human and machine labour. Telangana has the highest operational costs among the top 5 paddy producing states*** (Orisha, Punjab, Telangana, Uttar Pradesh, and West Bengal). In addition to operational costs, there are fixed costs associated with paddy cultivation. These fixed costs comprise the rental value of owner and leased land, land revenue, depreciation on farm equipment, and interest on fixed capital.

Figure 20: *Proportion of different components in the total cost of cultivation for Paddy in 2021-22*



Source: Department of Agriculture and Farmer's Welfare

As per the input costs (A2+FL), profits from paddy cultivation in 2021-22 were Rs.34,075. The profits from paddy cultivation increased and showed a slight decline after 2019-20. The government of Telangana procures paddy through paddy procurement centres. Since 2014-15, Telangana has procured 46,138 thousand tonnes of paddy (GOI, MAFW, & DES, 2023). In 2020-21, 9,453 thousand tonnes were procured, 92.5 per cent of the total paddy produced in the state.

Table 11: *Cost of Cultivation for Paddy (A2+FL), Total Value and Profits (per hectare)*

Paddy	Cost of Cultivation (A2+FL) * (Per Hectare)	Total Value (Per Hectare)	Profit (Per Hectare)
2017-18	62,922.93	83,344.63	20,421.70
2018-19	63,694.55	1,03,799.65	40,105.10
2019-20	76,780.57	1,16,936.89	40,156.32
2020-21	72,353.64	1,03,822.09	31,468.45
2021-22	79,413.00	1,13,488.68	34,075.68

Source: Directorate of Economics and Statistics | *FL - Family Labour

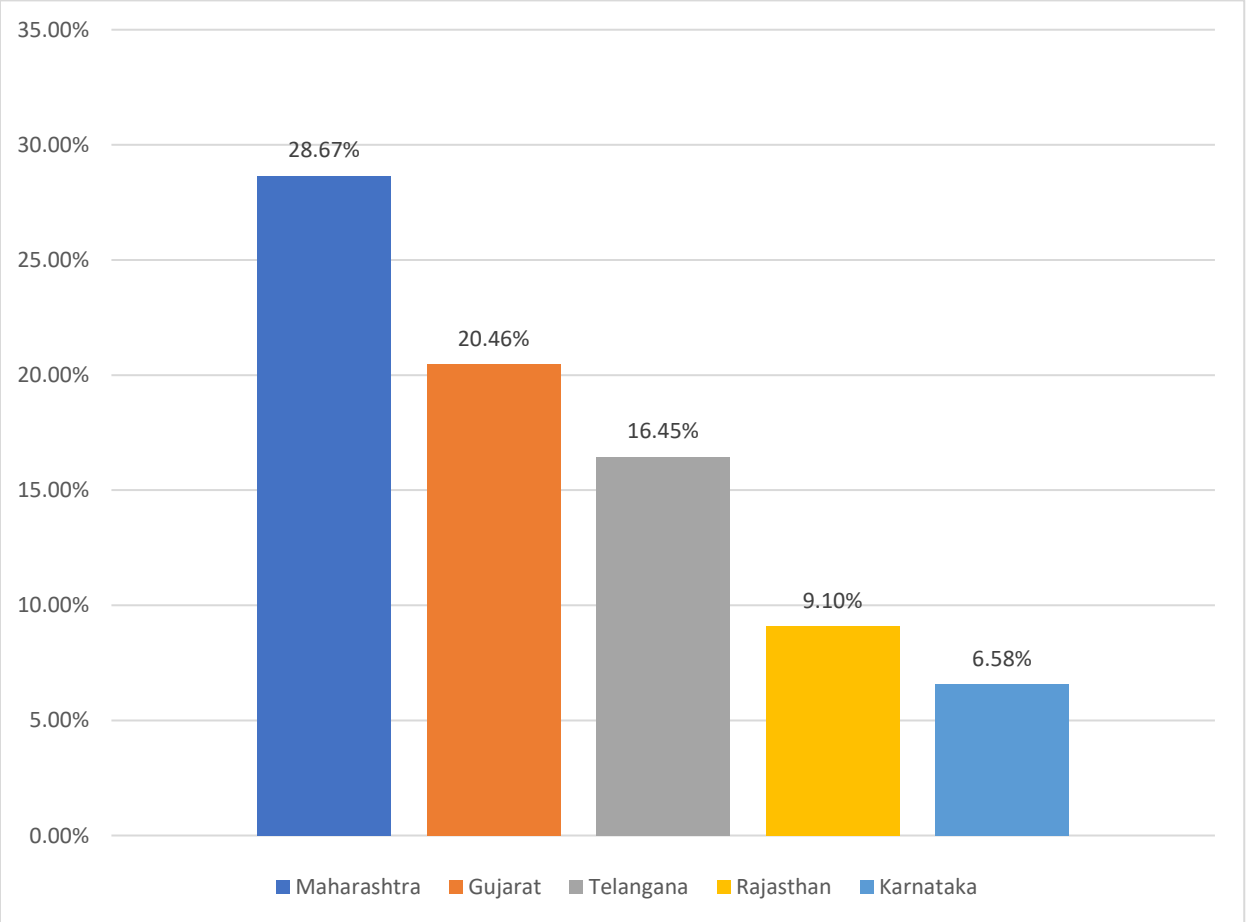
Cotton

The second major crop in Telangana is Cotton. In 2020-21, it significantly contributed 16.45 per cent to the total cotton production in India. As per the 2020-21 figures, Telangana ranks as the third-largest producer of Cotton, following Maharashtra and Gujarat.

The gross area under cotton cultivation in Telangana has increased by 39.31 per cent, growing from 1692.95 thousand hectares in 2014-15 to 2358.4 thousand hectares in 2020-21. Likewise, the production saw a considerable rise of 52.5 per cent from 3800 thousand bales in 2014-15 to 5797 thousand bales in 2020-21.

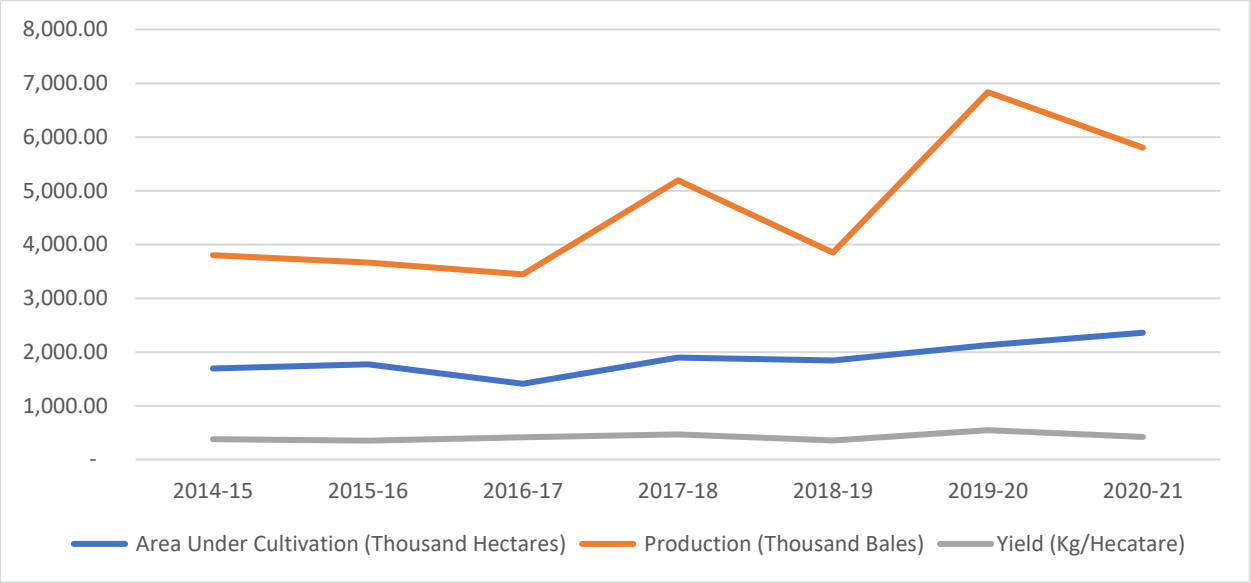
However, it's important to note that Telangana's cotton yield in 2020-21 was 418 kg per hectare, slightly lower than the Indian average of 451 kg per hectare. 2020-21, Rajasthan had the highest yield at 675 kg/hectare. Among the top 5 highest-producing states, Maharashtra has the lowest yield at 378 kg/hectare, and the second lowest is Telangana. ***Furthermore, a relatively low percentage of the total area under cotton cultivation was irrigated in 2020-21, accounting for only 18.65 per cent.*** It indicates room for improvement in expanding the area under irrigation, which could positively impact cotton production.

Figure 21: *Proportion of Production of Cotton (Lint) to Total India Production in 2020-21 - Top 5 States*



Source: RBI Handbook of Indian States

Figure 22: *Gross Area Under Cultivation, Production, and Yield of Cotton in Telangana*

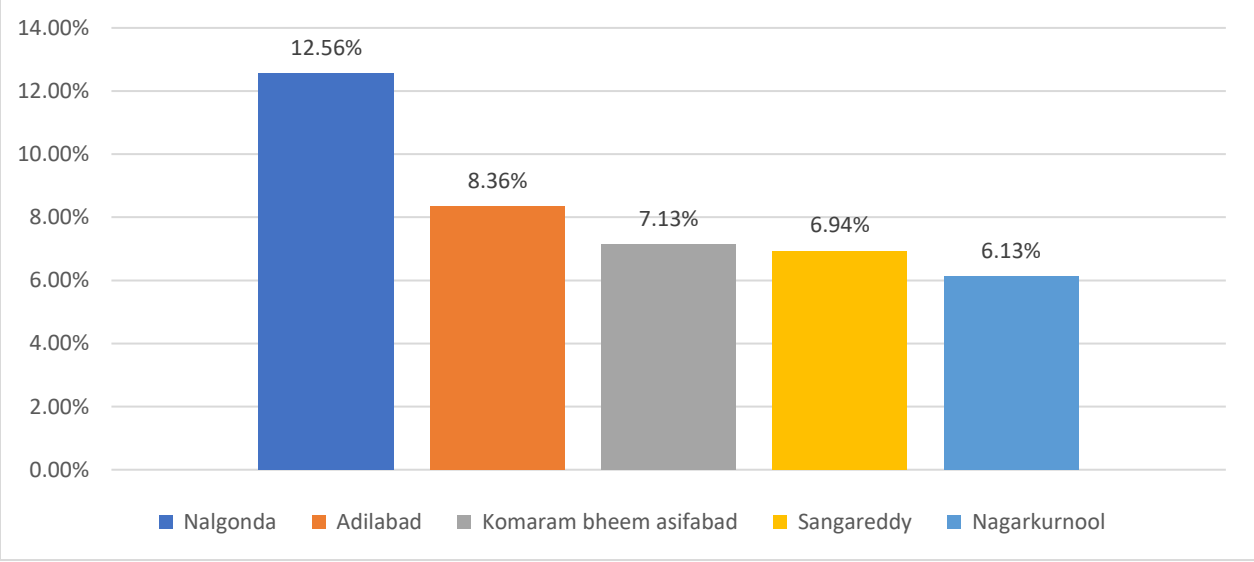


Source: RBI Handbook of Indian States and Ministry of Agriculture and Farmer's Welfare

Districts

In 2021-22, the top 5 districts in producing Cotton in Telangana are Nalgonda (12.56 per cent), Adilabad (8.36 per cent), Komaram Bheem Asifabad (7.13 per cent), Sangareddy (6.94 per cent), Nagarkurnool (6.13 per cent). Together, the five districts contribute 41.11 per cent of total cotton production in Telangana.

Figure 23: *Proportion of Production of Cotton (Lint) to Total Telangana Production in 2021-22 -Top 5 districts*

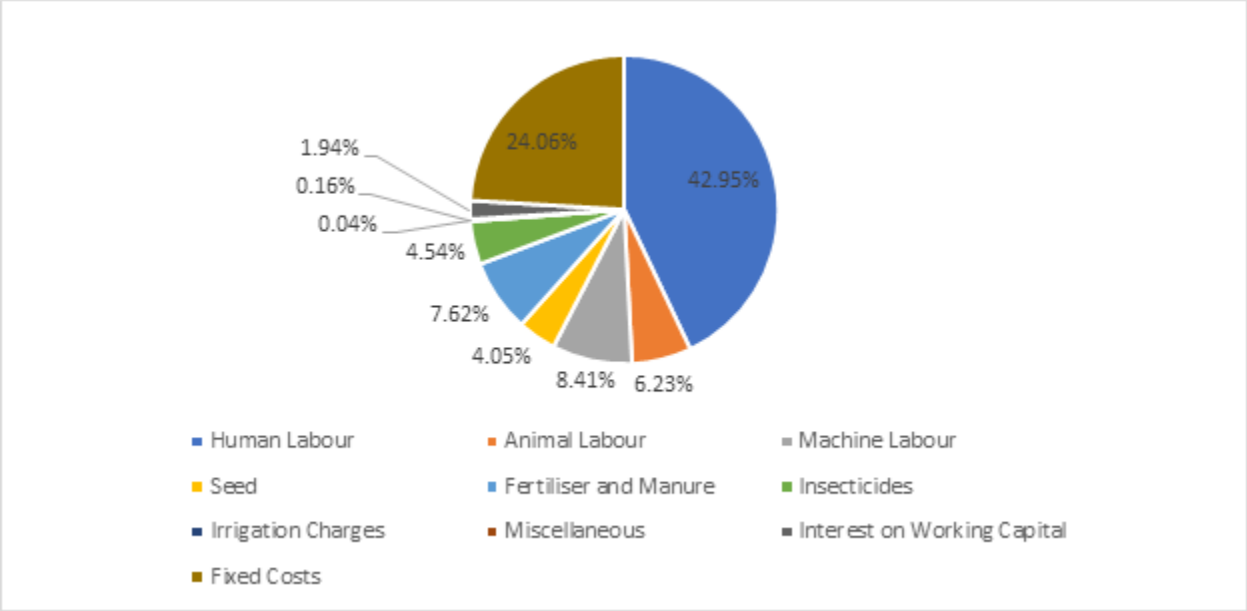


Source: Ministry of Agriculture and Farmer's Welfare

Cost of Cultivation and Profits

The cost of cultivating Cotton in Telangana is Rs. 1,05,757 / hectare, of which 75 per cent are operational costs. Major operational costs include labour, seeds, fertilisers, insecticides, and irrigation charges. In Telangana, 42 per cent of the cost is from human labour. Telangana has the highest operational costs among the top 5 cotton-producing states (Maharashtra, Gujarat, Rajasthan, Karnataka).

Figure 24: *Proportion of different components in the total cost of cultivation for Cotton in 2021-22*



Source: Department of Agriculture and Farmer's Welfare

As per the input costs data, profits from cotton cultivation in 2021-22 were Rs.4,956. Owing to high costs, the profits obtained from Cotton have declined over the period.

Table 12: *Cost of Cultivation for Cotton (A2+FL), Total Value and Profits (per hectare)*

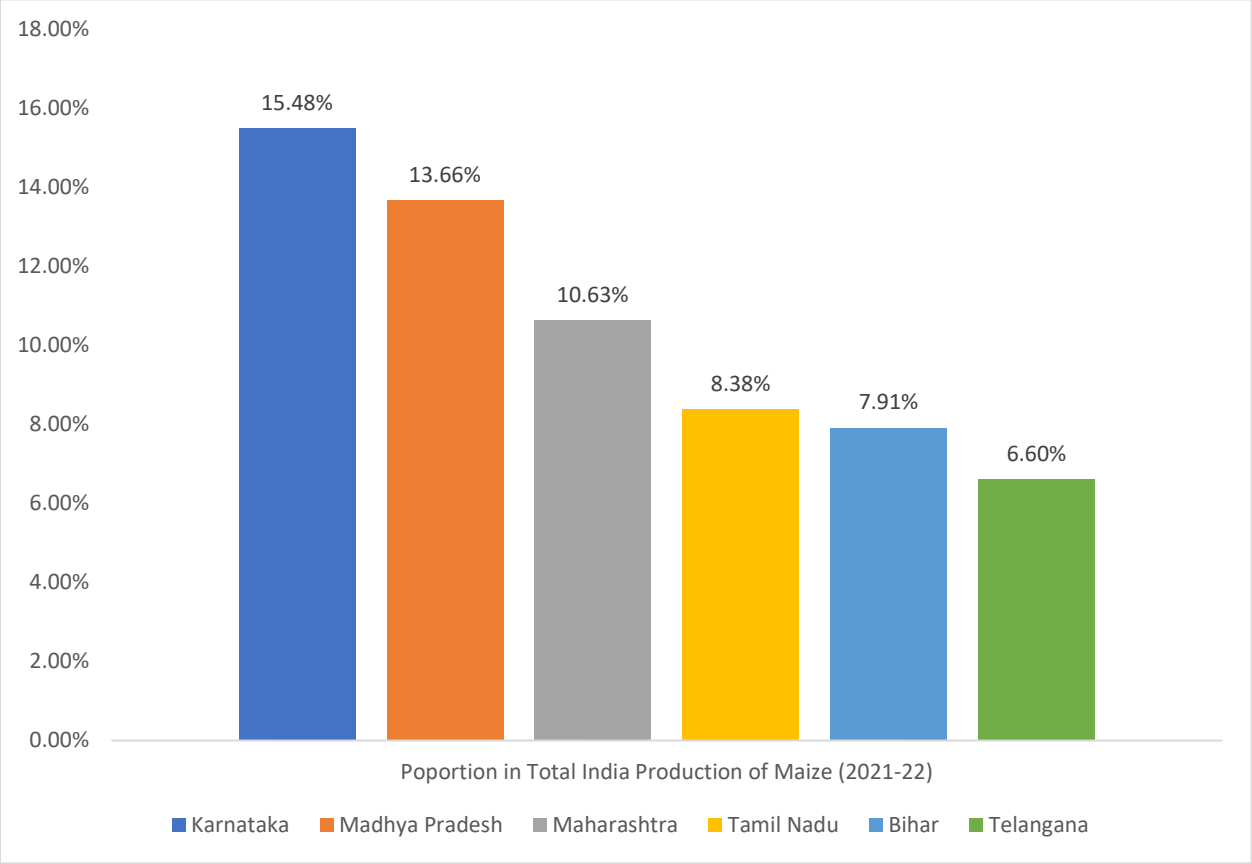
Years	Cost of Cultivation (A2+FL) *	Total Value	Profit
2017-18	66,850.58	69,882.64	3,032.06
2018-19	61,126.85	78,324.58	17,197.74
2019-20	82,501.16	1,01,091.66	18,590.50
2020-21	75,188.30	70,950.76	-4,237.54
2021-22	81,286.40	86,242.62	4,956.22

Source: Directorate of Economics and Statistics | *FL – Family Labour

Maize

The third major crop in Telangana is Maize. 2021-22, it contributed 6.60 per cent to the total Indian production. Telangana is the 7th largest producer of maize (as per 2021-22 figures). The top 5 producing states are Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, and Bihar.

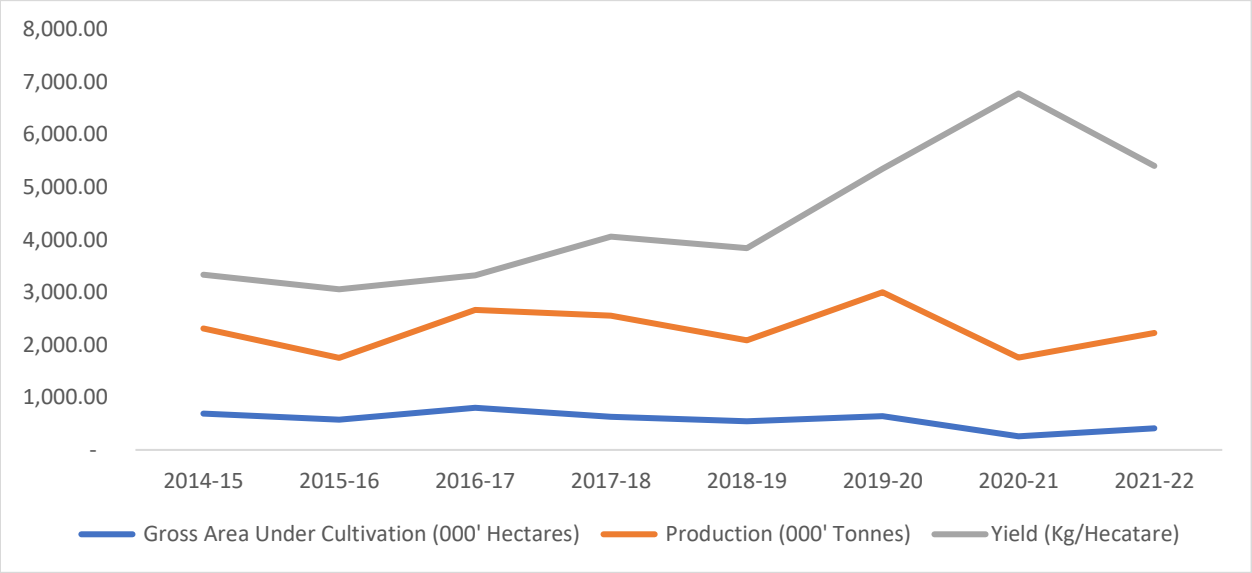
Figure 25: *Proportion of Production of Maize to Total India Production in 2021-22 - Top 5 States and Telangana*



Source: IndiaStat

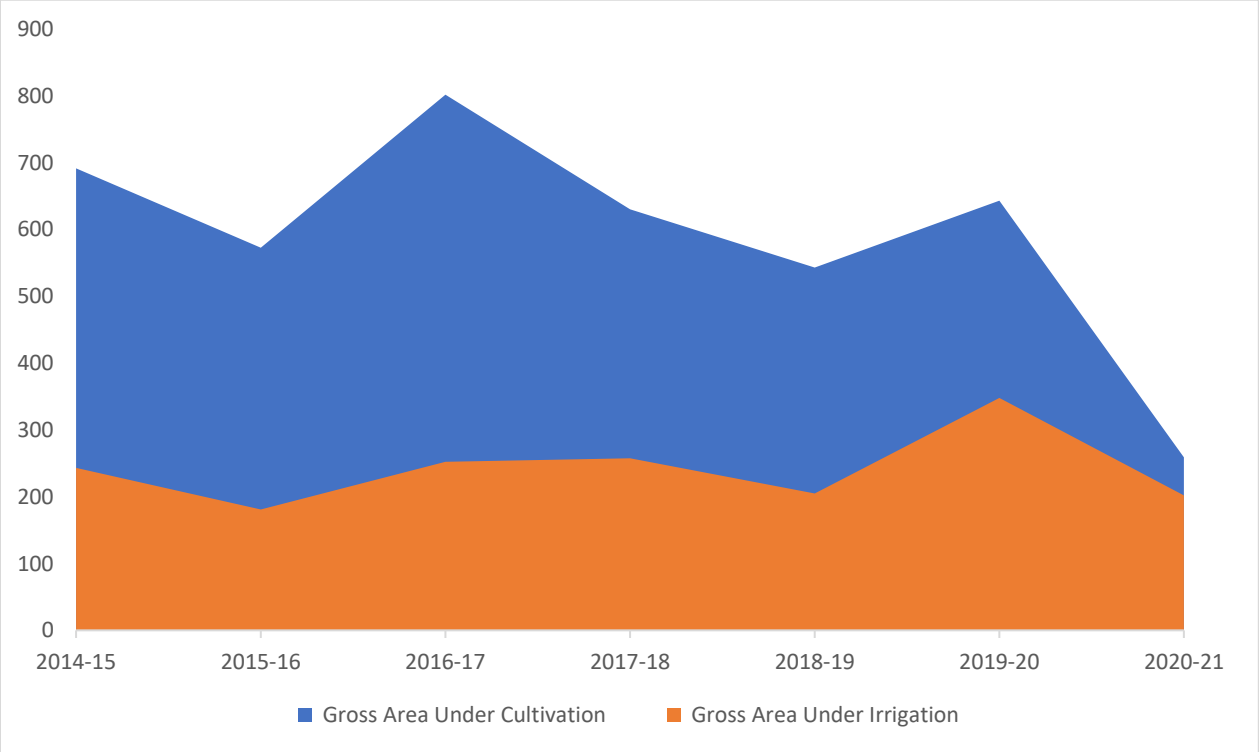
Interestingly, despite a significant decline of 40.4 per cent in the gross area under maize cultivation, decreasing from 691.47 thousand hectares in 2014-15 to 412.1 thousand hectares in 2021-22, maize production has only decreased by 3.5 per cent compared to the production levels in 2014-15. It can be attributed to the higher yields, especially during the rabi season. Telangana's yield in 2021-22 was 5403 kg/hectare, higher than the Indian average of 3387 kg/hectare. Telangana's yield during the rabi season is 7386 kg/hectare, which is the second-highest yield among top maize-producing states. The highest yield during the rabi season is in West Bengal, which is 7652 kg/hectare. These higher yields can be attributed to a significant increase of 42.95 per cent in the gross irrigated area under cultivation from 2014-15 to 2021-22. In 2021-22, 78 per cent of the gross area under maize cultivation was under irrigation, further contributing to the enhanced maize production.

Figure 26: *Gross Area Under Cultivation, Production, and Yield of Maize in Telangana*



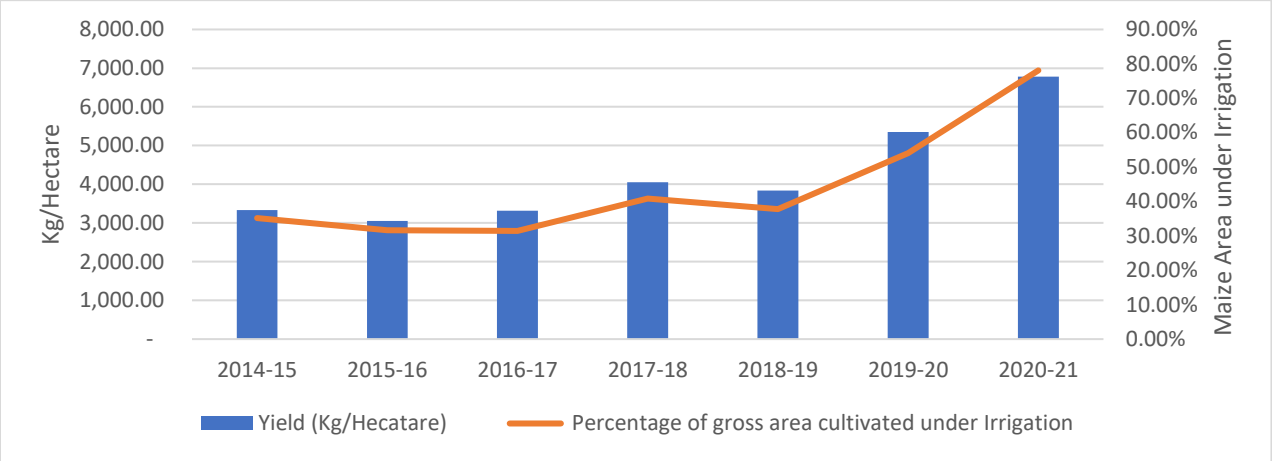
Source: IndiaStat and Ministry of Agriculture and Farmer's Welfare

Figure 27: *Gross Area Under Cultivation and Gross Area Under Irrigation for Maize (000' hectares)*



Source: Ministry of Agriculture and Farmer's Welfare

Figure 28: *Yields and Percentage of Gross Area Under Irrigation for Maize*



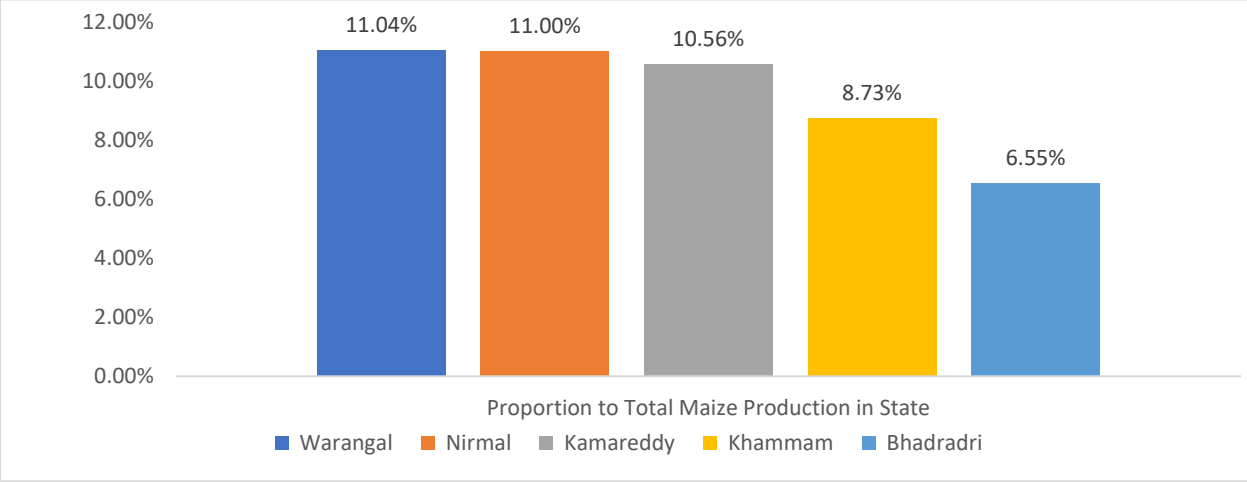
Source: IndiaStat and Ministry of Agriculture and Farmer's Welfare

Districts

The top 5 districts in producing maize in Telangana are Warangal (11.04 per cent), Nirmal (11.00 per cent), Kamareddy (10.56 per cent), Khammam (8.73 per cent), Bhadrari (6.55 per cent). Together, the five districts contribute 47.8 per cent of total maize production in Telangana.

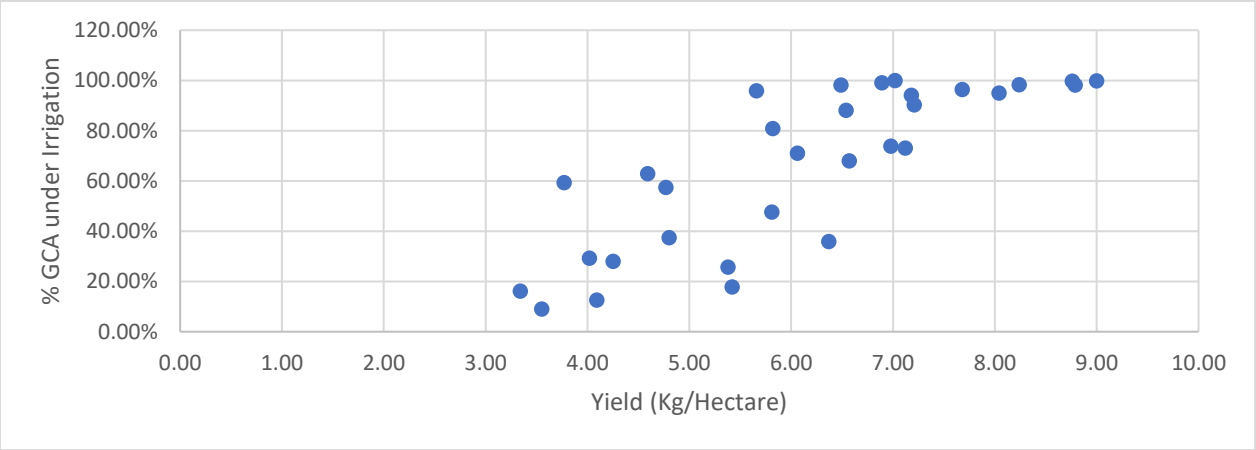
A positive relationship can be observed among yields and districts with a higher percentage of gross area under maize cultivation covered by irrigation. (Figure 29). For instance, Khammam boasts a substantial yield of 9 tonnes per hectare, and an impressive 99.89 per cent of its maize cultivation area is under irrigation. Likewise, Nirmal achieved a commendable yield of 8.79 tonnes per hectare, with 98.2 per cent of the gross area under maize being irrigated.

Figure 29: *Proportion of Production of Maize to Total Telangana Production in 2021-22 Top 5 districts*



Source: Ministry of Agriculture and Farmer's Welfare

***Figure 30**: Yields for all Districts' and Gross Cropped Area of Maize under Irrigation in Telangana (2021-22)*

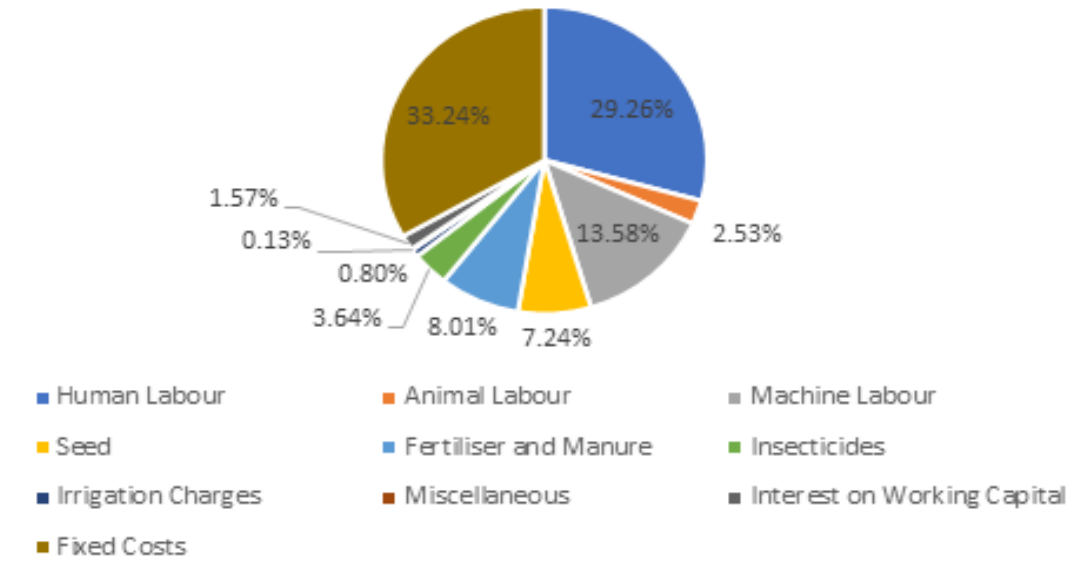


Source: Ministry of Agriculture and Farmer's Welfare

COST OF CULTIVATION AND PROFITS

The cost of cultivating Maize in Telangana is Rs. 96,049 / hectare, of which 67 per cent are operational costs. Significant operational costs include different types of labour, seeds, fertilisers, insecticides, and irrigation charges. ***In Telangana, 42.84 per cent of the cost is from human and machine labour. Telangana has the second-highest operational costs among the top 5 maize-producing states*** **(**Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, and Bihar).

***Figure 31:** Proportion of different components in the total cost of cultivation for maize in 2021-22*



Source: Department of Agriculture and Farmer's Welfare

As per the input costs for costs, the profits from maize cultivation in the year 2021-22 reached an impressive Rs. 42,189 per hectare, primarily due to the high value derived from the produce. When we consider the profits from maize cultivation from 2017-18 to 2021-22, it has maintained an average of Rs. 30,000 per hectare. This consistent level of profitability highlights maize as a beneficial crop choice for farmers in the region.

Table 13: *Cost of Cultivation for Maize (A2+FL), Total Value and Profits (per hectare)*

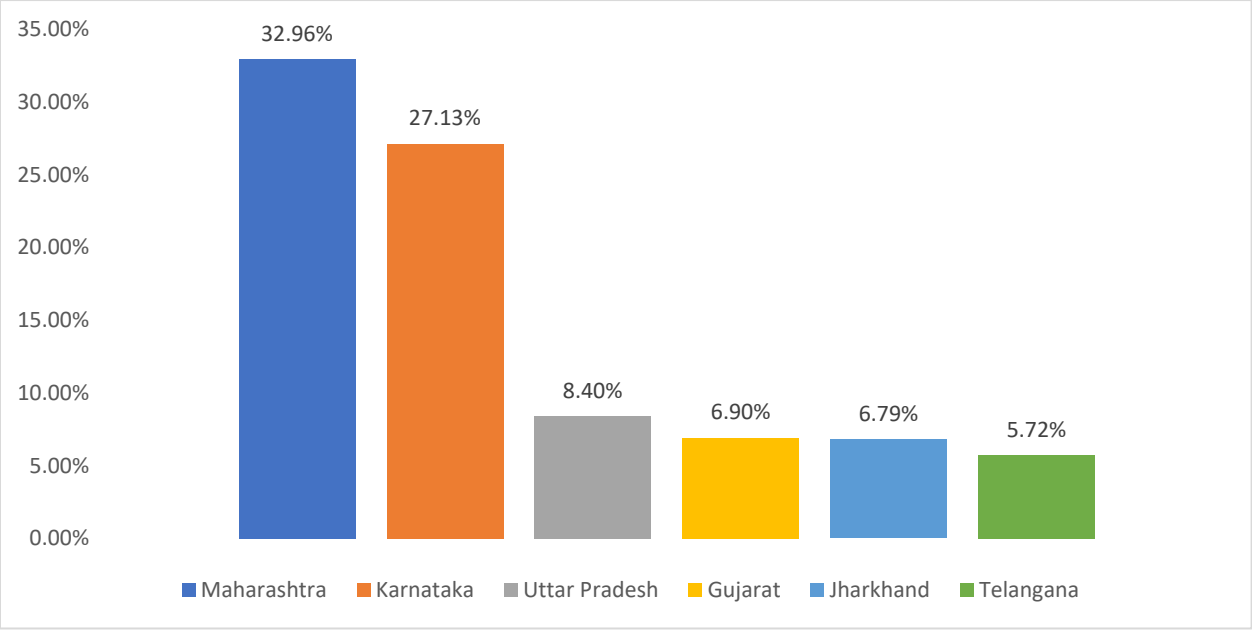
Maize	Cost of Cultivation (A2+FL) *	Total Value	Profit
2017-18	44,727.17	89,791.93	35,539.73
2018-19	54,564.98	83,887.26	29,322.28
2019-20	60,293.97	95,371.00	35,077.03
2020-21	66,009.81	85,516.02	19,506.21
2021-22	67,040.89	1,09,230.26	42,189.37

Source: Directorate of Economics and Statistics | *FL – Family Labour

Tur/Arhar

Arhar/Tur is the fourth major crop in Telangana, and in the year 2021-22, it made a substantial contribution of 5.72 per cent to the total Arhar/Tur production in India. As per the 2021-22 figures, Telangana ranks as the sixth-largest producer of Arhar/Tur. India's top five Arhar/Tur producing states are Maharashtra, Karnataka, Uttar Pradesh, Gujarat, and Jharkhand.

Figure 32: Proportion of Production of Arhar / Tur to Total India Production in 2021-22 - Top 5 States and Telangana



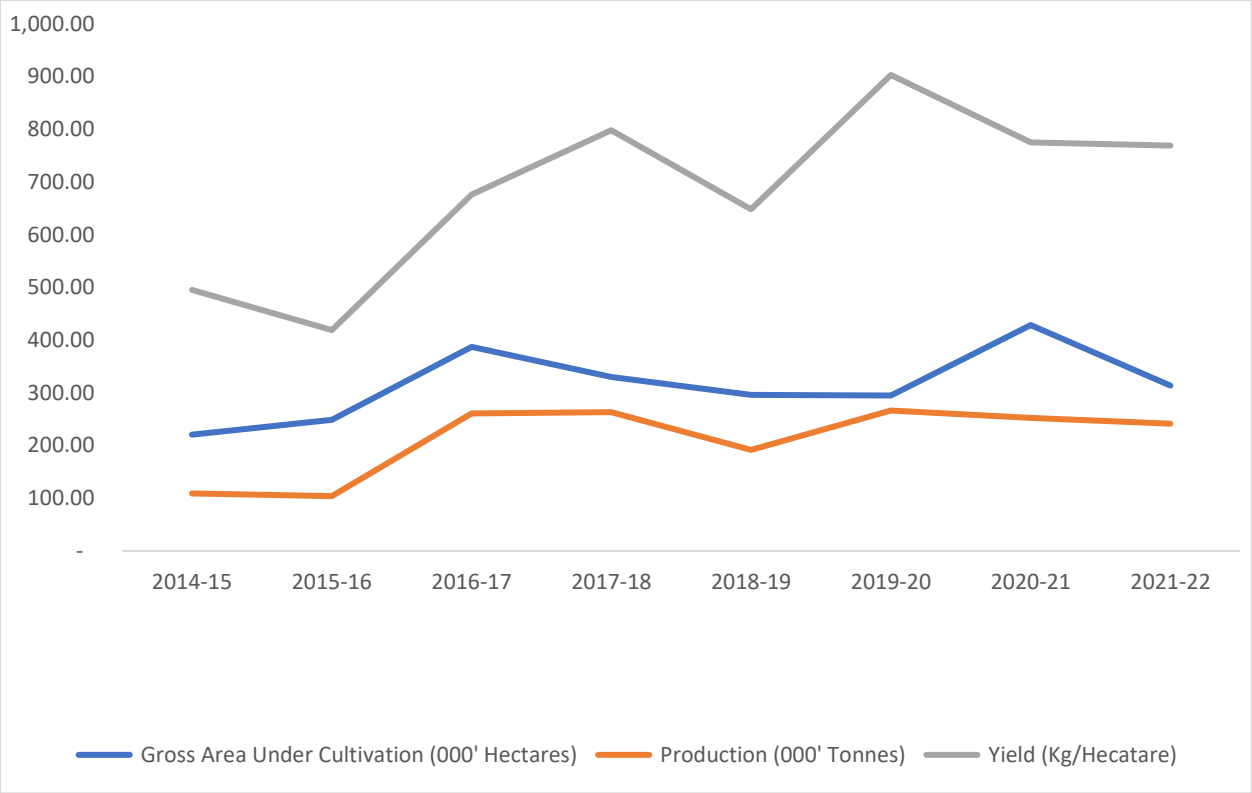
Source: Indiastat

The gross area under tur/arhar cultivation has increased by 42.49 per cent from 220.67 thousand hectares in 2014-15 to 314 thousand hectares in 2021-22. Accordingly, the production has increased by 121.5 per cent compared to 2014-15 production levels.

Telangana's Arhar/Tur yield has significantly improved, rising from 495 kg per hectare in 2014-15 to 769 kg per hectare in 2021-22. However, it's important to note that this yield is still lower than the Indian average of 861 kg per hectare. Uttar Pradesh boasts the highest yield among the five Arhar/Tur-producing states at 1223 kg per hectare.

Regarding the area under irrigation for Arhar/Tur, a meagre increase of 3 per cent from 2014-15 to 3.25 per cent from 2020-21. This suggests there may be room for further expansion of irrigation practices to boost Arhar/Tur production in Telangana potentially.

Figure 33: *Gross Area Under Cultivation, Production, and Yield of Arhar/Tur in Telangana*

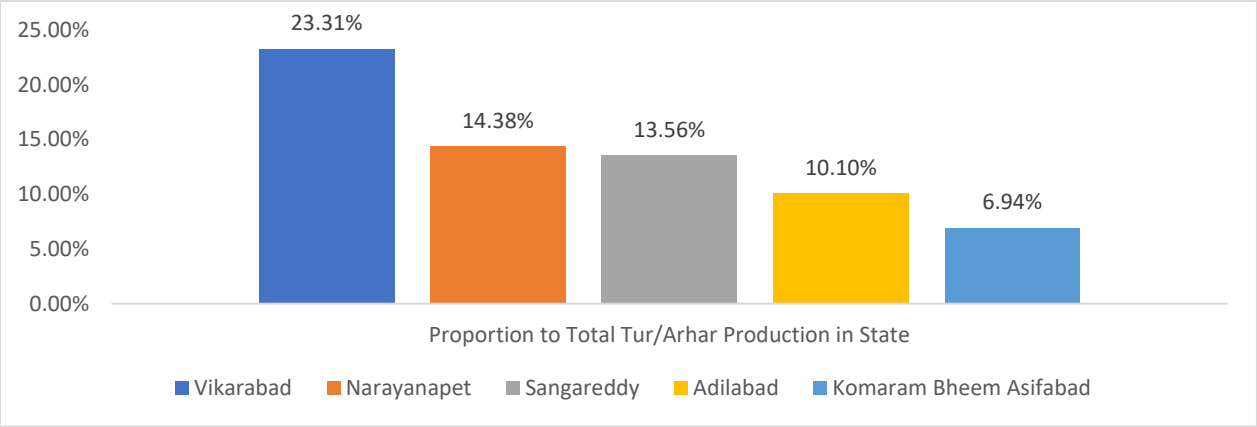


Source: IndiaStat and Ministry of Agriculture and Farmer's Welfare

Districts

The top 5 districts in producing Arhar/Tur in Telangana are Vikarabad (23.31 per cent), Narayanpet (14.38 per cent), Sangareddy (13.56 per cent), Adilabad (10.10 per cent), Komaram Bheem Asifabad (6.94 per cent). Together, the five districts contribute 68.28 per cent of Tur/Arhar production in Telangana. Yalal Farmers Producer Company in Tandur, Vikarabad, applied and was granted a geographical indication (GI) tag for Arhar/Tur in 2022.

Figure 34: *Proportion of Production of Arhar / Tur to Total Telangana Production in 2021-22 - Top 5 districts*

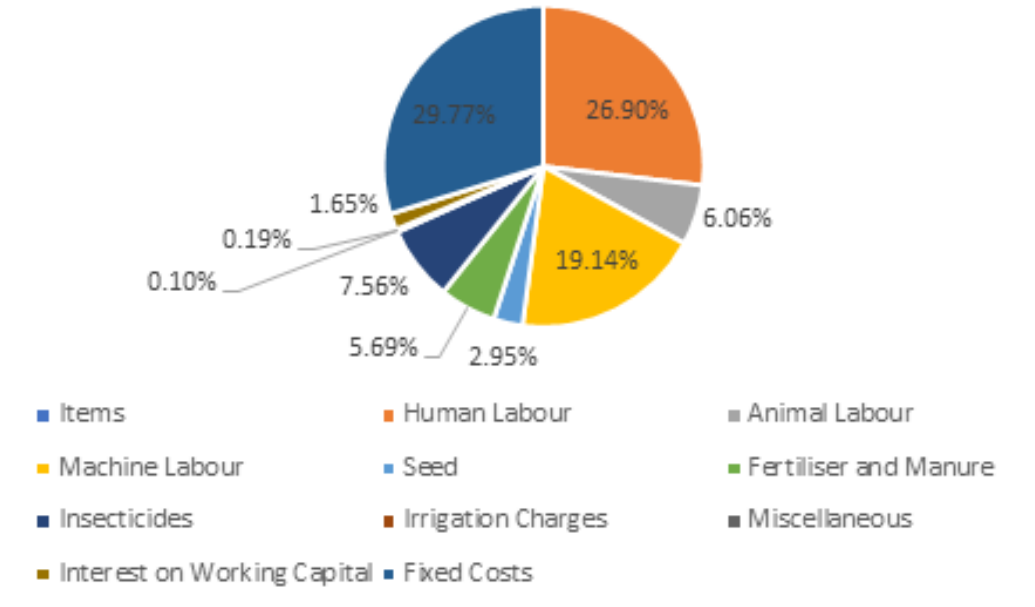


Source: Ministry of Agriculture and Farmer's Welfare

COST OF CULTIVATION

The cost of cultivating Arhar/Tur in Telangana is Rs. 50,175 / hectare, of which 70.23 per cent are operational costs. Major operational costs include labour, seeds, fertilisers, insecticides, and irrigation charges. In Telangana, 46.04 per cent of the cost is from human and machine labour. Telangana has the second lowest operational costs among the top 4 Arhar/tur producing states (Maharashtra, Karnataka, Uttar Pradesh, Gujarat).

Figure 35: Proportion of different components in the total cost of cultivation for Arhar/Tur in 2021-22



Source: Department of Agriculture and Farmer's Welfare

According to the input cost data, the profits from tur cultivation in 2021-22 amounted to Rs. 16,377 per hectare. In contrast, tur cultivation was not profitable from 2017-18 to 2019-20. However, in 2020-21 and 2021-22, profits of more than Rs.10,000 per hectare were achieved, primarily due to better prices received for the produce. Considering the relatively low operational costs and better crop prices, tur can be considered a profitable crop for farmers to cultivate.

Table 14: *Cost of Cultivation for Arhar/Tur (A2+FL), Total Value and Profits (per hectare)*

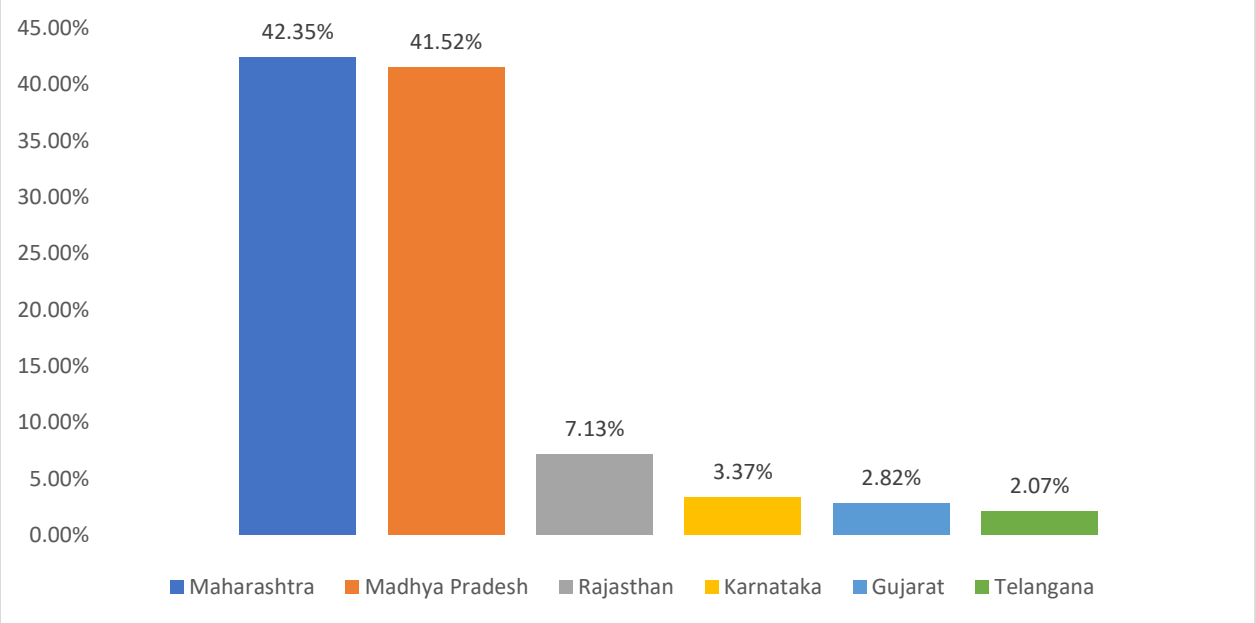
Years	Cost of Cultivation (A2+FL) *	Total Value	Profit
2017-18	25,070.72	25,033.77	-36.95
2018-19	23,655.60	14,126.43	-9,529.17
2019-20	36,117.75	33,028.27	-3,089.48
2020-21	33,341.27	44,815.17	11,473.90
2021-22	35,773.94	52,150.98	16,377.04

Source: Directorate of Economics and Statistics | *FL – Family Labour

Soyabean

Soybean is the fifth major crop in Telangana, and in the year 2021-22, it contributed 2.07 per cent to the total soybean production in India. As per the 2021-22 figures, Telangana is the fifth-largest soybean producer. The top five soybean-producing states in India are Maharashtra, Madhya Pradesh, Rajasthan, Karnataka, and Gujarat, with Telangana rounding out the list.

Figure 36: *Proportion of Production of Soyabean to Total India Production in 2021-22 - Top 5 States*

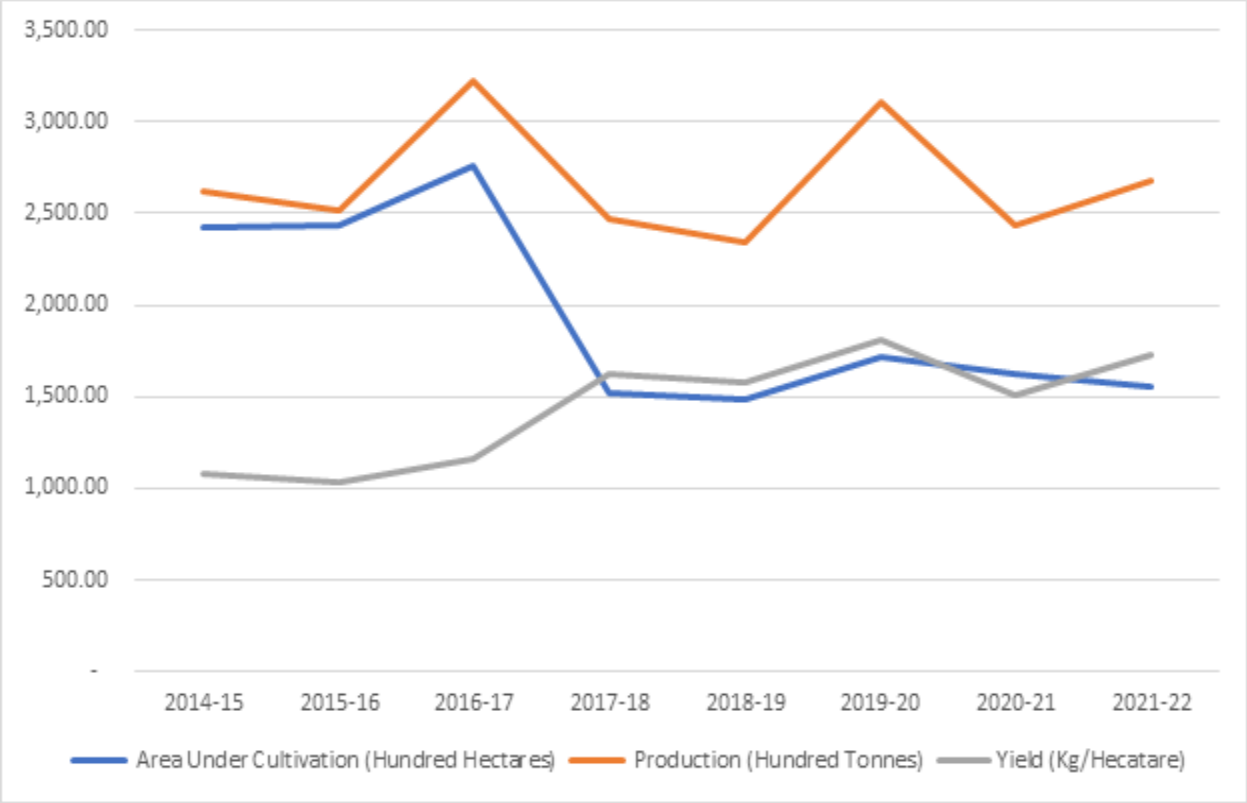


Source: Indiastat

The gross area under soybean cultivation in Telangana has decreased by 36.12 per cent, declining from 2,426.39 hundred hectares in 2014-15 to 1,550 hundred hectares in 2021-22. However, production increased by 2.41 per cent compared to the production levels in 2014-15. This trend can be attributed to the high yields achieved.

Markedly, the soybean yield in Telangana is 1,731 kg per hectare, the highest among the top 5 soybean-producing states. This high yield has compensated for the reduction in the cultivation area, resulting in a slight increase in overall production. Regarding the area under irrigation for soybeans, in 2020-21, it covered 16.23 per cent of the gross cultivated area, an increase of 8.47 per cent compared to 2014-15.

Figure 37: Gross Area Under Cultivation, Production, and Yield of Soyabean in Telangana

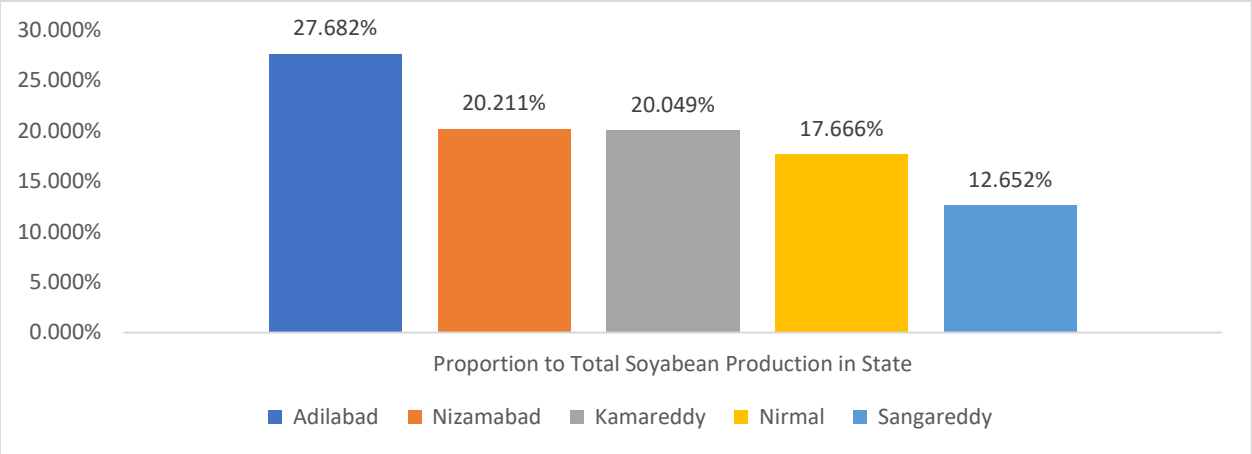


Source: IndiaStat and Ministry of Agriculture and Farmer's Welfare

Districts

In 2021-22, the top 5 districts in producing Soyabean in Telangana were Adilabd (27.68 per cent), Nizamabad (20.21 per cent), Kamareddy (20.04 per cent), Nirmal (17.66 per cent), Sangareddy (12.65 per cent). Together, the five districts contribute 98 per cent of total soybean production in Telangana.

Figure 38: *Proportion of Production of Soyabean to Total Telangana Production in 2021-22 - Top 5 districts*

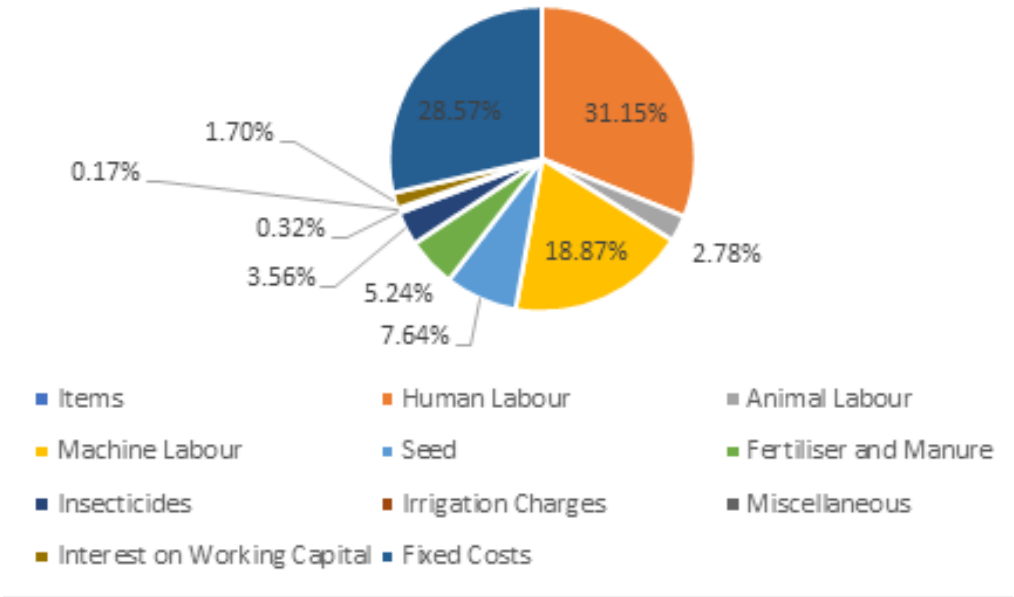


Source: Department of Agriculture and Farmer's Welfare

COST OF CULTIVATION AND PROFITS

The cost of cultivating soybeans in Telangana is Rs. 50,060 / hectare, of which 71.43 per cent are operational costs. Major operational costs include labour, seeds, fertilisers, insecticides, and irrigation charges. **In Telangana, 50.02 per cent of the cost is from human and machine labour. Telangana has the second lowest operational costs (after Madhya Pradesh) among the top 5 Soyabean producing states** (Maharashtra, Madhya Pradesh, Rajasthan, Karnataka, Gujarat).

Figure 39: *Proportion of different components in the total cost of cultivation for Soyabean in 2021-22*



Source: Department of Agriculture and Farmer's Welfare

As per the input cost data, the profits from soybean cultivation in 2021-22 amounted to Rs. 5,527 per hectare. Contrary to this, soybean cultivation was profitable from 2017-18 to 2019-20. However, in 2020-21, it was not profitable primarily due to a lack of value for the produce. Fortunately, profits rebounded in 2021-22, thanks to better crop prices. Considering the relatively low operational costs and improved crop prices, soybeans can be considered a profitable crop for farmers to cultivate.

Table 15: *Cost of Cultivation for Soyabean (A2+FL), Total Value and Profits (per hectare)*

Years	Cost of Cultivation	Total Value	Profit
2017-18	34,888.31	50,143.10	15,254.79
2018-19	36,551.28	62,991.23	26,439.95
2019-20	38,331.97	73,918.08	35,586.11
2020-21	34,864.39	28,531.46	-6,332.93
2021-22	36,012.26	41,539.41	5,527.15

Source: Directorate of Economics and Statistics

Crop Profits and Gross Cropped Area

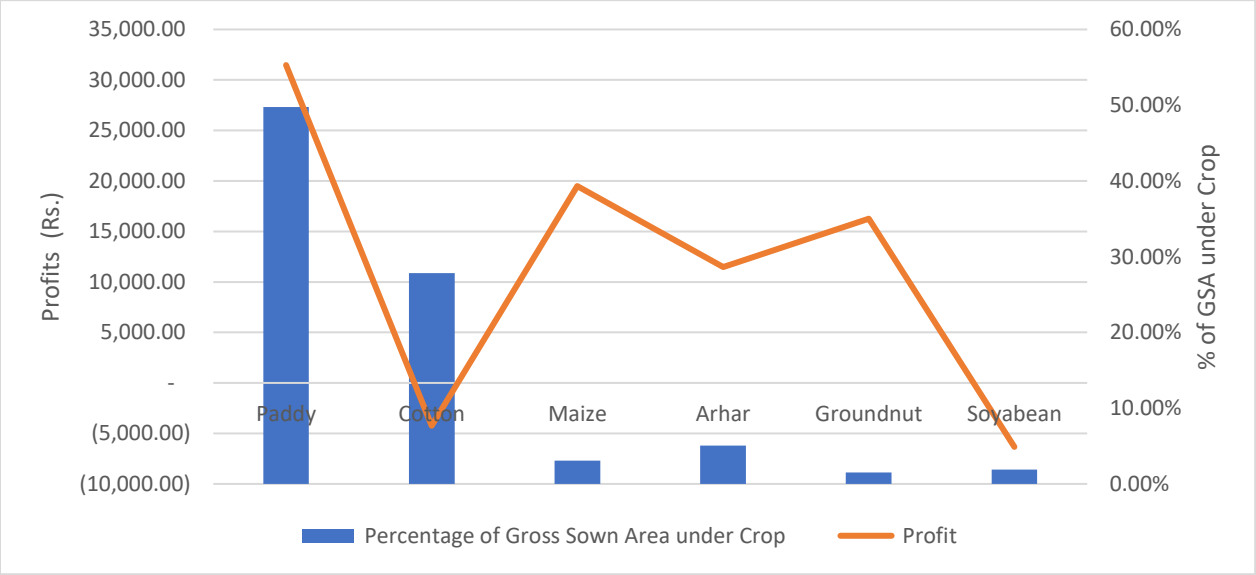
Observing the percentage of gross cropped area (GCA) under each crop and their respective profits, only paddy has a high profit of Rs.31,468 with a high GCA of 49.75 per cent. On the other hand, maize, tur, and ground nuts, while showing reasonable profits, have a relatively lower GCA. It suggests that while these crops are profitable, they are not as extensively cultivated as paddy. In the case of Cotton, even though its cultivation is not profitable, it occupies a significant portion of GCA. It indicates that Cotton is being grown in Telangana despite not being profitable.

Table 16: *Percentage of Gross Sown Area under Crop and Profits in 2020-21*

Crops (2020-21)	Percentage of Gross Sown Area under Crop	Profit
Paddy	49.75%	31,468.45
Cotton	27.81%	-4,237.54
Maize	3.05%	19,506.21
Arhar	5.05%	11,473.90
Groundnut	1.50%	16,274.34
Soyabean	1.91%	-6,332.93

Source: Directorate of Economics and Statistics

Figure 40: *Gross Cropped Area and Profits of Selected Crops in 2020-21*



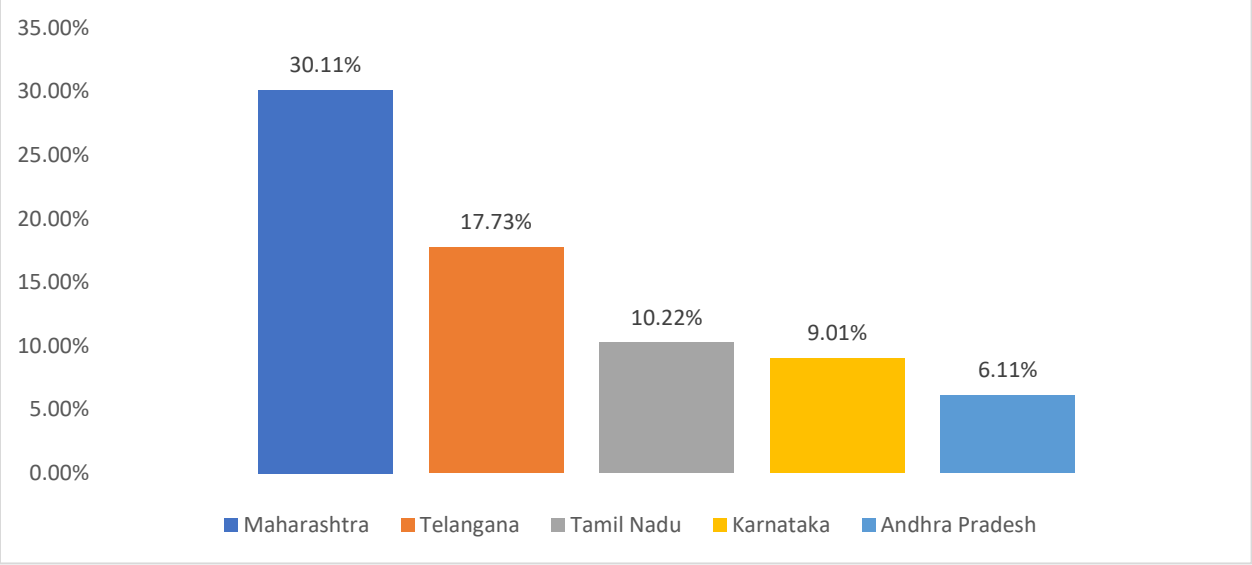
Source: Directorate of Economics and State and Department of Agriculture and Farmer's Welfare

HORTICULTURE

Turmeric

In 2021-22, Telangana was the 2nd largest producer of turmeric, contributing 17.73 per cent of the total Indian production. The largest producer is Maharashtra, contributing 30.11 per cent to total production. Other major producers are Tamil Nadu, Karnataka, and Andhra Pradesh.

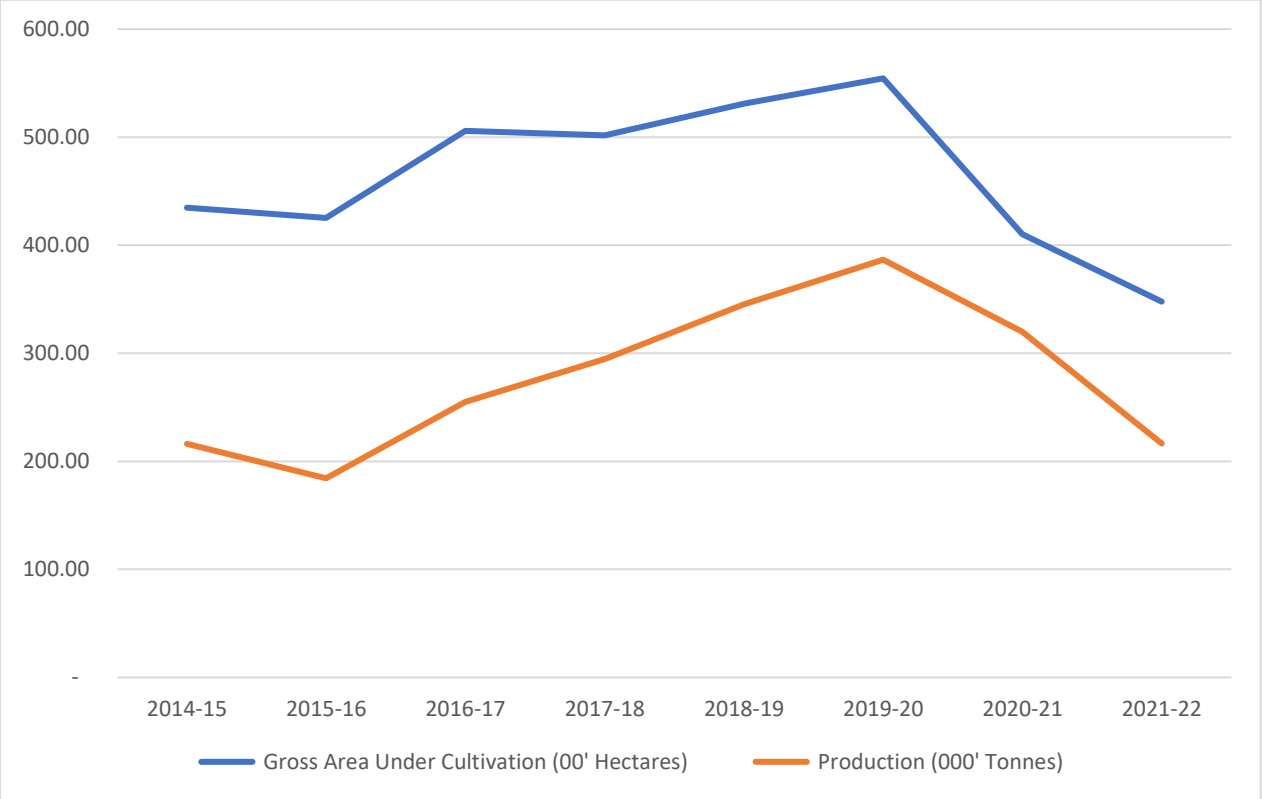
Figure 41: Proportion of Production of Turmeric to Total India Production in 2021-22 - Top 5 States



Source: Indiastat

The gross area under turmeric cultivation has declined by 40.4 per cent from 43.48 thousand hectares in 2014-15 to 41.01 thousand hectares in 2020-21. And in 2020-21, the production has increased by 47.85 per cent compared to 2014-15 production levels. However, in 2021-22, there was a decline in the area under cultivation and production. It can be attributed to the higher yields of turmeric. In 2021-22, the yield of turmeric in Telangana reached an impressive 6,230 kg per hectare, surpassing the Indian average of 3,670 kg per hectare. Furthermore, it has the highest yield among all the top five turmeric-producing states. It indicates that the high yield per hectare has compensated for the reduction in the cultivation area, resulting in increased overall production of turmeric in Telangana.

Figure 42: Gross Area Under Cultivation and Production of Turmeric in Telangana



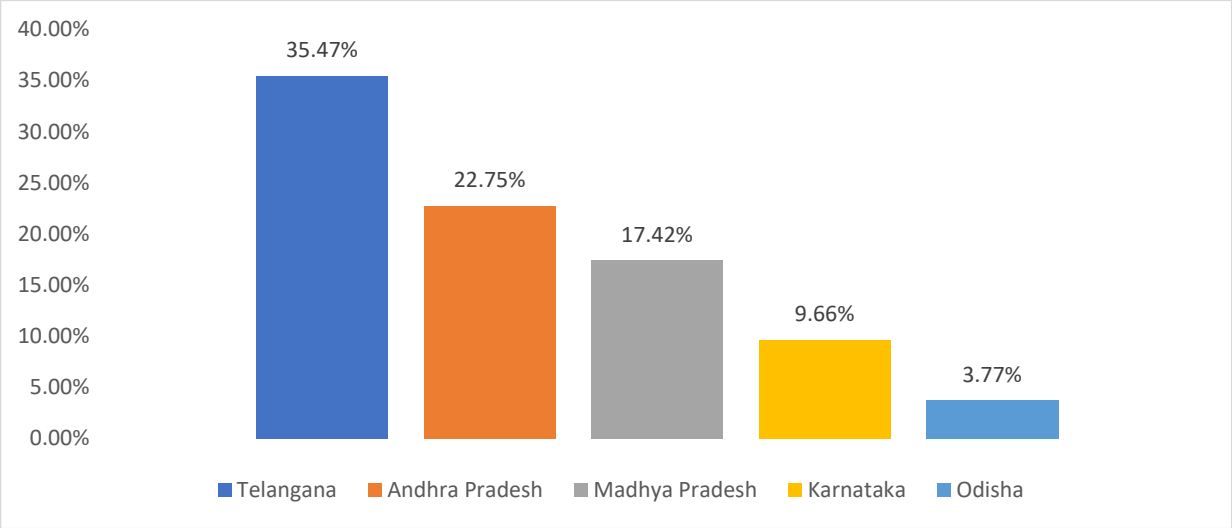
Source: IndiaStat and Ministry of Agriculture and Farmer's Welfare

When analysed at the district level, in 2021-22, Jagitial takes the top position, contributing 30.43 per cent to the total turmeric production in Telangana. It is followed by Nizamabad at 28 per cent, Nirmal at 15.8 per cent, Vikarabad at 5.6 per cent, and Warangal at 4.5 per cent. Collectively, these five districts contributed a significant 89 per cent of the total turmeric production in Telangana.

Dry Chilli

In 2021-22, Telangana was the largest producer of dry chilli, contributing 35.47 per cent of the total Indian production. Other major producers are Andhra Pradesh, Madhya Pradesh, Karnataka, and Orissa.

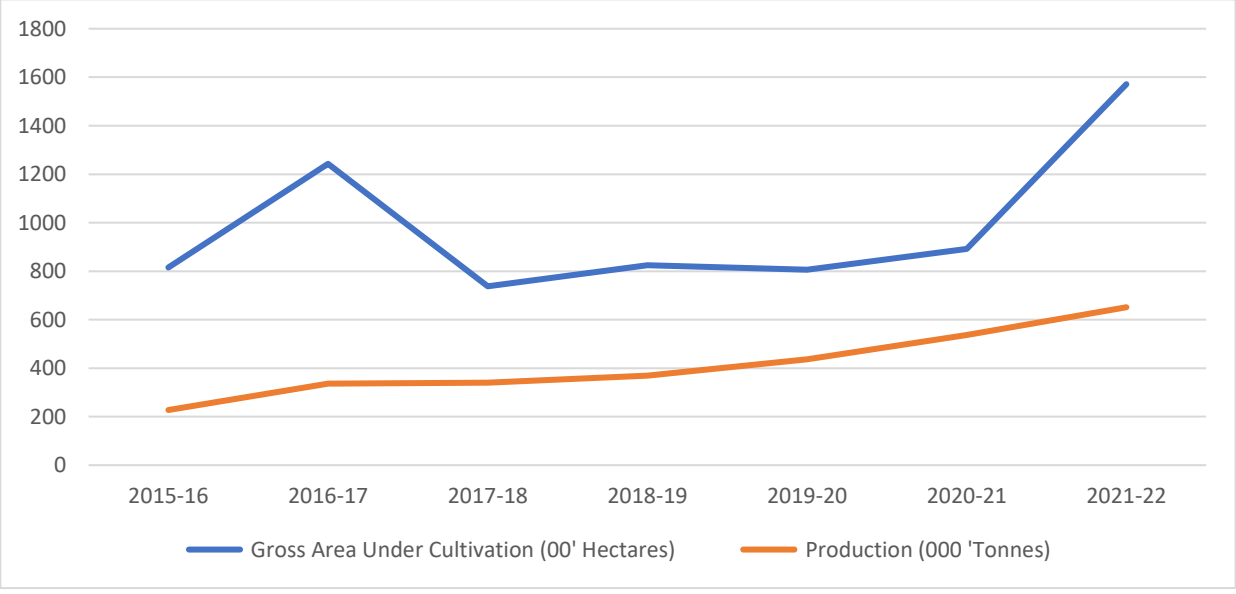
Figure 43: *Proportion of Production of Dry Chilli to Total India Production in 2021-22 - Top 5 States*



Source: IndiaStat

The gross area under dry chilli cultivation has increased by 9.26 per cent from 815.97 hundred hectares in 2014-15 to 89,156 hundred hectares in 2020-21. Also, the production in 2020-21 has increased by 135.73 per cent compared to 2014-15 production levels. It can be attributed to the higher yields of dry chilli. The yield of dry chilli in 2021-22 was 4150 kg/hectare, higher than the Indian average of 2080 kg/hectare. It is also the highest among all the top 5 producing states.

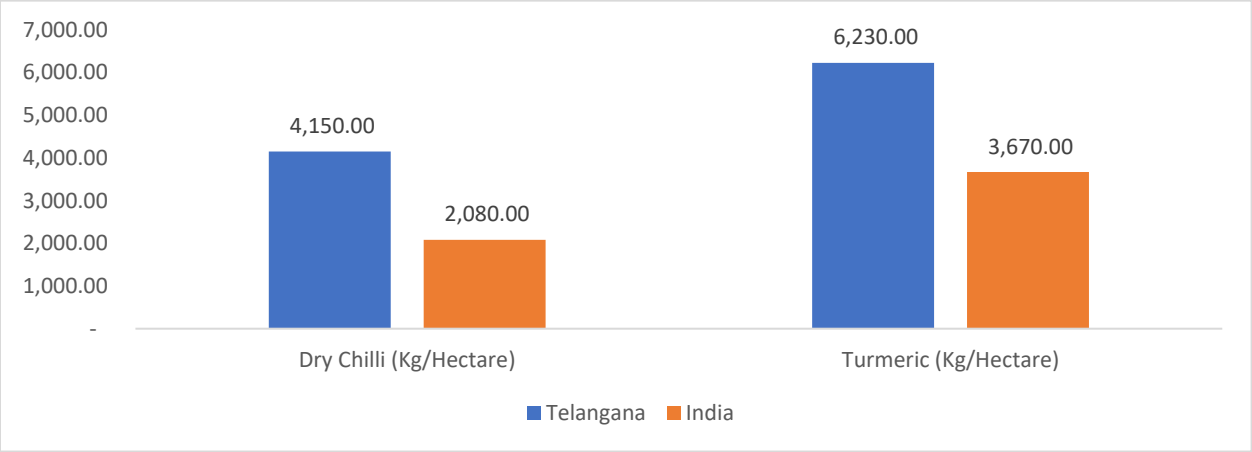
Figure 44: *Gross Area Under Cultivation and Production of Dry Chilli in Telangana*



Source: IndiaStat and Ministry of Agriculture and Farmer's Welfare

At the district level, in 2021-22, Khammam took the top position, contributing 22 per cent to Telangana's total dry chilli production. Mahabubabad follows it at 14.9 per cent, Jogulamba at 11.41 per cent, Bhadradri at 11.31 per cent, and Mulugu at 10.2 per cent. These five districts account for 70 per cent of Telangana's total dry chilli production.

Figure 45: *Yields of Turmeric and Dy Chilli for Telangana and India in 2021-22* (Kg/hectare)

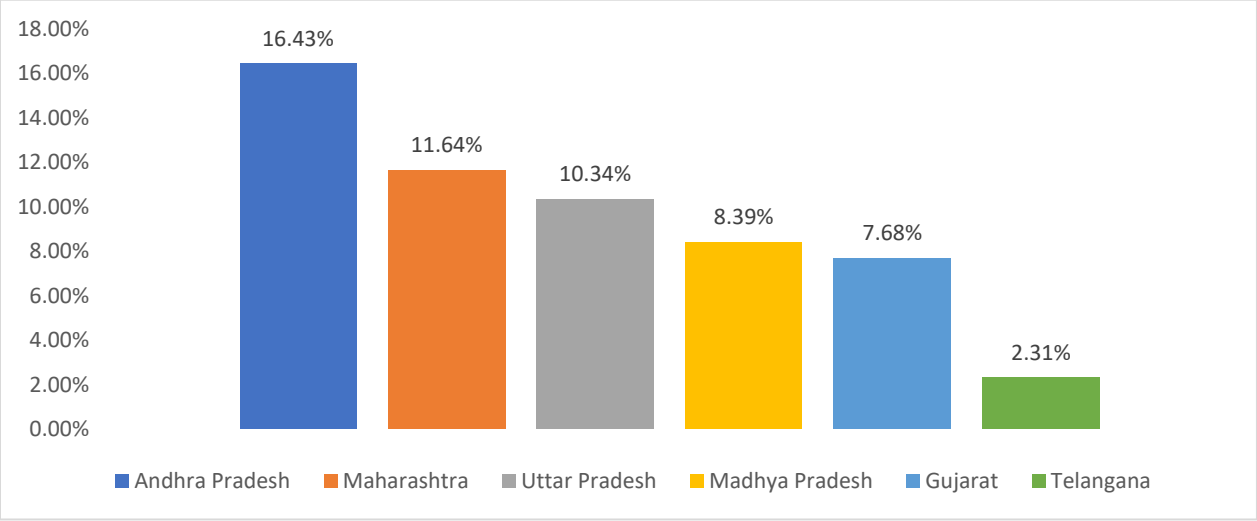


Source: IndiaStat

FRUITS AND VEGETABLES

In 2021-22, Telangana contributed 2.31 per cent of the total Indian production (Ranks 13 in fruits production). The top 5 major states producing fruits are Andhra Pradesh, Maharashtra, Uttar Pradesh, and Madhya Pradesh.

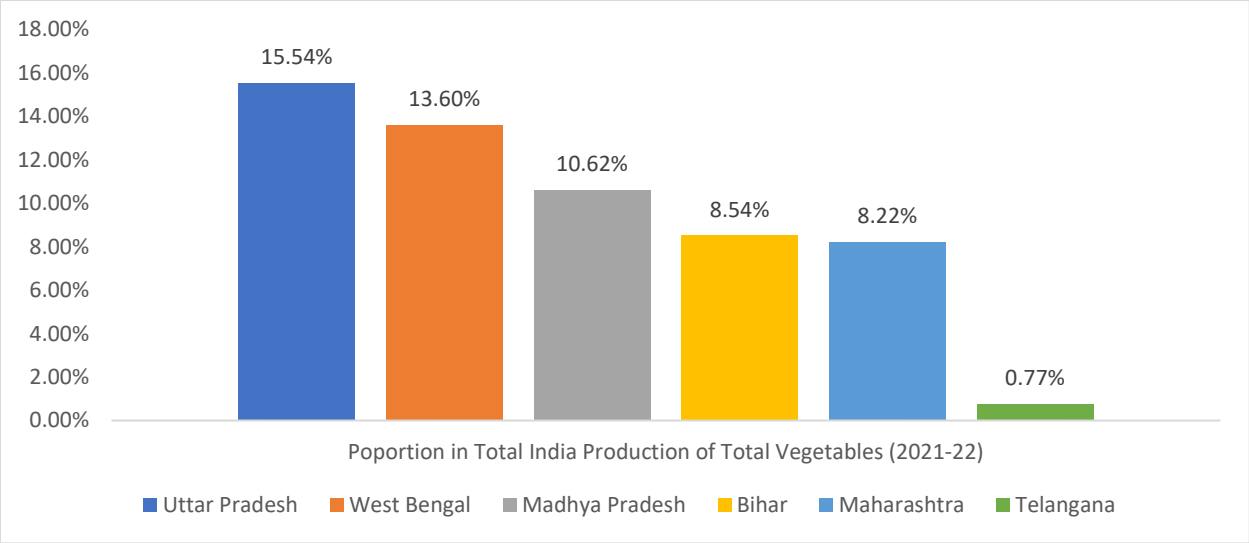
Figure 46: *Proportion of Production of Total Fruits to Total India Production in 2021-22 - Top 5 States*



Source: IndiaStat

In 2021-22, Telangana contributed a meagre 0.77 per cent of the total Indian production (Ranks 20th in vegetable production). The top 5 major states producing fruits are Uttar Pradesh, West Bengal, Madhya Pradesh, Bihar, and Maharashtra. The yield for vegetables in Telangana in 2021-22 was 22.02 k/hectare, higher than the Indian average of 18.39 MT/hectare.

Figure 47: *Proportion of Production of Total Vegetables to Total India Production in 2021-22 - Top 5 States*



Source: IndiaStat

Cropping Pattern

Telangana's cropping pattern has shifted in favour of paddy cultivation. In contrast, the proportion of Tur/Arhar and Jowar cultivation in the gross sown area has increased by a modest 0.9 per cent and 0.22 per cent, respectively. Meanwhile, the proportion of maize and soybean cultivation in the gross sown area has declined by 9.96 per cent and 2.66 per cent, respectively. In addition, the proportion of fruit and vegetable cultivation has decreased by 1.92 per cent during this period. ***These changes indicate a transformation in the agricultural cropping pattern in the state, with an increased focus on paddy cultivation.***

Table 17: *Percentage change in the proportion of major crops in the gross sown area from 2014-15 to 2020-21*

Years	2014-15	2020-21	Change
Rice	26.63%	49.75%	23.12%
Maize	13.01%	3.05%	-9.96%
Arhar(Tur)	4.15%	5.05%	0.90%
Chillies	1.38%	1.05%	-0.33%
Turmeric	0.82%	0.48%	-0.33%
Total Fruits and Vegetables	4.89%	2.98%	-1.92%
Groundnut	2.91%	1.50%	-1.41%
Soyabean	4.56%	1.91%	-2.66%
Cotton	31.85%	27.81%	-4.04%

Source: Author Calculation (Ministry of Agriculture and Farmer's Welfare)

One of our speakers, the executive director of the rural development society, pointed out that irrigation has the issue of huge areas of land coming under paddy cultivation. Since it is not a water-conserving crop, there is little optimal water use. On the other hand, there is an increasing amount of surplus at the state and national levels. Since the Food Corporation of India (FCI) cannot take up more than the stipulated limit, it becomes a political burden for the government to procure the entire surplus.

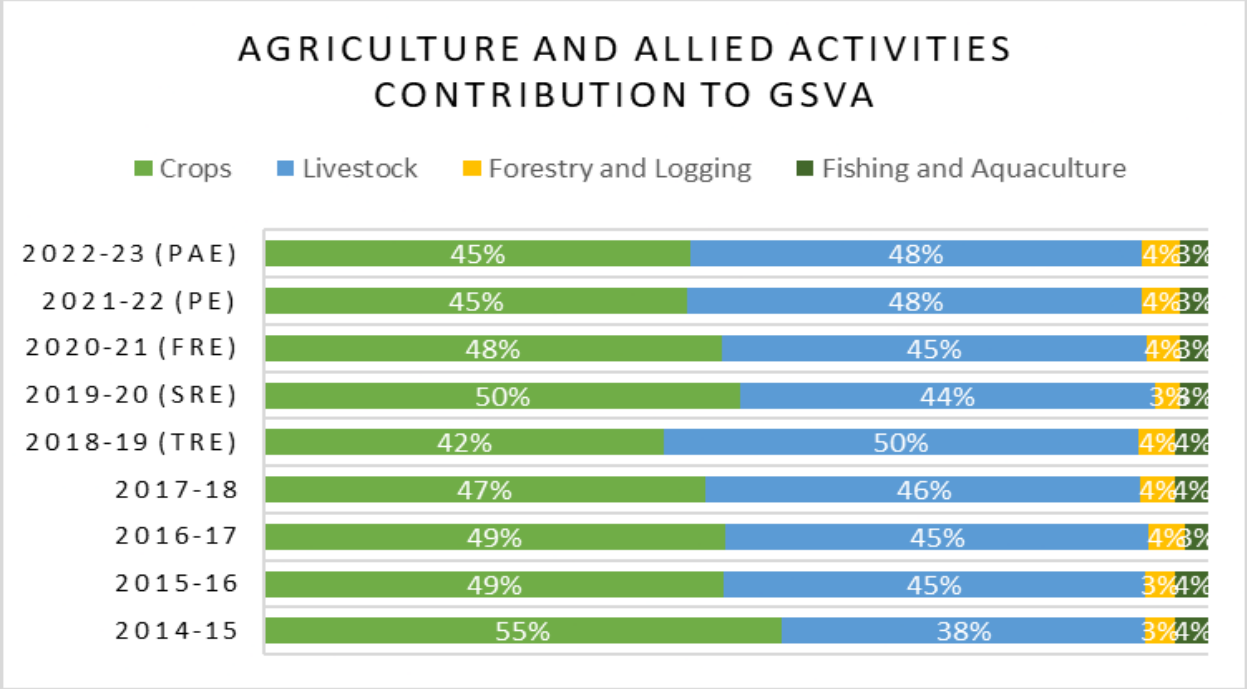
Once the paddy is procured, further issues of storage arise. There are no adequate storage facilities, with even marriage halls and function halls being used to store paddy. Since these are not suitable for storage, many grains get spoilt. There is huge pressure imposed on the millers along with frequent raids, because of which they are also struggling. The uninterrupted supply of power results in huge power consumption, which causes a burden on the exchequer for the electricity department. Hence, the over-reliance on paddy is an issue. Alternate crops like irrigated dry crops should also be encouraged.

SECTION - IV
DATA INSIGHTS INTO THE ALLIED SECTORS

SECTOR CONTRIBUTION

Livestock in Telangana made up 47.69 per cent of the contribution of GSVA at Current prices for the year 2022-23 (PAE). Livestock has also exceeded the contribution of Crops three times in the past five years, showcasing the impressive productivity of this sector.

Figure 48: *Agriculture and Allied services contribution to GSVA between 2014-15 to 2022-23 (PAE) at current prices*



Source: Directorate of Economics and Statistics, Government of Telangana

Livestock has also almost always contributed more to the sub-sectoral growth rate, except for a few occasions where Crops have had a higher share in the sector growth.

Figure 49: *Sub Sectoral Growth Rate Contribution to Overall Sector Growth (at Current Prices) between 2015-16 and 2022-23 (PAE)*

Sub sector of Agriculture and Allied Activities	2015-16	2016-17	2017-18	2018-19 (TRE)	2019-20 (SRE)	2020-21 (FRE)	2021-22 (PE)	2022-23 (PAE)
Crops	-6.4%	8.9%	4.4%	0.9%	26.7%	4.5%	0.8%	5.7%
Livestock	5.9%	8.0%	7.6%	10.8%	9.9%	7.0%	7.8%	5.3%
Forestry and Logging	0.0%	1.1%	0.4%	0.7%	-0.2%	1.4%	0.8%	0.5%
Fishing and Aquaculture	0.0%	-0.5%	1.6%	0.4%	0.6%	0.4%	0.4%	0.4%
Agriculture and Allied Activities Growth rate (in %)	-0.5%	17.5%	13.9%	12.7%	37.1%	13.3%	9.7%	11.9%

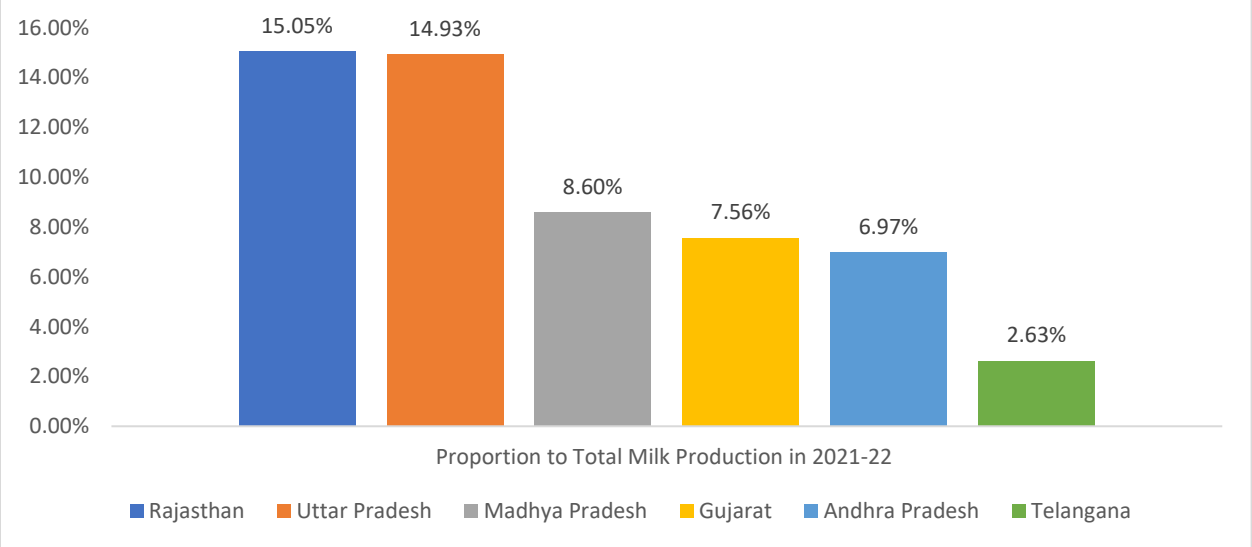
Source: Directorate of Economics and Statistics, Government of Telangana

According to the Socio-Economic Outlook 2023, around 25.82 Lakh families participate in rearing livestock or related activities to try and improve their livelihood. Between 2012 and 2019, the livestock population in the state increased from 2.67 crore to 3.26 crore, equating to a 22 per cent growth. It places Telangana second to West Bengal in the growth of livestock population. With 19.1 million sheep, Telangana has the largest sheep population. From 2012 to 2019, the number of sheep in the state increased by 48.51 per cent.

Milk

In 2021-22, Telangana's milk production share to India's production was 2.63 per cent and ranked 13th. The top 5 largest shares are Rajasthan (15.05 per cent), Uttar Pradesh (14.93 per cent), Madhya Pradesh (8.60 per cent), Gujarat (7.56 per cent), and Andhra Pradesh (6.96 per cent).

Figure 50: Proportion of Production of Milk to Total India Production in 2021-22 – Top 5 states and Telangana in 2021-22



Source: Basic Animal Husbandry Statistics, 2022

From 2014-15 to 2021-22, milk production in Telangana witnessed a substantial growth of 30.73 per cent. The CAGR during this period stood at 4.6 per cent for Telangana and India. The average yield of non-descript/indigenous cows has improved from 2.59 to 2.90 kg/per day between 2014-15 to 2021-22. However, compared to India's top 5 milk-producing states, the average yield is the lowest and lower than the Indian average of 3.36 kg/day. Rajasthan has the highest 5.68 kg/day yield among the five states.

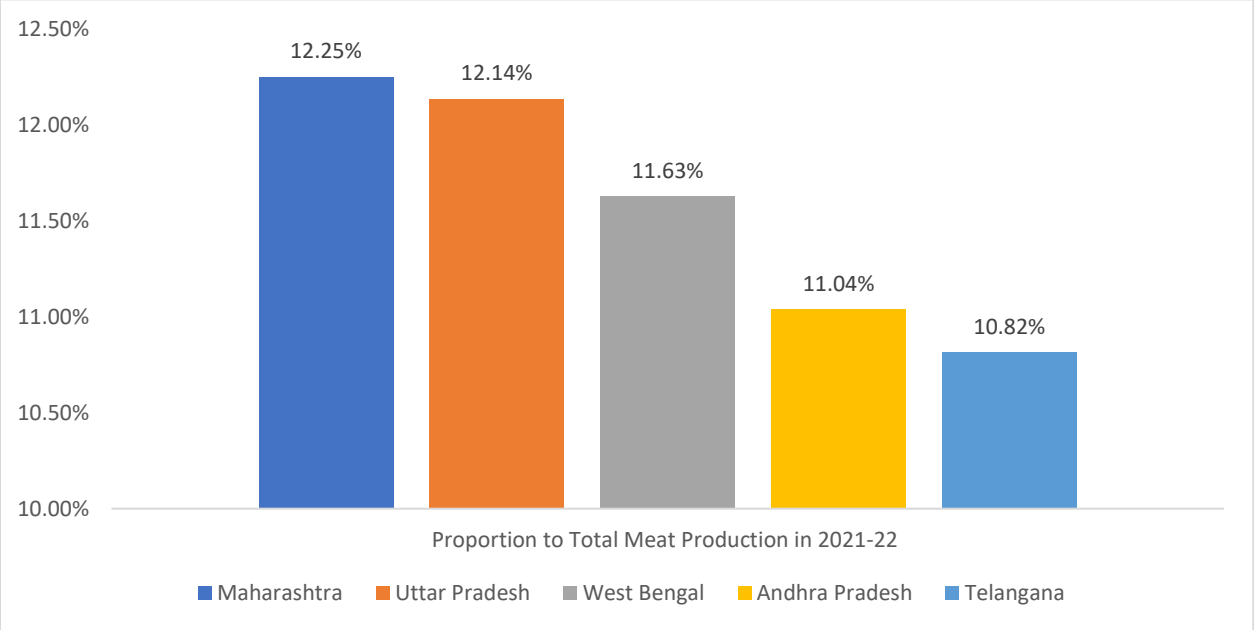
Telangana has seen a 25.6 per cent increase in per capita milk availability, rising from 336 grams per day in 2014-15 to 422 grams per day in 2021-22. Nonetheless, this figure falls below the Indian average of 444 grams per day.

The value of output (VOO) of milk at constant prices saw a compound annual growth rate of 5.35 per cent in Telangana from 2014-15 to 2020-21, and in India, it was 5.21 per cent (Table 18). Over this period, the VOO at constant prices in Telangana grew by 36.71 per cent. In 2020-21, it constituted 3.46 per cent of India's total VOO, maintaining an average share of 3.5 per cent in India's VOO since 2014-15.

Meat

Telangana in 2021-22 was the 5th largest meat producer, producing 10.82 per cent of Indian production. The largest producer of meat is Maharashtra (12.25 per cent), followed by Uttar Pradesh (12.14 per cent), West Bengal (11.63 per cent), and Andhra Pradesh (11.04 per cent).

Figure 51: Proportion of Production of Meat to Total India Production in 2021-22 - Top 5 states in 2021-22



Source: Basic Animal Husbandry Statistics, 2022

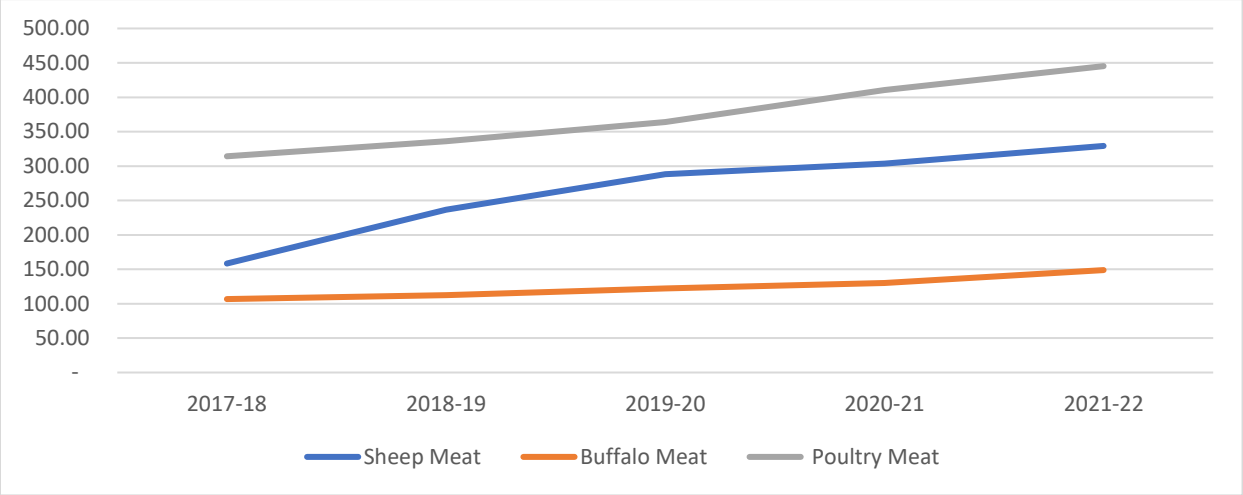
Between 2015-16 and 2021-22, meat production in Telangana experienced a significant 85.41 per cent increase, rising from 542 thousand tonnes to 1004.99 thousand tonnes. The CAGR of meat production in Telangana between 2014-15 and 2021-22 was 10.84 per cent, higher than the Indian CAGR of 4.74 per cent. The primary contributors to meat production in Telangana are sheep, buffalo, and poultry, accounting for approximately 90 per cent of the total meat production in Telangana.

The introduction of the sheep distribution scheme in March 2018 played a pivotal role in boosting sheep meat production in the region, witnessing a remarkable 108 per cent increase from 158.39 thousand tonnes in 2017-18 to 329.3 thousand tonnes in 2021-22. Following the scheme's launch, a significant 49.37 per cent rise in sheep meat production was observed in 2018-19.

In 2021-22, Telangana also boasts the highest per capita availability of meat at 26.64 kg per annum, which contrasts with the Indian average of 6.82 kg per annum.

The value of meat output at constant prices has seen a CAGR of 10.76 per cent from 2014-15 to 2020-21; for India, during the same period, it was 6.74 per cent (Table 18). Over this period, the VOO at constant prices in Telangana has increased by 85 per cent. In 2020-21, it accounted for 11.32 per cent of the VOO for India. Since 2014-15, Telangana's share in India's VOO has averaged around 10.08 per cent.

Figure 52: *Total meat, sheep meat, buffalo meat, and poultry meat production (000' tonnes)*



Source: Basic Animal Husbandry Statistics, 2022

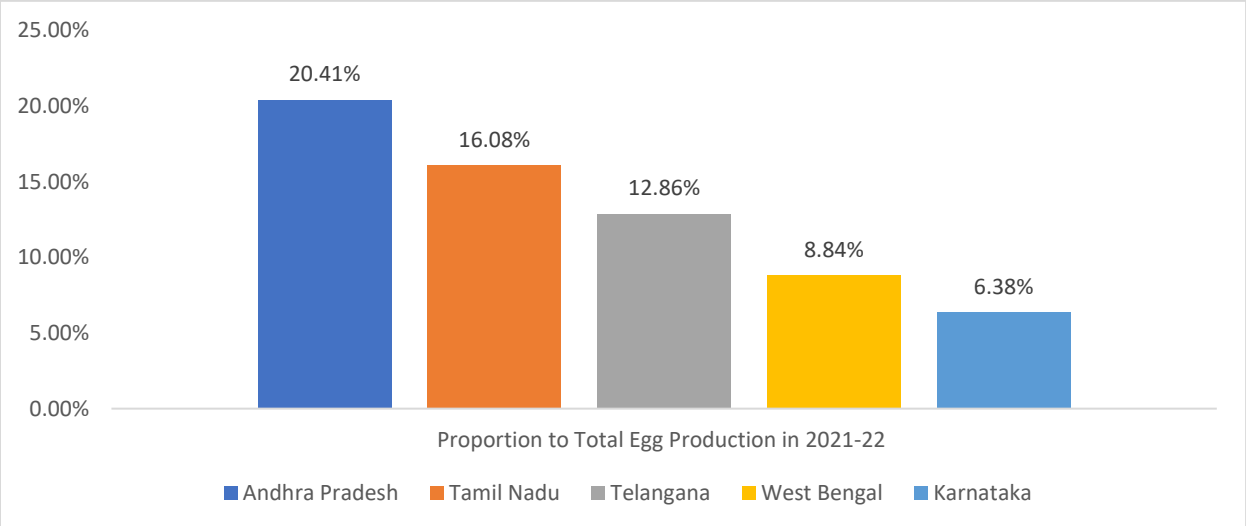
Wool

Wool production in Telangana declined since 2016-17 and ultimately reached zero tonnes in 2021-22. This decline in wool production can be attributed to the absence of wool-producing breeds in Telangana, as the focus shifted primarily towards meat production. (GOI & DAHD, 2022)

Egg

Telangana in 2021-22 was the 3rd largest producer of eggs and produced 12.86 per cent of the total Indian production. The largest producer of eggs is Andhra Pradesh (20.41 per cent), followed by Tamil Nadu (16.08 per cent), Telangana (12.86 per cent), West Bengal (8.84 per cent), and Karnataka (6.38 per cent).

Figure 53: Proportion of Production of Eggs to Total India Production in 2021-22 - Top 5 States



Source: Basic Animal Husbandry Statistics, 2022

Between 2015-16 and 2021-22, egg production in Telangana recorded an increase of 48.77 per cent, rising from 1120.58 crore eggs to 1667.08 crore eggs. The CAGR for egg production in Telangana, from 2014-15 to 2021-22, stands at 6.84 per cent, whereas the Indian CAGR during the same period was 7.73 per cent.

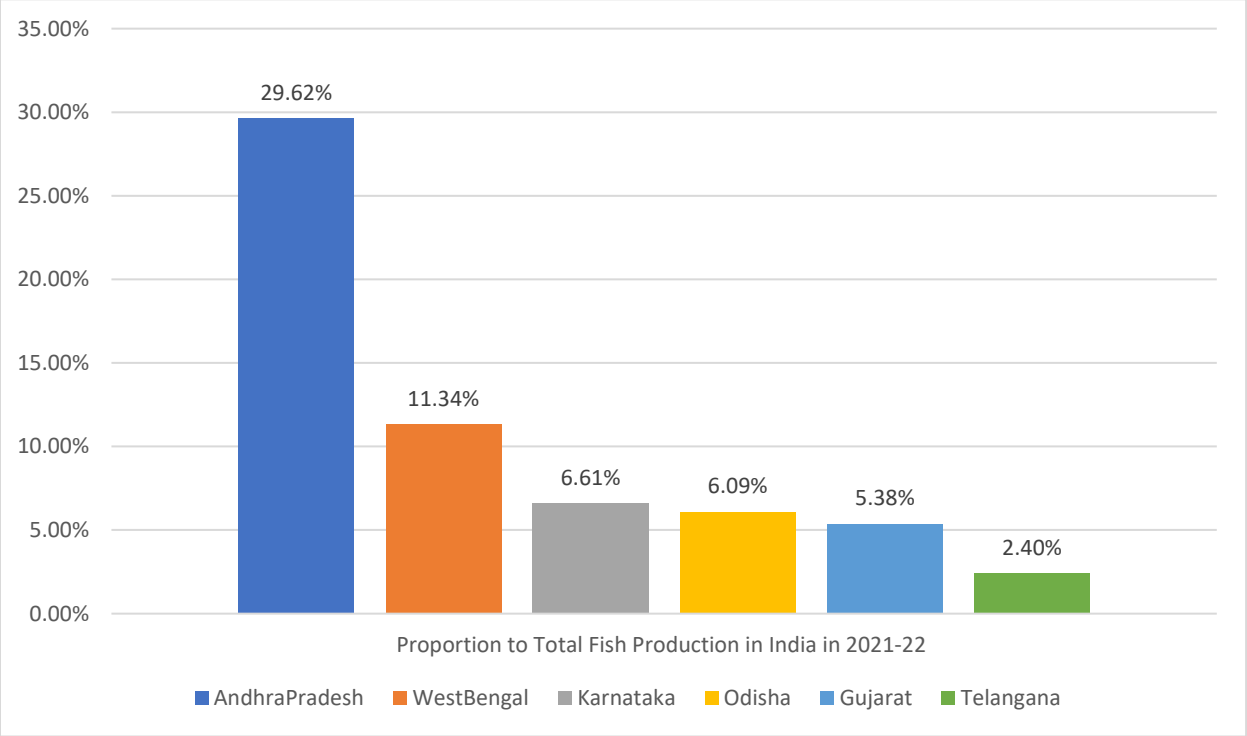
In 2021-22, Telangana ranks second in per capita egg availability at 442 eggs per annum, with Andhra Pradesh leading with 501 eggs per annum. The national average per capita egg availability in India is 95 eggs per annum.

Regarding the value of the output of eggs at constant prices, Telangana experienced a CAGR of 6.9 per cent from 2014-15 to 2020-21, whereas for India, it was 5.21 per cent (Table 18). The VOO at constant prices has increased by 49.24 per cent from 2014-15. In 2020-21, it accounted for 12.02 per cent of the VOO for India. From 2014-15, the share in India's VOO has been, on average, 12.24 per cent.

Fish

Telangana, in 2021-22, produced 2.40 per cent of Indian production and ranked 13th. The largest producer of fish is Andhra Pradesh (29.62 per cent), followed by West Bengal (11.34 per cent), Karnataka (6.61 per cent), Orissa (6.09 per cent), and Gujarat (2.40 per cent).

Figure 54: *Proportion of Production of Fish to Total India Production in 2021-22 – Top 5 States and Telangana*



Source: Handbook of Fisheries Statistics 2022

Fish production in Telangana has increased by 64.72 per cent from 236.75 thousand tonnes in 2015-16 to 389.97 thousand tonnes in 2021-22. The compound annual growth rate of fish production in Telangana between 2014-15 and 2021-22 is 8.67 per cent, higher than the Indian annual average growth of 7.11 per cent. In Telangana, inland fish make up the majority of the fish production.

In 2016, the Telangana government introduced a scheme where fish seed and prawn juveniles were stocked in existing water bodies with a 100 per cent grant. This initiative had a positive impact on fish production in Telangana. In 2016-17, 27.85 crore seeds were stocked, followed by 51.08 crore seeds in 2017-18 and 49.14 crore seeds in 2018-19.

Regarding the value of the output of inland fish at constant prices, Telangana's CAGR from 2014-15 to 2020-21 was 4.42 per cent, and India experienced a CAGR of 5.78 per cent (Table 18). Specifically, Telangana's constant price value of inland fish output increased by 29.6 per cent from 2014-15. In the year 2020-21, inland fish constituted 3.12 per cent of India's total value of output (VOO). Telangana's share in India's VOO has averaged around 2.99 per cent for inland fish since 2014-15.

Table 18: *Allied Sectors percentage increase in VOO, average proportion in India's VOO, CAGR(Telangana), and CAGR(India) from 2014-15 to 2020-21*

Item	Percentage Increase	Average Proportion in India's VOO	CAGR (Telangana) of VOO	CAGR (India) of VOO
Milk	36.71%	3.56%	5.35%	5.21%
Meat	84.59%	10.08%	10.76%	6.74%
Eggs	49.24%	12.24%	6.90%	5.86%
Inland Fish	29.65%	2.99%	4.42%	5.78%

Source: MOSPI

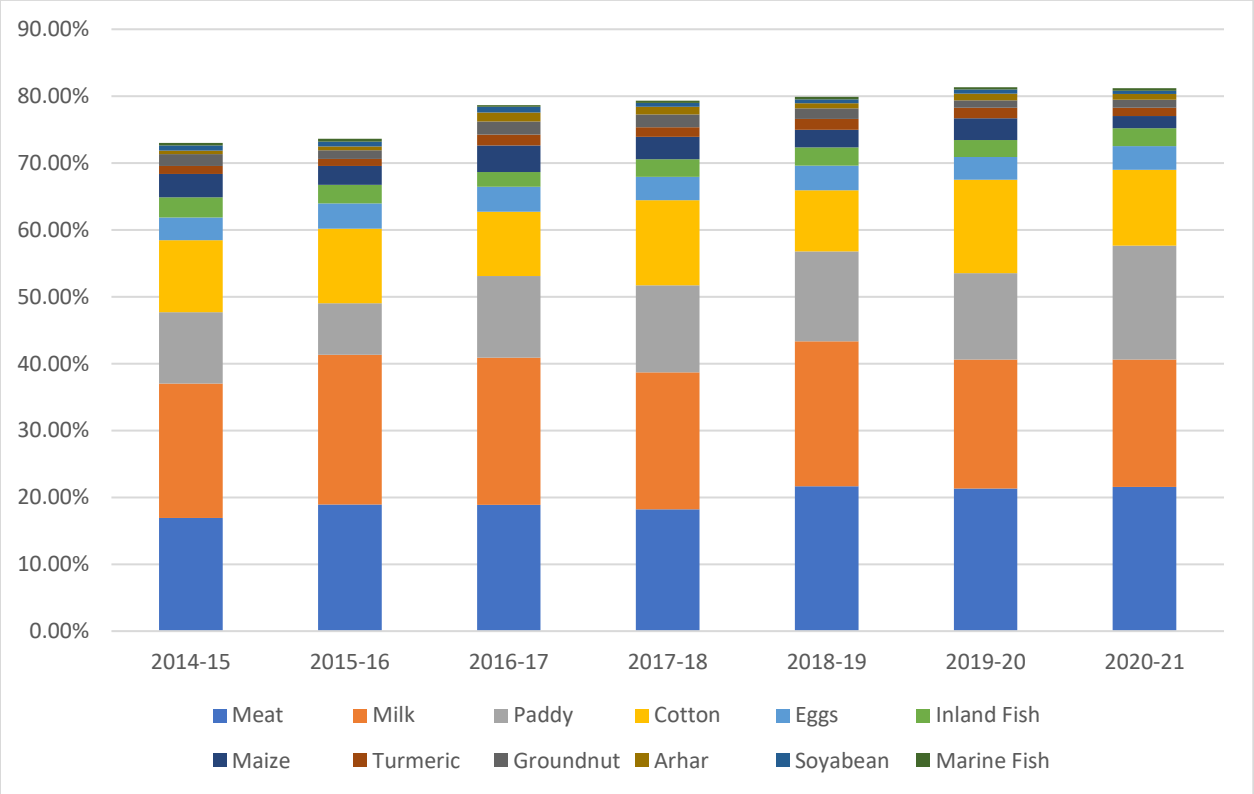
SECTION - V
COMPOSITION AND SOURCES OF AGRICULTURE GROWTH

Composition of Agriculture Growth in Telangana

In 2020-21, meat, milk, paddy, and cotton together had a 69 per cent share in the gross value of meat's contribution increased significantly, rising from 16.91% in 2014-15 to 21.59% in 2020-21, indicating substantial growth in the meat industry. Paddy also saw an increase in its contribution, with a growth of 6.35% over the same period. In contrast, the contribution of milk decreased by 1.1%. Cotton's contribution showed a modest increase of 0.59% from 2014-15 to 2020-21, indicating slower growth in the cotton industry.

These shifts reflect changes in the agricultural sector, with meat and paddy becoming more prominent and limited growth in the cotton sector.

Figure 55: *Share of different items in total gross value of output at basic prices (2011-12)*



Source: MOSPI

The methodology used in this analysis to decompose the sources of agriculture growth is adopted by Hoda et al. (2021). This process requires the utilization of the gross value of output (GVO) at base prices (2011-12) for various agricultural items and the total gross value of output from agricultural and allied activities

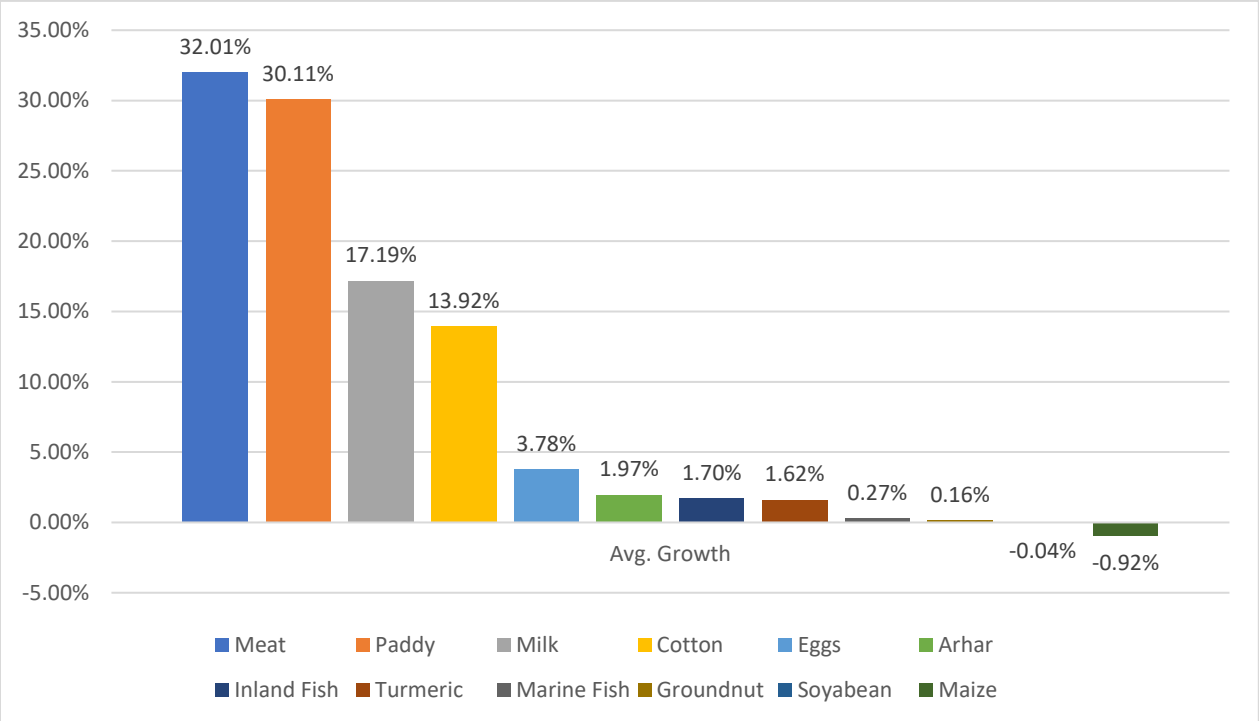
(GVOA). To understand the sources of growth, the year-on-year growth in GVOA is computed by calculating the year-on-year difference in the GVO for each item and expressing it as a proportion of the previous year's GVOA.

This methodology found that the annual average growth of GVOA between 2014-15 and 2020-21 was 6.57 per cent. This growth can be further broken down into the contributions of specific items:

1. **Meat:** Meat contributed **the highest share to the growth at 32.01 per cent**. It indicates that the meat sector played a significant role in driving overall agricultural growth during this period.
2. **Paddy:** Paddy contributed 30.11 per cent to the growth, making it the second-largest contributor. It suggests that the paddy sector also substantially impacted agricultural growth.
3. **Milk:** Milk was the third-largest contributor, accounting for 17.19 per cent of the overall growth.
4. **Cotton:** Cotton contributed 13.92 per cent to the growth, indicating its moderate role in driving agricultural growth during this time.

When considering livestock contributed 53.15 per cent to the overall growth, while crops contributed 43.17 per cent. This breakdown provides valuable insights into the specific items and sectors that fueled the growth in agriculture between 2014-15 and 2020-21.

Figure 56: *Sources of growth in GVOA of Telangana from 2014-15 to 2020-21*



Source: MOSPI

Drivers of Agriculture Growth: Econometric Analysis

In this section, we employ econometric analysis to identify the sources influencing agricultural growth in Telangana over the past decade. We have used a simple linear regression model for this purpose. The

dependent variable in our analysis is the natural logarithm (log) of the Gross Value Added of Agriculture and Allied Activities (GSVAA). In contrast, the explanatory variables are the log of canal and tank gross irrigation, the log of well gross irrigation, and the log of the meat share in the total value of Output in Telangana. We have utilized data for these variables from 2014-15 to 2020-21. The estimated model used in our analysis is as follows:

Ln GSVAA = $\alpha + \beta_0 Ln\ CTGI + \beta_2 Ln\ WGI + \beta_3 Ln\ MVOO + \varepsilon_i$

Variables:

Ln GSVAA: Natural Log of Gross State Value Added for Agriculture and Allied at Constant Prices (2011-12)

Ln CTGI: Natural Log of Canal and Tank Gross Irrigation

Ln WGI: Natural Log of Well Gross Irrigation

Ln MVOO: Natural Log of Share of Meat in Value of Output (%)

According to the model, all other factors remaining constant (ceteris paribus), a one per cent increase in canal and tank gross irrigation leads to a 0.08 per cent rise in Telangana's Gross Value Added of Agriculture and Allied Activities (GSVAA). Similarly, a one per cent increase in the well gross irrigation results in a 0.34 per cent increase in Telangana's GSVAA. Furthermore, a one per cent increase in the share of meat in the total value of output results in a 0.682 per cent increase in Telangana's GSVAA. These three factors account for 99.4 per cent of the variation observed in Telangana's GSVAA. It underscores the significant impact of canal and tank gross irrigation, well gross irrigation, and the meat sector's contribution to explaining the changes in Telangana's GSVAA. All the coefficients are significant at the 0.05 level of significance. The model has been run with robust standard errors and checked for multicollinearity and normality of error term.

Table 19: Regression Coefficients and Correlation with GSVAA

Variables	Coefficient	Correlation with GSVAA
Canal and Tank Gross Irrigation	0.082*	0.7862
Well Gross Irrigation	0.343*	0.3089
Share of Meat in Total Value of Output	0.68 *	0.9495
Constant	10.05*	
R^2	99.4	

* Significance at 0.01 level

SECTION - VI
ADDRESSING SUSTAINABILITY

About Climate Change

Climate change is one of the most significant concerns in our modern world, profoundly reshaping and potentially altering Earth's ecosystems. ***While climate change has been a natural process, its pace has dramatically accelerated in the last century, particularly over the past hundred years.*** This rapid change, driven by human activities, has caused the Earth's average temperature to rise by 0.9°C since the 1800s, primarily due to the emission of greenhouse gases into the atmosphere.

Projections suggest that this temperature increase could reach 1.5°C by 2050 or surpass it, given the ongoing trends of deforestation, increasing greenhouse gas emissions, and environmental pollution. This unprecedented temperature rise has led to a surge in extreme events like droughts, floods, irregular precipitation patterns, heatwaves, and other such occurrences on a global scale. The impact of climate change is far-reaching and complex, but its significant effects are becoming increasingly evident in the agricultural sector (Arora, 2019).

Impact of Climate Change on Agriculture

Agriculture is highly vulnerable to climate change due to its large scale and sensitivity to weather conditions, leading to significant economic impacts. Changes in temperature and rainfall have a significant impact on crop yields. Rising temperatures generally decrease yield, while increased precipitation can offset some negative effects of higher temperatures. The effects vary depending on factors like crop type, location, and changes in climate parameters. Climate change also affects microbial populations in soil.

In some cases, rising CO2 levels can enhance plant growth. Still, elevated temperatures and altered precipitation patterns can counteract this positive effect. The frequency periodicity will decrease, leading to few rainy days and high-intensity rains with long dry spells on seasonal rains, raising temperatures and leading to El Nino or La Nino.

Extreme weather events, insect pests, and diseases are more prevalent in warmer regions. Climate change's impact on crop yields varies depending on area and irrigation methods. While some areas might experience positive effects, climate change is projected to decrease crop yields in many places, affecting food prices and global agriculture welfare. Developing countries, especially those in tropical regions, will face severe consequences. Strategies for adaptation and flexibility are crucial to mitigating these impacts (Malhi, Kaur & Kaushik, 2021).

Therefore, promoting sustainable agriculture is imperative for safeguarding the environment, ensuring stable food production, and fostering economic growth. Sustainable agriculture enhances long-term resource availability. It mitigates climate change impacts, contributes to healthier and more nutritious food production, and empowers rural communities through job creation and market development. Such initiatives align with global responsibilities and enhance resilience to shocks, ensuring a secure and prosperous future for agriculture and society.

Sustainable Agriculture

By 2050, the global population is projected to increase by about two billion, necessitating a 70% surge in food production to cater to the needs of almost eight billion individuals. Concurrently, the Indian population's continuous growth amplifies the urgency for adequate and sustainable food production. This notable increase in the global as well as the Indian population has heightened concerns regarding the feasibility of sustainable food production.

Hence, it's becoming clear that the agricultural sector needs significant changes to prepare the food system for the challenges of a growing global population. This shift requires progress from the traditional industrial food system, which has been dominant for a long time, towards sustainable farming.

In a world of droughts and energy demands, transitioning from industrial to sustainable agriculture offers long-term promise. The challenges encountered can be addressed by looking at the present experience in the field in various parts of the country. Modern farming produces many jobs and abundant output in a single harvest season, but it also brings severe problems that sustainable farming can fix.

What is Sustainable Agriculture, and Why is it Important?

The concept of sustainability encompasses multiple dimensions. Environmental sustainability, for instance, revolves around the responsible management of the natural systems and resources that underpin agricultural operations. It involves practices such as nurturing and safeguarding healthy soil to prevent erosion, practising efficient water management, reducing the release of air and water pollutants, capturing carbon within farms, fortifying resistance against extreme weather events, and fostering biodiversity to maintain ecological balance.

On another front, an agriculture system is deemed economically and socially sustainable when it guarantees the profitability of farms across all scales and their positive contributions to local economies. This system also supports the next generation of farmers, ensures equitable treatment for labourers, champions justice and inclusivity, facilitates access to nutritious food for everyone, and places the well-being of individuals and communities above the interests of corporations.

While building upon decades of research and practical experience, certain sustainable agricultural practices have proven effective, particularly when employed in tandem. Crop rotation and diversification, for instance, offer advantages such as improved soil health and enhanced pest control. Strategies like intercropping and multilayer crop rotations underscore this approach. Incorporating cover crops during off-season periods maintains soil coverage throughout the year, safeguarding soil health by preventing erosion, replenishing nutrients, and suppressing weed growth.

> A speaker among us, possessing expertise in development work, highlighted that the state of Telangana should focus on existing viable alternatives rather than relying solely on palm oil. In the southern region of Telangana, there is a strong focus on cultivating groundnuts, while in the northern areas, sunflowers have been traditionally favoured. There is undoubtedly untapped potential for diversification within the category of oilseeds.
>
> Furthermore, the speaker expressed that Telangana faces a deficiency in meeting its fruit and vegetable demands, particularly in Hyderabad. The state compensates for this shortfall by importing this produce from Karnataka, Maharashtra, and Andhra Pradesh.

Overall, Telangana predominantly concentrates on cultivating paddy, cotton, and maize, making it imperative to diversify its crop portfolio. It is worth noting that these three crops also significantly burden the government for procurement at the Minimum Support Price (MSP). However, crop diversification is something that should be supported in the state.

Another speaker, a distinguished professor, highlighted that to ensure sustainable agricultural policies, three essential factors were identified by the speaker for both Telangana and India as a whole: agricultural growth, inclusiveness, and sustainability. It was recognised that nutrition and sustainability were interconnected concepts linked to farmer incomes. Diversification of crops was considered crucial to achieving a varied diet, and macro policies like fiscal and monetary policies were analysed for their impact on agriculture.

India and Telangana were found to have two distinct types of agriculture: cereal-based and non-cereal-based. However, policymakers predominantly focused on cereals, supporting rice and wheat cultivation significantly. The speaker emphasised the need to prioritize nutritious cereals alongside cereals for policy support.

Moreover, adopting reduced or no-till methods in farming, where seeds are directly sown into undisturbed soil, minimises soil loss and promotes soil health. Integrated Pest Management (IPM) upgraded to non-pesticidal management utilising a systematic blend of mechanical, biological, and plant-based botanical controls to manage pest populations. Integrating livestock with crop production enhances overall farm efficiency and profitability. Agroforestry practices involve integrating trees or shrubs, including orchards (going up to five layers, vertically leading to effective sunlight harvesting) to provide stability to the production system, and nutrient recycling provides leaf mulch, covering soil 365 days with mulch.

D.V. Raidu, a technocrat with long experience in the agriculture sector and a distinguished former civil servant with a background in the Indian Administrative Service (IAS) , opined that there has been a notable shift in fertiliser application practices in India as well as in Telangana. In the past, a half bag of Di-ammonium Phosphate (DAP), along with favourable rainfall, could yield 10-12 quintals of jowar. However, present conditions necessitate five to six times the fertiliser for comparable output. Due to skewed fertiliser subsidies, the application of nitrogenous fertilisers has increased, creating an imbalance in the N:P: K ratio. Over the last 60 years, soil organic carbon has remained low from 0.2 to 0.4 per cent, with soil microbiome depletion necessitating the perennial application of external inputs and disturbing plant-root microbial symbiotic relationship. Applying all biocides (including weedicides) deplete rich soil microbiome, making agriculture cost incentive and reducing profits. This hurts badly the livelihoods of 55 per cent of the population dependent on agriculture.

Increased application of Nitrogenous fertilisers such as Urea tends to attract pests and diseases, leading to increased use of highly toxic broad-spectrum biocides killing beneficial insects and disrupting the ecosystem's delicate balance. This, in turn, leads to pests developing resistance over successive generations, complicating pest control efforts.

A comprehensive approach to managing the entire farming system and its landscape also contributes to sustainability. By considering uncultivated or less intensively cultivated areas as integral components of the farm, erosion can be curbed, runoff reduced, and biodiversity supported.

An essential element linking many of these practices is their shared emphasis on soil health. Maintaining vibrant and robust soil addresses numerous challenges linked to industrial agriculture, supporting healthy crop growth, efficient water retention, pollution prevention, and community prosperity. Diversification emerges as another common thread. Agricultural systems that mirror the complexity and diversity of natural ecosystems tend to be more productive and sustainable in the long run.

> Another speaker with experience in the development of rural communities pointed out that an ideal multiple-cropping plot in Telangana should grow around 30 crops. Apart from the pre-existing paddy, this can include all millets and dals, groundnuts, all oils, local cereals, varieties of rice, and cotton. Since Telangana is a seed market, local seeds should also be encouraged, which can be supplied to many neighbouring states. As a meat-consuming state, produce for livestock is also important.
>
> Most consumers are also moving into consuming more fruits and vegetables than normal cereals, and hence, horticulture should be encouraged as well. Large incomes are possible from these crops, enhancing the livelihood of the farmers.

Efforts by Telangana to Address Climate Change

The state of Telangana recognises that the proliferation of detrimental chemical-intensive farming practices necessitates a shift towards ecologically sustainable farming methods in numerous regions, as failure to do so could potentially lead to a crisis. While focusing on these concerns, ***the Government of Telangana has strategically initiated a range of flagship programs focusing on providing credit, knowledge extension, life insurance, palm oil cultivation, and irrigation facilities, as mentioned in our previous sections. These endeavours are designed not only to enhance farmers' income but also to holistically improve the overall well-being of the agricultural community within the state*** (Telangana Socio-Economic Outlook, 2023).

Specifically, ***the governmental initiative known as the Crop Diversification Index of Telangana is centred on meticulously documenting shifts in crop diversification through introducing a specialised index.*** This innovative measure provides a comprehensive overview of the state's cultivation practices, revealing that it encompasses a diverse array of 77 distinct crop varieties. The state has strategically emphasised approximately ten key grain-based crops to encourage and facilitate diversification efforts. Noteworthy variations in diversification levels are observed across different districts, with Nirmal, Vikarabad, and Sangareddy as examples of higher agricultural diversity.

Conversely, Peddapalli, Karimnagar, and Suryapet emerge as the three districts lagging in diversification. Despite traditionally being associated with paddy cultivation, these regions have notably witnessed a decline in maize farming activity, alongside a noticeable expansion in cotton cultivation. State authorities regard this pioneering index as a vital benchmark for shaping forthcoming strategies aimed at fostering agricultural diversification.

With this regard, in tandem with traditional paddy and maize cultivation, pulses have emerged as an increasingly favoured alternative in the state's agricultural landscape. Following paddy, farmers have

demonstrated a keen interest in cultivating wheat, jowar, bajra, maize, green gram, black gram, red gram, Bengal gram, cow gram, and chilli crops. Agricultural department officials noted that before the surge in paddy production, farmers cultivated a wide assortment of pulses and other food crops, a practice they aspire to revive based on the insights gleaned from this pattern.

Upon meticulous analysis of the index data, officials are inclined to advocate for an augmented drive towards diversification. The pursuit of enhanced diversification has yielded substantial outcomes, leading to an impressive 77.9% reduction in maize cultivation area, dwindling from 9.7 lakh acres during 2019-20 (Vaanakalam) to 2.1 lakh acres in 2020-21. In contrast, the cultivation area for cotton has experienced a growth of 10.9% over the same period, surging from 52.6 lakh acres to 58.3 lakh acres. Likewise, the acreage dedicated to red gram cultivation has expanded by a notable 45.1%, escalating from 7.3 lakh acres to 10.6 lakh acres.

Additionally, the Giri Vikasam initiative represents a state government effort in Telangana aimed at sustainable agricultural development within the Scheduled Tribes community. Functioning under the purview of the state's rural development department, this scheme revolves around the transformation of lands belonging to small and marginalised tribal farmers into productive agricultural plots. Its goal is to enhance the income of tribal farmers.

The government also acknowledges that two significant domains wherein organic methods exhibit superior yields compared to conventional farming are climate-influenced cultivation and small-scale farming systems. Given that approximately 88% of farmers in Telangana fall within the smallholder category, the state possesses substantial potential to excel in organic farming, setting a commendable example for others to follow. Organic agriculture offers several advantages, including the production of high-quality food, bolstering natural resources and the environment, augmenting income (even with a slight decrease in yields due to the premium pricing of the produce), and enhancing the overall well-being of farmers (Telangana Socio-Economic Outlook, 2023).

Furthermore, ***the inauguration of the Telangana Centre of Excellence for Sustainable Cooling and Cold Chain in August 2023, overseen by Industries and IT Minister K T Rama Rao, marked a significant stride towards promoting food and health security, empowering farmers, and fostering exports.*** The centre's unique objective is to advance sustainable cooling technology and energy-efficient refrigeration, particularly for the intricate food and vaccine supply networks spread across India. This collaborative initiative involves a partnership between the Telangana government, the Centre for Sustainable Cooling (CSC), the University of Birmingham, the United Nations Environment Programme (UNEP), and the GMR Group. This endeavour was set into motion through a memorandum of understanding inked between the Telangana government and the University of Birmingham. With a paramount focus on enhancing food security and minimising environmental impact, the centre aspires to curtail greenhouse gas emissions, mitigate food losses, and stimulate sustainable development.

Telangana also successfully integrated agritech to transform its agricultural landscape and is working to extend these benefits to around 100,000 farmers by 2025. Despite challenges in India's agritech sector due to fragmented land ownership and an unorganised industry, Telangana stands out by recognizing agriculture's importance and using agritech as a driver for sustainable rural development.

Telangana's PPP-driven model showcases the importance of strategic partnerships in addressing agricultural challenges, emphasising targeted interventions and digital infrastructure investments. This transformation serves as a valuable example for other regions facing similar complexities.

Established and Proven Sustainable Farming Methods in Telangana

Community and individual efforts are crucial in advancing sustainable farming practices, collectively contributing to a more environmentally conscious and resilient agricultural system.

At the community level, collaborative initiatives such as community-supported agriculture (CSA) programs have gained traction. These programs link local consumers directly with nearby farms, fostering a sense of shared responsibility for sustainable practices (Hinrichs, 2000). Additionally, farmer cooperatives and agricultural associations facilitate knowledge exchange and the implementation of eco-friendly techniques, pooling resources for collective benefits (Darnhofer et al., 2010).

On an individual level, farmers adopting sustainable practices make significant contributions. Implementing agroecological methods, like crop rotation and organic farming, minimizes the use of synthetic inputs and promotes biodiversity (Reganold & Wachter, 2016). Furthermore, embracing precision agriculture technologies reduces resource wastage through optimized resource application (Scharf et al., 2016).

Moreover, advocacy and education are pivotal. Individuals engaged in sustainable farming can serve as role models, inspiring others in their community to adopt similar practices (Niles et al., 2018). Participating in workshops, seminars, and extension programs contributes to knowledge dissemination and capacity building within the agricultural community (Steele et al., 2018).

Furthermore, ***community and individual efforts serve as guiding beacons for government policies and initiatives in sustainable agriculture. By actively participating in local agricultural practices, communities provide valuable insights into the specific challenges and opportunities faced on the ground.*** They serve as testbeds for innovative techniques and can showcase successful sustainable farming models to inform policy decisions (FAO, 2018).

Individual farmers, as key stakeholders, often act as advocates for sustainable agriculture, sharing their experiences and expertise with policymakers. Their firsthand knowledge of the benefits and challenges associated with sustainable practices offers invaluable input for crafting effective and realistic policies (Hobbs, 2007). Additionally, organized groups of farmers, such as cooperatives and associations, amplify their collective voice, ensuring that government policies align with the needs and aspirations of the agricultural community (Jolly & Taylor, 2017).

Furthermore, community and individual efforts can catalyse policy change through grassroots movements and advocacy campaigns. By mobilizing public support and raising awareness about the importance of sustainable agriculture, these efforts influence the political agenda and encourage governments to prioritize policies that promote eco-friendly farming practices (Collier et al., 2013). Some of these community-level and individual efforts regarding Telangana are listed below.

Table 20: *Community-based Efforts*

Community-based Efforts	**Location**	**Description**
Enabavi Village	Telangana	Transitioned to organic farming methods, including bio manure utilization, neem oil for pest control, and diverse cropping systems. Initially faced challenges with soil recovery, but eventually achieved higher yields, inspiring neighbouring farmers (NDTV, 2019).
Ibrahimpur Village	Telangana	Cultivated green manure crops under the Agriculture Extension Officer's (AEO) guidance, leading to improved soil fertility, reduced expenses, and decreased reliance on chemical fertilisers (Raina, 2021).
Zaheerabad Women Farmers	Telangana	Grew over 150 varieties of millets, pulses, and oilseeds using organic methods. Embraced innovative practices like sprouting millets for enhanced nutrition. Demonstrated self-sufficiency and resilience (The Wire, 2023).
Sahaja Aharam Producer Company Limited	Telangana, Andhra Pradesh, & Maharashtra	Cooperative society promoting direct-to-consumer organic farming, evolved from the Centre for Sustainable Agriculture. Increased farmers' income and promoted sustainable practices.
Chetna Organic Agricultural Producers Company Limited (COAPCL)	Adilabad District, Telangana	Managed by Gondu tribal farmers benefiting from the Scheduled Tribes and Other Traditional Forest Dwellers Act (RoFR). Involved in organic farming practices and maintenance of a seed bank (Singh, 2022).
Community Managed Sustainable Agriculture (CMSA)	Andhra Pradesh	Replaced chemical pesticides with physical and biological methods, enhanced soil fertility, and reduced cultivation costs and indebtedness. Implemented through community organisations and federations, benefiting over 300,000 farmers (The World Bank, 2009).

Rythu Vikasa FPO	Warangal	Formed by organic farmers under the Cooperative Act, planning to sell produce online and through outlets. Supported by Bala Vikasa NGO and certified by APEDA (Telangana Today, 2023).
Vermicompost Units	Aliguda, Umapathi Kunta, GR Nagar, Thukaram Nagar Villages	Collaboration to produce vermicompost instead of selling cow dung to middlemen. Initiated with support from the Centre for People's Forestry (CPF). Resulted in monthly earnings for tribal farmers (Ravi, 2023).

***Table 21**: Individual Efforts*

Individual Efforts	**Location**	**Description**
Mallikarjun Reddy	Telangana	Former tech worker recognised for innovative organic farming techniques, including drip irrigation, waste decomposition, and integrated farming. Achieved lower investment and higher returns (The Hindu, 2021).
Arun Srinivas	Vikarabad, Telangana	The former photographer who transformed 12 acres near Anantagiri foothills into a permaculture experiment, cultivating fruits and local grains. Promotes organic farming through training and practical education. Collaborates with local Gurukul to encourage mindset change among farmers (The Better India, 2018).
Srikanth	Shivvaram village, Jaipur mandal	Quality analyst for a Bengaluru-based multinational company that embraced organic farming during the pandemic-induced work-from-home period. Cultivated various crops on two acres of land, including paddy, vegetables, pulses, and fruits. Managed a 12-acre mango farm in Rapalli village. Delivers organic products and mangoes across Telangana, advising fellow farmers on eco-friendly practices. Recognised and honoured by local authorities and organisations (Santosh, 2023).

Nandurka Suguna	Nagasamudram village, Dandepalli mandal	Female farmer awarded at a national conference held in Hyderabad on World Food Day in October 2022. Acknowledged for cultivating a variety of crops using organic fertilisers and pesticides. Conference arranged by Siri Foundation at the National Rice Research Institute (Telangana Today, 2022).

Box 1: *D.V. Raidu's Sustainable Farming Method: A Model of Holistic Agricultural Innovation*

D.V. Raidu's Sustainable Farming Method: A Model of Holistic Agricultural Innovation

In 2023, D.V. Raidu's farm achieved the prestigious certification of being fully organic, endorsed by the ADA. This recognition is a testament to the meticulous implementation of sustainable farming practices that define Mr Raidu's agricultural endeavours.

Spanning across 8 acres of land, Mr Raidu's farm is a harmonious tapestry of diverse crops and trees, meticulously planned to maximize sunlight, water, and nutrient uptake. The five-layer model ensures varying heights of crops and trees, fostering efficient resource utilization. Orchard crops like oil palm, banana, areca nut, cocoa, sandalwood, and teak coexist with ground cover vegetation, including sweet potato, ginger, mango-ginger, and curry leaves.

A notable innovation is adopting a System of Rice Intensification (SRI) for paddy cultivation, significantly reducing water requirements compared to conventional flooding irrigation. Multiple crops are cultivated using the pandal method, a multi-layered approach incorporating green leafy vegetables, tubers, creepers, climbers, and fruit crops like custard apple, amla, and kondala.

The farm's irrigation system relies on drip technology, ensuring efficient water usage. Additionally, it is completely free from synthetic chemicals, employing minimal tillage and integrated aquaculture and poultry systems. Rainwater harvesting structures further exemplify the farm's commitment to a cradle-to-cradle principle.

One striking achievement is the successful cultivation of Pre-Monsoon Dry Sowing Crops, which mitigate the effects of scorching Telangana summers and minimise weed growth. Once alkaline with a pH of 8.5, the soil has been rejuvenated through the cultivation of subabul and the use of leaf litter, effectively addressing alkalinity issues.

Regarding income generation, Mr Raidu's farm recorded an impressive average of 7,00,000 INR from organic farming, including teak. Since defunct open wells have been rejuvenated, in the next three years, guava and oil palm will be the main sources of income. It then underscores the financial viability of sustainable farming practices.

This approach provides rotational income while safeguarding the soil year-round, preventing erosion and enhancing soil health.

Integrated farming is a cornerstone of Mr Raidu's methodology. Cows are the main source of dung and urine for natural farming inputs, contributing to the farm's energy sustainability. Furthermore, manure is carefully managed to nurture maggots and earthworms, which in turn serve as nutrient-rich poultry feed, ensuring the health and productivity of the farm's poultry population.

The farm's aquaculture endeavours yield profitable returns, while the wastewater is efficiently repurposed in vertical gardens, showcasing a seamless integration of resources. This circular economy model stands as a beacon of sustainable agriculture, offering valuable insights into how such practices can be effectively applied in the field.

In conclusion, D.V. Raidu's sustainable farming method is a beacon of innovation and conscientious resource management. Through a combination of agroecology, natural farming, and integrated systems, this farm exemplifies how agriculture can be productive and environmentally responsible. This farm stands as an inspiring model for the future of sustainable agriculture, demonstrating that with thoughtful planning and dedication, it is possible to cultivate abundance while preserving our precious natural resources.

SECTION - VII
REVOLUTIONISING AGRIBUSINESS: AGRITECH, STARTUPS, AND FPOS

Introduction

In recent years, the agriculture sector in India and Telangana has witnessed a transformative shift driven by the infusion of technology, the emergence of startups, and the establishment of Farmer Producer Organisations (FPOs). Startups have emerged as dynamic catalysts, introducing cutting-edge solutions to age-old challenges. They harness innovative technologies to enhance productivity, optimise resource utilisation, and mitigate risks associated with farming.

Additionally, the application of AI (Artificial Intelligence), IoT (Internet of Things), Big Data Analytics, drones for agricultural mapping, ICT (Information and Communication Technology) solutions, and advanced weather forecasting technology, among other technological advancements, exemplifies the immense potential of Indian agricultural technology in revolutionising the nation's agricultural sector.

Furthermore, Farmer Producer Organisations (FPOs) have emerged as a potent force, uniting smallholder farmers and empowering them with collective bargaining power. These entities facilitate the aggregation of produce, enable access to credit, and provide technical know-how, thereby fostering economic sustainability for farmers.

In this section, the role and importance of these three notions, i.e., the impact of FPOs, the culture of agricultural startups, and the involvement of technology, are discussed below.

Linking Technology with Agriculture in Telangana

Agri-tech is a term that has been newly introduced into Indian practices for the agriculture business. It refers to applying digital tools and technology to farming to ensure sustainability and profitability. This evolution of agricultural practices has brought about opportunities to transform the agricultural sector, improve yield, increase efficiency, and revolutionise how farming is viewed. The replacement of traditional practices in Telangana has been slow but sure, and significant positive change can be observed. It is important to note that the agricultural industry is one of the most unpredictable because of varied weather conditions. So, it is necessary to build tools which aid the farmers and strengthen production irrespective of the natural weather conditions. Some of the challenges that this sector faces include insect and bug infestations, droughts, floods, losing land to urbanisation and a labour shortage (George, 2023). There must be systems to maintain yield and solve issues created by these factors which cannot be controlled. Improving production without affecting climate also arises, which can be done through innovative approaches.

Across India, farmers and other stakeholders are gearing up for advancements in technology to boost their business. ***Telangana has been acting as the frontrunner of this transformation, being the success story of Indian agri-tech.*** According to a news report by Telangana Today, Agriculture Minister S Niranjan Reddy said, “A new revolution in agriculture has already started with the adoption of emerging technologies in the sector. With this project, Telangana will be in the forefront and lead the revolution in our nation to improve farmers’ lives”. IT and Industries Minister KT Rama Rao also commented, "Telangana is leading by example – mainstreaming responsible and scalable deployment of emerging technology in agriculture,

the highest priority sector for the country" (Telangana govt launches 'Saagu-Baagu' to promote innovation in agriculture, horticulture, 2023).

Need for Agritech

The need for technological tools in agriculture is becoming increasingly evident. India's population is expected to surpass 1.7 billion by 2050, necessitating a substantial increase in food production. Agritech can be pivotal in achieving this by enhancing productivity through precision farming techniques, data-driven decision-making, and smart resource management. Technologies like IoT-enabled sensors, drones, and satellite imagery can provide farmers with real-time information on soil health, weather patterns, and crop conditions, enabling them to optimise their farming practices. Agritech can help farmers adapt to the challenges of pest infestations and erratic weather conditions by offering climate-resilient crop varieties, water-efficient irrigation systems and early warning systems for pest control. Long-term environmental stability and creating jobs in rural areas are also advantageous outcomes, curbing adverse effects of climate change and making the agricultural business more attractive, preventing migration and harnessing urbanisation.

The benefits extend to farmers, consumers and the environment, making it a vital component of modern agriculture as we work towards addressing the challenges of feeding a growing global population while preserving our planet's resources. By harnessing technology, India can ensure food security, increase farmer incomes, and mitigate the adverse impacts of climate change, ultimately contributing to the nation's economic growth and rural development. However, it is essential to ensure that these technological advancements are accessible and affordable to all farmers, including smallholders, to realise the full potential of Agritech in India. Agritech startups are leveraging the widespread use of the internet, even in rural regions, to provide farmers with access to markets, credit, and insurance, reducing their vulnerability to market fluctuations.

Types of Technological Implementations

Many different technologies have the potential to aid agribusiness, and they can be used in various aspects of the operation to support it. Some of the most promising tools are given as follows:

Internet of Things: This is an innovative farming solution for remotely monitoring the crop field. It uses sensors to track soil moisture, crop health, livestock conditions, temperature, etc. It makes it possible to create automated irrigation structures to manage water resources efficiently (Top 13 Innovations in Agriculture/Farming in 2023, January 2023).

Drones: These are increasingly becoming useful in crop and livestock management. Farmers can use sensor-equipped drones to monitor the growth of plants, detect disease stress, monitor field temperature, and spray pesticides or fertilisers at desired locations on the field. They help farmers acquire comprehensive data to make timely decisions (Top 13 Innovations in Agriculture/Farming in 2023, January 2023).

Blockchain Technology: Enhancing agricultural supply chains by creating a shared, decentralised ledger of agricultural information can serve as a transparent and trusted source of truth. It empowers farmers and creates a direct link between farmers and consumers with traceability options (George, 2023).

Artificial Intelligence: It is the next big thing that can improve agriculture by collecting data and providing better insights and suggestions to farmers to take appropriate action. Predictive analysis can also help the

business by revealing the likelihood that a crop will be harvested successfully, and it allows for making changes based on the projections (How New Technology in Agriculture Help Indian Farmers, 2022).

Data Science: Big data analytics are changing the course of businesses across the globe, and agriculture is no different. Data-driven decision-making relies heavily on data mining techniques, building a database and providing precise calculations to control each decision impacting yields and profitability (How New Technology in Agriculture Help Indian Farmers, 2022).

Challenges of Introducing Technology in Agriculture

Technological implementation to enhance agriculture raises concerns and challenges, especially in a developing state like India. The most critical issue that needs to be addressed is illiteracy. Lack of knowledge and inadequate skills among farmers require extra time to be spent on training and teaching about how the technology works, how it should be used and its benefits. Poor infrastructure, lack of storage space and inept transport facilities also add to the obstacles (Manish, 2023). Investment technologies require some amount of money that farmers do not have, and to access these technologies, they depend on external stakeholders like private startups or the government. Overcoming these challenges will take a lot of effort from all involved entities, especially the government and farmers. The partnerships between public and private organisations, giving incentives and formulating related policies, play a massive role in moving the agritech movement forward.

Telangana as the Frontrunner of Indian Agritech

Telangana is the first state in India to adopt a Public Private Partnership (PPP) framework in partnership with the WEF (World Economic Forum) to scale digital agriculture in the state (Neo, 2023). It has adopted a proactive strategy to use Agritech as a vital rural development and economic expansion. It has also received praise from the WEF for creating an agriculture data management framework that emphasises user protection, harm minimisation, and innovation promotion. The PPP framework has four pillars:

1. **Agri value chain transformation:** Integrating digital agritech services in the value chain to address specific challenges along with offering financial and non-financial incentives to the private sector to scale agritech. ***Saagu-Baagu is a prime example, focussing on easing agritech services delivery to the end customer through administrative and policy support and digital public infrastructure.***
2. ***Agritech sandbox:*** Setting up sandboxes to incubate, improvise and validate agritech solutions to safeguard farmers while encouraging innovations. This controlled environment is provided for limited-scale testing and certification of a new product or service, which conforms to the norms and standards of the agricultural domain and technology.
3. **Agriculture data exchange (ADEx)**: Enabling innovation through public data platforms and allowing data sharing. It promotes trusted and responsible data sharing between data producers and consumers, keeping in mind the delivery of digital services to farmers. The initial phase is centred on use cases such as soil health advisory, pest prediction, daily market prices and credit assessment.
4. **Agriculture data management framework**: Policy framework to manage, collect, store and share data with stakeholders. It ensures the development of a reliable data-sharing ecosystem that provides data rights, metadata management, accountability procedures and guidelines to protect users, prevent harm and promote innovation.

While the focus of value chain transformation and agritech sandbox is to develop the ecosystem to scale the adoption of agritech services, the last two pillars are focused on developing digital public infrastructure and policies to enable the efficient use of high-value data to fast-track the development of customised services for farmers. The initiative focussing on agriculture is the AI4AI, which stands for Artificial Intelligence for Agriculture Innovation (Rao, 2023).

Other Agritech initiatives and solutions in Telangana

The state's government and numerous startups have been collaborating to introduce innovative technologies to farmers. The state's commitment to leveraging technology to improve agricultural practices, increase farmer incomes, and ensure food security is evident in the collaborative efforts in driving agritech adoption. Some examples of this are given below.

Chilli Farming: AGNEXT is a startup providing Telangana government AI solution that provides the chilli crop's physical, chemical and moisture parameters of the chilli crop. The CTO (Chief Technology Officer) Subrath Kumar Panda said, "Visio Box checks pod quality such as size, damage, insect infestation, etc. With the help of human experts, we took thousands of pictures capturing various characteristics of chilli and then programmed the Visio Box with the feedback. When we put chillis in the Box, it accurately predicts the quality outcome as a human expert with an accuracy of 98%" (Vadlapatla, 2023).

Fasal: Fasal is an Agritech startup providing real-time weather, crop, and irrigation management solutions through remote sensing. Their technology helps Telangana farmers optimise irrigation, reduce water usage, and enhance crop quality and yield (Mitter, 2021).

MRIDA by ICRISAT: The International Crops Research Institute for the Semi-Arid Tropics introduced a mobile app, MRIDA (Managing resources for integrated development of agriculture), to help smallholder farmers strategise climate-smart agricultural practices to enhance soil carbon that eventually increases yield and builds resilience (ICRISAT develops gaming app MIRDA to help farmers increase farm yield, 2022).

T-Hub Agritech Accelerator: Hyderabad state government-backed startup incubator T-Hub has launched an 'AgriTech Accelerator Program' in partnership with ICRISAT. The programme is designed to enable participating startups to scale their projects through real-time management, full-time engagement, and knowledge sharing. ICRISAT Director General Dr David Bergvinson commented, ***"To double Indian farmers' income by 2022, we need to accelerate the development and delivery of demand-driven innovation that gives economic agency to farmers. The AgriTech Accelerator program will bring together agriculture, IT, and finance entrepreneurs to develop tailored services, technologies, and market integration to support sustainable (social, economic, environmental) rural development at scale"*** (Modgil, 2016).

While there is a long journey ahead with endless possibilities, India, especially Telangana, is already seeing the growth and advancement of agritech. The farmers are the lifeline of our country, and it is time that they are presented with all the latest technology tools they need. This agritech revolution is a precursor to economic growth, and it supports education, indigenous availability and affordability and improves livelihood.

Optimising eNAM: Since the early 1960s, numerous Indian states have established Agricultural Produce & Livestock Market Committee (APMC) markets as primary points of sale for farmers. Initially, these markets were set up to introduce fair market practices through an open outcry auctioning system. However,

over time, they have unfortunately become grounds for exploiting farmers. Over the years, traders and commission agents have engaged in various unscrupulous practices, including colluding to bid at lower prices for produce, using inaccurate weighing measures, delaying payments, and making unauthorized deductions, sometimes amounting to 10–20 per cent value of the produce in the form of market fees, commissions, loading and unloading charges, and involvement of too many middlemen (Aggarwal, Jain, & Narayanan, 2017; Chand, 2016; Reddy, 2016a, 2016b).

The Government of India has emphasised market reforms to encourage states to adopt the Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act of 2017. Many states have amended their APMC Acts to incorporate various components of this model act. The model APLM Act aims to enhance transparency, competition, investment, and infrastructure in agricultural markets nationwide. It encompasses provisions for private markets, direct marketing, contract farming, consumers' markets, farmers' markets, single levies, single licenses, and the provision of e-auction through the electronic National Agricultural Market (eNAM) to foster competition and improve the functioning of agricultural markets.

The National Agriculture Market (eNAM) is an all-encompassing electronic trading platform designed to link existing APMC markets, creating a unified national market for agricultural commodities. The eNAM portal offered a centralized platform for APMC-related information and services. It seeks to standardise marketing procedures, ensure equitable pricing, and provide channels for grievance redressal while still maintaining the flow of agricultural produce through the APMC markets (Press Information Bureau (PIB), Government of India, 2023).

With 57 of the 1,000 integrated Mandis in Telangana, the state has made noteworthy progress in this endeavour. Boasting a registration of 18,23,782 farmers and 5,799 traders, Telangana has facilitated trade amounting to INR 16,661 crores as of June 2022. While it currently trails behind states like Haryana, Rajasthan, and Andhra Pradesh regarding trade value, Telangana's efforts represent a commendable stride towards a more efficient and farmer-friendly agricultural market.

Table 22: *State-wise Number of Mandis Integrated in India (As of June 2022)*

States/UTs	No. of Mandis (APMC) Integrated
Rajasthan	144
Uttar Pradesh	125
Gujarat	122
Maharashtra	118
Haryana	81
Madhya Pradesh	80
Tamil Nadu	63
Telangana	**57**
India	**1000**

Source: Lok Sabha Unstarred Question No. 2721, dated 02.08.2022.

***Table 23**: State-wise Number of Farmers Registered (As of June 2022)*

States/UTs	Registered No. of Farmers
Uttar Pradesh	3300715
Madhya Pradesh	3021934
Haryana	2725240
Telangana	**1823782**
Rajasthan	1500477
India	**17341852**

Source: Lok Sabha Unstarred Question No. 2721, dated 02.08.2022.

***Table 24:** State-wise Number of Traders Registered (As of June 2022)*

States/UTs	Registered No. of Traders
Rajasthan	82359
Uttar Pradesh	35029
Madhya Pradesh	22337
Maharashtra	21510
Haryana	14424
Gujarat	9401
Odisha	7393
Telangana	**5799**
India	**226139**

Source: Lok Sabha Unstarred Question No. 2721, dated 02.08.2022.

***Table 25:** State-wise Total Trade Value on National Agriculture Market (e-NAM) Platform in India (As of June 2022)*

States/UTs	Total Trade Value (Rs. in Crore)
Haryana	62757
Rajasthan	38794
Andhra Pradesh	30890
Telangana	**16661**
Madhya Pradesh	16486
India	**204949**

Source: Lok Sabha Unstarred Question No. 2721, dated 02.08.2022.

The research paper titled 'Utilisation of e-NAM Facilities and Services by Farmers in Telangana' (2023) sheds light on the critical role of education and awareness in influencing farmers' participation in the e-NAM platform. It strongly advocates for an increased emphasis on education, particularly in digital technologies. This proactive approach is essential in bridging the digital divide and ensuring widespread adoption of e-NAM among farmers. Consequently, this suggests that with informed decisions and concerted efforts by the state, the utilization and profitability of eNAM can be extended.

Another comprehensive study, 'Electronic National Agricultural Markets, Impacts, Problems, and Way Forward,' provides additional insights from a nationwide perspective regarding the implementation and success of the electronic National Agricultural Market (eNAM) platform. The study identifies several key areas that warrant attention:

Firstly, there is a significant challenge related to the lack of consistent and accurate price information available to farmers. It hampers their ability to make well-informed decisions regarding the timing and location of their produce sales.

Additionally, there is a pressing need for improved recording and dissemination of market information through platforms like dashboards. This includes vital data such as prices in adjacent markets, buyer contacts, market channels, grading standards, etc. Encouraging public-private partnerships in funding market information infrastructure is strongly recommended. Reliable internet connectivity is a crucial factor for the smooth operation of eNAM, and measures should be taken to avoid frequent internet shutdowns.

To foster healthy competition and prevent collusion among traders, there is a suggestion to incorporate multimedia elements, allowing for the real-time display of photographs of commodities during auctions.

A proposed system that separates electronic transactions from the physical movement of produce could streamline operations. However, this necessitates robust institutional rules and effective grievance redressal mechanisms to ensure accuracy and trust in the system. Market development activities should extend beyond fee collection, encompassing infrastructure improvements and disseminating price and market arrival information to farmers. Transforming rural periodic markets into GrAMs (Gramin agricultural markets) and linking them electronically to eNAM can significantly broaden the platform's reach to farmers.

Strategically locating warehouses and markets between production and consumption centres is crucial. Accredited warehouses must adhere to proper storage practices and issue e-warehouse receipts. A swift and accurate assaying system is deemed indispensable for the success of eNAM. It ensures that product information is correct and fosters trust in the system. The eNAM platform must be equipped to handle fluctuations in load, particularly during peak seasons, focusing on minimising maximum waiting times. Demonstrating the benefits of the online platform in select markets is pivotal in building confidence in its utility.

Specialised training is imperative for farmers, commission agents, traders, and market administrators to utilise the eNAM platform effectively. Farmer-producer organisations (FPOs) can serve as vital intermediaries, aggregating commodities and linking small farmers with eNAM for improved market access.

Private sector involvement can bolster the supply chain and reduce transaction costs, particularly through partnerships with major private food retailers and FPOs. ENAM farmers to engage with buyers, reducing

dependency on commission agents. Each state should craft a tailored roadmap for eNAM implementation, considering variations in capacity and infrastructure.

The study also suggests involving farmer-producer groups in direct auctions to exporters or processors is a critical step forward. Education and awareness campaigns are imperative to address concerns and promote eNAM adoption. These comprehensive suggestions and insights underscore the multifaceted approach needed to optimize the potential of the eNAM platform for the benefit of farmers across the state.

The Transformative Role of Farmer Producer Organisations (FPOs)

Since their inception via a 2002 amendment to the Producer Companies Act, Farmer Producer Organisations (FPOs) or Farmer Producer Companies (FPCs) have enjoyed robust advocacy and support from the central government since 2017. The observation in the decline of cooperative societies led to the introduction of FPOs as legal entities owned and run by farmers. Unlike cooperative societies, their membership is restricted only to primary producers. They undertake a wide range of activities from bulk procurement, grading and sorting the produce, transportation, supply of inputs to farmers, and value-addition activities like pulping juice, sun drying vegetables, and packaging chopped vegetables. While predominantly agricultural, such companies can also be formed by dairy producers. The primary purpose of FPOs is to overcome the fragmentation of land, due to which returns on produce are very low. By pooling in large quantities of produce, FPOs can reduce transportation and commission costs, which are the major obstacles for small farmers (Govil, Neti, & Rao 2020, 19).

The structure and function of an FPO

A Producer Organisation can have as few as ten members to as many as 10,000. Each member buys a minimum number of shares of the FPO, which forms the share capital, and in return, gets the exclusive advantages to members. FPOs have developed incredible backward and forward linkages. FPOs have three major components, i.e., marketing, finance, and input supply. The FPO buys produce from farmers locally and reimburses them through bank account transactions after selling it in the market. Since the FPO is so closely situated, they can get the best grade of produce. The FPO managers then take the produce to significant markets in big cities, where they can even have tie-ups with retailers like *Ratnadeep* or *Nilgiris*, who offer premium prices as they often as market leaders. FPOs also have better information. Secondly, members buy production inputs from the FPO, which has the advantage of bulk ordering and may receive discounted prices. Some FPOs also supply other consumer commodities to farmers, such as spices.

There are around 24,183 FPOs registered across India as of March 2023, although the numbers are lesser, according to other reports. Almost half of them were set up or continue to receive government support, as well as that of various NGOs (Non-Governmental Organisations), foundations, corporate CSR (Corporate Social Responsibility) and other individuals. Government support for POs included equity grants, paying salaries of CEOs (Chief Executive Officers) or administrative costs, providing low-interest (or inter-rest-free) loans, or extending credit. Grants up to Rs. 2 crores have been provided, including money for building warehouses or buying transport vehicles. The Department of Agriculture is also regularly in touch with the Chairmen and CEOs of FPOs, to whom they give valuable training in entrepreneurial practices. FPOs contact the Department for information on various issues, like government programs (State of Sector Report 2023, 14).

Government Support to FPOs

The government has been proactive in encouraging the setting up of FPOs in the last few years. In the 2018-9 Union Budget, FPOs were given a 5-year tax holiday. In the following year's budget, the Central government committed itself to the setting up of 10,000 FPOs in the next five years with the help of the Small Farmer's Agri-Business Consortium (SFAC) which was set up as a facilitating agency for FPOs. SFAC has drawn up a budget of Rs 6866 crore. Before this, the SFAC had already been helping FPOs under schemes like Rashtriya Krishi Yojna Vikas. In the 2013-14 Budget, the government announced Rs 100 crore for establishing a Credit Guarantee Fund for FPOs and Rs 50 crore for an Equity Grant Scheme. As of 2019, SFAC had supported 440 FPOs under the latter.

The Credit Guarantee Scheme gave loans up to Rs 100 lakh to FPOs with at least 500 members. Under SFAC, FPOs are also seen as procurement agents for mandis. In addition to this, FPOs also receive a lot of support from the National Bank for Agricultural and Rural Development (NABARD). As of 2019, NABARD had promoted 4000 FPOs under the Producer Organisation Development Fund (2011) and the PRODUCE Fund (2014). While self-supported FPOs also exist, their returns tend to be smaller (Govil, Neti and Rao, 2020).

Under the 10,000 FPOs scheme, FPOs were to be federated at the district or state level for marketing and processing purposes. This is expected to result in higher supply volumes and, therefore, greater bargaining power. Further institutional support is mentioned by providing market and value chain linkages to FPOs. Other government schemes are also made available for FPOs. On the government's digital auction platform, e-NAM, FPOs can register and connect with buyers. Currently, however, less than 3000 FPOs are registered on e-NAM. There has also recently been interest from private parties to fund FPOs. The Walmart Foundation committed to invest $3.5 million in developing FPOs in Madhya Pradesh and West Bengal. Similarly, Mastercard and Flipkart have made similar commitments.

The status of FPOs in India and Telangana

There has undoubtedly been an exponential growth in FPOs. More than 8500 FPOs have been registered nationwide since 2020 (Neti and Govil, 2022). However, most of them are small in size and capital. As of 2019, the distribution of FPOs across India was overwhelmingly uneven. Furthermore, states with large FPOs of paid-up capital of more than Rs 20 lakh were also concentrated in some states. A definite trend in the middle and southern states can be seen, while the system has yet to reach states like Rajasthan, Jammu and Kasmir or any of the Northeast states extensively (Govil, Neti and Rao, 2020).

Telangana was one of the states that had previously been behind in the number of FPOs it had housed in 2019, when it had a total of 400 FPOs registered in the region. Under the 10,000 FPO scheme, SFAC registered 113 targeted FPOs, 76 registered FPOs and 37 more in the registration process. There has yet to be a comprehensive report on the growth of FPOs in the state, although many qualitative studies have been done on a few select FPOs. So far, there have been a few major success stories. For instance, in 2020, mango-producing FPOs achieved a turnover of nearly Rs 2 crore, with an investment of Rs 40 lakh. There has also been some interest from corporations in promoting FPOs. In 2022, Flipkart signed a Memorandum of Understanding with the Society for Elimination of Rural Poverty (SERP) to help self-help groups, like FPOs, and promote women-centric organisations. However, the state government's own schemes do not mainly cater to the needs of FPOs.

During the field visits covering FPOs, CDPP interviewed the members from the Keshavapally Procurement Office (KPO), which was started in 2019 with a grant of Rs 30 lakhs from NABARD as initial capital and spans three villages, which all primarily grow vegetables, particularly carrots. All the shareholders of the company are farmers. The FPO has agreements with input companies that supply them with seed, pesticides, and fertiliser, which the farmers buy from them. The other component they have is the Collection Centre (CC). The CC primarily buys produce from the farmers and sells it directly to supermarkets like Ratnadeep in Hyderabad at a higher value. It saves the farmer the transport cost as well as the commission cost and is overall more profitable than selling directly in Hyderabad. They also supply a certain number of seeds, fertilisers and pesticides to farmers as they have agreements with companies to buy in bulk. Almost all their members buy these from the KPO.

Additionally, they also sell spices to farmers. The Collection Centre transports 30-40 tonnes of produce in a day. They have a fixed amount of Grade A produce they take from each farmer, but often, what farmers offer exceeds the CC's capacity. Hence, the members also sell directly in the market when the CC cannot accommodate them. KPO now has 500 members and is expecting to expand. Each member owns ten shares, which cost Rs. 10 each.

The CEO reported that establishing the FPO in the region significantly improved the condition of the farmers. Since Vikarabad is a dry region and cannot primarily sustain paddy, vegetables, maise, and pulses are the preferred and viable options. However, the perennial problem had been the need for more markets and assured income since agriculture market prices are notoriously uncertain. Having an FPO has helped alleviate this problem. They also perform other activities like soil testing or communicating with the Department of Agriculture in case any crop issues arise. The FPO additionally receives the latest information on technology, schemes, credit, and so on, which has been helpful. However, it was opined that attempts to scale up the business have yet to be fruitful. For instance, a central government scheme like e-NAM has had limited reach in the region and aptly failed so far. Although the Keshavapalli FPO has registered itself on the website, it has yet to receive any information on the next steps regarding doing business via the portal, so KPO remains unsure and sceptical. Furthermore, the need for more capital to own their vehicle to transport produce has also been an issue.

There are many advantages to propagating the institution of FPOs, not least because the cooperative societies still need to reap results. FPOs take fresh producers directly to consumers and can fetch better prices than through local markets and, especially, middlemen who otherwise extract hefty commission payments from farmers. Coordinating with corporations for bulk purchases of inputs for pesticides, seeds, pheromone traps, fertiliser, and so on helps them fetch a lower price.

As opposed to cooperative societies, FPOs avoid an elite or upper-caste capture of power, although the participation of female farmers has been limited. The fact that no non-farmers can hold positions of power is also essential and helps protect the interests of the actual stakeholders. The structure of a business model

also helps orient farmers to meet the market's specific demands. It has the potential to provide them with better information. Furthermore, collaborating with NGOs, like the Centre for Sustainable Agriculture and Cooperative Research Programme on Poverty (CROP), and other organisations has helped facilitate sustainable methods of farming (Kumar, Prakash, Permal and Kar, 2020).

Nonetheless, the FPO system exhibits a range of areas for improvement, warranting focused attention for its widespread success. Initially, FPOs heavily rely on government funding from institutions like NABARD or SFAC as initial capital, particularly during their establishment phase. These entities typically offer support for up to three years before gradually withdrawing, often leading to operational challenges for FPOs.

Hence, it remains imperative for the government to maintain its steadfast commitment to FPOs in the present scenario. Additionally, securing credit for FPOs has been a challenging endeavour. In many cases, their paid-up capital constitutes their primary equity, given the difficulties encountered in obtaining loans from commercial banks. Before introducing the 10,000 FPO scheme, government initiatives to facilitate loans for FPOs were virtually non-existent. As anticipated, given that CEOs and Chairmen predominantly hail from the farming community, broader business training appears to be needed. Like cooperative societies, a deficiency in ownership and trust among the farmers has been observed (Kumar, Prakash, Permal, & Kar, 2020).

Structurally, there are notable challenges in the composition of FPOs. For example, the representation of women in FPOs still needs to be improved. While the inclusion of women board members is a requirement for accessing many SFAC schemes, adherence to this rule was found to be lacking. It has been noted that women hardly consist of memberships with the FPOs. Moreover, mixed-gender FPOs may, at times, exhibit token representation rather than genuine inclusivity. Research indicates that all-women organisations demonstrate superior performance, including management and repayment rates, while mixed-gender organisations experience higher dropout rates (Neti and Govil, 2022).

Presently, a mere 2.4% of FPOs are exclusively women-led. Encouraging the formation of women-only FPOs and actively promoting women's leadership roles has been proposed as a crucial step forward. Similarly, although the situation is comparatively better than in cooperative societies, the FPOs that excel tend to have members who are large or middle-scale farmers. These individuals, often not belonging to the SC (Scheduled Caste)/ST (Scheduled Tribes) category due to prevailing Indian caste and land structures, are more prevalent in the better-performing FPOs. Conversely, smaller FPOs primarily comprise of smaller-scale farmers with a higher representation of SC and ST members. It has also been observed that the top-performing FPOs are typically located in well-irrigated, cluster-based, or coastal regions (Rani, Reddy, and Mohan, 2023).

A distinguished speaker serving as an executive director of a research organisation shared valuable insights. He emphasized that Farmer Producer Organisations (FPOs) should proactively take control of their livelihoods. Instead of succumbing to market pressures, FPOs should strategically plan their cropping patterns based on their available resources, prioritizing low-cost production systems.

Regrettably, he opined that FPOs have transitioned from being a platform for farmers to sell their produce to becoming venues for input companies to promote their products. To address this, the state government should spearhead the establishment of shared

infrastructure facilities to enhance access to financial resources. This necessitates a substantial investment from the state. There is a noticeable bias towards supporting startups in urban areas, overshadowing the support provided to rural counterparts. The government should take proactive measures in incubating, fostering, and establishing facilities tailored for the benefit of FPOs. For instance, a dedicated farmer hub, similar to T-Hub, could be instituted.

Drawing from Odisha's successful policy, where FPOs gain access to interest-free or low-interest loans backed by government collateral guarantees, similar mechanisms can bolster support for FPOs. The creation of more markets for farmers, coupled with increased investment in production and fortifying infrastructure, would be immensely beneficial for the growth and sustainability of FPOs.

Box 2: *A Farmers Producer Organisation in Adilabad at a Glance*

A Farmers Producer Organisation in Adilabad at a Glance

One of the Farmers Producer Organisations in Adilabad (FPO) that was visited has made significant strides in benefiting local communities. Covering 31 villages and 3800 acres, divided into clusters, the FPO has effectively mobilized 635 members and garnered support from non-members.

Since its inception in 2016, the FPO has prioritised outreach, membership expansion, and knowledge dissemination. Starting with 168 members, they registered as a company in 2017 and have seen steady growth. With an initial capital of 21 lakhs and an annual collection of 1000 rupees from each member, they initiated their business in seeds, fertilisers, and pesticides, leading to impressive yields.

The introduction of output procurement subsequently boosted their turnover. The FPO's inclusive approach has led to the participation of various tribal communities, including ST, SC, OC, and BC (Backward Class) members, totalling 312 females and 323 males. The support from the Tribal Welfare Department, including a significant go-down allocation and funding from various enterprises, along with their own contribution, have propelled their projects.

The FPO ensures year-round activity by efficiently timing inputs of fertilisers and pesticides, followed by the procurement of soybean, cotton, and red gram. Among the crops, cotton proves most profitable, routed to a private spinning mill. However, price fluctuation presents a challenge, leading to substantial profits or significant losses.

Soybean, a once-a-year profitable crop, undergoes grading and commands higher prices. Byproducts like oil, powder, and milk find high demand, with production capacity reaching 100 trucks sent to Sneha Food and Feeds in Chandrapur.

The FPO is actively addressing challenges faced by farmers. They have invested to secure electric power access, overcoming a longstanding issue. However, they encounter obstacles from various industrial departments in obtaining permits swiftly. They also grapple with tax-related challenges, particularly with GST collection, impacting their mill transactions.

Despite these accomplishments, the FPO faces several hurdles. The existing institutions, agriculture officers, and markets often lack awareness about FPOs and their operations. Local institutional support and recognition are the need for more comprehensive schemes.

Over time, as per the members, cotton yield has decreased over time due to rising input costs. Initiatives like Rythu Bandhu have benefited farmers, but technical and logistical challenges persist. Additionally, vegetable crops, while cultivated, present unpredictable profits or losses.

The FPO recognises the importance of technology in bridging information gaps. Apps and technology serve as conduits for crucial updates to farmers, facilitating better decision-making. The organisation's move towards organic farming underscores its commitment to sustainable practices, incorporating vermicompost and cow dung.

The FPO's establishment of a ginning mill and plans for infrastructure development exemplify their dedication to enhancing the agricultural landscape. This includes consideration for factors like cultural practices and geographical nuances.

In conclusion, the FPO's journey reflects a commendable effort in bolstering local agriculture. By addressing challenges and building on their successes, they are poised to continue to positively contribute to the lives of farmers in the region.

Agriculture Business & Startups in India & Telangana

The notable transformation in the Indian agricultural industry is also being driven by the innovative endeavours of agricultural enterprises and emerging businesses. These forward-looking initiatives are harnessing technology, financial resources, and market connections to uplift rural farmers, enhance output, and tackle persistent obstacles. This section delves into the influence of agricultural startups in India, emphasising their valuable contributions and accomplishments. It subsequently shifts focus to Telangana, where initiatives such as AgHub are trailblazing innovative routes for agricultural entrepreneurship.

Impact Of Agriculture Business & Startups on the Economy

Technological Advancements

In recent years, agriculture startups have spearheaded the integration of cutting-edge technologies into rural areas. These technologies encompass precision agriculture, data analytics, Internet of Things (IoT) devices, and mobile applications (Anand & Raj, 2019). By facilitating data-driven decisions in planting, irrigation, and harvesting, these innovations enable rural farmers to optimise crop yields, reduce wastage, and enhance overall productivity.

Access to Finance

One of the pivotal contributions of agriculture startups is addressing the longstanding issue of rural credit accessibility. These startups offer financial solutions and credit facilities to small and marginal farmers previously marginalised by formal financial institutions. This newfound access allows farmers to invest in superior seeds, fertilisers, and modern machinery, ultimately enhancing agricultural productivity (Anand & Raj, 2019).

Market Linkages

Agriculture startups are instrumental in bridging the rural-urban divide by providing platforms for farmers to connect directly with buyers. This cuts out intermediaries and ensures fair prices for agricultural produce (Anand & Raj, 2019). By establishing efficient market linkages, these startups empower farmers to increase their income and mitigate post-harvest losses.

Skill Development

Beyond technological advancements, agriculture startups invest in skill development initiatives in rural areas. Through training and education programs, they equip farmers with the knowledge required to adopt modern farming practices effectively and utilise technology to its fullest potential. This knowledge transfer contributes to sustainable agricultural practices and increased yields (Anand & Raj, 2019).

Several Indian states have emerged as leaders in promoting agricultural startups and incubators, with Gujarat, Telangana, and Maharashtra standing out prominently in this regard.
Gujarat has taken pioneering steps to foster agricultural startups, implementing various policies and initiatives to support this sector. Some key measures include the Agriculture and Agro-Processing Policy, the establishment of Agribusiness Incubation Centers, and the promotion of Cluster Development.

Telangana has actively encouraged agricultural startups and incubators, with a strong emphasis on technology-driven solutions. Notable policies and initiatives in the state include the Telangana State Innovation in Digital Entrepreneurship and Acceleration (T-IDEA) and the Rythu Bandhu Scheme and have harnessed growth via the Agricultural Technology Management Agency (ATMA).

Maharashtra has also been a frontrunner in promoting agricultural startups and agribusiness incubators. The state has implemented key policies and initiatives like the Chief Minister's Agribusiness and Food Processing Policy, the Maha-AGRISNET program, and the promotion of Farmer Producer Companies (FPCs).

These states have excelled in fostering thriving agricultural startup ecosystems through a range of shared policies and practices. They offer robust financial support to agricultural startups, including grants, subsidies, and low-interest loans, which enable these ventures to grow and innovate. Furthermore, they prioritise infrastructure development by establishing dedicated agri-tech parks and incubation centres equipped with cutting-edge laboratories, research facilities, and collaborative workspaces. In tandem, these states emphasise capacity building through comprehensive training and skill development programs tailored to rural entrepreneurs and farmers, thereby enhancing their knowledge and capabilities within the agricultural sector. Additionally, they facilitate market access, both locally and internationally, by leveraging e-commerce platforms and export promotion initiatives, ensuring that agricultural startups can tap into diverse markets and expand their reach (Krishnamurthy & Ganesamoorthi, 2020).

Opportunities for Agri-startups in India

The agricultural sector faces a significant challenge in the form of an inefficient supply chain, where dominant players exert control over critical farming resources, spanning from financial support to seed procurement and the intricate web of distribution and supply chains. However, this status quo presents an opening for startups to intervene and optimise these supply chains. Their goal is to introduce reforms that enhance equity, efficiency, and accessibility for all stakeholders within the agricultural ecosystem. Through

innovative approaches and technology-driven solutions, startups have the potential to transform the way resources flow through this complex network, ultimately benefiting farmers and the agricultural industry as a whole (Sailaja, Nikhitha & Kiran, 2022).

In India, middlemen and agents play a pivotal role in shaping the dynamics of the agricultural sector, particularly on the demand side. They wield considerable influence over pricing structures and are central to managing fragmented supply chains. This influence often results in an uneven distribution of profits, negatively impacting both farmers and consumers. Startups can disrupt this entrenched system by facilitating direct transactions between farmers and the market. By doing so, they can ensure fair pricing mechanisms and eliminate the unnecessary intermediaries that have historically hindered the industry's progress. This shift towards more direct farmer-to-market interactions holds the promise of a more equitable and efficient agricultural landscape (Sailaja, Nikhitha & Kiran, 2022).

One of the other pressing issues plaguing Indian agriculture is the scarcity of affordable financing options for farmers, which, in turn, contributes to the growing burden of debt within the farming community (Sailaja, Nikhitha & Kiran, 2022). Adding to the complexity of this problem is the fact that distributors often assume the role of lenders, further exacerbating the financial challenges faced by farmers. Here, startups can play a transformative role by introducing innovative financial solutions tailored specifically to the unique needs of the agriculture sector. These solutions aim to ensure that essential funds reach the farmers who require them the most, ultimately easing the financial strain and promoting sustainable growth within the agricultural industry.

Additionally, a critical challenge in Indian agriculture is the overreliance on rainfall for irrigation, particularly prevalent in the majority of the country's 600,000 villages. This dependence poses a substantial risk, especially in the face of unpredictable weather patterns. Furthermore, the steady depletion of groundwater levels further compounds the sector's vulnerability. In response to this, startups can direct their efforts toward water management and the development of innovative irrigation technologies. By mitigating these irrigation challenges, startups not only enhance crop yields but also promote sustainable farming practices that are crucial for the long-term health and resilience of the agricultural sector (Sailaja, Nikhitha & Kiran, 2022)

A unique aspect of Indian agriculture is the inverse relationship between farm size and productivity. On average, Indian farms are smaller, with approximately 70% of them spanning less than one hectare, a stark contrast to significantly larger farms in regions like Europe and the United States. This distinctive landscape presents a compelling opportunity for startups to innovate. They can focus on devising solutions tailored to enhance productivity on these smaller agricultural plots. By doing so, startups hold the potential to revolutionise Indian agriculture, driving increased efficiency and sustainability in farming practices while simultaneously addressing the challenge of feeding a growing population within limited land resources (Sailaja, Nikhitha & Kiran, 2022).

Agri-tech businesses and startups are reshaping the agricultural landscape through several key focus areas. They harness the power of Big Data to provide data-driven insights that optimise farming practices. With Farming as a Service (FAAS), they offer affordable access to modern equipment, particularly benefiting small-scale farmers. Additionally, these innovators streamline supply chains using Market Linkage Models, connecting farmers directly with markets to ensure fair prices. Fintech solutions digitise payments and

provide tailored financing options, easing financial constraints for farmers. Finally, the implementation of IoT for Farmers introduces intelligent farming practices, utilising real-time data to boost efficiency and sustainability. These focus areas drive agricultural innovation and foster a more resilient farming industry.

Agri-startups and Businesses in Telangana

Telangana is fast emerging as a vibrant hub for agri-businesses and startups. The state's proactive government initiatives and favourable agro-climatic conditions have created an environment ripe for agricultural innovation and entrepreneurship.

Telangana hosts a diverse array of agriculture startup incubators, each with its distinct focus. These incubators, including a-IDEA at NAARM, Agribusiness Incubator at ICRISAT, Agri-Techies Nest Foundation, AISEA, ASHOKA Innovazi, the Center for Innovation Agripreneurship, ICAR's National Research Institute Agri-Business Incubator, and Nutri Hub at TBISC, among others, collectively form a robust ecosystem supporting innovation and entrepreneurship in agriculture. From crop yield enhancements to sustainability and social impact-driven ventures, these incubators play a pivotal role in catalysing positive changes within Telangana's agricultural sector, fostering startups that harness technology, sustainability, and social responsibility for agricultural advancement.

Mr. Nadiminti, the CEO & Director of AgHub, delivered an enlightening overview, tracing back to the inception of one of the pioneering agricultural incubators, the AIP Agri Innovation Platform, in 2005. This incubation centre, which initially complemented a renowned institution, has made substantial strides. The subsequent emergence of other notable incubators like the IIM Nutri Hub signifies the growing enthusiasm and investment in agricultural startups.

Expanding the perspective to the broader landscape of incubators in India, the speaker highlighted a remarkable surge in their numbers, from just a handful in 1983 to over 450 in 2023. This exponential growth, propelled in large part by the Startup India Initiative, reflects the increasing interest and support for startups across various sectors.

Zooming in on Telangana, the statistics are striking. **Since 2005, the state has transformed from having a modest number of incubators to now hosting over seven agriculture-focused ones, showcasing exceptional growth in incubation efforts across all sectors. This surge stands as a testament to Telangana's unwavering dedication to fostering innovation in agriculture**, surpassing other states in this endeavour and demonstrating a distinct commitment to agritech.

The speaker underscored the pivotal role these incubators play in nurturing startups. This hands-on approach, coupled with the collaborative efforts of incubators, has resulted in the growth and development of over 250 startups. It's worth noting that this quality-driven approach ensures these startups are positioned for sustainable success.

Shifting the focus to the broader entrepreneurial landscape in Telangana, the speaker, referencing data from the Startup Telangana website, estimated that there are approximately 6600 registered startups spanning various sectors. While the exact count of agritech startups is yet to be examined, the speaker offered a

conservative range of 250 to 500. This range, though cautious, lays a solid foundation for the burgeoning agritech sector in the state. This showcases a promising trajectory for the agritech sector's growth and potential in Telangana.

AGHUB in Telangana

AgHub, situated in Telangana, aspires to be recognised as a "World Class Agri Innovation Hub" committed to catalysing innovation and entrepreneurship within the agriculture and food systems. Its vision encompasses a holistic approach that seeks to transform the agricultural and rural landscapes, leveraging innovation and entrepreneurial spirit to drive positive change.
To fulfil its mission, AgHub operates on a multifaceted strategy that includes mentoring, piloting, and facilitating access to essential components such as markets, research, and investment opportunities. This approach is designed to empower individuals and entities within the agricultural sector, promoting innovation as a means to enhance sustainability and economic prosperity.

What sets AgHub apart is its distinctive Hub and Spoke model. This model nurtures innovation not only within its Innovation Hub located in Hyderabad but also through its Innovation Spokes strategically situated in Tier-II and Tier-III towns across Telangana. By extending its reach beyond urban centres, AgHub ensures that innovation and entrepreneurship flourish at regional and grassroots levels.

Furthermore, AgHub understands the importance of global and national collaborations in fostering innovation. The organisation actively partners with technology incubators, agencies, and organisations both within India and on the international stage. These collaborations promote cross-cultural learning, knowledge exchange, and the infusion of diverse perspectives into the realm of agricultural innovation, enriching the ecosystem and driving forward transformative changes in the sector.

Saagu-Baagu

In a groundbreaking partnership, Telangana has teamed up with the World Economic Forum's AI for Agriculture Innovation (AI4AI) initiative, bolstered by the Bill and Melinda Gates Foundation, to introduce the transformative 'Saagu-Baagu' project facilitated by Digital Green. This collaborative endeavour stands as a shining example of what can be achieved when diverse stakeholders unite to revolutionise agriculture, meeting time-bound goals and delivering targeted results. Saagu-Baagu also showcases innovative approaches to scale up agricultural technologies and inspire shifts in farmer behaviour, instilling trust in the seamless adoption and consistent use of cutting-edge agritech services (World Economic Forum & Government of Telangana, 2023).

Traditionally, Saagu-Baagu in Telangana is a farming practice involving mixed cropping of various crops in the same field. It promotes biodiversity, natural pest management, soil health, and efficient water use. However, it faces challenges due to modernisation, knowledge preservation, and market access. This practice reflects local wisdom and cultural heritage, offering sustainable agricultural benefits to the region. Integrating Saagu Baagu practices with agricultural startups and businesses can bring about numerous benefits for both traditional farmers in Telangana and the emerging agri-tech industry.

Agri-startups have a crucial role to play in promoting sustainable innovation and crop diversification within Saagu-Baagu practices. Collaborating with traditional farmers, these startups can introduce modern

technologies such as precision farming techniques, IoT-based monitoring, and data analytics. These advancements optimise crop selection and planting, aligning with the principles of Saagu-Baagu. Additionally, agri-startups can facilitate crop diversification by providing access to a broader range of seeds, including high-yield and climate-resistant varieties. This not only enhances crop resilience but also improves marketability, reinforcing the sustainability of Saagu-Baagu traditions.

Furthermore, agri-tech companies can establish efficient supply chains and market linkages for saagu-baagu produce, ensuring fair prices for farmers and encouraging the continuation of sustainable practices. Knowledge transfer is also crucial, as agri-startups bridge the gap by providing training and resources on modern farming techniques, sustainable practices, and technology utilisation to traditional farmers. This preservation and evolution of Saagu-Baagu traditions are vital for the long-term success of these practices. Additionally, integration with agri-tech companies enables traditional farmers to make data-driven decisions based on weather forecasts and market trends, enhancing overall productivity and profitability. Agri-startups can also assist Saagu-Baagu farmers in obtaining sustainability certifications, which not only opens up opportunities for premium pricing in global markets but also appeals to environmentally conscious consumers. Moreover, by quantifying and marketing the carbon sequestration and biodiversity benefits of Saagu Baagu practices, agri-startups can potentially attract investments from environmental impact funds, aligning with modern environmental concerns (World Economic Forum & Government of Telangana, 2023).

In essence, the integration of Saagu Baagu practices with agri-startups and businesses can modernise and enhance the sustainability of traditional farming while providing the agri-tech sector with unique opportunities to tap into a rich agricultural heritage and promote more responsible and diverse farming practices.

In the ever-evolving landscape of Indian agriculture, startups have emerged as catalysts for transformative change. They have harnessed innovation, technology, and entrepreneurship to rejuvenate the sector, empower farmers, and drive sustainable growth. As we conclude this exploration of agriculture startups in India, it's evident that these ventures are not just addressing challenges but also creating opportunities for rural communities and agribusinesses.

One shining example of this transformative potential can be found in Telangana. Telangana is at the forefront of agricultural innovation with its proactive government initiatives, visionary policies, and pioneering incubators like AgHub. Through programs like T-IDEA, Rythu Bandhu, and initiatives promoting precision farming and sustainable practices, Telangana is nurturing a thriving ecosystem where agriculture startups can flourish.

> One of the speakers, co-founder of an agriculture-based business, opined that the government has taken commendable steps by establishing special food processing zones. However, there's room for improvement in terms of being more startup friendly. Currently, these zones may require organisations to be of a substantial scale to fully utilize them. It's important to recognise that agriculture is a diverse landscape, and smaller players, like micro-enterprises, bring invaluable contributions that shouldn't be overlooked.

A forward-thinking government should consider the holistic picture, taking into account the environment and the challenges faced by all stakeholders, including the small and marginalized farmers, wholesalers, retailers, and ultimately, the end consumers. A comprehensive assessment of the entire food supply chain, at both state and national levels, is crucial for crafting effective interventions that benefit all involved. This approach ensures a thriving and inclusive ecosystem for the agricultural sector.

Another speaker also outlined several strategic steps that could further bolster the startup ecosystem. Grants targeted at early-stage startups, particularly those in the ideation and prototyping phases, would be instrumental. Ranging from 5,00,000 to 50,00,000, these grants could be a game-changer for transforming ideas into tangible products or services. Moreover, there is a pressing need for specialised schemes to encourage student entrepreneurship and rural enterprise-building. This could take the form of small grants, banking schemes, or technology validation funding. By incentivising startups in these critical stages, the government of Telangana can play a pivotal role in shaping the future of the agritech sector.

In addition, the establishment of an exclusive fund, specifically earmarked for food and agritech startups, would signal a strong commitment to nurturing innovation in this sector. This targeted approach aligns with Telangana's status as a burgeoning hub for agritech startups.

In conclusion, by leveraging government support, targeted grants, and strategic initiatives, Telangana can emerge as a trailblazer in agritech innovation, benefiting the state and the entire nation.

Enhancing Agriculture Through Private Sector Investments

A balanced approach that combines public and private investment in agriculture is essential to overcome the hurdles of the sector and stimulate sustainable growth. This section delves into how private investment can complement public investment in the agricultural sector of Telangana, ultimately leading to a robust and resilient agricultural industry.

The pre-budget Economic Survey of 2021-22, presented by Finance Minister Nirmala Sitharaman, advocated a targeted approach to capital investment in agriculture, citing its pivotal role in spurring farm income. It highlights a notable inconsistency in private sector investment in farming, contrasting with the relatively stable 2-3% public investment. The report urged the creation of an enabling policy framework to attract corporate investments, recognizing the need for robust private participation. Given this strong emphasis on encouraging private investment, it is essential to explore how this can be effectively put into practice at the state level (Haq, 2022).

Public investment in agriculture has been pivotal in laying the foundation for the sector's growth. Government expenditure encompasses a wide range of activities including infrastructure development, research and development, and availability of credit (Akber et al., 2022), as we have mentioned in our previous sections with reference to the various schemes in place in the state of Telangana. While public

investment lays the groundwork, private investment can bring efficiency, innovation, and market-oriented approaches to the agricultural sector.

This progress can be brought in by private investments in research and development to create innovative products and technologies tailored to the needs of farmers. Private investment in agriculture can also include initiatives like further facilitation to microfinance institutions, venture capital, and agribusinesses. These entities give farmers access to credit, enabling them to invest in better seeds, fertilisers, and machinery, thereby increasing their productivity (Giné, 2011).

> Mr Sachin Sharma, who holds the position of Vice President & Head of Agri & Dairy Operations at ITC Limited, expressed that Public-Private Partnerships (PPPs) present many opportunities. States can strategically organize clusters based on market demands and supplies to attract industrial collaborations. This approach has the potential for escalating production and value addition in various crops, including wheat-based products, cumin, coriander, rice, red gram, jowar, and Bengal gram. By consolidating efforts and encouraging the cultivation of high-demand crops, we can positively impact both local and international markets.
>
> For crops like wheat-based products, cumin, and coriander, which face high consumption but currently have low production levels, focused promotion to local farmers is essential. Additionally, there exists a promising opportunity for industry partnerships in these areas.
>
> On the other hand, crops like rice, red gram, jowar, and Bengal gram, which boast both high production and consumption, can benefit from an enhancement in overall productivity. Measures to enhance climate resilience and ensure environmental sustainability are also crucial for further growth in these sectors.
>
> As for products with high production but relatively lower consumption such as turmeric, chilis, maize, and soybean, there lies a significant opportunity for export and value addition. Creating specialized clusters for these products can serve as a strategic approach towards ensuring food security.
>
> Finally, industry partnerships becomes imperative for maintaining a steady balance between supply and demand for products with low production and consumption rates.

Private companies can also play a vital role in establishing efficient market linkages and value chains, connecting farmers to consumers and ensuring a fair price for their produce. Initiatives like contract farming and farmer producer organisations (FPOs) facilitate better price realization for farmers (World Bank, 2020).

In terms of creating synergies between Public and Private Investment, collaborations between the public and private sectors can leverage both strengths. For instance, India's National Dairy Development Board (NDDB) has successfully implemented PPP models to enhance dairy production and marketing (NDDB, 2020).

Public investment can also be directed towards -building programs that empower farmers with knowledge and skills to engage with private entities effectively. Thisincludes training in modern farming techniques, financial literacy, and market-oriented practices.

An enabling policy environment is also essential to encourage private investment in agriculture. This involves creating transparent and predictable regulations, ensuring property rights, and providing incentives for private sector participation (World Bank, 2020). By fostering synergies between these two realms, Telangana can unlock the full potential of its agricultural sector, ensuring sustainable growth and improved farmers' livelihoods.

"Project Saagu Baagu" is a groundbreaking collaboration between the Telangana government, the World Economic Forum, the Bill and Melinda Gates Foundation, and Digital Green. It marks a significant agricultural advancement, with Telangana leading India in a unique Public-Private Partnership model. Using advanced technology, the project focuses on enhancing agriculture sustainably, particularly in the chilli industry. By offering tailored advice, quality testing, and e-commerce services, it has notably increased the incomes of over 7,000 small-scale farmers. This success underscores the importance of such partnerships, relying on government support, data access, and seamless coordination with existing programs. The impact of Project Saagu Baagu paves the way for further growth, promising a more resilient and productive future for Indian agriculture.

Box 3: *Rythu Bazaars in Telangana*

Rythu Bazaars in Telangana

To foster direct marketing between consumers and farmers, the initiative of Rythu Bazaars was established in 1999. These Bazaars witness about 3,155 farmers daily, selling 9,000 to 10,000 quintals of vegetables. They operate under Agricultural Market Committees without service charges or market fees. The selling price is determined by growers' committees. District Administrations oversee Rythu Bazaars under Joint Collectors' direct supervision. The Chief Executive Officer at the state level coordinates operations.

The traditional marketing system suffers from middlemen exploitation. Additionally, Inefficient wholesale markets result in quality loss, increased prices, and a disconnect between producers and consumers.

Rythu Bazaars aim to eliminate middlemen, ensuring fair prices and quality. Objectives include providing remunerative prices to farmers, offering fresh produce at reasonable rates, and preventing malpractices in weighments. These Bazaars operate on government lands, requiring at least one acre of space and 250 participating farmers.

They offer necessary facilities like sheds, water supply, sanitation, parking, and waste management. Proper identification of villages and farmers is crucial. Identity cards are issued and renewed for six-month periods. Shops are allocated on a first-come, first-served basis to card-holding farmers. Middlemen entry is strictly regulated.

These markets intend to stabilize prices, benefiting both growers and consumers. Joint Collectors play a pivotal role in transport arrangements and overall management. Rythu Bazaars' success relies on farmers' active participation, facilitated by Horticulture Consultants and Agriculture Officers. Self-Help Groups assist in selling non-local vegetables and essential commodities. Proper record-keeping and maintenance are vital. Permanent Rythu Bazars are under construction for long-term sustainability (Government of Telangana, Agricultural Marketing Department).

SECTION - VIII
Expanding Opportunities through Livelihood Diversification

The enduring pressure on agriculture for employment, notwithstanding its diminishing contribution to the national income, is a considerable concern in India. According to the most recent report from the NSSO's (National Sample Survey Organisation) annual Periodic Labour Force Survey (PLFS) for 2021-22 (July-June), the agricultural sector constitutes a substantial 45.5% of the country's employed labour force.

Furthermore, data from the Second Advance Estimates of National Income for 2022-23, released by the Ministry of Statistics & Programme Implementation (MoSPI), shows that the Gross Value Added (GVA) of agriculture and its allied sectors in the overall economy stands at 18.3%, a slight decline from the 19.0% reported for the year 2021-22. It is also worth noting that Indian agriculture is characterised by small landholdings, with the average sizes for marginal and small landholdings being 0.38 hectares and 1.40 hectares, respectively.

This leads to a crucial question: can agricultural households truly subsist in the future? It is stated by Chand et al. in 2011 that if agriculture were the sole source of income for these small landholders, most of them would continue to face impoverishment. Several studies mentioned below have indicated that the addition of non-agricultural pursuits holds significant promise for increasing farmers' earnings and alleviating rural poverty.

Review of Literature on Agricultural Household Livelihoods in India

Understanding the dynamics of farm households' income sources and livelihood choices is pivotal for sustainable development. This comprehensive review synthesises key findings from four seminal studies conducted between 2014 and 2022. These studies shed light on the income-generating activities, attitudes towards diversification, and economic implications of various livelihood strategies among Indian farm households.

The first paper, **'Income Sources of Farm Households in India: Determinants, Distributional Consequences and Policy Implications'** (2014), investigated the income-generating activities of farm households in India, utilising data from a nationally representative survey. Contrary to the common belief that agriculture is the primary income source for these households, it was revealed that nearly half of their income is derived from non-farm activities. Particularly, households with smaller landholdings rely more on lower-paying non-farm work due to limited land, low agricultural productivity, and surplus labour. While non-farm income opportunities are accessible to only a fraction of farm households, they contribute positively to overall income. This suggests that the non-farm sector offers potential for land-constrained farm households to improve their income levels.

Various factors influence the degree of diversification towards non-farm activities. Smaller landholdings, lower farm profits, and excess labour tend to drive farm households away from agriculture, while education and access to credit facilitate their transition into the non-farm sector. Although agriculture remains the largest income source, changes in agricultural income are unlikely to impact income distribution due to its widespread nature significantly. Conversely, wage increases, salary, and livestock-related income contribute to more equitable income distribution. However, it should be noted that the income from non-farm businesses tends to exacerbate income inequality.

The study's policy implications are noteworthy. Firstly, to address inequality, policies should focus on intensifying and diversifying small farms, which are prevalent in Indian agriculture and crucial for food security. Simultaneously, efforts should be made to develop markets, infrastructure, and institutions to support sustainable growth in agriculture. Secondly, given the prevalence of animal husbandry among smallholders, investments should be directed towards its development. Livestock provide consistent outputs and serve as a form of insurance for smallholders. Thirdly, as poorer households heavily rely on wages, creating sustainable employment opportunities in the rural non-farm sector is imperative. Finally, facilitating the entry of people with low incomes into the non-farm sector by addressing financial and market barriers could significantly boost their income levels.

The second research study, 'Attitude of Farmers towards Livelihood Diversification' (2021), conducted in Kolar district, Karnataka, in 2018-19, assessed farmers' perspectives on livelihood diversification. The findings indicated a positive inclination towards diversification, viewing it as a vital risk management strategy amidst crises. It was also seen to optimise existing resources and ensure livelihood stability. Notably, the influence of friends emerged as a significant factor in encouraging farmers to adopt diversified livelihoods, with low crop income identified as a key driver for this shift.

Path analysis results underscored the pivotal role of extension participation in fostering a favourable attitude towards livelihood diversification, both directly and indirectly. Consequently, the study suggests that development departments and non-governmental organisations should actively promote adopting both on-farm and off-farm livelihood activities. This approach is viewed as instrumental in augmenting farmers' income in a sustained manner.

The third paper, titled 'Effects and Determinants of Diversification of Livelihood Options amongst Agricultural Households in India: A State Level Analysis,' assessed the extent of diversification in livelihood options, the types of options favoured by agricultural households, and the impact of these choices on key economic indicators. Additionally, they identified the factors influencing the likelihood of selecting various combinations of livelihood options.

Findings indicate that in most states, most households engage in two or more livelihood options. Notably, households incorporating non-farm businesses as one of their livelihood strategies exhibit notably higher average income, increased consumption expenditure, and reduced poverty incidence. The multinomial logit model analysis reveals several influential factors, including household size, age, education, and gender of the family head, along with the number of adults and dependents in the family, social group, land category, access to technical guidance, per capita income, and the specific state or union territory to which the household belongs. These variables significantly impact the likelihood of a household selecting diverse combinations of livelihood options alongside cultivation.

The study's unequivocal conclusion is that promoting non-farm businesses in conjunction with cultivation is pivotal in elevating farmers' income and alleviating poverty. This approach is identified as the key to sustainable economic advancement for agricultural households.

The fourth study, titled 'Understanding farming systems and their economic performance in Telangana, India: Not all that glitters is gold' (2022), delves into the characteristics and economic outcomes of farming systems in Telangana, India. The research identified five distinct farming systems, categorised by agricultural activity and the nature of livestock tenure. These systems encompassed crops without livestock (CWL), crops with dairy (CD), landless with livestock (LWL), crops with small ruminants (CSR), and

crops with diverse livestock (CWDL). The CWL, CD, and CSR systems represent specialised, intensive, and market-driven farming, whereas the LWL and CWDL systems exemplify subsistence-oriented approaches.

The economic performance assessment of the intensive farming systems (CWL, CD, and CSR) revealed that their outcomes were not consistently high. In fact, the two dominant systems, CWL and CD, displayed lower and more variable performances. These systems also faced various risks and lacked adaptability in dealing with disturbances and shocks. Despite being the most suitable for dryland regions and demonstrating the best economic performance, the CSR system may face constraints due to diminishing grazing resources in the future.

The study highlighted that intensive and specialised farming systems may potentially hinder the effectiveness of development strategies, like the WDP, focused on environmental conservation and pose long-term risks for households in coping with disturbances. This contradicts the intended goals of WDPs. The authors emphasised the need for a thorough understanding of the implications of existing farming systems and their long-term consequences. They advocated for re-evaluating current WDP approaches through comprehensive research on farming system characteristics, their socio-economic and environmental impacts, and anticipation of their future trajectories.

Furthermore, the study recommended further research to address potential unintended effects of development strategies, such as impacts on natural resources and household livelihoods. This included examining the role of financial mechanisms and effects on dietary diversity. Ongoing research and monitoring and adjustments in development mechanisms are seen as crucial steps toward implementing sustainable development programs in rapidly evolving socio-ecological systems.

These studies show that a nuanced approach to livelihood diversification, considering factors like landholdings, education, and access to credit, is crucial. The policy implications resonate across all studies, emphasising the need for intensified and diversified small farms, the development of markets and infrastructure, and sustainable employment opportunities in rural areas.

Hence, from this cohesive narrative of these studies, we can outline the numerous advantages of diversifying livelihoods while also offering a clear path for well-informed policy interventions.

Benefits

As highlighted through the review of literature, one of the advantages of livelihood diversification is that it serves as a strategy for risk management by spreading income sources across various activities like livestock rearing, horticulture, and skill-based training alongside farming. This helps buffer against seasonal and climate-related income fluctuations that affect agricultural households.

Secondly, diversification provides stability in the face of economic volatility caused by inflation and pandemics. This is crucial for rural livelihoods that often depend on urban-centric opportunities. Diversification protects against economic shocks, shielding against the ripple effects of market fluctuations.

Furthermore, it taps into emerging urban markets and capitalises on India's growing modern retail sector. Platforms like e-commerce and startups actively seek products from rural communities, creating opportunities for local industries. Additionally, products made from traditional materials stand to benefit from evolving environmental regulations.

Beyond economic gains, diversification addresses deeper issues, such as breaking free from generational poverty-induced mental and financial stagnation. Through training and mentorship, farmers can boost productivity and confidence, leading to a positive growth cycle. This, in turn, enables savings and investments for the future. With proactive engagement and a determined spirit, rural communities can drive their sustainable progress.

As stated, livelihood diversification holds significant potential for farmers, offering many benefits such as enhanced income stability, reduced vulnerability to market fluctuations, and increased resilience in the face of environmental challenges. By engaging in a variety of activities, farmers can tap into different revenue streams and create a safety net for themselves and their families. Additionally, diversification can foster skill development and knowledge acquisition, which can lead to increased agricultural productivity and improved overall well-being.

One of the speakers, a distinguished professor in Economics, opined that a key aspect is the need to provide alternative sources of income for farmers, as relying solely on agricultural income was insufficient, particularly for small and marginal farmers.

Another speaker, an executive director of a society for rural development, shared that many farmers are abandoning agriculture due to inadequate returns, compounded by factors like their children opting for different professions and the leasing out of land. Paradoxically, the demand for food is on a steady rise. The speaker asserts that the food industry has emerged as the sector with the greatest potential, potentially paving the way for the corporatization of agriculture. Those farmers who adopt an entrepreneurial approach may weather these industrial shifts. Thus, even within agriculture, there are fresh avenues for augmenting livelihoods.

Much like rural areas in other states, Telangana also offers various non-farm activities as alternative sources of income. The government has promoted such endeavours through various initiatives, including the launch of village entrepreneurship programs, a part of the National Rural Livelihood Mission (NRLM). Additionally, schemes like the Rashtriya Krishi Bima Yojana (RKBY) focus on fostering local processing and value addition.

Constraints

However, amidst the promise of livelihood diversification, farmers encounter several formidable obstacles that hinder their ability to realise it's their potential fully. One significant obstacle is the limited access to markets, which hinders rural households from reaching potential customers, often forcing them to rely on middlemen. The seasonal and agroecological conditions further complicate matters. This leads households to resort to alternative means of survival, such as timber extraction and charcoal production, exacerbating deforestation.

Moreover, the lack of awareness and training services in livelihood diversification is critical. Additionally, low levels of education and skills among rural populations curtail their employability and mobility within the job market.

Exposure to mass media also plays a crucial role in livelihood diversification. Factors like infrastructural challenges such as lack of road network and transport facilities, electricity and water supply, credit facility problems, and proximity to urban centres further compound the difficulties faced by the community in engaging in diverse means of livelihood strategies (Roy, Khatun, & Roy, 2018; Dibaba, Girma, & Haile, 2019).

It must also be noted that while all livelihood groups encounter these limitations, they disproportionately affect the tenant farmers and the landless labourer groups and have a comparatively lesser impact on the resource-affluent class. These constraints hinder the transition towards more profitable endeavours and force a shift towards less lucrative non-farm wage-earning activities.

Government Initiatives for Livelihood Diversification

I. Allied Sectors

The Telangana government has implemented several schemes to support livelihood diversification to bolster the allied sectors. Some of these initiatives are listed below.

The government introduced the Sheep Rearing and Development Programme (SRDP) to strengthen the rural economy and provide sustainable livelihoods for shepherd families in the State. Under this initiative, a unit of sheep, comprising 21 animals (20+1), along with Rs 1.25 lakhs, is supplied with a subsidy component of 75% of the unit cost. In the initial implementation phase, an expenditure of Rs 5,001 crores was incurred, distributing 82.64 lakh sheep to 3,93,552 members of Primary Sheep Breeder Cooperative Societies in the State. The sheep population rose from 1.28 crore to 1.91 crore, while meat production increased from 5.42 lakh Metric Tonnes to 10.04 lakh Metric Tonnes between 2015-16 and 2021-22 in the State. According to the 20th Livestock census, the State held the top position, contributing 25.72% to the national sheep population (Telangana Socio-Economic Outlook, 2023).

Due to the rise in sheep prices in the open market and transportation costs, the government increased the unit cost from Rs. 1,25,000 to Rs. 1,75,000 during the second phase of the scheme's implementation (2022-23 and 2023-24). The aim is to cover 3.50 lakh beneficiaries with a financial outlay of 6,085 crores in the State (Telangana Socio-Economic Outlook, 2023).

The dairy sector is crucial for farmers to enhance their earnings and provide more nutritious food for their families. To encourage dairy farming, the government introduced a scheme offering Rs. 4/- per litre of milk collected as an incentive to members of Cooperative dairies. This amount is directly credited to their respective bank accounts every month. The scheme has enrolled 29.39 lakh beneficiaries, with an expenditure of Rs. 361 crores. Milk production saw a 38% increase (from 42 lakh tons in 2014-15 to 58 lakh tons in 2021-22). Milk procurement rose to 5.60 lakh litres from 1.17 lakh litres per day (Telangana Socio-Economic Outlook, 2023).

For improving livestock production and productivity, the State, with 141.31 Lakh livestock units, emphasises the availability of quality feed and fodder. The government has prioritised supplying fodder seed to needy farmers with a 75% subsidy. 1,025 MTs of fodder seed, amounting to Rs. 8.00 Crores have been provided. In the ongoing year 2022-23, around 51,250 acres are expected to be sown with fodder crops to yield approximately 15.00 lakh MTs of green fodder. The government plans to supply the required fodder seed to farmers during 2022-23 (Telangana Socio-Economic Outlook, 2023).

Additionally, the state ranked 3rd in egg production in 2021-22, with an annual output of 1,667 crore eggs, contributing 12.98% to the country's production. The government incentivises this sector by providing free power up to 200/unit to poultry farms since 2015 (Telangana Socio-Economic Outlook, 2023).

Furthermore, the fisheries sector is rapidly growing, generating substantial income and employment. It plays a pivotal role in the socio-economic development of fishermen's families, offering good income and nutritional food. Recognizing its potential, the government has initiated various measures to enhance seed production, stock advanced fingerlings, and promote new technologies. Telangana is the only State where all suitable water bodies are stocked with quality fish seed with a 100% grant. In terms of creating employment opportunities for women groups, the government is providing 150 customised vehicles designed for dual usage of raw fish sales and Ready-to-Eat fish food, with an outlay of Rs 15.00 crores. The government also launched the "Integrated Fisheries Development Scheme" with an outlay of Rs 1,000 crores in 2017-18, in collaboration with the National Cooperative Development Corporation (NCDC), to support fishers. These initiatives led to an increase in Fish and Prawns production from 2.68 lakh tonnes (2.6 lakh tonnes of Fish and 0.08 lakh tonnes of Prawns) in 2014-15 to 3.90 lakh tonnes (3.76 lakh tonnes of Fish and 0.14 lakh tonnes of Prawns) in 2021-22. The production value also surged from Rs. 2,637 crores to Rs. 5,860 crores during this period (Telangana Socio-Economic Outlook, 2023).

II. **Debt Remission**

On the occasion of Independence Day, on 15 August 2023, Chief Minister Sri K. Chandrashekar Rao of Telangana made a significant announcement to ease the financial burden on farmers. This move reflects the government's steadfast commitment to fulfilling its promise of a comprehensive loan waiver scheme for farmers. Under this initiative, farmers with loans below Rs. 1 lakh will have their debts forgiven, with the respective amounts, up to Rs. 99,999, promptly repaid to their lending institutions.

To ensure the smooth execution of this plan, Finance Minister Harish Rao and Special Principal Secretary Ramakrishna Rao devised a well-structured 45-day action plan. This strategic approach involves regular reviews and meetings with financial institutions to facilitate the seamless implementation of the loan waiver scheme. In the initial phases, on August 3rd, an allocation of Rs. 237.85 crore was disbursed for 62,758 farmers with loans up to Rs. 41,000. Subsequently, on August 4th, an additional sum of Rs. 126.50 crore was allocated for 31,339 farmers with loans below Rs. 43,000, with the funds promptly credited to their bank accounts.

This endeavour underscores Telangana's unwavering commitment to the well-being of its farming community. The state has undertaken significant efforts to provide exceptional irrigation facilities, exemplified by transformative projects like Mission Kakatiya, which revitalised 35,000 abandoned ponds and water bodies. Initiatives like the Kaleshwaram project have revolutionised irrigation practices in the region.

It is noteworthy that this recent initiative builds upon prior government endeavours to support farmers. Since assuming office in 2014, CM KCR facilitated the waiver of loans up to Rs. one lakh, benefiting an astounding 35,32,000 farmers at a total expenditure of Rs. 16,144 crores. This was executed underscoring the state government's commitment to alleviating the financial burdens borne by farmers. The recent

decision to waive loans up to Rs. one lakh, announced during the 2018 elections, has resulted in the waiver of Rs. 7,753.43 crore in farm loans, positively impacting the lives of 16,66,899 farmers (Rajeev, 2023). This serves as a poignant testament to Telangana's steadfast dedication to the prosperity and well-being of its vital farming community.

III. **Cooperative Societies**

The Department of Cooperation of Telangana has played a significant role in governing Cooperative Societies within the state. The government's policy has shifted towards regulation rather than direct control, aiming to create a favourable environment for Cooperative growth. Two key Acts oversee Cooperative regulation: the Telangana Cooperative Societies Act of 1964, which imposes necessary restrictions on societies reliant on government support, and the Telangana Mutually Aided Cooperative Societies (MACS) Act of 1995, designed to empower societies with their resources, fostering a more dynamic Cooperative Movement.

The concept of Cooperation, centred around the principles of "ONE FOR ALL, ALL FOR ONE," has deep historical roots. Originating in England and Germany, Cooperative ideals eventually made their way to India, spurred by economic and political shifts in the 18th and 19th centuries, aimed to enhance national economic and social well-being.

The Cooperative Movement in India begins with the Inspired Agriculturists of the Deccan Plateau in 1901. Under the guidance of the Edward Law Commission, Cooperative Credit Societies were introduced, focusing on the financial needs of rural populations and farmers. This led to the enactment of the Cooperative Credit Societies Act of 1904 by the British Government, marking the inception of Cooperative Societies, officially recognised by the Government.

Over time, the Cooperative Movement evolved through various legislative acts, from the Cooperative Credit Societies Act 10 of 1904 to establishing different types of societies with diverse financial activities in 1912. Following independence, the Indian Government prioritised the Cooperative Movement in its five-year plans, commissioning the All-India Rural Credit Survey Committee in 1951 to study rural credit. The subsequent acceptance of the committee's recommendations in 1964 propelled the progress of Cooperative Societies across all development sectors.

In Andhra Pradesh, the Cooperative Societies Act of 1964 amalgamated several existing acts, setting the stage for a more streamlined Cooperative system. Additionally, the introduction of the Mutually Aided Cooperative Societies Act of 1995 aimed to grant greater autonomy and self-sufficiency to Cooperative Societies.

Within the state of Telangana, the Cooperative sector has a rich history. The establishment of the Department of Cooperation in 1914-15 marked a pivotal moment, leading to the passing of the first Cooperative Credit Societies Act in 1920. Subsequently, significant progress was made in the Cooperative Movement during the 1920s and 1930s. The cooperative sector witnessed a surge in importance with the formation of Andhra Pradesh in 1956, culminating in a multi-dimensional Cooperative system encompassing various institutions.

Today, a diverse array of Cooperative Societies operates under the framework of the Telangana State Cooperative Societies Act of 1964, the Telangana Mutually Aided Cooperative Societies Act of 1995, and the Multi-State Cooperative Societies Act of 2002, contributing to the socio-economic fabric of the state. The government has also instituted acts to guide and regulate smaller societies, emphasising self-sustainability and autonomy in their operations. Telangana's establishment in 2014 modified the Cooperative Acts to reflect the new state's identity and objectives (Department of Cooperation, Government of Telangana).

The Department of Cooperation in Telangana is crucial in overseeing and regulating Primary Agricultural Co-Operative Societies (PACS). It provides guidance and establishes norms to ensure the efficient functioning of these societies, which are integral to cooperative credit in the state. This partnership empowers PACS to effectively deliver financial services to farmers and allied activities, driving rural economic development. The department also facilitates knowledge sharing and accountability, strengthening the cooperative ecosystem. In short, the Department of Cooperation and PACS form an essential link in the cooperative credit delivery system, enhancing the well-being of Telangana's agricultural community.

The paper ‘Performance of Primary Agricultural Credit Cooperatives in Telangana – A Study’ (2021) delves into the pivotal role of Primary Agricultural Co-Operative Societies (PACS) in the economic landscape of Telangana. The study stated that throughout 2005-06 to 2016-17, PACS emerged as the cornerstone of cooperative credit, providing crucial short and medium-term loans to farmers and allied activities. The study reveals a noteworthy average annual growth rate of 1.8% for PACS, signifying their robust expansion and influence. Moreover, memberships in these societies demonstrated a growth rate of 3.3%, underlining their increasing relevance in rural economic development.

The assessment of PACS' physical performance elucidates a significant surge across various financial parameters. Share capital, reserves, deposits, borrowings, working capital, loans issued, loans outstanding, loan demand, and loan collection all exhibited average annual growth. The resulting R square values, ranging from 0.752 to 0.962, indicate strong correlations among these variables, emphasising their interdependence in bolstering agricultural credit and economic progress.

The study also provides an insightful analysis of loan distribution across different beneficiary categories. It categorises beneficiaries into distinct groups, including big, medium, small, and marginal farmers and non-farmers. The findings underscore the critical role of PACS in extending financial support to a diverse array of stakeholders in the agricultural sector. This inclusive approach contributes significantly to the economic empowerment of individual farmers and the broader agricultural community.

Hence, it can be gathered that PACs play an indispensable role in the cooperative credit framework of Telangana. Their consistent growth and positive performance indicators illustrate their profound impact on the economic well-being of the state's rural population. By providing accessible and affordable credit, PACS serve as a linchpin for agricultural and economic development, ultimately contributing to the overall prosperity of Telangana's agricultural sector.

Box 4: *Karimnagar DCCB: Pioneering Excellence in Cooperative Banking*

Karimnagar DCCB: Pioneering Excellence in Cooperative Banking

During our on-site visits, we had the privilege to explore a District Cooperative Bank in Karimnagar. District Central Co-operative Banks (DCCBs) are located in district headquarters or prominent towns and are essential in meeting the credit needs of member societies. Acting as intermediaries between these societies and the wider money market, DCCBs' success hinges on factors like deposit mobilisation, lending operations, and fund utilisation. They source their funds from share capital, public deposits, and loans from state cooperative banks. These banks primarily focus on agriculture and rural development.

The Karimnagar District Co-operative Central Bank (KDCCB) is a prominent example. They extend loans for various agricultural purposes and rural development and support government-sponsored schemes. Additionally, they offer various banking services to the semi-urban and rural population. The establishment of DCCBs in every district serves the critical purpose of providing financial assistance through loans.

The KDCCB demonstrated remarkable financial performance in the fiscal year 2022-23, reporting a substantial profit of Rs 91.40 crore, a notable increase from the previous highest profit of Rs 68.08 crore. Despite a slight deposit dip, KDCCB achieved steady growth without any negative trends. KDCCB's business volume for the year amounted to Rs 5,625 crore, contributing significantly to the overall business of State Cooperative Banks in Telangana.

Additionally, KDCCB made commendable strides in reducing gross non-performing assets (NPA) from 1.50 per cent in 2021-22 to 1 per cent in 2022-23. Recognizing their consistent profitability since 2012, KDCCB has set an ambitious target of conducting business worth Rs 7,000 crore in the upcoming financial year 2023-24 (Telangana Today, 2023).

Moreover, KDCCB has been honoured with prestigious awards by the National Federation of State Cooperative Banks (NAFSCOB) for its outstanding performance in 2020-21 and 2021-22 financial years. The bank received the All-India second DCCB and first best DCCB awards, affirming its all-encompassing excellence. This recognition further solidifies KDCCB's reputation as a leading financial institution, not only in the state but also nationally. The Choppadandi Primary Agricultural Cooperative Society, an affiliate of KDCCB, also received accolades, being awarded the Best Performing PACS among the vast network of 95,000 PACS in the country. This achievement underscores the cooperative's commitment to advancing agricultural activities.

Furthermore, the Telangana State Cooperative Apex Bank (TSCAB) and Cooperative Training Institute (CTI) of TSCAB in Hyderabad were honoured as the best performing State cooperative bank and training institute for the financial years 2020-21 and 2021-22, further emphasising the collective success of the cooperative banking sector in the region. In an impressive streak, the Karimnagar DCCB has clinched the all-India award for the seventh consecutive year, distinguishing itself as a standout performer among all 352 DCCBs nationwide since 2015-2016. This consistent recognition by NAFSCOB underscores KDCCB's enduring commitment to excellence in cooperative banking (The Hans, India, 2023).

Credit Facilities

To drive growth through credit facilities, the government of Telangana has implemented multiple initiatives, particularly with a focus on empowering women. On the occasion of International Women's Day on March 8, 2023, the Telangana government allocated a significant sum of Rs. 750 crores for interest-free loans to be distributed among Self-Help Groups (SHGs) in rural and urban areas across the State.

Of this allocation, Rs. 250 crores were designated for SHGs operating within municipal areas. In contrast, the remaining Rs. 500 crores would be disbursed to SHGs in rural regions. This announcement was made by Municipal Administration and Urban Development Minister KT Rama Rao (Jayachandran, 2023).

Subsequently, Panchayat Raj Minister E. Dayakar Rao released the annual credit plan target, a plan devised in collaboration with bankers by the Society for Elimination of Rural Poverty (SERP), in a meeting held in May 2023. The Minister underscored the importance of banks providing generous support to women in their entrepreneurial endeavours. He suggested that banks could be flexible with their requirements if necessary and should ensure that the interest rates on these loans are uniform across all banks. Additionally, the Minister urged banks to refrain from levying service charges on SHGs wherever possible.

The Minister pointed out an impressive 98% loan recovery rate for loans extended to women SHGs, and Telangana ranked among the top states in the country in terms of loans provided to these groups. On average, each SHG in Telangana received a loan of ₹5.56 lakh.

Currently, there are 4.3 lakh SHGs with a total enrolment of 46.46 lakh women. The cumulative assistance extended to these groups amounts to ₹3,924 crore. The loan amount, which stood at ₹3,722 crores in 2014-15 when the State was formed, increased to ₹12,722 crore in the preceding fiscal year. The prompt repayment by SHGs led to a significant enhancement in their creditworthiness, evident from the ₹3,500 crore rise in the annual credit plan. Simultaneously, non-performing assets (NPAs) have seen a decline. The NPAs decreased from 8.8% in 2014-15 to 1.62% in the previous fiscal year, encouraging banks to grant more loans to women SHGs.

Panchayat Raj secretary Sandeep Kumar Sultania emphasised the importance of bankers adapting their rules and procedures to align with the needs of women SHGs, whose business ventures have resulted in numerous success stories (The Hindu Bureau, 2023).

Additionally, to support the SHGs in the state, the government has also implemented the Stree Nidhi Credit Cooperative Federation Limited. The Government and the Mandal Samkahyas endorse it to supplement credit accessibility from the banking sector. It stands as a prominent government initiative and is considered a flagship program. Stree Nidhi is crucial in providing prompt and cost-effective credit to financially challenged Self-Help Group (SHG) members. This aligns with SERP's comprehensive strategy for alleviating poverty.

SHGs find it convenient to obtain hassle-free credit from Stree Nidhi, especially using mobile platforms, obviating the need to resort to other sources that may impose exorbitant interest rates. Notably, Stree Nidhi possesses the capability to swiftly extend credit to SHGs, even in remote areas of the state, within a span of 48 hours. This facilitates meeting urgent credit requirements related to health, education, and various income-generating activities like agriculture and dairy farming. The availability of credit is directly tied to the grading of Microenterprises (MS) and Village Organisations (VOs), prompting the community to actively enhance the functioning of these entities to access higher credit limits from Stree Nidhi (Stree

Nidhi Credit Cooperative Federation Limited & Department of Rural Development, Government of Telangana).

Furthermore, Telangana's Mission for Elimination of Poverty in Municipal Areas (MEPMA) has demonstrated significant achievements in its efforts to create self-sustainable institutions for urban poor communities. These institutions address many poverty-related concerns, including access to credit, financial autonomy, healthcare provisions, disability support, and vulnerability management.

One of the pivotal activities undertaken by MEPMA is Social Mobilisation and Institution Development (SM&ID). This initiative endeavours to organise urban poor women into Self-Help Groups (SHGs), fostering self-reliance through social mobilisation and institution building. Additionally, Community-Based Training (CBT) play a crucial role in enhancing the capacity of office bearers of Slum Level Federations (SLFs), Town Level Federations (TLFs), SHG members, and Community-Based Organization (CBO) staff.

Another integral aspect of MEPMA is the Self Employment Programme (SEP), which provides financial assistance to individuals or groups of urban poor. This financial support aids in establishing profitable self-employment ventures or micro-enterprises. Furthermore, the program focuses on establishing links with banks for Self Help Groups.

The Employment through Skill Training and Placement (ESTP) initiative aims to equip unskilled or semi-skilled urban youth with the necessary skills. This ultimately facilitates their placement in reputable organisations or empowers them to become self-employed entrepreneurs, contributing to their economic independence. Support to Urban Street Vendors (SUSV) is another targeted effort to identify and assist urban street vendors. This includes issuing ID cards and vending certificates, ensuring financial inclusion, and providing social security measures (Department of Municipal Administration & Urban Development, Government of Telangana).

Box 5: *History of Credit and Self-Help Groups (SHGs)*

History of Credit and Self-Help Groups (SHGs)

One of our distinguished speakers, who is an advisor on CSR, rural development livelihoods, and has been associated with livelihood support, highlighted the history of providing credit and Self-Help Groups in undivided Andhra Pradesh.

The speaker began with the year 1954 when a rural credit survey revealed that the primary solution advocated for the challenges faced by farmers was an increase in credit availability and financial resources. It was not until the Green Revolution following India's independence that a significant shift occurred. During this revolution, Prime Minister Indira Gandhi spearheaded a comprehensive investment strategy encompassing vital sectors such as healthcare, education, infrastructure, and agriculture to propel the nation forward. Regrettably, despite the conceptual strength of this idea, its execution faced two fundamental challenges.

Firstly, the vast bureaucracy of the Indian government meant that by the time everyone in the hierarchy comprehended the underlying principles of such policies, it was often too late for effective implementation. Secondly, coordinating numerous investment plans was a cumbersome

task, often resulting in disjointed efforts. Each plan was independently drafted, requiring one person to consolidate them into a coherent final investment plan. Unfortunately, this integration often fell short.

In undivided Andhra Pradesh, a group of insightful and influential IAS officers emerged with a visionary approach. During this period, the anti-arrack movement gained momentum, transcending party lines and uniting people regardless of their political affiliations. The movement's primary objective was to impose a ban on alcohol in the state, driven by women's concerns over their husbands returning home inebriated and engaging in domestic abuse. Their collective efforts successfully led to the declaration of Andhra as a dry state, marking a significant victory for women.

These forward-thinking IAS officers joined forces with the UN's South Asia Poverty Alleviation Program to capitalise on the social momentum generated by the anti-arrack movement. This collaboration paved the way for the establishment of Self-Help Groups (SHGs) in rural parts of Andhra Pradesh, marking the inception of a transformative movement.

While SHGs were not inherently designed for agricultural pursuits and were more inclined towards non-farm activities and financing, it was discovered that women within SHGs were channelling their funds towards agriculture. This unexpected development challenged the assumption that only men in households were engaged in agriculture. Women in SHGs actively participated in agricultural activities, bringing about a significant empowerment shift. Armed with capital and practical knowledge, their self-perception shifted from passive participants to active decision-makers in agricultural practices.

The SHG movement precipitated two significant outcomes. Firstly, it made capital available to farmers through the agency of women, a departure from the previous reliance on the banking system. Secondly, it integrated women into the decision-making process within agriculture.

The IAS officers also advocated for diversification in farming practices. The women in SHGs supported this call and advocated for a broader range of crops in the fields. Most SHGs were linked with NGOs or government-created departments.

In this context, the organisation SERP (Society for Elimination of Rural Poverty) was established. It took charge of existing schemes aimed at advancing agricultural technology. The individuals responsible for these schemes became accountable to SERP. SERP recommended utilising the SHG structure for the distribution of seeds, pesticides, and fertilisers.

SHGs were federated at both the cluster and village levels, a financial consideration that made the funding of smaller units feasible only when consolidated.

The same infrastructure was employed for both the distribution of agricultural inputs and the dissemination of agricultural knowledge. Additionally, some farmers began procuring through these channels. When farmers controlled the procurement, they also controlled the associated finances, granting them access to both markets and financial resources.

This approach garnered significant interest from agribusinesses. Companies like ITC and Nagarjuna Fertilisers established connections with cotton farmers. This dynamic created an interesting niche, although its success was not uniform. For instance, the Hindustan Unilever group

initially championed the SHGs concept, giving rise to the Shakti Project. However, the perspectives of the organisation and the local farmers diverged significantly, leading to the project's stagnation.

After elaborating on the definition, significance, and government interventions regarding livelihood diversification, there remain additional strategies warranting examination. To further diversify farmer livelihoods, implementing agroforestry practices (Nair et al., 2021) and promoting high-value horticulture and floriculture (Weinberger & Lumpkin, 2005) can augment income streams. Exploring non-farm enterprises, like handicrafts and food processing (Zilberman et al., 2019), offers additional avenues. Investing in sustainable rural tourism (Hall et al., 2005), leveraging digital technology and e-commerce platforms, and expanding market access should also be looked into. Supporting climate-resilient crop varieties and employing climate-smart agriculture practices (Lipper et al., 2014) enhances resilience to environmental challenges. When tailored and supported appropriately, these strategies enhance farmers' income and livelihood security.

SECTION IX
SYNERGIES BETWEEN DIFFERENT STATE GOVERNMENT DEPARTMENTS

Government departments involved in agriculture, directly and indirectly, should operate in a coordinated and synergistic manner, aiming to maximise the benefits of the agricultural sector. This collaborative approach is crucial for addressing farmers' multifaceted challenges and promoting sustainable agricultural practices. In pursuing a thriving agricultural sector, several Telangana government departments work in tandem, synergising their efforts for rural development.

In the preceding sections, we have underscored the pivotal policies undertaken by the Agriculture and Co-operation Department and initiatives by the various departments of Animal Husbandry and Fisheries, Irrigation and CAD, and Energy. In this section, we have focused on the noteworthy contributions of other governmental departments. These entities, each in their unique capacity, play a crucial role in shaping and bolstering the agricultural landscape and rural communities. Their efforts extend across a spectrum of areas, from infrastructural development to financial support, collectively working towards fortifying the foundations of sustainable agriculture and enhancing the livelihoods of rural populations.

Department of Agricultural Marketing

The Department of Agricultural Marketing in Telangana was instituted with a primary objective to oversee, regulate, and supervise the marketing operations involving the sale, purchase, and storage of Agricultural Produce, as specified in the Telangana Markets Act of 1966. Presently, the state boasts a network of 192 Market Committees, all dedicated to enforcing regulations and modernizing market infrastructure.

In a bid to empower farmers and eliminate middlemen, the department has launched two pivotal initiatives. The first focuses on cotton procurement, introducing bar-coded ID cards that facilitate direct transactions between farmers and the Cotton Corporation of India. This move expedites the process and ensures transparency and fairness in transactions.

The second initiative, "Mana Kuragayalu," is an extension of the Rythu Bazaar concept. It seeks to connect remote farmers with markets by shortening the supply chain. The heart of this endeavour lies in establishing Farmer Interest Groups (FIGs) and Farmer Producer Organisations (FPOs) in production clusters facilitated by the Horticulture Department. The vegetables provided under this project are distinguished for their low residual content, ensuring quality produce for consumers.

A systematic approach has been adopted to execute this vision, emphasizing collective marketing efforts. Collection Centers (CCs) play a pivotal role in this strategy. These centres are equipped with essential infrastructure and equipment, including electronic weighing scales, computers, and data recording tools, all provided free of cost. This ensures efficient sorting, grading, and record-keeping per farmer and per item.

Presently, 21 operational CCs serve Ranga Reddy and Medak Districts. A Distribution Center (DC) is also underway at the AMC Vegetable Market Yard in Bowenpally. This facility, complete with modern amenities like cold rooms and sorting lines, is slated to handle approximately 27,000 MTs of fresh produce.

The project's success is further underscored by the operationalization of 20 retail and bulk marketing outlets, including institutional collaborations. Ex-service personnel have been engaged to manage and operate these retail outlets under Mana Kuragayalu. To ensure seamless operations, plans are underway to outsource required manpower, covering various aspects from administration to security.

This innovative project aims to ensure equitable prices for farmers and accessible produce for consumers by streamlining the supply chain. Operating on a 'no profit, no loss' basis, it embodies a self-sustaining commercial model. In these ways, the Department of Agricultural Marketing is modernizing the agricultural landscape and significantly benefiting both farmers and consumers alike (Department of Agriculture Marketing, Government of Telangana, n.d.).

Forest Department

Another department that supports agriculture is the Forest Department of Telangana. The National Forest Policy of India aims for a minimum of 33% of the total geographical area to be under forest/tree cover, vital for ecological balance and sustaining all life forms. Telangana's flagship program, by the department, "Telangana Ku Haritha Haaram," seeks to raise the current 24% tree cover to 33%. This involves initiatives within notified forest areas and outside, focusing on rejuvenating degraded forests and enhancing protection measures. Social Forestry is a key component, with extensive planting in areas like roadsides, riverbanks, and institutional premises. The plan outlines planting 230 crore seedlings over three years, with a significant portion dedicated to areas outside notified forests.

The program has received widespread appreciation and is considered a pioneering effort in India. Field functionaries have identified planting sites and developed village Action Plans, consolidated at higher administrative levels. Additionally, "Telangana Haritha Nidhi," a dedicated Green Fund, was established to sustain and expand afforestation efforts, receiving contributions from various sources. So far, Rs.15.63 crores have been contributed to this fund.

The Haritha Haram initiative generally brings numerous advantages to the environment, economy, and human well-being. It has effectively met its goals of augmenting greenery and advocating for environmental preservation in Telangana (Telangana Forest Department, Government of Telangana, n.d.).

Professor Jayashankar Telangana State Agricultural University (PJTSAU)

Established on September 3, 2014, following the bifurcation of Andhra Pradesh, Professor Jayashankar Telangana State Agricultural University (PJTSAU) stands as the sole Farm University in Telangana. Named after the esteemed educationist and staunch Telangana ideologue, Professor Jayashankar, the institution operates under the adaptation of the ANGRAU (Acharya N. G. Agricultural University) Act of 1963 (Telangana Adaptation) order, 2014.

Comprising eleven constituent colleges, PJTSAU's academic structure is divided into eight colleges dedicated to the faculty of Agriculture, two to the faculty of Agricultural Engineering and Technology, and one to the faculty of Home Science. Additionally, there are thirteen constituent polytechnics, twelve in Agriculture and Agricultural Engineering.

The University also oversees sixteen Agricultural Research Stations, including three Regional Agricultural Research Stations, nine District Agricultural Advisory and Transfer of Technology Centres, and eight Krishi Vigyan Kendras. Complementing these, strategic units such as the Extension Education Institute,

Agricultural Information and Communication Centre, Agricultural Technology Information Centre, and Electronic Media Wing are dispersed strategically throughout the state.

Regarding its mission, PJTSAU is devoted to advancing Agricultural Sciences by producing globally competitive, high-quality human resources and generating cutting-edge technologies to tackle contemporary challenges in the agriculture sector. The institution aims to evolve responsive, effective, and dynamic outreach mechanisms.

In line with its vision, PJTSAU strives to be a Center of Excellence, acting as a comprehensive hub for agricultural innovation encompassing Education, Research, and Extension across all faculties. The ultimate goal is to empower farmers and rural communities, ensuring sustainable prosperity. Additionally, the university seeks to nurture a cadre of altruistic agricultural leaders and entrepreneurs committed to an ecologically and nutritionally balanced future for the State and the country and the global community at large. To enhance its impact, PJTSAU fosters partnerships and linkages with national and international educational, research, and developmental institutions, rural development sectors and agro-industries (PJTSAU, n.d).

Telangana State Seed Development Corporation (TSSDC)

The Telangana State Seed Development Corporation (TSSDC) is a crucial player in establishing Telangana as a leading seed producer in India. This achievement is attributed to the region's favourable agricultural conditions and well-developed seed production infrastructure. The state benefits from renowned national and international agricultural research institutions, collaborating to enhance seed production, productivity, and the development of new varieties and hybrids. Seeds from Telangana are highly sought after due to their outstanding quality, including shine, purity, and favourable storage properties, ensuring long-term viability.

As the sole State Public Sector Undertaking focused on seed production, the Corporation produces a wide variety of crop seeds. It holds a pivotal role in meeting the state's seed needs of the Department of Agriculture. In line with the government's initiative to boost individual farmer livelihoods through seed production, the Corporation subsidizes both seed distribution and production.

The Corporation's goals encompass various activities, including breeder seed production in oilseeds like Groundnut, Bajra, and Sorghum in partnership with institutions like ICRISAT and Agri University. It supports breeder seed production, foundation seed production, and certified seed production. Additionally, the Corporation engages in quality seed production for pre-released and non-notified varieties. Other functions include seed processing, packing, storage, marketing, and distribution. The Corporation also ensures seed supplies to different regions under contingency programs and maintains a Seed Bank of foundation and certified seeds. Collaborative efforts extend to seed technology research, coordination in seed import, consultancy, trading, and extension services.

To ensure quality control, a Central Quality Control Laboratory was established in 1983 at Jeedimetla, Hyderabad. This facility is crucial in maintaining quality assurance, conducting random inspections of seed production plots and lots, and analysing seed samples for parameters such as physical purity and germination. Additionally, internal grow-out tests are carried out on the Corporation's farms to assess the genetic purity of hybrid seeds. The laboratory at Jeedimetla has been further upgraded under the Rashtriya Krishi Vikas Yojana (RKVY) scheme.

In terms of distribution, the Corporation serves farmers through its outlets, Primary Agricultural Cooperative Societies, DCMS, and a network of dealers. This extensive distribution network ensures high-quality seeds are readily available to farmers throughout the region (Telangana State Seeds Development Corporation, n.d.).

Department of Consumer Affairs, Food and Civil Supplies

The Department of Consumer Affairs, Food and Civil Supplies has made several critical strides. They have increased the ceiling on land holdings, providing substantial relief to both wetland and dryland farmers. Moreover, extending the income limit for BPL families to Rs.1.50 lakhs in rural areas has enabled more farmers to access vital Food Security Cards. Minimum Support Price (MSP) operations have also been introduced, ensuring that essential crops like Paddy, Maize, Jowar, Bajra, Ragi, and Pulses fetch remunerative prices. This concerted effort underscores the commitment to fair compensation for the invaluable service rendered by farmers (Department of Consumer Affairs, 2023).

Department of Labour, Employment Training and Factories

A crucial facet of this synergy lies in the Department of Labour, Employment Training and Factories. Through incremental adjustments, the minimum wage for agricultural workers has been raised from Rs. 12,330 per month in 2021 to Rs. 12624 per month in 2022 (Department of Labour, 2022), signifying a positive step towards economic empowerment. However, the growth potential continues beyond here. By providing comprehensive training in the latest technology and machinery, Telangana's agriculture sector is poised to flourish. This, in turn, will translate into greater yields and more efficient labour utilisation, addressing critical challenges in the agricultural workforce.

Department of Road and Buildings

Supporting these initiatives, the Department of Road and Buildings plays an indispensable role. The department is responsible for planning and laying down roads, which extends to assessing the specific requirements for the seamless transportation of agricultural produce. This infrastructure is essential to meet regional demand and supply effectively. The growth in the length of roads is particularly notable, with figures indicating an increase from 128,071 km in 2018 to an impressive 140,555 km in 2019 (RBI, State-wise Length of Roads, 2019). The latest data available in 2023 shows that the road network has experienced an exponential surge, now spanning 24,245 km in length (Buildings, 2023).

This progress is evident in the expansive road network and resonates in the enhanced storage capacity for food grains. Over the years, the storage capacity has seen a commendable increase, rising from 13.27 to 16.56 lakh metric tonnes. Concurrently, the utilisation of these storage facilities has seen a substantial boost, climbing from 86% to an impressive 91% (RBI, Storage Capacity for Food grains and Utilization under FCI, 2022). This correlation between the expansion of road networks and the heightened utilisation of storage capacity is a testament to the department's pivotal role in optimising logistics for agriculture. It signifies a positive synergy between infrastructure development and agricultural productivity, ultimately bolstering the resilience and efficiency of the state's agricultural sector.

Department of Rural Development & Panchayat Raj

As we delve deeper into this collaborative effort, the Department of Rural Development & Panchayat Raj emerges as a linchpin. The introduction of the Panchayat Raj Institution, following the 73rd Constitutional Amendment Act, has been a transformative step. This institution is the fulcrum of rural development, providing a streamlined approach to implementing developmental schemes at the grassroots level

(Nagaraju, 2022). Moreover, the Telangana State Institution for Rural Development (TSIRD) serves as a vital catalyst, facilitating discussions on development issues and formulating micro-plans that align with district visions and agricultural strategies (Department Profile – Telangana State Institute of Rural Development, n,d,).

Departments of Backward Classes Welfare, Minorities Welfare, Social Welfare & Tribal Welfare

Inclusive policies from the Department of Backward Classes Welfare, Minorities Welfare, Social Welfare, and Tribal Welfare are fundamental to this collaborative framework. Telangana State has implemented notable initiatives in Backward Classes Welfare, Minorities Welfare, Social Welfare, and Tribal Welfare. A prime example is the Land Distribution to Dalits program, which allocates 3 acres of agricultural land to landless Scheduled Caste (SC) women. This initiative encompasses a comprehensive package, including provisions for establishing irrigation facilities, land development, and providing essential agricultural inputs to sustain their livelihoods. In its inaugural year, the government successfully distributed 2,524 acres of land to 959 Dalits, incurring an expenditure of Rs. 94 crores. The program directly addresses the issue of landlessness and empowers marginalised communities to actively engage in agricultural pursuits (Land Distribution to Dalits, 2023).

The T-PRIDE initiative is pivotal in promoting equity within the industrial sector, specifically by bolstering representation from Scheduled Castes, Scheduled Tribes, Women, and Specially-Abled Persons (SAP). This multifaceted scheme offers various incentives, subsidies, and reimbursements, including preferential allotment of industrial plots in designated parks, direct funding, provision of margin money, subcontracting opportunities with large industries, additional investment subsidies and other financial support mechanisms. T-PRIDE's overarching objective is to diversify income sources for these groups, stimulating agricultural investments and contributing to overall economic growth (Socio-Economic Outlook, 2023).

The government's visionary "Dalit Bandhu" scheme, introduced in the fiscal year 2021-22, stands as a monumental step towards the economic empowerment of Scheduled Caste individuals. This program extends substantial financial assistance of Rs. 10 lakhs to each beneficiary, free from any dependencies on traditional banking channels, facilitating the establishment of viable income-generating ventures.

Launched on August 4, 2021, this scheme empowers individuals to make strategic investments in agriculture and related sectors, thereby contributing to the overall advancement of agricultural development. To provide a safety net during financial adversities, establishing the Dalit Rakshana Nidhi ensures that beneficiaries of the Dalit Bandhu scheme and their families do not face undue hardships. This fund serves as a crucial financial safeguard, protecting the economic interests of the beneficiaries and providing vital support for their agricultural endeavours (Socio-Economic Outlook, 2023).

Lastly, the "Giri Vikasam" scheme provides essential irrigation facilities to previously fallow and uncultivable agricultural lands owned by small and marginal Scheduled Tribe (ST) farmers. By December 2022, an impressive 56,613 acres of land belonging to 19,698 ST farmers had transformed cultivable plots, all at an expenditure of Rs. 98.23 crore. The provision of irrigation facilities has significantly enhanced agricultural productivity, thereby playing a pivotal role in sustaining the livelihoods of ST farmers. This initiative is a testament to the state's commitment to sustainable agricultural development, underscoring the transformative impact of essential infrastructure on agricultural pursuits.

Department of Electronics & Communication

Complementing these endeavours, the Department of Electronics & Communication harnesses technology as a catalytic force. 2016 the Telangana government introduced the Rural Technology Centres policy, marking a significant stride in the state's agricultural landscape. The impact of this policy is profound, as these centres serve as hubs for adopting cutting-edge agricultural technologies. They play a pivotal role in augmenting rural farmers' skills and knowledge base, stimulating research and innovation, promoting sustainable farming practices, and facilitating access to markets. Furthermore, they empower rural communities, enabling data-driven farming decisions, and may necessitate infrastructure development to facilitate technology integration. It is worth noting that the full extent of this impact hinges on factors like robust implementation and considerations such as funding availability and farmers' readiness to embrace new technologies.

The Innovation Policy 2016 has also been a game-changer for agriculture in Telangana. It has fostered a thriving ecosystem of agricultural startups and agribusinesses. This transformation has been propelled by a conducive environment for agricultural innovation and entrepreneurship, marked by the establishment of incubation centres, facilitation of funding access, fostering collaborations in research and development, advocacy for digital agriculture, fortifying market linkages, provision of skill development programs, and staging agri-innovation challenges. These concerted efforts have supported farmers' livelihoods and led to a surge in innovative technologies and practices, driving growth in the agricultural sector. The upswing in Agriculture Startup Incubators has been staggering; in 2015, a mere 50 were in operation, compared to the current count of 250 active agricultural incubators in 2023. This burgeoning landscape of incubators indicates a proliferation of startups striving to introduce groundbreaking solutions to the challenges faced by farmers nationwide. Telangana is home to a burgeoning cohort of Agri-Startups, leading the charge in ushering cutting-edge technology into agriculture. The statistics evince a 50% increase in registered agribusinesses, fostering innovation and creating fresh employment opportunities since the framework's inception. A prominent figure in this landscape, AgHub, is a well-recognised startup incubator in Telangana, nurturing over 400 Agri startups (Department of Information Technology, Electronics & Communications, 2023).

The Telangana Agricultural Data Management Framework of 2022 is pivotal in fortifying agriculture in the state, addressing the imperative for efficient data handling. This framework underscores the significance of digital agriculture and emerging technologies like AI, ML, IoT, drones, and satellite imagery in furthering production, productivity, and profitability in the agricultural sector. The framework provides a systematic approach to collecting, processing, sharing, and utilising agricultural data, all while safeguarding the rights of farmers and other stakeholders. By streamlining procedures, standards, and practices about data management, the framework ensures that data is disseminated judiciously and in a coordinated manner. Statistics indicate that, within the sectors encompassed by the framework, farmers' incomes have witnessed an average upswing of 15-20%, culminating in an overall enhancement of livelihoods. This approach circumvents the emergence of data silos in both the public and private sectors, paving the way for innovative solutions to leverage the digital economy's full potential, benefiting farmers and all stakeholders alike (Department of Information Technology, Electronics & Communications, 2023).

Department of Industry & Commerce

The Department of Industry & Commerce propels this collective endeavour through policies. The Telangana State Food Processing and Preservation Policy (T-FAPP) of 2021 has played a pivotal role in fortifying the state's agricultural landscape. This policy has laid the foundation for a thriving ecosystem,

notably by establishing 10,000 acres dedicated to Special Food Processing Zones (SFPZs) and supporting an additional 4,900 acres earmarked for food processing industries. This strategic investment has not only enticed 2,156 food processing units. However, it has also garnered a substantial total investment of approximately INR 24,500 Crores, resulting in an annual power consumption of 28.8 lakh units.

Furthermore, the policy offers critical financial incentives, including power rebates, interest subventions, APMC fee reimbursements, and rebates on land costs. These incentives have been instrumental in propelling noteworthy growth within the sector. Consequently, the policy has yielded multifaceted benefits, including reducing food wastage, augmentation in value addition, and creating employment opportunities. The estimated contributions of 1,470 small and 686 large units have been pivotal in bolstering the economic prosperity of the state's rural and agricultural regions (Department of Industries & Commerce, 2021).

These collaborative efforts underscore Telangana's unwavering commitment to agricultural prosperity, intertwining various departments' functions to uplift the rural landscape. The state is charting a course towards a more sustainable and vibrant agricultural sector through coordinated policies and strategic investments.

SECTION - X
ADDRESSING CONCERNS AND SEIZING IMPROVEMENT OPPORTUNITIES

In today's dynamic agricultural landscape, many challenges and opportunities intersect, demanding keen attention and strategic interventions. Some of these pressing concerns are addressed in this section. This includes the evolving labour dynamics within the agricultural sector, the issue of post-harvest losses, the potential of youth engagement in agriculture, effective policy formulation in the notions of extension services, subsidies, debt remission, and Research and Development, among others.

Labour Scarcity and MGNREGS Work Allotment

Expanding job opportunities, while beneficial for the economy, can have specific negative implications for agriculture due to inadequate livelihood diversification strategies. This shift of agricultural workers to other industries creates a labour shortage for crucial farm tasks, particularly during peak times. Moreover, if the available workforce dwindles without a corresponding decrease in demand (due to labour-saving technologies), it can result in higher wages and increased labour costs. Since labour expenses constitute a substantial portion of overall production costs, an increase in wages can dent farm profits. It's imperative to closely monitor long-term shifts in labour availability in agriculture and grasp their impact on the farming economy. This understanding is essential for formulating effective labour management plans (Srivastava et al., 2020).

In the study titled "Constraints Experienced by Paddy Farmers in Three Agro-climatic Zones of Telangana State, India" (2023), it was indicated that the primary social constraint reported by the majority of farmers was the scarcity of labour due to the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). A shortage of labour followed this during critical agricultural operations, as well as high costs and wages during transplanting and harvesting seasons. Additionally, there was a challenge posed by unskilled or inadequately skilled labour.

During peak seasons when demand for labour is at its zenith, local availability tends to be inadequate. This scarcity significantly impacts the sustainability of paddy cultivation in the study. According to farmers, because resources are diverted towards non-agricultural activities, a significant portion of the farm labour force opts for the MGNREGS due to the guaranteed income. Consequently, farmers grapple with numerous challenges, especially labour-intensive tasks like transplanting, weeding, and harvesting. This compels them to rely on labour from other districts and regions, resulting in increased labour costs and a financial burden on farmers during peak periods.

> *In our field study, farmers in Utoor village, Karimnagar, expressed similar concerns about the elevated cost of labour. They attributed this primarily to these workers hailing from other states. Additionally, they also mentioned that there was a noticeable deficiency in the attention given to MGNREGS and agriculture-related activities under it.*

As a result, the discussions in the field and similar studies (Sowjanya, 2017; Srivastava et al., 2020; Rani et al., 2023) underscore how farmers advocate for prioritising agricultural-related activities within the

MGNREGS to ensure access to local labour. They suggest that the government should establish schemes facilitating collaboration between local labourers and farmers, with allocated government funds benefiting both parties.

Post Harvest Losses

An efficient post-harvest management system is crucial for optimising agricultural, and livestock produce. Since post-harvest losses occur at various stages of the supply chain, it is imperative to scrutinise the different pathways through which crops, and livestock reach consumers. This study aimed to map post-harvest losses at each stage, both at the farm and market levels.

The document 'Study to determine post-harvest losses of agri produces in India'' (2022) aimed to assess post-harvest losses in India's agriculture sector, focusing on perishable items like fruits and vegetables. It identified infrastructure, technology, and skill gaps, proposing necessary investments. The assessment covered 54 crops in 15 agro-climatic zones, with data collected from 292 districts. A stratified multistage random sampling method was used, employing inquiries and observations. Data collection utilised Computer Aided Personal Interview (CAPI) technology, followed by rigorous review and analysis to estimate losses.

The study's suggestions can serve as a blueprint for the state of Telangana to delve deeper, conducting tailored research based on their specific crop profiles. This will allow them to fine-tune policy recommendations to suit their individual needs better.

The study's significant findings and the range of post-harvest losses observed are summarised as follows:

In the category of cereals, post-harvest losses for various crops like paddy, wheat, maize, Bajra, and sorghum were evaluated. These losses ranged from 3.89 per cent in maize to 5.92 per cent in sorghum. The use of manual methods for operations such as harvesting and threshing contributed significantly to these losses.

Post-harvest losses in pulses (pigeon pea, chickpea, black gram, and green gram) ranged from 5.65 per cent in pigeon pea to 6.74 per cent in chickpea. Shattering of grains during harvesting, spillage during various operations, and mishandling led to these losses.

For oilseeds, such as mustard, cottonseed, soybean, safflower, sunflower, and groundnut, losses ranged from 2.87 per cent in cottonseed to 7.51 per cent in soybean. Post-harvest losses were primarily attributed to operations like harvesting and threshing at the farm level and inadequate storage conditions in market channels.

Among the 11 fruits studied, post-harvest losses ranged from 6.02 per cent in pineapple to 15.05 per cent in guava. Harvesting, sorting, and grading at the farm level, along with improper handling and storage conditions, were major contributors to these losses. This highlights the importance of better harvesting tools, proper handling, and an effective cold chain infrastructure to further reduce post-harvest losses.

Among 14 vegetables, losses ranged from 4.82 per cent in tapioca to 11.61 per cent in tomato. Farm operations, such as harvesting and sorting/grading, were responsible for post-harvest losses. Insufficient storage and improper handling practices by various stakeholders in market channels were the major

contributing factors. The cold chain infrastructure for vegetables in the country was still in its early stages and required special attention for reducing post-harvest losses and maintaining desirable quality for consumers.

Post-harvest losses for plantation crops (areca nut, cashew nut, coconut, and sugarcane) ranged from 3.72 per cent in cashew nut to 7.33 per cent in sugarcane. Operations such as harvesting and threshing were the main contributors to these losses.

For spices (black pepper, coriander, chilli, and turmeric), post-harvest losses ranged from 1.29 per cent in black pepper to 6.11 per cent in chilli. Shattering during harvesting and spillage at various stages were the leading causes of these losses.

Inland fish had a post-harvest loss of 4.86 percent, while marine fish had a loss of 8.76 percent. Post-harvest loss in marine fish was primarily attributed to discarding uneconomical fish after harvesting, along with losses at wholesaler and retailer levels. These could be mitigated by strengthening the cold chain infrastructure, including cold storages, ice plants, and freezing plants.
Meat had a post-harvest loss of 2.34 percent, while poultry meat had a loss of 5.63 percent. Improvement in farm-level operations and a shift from standalone slaughterhouses to integrated facilities led to reduced post-harvest losses.

Milk observed a post-harvest loss of 0.87 per cent. Enhancements in milk handling at the farm level and in processing units could further reduce post-harvest losses.

The study stated that in comparison to post-harvest losses during 2014-15, there was a significant reduction in losses for 25 crops, while 17 crops showed a non-significant reduction. However, for three crops—black pepper, turmeric, and tapioca—estimated post-harvest losses were slightly higher than in the previous assessment in 2015.

To enhance post-harvest management, developing infrastructure at both the farm and market levels is imperative. At the farm level, providing support for mechanical harvesters, threshers, and packaging materials to farmers is essential. Establishing collection centres, pre-cooling units, storage structures, and packing units near production centres is vital for better handling of produce at the farm level. In market channels, forward and backward linkages, adequate storage structures, and modern retail infrastructure are necessary.

In both farm and market operations, deploying various technologies and policy interventions can potentially reduce post-harvest losses. This includes organised marketing through the creation of Farmer Producer Organisations (FPOs) and Farmer Producer Companies (FPCs), improvements in crop production and protection technologies, and training and capacity building of farmers through extension activities to enhance crop management practices.

Chapter 8 from ‘Study to determine post-harvest losses of agri produces in India’ (2022) outlines comprehensive strategies aimed at reducing post-harvest losses across various agricultural sectors.

The focus should be on enhancing post-harvest infrastructure in the Fruit and Vegetable Sector. At the farm level, this includes providing necessary equipment such as pluckers and harvesters and containers like plastic baskets and crates for efficient harvesting and storage. Mechanical sorting and grading, along with practices like hot water treatment, are recommended. Additionally, modern packaging methods, including

waxing and shrink wrap, are encouraged. Precooling units and controlled atmospheric storage are suggested for different types of produce. Market-level measures involve establishing cold storage hubs, utilising technology for traceability, and promoting modern retail infrastructure.
The Milk and Milk Products Sector emphasises the strengthening of post-harvest infrastructure. This includes advocating for modern dairy practices, such as milking machines, and expanding refrigerated transportation networks. Training and capacity building initiatives focus on educating farmers about quality feed production, milking techniques, and proper post-milking milk handling. In terms of policy advocacy, the document suggests expanding cooperative and processing units, promoting genetic improvement of cattle, and pushing for structural changes in the unorganised sector.

In the Eggs and Poultry Meat Sector, efforts are to be made to enhance post-harvest infrastructure through the promotion of modern farming practices and mechanised production. This is coupled with support for safe packaging and storage methods. Training initiatives focus on educating stakeholders about hygienic post-harvest handling of birds and eggs. In terms of policy advocacy, the document calls for an expansion of processing plants, increased processing capacity, support for collectivization of smallholders, and the creation of policies for utilising food waste.

The Meat Sector also emphasises strengthening post-harvest infrastructure, with a focus on proper animal husbandry, modern slaughterhouses, and integrated processing units. Adequate packaging and transportation methods are encouraged. Training and capacity building initiatives in this sector revolve around promoting farmers' cooperatives, providing training in production and marketing, and encouraging backward integration. In terms of policy advocacy, the document suggests expanding capacity for processing plants, supporting the collectivisation of smallholders, and creating policies for utilising food waste.

In the Fisheries Sector (both Inland and Marine), post-harvest infrastructure should be strengthened by upgrading fishing vessels, modernising harbours, and promoting technology adoption. Adequate provision of ice and cold storage facilities is also prioritised. Training focuses on educating stakeholders about the hygienic post-harvest handling of fish. Policy advocacy efforts revolve around promoting a cluster-based approach for aquaculture, developing marketing strategies, implementing licensing and registration, and distributing training modules.

Finally, in the Cereals, Pulses, and Oilseed Sector, post-harvest infrastructure is enhanced by supporting the adoption of modern equipment and emphasising timely harvesting and quality packaging. Storage practices are improved, and technology is leveraged for marketing. Training initiatives focus on educating stakeholders about improved post-harvest management practices. Policy advocacy efforts aim to encourage organised marketing through FPOs/FPCs, improve storage practices, focus on crop protection, and create policies for utilising food waste.

During our field study, we discovered that transportation posed a significant challenge for a few villages in Ranga Reddy District of Telangana. The farmers and members of an FPO expressed that having more affordable transportation options would greatly benefit them. Additionally, the farmers expressed a keen interest in the establishment of cold storage warehouses.

Youth and Agriculture

The global agricultural landscape is witnessing a trend where the younger generation is increasingly opting for non-agricultural pursuits, diverting from the traditional paths of their parents and grandparents. This shift is noteworthy given that the average age of farmers worldwide stands at 60. Recognizing the vitality of youth as a resource, especially in sustaining the pivotal agricultural sector crucial for national progress, is imperative. Regrettably, this crucial demographic often finds itself overlooked when it comes to policy formulation and program considerations, even during a pivotal transitional phase into adulthood.

For agriculture to retain its fundamental role as a cornerstone of any civilization, rectifying this low level of youth engagement is paramount. Achieving this requires a concerted effort to captivate the interest and involvement of young people in agriculture. Their active participation in agricultural endeavours holds the promise of addressing the challenges posed by an ageing farming population, while simultaneously alleviating youth unemployment. This demographic constitutes the backbone of every society's economy, a wellspring of fresh ideas and innovations, the primary consumer base for food consumption, and often the influential drivers of public sentiment, policy decisions, and societal transformation (KhetiGaadi, 2022).

Rural youth aspiring to pursue agriculture as a profession encounter a series of formidable challenges. These hurdles encompass a range of critical areas. Firstly, there exists a notable deficit in access to knowledge, information, and educational resources. This scarcity hampers their ability to acquire the necessary skills and know-how required for success in the agricultural sector.

Secondly, the limited access to land emerges as a significant barrier. Securing plots for cultivation proves to be a formidable task, further complicating their entry into the agricultural domain.

Financial services represent another crucial area where these young individuals face shortcomings. The lack of adequate access to financial resources and services substantially impedes their ventures in agriculture.

Furthermore, opportunities in "green jobs," which are environmentally sustainable roles, are not easily accessible to them. This restricts their ability to engage in eco-friendly agricultural practices. Access to markets, a pivotal aspect of any agricultural endeavour, remains restricted for rural youth. This limitation stifles their potential for growth and prosperity within the sector.

Additionally, their involvement in policy dialogue, a vital avenue for influencing agricultural policies and decisions, is conspicuously minimal. This exclusion hampers their ability to advocate for their interests and contribute to the shaping of agricultural policies.

The deficiency of agricultural content in education exacerbates the situation. This absence means that these aspiring agriculturists are not adequately equipped with the requisite theoretical foundations for success in their chosen field.

Finally, the inherent high risks associated with the agricultural profession loom large. This factor, coupled with the aforementioned challenges, further underscores the formidable nature of the hurdles these rural youth must navigate in their pursuit of a career in agriculture (Shekara et al., 2016).

To revitalise the agriculture sector for the youth, the article by Katyal and Katyal (2018) suggested six interventions. Firstly, a thorough exploration of the needs, aspirations, and perceptions of young individuals regarding agriculture is imperative. The insights garnered from such investigations should serve as the guiding principles for formulating action plans. These plans should encompass education, mentorship, and support for young men and women in areas like professional farming techniques, effective management of

emerging business opportunities, market evaluation, consumer demands assessment, and monitoring of business progress. Additionally, becoming part of a producer group network should be promoted.

Creating a contemporary awareness of agricultural practices is essential. This includes modern crop and animal production methods, as well as understanding input and service provisioning institutions and schemes, efficient farm machinery management, proper handling and processing of produce, and an understanding of markets and consumer behaviour. Experiential learning programs should be implemented to facilitate this knowledge transfer. Specialised training programs focusing on producing high-value, low-volume products adaptable to controlled and uncontrolled conditions should be initiated under the guidance of the Agriculture Skill Council of India. Moreover, a shift in pedagogy ensuring the continuous transfer of fresh knowledge with a commitment to lifelong learning is necessary.

Transitioning agri-farmers into "Agripreneurs" demands the institutionalisation of youth-specific schemes that provide unimpeded access to financial services. The active involvement of civil society organisations in organising and supporting aspiring young men and women is equally pivotal.

Fostering a thriving market is crucial for the success of emerging speciality agriculture. This requires the elimination of existing barriers through the real-time dissemination of information on decision-support products, markets, and consumer demands. Incorporating state-of-the-art ICT tools for this purpose is paramount.

Promoting value addition through primary processing, including cleaning, grading, and packaging, increases income and employment opportunities. However, setting up processing plants on agricultural farms necessitates a change in land use, a process currently encumbered by bureaucratic procedures. Introducing flexibility in archaic clauses to facilitate the establishment of processing plants on farms is recommended. Furthermore, as value addition facilities are classified as industries, they incur commercial tariffs on power consumption. To incentivise primary processing, which maximises income, employment, and minimises waste, it is advisable to maintain subsidised electricity rates for these setups, akin to what is provided to regular cultivators.

Lastly, implementing a "sunrise agriculture enterprise" necessitates comprehensive support from public policymaking bodies. This support should encompass institutional, financial, and legal backing to effectively address the core concerns of the youth, thereby attracting and sustaining their engagement in agriculture while generating new employment opportunities.

Other Potential Concerns

Collaborating with over a hundred leading economists globally, renowned author Bjorn Lomborg has dedicated years to pinpointing the most effective solutions for global challenges in his book 'Best Things First'. Drawing from 12 recent, rigorously reviewed studies, soon to be published in the Journal of Benefit-Cost Analysis by Cambridge University Press, his latest work underscores the optimal strategies for improving the world.

In one of its chapters, 'Agricultural R&D: More and Cheaper Food' the author argued that certain widely adopted agricultural policies, especially in developing nations, may not yield significant benefits. For instance, providing subsidies for inputs to small farms is found to have relatively low societal returns. The book highlights the findings from the Copenhagen Consensus, which conducted 45 cost-benefit analyses on commonly used agricultural policies, consistently revealing their limited potential for generating

substantial returns. While policies like crop insurance may be necessary for small and marginal farmers, their costs often outweigh the benefits, with the majority of gains accruing to larger landowners. Similarly, subsidies for fertilisers and energy can lead to costly distortions and predominantly benefiting those already financially well-off.

The provision of extension services, aimed at disseminating practical agricultural knowledge to farmers, was found to generate only $3.50 in benefits for every dollar invested, according to one of the research projects conducted in Bangladesh. Although these returns are not negligible, considering the world's finite resources, there may be more efficient uses for government funding. Issues also arise with farm loan waivers, as the benefits they create are outweighed by their costs and tend to favour already advantaged farmers disproportionately. It is noted that previous loan waiver schemes have led banks to reduce credit for small farmers, diminishing their prospects for obtaining future loans and pushing them towards costly informal sources of credit.

Therefore, governments must undertake examinations that assess both the advantages and the returns of the policies they have. The book also proposes allocating resources towards Research and Development (R&D) technology, as each breakthrough has the potential to benefit countless farmers significantly. This is identified as the most effective agricultural intervention by every economist they consulted.

Increasing research and development funding beyond historical levels should be channelled in four key directions to benefit the global south. Firstly, funds should be allocated to internationally coordinated research centres focusing on innovation, technical advancements, and policy support to enhance food security, reduce poverty, and bolster ecosystem services. Essentially, this constitutes an international extension of the initial green revolution, known as CGIAR (Consultative Group on International Agricultural Research).

The paper emphasises the importance of investments by national agricultural research systems. This is critical as these systems carry out research that is specifically tailored to enhance the agricultural efficiency of individual nations. Their involvement is indispensable for crafting solutions that are attuned to specific climates and local circumstances.

The third facet of investment should be more modest in scale and directed towards innovations that can amplify the effectiveness of the first two applications. This may involve, for example, expediting and reducing the cost of DNA sequencing for plants. Lastly, resources should be allocated to the private sector to enhance the array of food choices available to consumers in developing nations.

CONCLUSION

This comprehensive study delved deeply into the multifaceted landscape of Telangana's agriculture through rigorous research and insightful interviews. It commenced with a historical perspective, providing a solid foundation for understanding the state's pivotal agricultural policies. Noteworthy policies such as Rythu Bandhu, Rythu Bima, Rythu Vedika, palm oil cultivation promotion, and the Dharani portal's implementation were meticulously scrutinised. This critical examination sheds light on their far-reaching influence on the agriculture sector while acknowledging pertinent concerns.

Furthermore, the report presented a meticulous statistical analysis, offering invaluable insights into the current state of agriculture and its allied sectors within the region. It also encompassed an evaluation of agricultural business facilitation, ecological and environmental considerations arising from farming practices, and the scope for diversification in rural livelihoods. A significant emphasis was placed on highlighting the harmonious interplay between various state government departments that collectively drive Telangana's agriculture sector.

By incorporating firsthand interviews, the study offered a human perspective on how these policies directly impacted farmers and their livelihoods, providing a tangible context for policy implications.

This amalgamation of diverse perspectives aims to construct a thorough and well-grounded report. Ultimately, the objective is to advocate for sustainable and resilient agricultural practices, enhancing productivity, improving the lives of farmers, and contributing to the overall advancement of the region.

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