

Sugarcane Farming in Uttar Pradesh with special reference to conditions of workers and pattern of Employment in the District of Muzaffarnagar

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V.V. Giri National Labour Institute

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Preface

Sugarcane farming is one of the most significant agricultural activities in India, providing livelihood to millions of farmers and labourers. As a major sugarcane-producing country, India occupies a crucial position in the global sugar industry, and the crop holds immense importance in the nation's employment market. Uttar Pradesh, in particular, stands out as the leading sugarcane-producing state in the country.

The historical growth of sugarcane cultivation in India reflects its importance in agriculture and industry. In 1950-51, the total area under sugarcane cultivation was 1.17 million hectares, which expanded to 4.85 million hectares by 2020-21 (Government of India, 2023). Similarly, sugarcane production rose from 57.05 million tonnes in 1950-51 to 405.40 million tonnes in 2020-21. States such as Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Gujarat, Bihar, Haryana, and others contribute significantly to sugarcane cultivation, with Uttar Pradesh alone accounting for 44.94% of the total sugarcane production in 2020-21, followed by Maharashtra at 23.56%. Together, these two states produced 68.50% of the country's sugarcane during the same period.

Sugarcane farming is not only vital for agricultural workers but also fuels industrial processes that generate employment across multiple stages of production and ancillary activities. Approximately 7 million farmers and agricultural laborers are engaged in sugarcane cultivation, with additional workers involved in related industries (Raj, A.; et al., 2021). However, despite its significance, the industry faces numerous challenges, such as low procurement prices during harvest, rising input costs, labor shortages, and limited technological awareness.

Given the versatile nature of sugarcane and the employment opportunities generated by its by-products, it becomes essential to assess the state of employment in cultivation and industrial processes. Within this above context the present research is an attempt to understand the conditions of workers engaged in sugarcane farming, particularly their socio-economic and health conditions, as well as their living and working environments.

I congratulate Dr. Shashi Bala, Senior Fellow & Project Director and the entire team for conducting the study which will be beneficial for policy makers, academicians and researchers working in this area.

Dr. Arvind
Director General
V.V. Giri National Labour Institute



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Dr. Shashi Bala
Senior Fellow



Executive Summary

This study explores the multifaceted aspects of sugarcane farming, with a particular focus on the socio-economic and health challenges faced by farmers, the contribution of sugarcane to economic growth, and the potential for employment generation. The research aims to provide a comprehensive understanding of the sugarcane farming ecosystem, particularly in Muzaffarnagar district.

The first chapter titled “Introduction” provides an overview of sugarcane as a critical crop for economic growth and rural development. It highlights the significance of the sugar industry in India’s economy and the role of government policies in supporting sugarcane farmers. The chapter also outlines the objectives of the study, which include analyzing the working and health conditions of farmers, understanding their socio-economic status, and assessing the challenges they face. Limitations of the study are also addressed, ensuring clarity on the scope of the research. The second chapter titled “Review of Literature” reviews existing literature on sugarcane farming, with a global perspective and a specific focus on India, particularly Uttar Pradesh.

The third chapter titled “Research Methodology” outlines the process of data collection and analysis. It details the selection criteria for the state, district, and villages, as well as the sample size and sampling techniques. Both primary and secondary data sources were used, with fieldwork conducted over a specified duration. A flowchart of the methodology provides a visual representation.

The fourth chapter titled “Socio-Economic Characteristics” examines the demographic and economic profiles of sugarcane farmers. It includes details on age, gender, education, household structure, and caste composition. Economic factors such as income levels, land ownership, employment status, and access to financial services are analyzed to understand the farmers’ status.

The Fifth chapter title “Working and Health Conditions” explores the working conditions of sugarcane farmers, including the cultivation process, labor dynamics, irrigation practices, and asset investments. The chapter also delves into the health challenges faced by farmers.

The sixth chapter titled “Cost-Benefit Analysis and Potential Employment Generation” evaluates the financial aspects of sugarcane farming, focusing on cost and benefit factors. It identifies the financial challenges farmers face and assesses the profitability of sugarcane farming. The analysis provides insights into the economic sustainability of sugarcane cultivation. Also this chapter will look into employment opportunities in sugarcane farming sector.

The seventh chapter titled “case studies” presents case studies to provide a deeper understanding of specific issues. One case study focuses on managing the red rot disease



effectively, while another highlights the life and challenges of *kohlu* (traditional sugarcane crusher) workers.

The eighth chapter titled, 'Research Findings and Conclusion' presents the major research findings and conclusion of the research. This chapter is followed by references and annexure. The annexure consists of a Sugarcane farmer's questionnaires and pictures from the field visit.



Chapter I : Introduction

1.1 Introduction to Sugarcane crop

Sugarcane (*Saccharum officinarum*) is one of the most significant commercial crops globally, playing a pivotal role in the agricultural economies of tropical and subtropical regions. Originating in South Asia and Southeast Asia, sugarcane belongs to the Gramineae family and is a tropical grass valued for its versatility and renewable nature. It is a labor-intensive crop, involving activities like planting, weeding, irrigation, harvesting, and transportation. Beyond sugar production, sugarcane serves as a critical agricultural resource, providing biofuels, fiber, fertilizers, and a variety of by-products, making it essential for ecological sustainability (Mishra et al., 2021). Sugarcane's composition typically includes 63-73% water, 11-16% fiber, 12-16% soluble sugars, and 2-3% non-sugar carbohydrates. The importance of sugarcane cultivation can be understood from the historical growth of sugarcane production and the increasing area under the sugarcane cultivation in the country. For example, in 1950-51, the total area under sugarcane cultivation was 1.17 million hectares. In 2020-21, the total area accounted for 4.85 million hectares (G.O.I., 2023). This explains the importance of this crop in both the agriculture and industry sectors.

In India, sugarcane is cultivated across two distinct agro-climatic zones:

- Tropical
- Subtropical

The tropical region comprises states like Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Madhya Pradesh, Goa, and Kerala, while the subtropical region includes northern states such as Uttar Pradesh, Bihar, Haryana, and Punjab. These climatic zones are ideal for sugarcane cultivation, which thrives in temperatures ranging from 20 to 40 degrees Celsius (NITI Aayog Task Force, 2023). In India, Sugarcane is planted in three distinct seasons: Autumn (September-October), Spring/Eksali (January-March), and Summer/Adsali (July-August). In tropical regions, year-round cultivation is possible due to stable weather conditions, whereas subtropical regions face climatic extremes, limiting the most productive cultivation period to 4-5 months annually. In subtropical zones, planting is typically done in spring or autumn, while in tropical areas such as Maharashtra and Karnataka, cultivation often occurs during July-August (Adsali). The crop duration in India ranges from 10 to 18 months, with the 12-month cycle being the most prevalent. Eksali crops are harvested after 12 months, autumn crops after 13-15 months, and Adsali crops after 15-18 months (NITI Aayog Task Force, 2023).

Figure 1.1 : Sugarcane crop in Muzaffarnagar district



Source: Field Survey

1.2. Sugarcane Farming: A Key Driver of Economic Growth and Rural Development

Agriculture is the backbone of India's economy, providing livelihoods to a significant portion of the population. As per Census 2011, **54.6% of the total workforce** in India is engaged in agriculture and allied sector activities. The sector remains a critical contributor to the country's economy, accounting for **18.4% of India's Gross Value Added (GVA)** at current prices during 2022-23. Sugarcane is a crucial driver of economic growth and rural development, particularly in countries like India and Brazil, where it plays a vital role in agricultural economies. Brazil alone accounts for 37% of the world's total sugarcane cropped area; with approximately 26 million hectares dedicated to its cultivation. Other top producers include India, Thailand, China, and Pakistan (FAO, 2018). India, in particular, accounts for about 25% of global sugar production, with approximately 7.5% of the rural population engaged in sugarcane farming (Solomon, 2016). The country's sugarcane production is divided between tropical regions, including Maharashtra, Karnataka, Tamil Nadu, and Andhra Pradesh, which contribute 51% of the production, and sub-tropical regions like Uttar Pradesh, Bihar, Uttarakhand, Punjab, and Haryana, which account for the remaining 49% despite having 55% of the total area under sugarcane cultivation (GOI, 2016).

India's sugarcane cultivation benefits from favorable climatic conditions, fertile soils, and a strong agrarian economy, positioning sugarcane as a primary cash crop that contributes significantly to the agricultural GDP. The country cultivates sugarcane on over 49.18 lakh hectares, and it accounts for 1.1% of India's total GDP. The sugar industry is the second-largest agro-based industry in India, following cotton, impacting the livelihoods of over 50 million farmers and their families.

Apart from its role in the sugar industry, the crop generates substantial direct and indirect employment opportunities, from small-scale farmers and field laborers to



workers in sugar mills and transportation sectors. Additionally, the sugarcane value chain contributes to rural industrialization through sugar mills, distilleries, and co-generation plants.

1.3 Significance of the Sugar Industry in the Economy

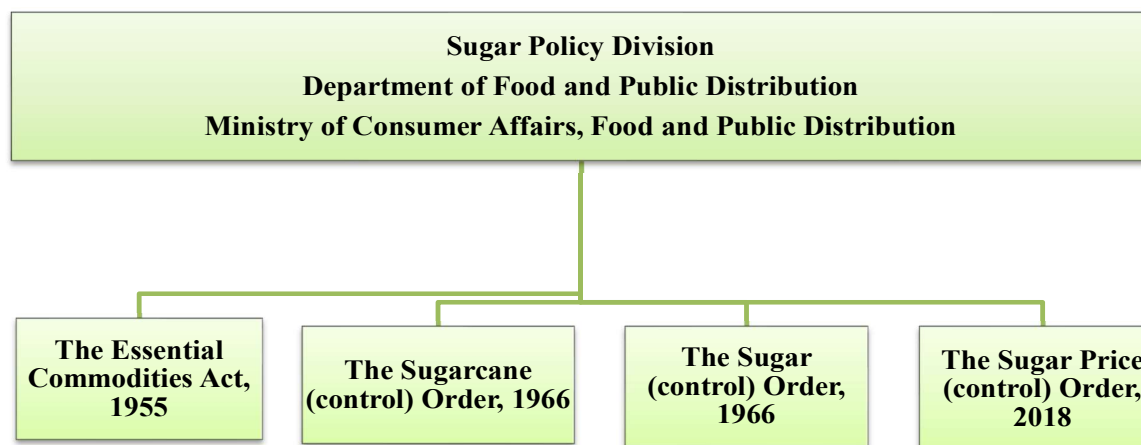
India holds the position of being the second-largest producer and the largest consumer of sugar globally, with sugarcane as the primary raw material used in the majority of sugar factories. The industry plays a crucial role in the economy, contributing to employment, revenue generation, and agricultural development, particularly in sugarcane-growing states like Maharashtra, Uttar Pradesh, Karnataka, and Tamil Nadu. Sugar industry provide direct and indirect livelihoods to a large number of individuals. Approximately 50 million farmers and their families depend on sugarcane cultivation for their income, particularly in sugarcane-growing states such as Uttar Pradesh, Maharashtra, Tamil Nadu, and Karnataka. Additionally, the industry provides direct employment to over 500,000 skilled workers, with a substantial number of semi-skilled laborers engaged in sugar mills and related industries. This sector's labor-intensive nature makes it a key contributor to rural employment, providing economic stability in these regions. The sugar industry generates several byproducts; including **ethanol, molasses, and bagasse**, which further boost the economic growth.

India currently operates approximately 529 sugar factories, including 32 integrated and standalone sugar refineries. This large number of operational mills shows the extensive infrastructure in place to process sugarcane and produce sugar and its byproducts. India's average annual sugarcane production stand at 35.5 crore tonnes, which is processed into approximately 3 crore tonnes of sugar. In the 2020-21 fiscal year, domestic consumption of sugar was estimated at 2.6 crore tonnes (India Budget, 2022). The country's annual turnover is around Rs 80,000 crore from sugar industry (NITI Aayog Task Force, 2023). India's sugar exports in the 2024-2025 marketing year (MY) are estimated at 3.7 MMT. The government is expected to maintain an export cap to ensure that the domestic market is adequately supplied with sugar to meet local demand. This is particularly important as the country's consumption of sugar is expected to rise to 32 MMT in the forecast year, driven by factors such as festival consumption, the growth of the pre-packed food market, and increasing demand from both organized and unorganized catering services.

The World Bank has also highlights that India's sugarcane-based industries have been among the fastest-growing industries over the past four and a half decades. Furthermore, the International Finance Corporation reports that the sugarcane sector covers more than 100,000 hectares and employs 200,000 farmers. These figures present the sector's significant role in employment generation and its contribution to the Indian economy.

1.4 Government Policies and Support for Sugarcane Farmers

Figure 1.2: Sugarcane policy for farmers over the years



■ Cane Price Payment mechanism to Sugarcane Farmers :

With the amendment of the Sugarcane (Control) Order, 1966 on 22.10.2009, the concept of Statutory Minimum Price (SMP) of sugarcane was replaced with the 'Fair and Remunerative Price (FRP)' of sugarcane for 2009-10 and subsequent sugar seasons. The cane price announced by the Central Government is decided on the basis of the recommendations of the Commission for Agricultural Costs and Prices (CACP) in consultation with the State Governments and after taking feedback from associations of sugar industry. FRP is the minimum price that sugar mills are supposed to pay to the farmers for purchase of sugarcane. However, some States determine their own State Advised Price (SAP) which is generally higher than FRP and it is announced by key sugarcane producing States namely Uttar Pradesh, Punjab, Haryana & Uttarakhand.

Table 1.1 : Difference between Fair and Remunerative Price (FRP) and State advised price (SAP)

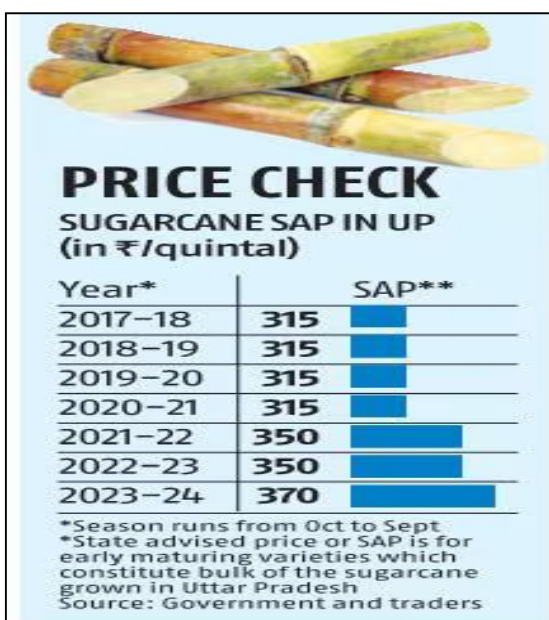
Fair and Remunerative Price (FRP)	State Advised Price (SAP)
- FRP of sugarcane is fixed before the commencement of Sugar Season to ensure guaranteed price to sugarcane growers. - FRP is decided on recommendations of the Commission for Agriculture Costs and Prices (CACP) in consultations with the State Government and other stakeholders. - FRP is linked to a basic recovery rate of sugar, with a premium payable to farmers for higher recoveries, to ensure that higher sugar recoveries are adequately rewarded.	4 States viz. Punjab, Haryana, Uttar Pradesh and Uttarakhand announces SAP which is normally higher than FRP. - In Uttar Pradesh and Uttarakhand, responsibility of cane payment at SAP is on sugar mills. Therefore, SAP puts additional burden on sugar mills of these States. - In Punjab, State Government pays SAP which is 100% in case of co-operative sugar mills and 2/3(66.6%) in case of private sugar mills of differential amount exceeding FRP. - In Haryana, State Government Provides subsidy to sugar mills based on recovery % to meet the gap between SAP and FRP.

Source: Department of Food and Public Distribution Ministry of Consumer Affairs, Food and Public Distribution, Government of India

Figure1.3 : Sugarseason wise FRP announced by Central Government

Sugar Season-wise FRP announced by Central Government for the year 2024-25 FRP for ensuing sugar season 2024-25 has been fixed at Rs.340 per quintal linked to a basic recovery rate of 10.25% subject to a premium of Rs. 3.32 per quintal for each 0.1% increase of recovery over and above 10.25% and reduction in FRP at the same rate for each 0.1% decrease in the recovery rate till 9.5%. With a view to protect interest of farmers the Government has decided that there shall not be any deduction in case where recovery is below 9.5%; such farmers will get Rs. 315.10 per quintal for sugarcane. FRP announced by the Government during last 12 years is as below:

The State Advised Price (SAP) for sugarcane in Uttar Pradesh over the years 2017-18 to 2023-24. The SAP is the mandatory price at which sugar mills purchase sugarcane from farmers. From 2017-18 to 2020-21, the SAP remained steady at INR 315 per quintal. However, in 2021-22, it increased to INR 350 per quintal, marking a notable rise after four years of stagnation. This price remained unchanged in 2022-23 but was further increased to INR 370 per quintal for the 2023-24 seasons. The sugarcane season runs from October to September, and these prices apply primarily to early-maturing varieties, which make up the majority of sugarcane production in the state. The SAP adjustments reflect efforts to improve farmer earnings while considering the financial constraints of sugar mills.

Figure.1.4 : State Advised Price (SAP) for sugarcane in Uttar Pradesh over the years



1.5 Objectives of the Study

The main objective of the study is to conduct an intensive study of the conditions of farmers and labourers engaged in the cultivation of sugarcane and the industrial process.

The specific objectives are:-

- ✓ To study a Socio Economic and Health conditions of Sugarcane cultivator and farmers.
- ✓ To study the Conditions of Sugarcane workers at farming level.
- ✓ To examine the potential employment generation in the Farming sector.
- ✓ To capture the case studies on corporative model of farming.
- ✓ To analysis the Cost Benefits mechanism in order to understand the problems of the farmers.

1.6 Limitations of the study

This study has been conducted exclusively in Muzaffarnagar, focusing solely on the sugarcane sector. The scope is limited to examining the socio-economic conditions, working and health conditions, potential for employment generation, and cost-benefit analysis of sugarcane farmers. The findings and conclusions drawn are specific to these aspects and may not be applicable to other regions, crops, or industries. Furthermore, this study can be utilized only in the sugarcane sector in the future.



Chapter II : Review of Literature

2.1 Overview of Sugarcane Farming in Global Context

Sugarcane (*Saccharum officinarum*) is one of the most globally significant crops, recognized for its varied contributions to economies and rural livelihoods worldwide. Originating in New Guinea, sugarcane spread through trade routes to Southeast Asia, South Asia, and the Pacific islands, becoming a staple agricultural commodity across tropical regions (Daniels & Daniels, 1993). Over time, sugarcane evolved from a simple source of sweetness to a major agricultural resource, driving industrial growth and ecological sustainability. Its cultivation has been deeply embedded in the history of economic expansion, particularly during the European colonial era, when sugarcane played a pivotal role in trade and commerce. Globally, sugarcane accounts for approximately 86% of total sugar production, with the remaining derived from sugar beet (Daniels & Daniels, 1993). As one of the most efficient plants in converting sunlight into energy, sugarcane not only contributes to the food industry but also serves as a primary feedstock for biofuels production. This dual purpose makes it essential for addressing food security and the energy needs of the modern world (Dotaniya et al., 2016). Brazil, India, Thailand, and China are among the largest producers, collectively accounting for a significant portion of global production, with Brazil alone representing 40% of the total (OECD & FAO, 2021).

The sugarcane industry is a major contributor to rural employment and economic development worldwide. Approximately 100 million people in 120 sugar-producing countries rely on sugarcane cultivation for their livelihoods (South African Sugar Association, 2022). In India, for example, the industry supports over 6 million smallholder farmers and an additional 50 million people involved in related activities, highlighting its critical role in rural socio-economic development (Bonsucro, 2021c). Similarly, in Brazil, sugarcane employs 773,000 workers directly, accounting for 25% of the rural workforce, although mechanization has reduced labor demands in recent years (ProTerra Foundation, 2020). Global sugarcane production has grown steadily over the years, reaching 1.87 billion tonnes in 2020, cultivated over 26 million hectares (FAOSTAT, 2022a). However, the compound annual growth rate (CAGR) has slowed, particularly due to climate variability, rising input costs, and geopolitical events such as the Russia-Ukraine conflict, which disrupted fertilizer supplies and increased production costs (FAO et al., 2022). Sugarcane yields are particularly vulnerable to extreme weather events, such as droughts and floods, which are becoming more frequent with climate change.

Sustainability has become a key focus in sugarcane production. Adoption of voluntary sustainability standards (VSS) has encouraged farmers to implement climate-smart agricultural practices, including the use of drought-resistant varieties, improved irrigation systems, and organic fertilizers. As of 2019, VSS-compliant sugarcane accounted for 7% to 8% of global production, with farmers benefiting from higher incomes and improved yields (Meier et al., 2021). Countries like Brazil and India have also leveraged sugarcane's potential in renewable energy, with significant portions of their production directed towards ethanol manufacturing (Bonsucro, 2020a).

The sugarcane productivity and juice quality are influenced by weather conditions prevailing during the various crop-growth sub-periods. Sugar recovery is highest when the weather is dry with low humidity; bright sunshine hours, cooler nights with wide diurnal variations and very little rainfall during ripening period. These conditions favour high sugar accumulation. The climatic conditions like very high temperature or very low temperature deteriorates the juice quality and thus affecting the sugar quality. Favorable climate like warm and humid climate favour the insect pests and diseases, which cause much damage to the quality and yield of its juice and finally sucrose contents. Short days of winter reduce tillering, produce thinner long plants, with less sucrose contents. Heavy rains create water logging conditions (www.sugarcanecrops.com).

Table 2.1 : Area, Production and Yield of Sugarcane Crop in Top Ten Countries in 2020

Country	Area '000 Hectares	Production '000 Tonnes	Yield Kg./Hectare	Percentage (%)
Brazil	10014	757117	75604	40.60
India	4603	370500	80497	19.0
Thailand	1834	74968	40868	4.0
China, Mainland	1353	108121	79888	5.80
Pakistan	1165	81009	69534	4.34
Mexico	777	53953	69424	2.89
Colombia	544	25742	47276	1.38
Australia	366	30283	82645	1.62
Indonesia	421	29300	69678	1.57
United states of America	383	32749	85400	1.76
Total	26455	1864663	70483	100.00

Source: FAOSTAT (as on 29.03.2023).

According to the FAO 2014 statistics, the top ten sugarcane-producing countries show the dominance of tropical and subtropical regions in global sugarcane cultivation. The majority of global sugarcane production 96% comes from developing countries. Among the top producers, countries like Brazil, India, China, Thailand, Pakistan, Mexico, Colombia, the Philippines, and Indonesia are noted, where non-compliance with core labor standards can pose a risk to workers, highlighting significant challenges in labor rights within the sugarcane industry.

Brazil leads the world as the largest sugarcane producer; accounting for over 40% of global production with 739.3 million tonnes. Brazil's sugarcane industry is a cornerstone of its economy, with a significant portion directed toward ethanol production, making it a global leader in biofuels. India, the second-largest producer with 341.2 million tonnes, contributes approximately 25% of global sugar production.

One of the important products of sugarcane is Sugar which is produced in over 123 countries worldwide, primarily from two sources: sugarcane and sugar beet. Of this, 80% of sugar is derived from sugarcane, which thrives in tropical climates. According to the OECD/FAO Agricultural Outlook 2015-2025 database (2016), global sugar production is highly concentrated, with the top 10 producing countries accounting for 82% of the total output.



One of the studies was conducted by Kees Bot under the International Labour Organization (ILO) on “Employment and Incomes in Sugarcane Cultivation in Thailand” which provides insights into the relationship between farm size, input use, and labor dynamics. Kees Bot’s study concludes that farm size has no systematic influence on input use or output in specialized sugarcane farms. Instead, differences in yields and incomes are primarily explained by factors such as land quality and water control across provinces. The study also emphasizes the reliance on hired labor, which constitutes 75% of the total labor used in sugarcane cultivation. Hired labor is predominantly utilized during three key operations: seedling preparation and planting, weeding, and harvesting, when the workload surpasses the capacity of the farm family labor force. From an employment perspective, the increasing prominence of sugarcane cultivation is favorable, as it absorbs more labor compared to other crops. However, the high labor intensity does not necessarily mean that it will generate higher productivity or incomes for small farmers. Instead, disparities in land quality, irrigation infrastructure, and access to mechanization create significant differences in economic outcomes between regions and farm sizes.

2.2 Overview of Sugarcane Farming in Indian context particularly in Uttarpradesh

Sugarcane (*Saccharum officinarum* L.) is a critical commercial crop in India, contributing significantly to the country’s agricultural economy and rural livelihoods. According to ICAR and other national-level research initiatives, sugarcane cultivation in India spans approximately 4.91 million hectares, producing over 341 million tonnes annually, with an average yield of 69.5 tonnes per hectare. It is the second-largest agro-based industry in the country after cotton and contributes 6% to agricultural GDP, emphasizing its role in economic development. The sugarcane industry in India has a great influence on the socio-economic development of rural areas, providing direct employment to over 50 million farmers and their families and supporting an additional 5 lakh workers in sugar mills. At the world level India is the second-largest producer of sugar and the largest consumer, with the sugar industry also producing by-products like ethanol, bagasse, and molasses, which are used in biofuels production, paper manufacturing, and alcohol production.

Table 2.2 : Important regions for sugarcane cultivation in India

Region	State
Tropical	▪ Maharashtra ▪ Andhra Pradesh ▪ Tamil Nadu ▪ Karnataka ▪ Gujarat ▪ Madhya Pradesh ▪ Telangana ▪ Goa ▪ Pondicherry ▪ Kerala
Subtropical	▪ Uttar Pradesh ▪ Uttarakhand ▪ Haryana ▪ Punjab ▪ Bihar ▪ Rajasthan ▪ Assam ▪ West Bengal

Source: *Glimpses of Sugarcane Cultivation, 2020, DSD, GOI*

Table 2.3 : Area, Production and Yield of Sugarcane Crops in major producing states of India in 2023-24

S. No	States / UT	Area (in lakh ha)	Production (in million tonnes)	Yield (in tonnes/ha)
1.	Uttarpradesh	26.53	215.81	81.35
2.	Maharashtra	14.37	112.09	78.00
3.	Karnataka	5.43	41.81	77.00
4.	Bihar	2.02	15.93	59.78
5.	Gujarat	2.02	14.48	71.62
6.	Tamilnadu	1.52	12.08	105.00
7.	Madhya Pradesh	1.15	7.37	66.00
8.	Haryana	0.88	7.51	83.58
9.	Punjab	0.90	7.9	83.25
10	Uttrakhand	0.94	7.78	82.65

Source - E&S, DA&FW - Final.Est.-2023-24

In 2023-24, Uttarpradesh accounted for 26.53 lakh hectare of sugarcane area in India, producing 215.81 million tonne of sugarcane with a yield of 81.35tonne/ha. Uttarpradesh and Maharashtra are the leading producers; collectively contributing to over 60% of India's total sugarcane production. Tamil Nadu achieved the highest yield reflecting the states effective policies ad favorable condition for growing sugarcane.

Table 2.4 : Temperature and Humidity requirement for sugarcane cultivation in India

S. No	Sugarcane crop stages	Growth stages duration (days)	Temperature requirement (°C)	Humidity requirement (%)	Sunshine (hrs)	
			Max.	Min.	Max.	Min
1.	Germination And emergence phase	15 to 30 Days after planting	30	15	50	10
2.	Tillering and Stem Elongation phase	31 to 120	30	15	50	10
3.	Grand growth phase	121 to 210	30	20	80	11
4.	Ripening phase	211 to 365	15	12	45	10

Source: ICAR-All India Coordinated Research Projection Sugarcane

A study by Rahman and Bee (2019) on sugarcane production in the Shahjahanpur district of Uttar Pradesh revealed uneven trends in both the area under cultivation and production levels, with government policies playing a crucial role in these fluctuations. The study highlighted the continuous agricultural development in these areas by identifying significant blocks with high concentrations of sugarcane crops, such as Jatipur and Dadrol. It also mentioned how politically sensitive sugarcane is, and how changes in government regulations directly affect how it is grown. Rahman and Bee (2019) identified that government policies, particularly those concerning pricing



and support mechanisms, play a significant role in influencing these trends. For instance, fluctuations in the area dedicated to sugarcane cultivation and production levels in Shahjahanpur were observed to be directly linked to changes in government policies, such as the introduction of the Fair and Remunerative Price (FRP) and state advisory prices (SAP).

Upreti and Singh (2017) conducted an economic analysis of sugarcane cultivation in Uttar Pradesh and Maharashtra. They observed that the increase in production is largely driven by area expansion rather than yield improvements. The stagnation in yield can be attributed to several factors, including varietal deterioration, biotic and abiotic stresses, declining soil productivity, low technology adoption, and climatic variability. One of the significant findings from this study was that the cost of cultivation in Maharashtra is higher compared to Uttar Pradesh, primarily due to higher input usage such as fertilizers, human labor, and mechanization. However, despite higher costs, sugarcane productivity is higher in Maharashtra. In contrast, Uttar Pradesh exhibited higher profitability, as the growth in the value of sugarcane output has outpaced the cost of production.

The Centre for Policy Research's article "Unlocking the Potential of Ganna Pradesh", 2022 look into the evolution and significance of sugarcane cultivation in Uttar Pradesh (UP), often referred to as "Ganna Pradesh." UP's fertile alluvial plains, nourished by rivers like the Ganga, Yamuna, and their tributaries, provide an ideal environment for sugarcane farming. The state's extensive canal network, established during the British colonial era—including the Eastern Yamuna, Upper Ganga, and Sharda Canals—ensures a reliable water supply, mitigating challenges faced by other states where water scarcity limits sugarcane cultivation. The sugar industry's expansion in UP gained momentum around 2004 with the introduction of the Sugar Industry Promotion Policy by the Mulayam Singh Yadav government. This policy offered various incentives for establishing new mills and expanding existing ones, such as a 10% capital subsidy, exemptions from stamp duty, registration charges, entry tax on sugar, purchase tax on sugarcane, and trade tax on molasses. Additionally, it provided reimbursements for transportation costs of sugar and cane, as well as commissions to cooperative societies on cane purchases.

One of Maharashtra's main commercial cash crops is sugarcane. About 8.35 lakh hectares, next to Uttar Pradesh, were planted with sugarcane in 2015–16, and 741 lakh tons were produced. As far as sugarcane recovery goes, Maharashtra is at the top. The Western India Sugar Mills Association (WISMA) reports that there are currently 186 sugar mills in Maharashtra, consisting of 94 cooperative and 92 private sugar factories. These mills produce ethanol, power, jobs, bio-compost, and a variety of other chemicals. Hence, the foundation of Maharashtra's economic growth is the sugar sector and sugarcane. Longer crop length, high-yielding, disease-resistant seed varieties, suitable climate, improved irrigation systems, and high-quality soil—all of which are perfect for sugarcane cultivation—are all factors that contribute to higher yields. A longer-duration crop is thought to have a higher sugar recovery rate. Another major factor for higher recovery is the quicker transportation of harvested sugarcane to the factories in the South, as compared to the North.

Maharashtra's sugarcane farmers cultivate sugarcane because there are no competing alternative commercial crops, funding is readily available at cheap interest rates, harvesting are controlled, and



sugar mills guarantee purchase (Jugale 2000; Narayanmoorthy 2013). Other reasons mentioned by sugarcane farmers include a feeling of security, a decreased risk of crop failure due to pests and diseases, the use of contemporary technology, the ability to intercrop, resistance to water stress, and the encouragement of ancillary activities (dairy, juice, jaggery, khandasari, etc.). In addition to providing crop loans through cooperative banks and credit-based inputs to growers, the sugar mills also register the farmer's area after planting. Additionally, According to the Supreme Court's decision 1, mills must buy sugarcane at these prices. In order to save money on transportation and maintain quality, the majority of India's 566 sugar mills are situated close to sugarcane production regions. The government also defines each sugar mill's "command area," which is made up of thousands of farms, including extremely tiny farms, spread out over a 25–50 km radius.

For growers, loading sugarcane is another challenging and time-consuming process. Consequently, With the exception of Uttar Pradesh, where payment for unloading was occasionally paid on a per quintal or per trolley basis, the majority of states have mechanical unloading systems, which are carried out by sugar mills. For sugar recovery, Maharashtra is the top state, but Uttar Pradesh, the greatest producing state, is not the top producer in terms of yield. These farmers are paid within 14 days after delivering the sugarcane to their various mills thanks to a number of variables, including favorable conditions and supporting state government programs.

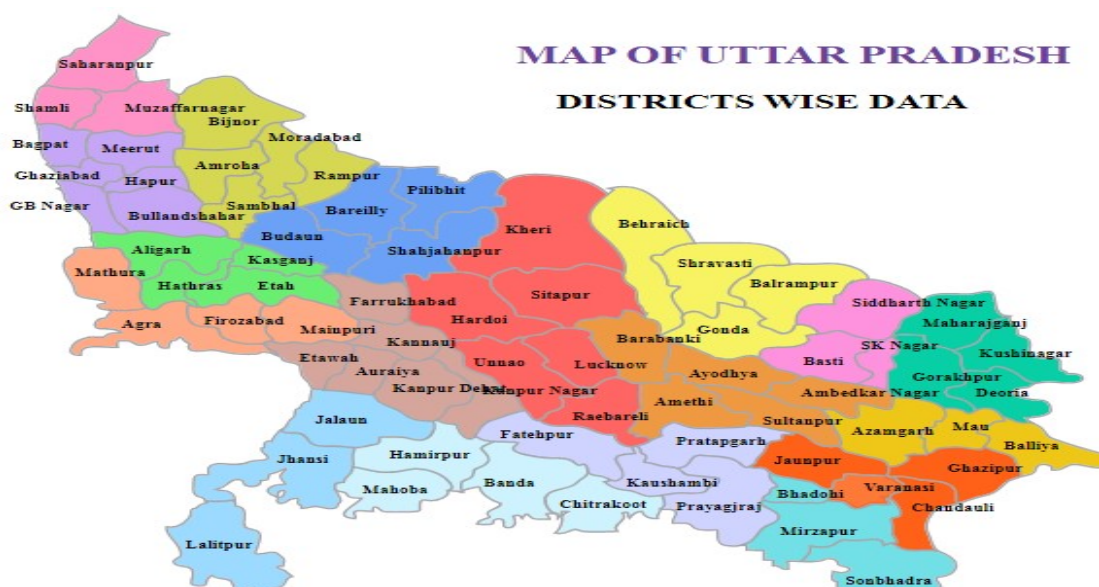
Chapter 3 : Research Methodology

3.1 Selection of the state

This study is based on a request issued by the **Ministry of Labour and Employment** following the Consultative Committee Meeting held on 10th August, 2023. The meeting discussed various issues concerning the workers of the sugar industry, and the Ministry mandated a comprehensive study to assess and address these issues. The methodology follows a systematic approach to collect, analyze, and interpret relevant data, specifically focusing on Uttar Pradesh, a region where no previous study has been conducted, in contrast to Madhya Pradesh where earlier studies have been undertaken.

Uttar Pradesh (UP) has long been the backbone of India's sugar industry. The state plays a critical role in both sugarcane production and the sugar industry, which provides livelihood to millions of farmers, workers, and entrepreneurs. According to the **Sugar Industry & Cane Development Department, Government of India** Uttar Pradesh is the leading producer of sugarcane in India, with a total cultivation area of **29.66 lakh hectares** during the 2023-24 crushing season. The state's sugarcane productivity stands at **841 quintals per hectare**, which marks an improvement of **2 quintals per hectare** compared to the previous year. This increase in yield reflects improvements in crop management practices, better irrigation facilities, and favorable climatic conditions in the region. Uttar Pradesh was selected due to its biggest contribution in terms of area-wise sugarcane farming and its top ranking in terms of sugarcane production.

Figure 3.1 : Map of Uttar Pradesh showing the entire district



Source: <https://skpn.up.gov.in/map/map.aspx>



3.2 Selection of the District

Muzaffarnagar is the major contributor of sugarcane cultivation and jaggery production in the state of Uttarpradesh. According to the census 2011, Muzaffarnagar had a population of 4,143,512 of which male and female were 2,193,434 and 1,950,078 respectively. Over 70% of the district's population is engaged in agriculture, with sugarcane cultivation being a primary focus. Muzaffarnagar, located in the northern part of Uttar Pradesh is popularly known as “**The Sugar Bowl of India**”.

The district is a leading producer of sugarcane, which forms the backbone of the Indian economy. Muzaffarnagar is home to 11 sugar mills, including prominent establishments such as **Tikaula Sugar Mills, IPL Sugar Mill, Titawi Sugar Mill, Triveni Sugar Mill, Mansurpur Sugar Mill, Uttam Sugar Mill, and Bhaiana Sugar Mill & Distilleries**. Additionally, the region is known for approximately 5,000 Kohlu (traditional jaggery production units), which contribute significantly to the district's jaggery production. These mills process sugarcane sourced from Muzaffarnagar and its surrounding villages, thereby making a notable contribution to the state's sugar industry. Strategically located in the fertile Ganga-Yamuna Doab region, Muzaffarnagar is one of the most prosperous areas of Uttar Pradesh. According to the **Official Website of Muzaffarnagar** the district spans an area of 4,008 square kilometers and encompasses 704 villages and 9 administrative blocks. Its fertile lands, combined with its proximity to New Delhi, position Muzaffarnagar as a key agricultural and industrial hub within the state.

Muzaffarnagar also hosts the world's largest jaggery market (locally referred to as “**Gud**”), establishing its global prominence in the jaggery trade. Despite this, a thorough literature review reveals that no study has been conducted specifically on Muzaffarnagar in the past. This gap in research has drawn attention to the district, making it a crucial focus for investigation. According to data from the Muzaffarnagar Krishi Vigyan Kendra, sugarcane remains the major crop of the district. In the agricultural year 2013-2014, approximately 201,436 hectares of land were dedicated to sugarcane cultivation, yielding a production of 151,752,584 quintals, with a productivity rate of 586 quintals per hectare— the highest among all crops. In contrast, the productivity of other crops, excluding potatoes, was below 40 quintals per hectare. This stark difference highlights sugarcane's exceptional productivity, being 13 to 15 times higher than other crops, which provides a compelling reason to conduct an in-depth study of the district.

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3.3 Selection of the villages

Following the identification of these sugar mills, the villages in proximity to the mills were determined, as well as those located farther from the mills. The corresponding villages were cross-checked with the village data available on the Panchayati Raj website of Uttar Pradesh. Surveys were then conducted in these villages through the use of structured questionnaires and face-to-

face interviews. This approach enabled the collection of data from both nearby and distant communities to gain a comprehensive understanding of the local agricultural practices related to sugarcane cultivation.

Table 3.1 : Block wise list of all the villages surveyed In Muzaffarnagar district

District	Block	Villages	Sugar mill
Muzaffarnagar	Purkaji	- Barla - Chappar - Doheli - Khaikari - Tajpur - Tejalhera - Tuglalkpur - Purkaji	- Uttam Sugar mills Ltd - Indian potash limited - Tikaula sugar mill
	Morna	- Morna - Bhopa - Bhokarhedi	Ganga Kisaan sahkari chini mills
	Khatauli	- Begrajpur - Bhainsi - Khatauli - Mansurpur	Trivani Engg & ind Ltd
	Jansath	- Shahpur - jansath	Uttam sugar mill
	Charthawal	- Charthwal - Malira - Rohana	- Indian Potash Ltd - Titawi Sugar Complex
	Budhana	- Harsauli - Bhudanakhadar - Bhudaan - Bhasana - Bhaisani	Bajaj Hindustan Ltd
	Sadar – Kukda	- Almaspur - Badheri - Datiyana - Mustafabad - Sisona	- Uttam sugar mill, - Indian potash limited - Titawi Suagr complex - Tikaula Sugar mill
	Shahpur	Purbaliyan	Trivani Engg & ind Ltd
	Muzaffarnagar	Muzaffarnagar	- Uttam sugar mill, - Trivani Engg & ind Ltd

Source: Field survey

3.4 Sample Size and Sampling Techniques

Table 3.2 : Number of Male and Female respondents in the study

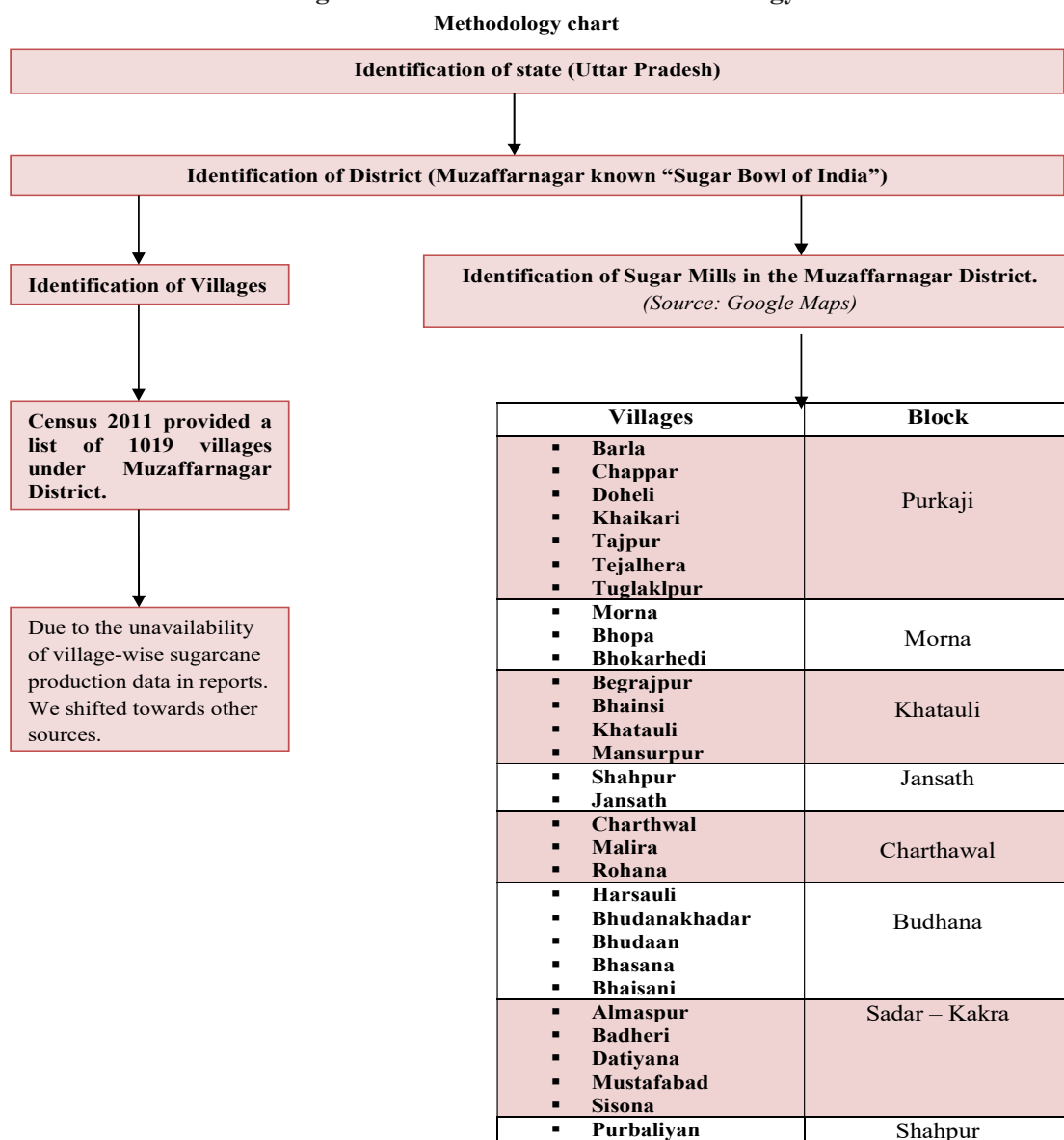
District	Block	No of respondents		Total
		Male	Female	
Muzaffarnagar	• Sadar–Kukda	147	2	149
	• Budhana	152	1	153
	• Muzaffarnagar	6	0	6
	• Shahpur	3	0	3
	• Purquazi	210	0	210
	• Charthawal	362	5	367
	• Morna	317	0	317
	• Jansath	30	1	31
	• Khatauli	321	4	325
	Total	1547	14	1561

Source: Field Survey

The **purposive random sampling method** is used in this study. Since the research is being conducted in Muzaffarnagar district of Uttar Pradesh (UP), the villages will be selected based solely on their proximity to operational sugar mills. The sugar mills in Muzaffarnagar district will be identified first, and then, the villages in close proximity and as well as those located farther from the mills will be chosen for the study. This approach ensures that the study focuses on areas that are directly connected to the sugarcane industry, allowing for a more relevant and focused analysis of sugarcane cultivation and its challenges. Once the relevant villages are identified, the survey will be conducted in these areas, targeting farmers and small level cane crusher factory such as Kohlu involved in sugarcane cultivation.

3.5 Flow Chart of Methodology

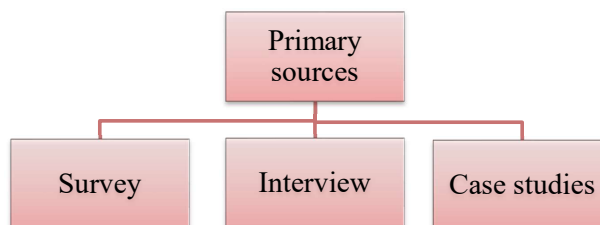
Figure 3.3 : Flowchart of the methodology



3.6 Sources of Data

3.6.1 Primary sources

Figure 3.4 : Different types of primary source



▪ Survey methods

A structured survey was conducted using a semi-structured questionnaire to collect quantitative data from farmers involved in sugarcane cultivation. The survey targeted a representative sample of respondents from various villages in Muzaffarnagar district. The questionnaire was developed to capture information on farming practices, sugarcane production, challenges faced by farmers, and their engagement with local sugar mills.

▪ Interviews

Semi-structured interviews were conducted with a selected group of farmers, local stakeholders, and industry representatives. These interviews were aimed at collecting qualitative insights into the experiences, perceptions, and challenges faced by sugarcane farmers. The interviews provided in-depth information on issues such as agricultural practices, market conditions, and the impact of sugar mill operations on local farming communities.

▪ Case studies

Case studies were carried out in selected villages to explore specific instances of sugarcane farming and its associated challenges in greater detail. The case studies helped highlight unique situations, best practices, and the socio-economic impacts of sugarcane cultivation on individual farmers and communities. These case studies offered a deeper understanding of the dynamics between sugarcane farmers and sugar mills, as well as the broader agricultural context in Muzaffarnagar district.

3.6.2 Secondary sources

The secondary data for this study will be gathered from a variety of reliable sources to supplement the primary data collected. These sources include:

- **District Sugarcane Office, Muzaffarnagar:** Official records and reports related to sugarcane production, distribution, and industry data at the district level.
- **U.P. Council of Sugarcane Research:** Research publications and reports from the Uttar Pradesh Council of Sugarcane Research, which provide insights into sugarcane cultivation techniques, advancements in the industry, and related studies.
- **Directorate of Sugarcane Development, Uttar Pradesh:** Reports and statistical data provided by the Directorate of Sugarcane Development that focus on policies, programs, and development initiatives for sugarcane cultivation in the state.



- **U.P. Cane (www.upcane.gov.in):** The official website for the Uttar Pradesh Cane Department, offering detailed information on sugarcane production, pricing, government schemes, and policies impacting the sugarcane industry in the state.
- **Census 2011:** Data from the 2011 Indian Census, including demographic and agricultural statistics that provide a broad understanding of the rural landscape in Muzaffarnagar district.
- **Agriculture Census:** Information from the Agriculture Census, which offers insights into land use patterns, crop distribution, and farming practices within Uttar Pradesh.
- **Books, Articles, and Other Publications:** Scholarly articles, books, and publications on sugarcane cultivation, farming practices, economic impact, and the sugarcane industry at both the state and national levels.

3.7 Data Collection Tools

- **Google forms:** Google Forms will be utilized as a primary data collection tool in this study. The form will consist of a structured questionnaire designed to capture both quantitative and qualitative data from respondents. The online format will facilitate the efficient collection of data, especially for participants who may be accessible through digital means.
- **Face to face Interaction:** In addition to Google Forms, face-to-face interaction will be conducted with respondents to capture more in-depth and qualitative insights. Personal interviews will be held with farmers, sugar mill workers, and other stakeholders in the selected villages. These interactions will provide an opportunity for participants to express their views and experiences in detail. Face-to-face communication ensures that complex or open-ended questions can be clarified, fostering a more comprehensive understanding of the issues at hand.

3.8 Duration of field work

The fieldwork for this study was conducted over a period of 4 months, starting in Mid-August 2024 to Mid-January 2025 as few Field Investigators joined in September. The initial month was dedicated to conducting a pilot study, which helped in refining the research tools, including the questionnaire, and assessing the effectiveness of the data collection methods.

Chapter VI : Profile of the Stakeholders

4.1 Demographic details of Farmers

Demographic details of farmers, such as gender, age, education level, marital status, caste composition, and household size, provide key details into the socio-economic and cultural aspects of agricultural communities.

4.1.1 Age Distribution

Table 4.1 : Age distribution of male and female respondents in the study

Age category	Male respondent	Female respondent	Total
Less than 18 years	0	0	0
18 to 30 years	69	0	69
30 to 42 years	320	1	321
42 to 54 years	467	7	474
54 to 66 years	608	6	614
Over 66 years	83	0	83
Total	1547	14	1561

Source: Field Survey

The above data shows that sugarcane farming is mostly carried out by middle-aged (42 to 54 years) and older farmers (54 to 66 years), with very few younger farmers or elderly women involved in the industry. The lack of younger generation involved in sugarcane farming indicates a gap in the next generation of farmers.

Gender Breakdown

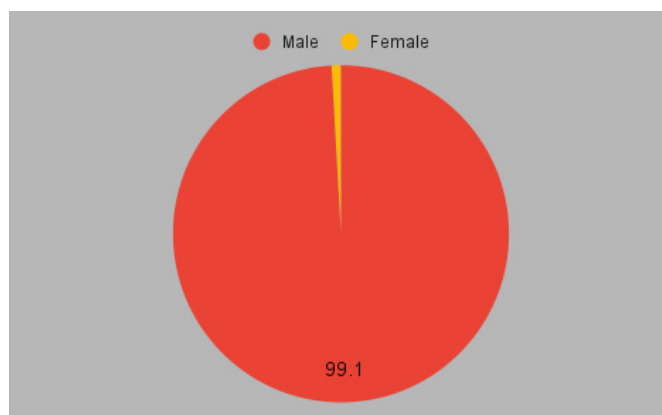
Table 4.2 : Gender composition of respondents in the study (n=1563)

Gender	Percentage (%)
Male	99.10
Female	0.90
Transgender	0
Total	100.0

Source: Field survey

The gender breakdown reveals a significant disparity, with 99.0% individuals identifying as male, 0.90% individuals identifying as female, and no one identifying as transgender, out of a total of 1,563 individuals. This data highlights the overwhelming majority of males in the group, while female's individuals represent a very small proportion.

Figure 4.1 : Percentage of Male and Female respondent in the study



A graphical presentation of the percentage of male and female respondent in the study has been shown. As per the pie graph, there are 0.90% female respondent (n=14) and 99.04% male respondent (n=1549) engaged in sugarcane farming.

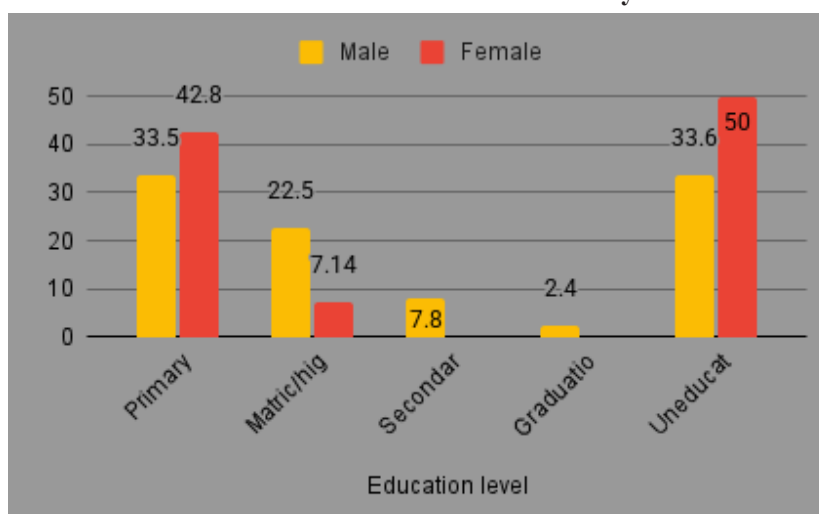
▪ Educational Background

Table 4.3 : Educational Qualification of the respondents in the study

Education level	Male	Female	Total
Primary level	514	6	520
Matric/high school	345	1	346
Secondary and higher secondary	121	0	121
Graduation/diploma/certificate	37	0	37
Uneducated	515	7	522
No response	15	0	15
Total	1532	14	1561

Source: Field survey

Figure 4.2 : Percentage of Male and Female respondent according to their educational level in the study



The educational background of farmers reveals significant disparities across gender and educational levels. Among the 1,561 individuals surveyed, 33.5% respondents have completed primary education under male category, while 33.6% respondents are uneducated under male category. Whereas under female category, out of the total 14 respondent 42.8% respondent have completed their primary education and 50% respondent were uneducated.

▪ Household Size and Structure

Table 4.4 : Family size of the respondents in the study (n=1534)

Family size	Percentage (%)
2 to 4	5.6
5 to 7	32.2
Above 7	61.3
No response	0.7
Total	100.0

Source: Field survey

From the above data it is quite clear that 61.3% majority of the respondent belongs to large family size having more than 7 members. While 32% respondent belongs to family size of 5 to 7 members. The surveyed farmers have revealed that their family also engage in the cultivation of sugarcane farming .They also revealed that they do not hire any labour from outside to work on their land as most of the task is done by family members. The survey revealed that most farmers do not hire migrant workers to work on their farm land.

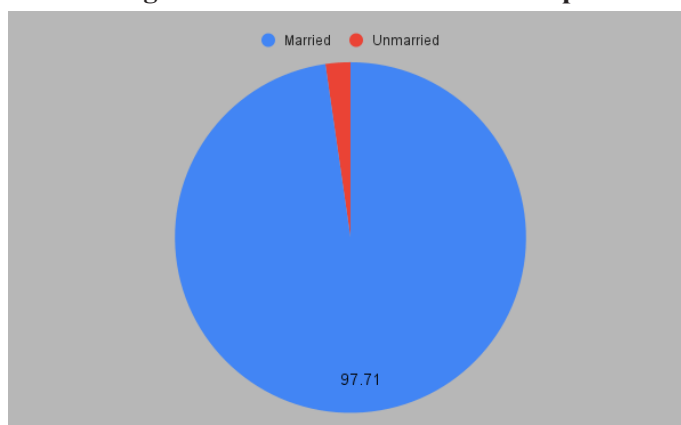
▪ Marital Status

Table 4.5 : Marital status of respondents in the study (n=1563)

Marital status	Percentage (%)
Married	97.71
Unmarried	2.29
Total	100.0

Source: Field survey

Figure 4.3 : Percentage of Married and Unmarried respondent in the study





A graphical presentation of the percentage of Married and Unmarried in the study has been shown. As per the pie graph, there are 97.7% respondent married and 2.29% respondent unmarried.

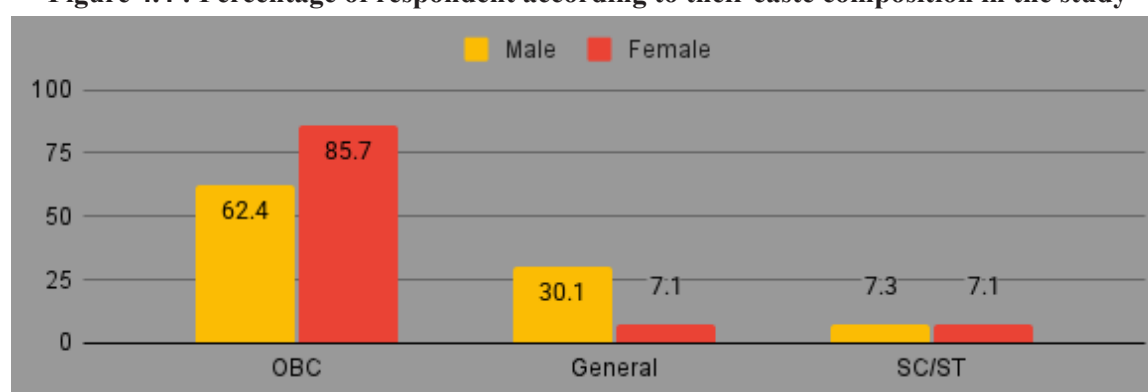
■ Caste composition

Table 4.6 : Caste composition of respondents in the study

Caste category	Male	Female	Total
OBC	959	12	971
General	463	1	464
SC/ST	113	1	114
No response	13	0	13
Total	1535	14	1562

Source: Field survey

Figure 4.4 : Percentage of respondent according to their caste composition in the study



The caste composition of the surveyed population reveals that out of 1562 respondent, 62.12% belong to the OBC category under the male category. The General category accounts for 30.1% respondent under the male category. The SC/ST category represents 7.29%. Whereas under the category of female respondent out of 14, 85.7% were from OBC category and 7.1% from general category and 7.1% from SC/ST category. It also highlights the dominance of the OBC group within the surveyed population.

4.2 Economic Status of Farmers

It is also important to look at the Economic status of farmers as it is a crucial aspect of rural development which is directly linked to their livelihoods, access to resources, and overall well-being. For sugarcane farmers, their economic status is influenced by several factors such as income sources, land ownership, access to credit and financial services and employment status of farmers etc.

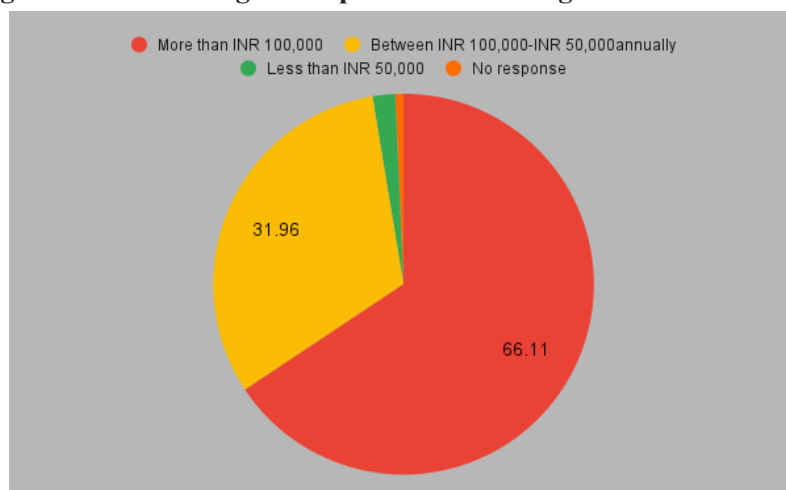
4.2.1 Income Sources

Table 4.7 : Income level of respondents in the study (n=1563)

Income level	Percentage (%)
More than INR 100,000	66.11
Between INR 100,000-INR 50,000 annually	31.96
Less than INR 50,000	1.93
No response	0.70
Total	100.00

Source: Field survey

Figure 4.5 : Percentage of respondent according to their income level



Out of the total 1,563 respondents involved in sugarcane farming, 66.11 % respondents reported earning more than INR 100,000 annually from their sugarcane farming activities. Around 31.96 % reported earning between INR 100,000 to INR 50,000. The survey revealed that most farmers have more than five bigha land to their name. Therefore the income that they have mentioned is for five bigha which is very less.

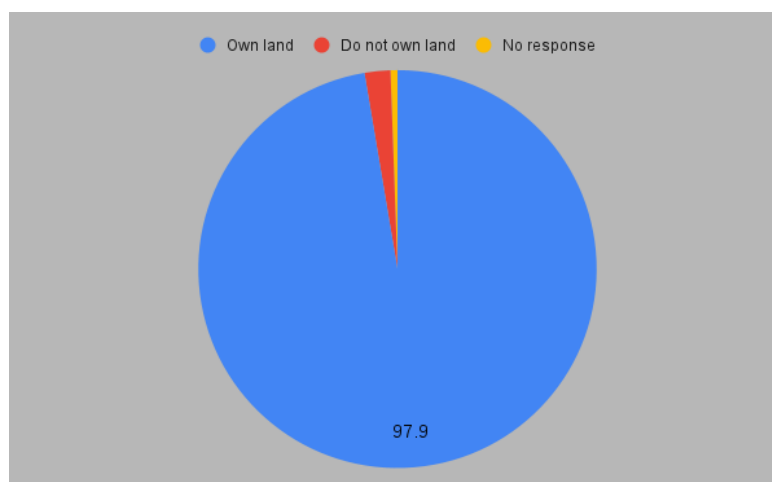
▪ Land Ownership

Table 4.8 : Land ownership of respondents in the study ($n=1562$)

Land ownership	Percentage (%)
Own land	97.9
Do not own land	2.1
No response	0.57
Total	100.0

Source: Field survey

Figure 4.6 : Percentage of respondent according to their ownership of land



It is very clear from the above table that Out of the total 1,562 respondents surveyed, 97.9% reported owning land, while 2.1% stated that they do not own any land. The survey revealed that majority of farmers work on their own land and sometimes they also lease their land to others for farming purpose.

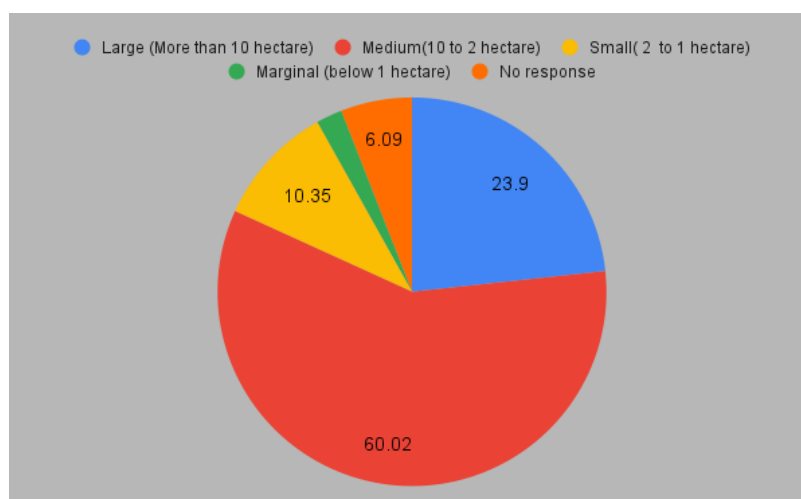
■ Size of Land in Different Category

Table 4.9 : Land size of respondents in the study (n=1526)

Category	In Uttarpradesh (1 Hectare = 3.98 Bigha)	Percentage (%)
Large (More than 10 hectare)	More than 39.8 Bigha	23.9
Medium(10 to 2 hectare)	Between 39.8 Bigha to 7.96 Bigha	60.02
Small(2 to 1 hectare)	7.96 Bigha to 3.98 Bigha	10.35
Marginal (below 1 hectare)	Below 3.98 Bigha	2.22
No response	-	6.09
Total		100.0

Source: Field survey

Figure 4.7 : Percentage of respondent according to their landholding size



The vast majority of landowners around 60% fit into the Medium landholding group. 23.9% fall into the category of large landholders. Only 10.35% of the sample said they owned small landholdings.

The **Bigha** is a traditional unit of land measurement commonly used in India, Bangladesh, and Nepal. With no standardized size, the measurement varies significantly across regions, making it a fascinating yet complex unit to understand. The definition of a Bigha varies across different states in India, leading to differences in land measurement. In Himachal Pradesh, one Bigha equals 8,712 square feet, with five Bighas making up one acre. In Punjab, one Bigha is equivalent to 4 Kanals or half an acre. Rajasthan recognizes two types of Bighas—"Pucca" Bigha, which measures 27,225 square feet, and "Kaccha" Bigha, which is 17,424 square feet in size. In Uttar Pradesh, the size of a

Bigha varies by region, with Western UP having it at 6,806 square feet, while in Purvanchal, it can be as large as 27,225 square feet.

In **Uttar Pradesh**, there is a limit of 12.5 acres in the case of agricultural **land** holdings. The maximum **ceiling** limit for Purchase of an Agricultural **land** in the State of **Uttar Pradesh** is 12.50 Acres which means that person cannot purchase agriculture land more than 20 Bigha in Uttarpradesh. However, in Muzaffarnagar, most farmers have reported that the land they own has been inherited through generations of their family. This generational transfer of land explains why many farmers in the region possess holdings larger than the prescribed ceiling limit.

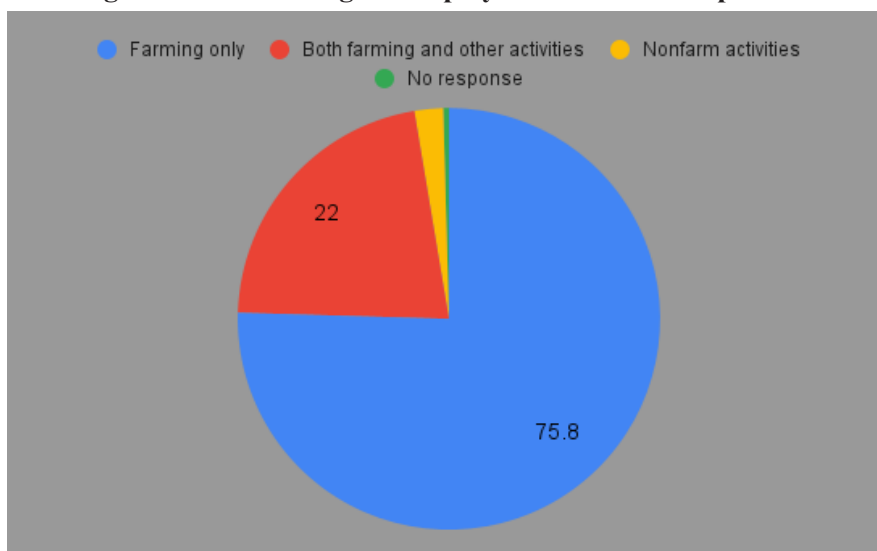
▪ Employment Status

Table 4.10 : Employment status of participants in the study ($n=1562$)

Employment status	Percentage (%)	Examples of other jobs
Farming only	75.8	
Both farming and other activities	22.0	Running provision stores, mobile shop, dairies, Tent house, etc
Nonfarm activities	2.2	Factory work, tailoring, driving, CSC centres, property dealing, etc
No response	0.44	
Total	100.0	

Source: Field survey

Figure 4.8 : Percentage of employment status of respondent



The data mentioned above makes it evident that the 75.8% majority of farmers rely on farming as their primary source of income, with only a small percentage engaging in non-farming activities. Farming is the most dominating occupation among the farmers while 22% respondent said that are engage in farming as well non farming activities such as owning a provision store etc.

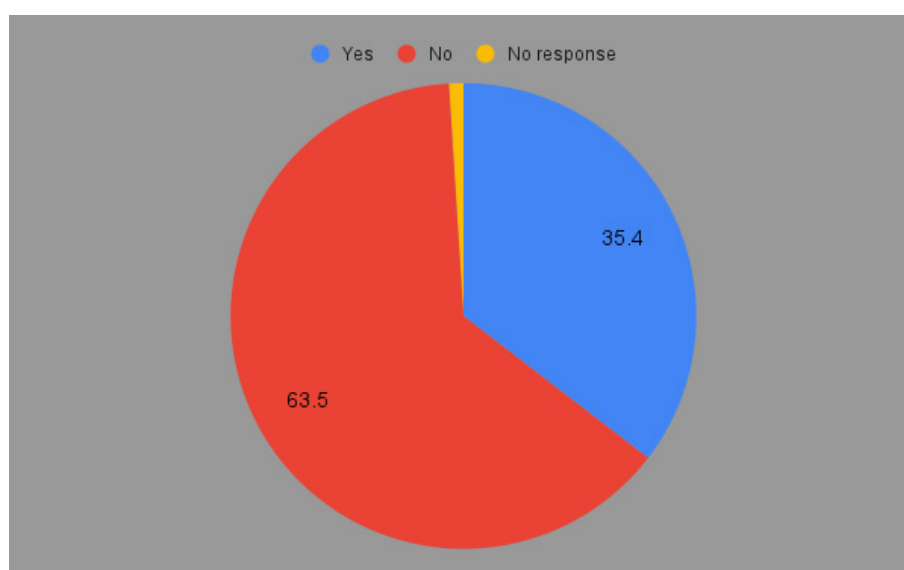
■ **Access to Credit and Financial Services**

Table 4.11 : No of respondent who have taken any loans ($n=1562$)

Taken any Loan	Percentage (%)
Yes	35.4
No	63.5
No response	1.0
Total	100.0

Source: Field survey

Figure 4.9 : Percentage of respondent who have taken loan

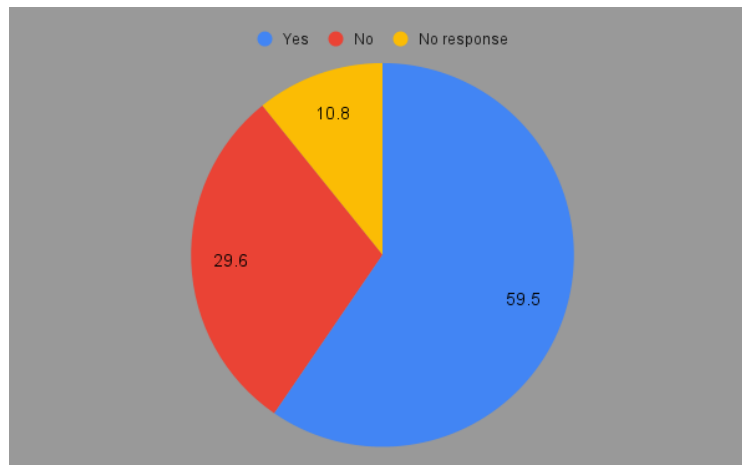


35.4% respondents stated they had taken out a loan, whereas 63.5% respondents claimed they had not taken out a loan for their farming operations. This demonstrates that the majority of farmers finance their farming activities on their own without assistance from third parties. The majority of them said that the main purpose for taking out a loan is for farming related activities. Purchasing tractors, buying fertilizers and seeds for farming were the main reasons.

Table 4.12 : Number of respondent who have access to Kisan credit card ($n=1562$)

Access to Kisan credit card	Percentage (%)
Yes	59.5
No	29.6
No response	10.8
Total	100.0

Source: Field survey

Figure 4.10 : Percentage of respondent who have access to Kisan credit card

About 59% respondents stated that they had a Kisan credit card, which they use to obtain loans, whereas 29.6% respondents stated that they do not, indicating that not everyone has benefited from this scheme. The Kisan credit card is a Scheme which was introduced by the government with the main objective of providing adequate and timely credit to the farmers for their agricultural operations. In India, Kisan Credit Card facilitates short-term loans for 7.7 crore (77 million) farmers, fishermen and dairy farmers. In This year Budget The loan limit under modified interest subvention scheme have been increased from Rs 3 lakh to Rs 5 lakh for loans taken through the KCC .This will help the farmers to overcome financial crisis during farming activities.

Figure 4.11 : Farmer Standing in Front of His Land During Survey



Chapter V : Working and Health Conditions

5.1 Working Conditions of Sugarcane Farmers

To understand the working conditions of sugarcane farmers, it is essential to first examine the nature of their work. Sugarcane cultivation is a labor-intensive process that requires significant physical effort and dedication. The hard work involved in sugarcane farming can be better understood by analyzing the step-by-step process of cultivation:

5.1.1 Process of Sugarcane Cultivation

Table 5.1 : Process of sugarcane cultivation

a. Land Preparation 1. Clearing and Levelling: The field is cleared of residual vegetation and levelled to facilitate uniform irrigation and planting. 2. Tillage: Deep ploughing and harrowing are performed to break compact soil layers, ensuring proper root penetration and aeration. 3. Manuring: Organic manure, such as farmyard manure or green manure, is incorporated into the soil to enhance fertility and improve soil structure.
b. Sowing Methods 1. Flatbed method Land is ploughed; harrowed, levelled and flat beds are prepared. One set is laid down in the flat bed end to end in a row. 60-90 cm distance is kept between 2 rows. This method is suitable in normal soil conditions for those farmers who have average means of irrigation, manure and labor. Heavy levelling is required after sowing. 2. Trench Method In this method, 20-25 cm deep trenches are prepared at a distance of 90 cm before one or one and half month. In the trenches, spread farm yard manure and prepare the soil well by irrigating and hoeing. After germination, the soil of bund is earth up on the roots of the plants along with gradual growth of the crop so that bund is placed trench and trench in place of bund is formed which works as trench for irrigation and water drainage in rainy season. This method is suitable for loamy soil and availability of sufficient inputs. This method gives comparatively more yield but requires more labor.
c. Irrigation In different part of the state, sugarcane crop requires 1500-1750ml of water of which 50% is received from rain and remaining 50% is fulfilled by irrigation. In the Eastern region of the state 4-5, in Central region 5-6 and western region 6-7 times irrigation (twice after rain) has been found beneficial. In case of deficiency of moisture, germination is comparatively better if a light irrigation is done after 20-30 days of sowing. Continue irrigation at an interval of 15-20 days in summer season.
d. Fertilizer The effect of nitrogen in essential nutritive element is well known for sugarcane crop. Potash and phosphorus should be used only if the deficiency is found in soil analysis. For good crop of sugarcane, use of 150-180 kg nitrogen per hectare has been found beneficial.

e. Pest and Disease Management

Sugarcane is vulnerable to several pests (e.g., borers and whiteflies) and diseases (e.g., red rot and smut). Integrated pest management (IPM) strategies, combining cultural practices, biological control, and targeted chemical application, are employed to mitigate crop losses.

f. Harvesting

The harvesting of sugarcane is typically carried out when the crop matures, approximately 10–16 months after planting, depending on the variety and climate. The process involves cutting the stalks close to the ground and transporting them to mills for processing. Mechanized harvesting is increasingly being adopted to reduce labor dependence and improve efficiency.

Source: <https://upagripardarshi.gov.in/StaticPages/JayadSugarcane3.aspx>

■ Factors Influencing Sugarcane Cultivation

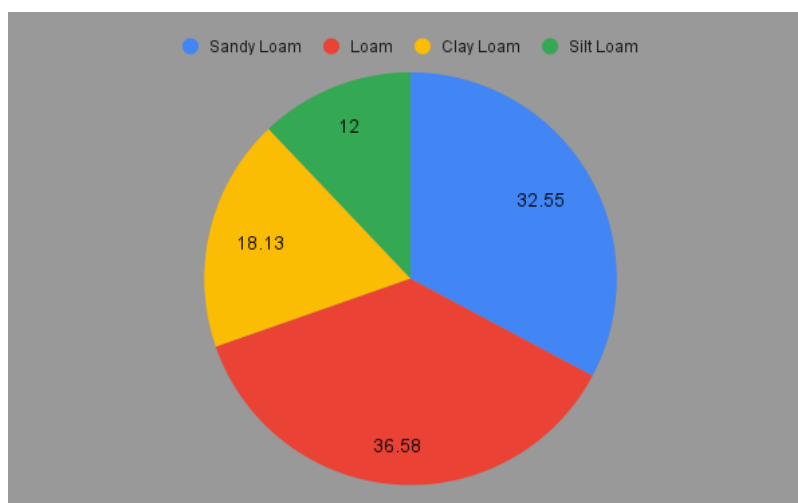
➤ Soil Texture of Muzaffarnagar District

Table 5.2 : Types of Soil Found in Muzaffarnagar

Major Soils	Area ('000 ha)	Per cent(%) of total
Sandy Loam	106.32	32.55
Loam	119.59	36.58
Clay Loam	59.27	18.13
Silt Loam	39.23	12.00

Source: [agricrop.nic.in/agriculture contingency/UP-2012](http://agricrop.nic.in/agriculture%20contingency/UP-2012)

Figure 5.1 : Percentage of types of soil found in Muzaffarnagar



These four types of soil—**sandy loam, loam, clay loam, and silt loam**—are the dominant soil types in **Muzaffarnagar district**, each providing different advantages and challenges for farmers. Together, they make the region suitable for diverse agricultural activities, particularly for crops like **sugarcane**, which require a balance of good drainage, moisture retention, and fertility.



1. **Loam** and **sandy loam** are the most prevalent soil types, covering a significant portion of the area, and they support high agricultural productivity with proper management of irrigation and nutrients.
2. **Clay loam** and **silt loam**, though covering smaller areas, are still critical for agriculture, especially for crops that require more moisture, such as sugarcane, but they require careful water management to avoid issues like water logging.

➤ **Crop rotation**

According to the official websites of sugar industry and cane development authority crop rotation refers to “Growing of crops in a certain period of time on a certain piece of land which gives maximum profit with least cost, without damaging soil health is known as crop rotation. An ideal crop rotation is one which provides maximum opportunity of employment for the labours of the region and family members and ensures maximum production by profitable and economic use of farm equipment’s.

In case of Muzaffarnagar district ranking of crops, sorghum (Jowar) is followed by sugarcane, pigeon peas (toor dal), pearl millet (bajra). Weaver’s method has identified ten crops combinations in the study region. Four crops combination appeared in Khatauli tehsil, six crops combinations in Budhana tehsil i.e., jowar, sugarcane, groundnut, maize, gram and bajara. Jansath tehsil comes under seven crop combinations. Six tehsils shows ten crops combinations as jowar, sugarcane, groundnut, sunflower, wheat, maize, gram, bajara, toor and fruits combinations

The rainfall, temperature humidity and other natural environmental factors along with socio-economic factors affect the cropping pattern in any region. The cropping pattern of the study area is dependent on the monsoon rainfall and water availability in the region. Rice, wheat and sugarcane are common where irrigation facilities are available. (Mishra, 2023)

Rotating sugarcane with other crop reduces the incidence of certain weed species, for example, puddling and growing paddy helps in reducing the incidence of several grass and broad leaved weeds.

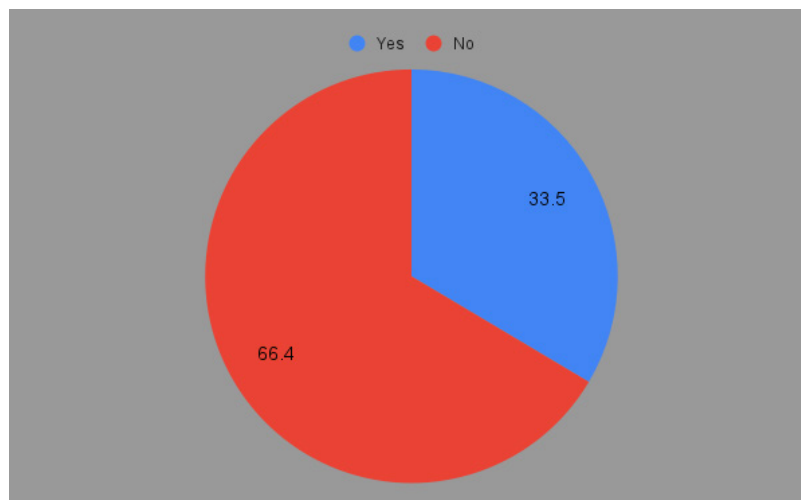
➤ **Intercropping with Sugarcane**

Table 5.3 : No of respondents who agreed on intercropping with Sugarcane ($n=1165$)

Intercropping with Sugarcane	Percentage (%)
Yes	33.5
No	66.4
Total	100.0

Source: Field survey

Figure 5.2 : Percentage of respondent who agreed on intercropping with sugarcane



The above table shows that **33.5% respondents** practice intercropping with sugarcane and **66.4% respondents** do not practice intercropping with sugarcane. Intercropping in sugarcane offers great opportunity for increasing farm income per unit area and time. The success of intercropping depends on the selection of crop, variety, sowing time, planting geometry, fertilizer management and other crop management practices. In southern India, sugarcane is usually rotated with rice. In north India, sugarcane is generally grown after harvest of cotton, maize, sorghum, paddy, toria, potato, pea, wheat etc. (Sugarcane in India, ICAR)

➤ **Varieties of Sugarcane crop**

Sugarcane varieties are mainly classified in three groups - Early varieties, Mid-late varieties, late varieties. Varieties have been recommended for each of state as for Uttarpradesh: Early varieties - Co. 88216, Co. 88230, Co. 95255, Co. 94257, Co. 94270 Mid-late varieties - CoS 767, BO 91, CoJ 20193, CoS 96275 (Sugarcane in India, ICAR). **CO 0238 (Karan 4) variety** of the sugarcane is a high yielding and high sugar content variety, it remains to be one of the most preferred varieties among farmers in the region of Muzaffarnagar. Other varieties include such as **13235, 0118, 15023** and **98014** commonly preferred by the farmers in this region.

▪ **Workforce and Labor Dynamics**

➤ **Engagement in Sugarcane Farming:**

We have already mentioned that Out of the surveyed population **75% respondents** reported being directly engaged in sugarcane farming. This indicates that sugarcane farming is the primary occupation for a significant portion of the population.

➤ **Family Involvement:**

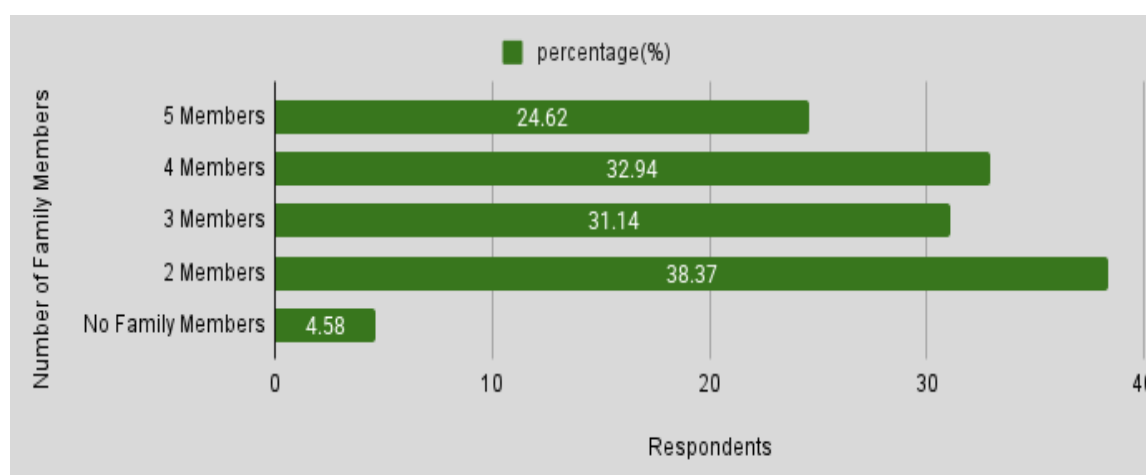
Many respondents highlighted the involvement of family members in sugarcane farming. The distribution of family participation is as follows:

Table 5.4 : No. of family members involved in sugarcane farming ($n=1551$)

Number of family members involved	Percentage (%)
5 members	24.62
4 members	32.94
3 members	31.14
2 members	38.37
No family members	4.58
Total	100.0

Source: Field survey

Figure 5.3 : Percentage of respondent who agreed on intercropping with sugarcane



The highest percentages of families have two members engaged in the activity, with 38%. This data suggests that while family labor is significant, the level of involvement varies, with most families engaging two to four members in the activity

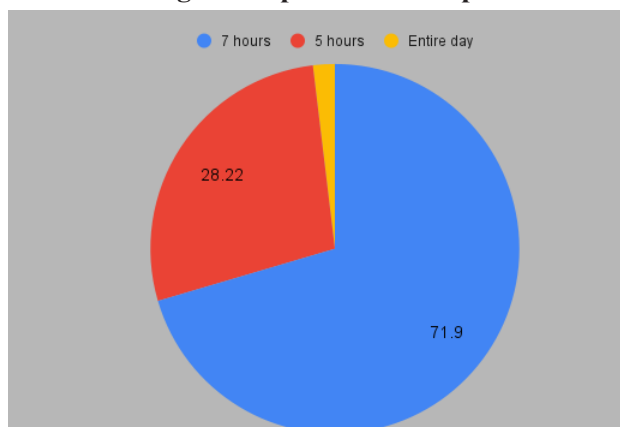
➤ **Time Spent on the Field:**

Table 5.5 : The amount of time respondents dedicate to farming activities daily ($n=1178$)

Time spent on field	Percentage (%)
7 hours	71.90
5 hours	28.22
Entire day	1.95
Total	100.0

Source: Field survey

Figure 5.4 : Percentage of respondent who spent time on the field



From the above pie chart we can see that around 71.9% respondent spent almost 7 hours on the field and 28% respondent spent almost 5 hours on the field.

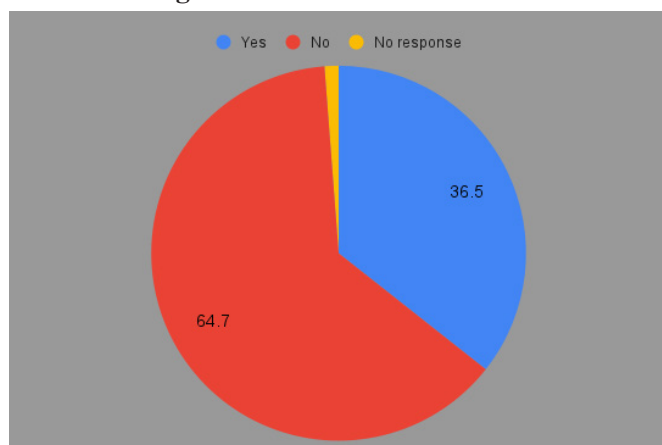
➤ **Engagement of Female Members in farming:**

Table 5.6 : Number of Female member's involvement in farming ($n=1526$)

Involvement of female member	Percentage (%)
Yes	36.5
No	64.7
No response	1.24
Total	100.0

Source: Field survey

Figure 5.5 : Percentage of Female member's involvement in farming



36% female members are involved in farming activities, while 64% female members, however, are not directly engaged in sugarcane farming.

▪ **Water Management and Irrigation Practices**

Irrigation plays a critical role in sugarcane farming, as the crop requires a consistent and substantial water supply throughout its growth cycle. Sugarcane is a water-intensive crop, and

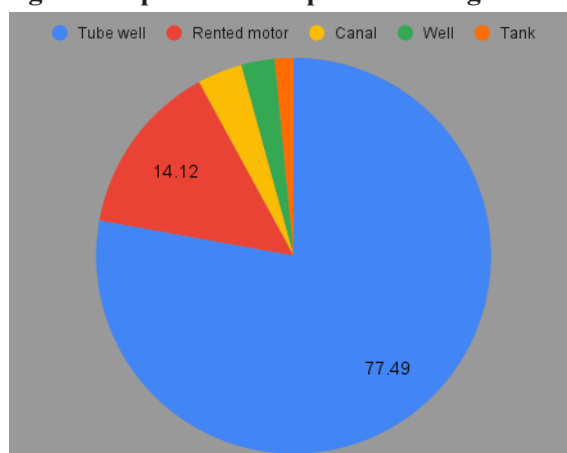
inadequate irrigation can significantly impact yield and quality. Effective water management ensures optimal growth, minimizes water wastage, and improves resource efficiency. Farmers often rely on various irrigation methods and water sources, depending on availability, cost, and local geography.

Table 5.7 : Respondents' response on irrigation method used by them (n=1544)

Irrigation method	Percentage (%)
Tube well	77.49
Rented motor	14.12
Canal	3.67
Well	2.71
Tank	1.55
Total	100.0

Source: Field survey

Figure 5.6 : Percentage of Respondents' response on irrigation method used by them



Around 77.49% respondents have said that they use Tube well for irrigating their sugarcane crop. Other sources of irrigation that are primarily used are rented motor and canal. Sugarcane, an important cash crop of the country, requires considerable quantity of water during its entire crop cycle of 12-18 months, depending upon agro-climatic regions varying from sub-tropical to tropical. The annual water requirement of this crop in sub-tropical states like Uttar Pradesh, Punjab, Haryana and Bihar is 1400- 1500 mm (Sugarcane in India, ICAR).

▪ Asset investment made by farmers

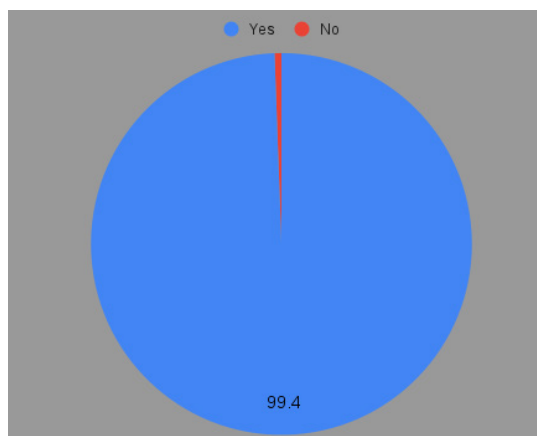
Farmers have made considerable investments in various assets to enhance their productivity and modernize their farming practices.

Table 5.8 : Asset investment made by farmers (n=1544)

Asset Investment	Percentage (%)
Yes	99.4
No	0.58
Total	100.0

Source: Field survey

Figure 5.7 : Percentage of Asset investment made by farmers



From the above table, a total of **99.4% respondents** reported investing in farming assets such as Tractors Harvesters, Drip Irrigation, Fertilizer Sprayer, and Mobile Apps for Weather Forecasting and Drones for monitoring the field.

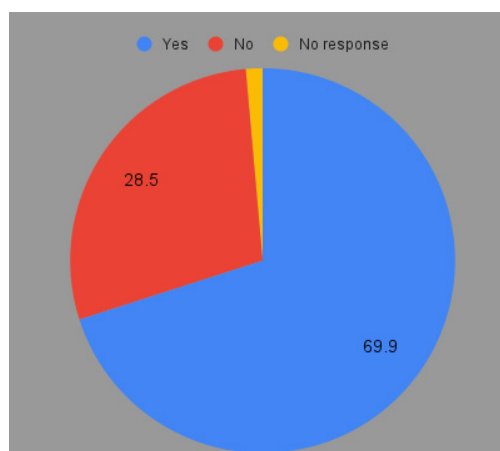
▪ **Access to storage facility:**

Table 5.9 : No. of respondent response on access to storage facility (n=1563)

Storage facility	Percentage (%)
Yes	69.9
No	28.5
No response	1.4
Total	100.0

Source: Field survey

Figure 5.8 : Percentage of respondent response on access to storage facility



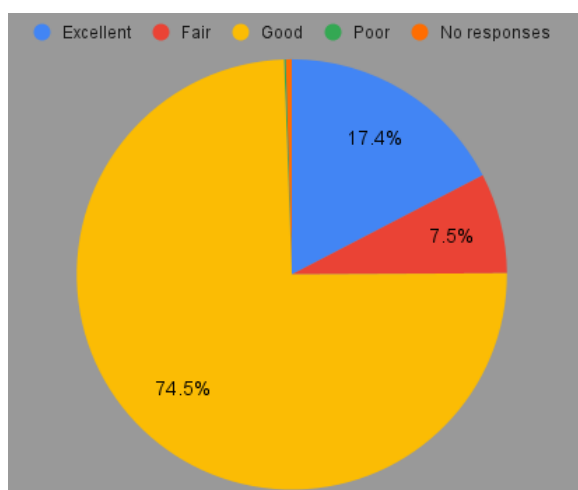
5.2 Health Challenges Faced by Farmers engaged in Sugarcane farming

Sugarcane farming is very labor-intensive in nature which requires significant physical effort at every stage of cultivation. This impacts the health of farmers, particularly small-scale cultivators who often lack access to adequate healthcare facilities. Excessive exposure to extreme weather,

pesticide use, repetitive heavy lifting, and inadequate access to nutritious food or medical care contribute to a range of health issues.

5.2.1 Common Illnesses and Health Conditions

Figure 5.9 : Percentage of respondent showing Overall health overview of farmers



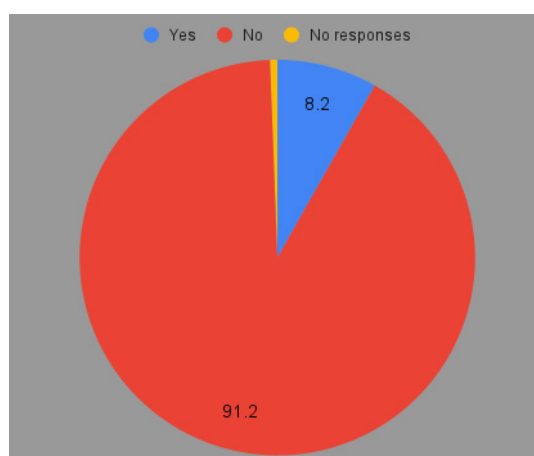
Source: Field survey

Table 5.10 : Number of respondent dealing with chronic illness (n=1563)

Dealing with chronic illness	Percentage (%)
Yes	8.2
No	91.2
No responses	0.6
Total	100

Source: Field survey

Figure 5.10 : Percentage of respondent dealing with chronic illness

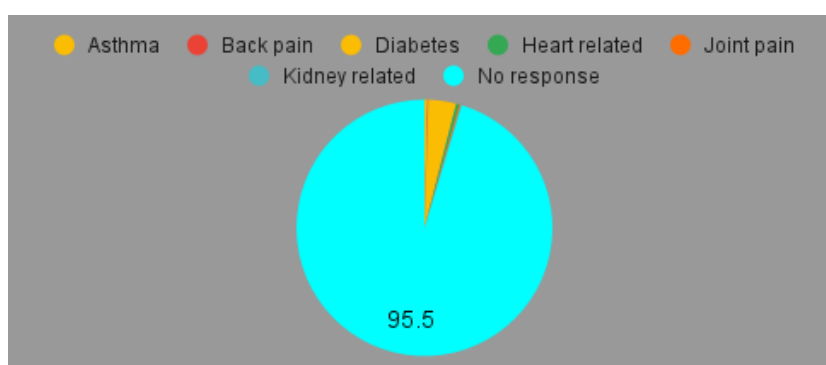


Out of the 1,563 respondents surveyed, 8.2% reported dealing with chronic diseases, while the majority, 91.2%, stated they were not suffering from any chronic conditions.

Table 5.11 : Respondent's Responses on the type of chronic illness they are facing ($n=1563$)

Type of chronic disease	Percentage (%)
Asthma	0.4
Back pain	0.1
Diabetes	3.5
Heart related	0.4
Joint pain	0.2
Kidney related	0.1
No response	95.5
Total	100

Source: Field survey

Figure 5.11 : Percentage of the type of chronic illness the respondents are facing


Among those who reported chronic diseases, the most prevalent condition was diabetes, affecting 3.5%, highlighting it as a significant health concern. Other reported conditions included asthma and heart-related issues, each affecting 0.4%, while joint pain was reported by 0.2%, and both back pain and kidney-related issues were reported by 1 respondent 0.1% each.

Mental Health Challenges

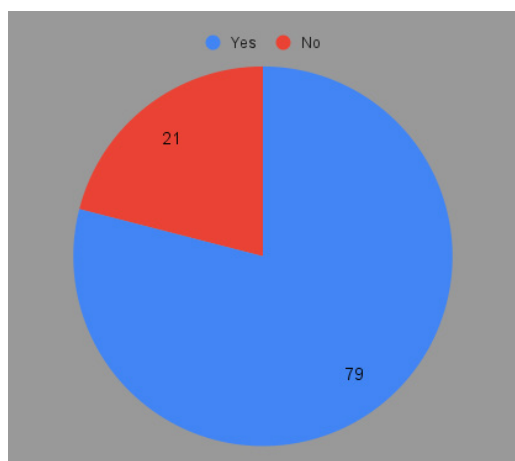
One of the major health challenges faced by farmers in Muzaffarnagar district is the mental stress caused by the prevalence of red rot disease in sugarcane crops. Often referred to as the “cancer of sugarcane,” this disease has created panic among farmers, leading to significant crop losses and financial instability. Red rot, caused by the fungal pathogen *Colletotrichum falcatum*, primarily affects the ‘0238’ variety of sugarcane, which is widely cultivated in the region due to its high yield potential. Due this disease farmers have incurred heavy losses and lead to mental stress as they are unable to recover the cost made in fertilizer and labor.

Access to Healthcare Services and Medical Facilities

Table 5.12 : Respondents's response on access to medical facility ($n=1562$)

Access to medical facility	Percentage(%)
Yes	79
No	21
Total	100

Source: Field survey

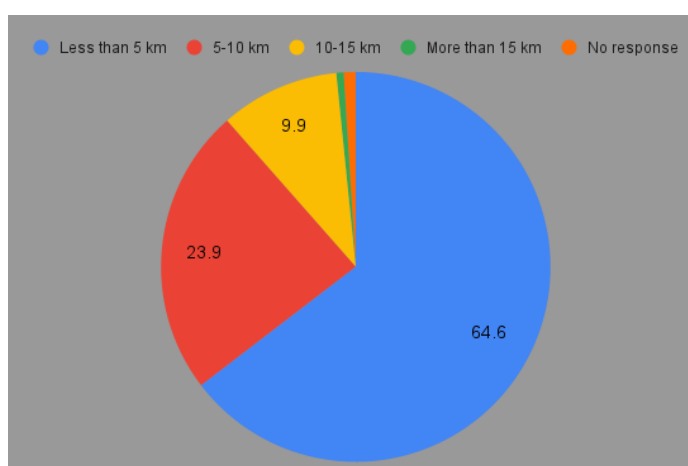
Figure 5.12 : Percentage of Respondents' response on access to medical facility

Out of the 1,562 respondents survey approximately 79% reported having access to medical facilities, while approximately 21% indicated that they do not have access.

Table 5.13 : Respondent's response on the Nearest medical facility from their villages (n=1563)

Distance from your village	Percentage (%)
Less than 5 km	64.6
5-10 km	23.9
10-15 km	9.9
More than 15 km	0.6
No response	1.0
Total	100

Source: Field survey

Figure 5.13 : Percentage of Respondents' response on the nearest medical facility

The majority 64.6%, reported that healthcare services are located less than 5 km from their village, indicating relatively easy access. Another 23.9% stated that these facilities were between 5-10 km away, while 9.9% reported a distance of 10-15 km.



Chapter VI : Cost-Benefit Analysis

6.1 Cost-Benefit Analysis to Understand the Problems of Farmers

According to Harvard Business School, a cost-benefit analysis is the process of comparing the projected or estimated costs and benefits (or opportunities) associated with a project decision to determine whether it makes sense from a business perspective.

Sugarcane is a key commercial crop that significantly impacts the agricultural economy of many regions. Conducting a cost-benefit analysis (CBA) of sugarcane cultivation will enable the farmers, policymakers, and stakeholders to make informed decisions. Cost-benefit analysis (CBA) is a quantitative analytical tool designed to help decision-makers assess the value of a project, program, or policy. It aids in making informed judgments and evaluating available options by identifying and quantifying the costs and benefits associated with specific activities or initiatives. By transforming complex data into actionable insights, CBA supports evidence-based decision-making and facilitates the efficient allocation of resources.

When it comes to sugarcane cultivation, it's critical to quantify the crop's production costs in order to assess output levels and recommend strategies for raising them. This will guarantee economic sustainability by enabling farmers to evaluate the advantages of growing sugarcane. While ratoon crops, which are grown from the stubble of harvested plants, require fewer inputs but require efficient management to maintain production, crops involve initial costs for land preparation, planting, irrigation, fertilizer, pest control, and harvesting. In addition, the cost of transportation and management varies from state to state. Geographical location, infrastructural development, labor costs, and state-specific agriculture regulations are some of the elements that affect these variances. For instance, regions with advanced irrigation systems and better transportation networks might experience lower costs compared to areas with inadequate infrastructure. We can determine how much production costs are involved and how much yield the farmers in Muzaffarnagar are getting through conducting cost-benefit analyses.

6.1.1 Cost Factors for Farmers

Operational cost: Land preparation, Sowing, Tying, Harvesting and transportation are the major components of operational cost.

Table 6.1 : Per bigha cost of production of sugarcane planted

Cost	Rs/bigha (approx)
Tillering cost (land preparation)	300
Sowing cost	700
Fertilizer application cost	500
Irrigation application	200
Tying	400
Harvesting cost	2000
Transportation cost	2500
Total operation cost	6600



Cost	Rs/bigha (approx)
Seed cost	3600
Fertilizer cost	2700
Irrigation cost	-
Total material cost	6300
Total cost = Operational Cost + Material Cost	12900

Source: Field survey

From the above table we can clearly see that Harvesting cost and Transportation cost is the highest under the Operational cost category. Whereas the cost of purchasing seeds and fertilizer cost are the highest. The overall total cost that the farmer's bears on per bigha is approximately INR 12,900.

6.1.2 : Benefit Factors for Farmers

Farmers in Muzaffarnagar achieve an average yield of 85 quintals per bigha. The State-Advised Price in Uttar Pradesh is INR 370 per quintal.

Table 6.2 : Per bigha yield and return from sugarcane (planted)

Particulars	Amount in INR (approx.)
Yield (quintal/bigha)	85
State advised price (Rs/quintal)	370
Gross return (Rs/bigha)	31450
Total cost of production (Rs/quintal)	12900
Miscellaneous	3000
Net returns (Rs/bigha)	15,550

Source: Field survey

From the above table we can clearly identified that the average yield that the farmer gets is approximately 85 quintal per bigha .The current Season state advised price for sugarcane is INR 370 per quintal. The gross return is approximately INR 31450. After considering the miscellaneous expenses we arrive at the Net return figure which is around INR 15,550 per Bigha.

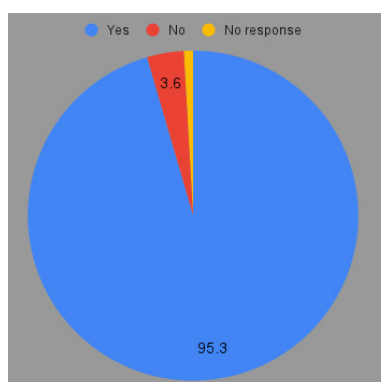
6.1.3 Challenges and Profitability in Farming

Farmers in Muzaffarnagar district face significant financial challenges that impact the profitability of sugarcane farming. One major issue is the delayed payments by sugar mills, which disrupts their cash flow and hinders their ability to manage day-to-day expenses and reinvest in farming. Additionally, the low market prices of sugarcane, despite increases in the State Advised Price (SAP), often fail to cover the rising costs of production. High input costs, particularly for sugarcane crop insurance, further add to their financial burden. These challenges collectively make it difficult for farmers to achieve sustainable profits, leaving them financially vulnerable. Also sometimes farmers need to bears the cost of transporting the sugarcane to mills by their own vehicle.

Table 6.3 : Awareness regarding FRP/SAP of sugarcane crop (n=1561)

Particulars	Percentage (%)
Yes	95.3
No	3.6
No response	0.9
Total	100.0

Source: Field survey

Figure 6.1 : Percentage of respondent who are aware regarding the FRP/SAP


The above graphical representation shows that 95.3% were aware of these prices, while 3.6% were unaware, and 0.9% respondents did not provide any response which reflects the level of awareness among respondents regarding the Fair and Remunerative Price (FRP) or State Advised Price (SAP) for sugarcane crops. This indicates that a large majority of the respondents are familiar with the price guidelines set by the government for sugarcane.

Table 6.4 : Respondents' response regarding satisfactions of rates decide by the government of sugarcane crop (n = 1562)

Particulars	Percentage (%)
Yes	28.1
No	71.0
No response	0.8
Total	100.0

Source: Field survey

The above table shows the respondents' satisfaction with the rates set by the government for sugarcane. Only 28.1% expressed satisfactions with the rates, while a significant 71% were dissatisfied with the prices. This suggests a general dissatisfaction among the farmers regarding the rates, despite their awareness of the FRP/SAP.

Also the farmers of Muzaffarnagar district face the challenge of red rot disease which affects the 0238 variety of sugarcane during the 2023–24 sugarcane seasons. The main reason behind this red rot disease is that this variety now has become very old and cannot adapt with current condition. The widespread occurrence of red rot disease caused significant reductions in sugarcane yields, with losses estimated at 25–30%. This had a profound impact on farmers, particularly those



cultivating the Co 0238 variety, which dominates the region due to its historically high yields and recovery rates. Despite these losses, farmers in Muzaffarnagar remain hesitant to move away from Co 0238. The variety has become very important because of its previous success in boosting income. Transitioning to new varieties is further hindered by the high costs of uprooting diseased crops, replanting, and purchasing new seeds, often sold at inflated prices due to shortages. Efforts by sugar mills and government agencies to promote diversification and introduce disease-resistant varieties face resistance, as many farmers prioritize short-term recovery over long-term risk mitigation.

Table 6.5 : Awareness among the farmers on Red Rot Disease affecting the Co 0238 variety of sugarcane (n=1562)

Particulars	Percentage (%)
Yes	84.6
No	0.3
No response	14.9
Total	100.0

Source: Field survey

The data presented highlights the level of awareness among respondents regarding Red Rot Disease affecting the Co 0238 variety of sugarcane. Out of the total 1562 respondents, 84.6% were aware of the disease, while only 0.3% respondents were unaware. Additionally, 14.9% individuals did not provide a response, indicating a certain degree of non-communication or lack of information on the subject.

Figure 6.2 : Percentages of respondent who are aware regarding the Red rot disease

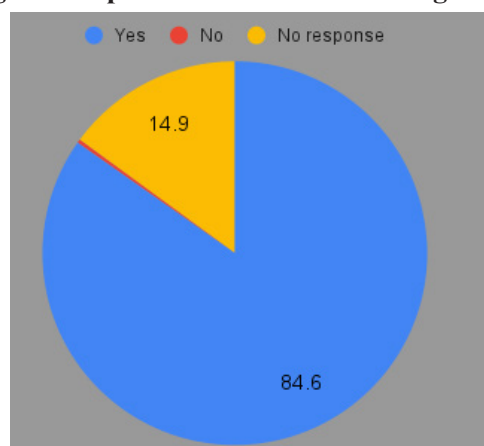


Table 6.6 : Respondent's response on Taking any measures to control or manage Red Rot Disease on your farm

Particulars	Percentage (%)
Yes	83.8
No	0.7
No response	15.3
Total	100.0

Source: Field survey

From the above data, the focus shifts to whether respondents have taken any measures to control or manage Red Rot Disease on their farms. Among the 1562 respondents, 83.8% reported having taken actions to manage the disease, suggesting a high level of engagement in disease management. In contrast, only 0.7% respondents did not take any measures. Whereas 15.3% respondent did not respond to this question.

6.2 Employment Opportunities in Sugarcane farming

Uttar Pradesh plays a vital role in the field of agriculture as it contributes 20% of total agricultural output despite having only 11% of country's cultivable land. The economics of Uttar Pradesh is based mainly on Agriculture and round 65 % of the total population is dependent on Agriculture. Contribution of agriculture sector is significant in Economic development of the state. According to the survey of 2014-15, approximately 165.98 lac hectares (68.7%) land is used for cultivation. According to Agriculture survey 2011-12, there are 233.25 lac farmers in the state.

Uttar Pradesh is one of India's largest sugarcane-producing states in the country and home to the largest number of private sugar mills in the country. Nearly 5 million farm households are directly associated with sugarcane farming in UP and cane by-products including sugar, ethanol, molasses etc generate an annual economy of over Rs 50,000 crore in the state. (Business standard, 2025). The cultivation and processing of sugarcane in Uttar Pradesh is deeply linked with potential employment generation, making it a cornerstone of the state's rural economy.

According to Central Policy Research a well-known policy think tank have revealed that Sugarcane is cultivated on approximately 2.5 million hectares in the state, involving around 2.5 million farming households, based on an average one-hectare holding size. UP produces over 200 million tonnes of sugarcane annually, and harvesting this massive output requires significant labor. A single laborer can harvest about one tonne daily, and with 150 workdays during the crushing season (November to April), harvesting alone employs nearly 1.5 million laborers. Additionally, another half-million workers are engaged in related activities such as weighing, loading, transportation, sugar mill operations, distilleries, and production of Gur and khandsari. In total, around 4.5 million families, including farmers and workers, rely on sugarcane for their livelihoods. Considering an average family size of 4–5 members, this translates to about 20 million people – over 8% of UP's 240 million population – making one in every 12 individuals in the state directly or indirectly dependent on sugarcane farming. This explains the crop's critical role in sustaining livelihoods and driving the rural economy of Uttar Pradesh.

In order to boost income and rural employment it is necessary to take initiatives such as moving towards

Figure 6.3 : Farmer setting up the water tube in his field



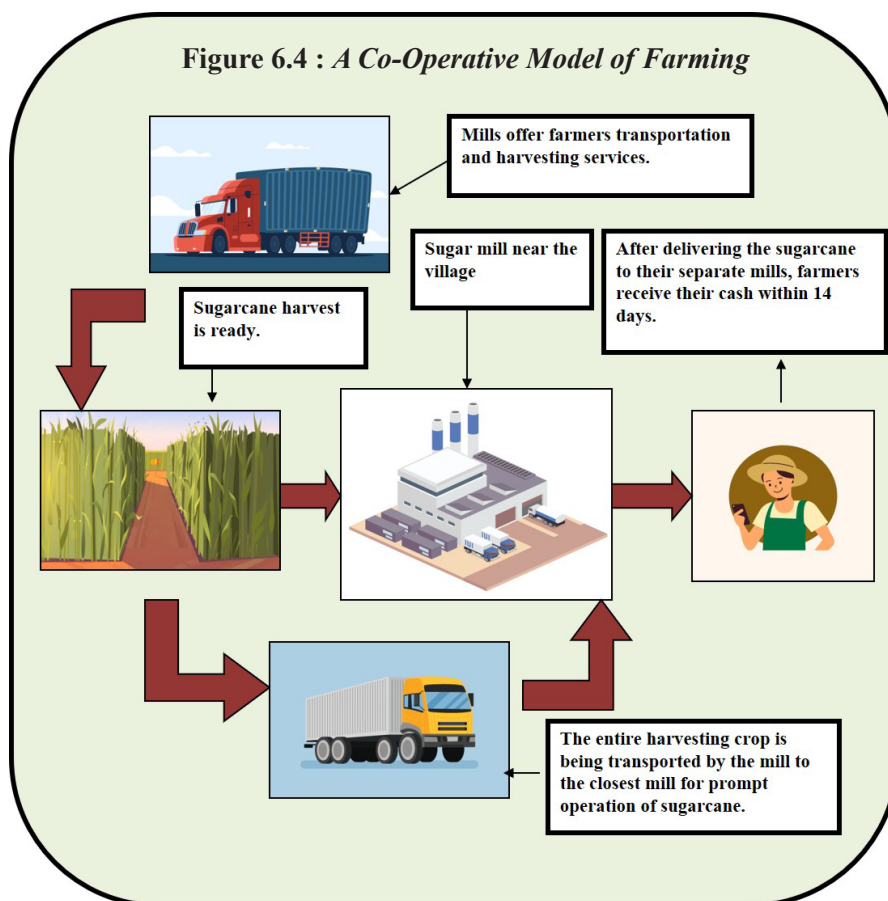
mechanization methods of harvesting, adopting technology and adapt to new varieties that has been introduced in recent years. Some of these initiatives have already been implemented presently to double the income of farmers.

6.3 A Co-operative model of farming

According to the International Labour Organization Recommendation 193, “a cooperative is an autonomous association of women and men, who unite voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise”.

The three Rome-based United Nations agencies – the Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP) – work closely with agricultural cooperatives and will act as a driving force throughout the IYC and beyond, promoting the growth of cooperatives in many ways.(FAO,2012)

In India, Cooperative farming mainly refers to farming practices where farming operations are conducted cooperatively. In Maharashtra the sugar mills have the responsibility to provide services regarding the harvesting and transportation. Therefore by including the same best practices in Uttarpradesh we can increase the income of farmers and thereof cutting the cost of sugarcane production.



Chapter VII : Case Studies

7.1 Case Study: Managing Red Rot Effectively

Farmer's Profile:

Name	Raju Chaudhary's (Son of Baljeet Singh)
Village	Nagla Duheli
Post	Tuglakpur
Block	Purkazi
District	Muzaffarnagar, Uttar Pradesh

Problem:

Raju Chaudhary's is a sugarcane farmer and he comes from a small village named Nagla Duheli which comes under the block Purkazi of Muzaffarnagar district. In the past season he noticed that once green leaves of sugarcane started turning to yellow. He immediately splitted the stalk of sugarcane only to find the pith reddened with white patches, a clear case of red rot disease. To address this, Raju immediately took action such as removing the infected plant and with the help of others he decided to plant disease resistant sugarcane varieties.



Figure 7.1: Red Rot Disease in 0238 sugarcane variety

Measures Taken:

Table 7.1. Measures taken by farmer to remove the red rot disease

Field sanitation	Adapting new varieties	Fungicidal treatment
Removed and destroyed infected canes.	Shifted to resistant sugarcane varieties like Co 1148, and CoS 767	By applying fungicides can help control the spread of the disease.

Outcome:

Through the above action Raju successfully managed to control the red rot disease in his fields. He makes sure to use disease resistant sugarcane varieties in the next season as to not get affected by this disease. He also makes sure to share his experience and knowledge with fellow farmers who are facing the similar problem in their farms.



Figure7.2: Sugarcane crop after incorporating the measures

7.2 Case study: Life of a Kohlu worker

Ramu works in a Kohlu. He is a 48 year old worker who is working as a cane loader in a Kohlu. He does not own any land and he is on a contractual period. The monthly payment that he receives is INR 10,000/- from the Kohlu owner. He said that he has only been provided with 'gloves' as safety equipment for working. He works 12 hours a day. Kohlu owner provided him a make-shift tent near Kohlu. His family stays there with him. His work is labour intensive and he is not being provided adequate support in terms of finance, safety and security.



Figure 7.3 : Jaggery making in progress in Kohlu



Figure 7.4 : Living condition of Kohlu workers



Figure 7.5 : worker crushing the sugarcane crop in machine in kohlu



Chapter VIII : Research Findings and Recommendation

The sugarcane industry plays a pivotal role in rural employment and economic development globally, providing livelihoods to approximately 100 million people across 120 sugar-producing countries. In India, sugarcane serves as a vital cash crop, supporting millions of farmers and significantly contributing to rural development. Secondary research indicates that the industry sustains over 6 million smallholder farmers and an additional 50 million individuals engaged in associated activities. This shows the sugarcane sector's crucial role in driving rural socio-economic development and highlights its importance in the agricultural and economic landscape of the country.

The findings of the study reveal several significant insights about the demographic, social, and economic aspects of sugarcane farming. The gender distribution indicates a notable gap, with 99.04% identifying as male, 0.90% as female, and 0.04% as transgender. This highlights the male dominance in the sector, while women, though fewer in number, contribute significantly through active involvement in farming activities. 36.5% female members are directly involved in farming tasks, while 64.5% women contribute indirectly. The majority of respondents belong to the OBC category 62.1%, followed by the General group 29.69% and SC/ST group 7.29%. Most farmers surveyed fall into the middle-aged category, with the largest group aged between 54 to 66 years. This reflects the declining participation of the younger generation in farming. Educational levels remain low, with 33% of respondents uneducated and an equal percentage having completed only primary education. Despite this, sugarcane farming remains a viable source of income, as 66.1% of respondents earn more than INR 100,000 annually.

The vast majority of landowners around 60 % fit into the Medium landholding group. 23.9% fall into the category of large landholders. Only 10.35% of the sample said they owned small landholdings. Farming remains the primary occupation for 75.8% of respondents, indicating a high dependency on agriculture. Tube wells serve as the primary source of irrigation for 77% of farmers, while others rely on rented motors or alternative methods. The study also highlights infrastructural issues. While 70.3% have access to storage facilities, the remainder lack such support, which affects their farming efficiency. Additionally, weather-related challenges, such as heat waves and climate variability, moderately impact 65% of farmers, signaling the need for adaptation strategies.

In terms of health and well-being, most respondents reported good health and minimal chronic illnesses. Furthermore, 79% have access to medical facilities, while 21% remain without adequate healthcare. The study also emphasizes the necessity of investments in farming assets like tractors, harvesters, and irrigation tools, as 99.4% respondents reported owning these resources to enhance productivity.

The case studies which were included in this study to get the overall viewpoint of farmers have also agreed on the increase awareness of new varieties that are being issued by authorities and also to train them regarding the use of new varieties in order to achieve the productivity and income from this sugarcane farming. We have also look at the conditions of Kohlu workers who works in Kohlu (small jaggery makers). There is a need to address their issues also in terms of their living and working conditions and especially the health hazard they faced while working in kohlu .



Recommendations of this study would be:

- Encourage youth and women participation in sugarcane farming via provision of trainings in ITI or training institution to youth and women regarding Sugarcane farming.
- With the support of Panchayat, Cane officer and Block Development Officer, awareness can be raised regarding crop disease via providing robust infrastructure.
- Introduce and subsidize modern farming tools and machinery to reduce the physical labor required in sugarcane farming.
- Majority of farmers use chemical fertilizers without having proper training, therefore, experts from ICAR or Sugarcane Institutes should visit the villages regarding provision of awareness on health issues arising from Sugarcane farming and encourage them to shift towards sustainable organic farming.
- Experts from Sugarcane Institutes with the help of Village Panchayat should also play a role in shifting the mindset of farmers towards alternative varieties of sugarcane crop.
- Farmers should be provided acquaintance with the new varieties of Sugarcane crop with the support of Village Panchayat, Cane Office and Block Development Officer.
- The responsibility of harvesting the sugarcane crop and transportation operation should come under the Sugar mill jurisdiction for efficient and processing.



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Annexure 1

“Sugarcane Farming in Uttar Pradesh with special reference to conditions of Workers and pattern of Employment in the District of Muzaffarnagar”

Project Director: Dr. Shashi Bala., Senior Fellow, VVGNLI

Your precious responses are required for this research study. Please tick at the appropriate box in the given in grid. Some question may have multiple response. The data provided will be kept confidential and will be used solely for the purpose of research.

इस शोध अध्ययन के लिए आपकी बहुमूल्य प्रतिक्रियाएँ आवश्यक हैं। कृपया दिए गए ग्रिड में उपयुक्त बॉक्स पर टिक करें। कुछ प्रश्नों के एक से अधिक उत्तर हो सकते हैं। प्रदान किया गया डेटा गोपनीय रखा जाएगा और इसका उपयोग केवल अनुसंधान के उद्देश्य से किया जाएगा।

VILLAGE QUESTIONNAIRE

1) Date/दिनांक	
2) Name of the Field Investigator/फील्ड अन्वेषक का नाम	
3) District/ज़िला	
4) Village/गाँव	
5) Name of the Respondent/प्रतिवादी का नाम	
6) Sex/लिंग	1. Male/पुरुष 2. Female/महिला 3. Transgender/ट्रांसजेंडर
7) Age/आयु	
8) Caste/	1. General/ सामान्य 2. OBC/ ओबीसी 3. SC/ST/ एससी/एसटी
9) Size of the Family/परिवार का आकार	
10) What is the Highest Qualification you have? आपके पास उच्चतम योग्यता क्या है?	1. Primary Level/प्राथमिक स्तर 2. Matric/High School/मैट्रिक/हाई स्कूल 3. Secondary and Higher Secondary/माध्यमिक और उच्चतर माध्यमिक 4. Graduation/Diploma/Certificate/स्नातक/डिप्लोमा/प्रमाणपत्र 5. Uneducated
11) From which type of Institution you have obtained your qualification? आपने किस प्रकार के संस्थान से अपनी योग्यता प्राप्त की है?	1. Government/सरकार 2. Private/निजी 3. Deemed/मानना 4. Any other, please specify/कोई अन्य, कृपया निर्दिष्ट करें
12) Who is the head of your household? आपके घर का मुखिया कौन है?	1. Eldest male member of the family/परिवार का सबसे बड़ा पुरुष सदस्य 2. Eldest Female member of the family/परिवार की सबसे बड़ी महिला सदस्य 3. Any other, please specify/कोई अन्य, कृपया निर्दिष्ट करें
13) What is your Primary Occupation? प्राथमिक व्यवसाय	1. Farming/खेती 2. Other/अन्य 3. Both/ दोनों
14) If other, then please mention the specific.	



15) Do you own any Land? क्या आपके पास कोई ज़मीन है?	1. Yes/ हां 2. No/ नहीं
16) If yes, what is the Size of Land Holding? भूमि जोत का आकार	1. Large (more than 10 hectare)/बड़ा (10 हेक्टेयर से अधिक) 2. Medium (10-2 hectare)/मध्यम (10-2 हेक्टेयर) 3. Semi medium (2-1 hectare)/अर्ध मध्यम (2-1 हेक्टेयर) 4. Marginal (Less than 1.0 hectare)/सीमांत (1.0 हेक्टेयर से कम)
17) How do you utilize your land? आप अपनी भूमि का उपयोग कैसे करते हैं?	1. Cultivation/खेती 2. Non-cultivation/गैर खेती 3. Non agriculture uses/गैर कृषि उपयोग 4. Any other, please specify/कोई अन्य, कृपया निर्दिष्ट करें
18) How many years have you been farming? आप कितने वर्षों से खेती कर रहे हैं?	
19) Do you practice crop rotation? क्या आप फसल चक्र का अभ्यास करते हैं?	1. Yes/ हां 2. No/ नहीं
20) If yes What type of crops do you grow? (Please list all) आप किस प्रकार की फसलें उगाते हैं? (कृपया सभी की सूची बनाएं)	1. Wheat/गेहूँ 2. Rice/चावल 3. Jowar/ज्वार 4. Mango/आम 5. Potato/आलू 6. Any Other, please specify/कोई अन्य, कृपया निर्दिष्ट करें
21) Do you grow any other crops along with sugarcane? क्या आप गन्ने के साथ-साथ कोई अन्य फसल भी उगाते हैं?	1. Yes/ हां 2. No/ नहीं
22) If yes, please select the crops you grow alongside sugarcane (you may choose multiple options)? यदि हां, तो कृपया उन फसलों का चयन करें जिन्हें आप गन्ने के साथ उगाते हैं (आप कई विकल्प चुन सकते हैं):	1. Marigold/ गेंदा 2. Brinjal/ बैंगन 3. Tomato/ टमाटर 4. Lady finger/ भिंडी 5. Pulses/ दालें 6. Other/ अन्य
23) If other please mention the name? यदि अन्य हों तो कृपया नाम बताएं?	
24) What type of soil is present on your farm? आपके खेत में किस प्रकार की मिट्टी मौजूद है?	
25) How many years have you been growing sugarcane? आप कितने वर्षों से गन्ना उगा रहे हैं?	1. 0-1 years 2. 1-3years 3. 3-5 years 4. 5 & above
26) What is the total area under sugarcane cultivation (in Bigha)? गन्ने की खेती का कुल क्षेत्रफल (में बीघा) कितना है?	
27) Which sugarcane varieties do you cultivate? आप गन्ने की कौन सी किस्मों की खेती करते हैं?	
28) What method do you use for planting sugarcane? गन्ना बोने के लिए आप कौन सी विधि अपनाते हैं?	1. Trench method/ ट्रेंच विधि 2. Flat method/ समतल विधि



29) What is your average yield of sugarcane per bigha? आपकी प्रतिबीघागन्ने की औसत उपज क्या है?	
30) What is the primary source of irrigation for your sugarcane fields? आपके गन्ने के खेतों के लिए पानी का प्राथमिक स्रोत क्या है?	1. Canal/नहर 2. Tube well (GOVT./PRIVATE)/ट्यूबवेल (सरकारी/निजी) 3. Rainfed/रेनफेड 4. Wells/वेल्स 5. Tanks, Lakes or Ponds/टैंक, झीलें या तालाब 6. Rented Motor/Borrow from other farmer/किराये की मोटर/दूसरे किसान से उधार
31) Are you currently using any technology in your farming activities? क्या आप वर्तमान में अपनी कृषि गतिविधियों में किसी तकनीक का उपयोग कर रहे हैं?	1. Yes/ हां 2. No/ नहीं
32) If Yes, What type of technology are you using? यदि हां, तो आप किस प्रकार की तकनीक का उपयोग कर रहे हैं	1. Tractors (ट्रैक्टर) 2. Harvesters (कटाई मशीन) 3. Drip Irrigation (टपक सिंचाई) 4. Fertilizer Sprayers (खाद छिड़कने वाली मशीन) 5. Mobile Apps for Weather Forecasting (मौसम पूर्वानुमान के लिए मोबाइल ऐप) 6. Drones for Monitoring (निगरानी के लिए ड्रोन)
33) What type of fertilizers do you use? आप किस प्रकार के उर्वरकों का उपयोग करते हैं?	1. Chemical fertilizers/रासायनिक खाद 2. Organic fertilizers/जैविक खाद 3. Both/दोनों
34) How many hours spent by farmers on land? किसान जमीन पर कितने घंटे बिताते हैं?	1. 5 hours 2. 7 hours 3. Whole day 4. Other, please specify
35) What is the cost of sugarcane cultivation per 5 acre? प्रति एकड़ गन्ने की खेती की औसत लागत क्या है?	1. 10000 INR-15000 INR 2. 15,000INR-20,000 INR 3. 20,000INR-25,000 INR
36) What is the income from sugarcane annually per 5 bigha? गन्ने से सालाना कितनी आय होती है?	1. Less than 50,000/50,000 से कम 2. 50,000-100,000 3. More than 100,000/100,000 से अधिक 4. Any other please specify/कृपया कोई अन्य बताएं
37) Where do you sell your sugarcane produce? आप अपनी गन्ने की उपज कहाँ बेचते हैं?	1. Local market/स्थानीय बाजार 2. Sugar mills/चीनी मिलें 3. Middlemen/बिचौलियों 4. Cooperative societies/सहकारी समितियाँ 5. Kolhu
38) What is the selling price of sugarcane per quintal? प्रति क्विंटल गन्ने का औसत विक्रय मूल्य क्या है?	1. Less than 250 INR 2. 250 INR - 300 INR 3. 300 INR-350 INR 4. 350 INR -400 INR 5. More than 400 INR
39) How would you rate your overall health? आप अपने समय स्वास्थ्य का मूल्यांकन कैसे करेंगे?	1. Excellent/ उत्कृष्ट 2. Good/ अच्छा 3. Fair/ निष्पक्ष 4. Poor/ गरीब
40) Do you have any chronic health conditions? क्या आपको कोई पुरानी स्वास्थ्य समस्या है?	1. Yes/ हां 2. No/ नहीं



41) If Yes, please mention the chronic health condition that you have? यदि हाँ, तो कृपया अपनी पुरानी स्वास्थ्य स्थिति का उल्लेख करें?	
42) Have you experienced any injuries while working on the farm? क्या आपको खेत पर काम करते समय कोई चोट लगी है?	1. Yes/ हाँ 2. No/ नहीं
43) Do you have access to any mental health support or counseling services? क्या आपके पास किसी मानसिक स्वास्थ्य सहायता या परामर्श सेवा तक पहुंच है?	1. Yes/ हाँ 2. No/ नहीं
44) How far is the nearest healthcare facility from your home? आपके घर से निकटतम स्वास्थ्य सुविधा कितनी दूर है?	1. Less than 5 km/5 किमी से कम 2. 5-10 km/5-10 कि.मी 3. 10-20 km/10-20 कि.मी 4. More than 20 km/20 किमी से अधिक
45) Have you heard about the Fair and Remunerative Price (FRP)? क्या आपने उचित एवं लाभकारी मूल्य (एफआरपी) के बारे में सुना है?	1. Heard/ सुना है 2. Not heard/ सुना नहीं
46) What is the current subsidy you are getting for the sugarcane? गन्ने पर आपको वर्तमान में कितनी सब्सिडी मिल रही है?	
47) Then, overall are you happy/satisfied with the rates of crops decided by the Government? तो फिर, कुल मिलाकर क्या आप फसलों की तय की गई दरों से खुश/संतुष्ट हैं? सरकार?	1. Yes/ हाँ 2. No/ नहीं
48) Are you aware of the Pradhan Mantri Kisan SammanNidhi (PM-KISAN) Scheme? क्या आप प्रधानमंत्री किसान सम्मान निधि (पीएम-किसान) योजना के बारे में जानते हैं?	1. Yes/ हाँ 2. No/ नहीं
49) Are you enrolled in the PM-KISAN Scheme? क्या आप पीएम-किसान योजना में नामांकित हैं?	1. Yes/ हाँ 2. No/ नहीं
50) If yes, how many instalments have you received so far? यदि हाँ, तो आपको अब तक कितनी किश्तें प्राप्त हुई हैं?	
51) How has PM-KISAN benefited you financially? PM-KISAN से आपको आर्थिक रूप से कैसे लाभ हुआ है?	1. Significantly/ गौरतलब है 2. Moderately/ मध्यम रूप से 3. Marginally/ सीमांततः 4. No impact/ कोई प्रभाव नहीं
52) Are you aware of the Pradhan Mantri GaribKalyan Yojana (PMGKY)? क्या आप प्रधानमंत्री गरीब कल्याण योजना (पीएमजीकेवाई) के बारे में जानते हैं?	1. Yes/ हाँ 2. No/ नहीं
53) Has it benefited you? क्या इससे आपको फायदा हुआ?	1. Yes/ हाँ 2. No/ नहीं
54) What is the reasons behind not availing the benefit of this scheme? इस योजना का लाभ न मिलने के पीछे क्या कारण हैं?	



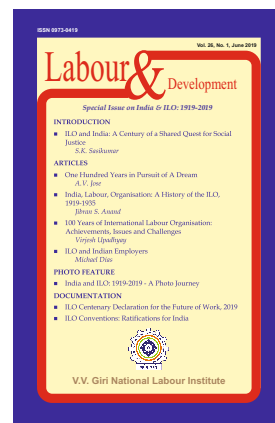
55) Are you aware of the Pradhan Mantri Fasal Bima Yojana (PMFBY)? क्या आप प्रधानमंत्री फसल बीमा योजना (पीएमएफबीवाई) के बारे में जानते हैं?	1. Yes/ हां 2. No/ नहीं
56) Are you aware of the MGNREGA scheme? क्या आप मनरेगा योजना के बारे में जानते हैं?	1. Yes/ हां 2. No/ नहीं
57) Do you avail any facilities such as Kisan credit card? क्या आप किसान क्रेडिटकार्ड जैसी किसी सुविधा का लाभ उठाते हैं?	1. Yes/ हां 2. No/ नहीं
58) Do you have access to storage facilities? क्या आपके पास भंडारण सुविधाओं तक पहुंच है? यदि हां, तो कृपया निर्दिष्ट करें।	1. Yes/ हां 2. No/ नहीं
59) How far is Storage facility from your village? आपके गाँव से भंडारण सुविधा कितनी दूर है?	
60) Do you have access to transportation facilities? If yes, please specify: क्या आपके पास परिवहन सुविधाओं तक पहुंच है? यदि हां, तो कृपया निर्दिष्ट करें।	1. Yes/ हां 2. No/ नहीं
61) Are you aware of any awareness programs currently being run in your village? क्या आपको अपने गाँव में चल रहे किसी जागरूकता कार्यक्रम के बारे में जानकारी है?	1. Yes/ हां 2. No/ नहीं
62) What is the primary focus of the program? कार्यक्रम का मुख्य उद्देश्य क्या है?	1. Health (स्वास्थ्य) 2. Education (शिक्षा) 3. Sanitation (स्वच्छता) 4. Environment (पर्यावरण) 5. Women's Empowerment (महिला सशक्तिकरण) 6. Other, Please specify (कृपया उल्लेख करें)
63) Who is conducting this program? इस कार्यक्रम का संचालन कौन कर रहा है?	1. Government (सरकार) 2. NGO (गैर सरकारी संगठन) 3. Private Organization (निजी संस्था) 4. Other (अन्य)
64) Are you part of the society member? क्या आप सोसायटी के सदस्य का हिस्सा हैं?	1. Yes/ हां 2. No/ नहीं
65) If yes what kind of facilities do you avail from these societies? यदि हां, तो आप इन सोसायटियों से किस प्रकार की सुविधाएं प्राप्त करते हैं?	
66) Have you taken any loan for farming in the last five years? क्या आपने पिछले पांच वर्षों में खेती के लिए कोई ऋण लिया है?	1) Yes/ हां 2) No/ नहीं
67) The loan you took for farming was used mainly for which purpose? खेती के लिए आपने जो ऋण लिया था उसका उपयोग मुख्यतः किस उद्देश्य के लिए किया गया था?	1. To purchase land /जमीन खरीदना 2. To purchase fertilizers, seeds, pesticides etc. To purchase farming equipment's like tractor, thrasher etc./उर्वरक, बीज, कीटनाशक आदि खरीदने के लिए। खेती के उपकरण जैसे ट्रैक्टर, थ्रेशर आदि खरीदने के लिए। 3. To return money to the money lender/ साहूकार को पैसा लौटाना 4. To return bank's old debt/बैंक का पुराना कर्ज लौटाने के लिए 5. Other



68) From where all did you take the loan? आपने कहाँ-कहाँ से कर्ज लिया?	1. Public/Govt. bank/सार्वजनिक/सरकारी। 2. Private Bank/प्राइवेट बैंक 3. Cooperative bank/सहकारी बैंक 4. Friend or relative/दोस्त या रिश्तेदार 5. Self-help group/स्वयं सहायता समूह 6. Money lender/साहूकार 7. Agricultural Trader/कृषि व्यापारी 8. Other (Specify)
69) What are the main challenges you face in sugarcane farming? गन्ने की खेती में आपके सामने मुख्य चुनौतियाँ क्या हैं?	1. Pest attacks/कीट आक्रमण 2. Lack of water/पानी की कमी 3. High cost of inputs/इनपुट की उच्च लागत 4. Low market prices/कम बाज़ार कीमतें 5. Lack of storage facilities/भंडारण सुविधाओं का अभाव 6. Lack of subsidy on fertilizers 7. No insurance of Sugarcane crop 8. Delayed Payment by Sugar mill 9. Lack of Electricity facilities 10. Other (please specify) अन्य (कृपया निर्दिष्ट करें)
70) Are you aware of Red Rot Disease affecting the Co 0238 variety of sugarcane? क्या आप गन्ने की Co 0238 किस्म को प्रभावित करने वाले लाल सड़न रोग से अवगत हैं?	1) Yes/ हां 2) No/ नहीं
71) Have you taken any measures to control or manage Red Rot Disease on your farm? क्या आपने अपने खेत में लाल सड़न रोग के नियंत्रण या प्रबंधन के लिए कोई उपाय किया है?	1) Yes/ हां 2) No/ नहीं
72) If yes, what precaution have you taken? यदि हां, तो आपने क्या सावधानी बरती है?	
73) How many members of your family are engaged in sugarcane farming? आपके परिवार के कितने सदस्य गन्ने की खेती में लगे हुए हैं?	1. 0 members 2. 2 members 3. 4 members 4. 5 or more
74) Is there any female family member engaged in sugarcane farming? क्या परिवार की कोई महिला सदस्य गन्ने की खेती में लगी हुई है?	1. Yes/ हां 2. No/ नहीं
75) Is there any children engaged in sugarcane farming? क्या कोई बच्चा गन्ने की खेती में लगा हुआ है?	1. Yes/ हां 2. No/ नहीं
76) What support or facilities do you think are necessary to improve sugarcane farming in your area? Please specify. आपके विचार में आपके क्षेत्र में गन्ने की खेती को बेहतर बनाने के लिए कौन सी सहायता या सुविधाएं आवश्यक हैं?	1. Increase FRP for sugarcane/गन्ने के लिए एफआरपी बढ़ाएँ 2. Installation of weighing machines at sugar mills/चीनी मिलों में तौल मशीनों की स्थापना 3. Timely payment of sugarcane /गन्ने का समय पर भुगतान 4. Availability of transportation facilities/परिवहन सुविधाओं की उपलब्धता 5. Storage Availability/भंडारण उपलब्धता 6. Other, please specify

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