



Maize-mustard (2M) Cropping System for Sustainable Agri-business: A Study on Shifting of Crop Preference from Paddy to Maize in Assam with Special Reference to Darrang District

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ABSTRACT

Background: An integrated maize-mustard model explains an economically viable and socially adaptable framework for long-term agricultural sustainability. The paper examines the macro- and micro-level dynamics of the changing crop calendar and explores its linkage with the scope for value addition and opportunities for increasing income for both the farm and the livestock sector. Integration strengthens linkages with the livestock sector, as maize serves as a major energy component in animal feed while oilseed by-products provide valuable protein supplements. However, successful agri-business development depends not only on production but also on key decision variables such as price volatility, quality management and supply chain stability. In this study, the entire agricultural ecosystem is considered. To accurately understand supply-side behaviour, the analysis goes beyond a five-year historical trend to actively evaluate current market data and post-harvest quality constraints.

Methods: Quantitative data analysis was employed to examine trends in production and yield over the period 2020-21 to 2024-25, using regression and correlation techniques to identify patterns and relationships among key variables. At the macro level, the study analysed changes in production patterns across Assam. At the district level, it further assessed the scope for implementing the proposed model in Darrang district, focusing on its applicability and potential impact. Secondary data on production were collected from the Department of Agriculture and Farmers Welfare. Data on price volatility and quality indicators were sourced from National Commodity and Derivatives Exchange Limited and AGMARKNET (including MSP data).

Result: A gradual structural shift in the cropping pattern is seen, where maize is increasingly replacing paddy in the local cropping calendar of Assam. Regression analysis confirms this trend, with the coefficient for year (17.871) indicating that the area under maize cultivation increases by approximately 17.87 units annually, showing a statistically significant upward trend ($p = 0.035$). The study also highlights the growing importance of oilseeds in Assam, where production increased by 30.4% along with a 22% improvement in yield during the study period. Increasing minimum support price (MSP) incentives and rising market demand are encouraging farmers to diversify toward maize and oilseeds. The study concludes that strengthening value addition, improving market linkages and integrating feed-based livestock systems with maize and oilseed production can significantly enhance farmers' income and support sustainable agricultural livelihoods in the region.

Key words: Farm, Integration, Livestock sector, Maize-mustard, Trend, Value addition.

INTRODUCTION

The rural economy is endowed with multiple capitals, which are now open to interaction and integration, as agriculture is no longer merely a way of life but a pathway to enhance income. In the process, the right decision for sustainable rural livelihoods on trading and value-added business plays a significant role. The changing consumption basket in rural areas, along with shifts in occupational distribution, clearly indicates the need for an integrated model to commercialise the subsistence agriculture. Aggregative institutional models such as farmer producer companies (FPCs), promoted and supported by agencies like NABARD, NAFED, SRLM, FDRVC and cooperative institutions, have emerged as effective mechanisms for farmer mobilisation and production aggregation. To strengthen the process further, commodity-specific boards such as the Spices Board, National Bamboo Mission, Coconut Development Board and Cashew Export Promotion Council of India support value addition by providing machinery, training and technical assistance under

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various schemes and programmes, often at subsidised rates.

Traditionally, agricultural economics in India operated under a supply-oriented framework, where production decisions were largely driven by existing cultivation patterns and resource availability. However, the present model has gradually transformed into a demand-centric approach,

where market demand, consumption trends and value chain integration determine crop choices.

In addition, state governments are also introducing specialised programmes to strengthen agribusiness opportunities by facilitating credit linkages and providing machinery support at subsidized rates. Mukhya Mantri Utkarsh Yojana in Assam is providing financial assistance of up to ₹ 15 lakh to around 500 in Assam for agri business enterprises.

The transition from paddy to maize is often driven by the necessity for sustainable agriculture, water conservation and the opportunity for higher returns via expanding value chains (Gulati *et al.*, 2018). Maize has experienced one of the highest compound annual growth rates among food crops in recent decades, heavily driven by its diversification into poultry feed, livestock feed and industrial uses (Kumar *et al.*, 2013). Furthermore, localized studies show that shifting from rice to maize cultivation frequently acts as a supply-side response to regional resource constraints, such as groundwater depletion, positioning maize as a highly viable alternative for farmers seeking to maintain productivity (Singha *et al.*, 2013). Studies made on crop diversification explain that maize and mustard can contribute to improved resource-use efficiency, sustainability and farm income in Assam (Buragohin *et al.*, 2019). Sustainability of livelihood is now more dependent on practising diversification, as it compels households to be more vigilant and adopt the change occurring over time (Bhattacharjee, 2010).

Beyond market prices, a farmer's crop choice is heavily constrained by post-harvest handling risks and grading standards. The fear of impending post-harvest losses from moisture, pests, or poor storage capacity is a dominant factor that influences a farmer's marketing behaviour, often forcing them to dispose of their harvest immediately at lower prices (Gabriel, 2020.) An empirical study on maize-based crops estimated the profitability and resource use by diversification in the North-Eastern region (Islam *et al.*, 2018).

Objectives of the study

1. To analyse the potential of integrated cropping practices involving maize and mustard and assess the scope of value chain integration in Assam with special reference to Dhemaji.
2. To examine the key requirements for sustainable agribusiness development in the maize-mustard production and value chain ecosystem, including production, processing, market linkage, institutional support and environmental sustainability.
3. To assess the existing cropping pattern and value chain interactions of maize and mustard cultivation in Assam and identify opportunities for enhancing farmers' income and livelihood security.

Hypotheses of the study

H1: Increase in cultivated area is positively associated with crop productivity.

H2: The economic value of crops significantly influences cropping pattern dynamics in Assam.

Integration rather than a pure top-down or bottom-up model

Agriculture is deeply embedded in the socio-cultural systems of India. Therefore, neither a purely top-down nor purely bottom-up development model is feasible. A mixed, evolutionary approach that integrates institutional support with farmer participation is more sustainable and socially acceptable.

The maize-mustard combination offers multiple value streams, as both crops have diverse value-added product pathways. A key common linkage between the two is their role in livestock feed systems, which is particularly relevant in the north eastern (NE), where livestock forms an integral component of rural livelihoods. Maize is widely used as an energy-rich ingredient in poultry and animal feed, while mustard by-products- mustard oil cake, provide a protein-rich supplement for cattle and other livestock. A study on the pork marketing chain in NE states indicates that (Bhattacharjee *et al.*, 2023) the three cost-influencing factors for the backyard farmers are the purchase of pig stock, feed cost and vaccination in NE states. Feed cost is higher as the region does not have feed producing unit, as a major portion of maize has to be imported from nearby states, which makes the unit less economically viable. This complementary use creates opportunities for value addition and market linkages through local feed processing, oil extraction units and integrated agri-livestock enterprises. By linking crop production with livestock feed demand, farmers and producer enterprises can tap into stable and growing markets, particularly from poultry, dairy and piggery sectors that are expanding across the NE region. Such integration not only improves resource efficiency and reduces input costs for livestock farmers, but also enhances farm-level profitability, diversification of income sources and resilience of rural enterprises. The transition from subsistence to commercial production poses uncertainty and risks that require putting in place adaptive systems (Dlamini *et al.*, 2022).

With increasing land fragmentation and a rising number of marginal farmers, diversification through livestock integration. The rising cost of livestock feed negatively impacts backyard farmers, but integrated crop-livestock systems can reduce input dependency and improve overall farm income. The agribusiness model operating on an aggregation-based approach should initially focus on trading activities to gain a broader understanding of market dynamics. In the subsequent stage, value can be added by establishing processing units, which would enhance product value, improve market competitiveness and strengthen the sustainability of the enterprise.

Consumption patterns indicate a growing demand for livestock products, suggesting strong market potential. The animal feed market is projected to generate approximately ₹ 1,186.30 billion in 2025, growing at a CAGR

of 6.6% between 2026-2034. This growth is driven by increasing demand for animal protein products.

The scope for developing new value-added products—such as processed maize feed, maize flour products, mustard oil and mustard cake-based feed supplements—enhances the profitability potential of the integrated model. Such diversification not only reduces market risk but also creates opportunities for small enterprises, producer organisations and rural entrepreneurs to participate in processing, aggregation and marketing activities.

In this evolving process, new opportunities and emerging crops in diverse agro-climatic locations are being explored continuously. Since these models must evolve dynamically to remain relevant and effective, the present paper aims to examine the potential of a value-added, integrated cropping and enterprise model based on maize, rapeseed and mustard for sustainable livelihoods in Assam, with specific reference to the darrang region.

MATERIALS AND METHODS

An analysis of crop performance in Assam over the last five years examined to understand this changing pattern, a simple quantitative analysis was carried out for the period 2020-21 to 2024-25 using descriptive statistics, correlation analysis and linear regression.

Descriptive statistics were used to examine the average performance of key indicators such as cultivated area, production and yield for both crops. Correlation analysis helped in understanding the relationship between area, production and yield of maize and paddy, while a comparative assessment was undertaken to observe variations in productivity in response to changes in cultivated area.

To better understand the relationship among variables and interpret changes over time, regression analysis was conducted separately for both crops. Further, growth projections were estimated considering the dependence of production on yield and area under cultivation. The crop dynamics of Darrang district were also examined, with a specific focus on the three major crops.

Since price volatility and quality parameters play an important role in agricultural business decisions, demand patterns were also studied within the relevant market context to understand emerging trends and opportunities.

RESULTS AND DISCUSSION

Paddy is the most preferred crop for cultivation in Assam. To understand the changes, if a similar analysis for paddy is taken up to know the crop dynamics and changes over the last 5 years.

Analysis of crop preference in Assam-paddy to maize cultivation (2020-21 to 2024-25)

Descriptive statistics

The results (Table 1) indicate that the average area under maize cultivation was approximately 68 thousand hectares, with a mean production of 303.69 thousand tonnes and an average yield of about 4228 kg per hectare during the five years. The relatively high standard deviation suggests variability in maize expansion and productivity across years. The mean area under paddy cultivation is 2306.05, with a standard deviation of 63.44, indicating relatively small fluctuations in the cultivated area during the period. The variance of 4025.10 further confirms that the area under paddy has remained fairly stable over the years. The average production of paddy is 5132.25 and the mean yield is 2227 kg/ha, with a standard deviation of 227.90, reflecting some variability in productivity levels across the years.

Research gap

Despite the growing emphasis on crop diversification and sustainable agriculture in Assam, limited research has comprehensively examined the integrated cropping potential of maize and mustard along with value chain interactions, particularly in the context of Dhemaji. Existing studies have largely focused on crop production, yield performance, or broad agricultural trends, with inadequate attention to the interlinkages between cropping practices, market systems, processing and institutional support mechanisms.

Further, there is a lack of location-specific studies analysing how integrated maize-mustard cropping

Table 1: Trend of maize and paddy cultivation from 2020-21 to 2024-25.

Year	Crops	Area (000' hec.)	Production (000' tonnes)	Yield (kg/hect.)
2020-21	Maize	41.15	147.91	3594
2021-22	Maize	42.92	170.19	3965
2022-23	Maize	52	192.3	3698
2023-24	Maize	103.67	533.12	5143
2024-25	Maize	100.13	474.91	4743
2020-21	Paddy	2360.47	5214.76	2209
2021-22	Paddy	2353.26	4382.14	1862
2022-23	Paddy	2318	5624.32	2426
2023-24	Paddy	2295.72	5538.54	2413
2024-25	Paddy	2202.8	4901.47	2225

Directorate of Economics and Statistics (DES), Government of Assam, Agricultural Statistics of Assam, 2020-21 to 2024-25.

systems can contribute to sustainable agribusiness development, livelihood enhancement and climate resilience in Assam. Limited evidence is available regarding the influence of economic value, market demand and value chain efficiency on cropping pattern dynamics among small and marginal farmers. Additionally, the role of aggregation, storage, processing, input access and institutional buyer arrangements in strengthening the maize and mustard ecosystem remains underexplored.

Therefore, the present study seeks to bridge this gap by analysing the potential of integrated maize and mustard cultivation and value chain interaction in Assam, with special reference to Dhemaji, while identifying key requirements for sustainable agribusiness development and assessing factors influencing cropping decisions and productivity.

Correlation analysis

The correlation matrix highlights the relationship between area, production and yield of maize.

- Area and production show an extremely strong positive correlation ($r = 0.996$).
- Production and yield also demonstrate a strong positive relationship ($r = 0.976$).
- Area and yield are strongly correlated ($r = 0.954$).

This suggests that increases in cultivated area are strongly associated with higher maize production and yield, indicating the expansion of maize cultivation alongside productivity improvements.

In the case of paddy, the correlation between area and production is -0.042 , which indicates a very weak negative relationship. This suggests that changes in the cultivated area have almost no influence on production, implying that production variations are not primarily driven by expansion or reduction in area. Changes in paddy production are largely explained by variations in yield rather than changes in cultivated area.

Regression analysis

Maize

The regression analysis was conducted to examine the trend in maize and paddy cultivation area over time. The regression results clearly indicate an upward trend in maize cultivation in Assam during the study period, suggesting that farmers are increasingly allocating land to maize cultivation.

The regression coefficient for year (17.871) indicates that the area under maize cultivation increases by approximately 17.87 units every year with statistically significant increasing trend (p -value = 0.035). The standardized beta value is 0.904 indicating a very strong positive relationship between time and maize cultivation area (Annexure).

Paddy

Area = $3163.674 - 37.288$ (Year). The coefficient for year (-37.288) indicates that the area under paddy cultivation decreases by approximately 37.29 units per year. With a

p -value of 0.022 , the relation is found to be statistically significant. The value of Standardised Beta = -0.929 indicates a very strong negative relationship between year and paddy cultivation area.

The robustness of the regression model was assessed using the coefficient of determination (R^2), standardized beta values and significance levels. For maize, the model explained approximately 82 per cent of the variation in cultivated area ($R^2 = 0.82$), while for paddy, the explanatory power was around 86 percent ($R^2 = 0.86$). The high standardized beta values and statistically significant p -values indicate a strong association between time and cultivated area. However, as the analysis is based on a limited time series of five years, the findings should be interpreted cautiously and a longer time horizon may provide stronger evidence of the observed trends.

The regression analysis reveals a statistically significant decline in the area under paddy cultivation, accompanied by a significant increase in maize cultivation over the five years.

The results suggest a structural shift in cropping patterns in Assam, where farmers are gradually reallocating land from paddy to maize cultivation.

Demand-supply gap of oilseeds in India

It is projected that India will be the world's largest vegetable oil importer (OECD-FAO 2023) in the near future and, with rising per capita consumption in lower- and middle-income countries, vegetable oil consumption for food purposes is expected to account for 57% of the total world consumption. In a study of ICAR-Indian Institute of Oilseeds on regional preference of edible oil consumption, mustard oil is found to be most preferred in India's north (61%) and east (35%) zones, followed by sunflower oil. In the west zone, soybean oil held a slight edge (28%) over mustard (25%) and sunflower (25%) oils. The south zone presented a different picture, with sunflower oil (44%) dominating, followed by groundnut oil (29%). These variations likely reflect traditional culinary practices and locally available oilseeds.

Limitation

While the R^2 , Beta values and p -values all point to strong and robust models, the text explicitly notes a significant limitation: the analysis is based on a very short time series of only five years.

A longer time horizon would be required to provide stronger, more definitive evidence of these observed trends but to get a snapshot and demand supply status integrated model is required which can be suggested for future analysis.

Production and yield of rapeseed and mustard in Assam

During the period as represented in Graph 1, 2020-21 to 2024-25, the trend of rapeseed and mustard shows moderate improvement in area, production and yield with some fluctuations. The cultivated area increased from 286.35 to 306.52 , registering an overall increase of about 7.0%, although it peaked at 319.62 in 2023-24 before slightly

declining. Production rose more substantially from 185.27 to 241.53, reflecting an overall increase of about 30.4% over the period. Similarly, yield improved from 647 to 788, showing an increase of about 21.8%, with a sharp rise observed from 2022-23 onwards and stabilization thereafter (Department of Agriculture and Farmers Welfare). Overall, the increase in production was largely driven by improvements in yield rather than expansion in area, indicating enhanced productivity during the study period.

Oilseeds, are highly susceptible to quality deterioration; excess moisture severely impacts critical quality parameters like oil content and protein balance, increasing the risk of rancidity (Sabbahi *et al.*, 2023). Because oilseeds face highly stringent grading standards to prevent these extraction quality issues, farmers face elevated operational risks. In contrast, maize's comparatively higher tolerance for moisture and foreign matter reduces post-harvest vulnerability, acting as an operational safety net that further drives the supply-side shift.

The comparison between three crops as shown in Table 2 on MSP (2026-27) of selected crops in India, shows that oilseeds have a significantly higher market value (₹ 5950) compared to maize (₹ 2400) and paddy (₹ 2369). This indicates that oilseed crops provide relatively higher price realisation per unit, which can incentivize farmers to diversify towards oilseed cultivation where agro-climatic conditions permit. However, maize and paddy continue to dominate the agricultural practice mostly for the steady demand, traditional procurement channels and relatively less risk.

Table 2: MSP (2026-27) of selected crops in India.

Crops	Rs/quintal
Maize	2400
Paddy	2369
Oilseeds	5950

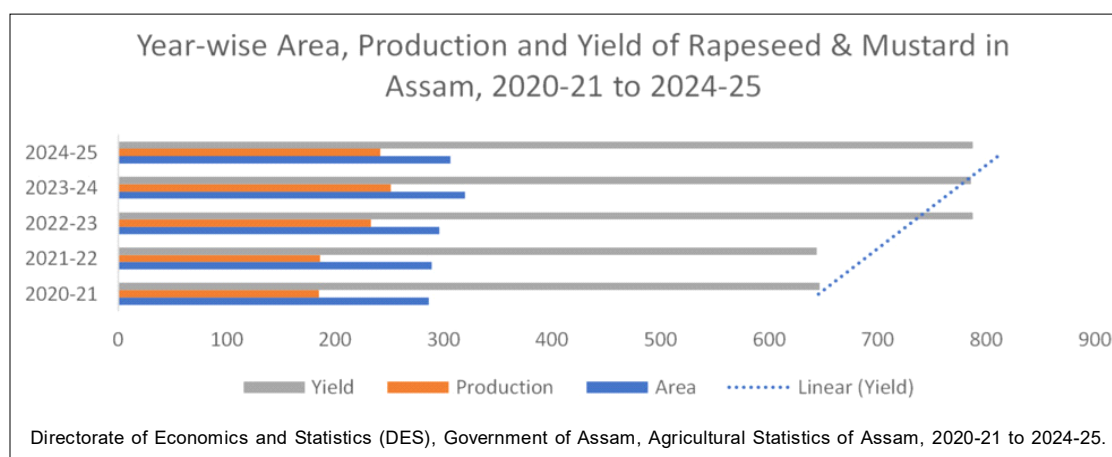
Source: www.agmarkenet.gov.in.

Scope to increase in income by the M2 (Maize and mustard) value addition

The above discussion clearly indicates that the economic value of crops plays a significant role in influencing cropping pattern dynamics. Farmers increasingly tend to choose crops that offer higher market value, better price realization and relatively lower production risk. In this context, crop diversification can help mitigate production and market risks to some extent. However, diversification alone may not be sufficient to substantially enhance farm income. In line with the national objective of doubling farmers' income, greater emphasis should be placed on value addition, processing and direct market linkages, which can significantly enhance the profitability of agricultural produce.

In the North Eastern region of India, livestock plays a crucial role in rural livelihoods, as the consumption patterns and socio-cultural practices of the region are closely linked with livestock rearing, particularly piggery and poultry. One of the major challenges faced by the livestock sector in the region is the rising cost of feed, which directly affects the profitability of livestock farming. Feed for pigs and poultry largely depends on maize and oilseed-based ingredients. However, a significant portion of livestock feed is currently sourced from other states, leading to higher transportation costs and increased feed prices in the region.

This dependence on external supply has resulted in rising production costs and declining profitability for livestock farmers. Recent studies also indicate a declining trend in piggery and poultry rearing in several north eastern states, primarily due to the increasing cost of feed and limited availability of locally processed feed ingredients. Therefore, establishing maize-and oilseed-based value-added feed processing units within the region should be considered a priority intervention. Such initiatives would not only strengthen the livestock value chain but also create local market demand for maize cultivation, thereby supporting crop diversification and enhancing farmers' income in the region.



Graph 1: Positive trend of rapeseed and mustard in last 5 years.

Regional profile and agricultural context of Darrang districts, Assam

Darrang district is located as shown in Map 1, is situated in the north-central part of Assam and forms an important part of the Brahmaputra valley. The district is bounded by Udalgori district to the north, Sonitpur district to the east, Kamrup (Rural) district to the west and the Brahmaputra River to the south, which serves as a major physical and economic lifeline for the region. The total geographical area of Darrang district is approximately 1,850 square kilometres. The soils of Darrang district range from old alluvial to new alluvial formations, with textures varying from sandy to sandy loam and generally acidic in reaction. These soils are characterized by medium to high organic carbon, low to medium phosphorus and medium potash content, making them suitable for diversified cropping. Geologically, the northern belt consists of alluvial formations with pockets of older alluvium, while the remaining areas are underlain by sandstone and shale formations.

Darrang has relatively better irrigation coverage, with about 50% of its cultivated area (35,416 hectares) under irrigation. During the *Kharif* season, cereals are cultivated on 10,539 hectares of irrigated land, while 3,880 hectares are used for irrigated cereal cultivation in the *Rabi* season. In the summer season, a total area of 8,924 hectares is cultivated entirely under irrigated conditions.

Darrang district is marginally surplus in rice production. In addition to paddy, farmers cultivate a variety of oilseeds, including mustard, sesamum, niger, castor (primarily for

sericulture), sunflower and groundnut. Other crops grown include maize, wheat, potato, sugarcane and jute, reflecting emerging diversification trends (NITI Aayog, 2024).

Despite this diversity, the district remains deficient in oilseed and maize production, necessitating imports from other regions. This production gap highlights significant potential for integrated cropping systems and value-chain interventions, particularly through oilseed-cereal combinations such as maize-rapeseed-mustard, supported by aggregation and market-led institutional models.

On examining the dynamics of crops in Darrang a mixed scenario is seen in the time period 22-23 and 2023-24 (Table 3). Crops like paddy and maize have made more than 17 per cent increase in yield, indicating a gain in productivity. In contrast, rapeseed had a decline in yield despite an increase in area, which needs crop-specific research to understand the need of targeted intervention.

Scope of agri business with 2M model in Darrang district

Mustard oil is extracted from the black mustard seed is lighter in colour and stronger in taste whereas yellow mustard seed produces more yellowish and pungent oil. Mustard seed is a rich source of oil and protein. The seed has approximately 36 to 42 per cent of oil and the whole seed meal has about 43 per cent of protein (<https://ncdex.com/>). Table 4 explains the possibility of business around mustard, as its marketable surplus in 20-21 is estimated at around 26367 MT, with Darrang contributing the highest (Table 4).



Map 1: Directorate of Agriculture, Government of Assam, District Irrigation Plan, Darrang.

Table 3: Crop dynamics of Darrang, Assam from 2022-23 to 2023-24.

Crops	Year	Area (hec.)	Production (000' tonnes)	Yield (kg/hect.)
Rapeseed	23-24	20.75	12.91	622
	22-23	20.16	13.35	662
Paddy	23-24	67.01	192.46	2872
	22-23	68.75	168.31	2448
Maize	23-24	17.46	149.58	8566
	22-23	18.31	132.46	7235

Directorate of Economics and Statistics (DES), Government of Assam, Agricultural Statistics of Assam, 2020-21 to 2024-25.

In the business of agricultural commodities, three important variables play a dominant role in decision-making: price volatility, quality and stability of the supply chain. Production alone does not ensure a steady supply chain, as it depends on several additional factors such as seasonal variations, weather conditions, storage capacity, logistics and market linkages. Even when production levels are high, fluctuations in price or inconsistencies in quality can affect market demand and profitability.

Therefore, for a sustainable agri-business model, it is essential to ensure consistent quality standards, reliable procurement networks and mechanisms to manage price volatility, such as aggregation, storage, processing and market intelligence. A stable supply chain built on these factors enables enterprises to maintain regular market participation and build long-term relationships with buyers.

A comparison of price volatility based on data from National Commodity and Derivatives Exchange Limited,

2024 between maize and mustard (oilseed) during April 2024-March 2025 shows (Table 5) that mustard experiences relatively higher volatility than maize in both spot and futures markets. The volatility of maize reached a maximum of 0.01411 in January and a minimum of 0.00684 in August, whereas mustard futures volatility was considerably higher, with a maximum of 0.0271 in April and a minimum of 0.0095 in November. Similarly, in the spot market, maize showed a maximum volatility of 0.0142 in June and a minimum of 0.0060 in January, while mustard spot volatility ranged from a high of 0.0267 in April to a low of 0.0077 in October. This comparison indicates that oilseeds such as mustard are subject to greater price fluctuations than maize, possibly due to stronger influence of seasonal arrivals, processing demand and edible oil market dynamics, while maize prices remain relatively more stable due to consistent demand from feed and industrial sectors. Volatility-based results can help market participants to benefit by hedging uncertainty and help policymakers to design futures contracts to improve the efficiency of the agricultural commodity derivatives market (Manogna and Mishra, 2020).

Moisture tolerance (Table 6) is significantly higher in maize (14%) compared to oilseeds (5%), mainly because oilseeds are more prone to rancidity and quality deterioration if moisture increases. Foreign matter tolerance is also higher in maize (2%) than in oilseeds (0.5%), indicating stricter cleaning standards for oilseeds. Damaged grain tolerance is much higher in maize (8%) compared to oilseeds (0.75%), reflecting the stricter grading needed for oil extraction quality in oilseeds. Maize standards specifically mention fungal contamination (1%) and the absence of colouring agents, moulds, live pests and bad odour, which are important for feed and food safety.

Table 4: Mustard production in 2020-21 and marketable surplus in districts of Assam.

District	Production in 2020-21 (in MT)	Estimated marketable surplus (in MT)
Tinsukia	5911	3547
Majuli	8018	4811
KarbiAnglong	6169	3700
Morigaon	8134	4880
Nalbari	5937	3562
Darrang	9778	5867
Total	43947	26367

Source: www.asamb.assam.gov.in.

Table 5: Price volatility of mustard and maize in India.

Volatility of mustard	Month	Value	Volatility of maize	Month	Value
Future	Max Apr	0.027147	Future	Max Jan	0.01411
	Min Nov	0.009501		Min Aug	0.00684
Spot	Max Apr	0.026749	Spot	Max Jun	0.014217
	Min Oct	0.007723		Min Jan	0.006036

Source: <https://ncdex.com/>.

Table 6: Percentage value of the quality Indicators of oilseeds and maize.

Quality indicators	Oilseeds (%)	Maize (%)
Moisture content	5	14
Foreign matter	0.50	2
Damaged or shriveled or discoloured seeds	0.75% (max)	8 (Out of this weevil grains will be 0.5% max)
Insect-damaged matter	within 0.75%.	
Fungus		1
Added point		Free from any colouring agent, moulds, live pests and obnoxious smell

Source: <https://ncdex.com/>.

While the five-year time series for area and production limits the ability to project multi-decade historical trends, this study mitigates that constraint by employing a comprehensive “snapshot” approach. By integrating recent high-frequency market data and post-harvest grading standards, the study captures the immediate economic and operational drivers influencing farmer behaviour. The observed structural shift toward maize cultivation is validated by its highly favourable risk profile compared to competing crops like oilseeds across two key dimensions.

Market price stability (Economic risk)

An assessment of price volatility during April 2024-March 2025 reveals that maize maintains significantly lower volatility in both spot and futures markets compared to mustard. Maize spot volatility peaked at just 0.0142, whereas mustard experienced much sharper fluctuations (peaking at 0.0267), driven by seasonal arrivals and edible oil market dynamics. The consistent demand from the feed and industrial sectors insulates maize from the severe price shocks seen in oilseeds, ensuring safer price realization for farmers.

Post-harvest handling and grading (Operational risk)

The shift to maize is further justified by its more forgiving post-harvest parameters. Oilseeds require highly strict grading to ensure oil extraction quality and prevent rancidity, limiting moisture tolerance to just 5%, foreign matter to 0.5% and damaged grains to 0.75%. In contrast, maize is significantly more resilient, tolerating much higher moisture levels (14%), foreign matter (2%) and damaged grains (8%). While maize must still meet critical food and feed safety standards-such as strict limits on fungal contamination (1%) and the total absence of colouring agents, moulds, live pests and bad odours-its overall hardness reduces immediate post-harvest losses and storage complexities for farmers.

By integrating real-time price volatility and comparative quality standards, the study provides a robust, real-time snapshot of the agricultural landscape. It contextualizes the five-year expansion in maize acreage not merely as a statistical trend, but as a highly rational, risk-averse economic response by farmers seeking stable incomes and manageable post-harvest operations. Therefore, an integrated demand-supply and risk-assessment model serves as a highly reliable framework for evaluating current structural shifts in cropping patterns.

CONCLUSION

A steady supply chain depends on strict adherence to quality standards, which ensures smooth market linkages and consistent product flow. Maintaining the prescribed quality parameters across different stages of the value chain helps reduce rejection, post-harvest losses and price fluctuations. A well-managed quality control system covering production, aggregation, storage and transportation

strengthens the overall stability and efficiency of the maize and oilseed supply chains by ensuring that the produce reaching the market meets the required standards and remains acceptable to processors, traders and end users. The crop portfolio should be determined according to the prevailing production conditions, market demand and procurement scenarios in the region. Increasing demand for animal feed, edible oils and by-products such as mustard oil cake strengthens the requirement of market linkage for both crops. The maize-mustard complementary utilisation supports an integrated farming system where crop production and livestock activities reinforce each other, ensuring a more profitable and efficient supply chain.

Conflict of interest

The author declare that there are no conflicts of interest regarding the publication of this paper.

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