Journal of Informatics Education and Research
ISSN: 1526-4726
Vol 4 Issue 3 (2024)

COTTON FARMERS' PERCEIVED RISK AND INCOME VARIABILITY AFFECTED BY COMMODITY DERIVATIVE MARKETS: A CASE STUDY ON ODISHA (INDIA)

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ABSTRACT
Agricultural production, particularly cotton farming, is highly vulnerable to fluctuating commodity prices and unpredictable weather, making risk mitigation crucial for sustainability and profitability. Cotton growers face market volatility and climate challenges that impact yields and income. Previous studies, such as Sharma & Bhushan (2019), highlighted the correlation between market instability and income fluctuation for smallholder cotton farmers, emphasizing improved risk management strategies. The quantitative study used data from 1000 cotton farmers from Odisha (India), selected via stratified random sampling to capture demographic diversity. A structured questionnaire was employed to gather information on key variables, with electronic distribution increasing accessibility. While the research provides. valuable insights, its cross-sectional design limits causal conclusions, and reliance on self-reported information may introduce bias and utilize SPSS to perform structural equation modeling (SEM) to understand the relationships between farmers' perceived risk, income variability, and the use of commodity derivatives. The result shows the negligible effect of commodity derivatives on the revenue stability of cotton growers, except for input costs. The varied risk assessments of farmers indicate that essential financial aspects are overlooked.

1. INTRODUCTION

Agricultural production is intrinsically vulnerable to various variables, including fluctuating commodity prices and erratic weather patterns, posing considerable problems for farmers globally (Lawrence. et.al, 2018). Cotton growers are particularly vulnerable to these risks due to market changes and climatic factors that can significantly affect production yields & financial results. Mitigating these risks is essential for guaranteeing cotton agriculture's long-term sustainability &profitability.

Agriculturalists operate within an environment characterized by various vulnerabilities and uncertainties, influenced by natural conditions, market failures, and societal instabilities. Farmers must invest both financially and temporally to mitigate diverse risks to formulate strategies and implement adaptive measures. These investments have higher return expectations while carrying an increased chance of failure. Farmers typically have a propensity for risk aversion in their decision-making processes. The hazards faced by farmers may arise from uncertain climatic conditions, pest infestations, diseases, market fluctuations, and price volatility, as well as severe climate and weather occurrences (Sutherst. et.al, 2011). Farm-level risk can be categorized into many groups according to their nature and the crops involved. Literature has identified several categories of risk, including personal, production, and technological hazards, as well as financial, economic, & environmental risks. Certain categories may exhibit overlap.

Agricultural output serves as the primary revenue source for farming households; therefore, farmers must recognize and mitigate production risks. The farmer's mindset and view of risks significantly influence their management and adaptation decisions about risks encountered at the farm level. Timely and precise risk perception can aid farmers in evaluating the likelihood and impact of identified threats. “Prompt assessments of risk can assist farmers in making informed decisions regarding crop management & adaptive strategies (Reid.et.al, 2007).” The assessment of farmers' perceptions and their responses to risks is crucial for understanding their decision-making behavior in uncertain situations. To evaluate the farmer's decision-making under risky and uncertain conditions, it is essential to examine their perception of risk and their responses to different types of risks.

In July 2007, the Indian ministry sanctioned the marketing of 73 new genetically modified cotton types containing Bacillus thuringiensis (Bt) to confer resistance against cotton bollworms. “At that time, a total of 135 hybrid Bt cotton types were offered in the Indian market (SABP 2007). By 2006, four years post-introduction, Bt cotton encompassed 3.8 million hectares or over 39 percent of the total cotton acreage (Economic Times 2007). For the initial time, the area cultivated with Bt cotton in India surpassed that of China, a prominent nation in Bt cotton production, thereby establishing India as the leader in Bt cotton cultivation in Asia.” Officials anticipate a sustained expansion of the total area cultivated with Bt cotton in India during the forthcoming years, potentially encompassing 60 percent of the overall cotton acreage. These several indices illustrate the significant economic impact of Bt cotton in India.

The ability to adjust to identified hazards is severely restricted at both the national and farm levels due to resource scarcity and financial limitations. Despite their presence at the local level, official institutions are unable to assist farmers due to constrained resources. Conversely, the private sector remains in a developmental phase and has restricted outreach. The agriculture insurance system in India is somewhat underdeveloped. The agricultural loan insurance plan was established in 2008, although a significant proportion of farmers still lack access to financial services. Consequently, companies must depend on conventional approaches to mitigate the dangers (Ullah. et.al, 2016).

The inadequate information regarding local processes of risk perception and management poses a significant problem for policymakers and researchers in developing an effective risk management system at the farm level (Fahad & Wang, 2018). Therefore, to formulate an effective policy that aids farmers in risk management at the farm level, gathering information on local perceptions of hazards at that level is essential. Despite the availability of extensive knowledge of numerous global hazards to the agriculture industry and crops, limited work has been conducted, particularly with farm-level risk management.

In recent years, the utilization of financial instruments like commodities derivatives has surfaced as a viable approach for alleviating certain difficulties (Gupta & S. L. 2017). Commodity derivatives, such as futures and options, enable farmers to mitigate price volatility & market risks by securing pricing for their crops. These instruments are intended to stabilize income by offering a safeguard against detrimental price fluctuations and other external disturbances, such as adverse weather events or market interruptions.
Nonetheless, the utilization and efficacy of derivatives of commodities among farmers exhibit considerable variability (Vedenov. et.al, 2004). Some farmers regard these instruments as excellent

risk management strategies, while others consider them difficult or ineffectual, frequently due to insufficient understanding or perceived advantages. Moreover, the influence of derivatives of commodities on income stability is inconsistent among various agricultural enterprises, and numerous farmers continue to encounter considerable income fluctuations despite utilizing these financial instruments.

2. REVIEW OF LITERATURE

A Comprehensive Analysis of Global Perspectives and Trends

The dynamics of cotton agriculture, particularly its economic viability and revenue stability, have been extensively analyzed in recent research. A comprehensive exploration of varying perspectives highlights the multifaceted nature of the challenges faced by cotton growers and the strategies employed to mitigate these issues.

Martinez et al. (2021) provide an in-depth analysis of how variations in input costs and commodity prices exacerbate revenue volatility in cotton farming. Their quantitative approach underscores the correlation between escalating costs of fertilizers and seeds with shrinking profit margins, especially during periods of declining commodity prices. The study concludes that the rising costs of inputs heighten perceived risk, making cotton farming increasingly vulnerable to market fluctuations. This research sheds light on a critical aspect of cotton agriculture, emphasizing the necessity of cost management strategies to sustain profitability.

Davis and Lopez (2020) focus on the role of higher education in equipping cotton growers with effective risk management tools. Through interviews and surveys, they demonstrate that educated farmers are more adept at employing strategies such as crop diversification and futures contracts to mitigate revenue variability. Their findings highlight the transformative impact of education on enhancing financial resilience among cotton producers, providing a compelling case for the promotion of educational programs tailored to agricultural needs.

Jackson and Lin (2022) explore the contribution of commodities cooperatives to income stabilization for cotton farmers. Using a mixed-methods approach, they compare the incomes of cooperative members to non-members and delve into the qualitative experiences of participants. The study reveals that cooperatives significantly reduce risks and improve market access, thereby stabilizing income. However, uneven participation rates among farmers limit the effectiveness of cooperatives, signaling a need for greater inclusivity and awareness to maximize their benefits.

Xie and Yu (2020) assess the impact of commodities futures markets on income volatility in cotton production. Employing statistical models, they highlight the potential of futures contracts to mitigate perceived risks, contingent upon farmers' financial literacy and market knowledge. Their findings underscore the importance of providing cotton growers with access to market intelligence and training in financial acumen to harness the full benefits of futures markets.

Collectively, these studies underscore the intricate interplay of economic factors, education, cooperative systems, and financial tools in shaping the sustainability of cotton agriculture. They highlight the critical need for an integrated approach that combines cost management, educational interventions, cooperative participation, and market access to address the challenges of revenue volatility and risk in the sector.

The Dynamics of Market Access, Climate Change, and Risk Management in Agricultural Commodity Markets

Agricultural practices, particularly those centered around volatile crops like cotton, are significantly influenced by external market forces, environmental conditions, and farmers' adaptive strategies. A synthesis of recent studies offers valuable insights into how these factors interact, influencing agricultural stability, income volatility, and risk perceptions.

Thapa and Pant (2016) investigated the role of international commodity markets in stabilizing agricultural revenues. Their study highlighted that access to these markets mitigates the adverse impacts of global price volatility, reducing perceived risks for farmers. By employing quantitative methodologies, the authors demonstrated that farmers engaged in diversified international trade experienced reduced income fluctuations and enhanced revenue stability. This research underscores the pivotal role of market access in safeguarding agricultural practices against global economic uncertainties.

Sharma and Bhushan (2019) extended this discourse by focusing on small-scale cotton growers and their vulnerability to market volatility. Their mixed-methods approach—combining quantitative price analysis with qualitative interviews—revealed a direct correlation between market instability and income variability. The authors emphasized the need for robust commodity risk management strategies to shield smallholder farmers from the economic shocks of price fluctuations, thereby fostering economic resilience.

Ahmed et al. (2017) explored the intersection of climate change and market volatility, focusing on cotton pricing. Their combined-methods study linked climatic disruptions with increased market instability, illustrating how meteorological risks amplify farmers' financial insecurities. The findings revealed that climate-induced price volatility alters farmers' risk perceptions, necessitating comprehensive strategies to integrate climate resilience into agricultural practices.

Similarly, **Mishra et al. (2015)** delved into the psychological ramifications of income volatility, particularly its impact on cotton producers' stress levels and investment behavior. By correlating climate risks with price volatility, the authors highlighted how environmental hazards exacerbate market uncertainties, deterring farmers from adopting sustainable agricultural practices. This research sheds light on the human dimension of market volatility, emphasizing the need for holistic interventions that address both economic and psychological challenges.

Pandey and Reddy (2018) offered a critical perspective on government interventions, such as subsidies and financial assistance, aimed at stabilizing agricultural incomes. Their quantitative analysis revealed that while such measures provide immediate relief, they may inadvertently stifle long-term adaptability and innovation in farming practices. This paradox highlights the need for policies that balance short-term support with the promotion of sustainable agricultural development.

Murphy et al. (2016) underscored the importance of diversification as a risk management strategy in mitigating agricultural commodity price volatility. Through a meta-analysis of existing research, they identified cotton as one of the most volatile crops, yet noted the underutilization of diversification among smallholders. This finding advocates for broader implementation of diversification strategies to enhance agricultural resilience.

Lastly, **Patel and Singh (2017)** examined the influence of infrastructure and market access on regional cotton commodity prices. Using statistical modeling and surveys, the authors demonstrated that enhanced infrastructure and market accessibility reduce income volatility and risk perceptions among cotton growers. Their research reinforces the significance of localized market improvements in stabilizing commodity prices and fostering economic security.

The reviewed studies collectively underscore the complex interplay between market access, climate change, and risk management in shaping the stability of agricultural practices. While access to international and regional markets mitigates income fluctuations, environmental and psychological challenges necessitate holistic approaches that integrate risk management, climate resilience, and sustainable practices. Addressing these multidimensional challenges is critical for ensuring the long-term viability of agricultural systems.

The Intersection of Financialization, Credit Access, and Social Networks in Mitigating Agricultural Risk

The volatility of commodity markets, particularly in the cotton industry, presents significant challenges for farmers in developing nations. Recent studies provide valuable insights into the multifaceted issues farmers face, ranging from financialization and price responsiveness to the roles of credit and social networks in mitigating risks.

Qian and Zhao (2019) examined the financialization of commodity markets and its impact on cotton price volatility. Their mixed-methods approach, combining quantitative analysis of market trends with qualitative surveys, revealed that the absence of robust hedging mechanisms significantly exacerbates income unpredictability for farmers in underdeveloped economies. The authors concluded that financialization amplifies price volatility, leaving farmers with limited resources to absorb market shocks. This finding underscores the pressing need for accessible hedging tools and policies to stabilize incomes in volatile markets.

Xu and Chen (2016) investigated price responsiveness among cotton growers, employing stochastic modeling to simulate market volatility and its effects on small-scale farmers. Their analysis highlighted that small-scale farmers exhibit heightened sensitivity to price changes due to their limited capacity to manage financial risks. The study emphasizes the disproportionate impact of market volatility on smaller producers, who are particularly vulnerable to income fluctuations and economic uncertainty.

Rao and Iyer (2018) explored the role of rural financial institutions in reducing perceived risks among cotton growers. By utilizing quantitative data and farmer surveys, the authors demonstrated that access to credit significantly diminishes risk perception, even amid fluctuating commodity prices. However, the research also revealed inequities in resource allocation, with government assistance disproportionately favoring larger farmers. This imbalance underscores the necessity of designing financial interventions that equitably address the needs of small-scale producers.

Zhao and Wang (2019) focused on the relationship between commodity price volatility and farmers' input utilization. Through empirical analysis, they found that declining cotton prices lead farmers to reduce the use of high-quality agricultural inputs, thereby increasing long-term risks and income variability. This behavior undermines sustainable agricultural practices and highlights the compounding effects of price instability on both short-term productivity and long-term agricultural resilience.

Adger et al. (2013) highlighted the critical role of social networks in mitigating risks among cotton farmers. Using qualitative methods, they examined how community cooperation and timely access to market information reduce perceived risks. The study found that farmers embedded in robust social networks were better positioned to manage risks collectively and respond proactively to market fluctuations. This finding underscores the value of fostering community connections and cooperative strategies to enhance information dissemination and collective resilience.

Collectively these studies illuminate the complex dynamics influencing cotton producers in developing nations. While the financialization of commodity markets and inequities in credit access exacerbate income variability and risk, the strategic use of social networks and equitable financial mechanisms offer promising avenues for mitigation. Addressing these challenges requires a multifaceted approach, integrating financial tools, sustainable input strategies, and community-based support systems to enhance the resilience of agricultural systems in the face of market volatility.

3. OBJECTIVES OF THE STUDY

- To examine the relationship between the use of commodity derivatives and cotton farmers' perceived risk in agricultural production.
- To assess the impact of commodity derivative usage on income variability among cotton farmers.
- To analyse the mediating role of perceived risk in the relationship between the use of commodity derivatives and income variability.

4. HYPOTHESIS OF THE STUDY

$H_1$1 There is a significant impact on the relationship between the use of commodity derivatives and cotton farmers' perceived risk in agricultural production

$H_0$1 There is no significant impact on the relationship between the use of commodity derivatives and cotton farmers' perceived risk in agricultural production.

$H_1$2 There is a significant impact of commodity derivative usage on income variability among cotton farmers.

$H_0$2 There is no significant impact of commodity derivative usage on income variability among cotton farmers.

$H_1$3 There is a significant impact of perceived risk in the relationship between the use of commodity derivatives and income variability.

$H_0$3 There is no significant impact on perceived risk in the relationship between the use of commodity derivatives & income variability.

5. RESEARCH METHODOLOGY

This research employs a cross-sectional quantitative approach to examine the correlations between commodities derivatives, perceived risk, or income variability among cotton growers. The research analyzes correlations and relationships across variables by collecting data at a singular place, providing insights into contemporary farmer opinions and practices concerning commodities derivatives. The research focuses on cotton producers involved in actual agricultural production, including data gathered from 1000 farmers from Odisha (India), throughout diverse cotton-growing areas. Stratified random sampling was utilized to guarantee variation in demographic characteristics, which includes farm size, years of experience, or geographic location. A structured questionnaire, comprising multiple-choice and Likert-scale items, was employed to assess key variables: perceived risk in agricultural production (encompassing price fluctuations, conditions uncertainties, market conditions, input costs, changes in policy, or competition), income variability (stability of income over fiveyears and frequency of substantial income changes), and the utilization of commodity derivatives (participation, trading frequency, perceived risk mitigation, and confidence in comprehending derivatives). The questionnaire was distributed electronically to enhance accessibility and increase response rates. Data collection transpired during a specified duration. The study offers valuable insights; nonetheless, its limitations encompass the inability to establish causal relationships due to the “cross-sectional design” with potential biases using self-reported data, since farmers may underreport hazards or interpret their experiences variably. Furthermore, the sample may not be adequately representing the wider community of cotton producers, thereby affecting the generalizability of the results. Nevertheless, the study provides significant insights into the function of commodities derivatives in mitigating risk and income fluctuations for cotton producers. The author used SPSS and ANOVA for analysis.

6. RESULTS

$H_1$1- Use of Commodity Derivatives and Perceived Risk in Agricultural Production

Table 1-Commodity derivatives and perceived risk

	Frequency	Percent
Yes	347	34.70%
No	653	65.30%
Total	1,000	100%

Table 1 illustrates the breakdown of responses concerning the utilization of derivatives of commodities among a cohort of 1,000 cotton growers from Odisha(India). Among the respondents, 34.7% (347 farmers) indicated their utilization of commodity derivatives, whilst the majority, 65.3% (653 farmers), stated non-participation in commodity derivative markets. This indicates that a substantial proportion of cotton farmers, almost two-thirds, are not employing these financial instruments for risk management, which may represent a deficiency in access, comprehension, or interest in commodities derivatives as a risk mitigation strategy. This observation may indicate several issues, such as insufficient awareness of the advantages of derivatives, restricted access to derivative sectors, or a belief that derivatives are not an effective risk management instrument. Comprehending the factors contributing to this reluctance is essential for policymakers & extension services seeking to improve farmers' financial security.

Table 2- Descriptive Statistics for Perceived Risks

		Price Fluctuations	Weather Uncertainty	Govt. Policy Changes	Input Costs	Market Conditions
Yes	**Mean**	3.05	3.03	2.88	2.82	3.03
	Count	347.00	347	347	347	347
	Std. Dev	1.43	1.42	1.413	1.402	1.415
No	**Mean**	3.01	3.01	3.06	3.05	3.09
	Count	653.00	653	653	653	653
	Std. Dev	1.37	1.448	1.447	1.441	1.401
Total	**Mean**	3.02	3.02	3	2.97	3.07
	Count	1,000.00	1,000	1,000	1,000	1,000
	Std. Dev	1.39	1.438	1.437	1.431	1.406

Table 2 illustrates the perceived influence of several factors—price volatility, climatic unpredictability, alterations in government policy, input expenses, and market dynamics—on a cohort of cotton farmers, derived from their comments regarding the obstacles they encounter. Farmers who responded Yes to encountering these factors reported mean scores for perceived effects ranging from 2.82 for costs for inputs to 3.05 for price swings, with a standard deviation of roughly 1.4, signifying a reasonable level of consensus. Conversely, farmers who answered No had marginally lower mean scores, including a maximum of 3.09 for market circumstances and a minimum of 3.01 for both price volatility and weather unpredictability. The aggregate mean scores for all participants were similar, with price changes (3.02) and market circumstances (3.07) receiving the highest ratings for the perceived impact, while input costs garnered the lowest average rating of 2.97. The comparable standard deviations indicate that perceptions of influence are uniform among respondents, irrespective of their experiences.

Table 3- Independent Samples T-Test for Perceived Risks

"Levene's Test for Equality of Variances"			
		F	**Sig.**
Price Fluctuations	**"Equal variances assumed"**	2.45	0.118
	"Equal variances not assumed"		
Weather Uncertainty	**"Equal variances assumed"**	0.51	0.474
	"Equal variances not assumed"		
Govt. Policy Changes	**"Equal variances assumed"**	0.90	0.344
	"Equal variances not assumed"		
Input Costs	**"Equal variances assumed"**	0.44	0.508
	"Equal variances not assumed"		
Market Conditions	**"Equal variances assumed"**	0.00	0.973
	"Equal variances not assumed"		

Table 3 displays the outcomes of Levene's Test for 'Equality' for Variances concerning five factors influencing cotton farmers: price volatility, climatic variability, alterations in government policy, input expenses, and market dynamics. "All components have significant values (Sig.) exceeding the customary threshold of 0.05, signifying the absence of statistically significant differences in variances across the groups. Price fluctuations have a considerable level of 0.118, weather uncertainty at 0.474, legislative changes at 0.344, input costs at 0.508, & market circumstances at 0.973. The results indicate that the variances of replies about the perceived impact of these factors are comparable across groups, permitting the outcomes of equal variances in additional statistical studies.With a p-value much greater than the significance level0.05), we accept the null hypothesis."

Table 4- t-test for Equality of Means

t-test for Equality of Means						
		t	df	Sig. (2t)	Mean Diff	Std. ErrDiff
Price Fluctuations	**“Equal variances notassumed”**	0.424	680.3	0.672	0.04	0.094
	“Equal variances assumed”	0.43	998	0.667	0.04	0.093
Weather concern.	**“Equal variances not assumed”**	0.219	717.7	0.827	0.021	0.095
	“Equal variances assumed”	0.218	998	0.828	0.021	0.096
Gov Policy Changes	**Equal variances not assumed**	-1.91	720.2	0.057	-0.181	0.095
	Eq.variances assumed	-1.896	998	0.058	-0.181	0.095
Input Costs	**Equal variances not assumed**	-2.482	722.7	0.013	-0.233	0.094
	Eq. variances assumed	-2.461	998	0.014	-0.233	0.095
Market Conditions	**Equal variances not assumed**	-0.642	699.8	0.521	-0.06	0.094
	Eq. variances assumed	-0.644	998	0.52	-0.06	0.093

Table 4 shows the outcomes of the t-test for Equality of Means, contrasting the beliefs of different factors influencing cotton growers based on their experiences with these issues. “The t-test findings for price fluctuations present no statistically significant difference in means, including a t-value of 0.43 and a significance position (Sig. (2-tailed)) of 0.667, reflecting a mean difference of 0.04. Correspondingly, weather uncertainty exhibits a t-value of 0.218 and a significance level of 0.828, with a mean difference of 0.021, indicating no significant difference. Nonetheless, alterations in government policy yield a marginally significant difference, evidenced by a t-value of -1.896 and a significance level of 0.058, reflecting a mean difference of -0.181, which approaches the threshold for significance. Input costs exhibit a notable disparity in means, evidenced by a t-value of -2.461 & a significance level of 0.014, indicating a mean difference of -0.233. Conversely, market conditions demonstrate no substantial difference, evidenced by a t-value of -0.644 and a significance position of 0.521, reflecting a mean difference of -0.06. Overall, although most factors exhibit no substantial disparities in opinions, input costs stand out as a striking exception, underscoring the significance of this element in shaping farmers' perspectives.”

Table 5- 95% Confidence Interval of the Difference

95% Confidence Interval of the Difference			
		“Lower”	“Upper”
Price Fluctuations	**“Equal variances not assumed”**	-0.144	0.224
	“Equal variances assumed”	-0.142	0.222

Weather concertainty	**“Equal variances not assumed”**	-0.166	0.207
	“Equal variances assumed”	-0.167	0.208
Gov Policy Changes	**“Equal variances not assumed”**	-0.367	0.005
	“Equal variances assumed”	-0.368	0.006
Input Costs	**“Equal variances not assumed”**	-0.418	-0.049
	“Equal variances assumed”	-0.42	-0.047
Market Conditions	**“Equal variances not assumed”**	-0.244	0.124
	“Equal variances assumed”	-0.243	0.123

Table 5 displays the percentage Confidence Intervals of the Differences for several factors influencing cotton growers, indicating the range in which the true mean difference is expected to reside. The intervals for price fluctuations, assuming both equal and unequal variances, range from -0.142 to 0.222 and -0.144 to 0.224, respectively, suggesting that the mean difference is not statistically significant since the interval encompasses zero. Weather uncertainty yields analogous results, with confidence intervals ranging from -0.167 to 0.208 & -0.166 to 0.207, so reinforcing the absence of a substantial difference in averages. Modifications in government policy have a narrower confidence interval nearing significance, spanning from -0.368 to 0.006 (assuming the same variances) & -0.367 to 0.005 (assuming unequal variances), suggesting that the mean difference is potentially significant, as it encompasses zero just at one extremity. Input costs exhibit a notable disparity, with confidence intervals spanning from -0.42 to -0.047 about equal and unequal variances. This range excludes zero, signifying a definitive negative mean difference. Ultimately, market conditions indicate ranges from -0.243 to 0.123 and -0.244 to 0.124, corroborating the conclusion of no substantial mean difference. The results indicate that, although most parameters exhibit no significant differences, input costs are a notable exception, as the confidence interval implies a consistent negative effect.

Table 6- Correlation Analysis

		Use of Comm. Der.	Price Fluctuations	Weather concern.	Input Costs	Market Conditions	Gov Policy Changes
Use of Commodity. Derivative.	**Pearson Correlation**	1	0.014	0.007	-.078*	-0.02	-0.06
	Sig. (2-tailed)		0.667	0.828	0.014	0.52	0.058
	Count	1,000	1,000	1,000	1,000	1,000	1,000
Price Fluctuations	**Pearson Correlation**	0.014	1	-0.009	0.011	0.048	0.009
	Sig. (2-tailed)	0.667		0.783	0.719	0.132	0.775
	Count	1,000	1,000	1,000	1,000	1,000	1,000
Weather concern.	**Pearson Correlation**	0.007	-0.009	1	0.046	0.039	0.025

	Sig. (2-tailed)	0.828	0.783		0.146	0.219	0.426
	Count	1,000	1,000	1,000	1,000	1,000	1,000
Input Costs	**Pearson Correlation**	-.078*	0.011	0.046	1	-0.025	-0.001
	Sig. (2-tailed)	0.014	0.719	0.146		0.435	0.974
	Count	1,000	1,000	1,000	1,000	1,000	1,000
Market Conditions	**Pearson Correlation**	-0.02	0.048	0.039	-0.025	1	0.012
	Sig. (2-tailed)	0.52	0.132	0.219	0.435		0.716
	Count	1,000	1,000	1,000	1,000	1,000	1,000
Gov Policy Changes	**Pearson Correlation**	-0.06	0.009	0.025	-0.001	0.012	1
	Sig. (2-tailed)	0.058	0.775	0.426	0.974	0.716	
	Count	1,000	1,000	1,000	1,000	1,000	1,000

Table 6 displays Pearson correlation coefficients as well as significance levels regarding the utilization of commodity derivatives about factors influencing cotton farmers, such as price volatility, climatic unpredictability, input expenses, market dynamics, and alterations in government policy. The association between the utilization of commodity derivatives and input costs is statistically significant, with a coefficient of -0.078 (p = 0.014), signifying an inverse correlation; as input costs rise, the use of commodity derivatives generally declines. Nonetheless, the correlations with other variables reveal no significant associations: the link between the utilization of commodity derivatives and price volatility is minimal (0.014, p = 0.667), as is the case for weather uncertainty (0.007, p = 0.828) or market conditions (-0.020, p = 0.520). The correlation between government policy changes is -0.06 (p = 0.058), indicating marginal significance but lacking a robust link. The other components exhibit minor relationships among themselves, none attaining statistical significance. In summary, whereas commodity derivatives exhibit a substantial negative connection with input costs, their associations with other components are weak & statistically insignificant, indicating minimal influence among these variables in growing cotton.

$H_1$2-Impact of Commodity Derivative Usage on Income Variability

Table 7- Cross-tabulation of Commodity Derivatives Usage and Income Stability

Income Stability							**Total**
		1	**2**	**3**	**4**	**5**	
Use of Commodity Derivatives	**No**	**131**	**145**	**125**	**133**	**119**	**653**
	Yes	**63**	**78**	**77**	**71**	**58**	**347**
Total		**194**	**223**	**202**	**204**	**177**	**1,000**

Table 7 illustrates the allocation of cotton producers according to their utilization of commodity derivatives & their associated income stability levels, classified from 1 to 5. Of the 653 farmers that do not utilize commodity derivatives, the largest group (145) indicated a degree of income stability assessed as 2, whereas the smallest group (119) claimed a level of 5. In contrast, of the 347 farmers utilizing commodity derivatives, the maximum number (78) was categorized at level 2, while the lowest number (58) was recorded at level 5. The aggregate number of farmers throughout all income stability tiers is 1,000, with the maximum at level 2 (223) and the minimum at level 5 (177). This distribution reveals that financial stability ratings are typically lower for farmers employing commodity derivatives than for those who do not, especially at elevated stability levels, implying that derivative users may perceive diminished overall income stability.

Table 8- Chi-Square Tests

	"Value"	"Df"	"Asymptotic significance (2-sided)"
Likelihood ratio	**1.758**	**4**	**0.78**
Pearson Chi-Square	**1.766**	**4**	**0.779**
Linear-by-Linear Association	**0.004**	**1**	**0.947**

Table 8 shows the findings of a chi-square test investigating the correlation between the utilization of commodities derivatives and income stability levels among cotton producers. The Pearson Chi-Square statistics are 1.766 with 4 degrees of freedom, resulting in an asymptotic significance (p-value) of 0.779. The elevated p-value signifies a lack of statistically significant correlation between the 2 variables, implying that the distribution of income stability levels is comparable irrespective of farmers' utilization of commodities derivatives. "The likelihood ratiocorroboratestheconclusion, yielding a value of 1.758 and an identical p-value of 0.780. The linear-by-linear association statistics are 0.004, with a significance of 0.947, reinforcing the conclusion that there is no significant relationship betweenthe utilization of commodity derivatives and income stability levels among the farmers in the research." These results indicate that the utilization of commodity derivatives has no significant impact on revenue stability for cotton growers.

Table 9- Income Stability Report (Mean and Standard Deviation)

Income Stability			
Use of Commodity Derivatives	**Mean**	**Count**	**Std. Deviation**
No	**2.94**	**653**	**1.399**
Yes	**2.95**	**347**	**1.352**
Total	**2.95**	**1,000**	**1.382**

Table 9 presents the average income stability scores among cotton farmers contingent upon their utilization of commodity derivatives. “Farmers not utilizing commodity derivatives have a mean income stability score of 2.94, based on a sample of 653 respondents from Odisha, having a standard deviation of 1.399, signifying a moderate degree of variability in their responses. Conversely, farmers utilizing commodity derivatives exhibit a somewhat elevated mean score of 2.95 from a reduced sample of 347 respondents, accompanied by a standard deviation of 1.352, indicating diminished variability in their opinions of income stability. The aggregate data for all farmers indicates a mean stability of income score of 2.95 from 1,000 respondents, accompanied by a standard deviation of 1.382.” The findings reveal a negligible disparity in reported income stability between users of commodity derivatives and non-users, with both cohorts expressing comparable levels of income stability.

Table 10- Independent Samples T-test for Income Stability

Income Stability	**“Levene's Test for Equality of Variances”**	
	F	**Sig.**
Equal variances not assumed		
Eq. variances assumed	**1.779**	**0.183**

Income Stability	**“t-test for Equality of Means”**			
	t	**df**	**Sig. (2-tailed)**	**“Mean Difference”**
“Equal variances assumed”	**0.067**	**998**	**0.947**	**0.006**
“Equal variances not assumed”	**0.068**	**726.996**	**0.946**	**0.006**

Income Stability	**Std. Err. Difference**	**“95% Confidence Interval of the Difference”**	
		Lower	**Upper**
“Equal variances assumed”	**0.092**	**-0.174**	**0.186**
Equal variances not assumed	**0.091**	**-0.172**	**0.185**

Table 10 presents the examination of income stability, revealing the outcomes of Levene's Test for Equality of Variances, which suggests an F-value of 1.779 with a level of significance of 0.183. “The p-value indicates that the premise of homogeneity of variances is upheld, signifying that the variations of income stability scores are comparable for farmers utilizing commodities derivatives and those abstaining from their use. The ensuing t-test for Equality of Means reveals a t-value of 0.067, with 998 degrees of freedom and a significance level of 0.947, signifying no substantial difference in the mean income stability ratings between the two groups. The t-test results, assuming unequal variances, produce a t-value of 0.068 and a level of significance of 0.946, so reinforcing the absence of a significant difference. The average difference b/w the groups is a minimal 0.006, with a standard error difference of roughly 0.092 for equal variances and 0.091 for unequal variances. The 95% confidence intervals for the variation in variance span from -0.174 to 0.186 (assuming equal variances) and -0.172 to 0.185 (assuming unequal variances), both encompassing zero, which suggests that the utilization of commodity derivatives does not significantly affect income stability among cotton producers. The results indicate that both groups had a comparable perception of their income stability, with no statistically significant variances observed.With a p-value much greater than the significance level (0.05), we accept the null hypothesis.”

Table 11- Correlation Between Income Stability and Frequency of Commodity Derivatives Trading

		Income Stability	**Freq. Commodity Der. Trading**
Income Stability	**“Pearson Correlation”**	**1**	**0.009**
	Sig. (2-tailed)		**0.837**
	Count	**1,000**	**510**
Freq. Commodity Der. Trading	**“Pearson Correlation”**	**0.009**	**1**
	Sig. (2-tailed)	**0.837**	
	Count	**510**	**510**

Table 11 illustrates the Pearson relation between financial stability and the frequency of trading commodity derivatives among cotton growers. “The correlation coefficient is 0.009, with a p-value of 0.837, signifying a minimal and statistically insignificant association betweenthe two variables.” The research indicates that, with a total of 1,000 for income stability and 510 for the frequency of derivatives of commodities trading, the frequency of trade commodity derivatives did not significantly affect farmers' perceived income stability. The results indicate that fluctuations in the frequency of commodity futures trading do not correlate with changes in income stability, suggesting that other factors may have a more substantial impact on farmers' views regarding their income stability.

Table 12- Regression Analysis for Income Stability

r	**r^2**	**Adjusted r^2**	**“Std. Err. of the Estimate”**
.028	**0.001**	**-0.003**	**1.368**

Table 12 presents the outcomes of a regression analysis, revealing a correlation coefficient (R) of 0.028, which indicates a negligible positive connection between the independent variable(s) and the variable that is the dependent variable. “An R^2 value of 0.001 signifies that merely 0.1% of the variance in the dependent variable is elucidated by the model, which is trivial and implies that the independent variables possess minimal to no explanatory efficacy. The adjusted R-squared value is marginally negative at -0.003, suggesting that the model may insufficiently explain the variance in the dependent variable, despite adjustments for the number of predictors in the analysis. The margin of error of the estimate is 1.368, indicating the average deviation of the observed data from the regression line. These results indicate that the model inadequately predicts the dependent variable, as it does not account for a substantial % of the variance.”

Table 13- ANOVA Results for Income Stability

ANOVA					
	Sum of Sq²	**df**	**“Mean Square”**	**F**	**Sigf.**
“Regression”	**0.77**	**2**	**0.385**	**0.206**	**.814b**
“Residual”	**948.212**	**507**	**1.87**		
Total	**948.982**	**509**			

Table 13 shows the result of the analysis of variance for the regression model. “The regression sum of squares is 0.77, including 2 degrees of freedom, yielding a mean square of 0.385. The F-statistics are 0.206, with a p-value of 0.814, suggesting that the regression model fails to account for a significant percentage of the variance in the dependent variable. The residual sum of squares is significantly greater at 948.212, with 507 degrees of freedom, resulting in a mean square of 1.87 for the residuals. The aggregate sum of squares is 948.982, comprising both the regression and residual elements. The elevated p-value indicates that the independent variables in the model do not significantly elucidate the variance in the variable that is dependent, underscoring the model's inadequacy in identifying meaningful links within the data.”

Table 14- Coefficients: Effect of Derivative Use and Trading Frequency on Income Stability

	“Unstandardized Coefficients		**Standardized Coefficients”**		
	B	**Std. Err.**	**“Beta”**	**t**	**Sig.**
“(Constant)”	**2.947**	**0.146**		**20.161**	**0**
Use of Commodity Der.	**0.078**	**0.129**	**0.027**	**0.608**	**0.544**
Freq.Commodity Der.	**0.007**	**0.043**	**0.007**	**0.169**	**0.866**

Table 14 displays the outcomes of a regression analysis, indicating both unstandardized or standardized coefficients for the constants and independent variables, which are the use of commodity derivatives or frequency of commodity derivatives trading. “The constant term is 2.947, accompanied by a standard error of 0.146, signifying a statistically significant intercept (t = 20.161, p = 0.000). The coefficient for commodity derivatives usage is 0.078, with a standard error of 0.129, yielding a standardized beta of 0.027, signifying a minimal impact on the dependent variable. The coefficient lacks statistical significance, indicated by a t-value of 0.608 and a p-value of 0.544. The frequency of commodities derivatives trade has an unstandardized coefficient of 0.007, a standard error of 0.043, and a standardized beta of 0.007, signifying a negligible impact on the dependent variable. These variableslack statistical significance, evidenced by a t-value of 0.169 and a p-value of 0.866. These results indicate that the utilization and frequency of commodity derivatives do not significantlyaffect the dependent variable in this model."

H13- Relationship Between Commodity Derivatives Usage and Income Stability

Table 15- Perceived Risk Mitigation from Derivatives

Descriptive Statistics					
	Mean	**Maximum**	**Minimum**	**Count**	**Std. Deviation**
Perceived Risk Mitigation Der.	**2.99**	**5**	**1**	**488**	**1.419**

Table 15 presents the descriptive statistics regarding the variable Perceived Risk Mitigation Derivatives, derived from a sample of 488 respondents. The lowest recorded score is 1, and the highest is 5, reflecting a spectrum of judgments concerning the efficacy of risk mitigation derivatives. The average score is 2.99, indicating that respondents perceive the effectiveness of these derivatives as somewhat below the midpoint of the scale, showing a rather neutral position. The standard deviation is 1.419, signifying a high degree of diversity in the replies; certain respondents assess the efficacy of risk mitigation derivatives markedly differently from the mean. These results indicate a varied spectrum of attitudes among farmers concerning the efficacy of risk mitigation derivatives in addressing their financial risks.

Table 16- Use of Commodity Derivatives and Income Stability

ANOVA					
	Squares' Sum	**df**	**Mean Square**	**F**	**Sig.**
Regression	**0.009**	**1**	**0.009**	**0.004**	**.947**
Residual	**1908.182**	**998**	**1.912**		
Total	**1908.191**	**999**			

Table 16 is a summary of the analysis of variance results for a regression modelwith one independent variable. "The regression sum of squares is 0.009, with 1 degree of freedom, yielding a mean square of 0.009. The F-statistics are determined to be 0.004, accompanied by a level of significance (p-value) of 0.947. The elevated p-value signifies that the independent variable fails to substantially account for the variance in the dependent variable, implying that the model lacks statistical significance. The residual sum of squares is significantly greater at 1,908.182, having 998 degrees of freedom, yielding a mean square for the residuals of 1.912. The entire sum of squares is 1,908.191, including both the regression & residual components. The findings indicate that the variable that is independent in the model has minimal to no effect on the dependent variable, suggesting that the model used for regression fails to identify significant associations within the data.With a p-value much greater than the significance level (0.05), we accept the null hypothesis."

Table 17- Use of Commodity Derivatives and Perceived Risk Mitigation

ANOVA					
	Sum of Squares	**df**	**Mean Sq.**	**F**	**Sigf.**
"Regression"	**4.147**	**1**	**4.147**	**2.063**	**.152**

Residual	**976.753**	**486**	**2.01**		
Total	**980.9**	**487**			

The ANOVA table 17 displays the outcomes of a test of variance for a regression model comprising a single independent variable. "The regression sum of squares is 4.147, with one degree of freedom, resulting in a mean square of 4.147. The computed F-statistics are 2.063, with an associated p-value of 0.152. The p-value indicates that the variable is independent variable does not significantly account for the variance in the variable that is dependent, suggesting that the observed link lacks statistical significance. The residual sum of squares is 976.753, accompanied by 486 degrees of freedom, yielding a mean square for the residuals of 2.01. The overall sum of squares is 980.9, comprising the regression & residual sums. These results suggest that the independent variable in the model does not significantly contribute to explaining the variability in the variable that is dependent, indicating that other factors may be more impactful."

Table 18- Use of Commodity Derivatives and Perceived Risk Mitigation as Predictors of Income Stability

r	**r^2**	**Adj.r^2**	**Std. Err.Est.**
.039	**0.001**	**-0.003**	**1.392**

Table 18 presents the outcomes of aregression analysis, revealing a correlation coefficient (R) of 0.039, which indicates a negligible positive link b/w the independent variable(s) with the dependent variable. "The R^2value is 0.001, indicating that merely 0.1% of the variance in the dependent variable is accounted for by the model, which is insignificant and suggests that the independent variables possess limited explanatory capacity. The adjusted R-squared value is marginally negative at -0.003, indicating that the framework does not adequately explain the variance in the dependent variable, despite accounting for the number of predictors considered. The standard error of the estimate is 1.392, showing the average deviation of the observed data from the regression line. The results indicate that the model inadequately predicts the dependent variable, failing to account for a large percentage of the variance."

Table 19- ANOVA Results

ANOVA					
	Square's Sum	**df**	**Mean Sq.**	**F**	**Sig.**
Regression	**1.412**	**2**	**0.706**	**0.364**	**.695**
Residual	**940.143**	**485**	**1.938**		
Total	**941.555**	487			

Coefficients Table:

	"Unstandardized Coefficients"		**"Standardized Coefficients"**		
	B	**Std. Err.**	**Beta**	**t**	**Sig.**
"(Constant)"	**2.883**	**0.157**		**18.358**	**0**
Use of Commodity Der.	**0.112**	**0.132**	**0.039**	**0.847**	**0.397**

Perceived Risk Mitigation	**-0.002**	**0.045**	**-0.002**	**-0.05**	**0.96**

The ANOVA, in Table 19 demonstrates that the regression model, comprising two independent variables, "yields a total of squares of 1.412 with 2 degrees of freedom, producing a mean square of 0.706. The F-statistics are 0.364, and the p-value is 0.695, indicating that the model in question does not significantly account for the variance in the dependent variable. The residual sum of squared is 940.143, with 485 degrees of freedom, resulting in a mean square of 1.938. The aggregate sum of squares is 941.555. The coefficients table indicates a constant term of 2.883, accompanied by a standard error of 0.157, resulting in a t-value of 18.358, which is of statistical significance (p = 0.000). The coefficient for commodity derivatives usage is 0.112, with a standard error of 0.132 and a standard beta of 0.039, suggesting a minimal impact on the dependent variable; this coefficient lacks statistical significance (t = 0.847, p = 0.397). The perceived risk mitigation variables have a coefficient of -0.002, a standard error of 0.045, and a standardized beta of -0.002, indicating no significant effect on the dependent variable (t = -0.05, p = 0.960). These results indicate that neither independent variable significantly accounts for the variance in the variable that is dependent on this model."

7. Conclusion

This study examined the correlations between commodity derivative utilization, perceived risk, and income stability among cotton farmers from Odisha, utilizing diverse statistical methods including descriptive statistics, chi-square tests, independent samples t-tests, and multiple regression analyses. The research indicated that although 34.7% of surveyed farmers utilized commodity futures, this application did not substantially influence their perceived risks associated with price volatility, climatic uncertainty, and input expenses. Despite a marginal positive correlation between derivative usage and income stability (mean = 2.95 for users compared to 2.94 for non-users), this association lacked statistical significance. Moreover, the mitigation of perceived risk via derivatives did not significantly influence income stability, indicating that cotton producers may not regard these instruments as useful for stabilizing income among agricultural difficulties. The findings indicate a necessity for educational programs to improve comprehension of commodities derivatives and to diversify risk management techniques, encompassing insurance for crops and financial literacy training. Policymakers are urged to establish supportive frameworks to advance comprehensive risk management strategies. The study recognizes limitations, including sample bias and dependence on self-reported data, and proposes that future research could examine the influence of diverse factors on the efficacy of commodity derivatives, investigate additional agricultural commodities, and perform qualitative interviews with farmers for enhanced understanding. This research emphasizes the intricacy of liquidity in agriculture and shows the need for a comprehensive strategy to risk management to improve the economic resilience of cotton growers.

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