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DAIRY FARMING IN MYMENSINGH DISTRICT: RESPONSES TO ECONOMIC SHIFTS IN FEED INGREDIENT PRICES

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ABSTRACT

The dairy sector in Bangladesh is vital for providing essential food, protein, and employment. Despite significant growth over the past 40-50 years, the sector faces challenges such as low productivity, inadequate feed, and price fluctuations of input, exacerbated by the COVID-19 pandemic. Using a purposive sampling approach, primary data was collected from the dairy farmers of Mymensingh district. This study has sought to examine farmers' perception of feed ingredients price change and their responses to it. The study summarizes the present status of farmers' perception about the factors causing price changes. Results show the majority of the respondents marked 'global market trends' responsibility for the price fluctuations of the feed ingredients with the farmers' perception score 80.8%, where uncultivated grass, green fodder, urea molasses straw, etc. were stated as the most critical inputs considered by dairy farmers. Mustard oil cake, cattle pellet, and vitamin-mineral premix were the leading ingredients with high price fluctuation according to the respondents. More than three-fifths of the total respondents (65%) undertook adaptation strategies to cope with price fluctuations where 'bulk purchasing' was the most chosen strategy to gain economies of scale and reduce costs. Moreover, age and Farmers' Perception of Price Change (FCPI) had a negative and significant impact on the adoption of adaptation strategies, whereas experience had a positive and significant effect on it. However, the results given by the study can assist policymakers in organizing essential training and campaigns for adaptation strategies.

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I. INTRODUCTION

The agricultural economy of Bangladesh depends heavily on dairy farming because it ensures food security and nutritional needs while supporting rural communities. The dairy industry produces more than 14 million metric tons of milk yearly through its 24.9 million cattle population and 8–10 lakh dairy farms (DLS, 2023). The agricultural GDP from dairy products reaches 12% while the rural population depends on dairy for direct employment at 20% and indirect employment at 50% (DLS, 2023). The annual milk production deficit reaches 1.8 million metric tons because Bangladesh produces 221.9 ml/day/head but needs 250 ml/day/head (DLS, 2023).

Millions of dairy producers in Bangladesh were also impacted by the global coronavirus outbreak. The government of Bangladesh is making an effort to protect farming. Moreover, due to the recent spike in animal feed prices, milk production has become more expensive, giving dairy farmers little chance of making the anticipated profits. Several farmers around the nation claim that the country's lack of market control has caused feed prices to rise dramatically. The dairy producers are the poor and marginal ones because they cannot afford to purchase expensive dry feed and because there is not enough grazing land on their farms. Furthermore, Moses (2024) said that because of inadequate nutrition, the cows have become emaciated, and their milk yield has decreased, making it nearly hard to recoup production expenses. The existing feed price volatility worsens the situation because of the 2019 milk quality crisis and the COVID-19 pandemic (IDRN, 2020). Even the high feed expenses in 2022 forced numerous small dairy farms to shut down because of worldwide market patterns and rising fuel energy expenses and domestic supply-demand discrepancies (Tadesse et al., 2016).

The price instability of feed materials creates substantial difficulties for dairy farmers operating in Mymensingh and other areas where dairy farming serves as a primary economic source. The price instability of mustard oil cake and cattle pellets affects farmers' ability to plan their finances and maintain profitability (Mamun & Laborde, 2024). The U.S. Department of Agriculture predicted that feed prices would remain elevated throughout 2024 which would create additional difficulties for smallholder farmers who need to purchase feed (Star Business Report, 2024). The sustainable development of dairy farming faces additional challenges because of feed price fluctuations together with disease infections and limited veterinary care and inadequate transportation infrastructure (Patil et al., 2009).

The dairy farming industry requires adaptation strategies to reduce economic damage from feed price fluctuations while preserving its sustainability. The unpredictable nature of feed prices leads to higher production expenses and diminished profits which endanger the survival of smallholder farmers thus they need adaptive strategies to preserve their financial stability and resilience (Tadesse et al., 2016). The ability of dairy farmers to handle economic shocks improves through their implementation of feed management adjustments and resource optimization and income diversification strategies according to Wolf & Widmar (2014) and ElBenni & Finger (2013). Smallholder farmers in developing countries such as Bangladesh require these strategies because they operate with limited resources and restricted access to risk management tools (Patil et al., 2009). The identification of socioeconomic factors that drive these strategies becomes essential for developing sustainable dairy farming interventions.

The dairy sector remains crucial, but researchers have not yet fully understood how farmers view price volatility causes, and which inputs are most volatile and which adaptation methods work best. The current research lacks sufficient analysis of how socioeconomic factors

affect farmers' price change understanding and their adaptive actions. Research into these knowledge gaps will deliver essential economic data about dairy farming in Bangladesh which will help create specific support programs for farmers to manage feed price volatility while achieving Sustainable Development Goals (SDGs) related to food security and rural livelihoods. The following hypothesis was developed to lead this study in Mymensingh Bangladesh: H1: The adoption of adaptation strategies to manage feed ingredient price fluctuations depends heavily on socioeconomic factors including age and education level and experience and the number of milking cows.

II. MATERIALS AND METHODS

2.1 Selection of Study Area

Mymensingh Sadar, Trishal, Phulpur & Tarakanda upazila under the districts of Mymensingh stands as a pivotal hub for dairy farming due to the pastureland, an abundance of grazing field and low-income family. These favorable attributes collectively position Mymensingh district as an ideal focal point for examining the dynamics of dairy farming within the broader context of price changing perception.

2.2 Sample Design and Size

A total of 80 dairy farmers were selected through purposive sampling where half of the participants owned less than three cattle, and the other half owned more than three cattle. The selected sample represents the entire population of interest by effectively displaying its fundamental characteristics and attributes. Respondents were deliberately chosen to be women, who constituted 92% of the sample and were predominantly middle and old females (aged 36 and above), reflecting their significant role in dairy farming activities in Mymensingh. In rural Bangladesh, women typically spend a substantial portion of their working hours on livestock management, including feeding, milking, and cleaning, despite farm ownership often being held by male counterparts (Islam et al., 2019; Uddin et al., 2016). Male respondents (8%) were included only when female household members were unavailable, ensuring the sample remained representative of those directly involved in dairy operations.

2.3 Sources and Collection of Data

In the pursuit of data acquisition, a structured questionnaire was methodically devised in alignment with the precise objectives delineated for this study. The collection of primary data at the field level was entrusted to qualified enumerators, who embarked on this data collection process in the month of July 2024. Secondary sources of data were collected from the Department of Livestock Service (DLS), BBS, journals, newspapers, articles, the internet etc. For minimizing errors, data were collected in local units. After that the data was converted into appropriate standard units.

2.4 Analytical Techniques and Model Estimation

A comprehensive analytical framework encompassing both qualitative and quantitative methodologies were applied in the investigation. The data collection process ended with a thorough summary of the information followed by a detailed examination of the collected data.

The Microsoft Excel and SPSS applications performed data analysis which produced results that were presented through textual exposition and tabular representations and graphical illustrations.

Farmers' Perception on Causes Score and Index. To compare the perception of the respondents regarding the selected statements on causes of livestock rearing a Farmers' Perception on Causes Score **(**FPCS) which represent the observed perception score on the causes of price change, was calculated by using the following formula (concept adopted and modified from Biswas et al. (2022):

$$FPCS = N_{SA} \times 5 + N_A \times 4 + N_N \times 3 + N_D \times 2 + N_{SD} \times 1$$

Where, FPCS= Farmers' Perception on Causes Score; N_{SA}= Number of respondents rated the statement as strongly agree; N_A= Number of respondents rated the statement as agree.

N_N= Number of respondents rated the statement as undecided; N_D= Number of respondents rated the statement as disagree; N_{SD}= Number of respondents rated the statement as strongly disagree. Farmers' Perception Causes Index (FPCI) is the ratio of observed cause perception score to possible highest cause perception score and multiplied by 100. It was calculated the following formula. Based on the obtained FPCI value ranking was done among the individual statement.

$$FPCI\ (\%) = \frac{\text{Observed perception score on causes}}{\text{Possible highest perception of causes}} \times 100$$

Weighted critical inputs. The study area dairy farmers used a Four-point rating scale to evaluate their most important inputs and price volatility. The respondents evaluated multiple factors through the scoring system where '4' represented very high frequency and '3' represented high frequency and '2' represented low frequency and '1' represented very low frequency. The final scores were weighed before the factors received ascending rankings based on their scores for both concerns.

Multiple Linear Regression. To ascertain the factors influencing the adoption of adaptation strategies in response to feed ingredient price fluctuations, a multiple linear regression model was employed, with the Adaptation Strategies Undertaking Score (ASUS) as the dependent variable and age, experience, education, number of milking cows, cost of cow per month, and Farmers' Perception on Causes Index (FCPI) as explanatory variables.

The ASUS, ranging from 0 to 10, was constructed by assigning a score of 1 for each of the ten pre-determined adaptation strategies adopted by a respondent (e.g., bulk purchasing, reducing herd size), with 0 assigned if no strategies were adopted. This scoring mechanism is consistent with prior studies that use composite indices to measure adoption intensity in agricultural contexts (e.g., Deressa et al., 2009; Below et al., 2012). The range of ASUS (0 to 10) reflects the cumulative adoption of strategies, providing a continuous measure suitable for linear regression analysis.

The selection of explanatory variables was informed by theoretical and empirical evidence. Age, education, and experience are commonly included in models of agricultural decision-making, as they influence farmers' risk perceptions and adaptive capacity (Maart-Noelck & Musshoff, 2014; Below et al., 2012). For instance, Maart-Noelck and Musshoff (2014) found that age and

experience significantly affect risk attitudes in farming, with older farmers often exhibiting greater risk aversion. Education enhances farmers' ability to access and process market information, as shown by Deressa et al. (2009) in their study of climate adaptation strategies among Ethiopian farmers. The number of milking cows and cost of cow per month were included to capture farm-scale and economic constraints, as larger farms or higher costs may drive adaptation to mitigate financial risks (ElBenni & Finger, 2013). The FCPI, a novel perception-based index, was included to assess how awareness of price volatility causes influences adaptation, building on studies that link farmer perceptions to behavioral responses (Tadesse et al., 2016). The regression model is specified as:

$$ASUS = \alpha + \beta_1 X_1 + \ldots\ldots\ldots\ldots + \beta_6 X_6 + \mu$$

where α is the intercept, X_1=Experience, X_2=number of milking cows, X_3=Education, X_4=Cost of cow per month, X_5=Age, X_6=FCPI, β_1 to β_6 are the coefficients for the respective explanatory variables, and μ is the error term. Diagnostic checks, including Variance Inflation Factor (VIF) values below 4, confirmed the absence of multicollinearity, ensuring the reliability of the model (Gujarati & Porter, 2009).

III. RESULTS AND DISCUSSION

3.1 Socio-Demographic Profile of the Respondents

A total of 80 dairy-farm household respondents from Mymensingh, Bangladesh participated in the study whose socio-demographic information included gender, age, and education background (Table 1). The study sample consisted of females at 92% because women perform most dairy farm duties despite farm ownership resting with men (Islam et al., 2019). The gender distribution fits rural Bangladesh cultural patterns since women function as primary livestock caregivers (Halim & Kabir, 2021). The age distribution shows that 46.2% of respondents are older (above 50 years), 31.3% are middle-aged (36–50 years), and 22.5% are young (up to 35 years), indicating a sample skewed toward older women who likely have greater experience in dairy operations. Education levels are relatively low, with 73.8% having primary education, 17.4% secondary education, and 8.8% being illiterate, consistent with limited access to formal schooling among rural women, particularly older generations (Uddin et al., 2016).

The demographic data of this study allows for better understanding of the regression findings which show that age decreases the Adoption Strategies Undertaking Score (ASUS), and education has a positive effect. The data in the table shows the socioeconomic background of respondents including their occupation, experience and land ownership because these factors help explain their reaction to feeding price fluctuations. The occupational structure of the respondents shows that 52% practice dairy farming as their main work while 45% work in crops and 3% serve in other roles which matches the agricultural character of Mymensingh where dairy farms commonly operate alongside crop production. The experience levels of dairy farming vary among respondents because 46.3% have low experience while 25% have moderate experience and 28.7% have high experience which supports the study's conclusion that experienced farmers strongly adapt to strategies (standardized beta of 0.563). Land ownership is limited, with only 25% owning land and 75% lacking ownership, a common scenario in rural Bangladesh where landlessness constrains resources like grazing areas and fodder production (Das et al., 2021). The socioeconomic profile shows that respondents need to adapt their

practices through bulk purchasing and self-cultivation of fodder because they depend on purchased feed and have restricted access to land to stabilize feed price fluctuations.

Table 1: The socio-demographic profile of the respondents

Category	Details	Percentage (%)
Gender	Male	8
	Female	92
Age	Young (up to 35)	22.5
	Middle (36 to 50)	31.3
	Old (above 50)	46.2
Education	Illiterate	8.8
	Primary	73.8
	Secondary	17.4
Occupation	Cropping	45
	Service	3
	Dairy	52
Experience	Low	46.3
	Moderate	25.0
	High	28.7
Land Ownership	Own land	25
	No ownership	75

3.2 Causes of Price Volatility: Farmers' Perception

Most Critical Inputs for Dairy Farmers

The research of Mamun and Laborde (2024) identifies multiple factors which could affect price volatility in the market. Supply of raw materials together with demand shocks caused by weather conditions and consumer spending patterns serve as one of the sources. The behavioral responses of farmers to price signals and inventory holdings (whether government or commercial) lead to either over or under-use of contracts. The weighted averages for different cattle feed types including green fodder to boiled rice water are presented in Table 2.

The nutritional value of uncultivated grass makes it the preferred choice among all feed types since its weighted average reaches 3.70. The high preference for uncultivated grass may stem from its availability together with its palatability and nutritional advantages. The weighted average of 3.33 indicates that green fodder including Napier, German and Jambo varieties plays a vital role in cattle nutrition. The high yield and nutritional value of this feed make it essential for cattle diets. The weighted averages of 3.30 and 3.28 indicate that urea molasses straw and maize silage are highly valued. These feed types are valued for their enhanced nutritional profiles and preservation qualities, which make them reliable sources of energy and nutrients for cattle. The weighted averages of 3.20 and 3.15 show that rice straw and mustard oil cake hold moderate value. The availability of rice straw makes it a common choice for cattle feed even though it is a by-product while mustards oil cake gains value because of its protein content which serves as a beneficial supplement in cattle feed.

Table 2: The most critical inputs considered by dairy farmers

Traits	VHC*	HC	LC	VLC	Total Frequency	Weighted average
Green fodder (Napier, German, Jambo etc.)	36	34	10	00	80	3.33
Water hyacinth	04	20	54	02	80	2.33
Rice straw	25	46	09	00	80	3.20
Urea molasses straw	30	44	06	00	80	3.30
Maize silage	34	34	12	00	80	3.28
Tree leaves	08	14	36	22	80	2.10
Vegetables waste	10	50	16	04	80	2.83
Uncultivated grass	62	12	06	00	80	3.70
Mustard Oil cake	20	52	08	00	80	3.15
Broken wheat/maize/rice	00	36	38	06	80	2.38
Cattle pellet	20	34	14	12	80	2.78
Vitamin mineral premix	18	42	16	04	80	2.93
Boiled rice water	04	24	46	06	80	2.33

**VHC=Very highly critical, HC= Highly critical, LC=Low critical, VLC=Very low critical*

Vegetable waste and vitamin mineral premix have weighted averages of 2.83 and 2.93, respectively, indicating their moderate utility. Vegetable waste provides a cost-effective feed option, while vitamin mineral premix is essential for ensuring balanced nutrition and preventing deficiencies. Cattle pellet and broken wheat/maize/rice have lower weighted averages of 2.78 and 2.38. Cattle pellets, though nutritionally balanced, may be less preferred due to cost or availability, while broken grains are often used as supplementary feed rather than primary sources. Among the least preferred feed types are water hyacinth and boiled rice water, each with a weighted average of 2.33. Water hyacinth, despite being abundant, may have lower nutritional value or palatability issues, while boiled rice water is likely used sparingly due to its limited nutritional benefits. Finally, tree leaves have the lowest weighted average of 2.10, suggesting they are the least favored or nutritious among the listed feed types. This could be due to their lower digestibility or nutritional content compared to other feed options.

Rank order of the causes of price volatility

The data exhibited in Table 3 demonstrated multiple justifications for price volatility as well as the respondents perceived relative rankings for each cause. While the possible range was 80 to 400, the score ranged from 193 to 323. Global market trends are thought to be the most important element driving price fluctuations, according to the statistics, with a score of 323 and 80.8% of participants believe them to be important. This high ranking reflects how intertwined the world's economies are and how the dynamics of global markets can have a significant influence on local pricing. Tadasse et all. (2016) stated that events such as currency swings can drastically affect

international trade pricing and cause volatility, particularly when major currencies like the US dollar depreciate.

Table 3: The primary causes of price volatility

Causes of price changing	Score	FCPS (%)	Rank
Government policies	239	59.8	4th
Fuel energy costs	290	72.5	2nd
Local demand and supply fluctuations	256	64.0	3rd
Global market trends	323	80.8	1st
Climatic conditions	193	48.3	5th

Fuel energy costs come in second place with a score of 290, and 72.5% of the respondents said they had an impact. The elevated expenses associated with fuel and energy immediately influence the costs of production and transportation, hence influencing the final prices of goods and services. With a score of 256 and 64.0% of participants acknowledging its significance, third place goes to local variations in supply and demand. Prices are fundamentally influenced by the balance between supply and demand. Disruptions such as natural disasters, local economic situations, consumer preferences, geopolitical events, or pandemics can lead to sudden changes in supply or demand, causing price volatility (EIA, 2010). Price shifts may result from an abrupt rise or fall in supply or demand. It has a high score, and FCPS % because farmers believe that these variations have a big impact on prices. Price volatility may result from local market factors such as shifts in customer demand and interruptions in the supply chain. With a score of 239, government initiatives come in fourth place and are deemed significant by 59.8% of participants. Regulations, taxation, and subsidies are examples of policies that can directly affect market pricing by changing consumer behaviour and production costs.

Of the factors examined, climate is thought to be the least important, with a participant's score of 193 and 48.3% recognizing its influence. Although weather patterns have an impact on supply chains and agricultural output, their impact on prices is thought to be less direct than that of other variables. Besides conflicts and disputes between countries can cause disruption in markets and price volatility, especially for commodities like oil (Steer, 2024).

Respondents' categorization on the basis of perception on the causes of price volatility

Most of the decision makers specifically farmers in agricultural production are thought to be risk averse (Maart-Noelck and Musshoff, 2014). Risk-averse farmers, faced with increased milk price volatility, can be expected to pay a specific amount of money to eliminate exposure to this risk (El Benni and Finger, 2013). Here, the findings displayed in Table 4 demonstrate that the majority of participants have a moderate to high perception clarity index (FPCI) regarding the reasons behind price volatility of feed ingredients over the years which suggests lower level of risk because farmers are more aware of the causes and dynamics (e.g., price changes), enabling them to make informed about their decisions and adopt appropriate adaptation strategies. According to Table 4, no participant received a score lower than 33, which corresponds to the Low Perception Clarity group. This implies that all participants were able to perceive price volatility with at least

a little bit of clarity. There were 41 individuals in the Moderate category (scores 33–66), making up 51.2% of the sample. This suggests that a little more than half of the participants understood price volatility to a considerable extent. There were 39 participants in the High Perception Clarity Category (defined as scores more than 66), accounting for 48.8% of the sample. The distribution of the Moderate and High categories is almost equal, indicating that participants' overall perceptions of clarity are generally quite high.

Table 4: Distribution of the respondents according to their FPCI for livestock rearing

Fact	Categories of perception clarity	Score	N=80		Mean ± SD	Range	
			F*	%		Min.	Max.
Price Volatility	Low	<33	00	00	65.05±11.93	44	92
	Moderate	33-66	41	51.2			
	High	>66	39	48.8			

**F=Frequency*

There was a moderate degree of heterogeneity in the participants' mean score of 65.05, with a standard deviation of 11.93. The ratings showed that participants' perceptions of clarity varied widely, ranging from a minimum of 44 to a maximum of 92. The analysis reveals that the majority of participants have a moderate to high perception clarity of price volatility. The absence of participants in the Low category suggests a baseline level of understanding among the sample population. These findings can inform future research and strategies aimed at enhancing financial literacy and awareness of price volatility.

Input price volatility

The stability of cattle feed prices is crucial for effective financial planning and risk management in livestock farming. This study examines the price volatility of various cattle feed types, categorizing them based on their volatility levels and calculating a weighted average to represent the severity of price fluctuations over the year. The stability of cattle feed prices is crucial for effective financial planning and risk management in livestock farming. This study examines the price volatility of various cattle feed types, categorizing them based on their volatility levels and calculating a weighted average to represent the severity of price fluctuations over the year. The feed types analyzed include Green Fodder, Water Hyacinth, Rice Straw, Urea Molasses Straw, Maize Silage, Tree Leaves, Vegetables Waste, Uncultivated Grass, Mustard Oil Cake, Broken Wheat/Maize/Rice, Cattle Pellet, Vitamin Mineral Premix, and Boiled Rice Water.

Table 5 depicts the frequency of each feed type within these categories, and a weightage average is calculated to represent the severity of price fluctuations over the year. Mustard Oil Cake, with a weighted average of 3.20, ranked highest in price volatility, indicating significant fluctuations and potential risk for budget planning. Cattle Pellet and Vitamin Mineral Premix follow closely, with weighted averages of 3.00 and 2.88, respectively. These feed types exhibit considerable price changes, necessitating careful financial planning.

Conversely, tree leaves and boiled rice water, both with a weighted average of 1.00, show the least price volatility, suggesting either stable prices throughout the year or none buy these feeds for their cattle. In the study, it was found that there is no farmer who bought these to feed cattle.

Almost everyone supplied tree leaves and boiled water from home rather than buying them. This detailed categorization aids farmers and livestock managers in making informed decisions regarding feed procurement, ensuring better financial planning and risk management.

Table 5: The inputs with the most volatile pricing according to the dairy farmers

Traits	VHV*	HV	LV	VLV	Total Frequency	Weightage average	Rank
Green fodder (Napier, German, Jambo etc.)	07	33	36	04	80	2.54	6th
Water hyacinth	00	08	14	58	80	1.38	10th
Rice straw	04	40	34	04	80	2.50	7th
Urea molasses straw	06	58	16	00	80	2.88	4th
Maize silage	06	42	32	00	80	2.68	5th
Tree leaves	00	00	00	80	80	1.00	12th
Vegetables waste	04	32	30	14	80	2.33	9th
Uncultivated grass	00	04	18	58	80	1.33	11th
Mustard Oil cake	20	56	04	00	80	3.20	1st
Broken wheat/maize/rice	04	28	48	00	80	2.45	8th
Cattle pellet	16	50	12	02	80	3.00	2nd
Vitamin mineral premix	16	38	26	00	80	2.88	3rd
Boiled rice water	00	00	00	80	80	1.00	13th

**VHV = Very highly volatile, HV = Highly volatile, LV = Low volatile, VLV = Very low volatile*

3.3 Adaptation Strategies

Adaptation strategies undertaken by the number of dairy farmers

This part illustrates the proportion of dairy farmers who have adopted adaptation strategies in response to price changes in feed ingredients for cattle. Around 65% of dairy farmers have implemented various strategies to cope with the increased costs of feeding ingredients. On the other hand, 35% of dairy farmers have not undertaken any adaptation strategies, possibly due to different economic conditions, resource availability, or other mitigating factors. Wolf & Widmar (2014) highlighted those dairy farmers used forward pricing methods to adapt to volatility in milk and feed prices. This data highlights the significant impact of feed price fluctuations on dairy farming practices and underscores the need for adaptive measures to ensure economic sustainability in the sector.

Number of the practitioners of the particular adaptation strategies

The analysis of feed price volatility adaptation strategies by Mymensingh dairy farmers appears in Figure 3 with adoption scores representing the number of farmers using each approach. The majority of farmers (24) chose bulk purchasing because it helps them reduce costs through large-scale operations which Shamsuddoha et al. (2000) identified as a sustainable practice for dairy farming.

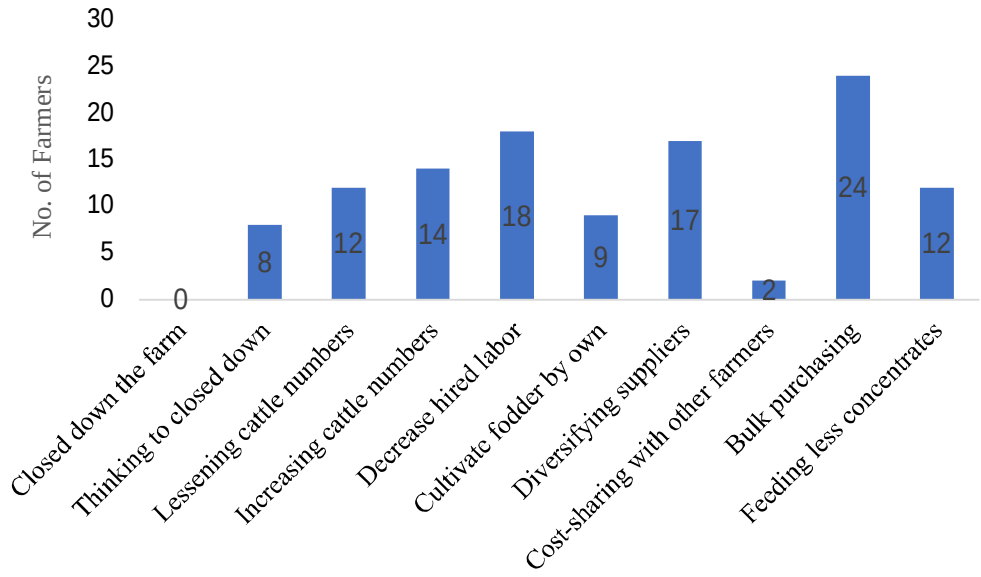

Figure 3. Distribution of the adaptation strategies according to their adoption

The majority of farmers use labor management by cutting back on hired workers and feed management through concentrating reduction and fodder cultivation to decrease market volatility. Farmers adjust their herd numbers either by adding or removing cattle to achieve cost-market equilibrium and some farmers spread their supplier base to reduce supply chain risks. The economic challenges have not led any farmers to shut down their operations although a small number of farmers are thinking about this possibility. The different adoption rates of these strategies demonstrate how farmers use various methods to stay profitable and sustainable during feed price changes while facing practical and logistical challenges.

Responsible factors to adaptation due to price change of feed ingredients

The multiple linear regression analysis investigates the determinants that affect the Adoption Strategies Undertaking Score (ASUS) because it measures adaptation strategy adoption from 0 to 10 in response to feed ingredient price variations. Table 6 shows the key factors that influence ASUS through corrected interpretations which maintain precision and readability. The negative coefficient of age equals -0.357 ($p = 0.040$) which demonstrates a statistically significant effect. Age increases by one year and the ASUS score decreases by 0.357 points while maintaining other factors at constant levels. The evidence shows that senior farmers adopt adaptation strategies less often because they fear risks and maintain conventional farming techniques and lack physical strength for new methods. The findings match those from Maart-Noelck & Musshoff (2014) which show that matured farmers tend to select stability over innovative approaches.

The standardized coefficient (beta) shows a strong positive effect between experience and ASUS at 0.563 ($p < 0.001$). An increase of one standard deviation in experience leads to a 0.563 standard deviation rise in ASUS while other variables remain constant. Farmers with more experience show higher probabilities of adopting adaptation strategies because they possess better skills and

self-assurance to tackle economic challenges. The low Variance Inflation Factor (VIF = 1.123) confirms minimal multicollinearity which strengthens the reliability of this effect.

The relationship between education and ASUS is positive because the coefficient shows 0.295 ($p < 0.001$). Each increase of one educational unit (such as a school year) leads to a 0.295 unit increase in ASUS while maintaining other factors steady. The findings demonstrate that farmers with higher education levels tend to adopt adaptation strategies because they obtain better market information and understand market trends and perform bulk purchases to save costs. The findings demonstrate that educational levels play a crucial role in building adaptive capacity.

Table 6: Responsible factors to adaptation

Variables	Standardized Coefficient Beta	t-value	Sig.	VIF	Collinearity Tolerance
Constant		2.590	0.012		
Age	-0.357**	-2.086	0.040	3.937	0.254
Education	0.295*	1.757	0.073	3.411	0.287
Experience	0.569***	6.164	0.000	1.123	0.890
Number of milking cow	0.118	1.294	0.200	1.124	0.889
Cost per cow per month	0.114	0.109	0.279	1.156	0.788
FCPI	-0.195**	-2.131	0.036	1.122	0.891
R^2	0.610				
Adj. R^2	0.560				
F value	12.096***				

Note: '***' denotes 1% level of significance, '**" denotes 5% level of significance, and '*' denotes 10% level of significance.

Farmers' Perception of Price Change (FCPI) is measured by -0.195 ($p = 0.036$) which shows a negative relationship. The increase of one unit in FCPI (a measure of price volatility cause understanding) leads to a decrease of 0.195 units in ASUS when controlling for other variables. The data indicates farmers who understand price volatility causes best adopt fewer adaptation strategies because they feel uncertain about their economic situation and risk aversion when markets become complex. The research shows that targeted programs need to be developed to help farmers with high FCPI scores adopt new strategies. The VIF values for every variable remain below 4 which confirms no major multicollinearity exists thus validating the reliability of the regression coefficients. The analysis reveals complex relationships between social factors and adaptation while offering valuable insights to create effective training programs and policy strategies for dairy farmers who need to manage feed-price fluctuations.

IV. CONCLUSIONS

The research reveals how dairy farmers in Mymensingh Bangladesh experience price volatility from feed ingredients because of worldwide market changes and fuel expenses and domestic market imbalances. The economic difficulties faced by smallholder farmers become evident through the volatility of mustard oil cake and cattle pellets and vitamin-mineral premixes because they need to handle these price fluctuations to stay profitable. The widespread adoption of adaptive strategies, particularly bulk purchasing, alongside reducing hired labor and cultivating fodder, reflects farmers' proactive efforts to mitigate rising costs. The dairy sector demonstrates resilience through adaptive strategies because it needs to balance economic pressures with food security and rural livelihoods in an evolving agricultural environment.

The research shows that farmers who have experience and education perform better in adaptation because they can execute cost-saving measures effectively but older farmers and those who understand price volatility causes are less likely to adopt such strategies because they tend to be risk-averse or stick to established practices. The research demonstrates that policy makers should create specific programs which provide price volatile input subsidies and accessible credit and training programs that match different farmer groups. The dairy sector will become more resilient when policymakers support education and skill development for older farmers and promote sustainable practices. The dairy farming sector will maintain its contribution to nutrition and employment and rural economic stability in Bangladesh through efforts that align with Sustainable Development Goals focused on poverty reduction and sustainable agriculture.

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