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Effect of Price Changes on Green Gram Yield in Tharaka South Sub-County, Tharaka Nithi County, Kenya

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Abstract: Kenyans in Arid and Semiarid Lands (ASALs), rely heavily on green gram as a source of nutrition, earnings, and soil improvement, but yield has not kept up with growth in demand. Due to this, the Kenyan government's declared goal of improving food access, diversity, and nutritional status has been hampered in these areas. In comparison to the worldwide and national averages of 0.73 mt/ha and 0.67 mt/ha, respectively, the yield in Tharaka South Sub-County is still too low at 0.56 mt/ha, considerably below the crop's estimated 1.5 mt/ha national potential. Green gram yield is mainly constrained by fluctuating producer prices and rational producers may only improve yields in response to a price increase. This study aimed at analysing the green gram yield responsiveness to the commodity's price changes in Tharaka South Sub-County, Tharaka Nithi County, Kenya for the period 2002-2021. The study employed descriptive research design and used secondary data. The data on seasonal green gram price and yield was collected from Tharaka Nithi County Department of Agriculture and analysed using linear regression model and qualitative methods. It was observed that the trends of green gram yield and price have been fluctuating over the study period. The green gram yield obtained during the October November December (OND) season was higher than the yield obtained during the March April May season (MAM). As portrayed by the economic law of demand and supply, green gram price during OND season was lower than the price offered during MAM season. Further the findings of the model showed that price changes explained 25.3% of the variables affecting green gram yield. Additionally, the findings of the regression analysis revealed that yield has been increasing at a decreasing rate as price increases by 1%. A 1% increase in price was associated with 0.47% decrease in yield probably due to reuse of seed. The study concluded that increasing green gram yield requires a supportive price, but this is not a sufficient condition but other support to reduce production risks should be provided. Further, access to certified seed should be enhanced to reduce chances of seed recycling or reuse. The study recommends the setting up of a functional agricultural commodity market for structured marketing of green gram as well as supporting production for sustainable yield.

Keywords: Green Gram, Price, Changes, Yield

1. Introduction

In Kenya Arid and Semiarid Lands (ASALs), green gram is a basic food, and the availability of this grain is a sign of food security [1]. The crop is ideal for improving food and nutrition security because it is a good source of protein, contributes to poverty alleviation by increasing and boosting ecological resilience [2]. The crop serves as a rotation crop and a substantial cover crop, and its roots are important suppliers of soil nitrogen [3]. The crop was domesticated in India around 1500 BC, where it is native before spreading to the world especially in United States of America, South Europe, Pakistan, Bangladesh, Thailand, Indonesia, Malaysia and Africa [4]. The crop is mostly produced for grains which are nutritive, well palatable and digestible. The grains are rich in a number of nutrients such as protein at approximately 2-28%;

fibre at 1.02- 1.05%, oil at 3.5-4.5%, ash at 4.5-5.5% and carbohydrates at 60- 65% on dry weight. Additionally, it has 94 mg of vitamin A, 8 mg of vitamin C, 7.3 mg of iron, 124 mg of calcium, 189 mg of magnesium, 367 mg of phosphorus, 1246 mg of potassium, 3 mg of zinc, and 549 mg of foliate. The grains also contain iron, calcium, magnesium, potassium, zinc, foliate, vitamin A, and vitamin C. Unlike other pulses, the grains have no flatulent effects on the stomach and are therefore fed to the vulnerable, particularly children and the elderly [1].

Kenya has an annual green gram demand of roughly 606, 767 mt, but only produces 112, 124 mt domestically each year, resulting to a deficit of 494, 643 mt [5]. In comparison to the worldwide and national averages of 0.73 mt/ha and 0.67 mt/ha, respectively, the yield in Tharaka South Sub-County is still too low at 0.56 mt/ha, considerably below the crop's estimated 1.5 mt/ha national potential [6]. This has been caused in part by two main issues; production risk and price risk. Production risks are linked to nature which the producers are exposed to for example climatic variations, invasions of pest and diseases, use of low quality seeds [5]. Price risk is associated with forces of demand and supply and is important for farmers because agriculture commodities are subject to strong fluctuations [7]. Changes in output price of a crop is an important factor affecting yield and producers are reported to react more to price incentives than non-price influences [8]. Economic theory, according to [9], contends that prices are important determinants of economic activity and that typical farmers should respond appropriately to fluctuations in output prices. Farmers in less developed nations are less receptive to changes in relative prices than farmers in developed nations. Farmers cite reasons including inadequate irrigation infrastructure, insufficient infrastructure, and the absence of complementary agricultural policy as explanations for the lack of reaction to price.

Price plays an "allocative" role because farmers are likely to select enterprises that provide high returns [10]. A price incentive of a crop can result to more investment in terms of input-use by farmers and increased adoption of technologies increasing yields [11, 7]. Prices are crucial to producers because they can affect their revenues or expenditures [12]. The commodity price increase may occur if demand is higher than the supply. According to demand and supply economic theory, a commodity's output is inversely related to the anticipated pricing of its rival agricultural commodities [13]. High commodity prices served as a motivation to increase global crop yield while price unpredictability discouraged farmers from producing in the subsequent season [14]. Effects of the price risk are detrimental to producers in Sub-Sahara Africa (SSA) since the farmers are both producers and consumers of their own commodities [15]. On the other hand, developing nations still lack or have weak market-based solutions to protect against price changes, such as use of insurance or futures markets [16].

The price, area and yield of a crop are positive correlated while a competing crop show a negative correlation with price, area and yield [17]. Price policy was helpful in formulation of future price in China and increased production of rice while in Vietnam's maize yield responded to price adjustments [18, 11]. In Africa, governments' implementation of a price policy for major staple crops in Sub-Saharan Africa led to an increase in acreage and yield of the crops [19]. Price risk affected maize farmers' actions in Benin, a 10% increase in pricing led to a 7.47% rise in maize yields. The growth in yield as well as area under maize production was attributed to increased market price [7]. In Kenya, Sorghum price-yield response showed no significant relationship between sorghum yield and price [20].

Rational producers improve yield in response to crop price increase, which implies that farmers make decisions about what to produce, how to produce it, and which inputs to use, by considering output prices [21]. Farmers are typically thought to respond to producer pricing [22]. However, majority (about 70%) of green gram farmers in Tharaka South Sub-County sell their produce to middlemen at the farm level at very low prices. The average farm gate price of a kilogram of green gram is KES 62 in the Eastern Kenya Counties but the price in Tharaka Nithi County is KES 61, slightly lower than the price received in Makueni, Kitui and Embu Counties [5]. In addition, prices of green gram are characterised with high fluctuation yet the actual response of green gram producers to price changes in Tharaka South Sub-County is unknown. The purpose of this research is to ascertain how the producers of green gram reacts to price variations. Focus on agricultural price policies has been recommended as a way of stabilizing yield [23]. Understanding how price changes affect green gram yield would promote sustainable production because policy-makers can gain insights into the effects of a price policy on green gram yield.

2. Theoretical Framework

The study was based on rational choice theory which states that when making decisions, people weigh the costs and benefits of the various options. The fundamental idea of the rational choice theory is rooted in the work of classical economists like Adam Smith. Human conduct is viewed as the outcome of decision-making; hence, before acting, a decision must be made amongst many action alternatives. According to the theory, people make reasonable decisions and accomplish outcomes that are in line with their own particular goals by using rational calculations. In order to make decisions, people weigh the costs and benefits of many options. People only take action when the benefits outweigh the costs, and they cease taking action when the costs outweigh the benefits. People also use the resources at their disposal to maximize rewards. This implies that an individual's logical, self-driven behaviors will benefit the individual as well as the economy as a whole. Self-interest, rational agents, and the invisible hand are the three concepts that rational choice theory examines. According to the rational choice theory, an actor is bound by specific societal and personal limitations. Given the limits, he or she assesses the possible courses of action and selects the one that best meets their preferences. Some of the assumptions the theory make are: all actions are rational and are made due to consideration of costs and rewards; an action must be more rewarding than the cost involved in carrying it out; a person will stop acting or ending a connection when the reward's value falls below the cost incurred; and people maximize their rewards by using the resources at their disposal [24]. Previous research has shown a high correlation between rational decision-making and actions or behaviors taken by farmers in the agricultural sector. Farmers often choose their enterprise after assessing the cost and benefits of various scenarios. Farmers' burden is thought to be reduced by lowering the costs they experience, which will improve their profit [25]. However, some of the limitations of the theory is that important social factors including the historical, cultural, and institutional uniqueness of a specific culture with respect to individual action are not taken into account [26].

3. Research Methodology

3.1. Study Area

Tharaka Nithi County covers an area of about 2,662.1 km^2; including the shared Mt Kenya forest estimated to cover 360 km^2. The County is located in the upper Eastern region of Kenya and borders Embu County to the South and South West, Meru County to the North and North East, Kirinyaga and Nyeri Counties to the West and Kitui to the East and South East. The county lies between latitude 000 07' and 000 26' South and between longitudes 370 19' and 370 46' East. The County is subdivided into four Administrative Sub-Counties and three political units (constituencies). The administrative Sub-Counties include: Tharaka North, Tharaka South, Meru South and Maara where Tharaka North Sub-County is the largest covering an area of 803.4 km^2, Tharaka South Sub-County covers an area of 746.1 km^2; and consists of three wards, fourteen locations, and thirty-three sub locations [27].

The largest proportion of arable land is used for agriculture with farms averaging 4.8 hectares and small scale farms average 2.9 hectares while large-scale farms average 6.7 hectares. Agriculture is the main source of livelihoods in the county because approximately, 80% of the county's population derive their livelihood from agriculture with about 43,799 hectares of land put under food crops, while cash crops covers 14,839 hectares. Annual rainfall in the county ranges between 500 mm in the lowland Tharaka region and 2200 mm in the highland region, while temperatures in the highland areas range between 14°C to 30°C while those of the lowland area range between 22°C to 36°C. Tharaka South and North Sub-Counties which are located in the lower parts of the County are classified as semi-arid. However, there are unusual climate variability incidences arising from climatic change. Tharaka constituency which lies in the lower side of the county experiences temperatures as high as 40°C at certain periods. Tharaka South Sub-County lies in a semiarid area characterized by a bimodal rainfall pattern and a temperature range of 24°C to 37°C, at times rising to 40°C [27].

The county had a total population of 393,170 as per the 2019 population and housing census. This was projected raise to 399,090 in 2021 (196,681 Males and 202,408 Females), and to 402,084 in 2022 (198,157 Males and 203,927 Females). The county's annual population growth rate is 0.75%. Tharaka South Sub-County has a total population of 75,250 (39,058 females and 36,190 males) [28]. The Sub-County experiences a bi-modal pattern of rainfall, with the long rains occurring from March, April and May (commonly known as MAM) and the short rains occurring during the months of October, November and December (commonly known as OND). About 500mm of low-quality, irregularly distributed rainfall and intermittently high temperatures of up to 40°C are experienced by the Sub-County [27].

3.2. Research Design

The study used descriptive research design which determines "the way things are". In descriptive research many variables can be compared at the same time. Researchers often employ descriptive research designs as effective tools to learn more about a specific population or phenomena. It involves a process of data collection that enables researchers to explain the situation more thoroughly than was possible without using this method and aims to shed light on current issues or problems. This kind of study offers a thorough and precise picture of the traits and habits of a specific community or subject. Research that is descriptive in nature describes the traits and/or behaviors of a sample population. It works well for gathering data that may be used to generate hypotheses and suggest connections. Importantly, the focus of these investigations is not on what causes the phenomena to occur. In other words, descriptive study does not address the question "Why?" and instead concentrates on the question "What?" Descriptive research design has the advantages of taking less time than quantitative studies and improving the application of research findings to real-world decision-making. The primary drawback of descriptive studies is that they are ineffective in determining the cause of the phenomenon they are describing [29].

3.3. Data Collection

The study used 20 years (2002-2021) seasonal green gram price and yield data which was sourced from Tharaka Nithi County Department of Agriculture using a checklist. Green gram in the Sub-County is grown in two seasons in a year where one season is considered the long rains occurring from March, April and May (commonly known as MAM) and the short rains occurring during the months of October, November and December (commonly known as OND). The data on green gram price considered the farm gate price because majority (about 70%) of green gram farmers in Tharaka South Sub-County sell their produce to middlemen at the farm level.

3.4. Data Analysis

Data for the study was analyzed using both qualitative and quantitative methods where the 20 years' trend analysis of green gram yield and farm gate prices was done using qualitative analysis.

3.4.1. Estimating the Effect of Price Changes on Green Gram Yield for the Period 2002 to 2021.

Quantitative methods were utilized to ascertain the kind and strength of the relationship between green gram yield and price changes. Correlation (pearson coefficient), coefficient of determination, Analysis of Variance (ANOVA), and regression analysis were used. The assessment was based on a 5% significant threshold [30].

A statistical indicator of how strongly two variables are linearly related is the correlation coefficient. Its values can be between -1 and 1 where a correlation coefficient of -1 indicates a perfect negative, or inverse, correlation, where values in one series increase as those in the other fall and vice versa. An exact positive correlation or direct association is indicated by a coefficient of 1 while 0 indicates absence of a linear relationship. A linear relationship between two variables' strength and direction is measured by the Pearson coefficient, sometimes known as Pearson's r. The Pearson Correlation Coefficient's drawbacks include its inability to evaluate nonlinear relationships between variables and its incapability to distinguish between dependent and independent variables.

Using the ANOVA test, you can compare more than two groups at once to see if there is a correlation between them. The F statistic, or F-ratio, which is the outcome of the ANOVA formula enables the examination of several groups of data to ascertain the variability within and across samples.

The Formula for ANOVA is:

$$F=MST/MSE$$

where:

F=ANOVA coefficient

MST=Mean sum of squares due to treatment

MSE=Mean sum of squares due to error

The coefficient of determination, R-squared which is abbreviated R^2 or r^2, is a statistical indicator that shows how much of the variance for a dependent variable in a regression model is explained by an independent variable. The variance of one variable's explanation for the variance of the second variable is measured by R-squared. The coefficient of determination is a measurement that tells the goodness of fit of a model. R-squared values can be expressed as percentages from 0% to 100% and range from 0 to 1. If a model's R-squared is 0.50, then roughly 50% of the observed variance can be explained by the model's inputs. An R-squared of 100% suggests that all dependent variables are totally described by the independent variable.

The effect of price on green gram yield from 2002 to 2021 was estimated using a regression model. The following regression model was used;

$$Y = \alpha_0 + \alpha_1 X_3 + \varepsilon$$

where;

Y= green gram yield (kg/ha).

α_0= the constant (expected estimate of green gram yield when the effects of price is zero)

α_1= Expected estimate of green gram yield when the effects of price is increased by one unit.

X_3= green gram price

ε= Error term.

3.4.2. Diagnostic Test

To determine whether the data used was from normal distribution, diagnostic tests such as test for normality and autocorrelation tests were conducted.

(i). Test for Normality

Shapiro Wilk test was performed in order to determine whether the data used was from a normal distribution. Shapiro wilk test provides that the null hypothesis is disproved and there is proof that the tested data are not normally distributed if a p value is lower than the selected alpha level, on the other hand if the null hypothesis—that the data came from a normally distributed population—cannot be rejected, if the p value is less than the selected alpha level. The findings on shapiro-wilk test for normality for an alpha level of 0.05 showed that price in the MAM season (p-value=0.061) was normally distributed because the p-values was greater than 0.05, indicating that the data was normally distributed. However, yield (p-value=0.027) and price in the OND season (p-value=0.061) recorded p-values greater than 0.05 implying that the null hypothesis was rejected due to yield (p-value=0.027), price in OND (p-value=0.002), having p-values lower than 0.05, indicating that the variables' data was not normally distributed (Table 1).

Table 1. *Shapiro-Wilk Test for Normality.*

Variable	Statistics	Df	Sig. (p-value)
Yield	0.890	20	0.027
Price in MAM	0.715	20	0.061
Price in OND	0.870	20	0.030

The Shapiro-Wilk Test findings led to log transformation of yield and price data to convert the non-normal data to normal data. The findings on the logarithmic transformation indicated that, the yield (p-value=0.188), the price in MAM (p-value=0.261), and the price in OND (p-value=0.818) were all more than 0.05, indicating that the null hypothesis was not rejected and that the data was normally distributed (Table 2).

Table 2. *Logarithmic Transformation of Variables for Normality.*

Variable	Statistics	Df	Sig. (p-value)
log Yield	0.934	20	0.188
Log Price in MAM	0.792	20	0.261
Log Price OND	0.887	20	0.818

(ii). Autocorrelation Tests

Autocorrelation is a problem which occurs when the error term is interrelated over time. Autocorrelation in the study was tested using Durbin Watson test statistics. Durbin Watson is a statistical test used in testing autocorrelation in regression analysis residues and it ranges from 0 to 4. A Durbin Watson value between 2 and 2.5 denotes the absence of both positive and negative autocorrelations. Correct model formulation of the functional form of the model can completely remove autocorrelation. A range of values between 1.5 and 2.5 imply no autocorrelation and in this study the Durbin-Watson statistics was 2.228 within the range indicating there was no autocorrelation.

4. Results and Discussion

The study sought to determine the effect of price changes on the yield of green gram produced by the farmers. The analysis involved establishing the trends of farm gate price for a period of 20 years as well as correlation and regression analysis for the price changes and green gram yield. The price of a commodity is undoubtedly an important factor in encouraging its production. Price is the most determinant of profit or loss for an enterprise and provides incentive for producers to grow. Producers should base their actions on the assumption of a future increase in the price of a commodity since rational producers are anticipated to raise yields in reaction to crop price increases. High price unpredictability raises the stakes and makes producers' yield-related decision-making more crucial [15].

4.1. Trends of Green Gram Price and Yield

The seasonal trends of green gram price and yield were analyzed for the period 2002 to 2021.

4.1.1. Trends of Green Gram Price (2002 - 2021)

The trends of green gram commodity prices were analyzed on seasonal basis. The trends showed that the prices have been fluctuating over the study period. Green gram price during OND season was lower than the annual average price and the price offered in MAM season. The trends show that in 2006 the price in OND was at the lowest at KES 20/kg while in 2016 and 2021, the prices rose to KES 80/kg. During the MAM season the lowest (KES 20/kg) price was reported in 2002 while the highest (KES 120/kg) price was reported in 2012 (Figure 1).

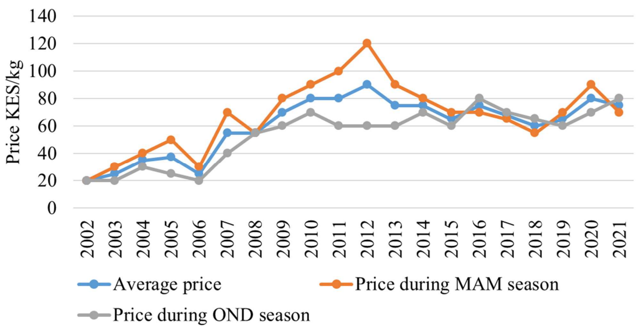

Figure 1. *Trend of Green Gram Price from 2002 to 2021.*

The observed findings can be explained by the fact that green gram yield is higher during OND than MAM season. It is possible that the higher supply of green gram in the OND led to flooding in the market resulting to decline in price. However, the low yield of green gram obtained during the MAM season may have provided high demand since market supply was low and resulting to price escalation. The findings of this study comply with the case of a normal good such that when prices are high there is low supply of the commodity and when the supply increases prices of the good goes down. Similarly, the supply of green gram is low in MAM season thereby increasing the prices due to lack of enough of the commodity in the market. Thornton [31] concluded that commodity price increased when demand did not keep up with the supply. Bairagi [32] also concluded that the covid pandemic caused a major decrease in the amount of agricultural produce available in the market, which raised the price of commodities.

4.1.2. Trends of Green Gram Yield (2002 - 2021)

During the study it was observed that the green gram yield obtained during the OND season was higher than the yield obtained during the MAM season. During MAM season year 2002 reported the highest yield (1.09 mt/ha) while the lowest amount of yield was reported in 2013 and 2019 at 0.18 mt/ha. During OND season the highest yield was reported in 2006 at 1.11 mt/ha with the lowest yield reported in 2017 at 0.25 mt/ha (Figure 2). The findings of this study does not violate the law of demand and supply because during OND when the yield is high, price trends are observed to be low.

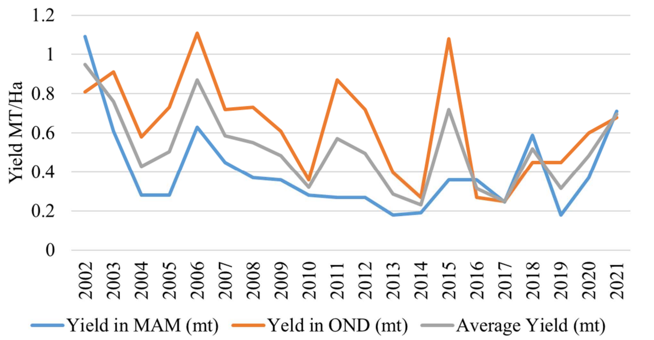

Figure 2. *Trend of Yield from 2002 to 2021.*

The observed findings are in line with observations of Kimani [33] who found reduced and high variation of kidney beans seed yield during MAM season. Similarly, Demissie [34] projected an increase in green gram yield during the OND season while [35] observed green gram increased yield during OND. The varying yield trends may be linked to variations in rainfall that occur annually and seasonally. Mumo [36] observed that rainfall was the dominant predictor of yield variance. Mkonda [37] also found a strong relationship amongst rainfall and crop output. Similarly, Koimbori [38] reported a high correlation between rainfall patterns and maize production that is significant, favourable, and supportive. It is possible that the increased adaption to climate change through use of certified seeds, maximum soil cover, minimum tillage, crop rotation and weather advisories may have resulted in an increase in output from 2019 to 2021. Vijayasarathy [39] concluded that smallholder farmers are greatly aided by the use of climate smart technologies in their ability to continue farming in spite of the changing climate.

4.2. Qualitative Analysis for the Effect of Price Changes on Green Gram Yield.

To estimate the effect of price changes on green gram yield for the period 2002 to 2021, both correlation and regression qualitative methods were used.

4.2.1. Correlation Analysis for Price and Green Gram Yield

Pearson Correlation coefficient was used to assess correlation of price and yield of green gram obtained for the period between 2002 to 2021. The findings of this study established that there was statistically significant negative relationship between price and the yield of green gram since the p-value was less than 0.05. (r=-0.503, p-value=0.012) (Table 3). These observed findings imply existence of an inverse relation between the price and the green gram yield. It was observed that increase in price was associated by a decrease in the level of green gram yield. The farmers therefore were not able to meet the market supply and therefore the little green gram supplied in the market fetched very high prices.

Table 3. *Correlation Coefficient for Price and Green Gram Yield.*

Model		Yield kgs/ha	Price
Yields kgs/ha	Pearson Correlation	1	
	Sig. (2-tailed)		
Price (KES)	Pearson Correlation	-0.503*	1
	Sig. (2-tailed)	0.012	

*Correlation is significant at the 0.05 level (2-tailed)

The findings of this study are in line with those of Boutesteijn [40] who reported, a negative correlation between the price and yield of rapeseed and sugar beet in the European Union. In addition, Nahar [41] showed that rice yield reduced when the rice price increased. On the contrary Onono [20] concluded that increases in the output price of sorghum in Kenya did not affect production. Huong [11] observed a favorable correlation between maize supply and price in Vietnam, on the other hand. Higher output prices were an incentive to increase the supply of crops globally, according to research by Haile [14] while output price swings was a deterrent in the subsequent season. Jongeneel [15] also found low price-yield sensitivity of twenty crops in main producing countries both from developed and developing nations.

4.2.2. Regression Analysis for Price and Green Gram Yield

This study sought to establish the regression analysis for price and green gram yield. The coefficient of determination (R squared) was used to assess the regression model's goodness of fit, and an ANOVA determined the model's suitability. The investigation looked at the relationship between price changes and the farmers' green gram yield. The null hypothesis was;

H_{05}: *Price has no statistically significant effect on green gram yield for the period 2002 to 2021.*

The proposed model after logarithmic transformation to enhance normality was obtained as follows:

$$Log\ Y = Log\ \alpha_0 + \alpha_1 Log X_3 + \varepsilon$$

The findings of the study showed that the R-squared was 0.253 implying that price explained 25.3% of the variables affecting green gram yield. It was observed that the R-squared change imply that the change in the prices of green rams in the market due to the differing forces of demand and supply contributed to 25.3% effect on the yield of green gram (Table 4).

Table 4. *Regression Model Summary for Price and Green Gram Yield.*

R	R Square	Adjusted R square	Std. error of the estimate
0. 503[a]	0.253	0.211	0.1730

The overall significance of the simple regression model was evaluated using the F-statistic. The ANOVA for green gram price and yield showed that the F-calculated=6.091 (p-value =0.024<0.05) (Table 5) which was greater than F-critical which equals 4.414 with 1 and 18 degrees of freedom implying that the model is useful in the prediction of how price affects the yield of green gram.

Table 5. *ANOVA for Price and Green Gram Yield.*

Source of Variation	Sum of squares	Df	Mean square	F	Sig
Regression	0.182	1	0.182	6.091	0.024[b]
Residual	0.539	18	0.030		
Total	0.721	19			

The regression model showed that the expected estimate of green gram yield when the effects of price is zero was 9.688. The observed findings revealed that yield was increasing at a decreasing rate as price increased by 1%. The model also showed that a 1% increase in price was associated by 0.47% decrease in yield (p-value=0.024<0.05) (Table 6). The observed inverse relationship between price and yield may be attributed to the adverse climatic changes of prolonged high temperatures and drought seasons that is detrimental to green gram productions as it has caused a steady decline in yield. The findings of this study are in line with Nahar [41] who showed an inverse relationship between rice yield and prices in Bangladesh. On the contrary, Miao [42] found a significant positive correlation between corn prices and output.

Huong [11] also observed that maize supply responded positively to price in Vietnam. The observed findings revealed that price risk affects the farmers' behavior because farmers were less willing to produce green gram or there was a possibility that they were not able to pay for production costs, leading to a decrease yield.

Table 6. *Regression Coefficients for Price and Green Gram Yield.*

Variables	Unstandardized Coefficients		Standardized coefficients	T	Sig.
	B	Std. Error	Beta		
Constant	5.151	0.532		9.688	0.000
Log price	-0.477	0.193	-0.503	-2.468	0.024

The findings of this study may also imply that price increase can reduce the demand for the commodity since the rise in price may make consumers to become less likely to purchase green gram due to the higher cost. The decrease in demand may lead to a decrease in the total supply of the produce, as producers may not be able to sell as many green grams due to fewer buyers in the market. In addition, the observed findings may also imply that the price increase could lead to a decrease in the total production area of the crop, that may reduce the total supply of green gram in the market. The findings may also imply that the price increase could have led to a decrease in the availability and quality of green gram thereby reducing the total supply to the market. Nasir [43] established that land area had a significant effect on the supply and the price of rice of tobacco farmers in Indonesia. Contrary to the findings of this study, Bor [21] reported that productivity was significantly influenced by the output price as well as price of commodities from related crops. Le [44] also observed that without government interventions on price policy rice yield was predicted to decline. Paul [23] also showed a favorable correlation between tomato yield and price in Cameroon. Abu [22] found that a decline in soybean prices caused farmers to plant less soybeans, which lowered their profit and deterred them from increasing their output.

5. Conclusion

It was observed that the trends of green gram yield and price have been fluctuating over the study period. The green gram yield obtained during the October November December (OND) season was higher than the yield obtained during the March April May season (MAM). As portrayed by the economic law of demand and supply, green gram price during OND season was lower than the price offered during MAM season. Further the findings of the model showed that price changes explained 25.3% of the variables affecting green gram yield. Additionally, the findings of the regression analysis revealed a statistically significant negative relationship between price and the yield of green gram. A 1% increase in price was associated with 0.47% decrease in yield probably due to reuse of seed. This may be attributed to the fact that majority of the farmers recycle seeds and during planting time green gram prices are high therefore majority could be un willing and unable to purchase the seed resulting to decreased area under green gram production as well as yield. Most of the farmers rely on local seeds which are susceptible to adverse effects of climate change as opposed to early maturing certified seeds resulting to low yields. The study concluded that increasing green gram yield required a supportive price, but this is not a sufficient condition but farmers need other support to reduce production risks. Further, access to certified seed should be enhanced to reduce chances of seed recycling or reuse. The study recommends the setting up of a functional agricultural commodity market for better marketing of green gram as well as supporting production for sustainable production.

Conflict of Interest

The authors declared no competing interest.

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