Assessment of Risk Attitudes and Mitigation Strategies Among Arable Crop Farmers in Semi-Arid Makueni County, Kenya.

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ABSTRACT

This study assessed risk attitudes and mitigation strategies of arable crop farmers in Semi-Arid Makueni County, Kenya. A multi-stage sampling technique was adopted in the selection of 163 respondents. Data were collected using research questionnaire and analyzed using frequency distribution and percentages, Ordinary Least Square (OLS) regression, safety first model and a 5-point likert scale. The results revealed that the major types of risk faced by arable crop farmers are production (93.3%) and climatic (89.6%), followed by market (74.2%), financial (66.9%) and institutional (50.9%) risks; about 65.6% of farmers were risk-averse, 23.9% risk-neutral and 10.4% risk-seeking. The OLS model indicated that education, farming experience, farm size and access to credit significantly influenced farmers' economic performance while risk attitude coefficient had a negative effect. The result also showed that the farmers adopted low-cost, experience-based strategies (crop diversification, intercropping, drought-tolerant varieties and soil and water conservation), however, uptake of formal instruments like crop insurance (11%) remained low. The study concludes that smallholder farmers in semi-arid Kenya are highly risk-averse and rely on adaptive strategies grounded in social capital and indigenous knowledge and recommended strengthening agricultural extension, access to affordable credit and insurance literacy.

Keywords: Arable crop, Kenya, Makueni, Risk attitude, Risk management, Safety-first model.

INTRODUCTION

Background to the Study

Agriculture remains the backbone of Kenya's rural economy, employing over 70 percent of the population and contributing significantly to food security and household income [6]. Within this sector, arable crop farming plays a central role, particularly in semi-arid regions such as Makueni County, where smallholder farmers dominate production. However, agricultural activities in these areas are inherently risky due to frequent droughts, erratic rainfall, pest outbreaks and volatile market prices [10]. These risks have profound effects on farm productivity, income stability and food availability, especially among smallholders who have limited resources to absorb shocks.

The risk attitude of farmers; risk-averse, risk-neutral or risk-seeking is strongly influenced by their production decisions, technology adoption and choice of management strategies [5]. Understanding these attitudes is crucial for designing interventions that promote resilience and sustainable agricultural practices. In Kenya, previous studies have examined risk perception and management in various contexts, but there is limited empirical evidence focusing on how arable crop farmers in Makueni County perceive and respond to risk within their unique agroecological and socio-economic setting [2].

Problem Statement

Despite the growing recognition of agricultural risk and vulnerability in Kenya's semi-arid counties, many

arable crop farmers continue to experience substantial yield fluctuations and income losses. Unpredictable weather patterns, declining soil fertility and pest infestations have increased production uncertainty, while limited access to credit, extension services and insurance restrict farmers' ability to manage these risks effectively [11]. Although farmers employ a range of coping mechanisms such as diversification, savings groups or soil conservation, the effectiveness and determinants of these strategies remain poorly understood [6]. Without this understanding, policy interventions may fail to target the real behavioral and structural constraints that shape farmers' responses to agricultural risk. Therefore, closing this gap in the Makueni context is essential for interventions that are both technically sound and socially acceptable. Based on the aforementioned, this study seeks to fill the research gap by providing answers to the following research questions: (i). what are the socio-economic characteristics of arable crop farmers in Semi-Arid Makueni County? (ii). what are the major types of risks faced by arable crop farmers in Semi-Arid Makueni County? (iii). What is the risk attitude of arable crop farmers in the County? and (iv). what are the risk management strategies adopted by arable crop farmers in the County?

Aim and Objectives of the Study

The aim of the study is to analyze risk attitudes and management strategies among arable crop farmers in Semi-Arid Makueni County, Kenya. The specific objectives are to: (i). describe the socioeconomic characteristics of arable crop farmers, (ii). identify the major types of risks faced by arable crop farmers, (iii). determine the risk attitude of arable crop farmers and (iv). identify the risk mitigation strategies adopted by arable crop farmers in the study area.

Justification of the Study

Assessing farmers' risk attitudes and management strategies provides valuable insight into their decision-making processes and the constraints they face in mitigating farm-level uncertainties [10]. This study therefore fills important empirical and policy gaps; by quantitatively analyzing risk attitudes among arable crop farmers in Makueni, it adds to the growing but still limited body of literature that integrates attitudes and perceptions with socioeconomic and farm-level factors in East Africa. It also helps to identify which risk management strategies are most likely to be adopted, providing evidence for more targeted agricultural policies and extension efforts in the county. The results can also inform scaling of innovations (organic fertilizers, conservation agriculture or index insurance) by revealing which strategies align with existing attitudes and constraints in similar environments.

METHODOLOGY

The Study Area

The study was conducted in Semi-Arid Makueni County, Kenya. Makueni County is located in the south-eastern region of Kenya, between latitudes 1°35′ and 3°00′ South and longitudes 37°10′ and 38°30′ East. It borders Machakos County to the north, Kajiado County to the west, Kitui County to the east and Taita Taveta County to the south. The county has an estimated population of about 987,653 persons, covers an area of approximately 8,008 km² and is administratively divided into six sub-counties ([8], [9]).

Makueni lies within the Arid and Semi-Arid Lands (ASALs), with mean annual rainfall ranging from 250mm in the lowlands to 1,200mm in the highlands, while temperatures vary between 20°C and 30°C [9]. The main economic activity is smallholder rainfed farming which is complemented by livestock production; however, productivity is constrained by climate variability, recurrent droughts, soil degradation, pest infestations and limited access to extension and financial services ([10], [6]). Therefore, the county's agro-ecological diversity and exposure to climatic shocks make it an ideal setting for analyzing farmers' risk attitudes and mitigation strategies for arable crop production.

Sampling Techniques

A multistage sampling technique was adopted in the selection of respondents for the study. Stage one involved

the stratification of Semi-Arid Makueni county into three agro-ecological zones; the lower, middle and upper zones. Stage two involved random selection of two sub-counties from each zone to make a total of six sub-counties. In the third stage, two wards were randomly selected from the sub-counties selected to make 12 wards. The final stage also involved random selection of two villages from each of the wards to make up 24 villages in total where arable crop farmer lists were prepared for sampling. The final sample allocation produced 22 villages with seven respondents each and one village with nine respondents, resulting in 163 interviewed farmers. To allow for unbiased population estimates, sampling weights were computed as the inverse of the overall inclusion probability and a design effect of 1.5 was assumed for variance estimation given the clustered design.

Methods of data collection

Primary data was used for this study and a well-structured research questionnaire was used to elicit information from the arable crop farmers. The questionnaire was pre-tested to ensure its validity and reliability for the purpose of this research.

Method of data analysis

Descriptive and econometric tools were used to analyze the data collected in line with the stated objectives. Objectives i and ii were achieved using frequency distribution and percentages, objective iii was achieved with the use of Ordinary Least Square (OLS) Regression and Safety-First models while a 5-point likert scale rating technique was used to achieve objective iv.

Model Specification

OLS Regression Model: To analyze the risk attitude of arable crop farmers, the OLS model was used to identify the farm specific factors affecting the economic performance (proxied as income) of arable crop farmers under risk. The explicit form of the model is specified in equation 1.

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + \varepsilon_i \quad (1)$$

Where;

Y_i = Annual Income (KES),

X_{1i} = Age (Years),

X_{2i} = Farm Size (Hectares),

X_{3i} = Farming Experience (Years),

X_{4i} = Years of Schooling (Years),

X_{5i} = Risk Attitude (Risk averse = 1, Otherwise = 0),

X_{6i} = Access to Credit (Amount Received),

X_{7i} = Extension Contact (Yes = 1, No = 0), and

ε_i = Error Term.

Safety First Model: The safety-first model was then used to classify the arable crop farmers into risk categories based on the risk attitude coefficient and complement the OLS analysis by linking income variability and minimum survival thresholds to behavioral decision patterns [7]. The safety-first model criterion is that farmers seek to minimize the probability that their income reduces below an acceptable minimum level (Y_m) expressed as: Minimize P ($Yi \leq Y_m$).

The standardized form of the model is presented in equation 2:

$$Z_i = \frac{\gamma_i - Y_m}{\sigma_i} \quad (2)$$

Where;

Z_i= Safety-first Index for farmer i,

γ_i = Mean income of farmer i,

Y_m = Minimum acceptable income level, and

σ_i = Standard deviation of farmer's income.

Farmers were classified into different risk categories based on the safety-first index values as:

$Z_i < 0$ = High Risk Averse

$0 \leq Z_i < 1$ = Moderate Risk Averse

$1 \leq Z_i < 2$ = Risk Neutral

$Z_i \geq 2$ = Risk Seeking

RESULTS AND DISCUSSION

Socio-economic Characteristics of Arable Crop Farmers in Makueni County The socioeconomic characteristic of arable crop farmers considered in this study includes age, gender, marital status, educational level, household size, years of experience, farm income, farm size and primary occupation as presented in Table 1. The result revealed that about 33% of the arable crop farmers were in their middle age (41 – 50), with a mean age of 46years. This implies that the farmers in Makueni were within their active age of farming activities which is consistent with Kenya's smallholder farmer's profile [6]. Also, majority of the farmers were male (56%) who were married (81%) with moderate levels of education; secondary (38.7%) and tertiary (16.6%) as indicated by the respondents suggesting that the farmers were relatively educated and as such understand the concept of risk and management strategies; which corroborate [2]. The mean farming experience was 16years which shows that the farmers had ample experience and practical knowledge of local farming risks and uncertainties. Majority of the farmers had small to medium farm sizes between 1 – 2 hectares with a mean farm size of 1.8 hectares which is consistent with land fragmentation in Makueni County ([8], [9]). Majority (48.5%) had household sizes of 4 – 6 persons with mean household size of 5 persons, which is typical of a rural demographic setting while the mean income was KES162,000 which is an indication of low profitability level of a typical Kenyan arable crop farmer.

Table 1 Socio-Economic Characteristics of Arable Crop Farmers in Makueni County

Variables	**Frequency**	**Percentage**	**Mean**
Age (years)			
≤ 31	21	12.90	
31 – 40	35	21.50	
41 – 50	54	33.10	
51 – 60	38	23.30	
> 60	15	9.20	46
Gender			

Male	92	56.40	
Female	71	43.60	
Marital Status			
Single	12	7.40	
Married	132	81.00	
Divorced	9	5.60	
Widowed	10	6.00	
Farming Experience (years)			
1 – 10	69	42.30	
11 – 20	58	35.60	
> 20	36	22.10	16
Educational Level			
No Formal	14	8.60	
Primary	59	36.20	
Secondary	63	38.70	
Tertiary	27	16.20	
Household Size			
1 – 3	28	17.20	
4 – 6	79	48.50	
> 6	56	34.40	5
Farm Income (KES)			
< 50,000	28	17.20	
50,001 – 100,000	42	25.80	
100,001 – 200,000	57	35.00	162,000
> 200,000	36	22.10	
Farm Size (Ha)			
< 1	39	23.90	
1 – 2	71	43.60	1.8
> 2	53	32.50	
Primary Occupation			
Farming	111	68.10	
Artisan/Businesses	37	22.70	
Civil Service	15	9.20	

Source: Data Analysis, (2025).

Major Types of Risk Faced by Arable Crop Farmers in Makueni County

The distribution of the major types of risks faced by arable crop farmers is presented in Table 2. The result

reveled that production and climatic risks are the most predominant type among arable crop farmers in Makueni County as indicated by 93.3% and 89.6% respectively suggesting the level of risk exposure of the arable crop farmers to production and climatic factors that affects their yield and income directly. [10] asserted in their study that production and climatic risks were the key drivers of yield loss among smallholder farmers in Kenya. The result further revealed that market (74.2%), financial (66.9%) and institutional (50.9%) risks were the other types of risk faced by arable crop farmers in the study area. These factors underscore the limited market linkages in rural areas, restricted access to credit as well as gaps in agricultural extension services in the county. Therefore, farmers in Makueni county faces multi-dimensional risk environment dominated by production and climatic challenges but exacerbated by weak institutional support and financial constraints. This finding reflects the similar pattern reported by [11] in Machakos and Kitui Counties.

Table 2 Major Types of Risk Faced by Arable Crop Farmers in Makueni County

Type of Risk Faced	**Frequency***	**Percentage (%)**
Production	152	93.3
Market	121	74.2
Financial	109	66.9
Institutional	83	50.9
Climatic	146	89.6

Source: Data Analysis (2025)

(*) indicates Multiple Responses

Risk Attitude of Arable Crop Farmers in Makueni County

The OLS regression result for the risk attitudes of arable crop farmers in the study area is presented in Table 3. The result shows a coefficient of determination (R^2) of 0.62 which implies that about 62% of the economic performance of the farmers was explained by the variables in the model while 38% was accounted for by the error term and other unidentified variables. The result further revealed that education ($P < 0.01$), farming experience ($P < 0.05$), farm size ($P < 0.01$) and access to credit ($P < 0.05$) were statistically significant and increased economic performance of arable crop farmers in the county. This implies that these factors helped the farmers to properly mitigate risk through informed decision making. Consistent with the findings of [1] and [10], the risk attitude ($P < 0.01$) was negatively significant, implying that risk averse farmers had lower economic performance than risk neutral and risk seeking farmers in the study area usually because they tend to avoid uncertain technologies with high-return thereby leading to reduced profitability.

Table 3 Ols Regression Result for the Safety-First Model

Variables	**Coefficient**	**Standard Error**	**t – value**
Age (X_1)	620.50	248.70	2.49**
Farm Size (X_2)	28902.60	5936.70	4.87***
Farming Experience (X_3)	1015.20	415.20	2.45**
Education (X_4)	3458.40	1212.30	2.85***
Risk Attitude (X_5)	-22134.80	8107.80	2.73***
Access to Credit (X_6)	18745.90	7993.30	2.34**
Extension Contact (X_7)	12856.40	6774.60	1.90
Constant	45213.00	18774.00	2.41**

R squared Adjusted R squared	0.62 0.59		
F-statistic	19.84***		

Source: Data Analysis, (2025).

*** and ** implies significant at 1% and 5% respectively.

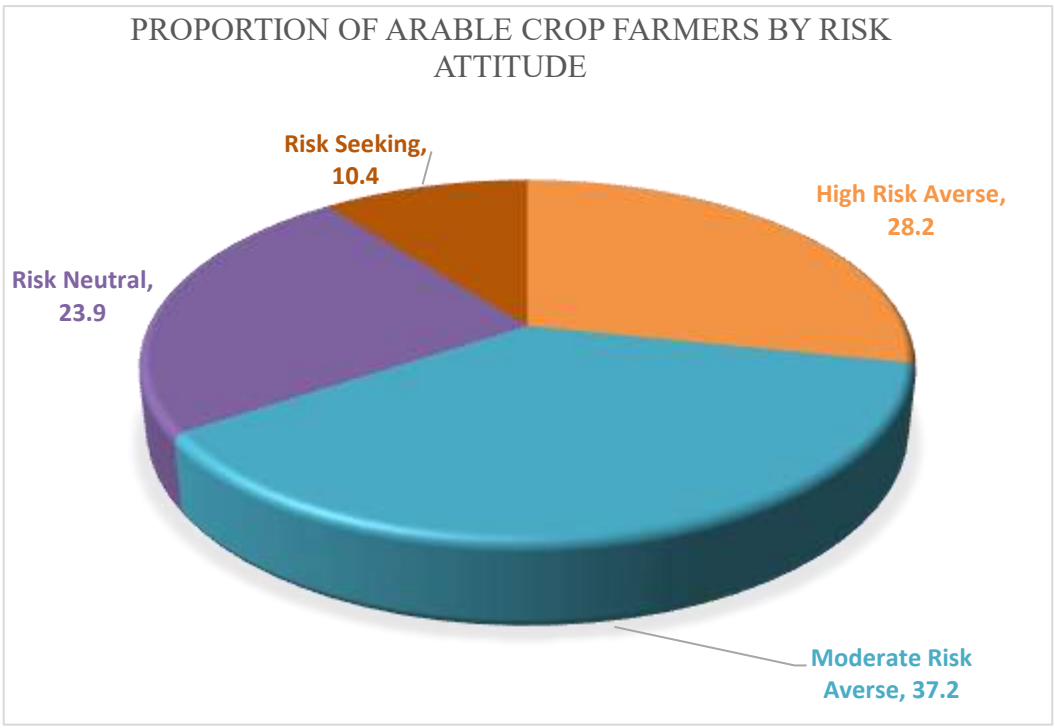
The risk attitudes of arable crop farmers were then made the basis for categorizing the farmers into groups of high risk averse, moderate risk averse, risk neutral and risk seeking farmers as presented in Table 4. This categorization formed a necessary condition for improving the typology of arable crop farmers, which was hypothesized to be influenced by socio-economic, demographic and other extrinsic risk factor. The findings revealed that about 65.6% of the farmers were risk averse, 23.9% were risk neutral and 10.4% were risk seeking thereby corroborating with empirical findings of Kenyan studies ([12], [10]) that smallholder farmers are highly risk averse. This implies that arable crop farmers in the county were highly averse to risk suggesting that farmers prioritize income stability over profit maximization. Figure 1 further shows the proportion of arable crop farmers in the county based on their risk behavior as determined by the safety-first model with majority being risk averse, thereby showing a cautious behavior under risk and uncertainties which is typical of farmers in the semi-arid regions.

Table 4 Result of The Risk Attitude of Arable Crop Farmers in Makueni County

Categories of Risk Attitude	Frequency	Percentage
High Risk Averse	46	28.20
Moderate Risk Averse	61	37.40
Risk Neutral	39	23.90
Risk Seeking	17	10.40

Source: Data Analysis, (2025).

Fig. 1: Proportion of Arable Crop Farmers by Risk Attitudes.



Risk Mitigation Strategies Adopted by Arable Crop Farmers in Makueni County

The risk mitigation strategies adopted by arable crop farmers was analyzed using a 5-point likert scale and the result is presented in table 5. The result revealed a clear preference for production and knowledge-based strategies of risk mitigation among the arable crop farmers in Makueni County. The highest levels of strong agreement were recorded by crop diversification ($\overline{X} = 4.29$) and intercropping ($\overline{X} = 4.19$) suggesting that arable crop farmers relied more on crop diversification as a low-cost and effective strategy against risk as supported by [11]. Also, the high levels of agreement of the use of drought-tolerant varieties ($\overline{X} = 4.11$) and soil and water conservation ($\overline{X} = 3.93$) measures falls in line with the adaptation behaviors of smallholder farmers in the semi-arid region of Kenya as reported by [2]. Membership of savings group ($\overline{X} = 3.52$) and diversification of off-farm income ($\overline{X} = 3.63$) were the major institutional and financial measures adopted by the arable farmers. This shows further buttress the role of social capital and livelihood diversification in risk mitigation [12].

Furthermore, at the least of agreement were the use of market/weather information services ($\overline{X} = 3.06$) and crop insurance ($\overline{X} = 2.02$) suggesting a low uptake of insurance which is consistent with empirical reports of low crop insurance uptake in sub-Saharan Africa due to high cost and trust issues as asserted by [4] and [3]. Therefore, the result presented in Table 5 suggests that arable crop farmers in Makueni County prefer risk measures with immediate, tangible and low entry costs.

Table 5 Risk Mitigation Strategies Adopted by Farmers in Makueni County.

Mitigation Strategy	**SA**	**%**	**A**	**%**	**N**	**%**	**D**	**%**	**SD**	**%**	**WS**
Crop Diversification	92	56.4	40	24.5	20	12.3	8	4.9	3	1.8	4.29
Intercropping /Crop Rotation	80	49.1	50	30.7	20	12.3	10	6.1	3	1.8	4.19
Drought-Tolerant / Early Varieties	78	47.9	45	27.6	25	15.3	10	6.1	5	3.1	4.11
Soil & Water Conservation	70	42.9	40	24.5	30	18.4	18	11.0	5	3.1	3.93
Membership in Savings Groups	50	30.7	40	24.5	30	18.4	30	18.4	13	8.0	3.52
Off-farm Income Diversification	48	29.4	52	31.9	30	18.4	20	12.3	13	8.0	3.63
Use of Organic Manure / Compost	45	27.6	40	24.5	40	24.5	25	15.3	13	8.0	3.48
Collective Marketing / Cooperatives	35	21.5	45	27.6	40	24.5	30	18.4	13	8.0	3.36
Small-scale Irrigation / Water harvesting	25	15.3	40	24.5	30	18.4	40	24.5	28	17.2	2.96
Storing Produce for Off-Season Sales	30	18.4	35	21.5	40	24.5	38	23.3	20	12.3	3.10
Use of Weather/Market Information	20	12.3	40	24.5	50	30.7	30	18.4	23	14.1	3.02
Crop/Weather-Index Insurance	5	3.1	14	8.6	30	18.4	50	30.7	64	39.3	2.06

Source: Data Analysis (2025).

Note: SA – Strongly Agree, A – Agree, N – Neutral, D – Disagree and SD – Strongly Disagree and WS – Weighted Score.

CONCLUSION AND RECOMMENDATIONS

The study concludes that arable crop farmers in Semi-Arid Makueni County operate within a highly uncertain production environment dominated by climatic and production risks. Majority of the farmers are risk-averse, traditional practices that ensure income stability over profit maximization. Education, experience and access to financial and extension services significantly improve their ability to cope with risk while lack of institutional support and credit constraints limit their adaptive capacity. Various informal and agronomic strategies are widely adopted but the low utilization of insurance and market information tools shows the persistent institutional and financial challenges.

Based on these findings, it was therefore recommended that stakeholders should develop affordable farmer-friendly credit and micro-insurance schemes for arable crop farmers, scale-up farmers training on risk-reducing technology, strengthen farmer group and cooperative to improve access to input, and foster on-and off-farm diversification initiatives through agribusiness development.

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