

Do Rice Farmers Share a Similar Perspective on the Choice of Varieties? Evidence from a Survey Across Selected Rice Growing Counties in Kenya



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Abstract

Aim: This baseline survey was designed to explore the demand for improved certified rice seed in Kenya, focusing on farmers' decision-making frameworks for selecting rice varieties.

Methods: Through participatory methods, 710 respondents were selected including key informants. For a more in-depth understanding, four counties were purposefully selected based on their differing histories and intensity of rice production: two counties with a long history and high intensity of rice farming, and two with a more moderate history and two with relatively low production intensity. The survey employed a cross-sectional design of a descriptive nature, involving 30 days of rigorous data collection using questionnaires across all rice production regions nested within counties. Key attributes/criteria that farmers use to select rice varieties were identified from data points across the four counties. These attributes were analyzed using a Grid Analysis approach, allowing for county-based and overall rankings of the varieties selected.

Results: The study found that farmers consistently prioritize attributes such as market demand, early maturity, head rice recovery, taste and high yield, irrespective of spatial separation. These influential variables govern attributes' preference and choice decisions. This influence is largely attributed to the shared public good of research and extension services.

Conclusion: The study confirms that Kenyan rice farmers are rational decision-makers, driven by the objective of profit maximization, as shown in their unanimous selection of market demand as the most critical attribute when choosing a rice variety to grow.

Recommendation: The study recommend that research planning and implementation of the rice improvement programme needs to involve farmers from the initial stages to ensure that their rational behaviour is integrated into future agricultural strategies.

Keywords: *Attributes, grid analysis approach, rational farmer, rice varieties, variety choice*

1.0 INTRODUCTION

Globally, farming is widely regarded as an investment, as it involves making economic decisions that require careful consideration (Wang *et al.*, 2019). In addition, farmers themselves constitute a distinct social group, often striving to remain relevant within their communities by engaging in practices that align with common norms, thus guiding their decisions through entrepreneurial thinking (FAO, 2015). As entrepreneurs, farmers are typically oriented toward profit or welfare maximization and are inclined to pursue ventures that minimize risk. For example, farmers engaged in crop production tend to select crop varieties with desirable traits such as resilience to environmental stressors (both biotic and abiotic) and high market demand (Simutowe *et al.*, 2024). From a sociological standpoint, farmers utilize various social platforms as avenues for learning and experimentation, which collectively contribute to the development of informed decision-making frameworks (Ingram, 2010). These platforms provide farmers with opportunities to explore new methodologies for addressing emerging challenges related to their agricultural practices.

In Kenya, rice is the third most important cereal crop, following maize and wheat. Its significance is highlighted by an annual consumption growth rate of 12%, compared to 4% for wheat and 1% for maize. Rice has been identified as a priority value chain in the National Agriculture Investment Plan (NAIP 2018-2028), which aims to accelerate the country's agricultural transformation by promoting the commercialization and modernization of the sector. This transformation is intended to sustainably support Kenya's food and nutrition security as well as socio-economic development. The importance of rice production and its value chain has also been underscored by the Agriculture Sector Transformation and Growth Strategy (ASTGS 2019-2029), which recognizes rice as a key value chain for advancing agricultural development beyond mere food production.

In recognition of rice as a crucial element in Kenya's food and income security, research and development efforts have led to the introduction of various rice varieties tailored for different ecological zones where rice cultivation is feasible (Mutisya, 2022). However, the responsibility of selecting the appropriate rice variety to cultivate ultimately lies with the farmer. While prior studies have assessed rice production or adoption of new varieties, limited attention has been paid to the underlying decision-making frameworks guiding farmers' variety choices across diverse rice-growing regions in Kenya. This paper aims to explore the framework within which farmers make variety selection decisions, based on data from a survey of rice farmers across ten rice-growing counties in Kenya. Specifically, it seeks to answer the question: 'Do rice farmers across different counties in Kenya prioritize similar attributes when selecting rice varieties?' The primary objective is to examine whether there exists a purely economic rationality, influence from institutions, or collective behavior patterns that guide farmers towards a preference for specific attributes when selecting rice varieties for cultivation.

2.0 THE THEORETICAL FRAMEWORK

The data generated from the survey draws heavily on neoclassical microeconomic theory, which posits that economic agents, as individuals, make decisions aimed at maximizing their utility (Ouattara *et al.*, 2022). This study adopts the random utility model to conceptualize the choice of rice variety that maximizes the farmer's expected utility. It was hypothesized that the choice of farmer i from a set of j attributes maximizes the farmer's objective function, denoted as V_{ij} . Given

that j follows a discrete distribution ($j=1, 2, 3, \dots, n$) for a vector of variety attributes that different rice varieties have and which the rational farmer selects the rice variety that maximizes the objective function V_{ij} , with the attributes ranked according to the farmer's perception. In this context, each attribute is assigned a weight based on its perceived importance by the farmer. Based on the assumption of rational decision-making, we propose a conceptual framework for understanding the decision-making process of rice variety selection.

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

Where U_{ij} is the maximized objective (the rice variety selected and being the response variable), and V_{ij} a vector of the variety attributes. U_{ij} in the case of being determined by the attributes can be decomposed to a deterministic form explained by the selected attributes V_{ij} and random ε_{ij} and therefore empowers model (1) to be sufficient enough for use in multiple choices (Aurier & Mejia, 2014). The random utility model (RUM) is a useful tool used to analyze and predict choices among multiple alternatives particularly in situations where individuals make decisions based on options as in the case with rice variety choices.

3.0 MATERIALS AND METHODS

3.1 The Study Area

This paper utilizes data from a study conducted in ten (10) counties in Kenya, including Kirinyaga, Kisumu, Tana River, Kwale, Taita Taveta, Busia, Homa Bay, Migori, Siaya, and Murang'a. These counties form over 95% of the rice-producing area in Kenya.

3.2 The Study Design

The survey design, the primary source of data, was cross-sectional in nature, encompassing both descriptive and causal elements, which comprise the various attributes that influence the choice framework of farmers on the rice varieties to grow. The choice of a cross-sectional design was informed by its recognized advantages, including the ability to effectively study associations, its cost-efficiency in administration, and its capacity to provide comprehensive coverage of all subjects of interest as data sources.

3.3 Sample Size Determination and Sampling

The sample sizes for the study counties were determined using a mathematical optimization method, as recommended by Lenth (2001). This method used the formula presented below;

$$N_0 = \frac{Z^2 \cdot p \cdot q}{E^2}$$

Where,

N_0 = the desired sample size,

Z = the desired confidence level (i.e., 95%),

p = the estimated proportion of the population that possesses the attribute and

$q = (1-p)$; the estimated proportion without the attribute. E is the margin of error.

The Lenth (2001) method ensures the generation of optimal sample sizes that account for the desired confidence level, margin of error, and expected variability within the study population. Following this approach, a total of 710 respondents were selected across the study counties, with the sample distribution being proportionate to the population of each county. A multi-stage

sampling technique was used, beginning with purposive identification of the rice farmers in each rice-producing county, followed by a systematic random selection of the respondents on the i^{th} occurrence of the respondents as guided by the determined sample size following the Lenth (2001) formula above.

Table 1: Sample Sizes (respondents' numbers by county)

County name	Respondents/sample size
Busia	37
Homabay	103
Kirinyaga	97
Kisumu	135
Kwale	75
Migori	44
Murang'a	37
Siaya	76
Taita-Taveta	57
Tana-River	49
Overall Sample size (N)	710

Source: Survey sampling tool, 2024

3.4 Data Collection

Data collection for baseline information was conducted through one-on-one interviews using a semi-structured questionnaire, which was administered via the Open Data Kit (ODK) tool. For the purpose of identifying the attributes that farmers use to select rice varieties, smaller sample sizes were drawn from four selected counties. Two of these counties, Kirinyaga and Kisumu, were chosen for their long history of rice production, with farmers having extensive knowledge of the key attributes that influenced variety selection. The remaining two counties, Busia and Tana River, were selected for their emerging rice production sectors, where farmers also possess considerable experience in identifying critical attributes for rice variety selection. These two categories of counties provided a diverse perspective on the factors influencing rice variety selection.

Level two extraction of data for identifying attributes that influenced the choice of rice varieties to grow was done through random selection of respondents' data that demonstrated completeness or had no data gaps. Following this strategy, the following sample (data-point) sizes were used for the level two analysis using the Grid Analysis (GA) tool.

Table 2: Sample sizes for the Grid Analysis (GA) data

County Name	No. of respondents
Kisumu	62
Kirinyaga	55
Busia	33
Tana-river	37
Total	187

Source: Baseline survey data, 2024

3.5 Data Management and Analysis

Data cleaning was conducted systematically, along with purposive coding to ensure alignment with the type and level of analysis required. Data synthesis was also carried out objectively. Descriptive statistics were employed to generate the socio-demographic characteristics of the respondents. To facilitate inferences regarding the rice attributes that influenced the choice of rice variety to cultivate, a Grid Analysis (GA) technique developed by Kelly (1955) was used. The GA is a tool that facilitates decision-making by evaluating options based on multiple criteria. It involves creating a table with options as rows and criteria as columns, assigning scores to each option based on each criterion, and then weighting those scores in an ordered pattern based on their relative importance to the "rational farmer," to enable comparing and prioritizing the options and facilitate an informed choice. The ordered pattern, reflecting the relative rating of the attributes, demonstrated the decomposition property of similar or different attributes, as utilized in the Multivariate Probit (MVP) model. Therefore, the GA method serves as a straightforward and effective analytical tool for handling multiple choices that a farmer may wish to make in an ordered fashion.

To evaluate and rank the choice framework for rice varieties (or alternatives) based on their respective traits, an ordered ranking (1, 2, 3...n) of the attributes was established from the data using generated frequencies. This analysis identified eight attributes considered important by farmers when selecting rice varieties: colour, grain shape, aroma, taste, early maturity, head rice recovery, yield and marketability. Each attribute's importance was also rated by the respondents, generating a frequency table, as presented in Table 3 below. Grid Analysis was performed for the four selected individual counties and the overall data (across four counties)

4.0 RESULTS AND DISCUSSION

4.1 Drivers for Variety Choice

Following the listing of the variety attributes, weights were assigned based on the comparative importance or significance of the attributes in selecting a rice variety to grow. Table 4 summarizes the weighting of the variety attributes. Higher value weights depicted that the attribute was very important and therefore a demand driver for the rice variety if it happened to have it.

Table 4: Weighted Rice Varieties' Attributes

Variety attribute/trait	Assigned weight
Color	2
Grain shape	4
Aroma	5
Taste	6
Early maturity	7
Head rice recovery	8
Yield	9
Market Demand	10

Source: Rice Baseline Survey Data, 2024

Note: Similar numbering of variety attributes implies that the attributes carry equal weights for consideration of their importance.

Tables 5 and 6 present the results of the grid analysis in each county and across the four selected counties using the weighting criteria set by the level two design for the determination of the influence of the weighted attributes. The survey identified three popular varieties grown by farmers. These were NIBAM11 (*Pishori 370*), mainly grown in Kirinyaga county, IR 2793-80-1 popular in Kisumu and Busia and *Komboka*, a variety of choice in Tana River and gaining popularity in Kirinyaga, Kisumu and Busia counties. The results showed that among the three varieties, market demand was the most critical attribute determining the choice of variety to grow. Ranking of the other attributes differed among the varieties.

In NIBAM11, market demand was followed by taste and aroma. IR 2793-80-1, market demand was followed by early maturity, head rice recovery and taste, while for *Komboka*, market demand was followed by high yield, early maturity, taste and head rice recovery. Overall, the results show clearly that market demand for a particular rice variety was the most critical attribute influencing choice of a rice variety to grow (as indicated using the signs "***"). High yield was also scored as a determinant attribute for variety selection on an ordered justification that it complements the farmers' profit maximization objective, where market demand is the overriding attribute (Wale *et al.*, 2007). This consideration of high yield as an important factor was also qualified by Langyintuo *et al* (2008), who argued that whether producing rice is mainly for home consumption or the market, yield potential plays a fundamental role in planting a given variety.

Other attributes identified as determinants for variety choice included head rice recovery as an important component of rice grain quality preferred by farmers due to its influence on market price, as confirmed by Anang *et al* (2011). On the other hand, variety early maturity provides leverage as an escape mechanism against harsh environmental/climatic conditions (Ndeko *et al.*, 2022), especially for upland rice varieties. Taste and aroma are the immediate or primary eating-quality attributes that consumers use, particularly through sensory evaluation. They directly contribute to the overall perception of a product through the sense of taste and smell and for rice, which is a food commodity, taste and aroma play a significant role towards enhancing its acceptability by consumers (Bhuiyan, 2015). These attributes were well acknowledged in the case of Kirinyaga County for both and Kisumu for taste.

The ranking of attributes, as reflected by the totals in the respective columns, is evaluated against other totals across the selected counties. This analysis suggests that the "similar" scoring behavior observed may indicate the influence of some influential factors that actively shape farmers' decision-making processes regarding rice variety choices. Furthermore, the findings support the notion that, regardless of geographical distance, farmers are guided by a singular overarching objective: the maximization of their outcomes, as posited by Solano *et al.* (2006). In line with the broader literature, the behavior of Kenyan rice producers mirrors that of farmers in other regions, exhibiting traits of rationality and transitivity, as documented by Kengo *et al.* (2022).

One significant factor contributing to the common behaviour observed among farmers is the source of information that shapes their production decisions. Chukwuma *et al.* (2023) found that the major pathways for accessing information, which influence farmers' decision-making frameworks, include fellow farmers (93.3%), personal observations, often during field days (86.7%), friends (66.7%), and input dealers (52%). This pattern is consistent with the rice variety selection framework in Kenya, as evidenced by the linear relationship and the consistent pairing/reflection of attribute weighting behaviours across the four counties.

A key element underlying the commonality in the rice variety attribute weighting behaviour among Kenyan farmers is their shared access to research and extension services. These are considered a public good. Extension service providers and researchers, including institutions such as the Kenya Agricultural and Livestock Research Organization (KALRO), the International Rice Research Institute (IRRI), the National Irrigation Authority (NIA), and various rice growers' associations, play a critical role in shaping farmers' knowledge and expectations over time. These services realign farmers' perspectives and reinforce their decision-making processes in rice production.

The observed similar behaviour in the weighting of criteria and variety attributes may therefore be attributed to two additional commonalities among the farmers: (i) they operate within similar environmental contexts and face similar challenges and constraints, and (ii) they occupy a dual role as both producers and consumers (Kengo *et al.*, 2022). This dual role encourages a "win-win" strategy, where market demand remains the principal driving force for their production decisions.

Table 5: The Grid Analysis Results - Ranking Rice Attributes That Farmers Use in Selecting the Variety to Grow Across Selected Counties

Kisumu (n=62)		Market Demand	High Yield	Head rice recovery	Early Maturity	Taste	Aroma	Grain shape	Color	Total
Weights		10	9	8	7	6	5	4	2	
Komboka		80	0	14	35	12	15	8	0	164
IR 2793-80-1		1110	162	455	490	378	290	236	118	3239
TOTALS		1190**	162	469**	525**	390**	305	244	118	
Kirinyaga (n=55)		Market Demand	High Yield	Head rice recovery	Early Maturity	Taste	Aroma	Grain shape	Color	Total
Weights		10	9	8	7	6	5	4	2	
Komboka		250	189	35	70	66	50	40	18	718
NIBAM11		670	0	140	126	174	160	92	32	1538
TOTALS		920**	189	175	196	240**	210**	132	50	
Tana River (n=37)		Market Demand	High Yield	Head rice recovery	Early Maturity	Taste	Aroma	Grain shape	Color	Total
Weights		10	9	8	7	6	5	4	2	
Komboka		450	261	189	133	144	130	76	30	1413
TOTALS		450**	261**	189**	133	144	130	76	30	1413
Busia (n=33)		Market Demand	High Yield	Head rice recovery	Early Maturity	Taste	Aroma	Grain shape	Color	Total
Weights		10	9	8	7	6	5	4	2	
Komboka		140	27	35	56	30	30	20	10	321
IR 2793-80-1		180	0	35	42	24	25	16	8	330
TOTALS		320**	27	70	98**	64	55	36	18	

**=A notable attribute scored across the selected counties and overall as the key guiding trait for selecting rice varieties to grow.

Table 6: Grid Analysis Results Table-Overall Data (Attributes across four counties)

Across n = 187	Market Demand	High Yield	Head rice recovery	Early Maturity	Taste	Aroma	Grain Shape	Color	Total
Weights	10	9	7	7	6	5	4	2	
Komboka	1800	846	483	609	552	460	308	146	5204
NIBAM11	1370	36	168	196	246	220	132	52	2420
IR 2793-80-1	1960	270	679	749	546	435	348	174	5161
Total	5140	1161	1337	1561	1350	1120	792	374	
Ranks	1	5	4	2	3	6	7	8	

5.0 Conclusion/Implications of the Results

Findings from the GA demonstrated that despite spatial separation, farmers engaged in the same value chain and operating under a similar policy environment developed distinct and reliable information access pathways. These pathways can be likened to some influential factors or variables that guide their decision-making patterns and processes. Moreover, farmers possess their own set of attributes ranking criteria, which they utilize as tools to make informed investment decisions, specifically for attributes like aroma, early maturity, color and taste of the different rice varieties available to them. The consistent, unitary direction observed in the variety choice decisions, which translates to points of convergence, is also demonstrated and ranked as market demand and yield further supports the conclusion that these farmers have established reliable networks for information sharing, which significantly influence their choices and overall production strategies. These networks of information sharing, which often include interactions with fellow farmers, extension services, researchers, and agricultural organizations, enable farmers to align their decision-making with the broader trends and practices within their community. Such networks ensure that the farmers are not isolated in their decision processes, but rather are part of a collective system where knowledge is disseminated and reinforced through social and professional channels. This inter-play not only helps in the adoption of improved agricultural practices but also enhances the farmers' ability to make choices that are both economically viable and aligned with market demands. As a result, the farmers' decisions are not solely based on individual experiences but are shaped by a broader, shared understanding that reflects both local and global agricultural trends.

6.0 RECOMMENDATIONS

Results of this paper show that there is enough justification that farmers know their production objectives, production environment and the requisite considerations for rice production, beginning with variety choice. For enhanced production and productivity, future research planning on variety improvement needs to focus on enhancing the market acceptability of released varieties, thereby satisfying market demand. The results also demonstrate that market demand is the key attribute influencing variety choice, which must be supported by high yield. This evidence also informs research and development policy makers that variety improvement efforts need to integrate

farmers' representatives in designing interventions that will enhance rice production and productivity.

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Conflict of interest

The authors declare no conflict of interest.

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