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## Analysis of Rice Marketing Channels Choices in Mwea Irrigation Scheme, Kirinyaga County, Kenya

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### ABSTRACT

The National Rice Development Strategy in (Kenya vision 2030) aims to improve food security, rural employment, and income for smallholder farmers in the Mwea irrigation scheme (MIS) through planned and intentional efforts. A study was conducted to identify major influences in choosing market avenues among rice farmers. The study used a sample size of 384 small-scale rice farmers to analyze the different rice marketing channels used in MIS, and to understand the factors that influence farmers' choices of marketing channels. A pretested semi-structured questionnaire was used for data collection. Descriptive statistics were used to characterize the marketing channels, multinomial logit model was used to evaluate channel choices. The marketing channels were Channel 1: Farmer-Consumer (0.3%); Channel 2: Farmer-Brokers-Millers-Consumer (51.1%); Channel 3: Farmer-Brokers-Millers- Retailer-Consumer (42.3%); Channel 4: Farmer- Millers-Retailer-Consumer (62.72%) and Channel 5: Farmer- Millers- Wholesaler-Retailer-Consumer (37.28%). The most profitable channel was direct sales to consumers, which accounted for only 0.3% of total rice production in MIS. The study also found that factors such as education level, participation in marketing groups, distance to market, and age of the household head significantly influenced farmers' choice of marketing channels. The study is critical in enriching literature on rice agricultural supply chains in Kenya. The study recommends policy considerations to protect small-scale farmers from exploitative brokers and suggests registering brokers to monitor their activities and set standards for fair practices, with the goal of regulating their activities to prevent exploitation of small-scale farmers in rice marketing.

### INTRODUCTION

Rice has been harvested, consumed, and produced by many people around the world for over 10,000 years, making it the oldest crop on the planet (Talhelm & Oishi, 2018). For more than half of the world's population, rice is the most important staple food (Tanaka *et al.*, 2017). Rice agriculture covers 150 million hectares (ha) globally, with annual paddy production averaging 759.6 million metric tons (MMT), or 503.9 million metric tons milled basis (MMT), with over 85 percent (408 MMT) for human use. This is equivalent to 29% of total grain crop output worldwide (FAOSTAT, 2017).

Rice growing is a significant concern in Kenya because it plays a crucial role in household food security and farmer income. The Mwea Irrigation Scheme (MIS) accounts for 80% of Kenya's rice output, which is a vital part of the grain supply in a country that relies on imports to meet its rice needs (Ndegwa, 2018). The fact that farmers in Kenya sell about 95 percent of the rice they produce locally, highlights the importance of rice in the country's economy. However, due to changing market conditions and consumer demand, several rice sellers in the country are taking advantage of small-scale farmers. The government-owned National Cereals and Produce Board (NCPB) is one of the main dealers, it buys paddy from farmers, processes it in state-owned mills, and sells milled rice to retailers (Serade *et al.*, 2015). This shows that the market is not favorable for small scale farmers and government's policies are not favorable for farmers.

Rice production in Kenya is estimated at 150,000 metric tons from 25,000 hectares of land (GoK, 2017). Rice production barely fulfils around 20% of overall demand, with rice consumption expected to climb as the world's population grows and eating patterns change (Atera *et al.*, 2018). Rice consumption in Kenya is estimated to be 550,000 metric tons per year (Kenya Bureau of Statistics, 2017), and it is growing at an annual rate of 12% , compared to 4% for wheat and 1% for maize, the leading basic food (Ministry of Agriculture, 2018). Per capita, rice consumption in Kenya is estimated to be 10-18 kilograms per year (Ministry of Agriculture, 2017). Rice demand surpasses supply, and the vast gap between supply and demand is covered at a high cost by importing to meet domestic needs. By 2030, the rice market is expected to grow to 517.5 million tons (Musila *et al.*, 2018). For Kenya to achieve rice self-sufficiency by 2030, total domestic rice output must increase at a rate of 9.3 percent each year (Ministry of Agriculture, 2018).

The Mwea Irrigation Scheme was established in 1958 as a resettlement scheme with the primary goal of resettling landless and ex-detainees. The program covers 30,350 acres, with 16,000 acres dedicated to rice production and the rest used for settlement, public amenities, subsistence farming, and horticultural crop farming. The Nyamindi and Thiba rivers provide water to the project. Around 7,500 households are working on an average of 4 acres of land (NIA, 2020). Until 1998, the government oversaw the plan through the National Irrigation Board (NIB). The

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NIB was the landlord, and the farmers were the tenants regarding land tenure. The tenant provided labour services at a cost established by the landlord, while the landlord provided inputs, infrastructure, machinery, and extension services. The government had an elaborate structure and mechanisms, farming operations management, water management, funding arrangements, storage, processing, and marketing (Mati *et al.*, 2016).

Farming is still a significant concern in Kenya because of its good impact on household food security and farmer revenue. Kenya's rice output is 80% based on the Mwea Irrigation Scheme. Because of its outstanding quality, MIS rice is frequently blended with low-quality imported rice in the region. Rice traders are increasingly capitalizing on changing market conditions and consumer preferences. In the recent decade, smallholder rice farmers have been less involved in rice marketing. Many new competitors have entered the rice marketing scene. NIB, Mwea Rice Millers, cooperative millers, distributors, merchants, brokers, and importers are among the marketing chain's actors (Ndegwa, 2018). Farmers in the Mwea Irrigation Scheme have numerous avenues to dispose their rice surplus. In the Mwea Irrigation Scheme, there is inadequate information on the specific avenues farmers may opt for and farmers' choices of rice marketing channels. This study identified the rice marketing channels and channel choices among rice farmers to bridge this knowledge gap.

## LITERATURE REVIEW

### Theoretical Review

Adam Smith's (1770) Rational Choice Theory (RCT) frequently assumes that the individual decision-making unit in question is typical or representative of a broader group, such as buyers or sellers in a given market. After determining individual behaviour, the research usually looks at how individual decisions interact to produce results. Theorists of Rational Choice Theory think that most human actions are made to maximize a person's benefits while minimizing those that may harm them.

The assumption behind the rational choice analysis is that some agent, or set of agents, maximizes utility by selecting the preferred option. The presence of restrictions is another crucial aspect of the decision-making process. Limitations necessitate the choice, and one of the benefits of rational choice theory is that it makes the trade-offs between alternative options very obvious. The budget restriction, which states that the customer cannot spend more than her income in a simple one-period consumer choice problem, is a common constraint. Rational Choice Theory is relevant because it assumes that rice agents, large-scale private millers, small private millers, NIB, Mwea Rice Millers, cooperative millers, wholesalers, retailers, brokers, and importers, among others, make rational choices with the farmers' choice in mind.

### Empirical Evidence on Farmer's Choice in Rice Marketing Channels

Using a logit model, Mburu *et al.* (2017) evaluated

farmers' milk marketing channel choices in central Kenya. According to the study, the land negatively influenced farmers' adoption of milk selling through the dairy cooperative channel, average milk price, the total number of cows milked, and farm acreage. Hired permanent labour, whether or not a household head worked off-farm, average milk output per cow (kg per day), dairy cooperative as a source of animal production information, and the availability of financial services all had a beneficial impact. The traders were divided into two groups in the study: cooperatives and itinerant traders (hawkers, neighbours, and hotels). The difference between Mburu *et al.* (2017) and this current study is that the study collapsed all market alternatives into a binary outcome while the current study does not. The current study built on Mburu's research by evaluating rice marketing channels using the multinomial logit (MNL), which captures each marketing channel separately.

Nyaga *et al.* (2016) investigated the factors influencing fish producers' marketing channel selection in Kirinyaga County. The data was analyzed using a multinomial logit model after a descriptive research design comprising 147 fish farmers in Kirinyaga's five sub-counties. It defined market channels for fish farmers and investigated the factors influencing their marketing channel selection. According to the survey, there are three main channels: neighbours, direct market, and traders, which account for 49 percent, 29 percent, and 22 percent of the total. Farmers' choice of the market channel was influenced by the gender of the household head, distance to market; marketing cost, land tenure, number of fish ponds owned, access to extension services, cost of marketing, membership in a fish farming group, access to inputs, household income, price of fish, and type of fish reared. Despite government assistance, farmers faced predators, insufficient extension services, and limited access to information. The conclusion is that county governments and other stakeholders must make it easier for practising farmers in their communities to access vibrant extension programs and market support.

Chalwe (2015) evaluated the factors influencing bean producers' decision to sell and their choice of marketing channel in Zambia using the multinomial probit. The results showed that farmers' choice of marketing channels was positively influenced by the price of beans, scale of operation (as measured by the number of beans harvested and quantity sold), distance to the market, farming mechanization used, and livestock ownership.

According to Ogunleye and Oladeji (2017), cocoa farmers in the research area chose choice market channels for their output based on time of payment, the form of payment, product pricing, distance from the farm, transportation cost, and product grading. In that order, the majority of the farmers in the study patronized itinerant buyers, cocoa merchants, fellow farmers, and cooperative society stores. They conclude that the time between when goods are sold and when they are paid is a high negotiation cost that determines cocoa growers' market choice. Farmers

were hesitant to choose an outlet because of payment delays. Transportation costs rise as the distance between the farm and the road deteriorates. Farmers will prefer a low transportation cost if they cannot entirely avoid it due to bad roads. Uncertainties are associated with produce grading because farmers risk having their produce rejected or reduced prices. As a result, farmers will seek to avoid any of the two repercussions associated with food grading.

According to a study by Wojciech *et al.* (2013) titled “Marketing Portfolio Choices by Independent Peach Growers,” Georgia commercial peach growers select a marketing channel for fresh peach sales after considering consumer preferences for quality qualities. Through the use of a polychotomous selection model and survey data, it was discovered that both external and internal quality attributes influenced the choice of marketing channel chosen and the percentage of the crop sold. Other influencing factors included orchard characteristics and the variety-determined fruit maturity.

Inadequate market channels and a lack of price knowledge were two problems Jaleta (2007) cited as limiting agricultural commercialization. Furthermore, a study by Eman and Gebremedhin (2007) claimed that insufficient local markets, a flawed pricing system, a lack of local markets to absorb supply, low produce prices, an excess of intermediaries, and poor marketing institutions and farmer coordination affect the marketing of horticultural crops in their study on market chain analysis. Inadequate product handling and packing, poor pricing mechanisms, and information asymmetry, according to Eman and Gebremedhin (2007), all have an impact on farm produce marketing.

### Summary of Research Gaps

The literature review suggests a gap in research on the factors that influence farmers’ choice of marketing channels for their products in different geographical locations and types of products. It would be valuable to investigate the impact of government policies and programs on farmers’ decision-making process and their choice of marketing channels.

## MATERIALS & METHODS

The research was carried out in the Mwea Irrigation Scheme (MIS), a National Irrigation Board (NIB) scheme located in Kirinyaga County, Central Kenya, near the base of Mount Kenya. The MIS is located 112 kilometres northeast of Nairobi. On the dry plains of Mt. Kenya’s southeast, it is located at latitude 0° 37’ S and longitude 37° 20’ E, at an elevation of 1159 meters above sea level. The Nyamindi and Thiba rivers provide water to the project. MIS is situated on top of a worn trachyte bed and is surrounded by impenetrable, heavy black cotton soil (NIB, 2017).

The MIS covers 30,350 acres (Ministry of Agriculture, 2017). Paddy production is spread across 16,000 acres (Ministry of Agriculture, 2017).

## Research Design

A cross-sectional survey research design was used in this study. Cross-sectional studies are studies in which data is gathered once, during a period of days, weeks, or months. Many cross-sectional studies are exploratory or descriptive in purpose.

## Target Population

The study population consisted of all rice farmers, wholesalers, retailers, and rice millers in Mwea Irrigation Scheme. According to the records from the Ministry of Agriculture County Director of Agriculture (CDA) Mwea Irrigation Scheme, has seven units with 5,576 households (Ministry of Agriculture Kirinyaga County Office, 2017). The target population for this study was 5,576 rice farmers. The choice of the respondents was purposive since they are aware of the rice production and marketing channels. Table 1 shows the total population.

**Table 1: Target Population**

No	Section	Farmers
1	Mwea	867
2	Thiba	776
3	Wamumu	794
4	Karaba	709
5	Ndekia	724
6	Tebere	950
7	Curukia	756
Total		5,576

## Sample Size and Sampling Techniques

In determining sample size, the researcher used a formula adopted by Yamane (1963)

$$n = \frac{N}{(1 + N)(e^2)}$$

Where n – Sample size, N – Population size, e – (the acceptable margin error)

Thus

$$n = \frac{5567}{1 + 5567 (0.05^2)} = 384$$

A total of 384 farmers was sampled from the target population. Table 2 shows the distribution of the sampled respondents.

**Table 2: Sample Size**

No	Section	Farmers
1	Mwea	60
2	Thiba	53
3	Wamumu	55
4	Karaba	49
5	Ndekia	50
6	Tebere	65
7	Curukia	52
Total		384



### Piloting and data collection

Data was collected by interviewing farmers using a semi-structured questionnaire. The researcher administered the questionnaires and waited to be filled out. This not only improved the reliability of given information but also assured a high return rate. Before collecting actual data, the research questionnaire was tested. This was aimed at identifying weaknesses and making requisite instrument adjustments before commencing data collection. Piloting involved collecting data from a sample of 20 farmers from the Karaba section, representing 5% of the study sample size of 384 respondents (Mugenda & Mugenda, 2003).

The data was collected over two months, between August 2018 and December 2018. The researcher sought permission from the County Administrator in Mwea County before commencing data collection. A research permit was also sought and granted from the National Commission of Science, Technology, and Innovation (NACOSTI). Five researcher assistants were recruited and trained on field data quantification, research ethics, triangulation, and probing to assist in data collection.

The study used primary data that was quantitative and descriptive. Primary data was obtained from the rice farmers, wholesalers, retailers, and rice millers using structured questionnaires.

### Data Analysis

Raw data was entered into a Microsoft Excel spreadsheet after the questionnaires were filtered to ensure the completeness and consistency of responses. Following that, the replies were coded for a statistical package of

social sciences (SPSS) analysis. The study's first objective identified rice marketing channels in the Mwea Irrigation Scheme. To attain this objective, descriptive statistics were employed in the analysis, which included means, frequencies, percentages, and standard deviations.

The study's second objective evaluated factors influencing farmers' choice of rice marketing channels. The multinomial Logit model analysis was utilized to assess the factors influencing the choice of rice marketing channel in MIS. Because it is chosen among other marketing channels, a specific marketing channel is distinct. If  $P$  is the likelihood of rice farmers choosing a particular marketing channel, then the equation to represent this is,

$$P_{ij} = \beta_0 + \beta_1 X_1 + \dots + \beta_k X_k + e \dots \dots \dots (1)$$

Where  $i$  takes values (1, 2, 3 and 4), each representing the choice of marketing channel ( $X_1, \dots, X_k$  = farmers choices),  $\beta$  are parameters to be estimated and  $e$  is randomized error.

The multinomial Logit model is given below:

$$P_{ij} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \epsilon_i \dots \dots \dots (2)$$

The choice of marketing channel is given by the variables of measurement for multinomial logit in Table 3.3 and the empirical equation:

$$P_{ij} = \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Ged} + \beta_3 \text{Edc} + \beta_4 \text{Hhse} + \beta_5 \text{HseY} + \beta_6 \text{Ocpt} + \beta_7 \text{Dmkt} + \beta_8 \text{Ricot} + \beta_9 \text{Mrktin} + \beta_{10} \text{Vop} + \beta_{11} \text{Mgrp} + \beta_{12} \text{Mrktac} + \epsilon_i \dots \dots \dots (3)$$

$P_{ij}$  = Mktcho dependent variable,  $\beta$  parameter to be estimated and  $\epsilon_i$  is the error term, and the other variables are specified in Table 3.

**Table 3:** Variables used in Multinomial logit

Variable code	Variable	Measurement of the variables	Expected sign
<b>Dependent variable</b>			
Mktcho	Rice marketing channel choice	Consumer=1,Retailer=2, Wholesaler=3,Processor=4,Broker=5	N/a
<b>Independent variables</b>			
Age	Age in years	In years Dummy (Male=1,Female=0)	+
Ged	Gender	No education=1,primary=2,	-
Edc	Education	secondary=3,Tertiary=4	-
Hhse	Household Size	Size of Household ( continuous)	+
Ocpt	Occupation	Farmer=1,Businessman=2, Employed=3	-
HseY	Household Income	In shillings (Ksh) continuous	+
Dmkt	Distance to market	In Kilometres ( Km) ( continuous)	+
Ricot	Rice output	In Kilograms	+
Mrktin	Market information	Dummy ( yes=1, No=0)	-
Mrktac	Market access	Dummy ( yes=1, No=0)	-
Mgrp	Marketing in groups	Dummy ( yes=1, No=0)	-

## RESULTS & DISCUSSION

This chapter presents the patterns of the results of the study. The findings are presented in tables and narrations as per the specific objectives. The chapter presents descriptive and inferential statistics, the pre-estimation and post-estimation tests.

### Response Rate

Table 4 shows the summary for the response rate.

The sample for the study was 384, although 372 were filled and returned, representing approximately 97% of the response. This response rate was appropriate since Kothari (2011) argued that a 50% response rate is

adequate, 60% good and above 70% rated as appropriate for analysis. Thus, the response rate was adequate for the study.

**Table 4:** Response Rate

Response Rate	Frequency	Percentage
Response	372	96.87%
Non-Response	12	3.13%
Total	384	100

### Demographics Characteristics

Descriptive analysis was conducted for demographics to show the frequencies for gender, level of education, access to rice market information, marketing channel and rice type, access to credit and finance and choice of rice marketing channel. The results are shown in Table 5.

From the results in Table 5, the number of female farmers composition was 27.42%, whereas 72.58% were males, an indication of male domination in rice farming. On education level, the results show that 29.84% had no formal education, 50.81% were of primary level, while only 7.53 % and 11.83% had secondary level and tertiary

**Table 5:** Demographics

Gender	Frequency	Percent
Female	102	27.42
Male	270	72.58
<b>Total</b>	<b>372</b>	<b>100</b>
Level of Education		
No formal education	111	29.84
Primary education	189	50.81
Secondary education	28	7.53
Tertiary education	44	11.83
<b>Total</b>	<b>372</b>	<b>100</b>

level, respectively. This indicated that there was a low level of education in the rice farming sector and could influence the understanding of the questions. However, the study used simplified questions that allowed all respondents to understand.

Respondent's access to rice market information, rice type produced, access to credit and finance, and difficulties in accessing credit responses are shown in Table 6.

Results in Table 6 showed that the majority, 56.99%, could not access rice market information, and only 43.01% were able to. This indicates that there could be a lack of meaningful information on the rice farming sector, which could have a negative effect. On the Rice Type, the majority of the respondents, 77.42%, indicated that they grow Basmati followed by BW 196 with 12.37%, and lastly, Nerica 1 having the least with 10.22%. On Access to Credit and Finance, the majority, 88.8% of farmers, do not have access to credit, while only 11.2% have access to credit. This could indicate that many farmers could be restrained in their farming activities due to a shortage in accessing credit and finance.

**Table 6:** Market Information

Access to Rice Market Information	Frequency	Percent
No	212	56.99
Yes	160	43.01
Rice Type		
Basmati	288	77.42
BW 196	46	12.37
Nerica 1	38	10.22
Access to Credit and Finance		
No	330	88.8
Yes	42	11.2
Difficulties in Accessing Credit		
Delays in payment	71	19
High interest rates	156	42
Lack of land title deed	60	16
Low yields	82	22
Not applicable	4	1
Reason for Choice of Channel		
Availability	1	0.27
Better prices	129	34.68
Credibility of weighing scale	3	0.81
Ease of cash payment/ prompt cash	118	31.72
Inputs for rice farming and services (loans)	26	7.26
Lack of security and stores	4	1.08
Nearer to market	90	24.19
Prompt payment, profitability, cost of water payment	1	0.27
<b>Total</b>	<b>372</b>	<b>100</b>

On the difficulties in accessing credit, the majority, 42%, indicated that they had difficulties accessing credit due to high-interest rates, followed by low yields with 22%. 19% of the respondents indicated difficulty accessing credit due to payment delays, while 16% cited a lack of land title deeds for acting as collateral. Lastly, regarding the choice of rice marketing channel, the majority of respondents, 129(34.68%), chose channels that provided better prices for their produce. 118(31.72%) acclaimed ease of cash payment as the reason for their choice of marketing channel. 90(24.19%) participants preferred market channels due to their nearness to the market. Other factors that the farmers looked at were access to credit and farm inputs (7.26%), the credibility of weighing scales (0.81%), provision of stores (1.08%), and low cost of water payment at 0.27%.

### Marketing Channels of Rice

Marketing channels link the market actors in the exchange process by indicating how the marketable and marketed

surplus is transferred from farms to the final consumer. They are routes through which agricultural commodities pass from different market actors to the final consumer. In evaluating a marketing system, marketing channels are very important as they indicate how market actors are organized to accomplish the product movement from the producer to the ultimate consumer. Marketing channels are also crucial in that they show a snapshot of the various agencies and thus help assess market performance. The complexity of the channel is governed by the distance from the production area to the terminal market. The purpose of marketing channels analysis was to provide

systematic knowledge of the flow of rice produce from the farmer to the final consumer. Data collected from the survey was used to construct the marketing channels. Based on the rice marketing pathways identified in Table 7, the typical marketing channels which were observed in the rice market are presented in Table 7 and Figure 1. Five main marketing channels were identified.

Channel 1: Farmer-Consumer

Channel 2: Farmer- Brokers-Millers-Consumer

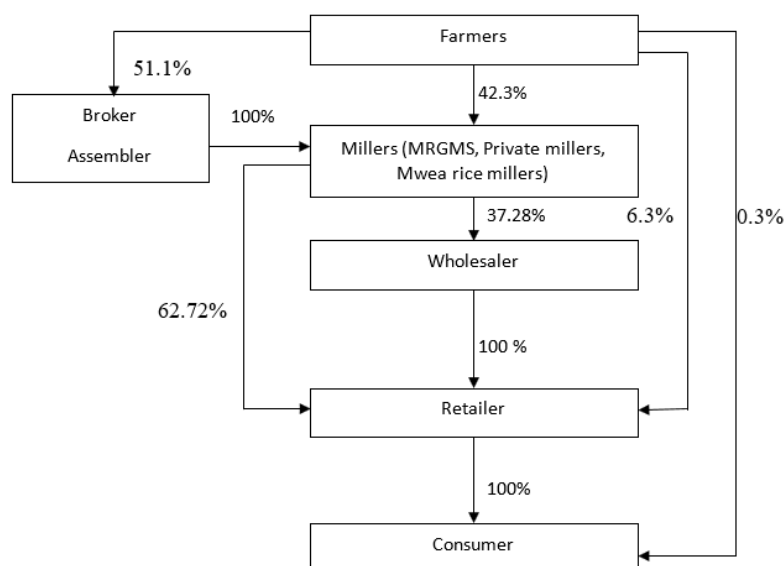
Channel 3: Farmer- Brokers-Millers- Retailer-Consumer

Channel 4: Farmer- Millers- Retailer-Consumer

Channel 5: Farmer- Millers- Wholesaler-Retailer-Consumer

**Table 7: Rice Marketing Channels Participation by Farmers**

Marketing channel	Farmers cumulative frequency	Percent of farmers who sold through the channel
1. Farmer-Consumer	102	27.42
2. Farmer- Brokers-Millers-Consumer	270	72.58
3. Farmer- Brokers-Millers- Retailer-Consumer	372	100
4. Farmer- Millers- Retailer-Consumer	111	29.84
5. Farmer- Millers- wholesaler-retailer-Consumer	189	50.81



**Figure 1: Flow Diagram Showing Percentage Marketed Volumes of Rice across actors**

In the figure 1, the first and shortest channel involved producers selling directly to consumers at the farm level. This accounted for 0.3% of total produce. The second channel involved farmers, brokers, millers and consumers where 51.1%, 42.3%, and 0.3% of the total sold rice by the farmer was taken up by brokers, millers and consumers respectively. The third channel entailed farmers, brokers, millers, retailers then consumer. Under this channel, 6.3% of the farmers' sales volume was sold to the retailers, 100% of the brokers' sales volume was sold to the millers, and 62.72% of the millers' sales volume was sold to retailers whereas 100% of retailers' marketed volume was sold to the consumers. The fourth channel involved farmers, millers, retailers and consumers. The

final channel consisted of farmers, millers, wholesalers, retailers and consumers. For the fifth channel, 37.28% of the millers' marketed volume was sold to wholesalers, while 100% of the wholesalers' marketed volume was sold to retailers.

### Factors Influencing Farmer's Choice in Rice Marketing Channels

The study's second objective was to evaluate factors influencing farmers' choice in rice marketing channels. To evaluate the factors influencing the choice of rice marketing channel in MIS, the multinomial Logit model analysis was used, as shown in Table 8.

The results show that household level of education has

**Table 8:** Choice of Channel Multinomial logit

Choice of channel multinomial logit	Coef.	Std. Err.	P>Z
Broker	Base outcome		
Consumer			
Age of household	-.0454955	.0789512	0.564
Gender	13.73346	1153.884	0.991
Household education level	.693347	.7755638	0.037
Distance to Market	-.0761318	.1197213	0.525
Marketing Groups	-13.98628	2292.413	0.010
Cons	-16.67165	1153.888	0.988
Retailer			
Age of household	.0299817	.0184035	0.103
Gender	-1.177961	.4718407	0.113
Household education level	-.3518268	.2908893	0.226
Distance to Market	-.0037031	.0242566	0.020
Marketing Groups	-.060495	.8250111	0.942
Cons	-1.937592	1.047563	0.064
Wholesaler			
Age of household	-.0021384	.0254887	0.933
Gender	-1.679302	.5986321	0.405
Household education level	-.221291	.3740105	0.554
Distance to Market	-.0449224	.0433417	0.030
Marketing Groups	.3090625	.8519942	0.717
Cons	-.6575785	1.326909	0.620
Mrgmcs Millers			
Age of household	.0479347	.0115128	0.000
Gender	-.0604444	.3448411	0.861
Household education level	.1855477	.1511891	0.220
Distance to Market	-.0003128	.0142207	0.982
Marketing Groups	-.2606187	.5374264	0.628
Cons	-3.356687	.6668942	0.000
Private Millers			
Age of household	.0229527	.0128331	0.074
Gender	.2735538	.3755243	0.466
Household education level	.0538184	.166681	0.747
Distance to Market	-.2136234	.0535911	0.000
Marketing Groups	-.5826178	.5254568	0.268
Cons	-.8896918	.731307	0.224
Mwea Rice Millers			
Age of household	.0591975	.0276663	0.032
Gender	.7640662	1.130448	0.499
Household education level	.1093976	.3586288	0.760
Distance to Market	-.4959636	.2714533	0.068
Marketing Groups	1.117868	.8165309	0.171
Cons	-4.790973	2.066583	0.020

a positive and significant relationship with the choice of marketing channels ( $\beta=0.693347$ ,  $p=0.037<0.05$ ). This implies that the odds of a consumer as a marketing channel over a broker is 0.693347 times higher given their household level of education. The results further show that household marketing groups have a positive



and significant relationship with the choice of marketing channels ( $\beta = -13.98628$ ,  $p = 0.010 < 0.05$ ). This implies that the odds of a consumer as a marketing channel over a broker is 13.98628 times lower given their marketing groups. Distance to market has a negative and significant relationship with the choice of marketing channels ( $\beta = -0.0037031$ ,  $p = 0.020 < 0.05$ ). This implies that the odds of a retailer as a marketing channel over a broker is 0.0037031 times lower given their distance to market.

The results show that distance to the market has a positive and significant relationship with the choice of marketing channels ( $\beta = -0.0449224$ ,  $p = 0.030 < 0.05$ ). This implies that the odds of a wholesaler as a marketing channel over a broker is 0.0449224 times higher given their household level of education. The results show that the age of the household has a positive and significant relationship with the choice of marketing channels ( $\beta = 0.0479347$ ,  $p = 0.000 < 0.05$ ). This implies that the odds of MRGMCS millers as a marketing channel over a broker is 0.0479347 times higher, given their household age. Distance to market has a negative and significant relationship with the choice of marketing channels ( $\beta = -0.2136234$ ,  $p = 0.020 < 0.05$ ). This implies that the odds of a private miller as a marketing channel over a broker is 0.2136234 times lower, given their distance to the market. Lastly, the results show that the age of the household has a positive and significant relationship with the choice of marketing channels ( $\beta = 0.0591975$ ,  $p = 0.032 < 0.05$ ). This implies that the odds of a consumer as a marketing channel over a broker is 0.0591975 times higher given their household age.

## DISCUSSION

The socio-demographic characteristics showed that on gender, females were 23.9% and 76.1% for males and thus indicated that the majority of the respondents were males involved in rice farming and marketing processes. On education, 29.8% had no formal education, 50.8% were of primary level, while only 7.5 % and 11.8% had secondary and tertiary levels respectively. This indicated that there was a low level of education in the rice farming sector and could influence the understanding of the questions. However, the study used simplified questions that allowed all respondents to understand. Under access to rice market information, the majority, 58.1%, are not able to access rice market information, and only 41.0% were able to. This indicates that there could be a lack of significant information on the rice farming sector that could influence farmers. On access to marketing channels, the majority of the respondents, with, 95.3%, indicated that they receive access to marketing channels, while only 4.7% indicated they do not receive market information. Under rice type, the majority of the respondents 83.2%, indicated that they grow Basmati followed by BW 196 at 9.6%, and lastly, Nerica 1 having the least at 6.8%. The majority of the farmers 88.8%, did not have access to credit, while only 11.2% had access to credit and finance. This could indicate that many of the farmers could be restrained in their farming activities due to a shortage in

accessing credit and finance. Further, the majority with, 42% indicated that they had difficulties accessing credit due to high-interest rates, followed by low yields 22%. 19% of the respondents indicated they had difficulties accessing credit due to delays in payment, while 16% cited a lack of title deeds for acting as collateral. Lastly, the majority of respondents, 113(35.1%), chose channels that provided better prices for their produce. 107(33.2%) acclaimed ease of cash payment as the reason for their choice of marketing channel. 78(24.2%) participants showed a preference for market channels due to nearness to the market. The farmers looked at other factors: access to credit and farm inputs (3.1%), the credibility of weighing scales (0.3%), provision of stores and low cost of water payment at 0.3% each.

In line with the study of Akwaa-Sekyi (2013), there is an increasing need to invest in agriculture worldwide due to the rising populations and to curb draughts and malnutrition. Access to finance and credit from microfinance would have a significant impact on the welfare of farmers and their farming activities like working capital, labour, farm input and output, among others.

The study sought to identify the rice marketing channels in Mwea Irrigation Scheme. There were seven rice marketing outlets identified. Of the rice marketing outlets, farmer to consumer represented 0.6%, farmer to retailer, 5%, farmer to broker, 46.0%, farmer to wholesaler, 2.8%, farmer to MRGMCS millers 23.9%, farmer to private millers 19.6% and farmer to Mwea rice millers, 2.2%. This implied that the most common channel was farmer to broker, and the least was farmer to consumer. Most respondents indicated they used brokers at 45% and MRGMCS millers at 23%. Private millers had 19%, while retailers had only 7%. The least were wholesalers, with 4%, Mwea rice millers, with 2%, and consumers, with 1%. Out of the rice marketing outlets, there were five rice marketing channels identified based on percentage margins across actors, and the first channel was the shortest. It involved producers selling directly to consumers at the farm level. This accounted for 1.78% of total sales. The second channel involved farmers, retailers and consumers, mainly at farms, accounting for 5.33% of sales volume. These were local retailers who bought direct from the farmers and sold to consumers in the neighboring market centers in the rice farming in Mwea Irrigation Scheme. The third channel consisted of farmers, brokers, millers, and consumers, and it handled 3.47% of the sales volume. While the fourth channel involved farmers, millers, retailers and consumers, and it handled 62.72% of the volume bought by millers. The final channel consisted of farmers, millers, wholesalers, retailers and consumers. It accounted for 37.28% of the volume handled by millers. The wholesaler sold its entire share to the retailer, who finally sold 100% to the consumer.

The study's second objective was to evaluate factors influencing farmers' choice of rice marketing channels. The results show that household level of education has a positive and significant relationship with the choice

of marketing channels ( $\beta=0.693347$ ,  $p=0.037<0.05$ ). This implies that the odds of a consumer as a marketing channel over a broker is 0.693347 times higher given their household level of education. The results further show that household marketing groups have a positive and significant relationship with the choice of marketing channels ( $\beta=-13.98628$ ,  $p=0.010<0.05$ ). This implies that the odds of a consumer as a marketing channel over a broker is 13.98628 times lower given their marketing groups. Distance to market has a negative and significant relationship with the choice of marketing channels ( $\beta=-0.0037031$ ,  $p=0.020<0.05$ ). This implies that the odds of a retailer as a marketing channel over a broker is 0.0037031 times lower, given their distance to the market.

The results show that distance to the market has a positive and significant relationship with the choice of marketing channels ( $\beta=-0.0449224$ ,  $p=0.030<0.05$ ). This implies that the odds of a wholesaler as a marketing channel over a broker is 0.0449224 times higher given their household level of education. The results show that the age of the household has a positive and significant relationship with the choice of marketing channels ( $\beta=0.0479347$ ,  $p=0.000<0.05$ ). This implies that the odds of MRGMCS millers as a marketing channel over a broker is 0.0479347 times higher, given their household age. Distance to market has a negative and significant relationship with the choice of marketing channels ( $\beta=-0.2136234$ ,  $p=0.020<0.05$ ). This implies that the odds of a private miller as a marketing channel over a broker is 0.2136234 times lower, given their distance to the market. Lastly, the results show that the age of the household has a positive and significant relationship with the choice of marketing channels ( $\beta=0.0591975$ ,  $p=0.032<0.05$ ). This implies that the odds of a consumer as a marketing channel over a broker is 0.0591975 times higher given their household age. The finding is consistent with Nyaga *et al.* (2016), who conducted a study on factors influencing fish farmers' choice of marketing channel in Kirinyaga County. The study identified three main channels; neighbours, direct market, traders and accounting for 49 percent, 29 percent, and 22 percent respectively. Gender of the household head, distance to market; marketing cost, land tenure, number of fishponds owned, access to extension services, cost of marketing, membership to a fish farming group, access to inputs, household income, price of fish and type of fish reared had significant influence on farmers' choice of market channel.

## CONCLUSION

The study found that brokers had the most significant impact on rice marketing channels in the Mwea Irrigation Scheme, and that rice supply chains can be improved through digital agriculture platforms. Education, marketing groups, distance to market, and age of household were found to affect farmers' choice in rice marketing channels. The study also noted that rice marketing relies on private and cooperative services for storage and milling due to farmers' limited assets, and that

the private sector improves production and marketing through horizontal or vertical integration.

## Recommendations

The study recommends that the management of rice farming in Mwea Irrigation Scheme take control of the marketing channels to protect farmers from brokers who take advantage of them. It suggests regulation to control the operations of brokers, who play a crucial role in the rice marketing channel. The study recommends better storage/warehouse plans to reduce marketing costs, and more research on the use of husks and straws for bioenergy and carbon sequestration. Additionally, it suggests that research on water availability in other rice-growing areas in Kenya is important for improving marketing channel choices and overall rice farming quality and profitability.

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