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Intensity of Usage of Paddy Sourcing Methods by Small and Medium-Scale Rice Millers in Mwea, Kirinyaga County, Kenya

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Abstract: *The purpose of this article is to determine the intensity of usage of paddy sourcing methods used by small and medium-scale rice millers in Mwea Irrigation Scheme in Kirinyaga County, Kenya. Data was collected using semi-structured questionnaires from 90 small-scale millers and 70 medium-scale millers amounting to a total of 160 rice millers. Descriptive statistics was used to achieve the objective of the study. The results show that rice millers commonly use direct sourcing from individual farmers to source paddy (88%), followed by individual farmers bringing paddy to the miller (83.9%), buying from traders (76.3%) and sourcing through agents (68.7%). Only 2.2% of the millers used a single sourcing method (individual farmers bringing paddy to the miller), 97.8% of the millers use a combination of paddy sourcing methods. The most frequently used sourcing methods by small and medium-scale millers are direct sourcing from farmers and individual farmers bringing paddy to the miller at 52.2% and 51.4% respectively. Sourcing using agents is not frequently used by the millers due to the high commission costs involved. This underscores the sole vitality of the unit price of paddy and transport cost as major determinants of frequency of utilization of paddy sourcing methods and the volume sourced and milled. An understanding of the intensity of usage of paddy sourcing methods can guide public and private policy and decision-makers on how to target rice millers' capacity to source reasonable volumes of paddy to reduce the time that the rice mills remain idle throughout the year.*

Keywords: *paddy, paddy sourcing method, intensity, usage, small-scale millers, medium-scale millers.*

1. INTRODUCTION

More than 50% of the world's population relies on rice as one of the most important food crops (Kaloi *et al.*, 2021). It not only contributes to food security but significantly influences income security across many parts of the world (Ara *et al.*, 2017). Currently, over 500 million metric tonnes of rice are produced worldwide on an estimated 160 million hectares of land (Kirby *et al.*, 2017). Sub-Saharan Africa (SSA) accounts for only 6% and 26% of the total world rice yield and cultivated area respectively (Adja *et al.*, 2022). Over 29% of this yield in SSA is attributed to expansion in harvested area (Saito *et al.*, 2015). Therefore, it is evident that despite the existence of country-specific objectives to drive rice production in SSA, the potential benefits remain greatly unrealized (Arouna *et al.*, 2021).

In Kenya, rice is regarded as the third most important cereal crop after maize and wheat (Obura *et al.*, 2017). It is mainly grown by smallholder farmers in Mwea and Western Kenya (Vishnu and Mukami, 2020) for food and income. By 2018, the total land area under rice production was 39,095ha which the government intends to increase to 104,000 ha by 2030 (Ndirangu & Oyange, 2019). According to KNBS (2019), the total national rice production was estimated at 150,000 MT in 2018. In the same year, national rice consumption increased at an average rate of 12% (Ndirangu & Oyange, 2019). This is attributable to a mix of elements such as populace development, urbanization, changing purchaser preferences, and financial turn of events (Kilimo Trust, 2019).

The increase in demand for milled rice created an opportunity for rice milling business to thrive within the rice-growing areas. One other explanation that could clarify the increase in rice milling businesses is the liberalization of the rice sector which permitted entry of private mill operators (Atera *et al*, 2018). Currently, the majority of the rice in Kenya is handled within the regions where it is cultivated (Ndirangu and Oyange, 2019). This is because the rice milling facilities are located in those specific

areas where rice is produced. As a result, Private rice plants in Mwea irrigation scheme represent the greater part of the absolute volume of regular rice handled in Kenya (Atera *et al.,* 2018).

Much as this is an opportunity on one end, it is a challenge on the other end since the previously existing rice mills are consistently exposed to fierce competition from the ever-emerging small-scale mill operators (Obura *et al.,* 2017). An example is Mwea Rice Growers Multipurpose Cooperative (MRGM) which currently handles only 10% of the total volume of paddy produced in the Mwea irrigation scheme which accounts for over 70% of the national total production (Vishnu and Mukami, 2020). Thus, the vast majority of the installed capacity of the mills are underutilized chiefly because of inadequate access to paddy. These mills experience high overheads which eventually diminishes mill operators and producers' benefits (Ndirangu and Oyange, 2019).

Large, medium, and small-scale millers are the main private actors who source paddy for milling in major rice growing areas (Moniruzzaman, 2020). These millers access paddy through private traders (including middlemen), agricultural cooperatives, individual farmers who deliver paddy to the millers, direct sourcing from individual farmers and through village agents (Atera *et al*., 2018; Kunihiro *et al.*, 2014; Muhunyu, 2012; Ndirangu and Oyange, 2019; Watanabe *et al.*, 2021). Thus, the volumes of paddy sourced and milled by rice millers depends upon the utilization of these paddy sourcing methods.

Despite the appreciation of these sourcing methods, very little information is known about the intensity of usage of the different paddy sourcing methods. Moreover, the intensity of usage basing on the categorisation of millers which include small, medium and large-scale millers has never been exhaustively explored. According to the study, intensity is used to refer to frequency of utilization of paddy sourcing methods in terms of frequently used, usually used, occasionally used, sometimes used, rarely used and not used. Therefore, this study contributes to literature by determining the intensity of usage of the different paddy sourcing methods among small and medium scale rice millers. This will give policy makers precision in case policy interventions are to target paddy sourcing methods.

The paper is organised following a chronological outline: Section 2 describes the literature related to paddy sourcing methods, Section 3 outlines the materials and methods including study area and sampling design, data collection procedure and data analysis. Section 4 presents the results from the descriptive statistics and the discussions, Section 5 presents the conclusion, recommendations and policy implication.

2. LITERATURE REVIEW

2.1 Evolution of rice milling in Kenya

Modern rice milling in Mwea irrigation scheme commenced in in 1967 when Mwea rice mills Ltd, a public rice miller imported milling machines from Germany. This was followed by purchase of a multi-stage milling machine by MRGM, Mwea and 10 other private millers (Mano *et al.,* 2021). In the rice growing areas of Western Kenya, rice milling machines were introduced in 1983 (Yamane, 2019). Currently, there are 16 large scale rice mills in Kenya with over 256 other small to medium rice mills in Mwea and the rest of the rice growing areas. Mwea irrigation scheme is a home for over 148 small scale rice millers.

The number of rice mills in Kenya has increased over years due to the increased production of rice and the increased uptake and adoption of rice as an important part of the diet. Even though rice production was introduced in Kenya in the early 1800s, rice milling did not commence immediately (Uma, 2022). This is because milling technologies were not known to the coastal communities that were cultivating rice. It can also be argued that the farming communities then were contended with the traditional methods of extracting grain form the rice panicles.

Large-scale rice mill operators own basically rice processing chain or compound rice plant with extra parts including mechanical dryer and a colour sorter (Githumbi (2017). This implies that it is extremely expensive for a rice miller to start the rice milling business as a large-scale rice miller. This is evidenced by the fact that currently, large scale mills in Kenya are only 16 with 8 of them located in Mwea and the remainder in other rice growing areas (Ndirangu and Oyange, 2019). This informed the decision to focus on only small and medium-scale rice millers.

2.2 Paddy sourcing methods

Understanding paddy marketing channels helps to reveal the different ways through which millers access raw materials for milling. Paddy is mainly traded through two different systems (Moniruzzaman,

2020), that is through the public and the private channels (Wijesooriya *et al*., 2020). The public channel involves government parastatals directly involved in buying paddy from smallholder farmers. Paddy procured by the government is either sold to the rice millers or it finally finds its way to the millers through different channels. Different categories of traders such as small village traders, traditional traders, middlemen, large traders and wholesalers collect paddy from various locations and sell directly to the millers.

A study by Wijesooriya *et al.* (2020), found that farmers in Sri Lanka sell paddy to the government which then distributes it to millers with the aim of stabilizing the market. In Bangladesh, government procures paddy and distributes less than 20% of the locally produced rice, while the private sector circulates the rest of the surpluses that enter the market (Moniruzzaman, 2020). Similarly, In India, the government procures surplus paddy from farmers and distributes to millers (WFP, 2017).

In Kenya, the state controlled National Cereals and Produce Board (NCPB) is involved in the purchase of paddy from producers and mills in the government-controlled mills. The state-controlled mills procure paddy from producers and mill the same through their rice mills in Ahero, Mwea and Kibos (Atera *et al*., 2018). A study by Muhunyu (2012), found that farmers in Mwea sell about 1% of paddy to NCPB. In the schemes under National Irrigation Authority (NIB), farmers are offered soft loans in form of credit and cash for school fees and farming purposes. They are then expected to convey paddy to NIB who thus deducts the credit and transmits the balance to the farmers (Ngige, 2004). The relevance of this arrangement in terms of its intensity need to be established to accurately measure its effectiveness.

Large, medium, and small-scale millers are the main private actors who purchase the paddy in major growing areas (Moniruzzaman, 2020). They tend to receive paddy from farmers because of the limited purchasing capacity of the government schemes (Wijesooriya *et al*., 2020). Paddy rice harvested by producers is delivered to rice mills by producers themselves or village collectors or agents sent by rice mills or town merchants (JICA, 2013). According to Kunihiro *et al.* (2014), 70% and 20% of paddy rice for milling in Uganda is brought to the millers by producers and town gatherers/brokers. About 10% of paddy is gathered by millers by going to rice cultivating areas to purchase paddy rice from farmers or sending their representatives to the towns for the procurement.

A study by Moniruzzaman (2020), found that farmers sell 17%, 23%, 42%, 8% and 10% of paddy to small village traders, traditional traders, large traders, wholesalers and millers, respectively. Large traders account for the highest volume of paddy received compared to the rest of the actors including millers. Both the scenarios presented are instances where farmers are dealing individually with millers. Instances where the same farmers collectively sell their produce may provide different reasoning, findings and statistics.

Private rice plants in Mwea represent the greater part of the absolute volume of the regular rice handled (Ndirangu & Oyange, 2019). Rice millers' endeavours to gather as much rice for processing as possible compels them to traverse other neighbouring districts and countries (Kunihiro *et al*., 2014). Middlemen are also involved in the sourcing of paddy, they visit the farmers as soon as they harvest, purchase paddy for cash, and transport it to private rice mills (Watanabe *et al*., 2021). In some instances, farmers prefer selling paddy directly to the millers, they transport paddy mainly by humans and animals, and sometimes using mechanical power to the mills (Ndirangu & Oyange, 2019).

Millers in competitive areas make various arrangements to acquire paddy. They cater for full or half the cost of transporting paddy to the mill, lend money to farmers during peak periods on condition that immediately rice is harvested, it is brought to the mill (Kunihiro *et al*., 2014). A study by Muhunyu (2012), established that farmers in Mwea Constituency sell about 24% of paddy to farm gate intermediaries, 39% to intermediaries in commercial centres, 35% to the Cooperative Society, and the rest collected by village money lenders. All the paddy sold to the different channels finds its way to the millers.

2.3 Challenges facing the rice milling industry in Kenya

The vast majority of the installed capacity of the mills are underutilized chiefly because of absence of paddy and breakdowns. One explanation that could clarify the sagging capacity in large scale public mills is the liberalization of the rice sector which permitted entry of private mill operators thus exposing

them to fierce competition from small scale mill operators (Ndirangu & Oyange, 2019). Mwea Rice Growers Multipurpose Cooperative (MRGM) handles only 10% of the total volume of paddy produced in the Mwea irrigation scheme which accounts for over 70% of the national total production (Vishnu & Mukami, 2020). These mills experience high overheads which eventually diminishes mill operators and producers' benefits (Ndirangu & Oyange, 2019).

According to Atera *et al.* (2018), white rice milled in Kenya has very high foreign matter content due to poor quality milling equipment and poor storage and handling of paddy before actual milling. They argue that the rice milling industry is characterised by very low competitiveness due to a spread of small privately owned rice mills that produce low quality milled rice. The large number of small-scale millers scattered all over rice producing areas equally impacts large scale millers' access to raw materials (paddy).

Ndirangu and Oyange (2019) assert that the low supply of paddy to rice as a result of production constraints impede the ability of rice millers to respond to the demand for milled rice in the Kenyan market. Due to the idleness and fast depreciation of the rice milling machines, high maintenance costs are incurred by the millers and mill owners. Additionally, high costs of labour, unreliable power supply, high costs of importation of raw material, inefficient transport facilities most especially within the lowland areas where rice is produced affects transportation during the wet seasons. All these factors combined contribute to very high milling costs in Kenya compared to the neighbouring countries like Uganda and Tanzania.

3. MATERIALS AND METHODS

3.1 Study area and sampling methodology

The study was conducted in Mwea Irrigation Scheme (MIS) which is situated in Mwea constituency of Kirinyaga County, Kenya. The region is on the South-Eastern part of the district, around 100 kilometres North-East of Kenya's capital city, Nairobi (Kaloi *et al*., 2021). The scheme was established in 1954 and at present has around 12,000 ha exclusively under rice development, delivering roughly 80% of the paddy rice produced in Kenya (Ngige, 2004). The Mwea Irrigation Scheme is the largest irrigation zone in Kenya in terms of area (Watanabe *et al*., 2021). The nuclear scheme is divided into 5 sections, namely; Tebere, Mwea, Thiba, Wamumu and Karaba (Nyabonyi, 2016). Over 70% of all locally grown rice in Kenya is produced in the Mwea Irrigation Scheme, including 95% of all domestically grown basmati (Muhunyu, 2012). The study adopted a cross-sectional survey design to get responses across a section of rice millers in Mwea.

The study adopted a multistage sampling technique to obtain the required sample size. Purposively selecting the Mwea irrigation scheme in Kirinyaga county comprised the first stage because it accounts for 70% of the total rice produced in the country. The second stage involved purposive selection of divisions which constitute Mwea Irrigation Scheme. Mwea irrigation scheme is also known to have around 256 small and medium scale rice millers. From the 256 small and medium-scale millers, a sample size of 160 was considered. Using the data from Ndirangu & Oyange (2019) that provides the total number of rice millers in Kenya, proportions were computed to arrive at 90 small scale millers and 66 medium scale millers. However, during the actual data collection, 70 medium-scale millers were considered.

3.2 Data collection and analysis

Primary data was collected through semi-structured questionnaires administered to the small and medium scale millers. The questionnaires were blended with both open ended and close ended questions. A pilot study was conducted prior to the actual data collection to test the validity of the questionnaire. Observation was used to provide additional information about the millers, their tasks and other sourcing methods.

From literature, there are five (5) paddy sourcing methods that small and medium scale rice millers use to access paddy for milling. However, during the actual data collection, it was found that millers do not source paddy from cooperatives because all cooperatives within Mwea Irrigation Scheme own rice milling facilities. The different sourcing methods determine the volume of paddy sourced and milled by these millers. In relation to this objective, descriptive statistics including mean, percentages, and

frequencies was used to identify the different paddy sourcing methods used by small and medium-scale rice millers. To identify the intensity of use of paddy sourcing methods by small and medium-scale rice millers, millers were asked to rank the paddy sourcing methods from 1 to 6 (with 1 showing the least commonly used methods and 6 showing the most commonly used method). The frequency of each paddy sourcing method was calculated, and the values were used to rank the position of each of the paddy sourcing methods. The results for the different sourcing methods identified and the intensity of their use was visualized using appropriate info-graphics, tabular presentations, and summary statistics.

4. RESULTS AND DISCUSSIONS

4.1 Paddy sourcing methods used by small and medium-scale millers

According to the study, individual farmers bringing paddy to the miller was the most (87.8%) commonly used paddy sourcing method among small-scale millers while direct sourcing from individual farmers was the most (97.1%) used method among medium scale millers. The least commonly used sourcing method among the small and medium-scale millers were sourcing using agents (54.4%) and buying from traders (71.4%) respectively. Considering all rice millers in the study, direct sourcing from individual farmers was the most commonly used method followed by individual farmers bringing paddy to the miller. The least used method was sourcing through agents (68.7%). It is important to note that only 2.2% of the millers used a single paddy sourcing method (individual farmers bringing paddy to the miller). The small-scale millers who relied on this method had an installed capacity of 0.1MT/hour and engaged in both farming and trading activities. The rest 97.8% of the millers use a combination of paddy sourcing methods.

4.2 Intensity of usage of paddy sourcing methods used by small and medium-scale rice millers.

Intensity of utilization of paddy sourcing methods among small and medium-scale rice millers was categorized into six different groups. Frequently used (above 71% of volumes of paddy is sourced using this method), usually used (between 51-70% of volumes sourced), occasionally used (between 31-50% of volumes sourced), sometimes used (between 11-30% of volumes sourced), rarely used (less than 10% of paddy volumes sourced) and did not use the sourcing paddy. Table 1 shows the most and least frequently used paddy sourcing methods by small and medium scale rice millers.

Table1. *Frequently used paddy sourcing methods*

Paddy sourcing method	**Category of miller**		
	Small scale-millers (%)	**Medium scale-millers (%)**	**All millers (%)**
Direct sourcing from individual farmers	35.6	20.0	28.8
Individual farmers bringing paddy to the mill	10.0	25.7	16.9
Buying from traders	1.1	0.0	0.6
Direct sourcing from farmers and individual farmers bringing paddy to the miller	52.2	51.4	51.9
None	1.1	2.9	1.9

Source: *Primary data collection, 2022*

The most frequently used paddy sourcing method among small and medium-scale millers is a combination of direct sourcing from farmers and individual farmers bringing paddy to the miller at 52.2% and 51.4% respectively. Other frequently used methods by small-scale millers include direct sourcing from individual farmers (35.6%), individual farmers bringing their paddy to the miller (10%), and buying from traders (1.1%). Among the medium-scale millers, individual farmers bringing their paddy to the miller (25.7%) and direct sourcing from individual farmers (35.6%) are also frequently used. About 1.1% and 2.9% of the small and medium-scale millers respectively do not frequently use any of the paddy sourcing methods. Millers reported that the unit price of paddy when sourcing directly from individual farmers is associated with the lowest compared to when sourcing from other sources. Individual farmers bringing paddy to the miller involves the farmers incurring transport costs that would have been incurred by the miller. This explains the dominance and reason for the frequent usage of the

two methods. Individual farmers bringing paddy to the miller is dominant due to the informal credit facilities offered by the miller to the farmers during rice production which is paid back in terms of paddy. Sourcing using agents is not frequently used by the millers due to the high commission cost associated with the use of agents. According to Ojwang (2012), maize millers in Kenya position themselves to frequently access raw materials at the cheapest cost possible while minimizing the cost of transportation.

Table 2 shows the paddy sourcing methods that are usually, occasionally, sometimes and rarely used by small and medium-scale rice millers. Majority of the millers 70.6% and 78.8% do not usually and occasionally use the different paddy sourcing methods. Since majority of the millers frequently use a combination of direct sourcing from individual farmers and individual farmers bringing paddy to the miller, the intensity of usage of other sourcing methods largely depends on how much paddy has been sourced using the frequently used methods. This is consistent with findings from Kunihiro *et al.* (2014) who noted that over 70% of the paddy sourced by the millers in Uganda is brought to the mills by farmers. Contrary to the frequently used methods, sourcing using agents is sometimes used (18.1%), rarely used (17.5%), occasionally used (8.1%) and usually used (3.8%) by rice millers. Nagalakshmi *et al.* (2013) noted that farmers and other actors in India tend to desist from dealing with commission agents because they frequently cheat them. Use of agents is an alternative method used during off season periods when accessing paddy from individual farmers becomes extra difficult for the millers. Millers also reported that agents own stores where they keep the paddy they buy from farmers during harvesting period. This leaves millers with no choice but to access paddy through agents. Nagalakshmi *et al.* (2013) reports that commission agents usually outline the preferred price of sale and other preferred conditions of the deal and always wait until the conditions are satisfied.

Table2. *Usually, occasionally, sometimes and rarely used paddy sourcing methods*

Paddy sourcing method	**Category of miller**		
	Small scale-millers	**Medium scale-millers**	**All millers**
Usually used (%)			
Direct sourcing from individual farmers	4.4	12.9	8.1
Individual farmers bringing paddy to the mill	15.6	11.4	13.8
Buying from traders	1.1	7.1	3.8
Using agents	2.2	5.7	3.8
None	76.7	62.9	70.6
Occasionally used (%)			
Direct sourcing from individual farmers	3.3	11.4	6.9
Individual farmers bringing paddy to the mill	0.0	1.4	0.6
Buying from traders	2.2	10.0	5.6
Using agents	8.9	7.1	8.1
None	85.6	70.0	78.8
Sometimes used (%)			
Direct sourcing from individual farmers	0.0	4.3	1.9
Individual farmers bringing paddy to the mill	20.0	4.3	13.1
Buying from traders	31.1	10.0	21.9
Using agents	11.1	27.1	18.1
None	37.8	54.3	45.0
Rarely used (%)			
Direct sourcing from individual farmers	1.1	7.1	3.8
Individual farmers bringing paddy to the mill	0.0	1.4	0.6
Buying from traders	41.1	38.6	40.0
Using agents	18.9	15.7	17.5
None	38.9	37.1	38.1

Source: *Primary data collection, 2022*

Buying from traders is rarely used (40%), sometimes used (21.9%), occasionally used (8.1%), usually used (3.1%) and frequently used (0.6%) by millers. The intensity of usage of buying from traders is low across different categories of usage. Millers reported that unit prices of paddy are highest among traders, millers complained of tampered and adjusted weighing scales used by traders, selling of mixed varieties of rice was associated with traders and the sale of improperly dried paddy. However, 0.6% of the millers frequently source paddy from traders. This is attributed to the fact traders have large stores and tend to stock paddy during harvesting period in order to benefit from the higher prices that follow suit during the off-harvest period. Millers can then access paddy from them without any competition from other suppliers. According to Yankson *et al.* (2016), some farmers in Ghana do not sell their produce to traders because of failure to agree on the price set by the farmers.

4.3 Likelihood of usage of paddy sourcing methods used by small and medium-scale rice millers in the next harvesting period.

Table 3 shows the likelihood of small and medium scale rice millers to use given paddy sourcing methods in the next harvesting period. Majority of the millers 75% and 61.3% are very likely to source paddy using direct sourcing from individual farmers and individual farmers bringing paddy to the miller respectively. At the same time, 25% and 38.7% of the millers are likely to source paddy directly from farmers and allowing individual farmers to bring paddy to the mill respectively. The low unit price of paddy when sourcing directly from farmers and the fact that smallholder farmers incur the transport cost when transporting paddy to the millers can explain the nature of likelihood of future usage of these methods. According to the MOA (2019), Mwea irrigation scheme has over 11,000 rice farmers. This offers an opportunity for millers to source directly from the abundance of rice farmers and individual farmers to deliver paddy to the mills closer to them or those with whom they have informal agreements. The likelihood of allowing individual farmers to bring paddy to the miller indicates that millers are still willing to offer credit facilities to the farmers during the production periods. This equally indicates the miller's continuation of offering both customized milling services and buying paddy for milling and for sale. Majority (67.1%) of small-scale millers are very likely to source paddy from individual farmers bringing paddy to the miller while majority (85.6%) of medium scale millers are very likely to directly source from individual farmers. This can also be attributed to the completion of the construction of Thiba dam which indicates an increased supply of water for irrigation purposes and possibility of rice production throughout the year in Mwea irrigation scheme (MOA, 2019).

Buying from traders and using agents are very likely to be used by 3.1% and 4.4% millers and likely to be used by 13.8% and 8.8% of the millers respectively. The likelihood of using these methods is largely associated with the fact that they own storage facilities where they stock cheap paddy that they buy during the harvest period. Since harvest period does not last for long, millers will have limited options of acquiring sufficient volumes of paddy. That's when millers turn their focus to traders and agents to access paddy. This is consistent with findings from Moniruzzaman (2020) who reported that rice farmers in Bangladesh sell paddy to traders and agents because they lack appropriate storage facilities to accommodate the volume produced and maintain the quality of paddy to meet the millers requirements.

Table3. *The likelihood of using different paddy sourcing methods.*

Paddy sourcing method	**Category of miller**		
	Small scale-millers	**Medium scale-millers**	**All millers**
Buying from traders (%)			
Very likely	3.3	2.9	3.1
Likely	17.8	8.6	13.8
Neutral	10.0	7.1	8.8
Unlikely	43.3	24.3	35.0
Very unlikely	25.6	57.1	39.4
Direct sourcing from individual farmers (%)			

Very likely	61.4	85.6	75.0
Likely	38.6	14.4	25.0
Neutral	0.0	0.0	0.0
Unlikely	0.0	0.0	0.0
Very unlikely	0.0	0.0	0.0
Individual farmers bringing paddy to the miller (%)			
Very likely	67.1	56.7	61.3
Likely	32.9	43.3	38.7
Neutral	0.0	0.0	0.0
Unlikely	0.0	0.0	0.0
Very unlikely	0.0	0.0	0.0
Using agents (%)			
Very likely	2.2	7.1	4.4
Likely	6.7	11.4	8.8
Neutral	4.4	4.3	4.4
Unlikely	24.4	12.9	19.4
Very unlikely	62.2	64.3	63.1

Source: *Primary data collection, 2022*

Majority 39.5% and 63.1% of the millers are very unlikely and 35% and 19.4% unlikely to buy paddy from traders and using agents respectively. This is due to the high prices of paddy from traders and inclusion of commission costs when using agents. Majority (57.1%) of the medium scale millers are unlikely to buy paddy from traders because they equally double as paddy traders during the harvesting period. Other reasons for the low likelihood of buying paddy from traders and using agents include use of adjusted or tampered weighing scales, sale of mixed varieties of paddy, supply of improperly dried paddy and delays in supply of paddy to the agreed miller. Ravikishore *et al.* (2022) posits that agricultural traders and agents incur high transaction costs while buying produce from farmers. They also reported that traders and agents inflate the prices of produce and some go ahead to adulterate produce in order to recover the high costs incurred.

5. Conclusion and Recommendation

In Kenya, rice is regarded as the third most important cereal crop after maize and wheat. The demand for milled rice increases at an annual rate of 12% which has created an opportunity for rice milling business to thrive within the rice-growing areas. As a result, Private rice plants in Mwea irrigation scheme represent the greater part of the absolute volume of regular rice handled in Kenya. The methods used by rice millers in Mwea to source paddy include buying from traders, direct sourcing from individual farmers, individual farmers bringing paddy to the miller and sourcing through agents. The purpose of this article was to determine the intensity of usage of paddy sourcing methods used by small and medium-scale rice millers in Mwea Irrigation Scheme in Kirinyaga County, Kenya. In achieving this objective, descriptive statistics was used and the results indicate that the most frequently used paddy sourcing method among small and medium-scale millers is a combination of direct sourcing from farmers and individual farmers bringing paddy to the miller at 52.2% and 51.4% respectively. The reasons for the intense utilization of the combination of these two methods are the low unit price of paddy under direct sourcing and transport cost incurred by the farmers when they individually deliver paddy to the mill. Individual farmers bringing paddy to the miller was also prominent due to the informal credit facilities offered by the miller to the farmers during rice production which is paid back in terms of paddy. Sourcing using agents is not frequently used by the millers due to the high commission cost associated with the use of agents. It can thus be concluded that the unit price of paddy, transport cost and credit facilities greatly influence the intensity of usage of a paddy sourcing method.

The implication of this study is that in order to improve the utilization of the less likely used paddy sourcing method, rules and regulations governing the operations and conduct of paddy traders and commission agents should be established and strictly followed. Establishing a body or an association that brings together rice millers to set the quality of paddy that should be delivered to the rice mills can directly impact the quality of milled rice released on the market. This can generally improve the competitiveness of locally produced rice against imported rice. Improving the conditions of roads within the rice growing areas ought to be given priority to lessen on the costs and burden of transportation during the wet seasons. Creating a financing mechanism for rice millers to access paddy from the different sources can greatly improve on the capacity utilization of the rice mills.

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CONFLICT OF INTEREST

We declare that this work is original academic research conducted by the authors. We declare no conflict of interest.

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