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Analysis of Millers in Kenya's Rice Value Chain

Samuel Njuguna Ndirangu[1]& Wilson A. Oyange[2]
[1]*Agricultural and Biosystems Engineering Department, Jomo Kenyatta University of Agriculture and Technology, Kenya*
[2] *Ministry of Agriculture, Livestock, Fisheries and Irrigation, Kenya*
Corresponding Author: Samuel Njuguna Ndirangu

Abstract: *Rice is the third most important cereal crop in Kenya after Maize and wheat. The annual consumption of rice is increasing at a rate of 12% making the production to continually reduce below 30% of demand. A holistic approach to rice production needs to be employed to bridge this gap. One key area along the rice value chain is the post-harvest management sub-chain that includes milling and related activities. In Kenya, most of the paddy rice is processed within the regions where it is produced. Efficiency of the milling industry is important in realisation of improved rice supply; this efficiency may be gauged in terms of three factors; degree of competition, technology, and capacity utilization. This paper analyses Kenya's rice value chain from these perspectives, and particularly capacity utilization and technology at the millers' level. Large and medium millers in Kenya were visited, interviewed and physical verification of the mills undertaken during the period of October 2018. Work done through the value chain study of 2010 was used to build the information. Data and information from other related studies was also factored, and the information on all mills has been updated to reflect the current situation. The findings indicated that there are about 16 medium and large-scale mills with an installed capacity of 66 tonnes/hour of which 56.1 % is currently in operation. The identified small-scale millers were 256 with an estimated capacity of 128 tonnes/hour, of which 122.5 tonnes/hour are operational. The average estimated capacity utilization for an 8 hour per day operation of all mills was low at 23.6%. Most of the milling technologies used by small scale millers were single pass with low conversion rates. The low capacity utilization and less efficient mills translates to high milling cost and low recovery. The millers however still realised fair margins. The findings indicate that there are a number of challenges and threats that need to be overcome or observed, and also strengths and opportunities that need to be exploited to support milling sub sector through better technology, capacity utilization and other related interventions.*

Key Words*: Rice, milling, capacity utilization, technology, opportunities*

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I. Introduction

1.1 Kenya Rice Value Chain

Rice is the third most important cereal crop, after maize and wheat, in Kenya[16]. It is grown by small-scale farmers for food and cash. About 80% of the rice crop is grown on irrigation schemes and 20% under rain fed conditions[17]. The country has a potential of about 540,000 hectares irrigable land and this can be increased to 800, 000 hectares and further 1million hectares for rain fed[4]. Currently, rice is grown on about 39,095 ha of land[11]. The National rice consumption was indicated to be growing at an average 12%[13] and 38%[9] yet the production was about a quarter of the consumption. The Kenyan local markets, was demanding in excess of 540,000 tonnes per annum in 2012[6] and the national rice consumption was estimated at 548,000 tonnes compared to an annual production of 129,000 tonnes in 2013[16]. The economic survey of 2017 indicated that the volume of total paddy produced declined by 20.0 per cent to 81.2 thousand tonnes in 2017[6].

A holistic approach needs to be considered in improving rice production in Kenya especially with the Coalition for African Rice Development, an initiative to double rice production in Africa within 10 years; under which the Kenyan government had set a goal of boosting domestic rice production from 50,000 tonnes in 2008 to 178,000 tonnes within 10 years[13]. To enhance this, growth in production need to be supported by increasing the capacity and efficiency of the rice milling industry.

The main actors in the Kenyan rice value chain are as illustrated in Figure 1. From the figure, one of the key value chain actors are the millers. Paddy rice from the small, medium and large-scale farmers is collected by paddy collectors or taken directly by farmers to the mills, where it's sold to traders or milled. The milled rice is distributed by traders or in some few cases sold directly to markets or consumer by the millers

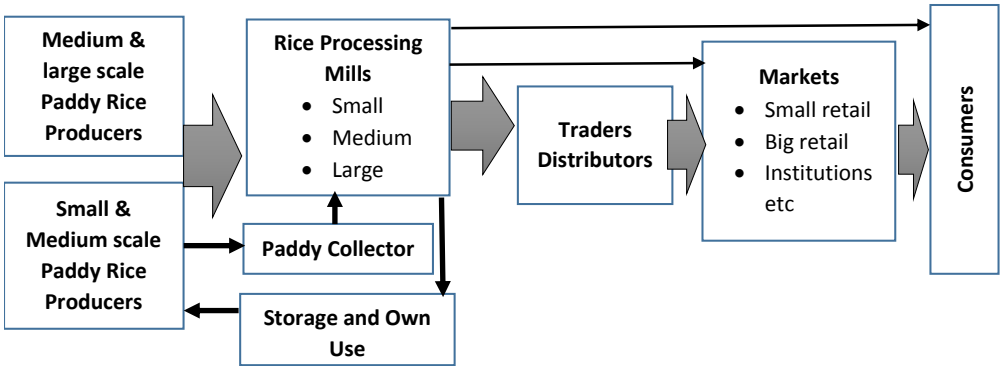


Figure1: Simplified Kenya Rice Value Chain

1.2 The Roles of Rice Millers

Improving the milling value chain can go a long way in improving rice production and food security. One study[21] noted that in Rwanda, the existing system for processing most rice in small hullers was not contributing to the objective of increasing supplies of domestic rice. It therefore did not reduce dependency on rice imports because of the poor quality of the hulled rice; this was reflected by the 30% lower price this rice received compared to imported rice. The figure relates with what was reported in another study[10], with rice having less than 5% broken grains commanding a 50% premium in Dares Salaam. Stryker also indicated that improved incomes through employment and entrepreneurship from such mills would support food security and it would also create competition and ensure that costs to consumers are minimized.

In a general, other factors within the miller's activities could influence rice production, such as; further located mills could discourage production through high cost incurred in transportation, high cost of milling could lead to farmers not recovering their costs, and transportation of paddy which is normally 35% – 40% heavier than milled rice to the milling location is expensive[10]. All these would discourage production.

According to a study[12], efficiency of the rice milling industry may be gauged in terms of three factors: technology, degree of competition and capacity utilisation (Figure 2).

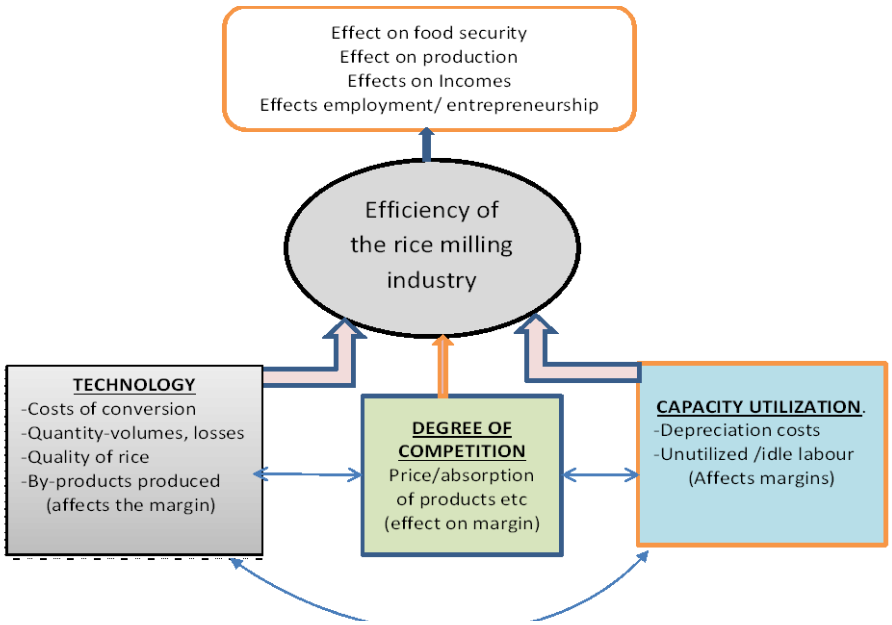


Figure 2: Factors influencing efficiency of the rice milling Industry

Technology influences efficiency of milling through its effect on costs of conversion, quantity and quality of rice, while by-products produced affect the margin between paddy and rice prices. Less than full capacity utilisation raises costs and may widen margins. Degree of competition affects margin substantially through prices realised and volumes absorbed amongst other effects. Managing these three aspects that are not mutually exclusive ensures a competitive rice industry through better rice margins and an effect on production, incomes, employment and food security

1.3 Review of Previous Related Studies on Rice Milling

A number of studies have been undertaken on capacity, utilization and technologies of rice mills in Kenya. The different studies have however given different capacities of the large eight mills. MRM has an installed capacity of 24tonnes/hr[9, 15], while another study[2]gave 3.5 tonnes/ hour. The rice value chain study[4]estimated it at 15 tonnes/hr. The National Rice Development Strategy (NRDS)[16] gave a capacity of 2.5 tonnes /hr. Most of the studies have given the capacity of LBDA and WKRM as 3.5 and 3.0 tonnes/ hour respectively. The TARDA capacity has been given as 3[15] and 7[16] tonnes /hr, while Dominion Farm one has been given as 2.5[16]and 2-5[2] tonnes /hr. Capwell capacity has been given as 2.5[16] and 2-2.5[2] tonnes/hr. The capacity of MRGM has been given as 3 tonnes/hr by many of these sources while the capacity of Nice Rice Millers has been indicated as 5[16] and 2-2.5[2] tonnes /hr. The estimate of number of small mills has also been inconsistent with some studies giving number of mills in Mwea as 350[23] and 148[4]. This could reflect usage at different times, but there is in general inconsistency in the information available

Few sources like the study by USAID[23] have given capacity utilization of specific mills. The few that have, indicated utilization of 13.5% for MRM, 40% for WKRM, 50% for LBDA, 40% for TARDA, 60% for Dominion Farms Mill, 85% for Capwell Industries, 37% for MRGM, and 47% for Nice Rice Millers. From the rice value chain study[4], the capacity utilization of small-scale rice mills translates to about 20 to 50%; as the designed production capacities of these mills was reported to vary from 30 to 100 bags/day while actual reported production ranged from 15 to 20 bags/day. The privately-owned large-scale mills were reported to attain capacity utilization levels in the range of 55 to 60%.

Rice milling is considered as a post-harvest process that entails removal of husk and bran layers to produce an edible white kernel/grain. The milling process is accomplished in one or several stages depending on the quantity and quality of rice to be produced. A study[5] identified three categories of rice millers in Kenya; Small millers with at least simple mill, weighing scale and a drying yard, Medium scale millers with at least rice milling chain or compound rice mill, drying yard, pre-cleaner, husker, de-stoner, grader, bucket elevators, a weighing scale, and a packaging unit and Large scale millers that own at least rice milling chain or compound rice mill, drying yard, mechanical dryer, pre-cleaner, husker, de-stoner, colour sorter, bucket elevators, a weighing scale and a packaging unit. Other studies have categorised the mills into small and large, while some have differentiated government and privately-owned mills.

II. Material and Methods

This paper analyses the miller's component of rice value chain in Kenya. Multiple approaches were utilised to gather information. Information gathered during value chain study of 2010, was analysed further and updated with recent information from literature and recent studies. Information was also got from recent rice mill studies undertaken mainly in Mwea. Key informants were also contacted to give more information related to the study.

Data on the respective mills was acquired during the month October, 2018. In Mwea, data on medium and large-scale millers was obtained by physically visiting the mills, interviewing the management and counterchecking the facility to ascertain the information. Information on small mills was obtained from trade offices responsible for licensing all business. This was then corroborated with already existing information. In Kisumu, Busia, Kwale, Lamu and Taveta counties, information on small mills was obtained from the Ministry of Agriculture, Livestock and Fisheries offices. Information on large/medium mills; TARDA, Lake Basin, Western mills, and NCPB (Sagana), was obtained by interviewing the management of the respective mills. Data obtained was compared and corroborated with other existing information.

Data for margin analysis was collected though structured questionnaires that captured the various costs and revenues. The data from value chain study was further analysed using the FAO's VCA to determine agents' margins and value added; with the inputs and outs, activities, plans and aggregated data been inputted and run with the software. The analysis differentiated small and large mills and also consolidated analysis for the two. The analysed data was also used to analyse the margins for the different value chain agents

Information gathered through the various studies and from literature was grouped along the SWOT analysis themes to identify the gaps and entry points in supporting improved capacities and capacity and technology utilization

III. Results and Discussions

3.1 Rice Milling Establishments

In Kenya, most of the rice is processed within the regions where it is produced through different arrangements. Generally, there are three kinds of rice mills: Simple one step process (single pass), two steps process (either single pass or two pass) and multi stage process (Figure 3). The mills are in many cases further classified into three types i.e. large scale, medium scale and small scale. The large-scale mills include both private and government enterprises.

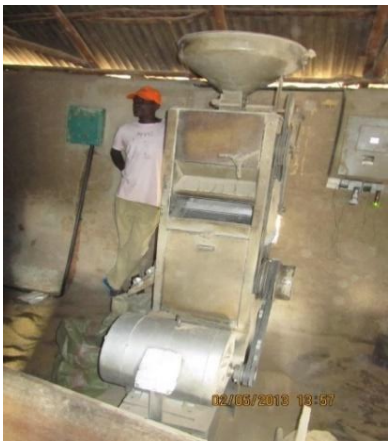



Figure 3: Single pass mill in Anyiko- Siaya (left) and Multi stage mill at MRGM- Mwea (right)

There were about eight large rice processing actor's mills in Kenya by 2014[16]. The current numbers of medium and large-scale mills have been established as 16 (Table 1). Additionally, there are over 256 other small to medium rice mills in Mwea and the rest of the rice growing areas such as Busia county (Bunyala, Teso South and North), Kisumu County(Ahero, West Kano and Katito), Siaya county(Anyiko in Gem), Migori county, Lamu county, Kwale, Taita Taveta and Kilifi county. Some (28) of these mills are indicated in Table 1. In an initiative to facilitate milling, the Ministry of Agriculture, through National Rice Development Strategy (NRDS), and in collaboration with JICA, distributed 25 mills to various farmer groups in Kenya (Table1).

3.2 Installed capacity, Capacity Utilization and Milling Technology

The different installations of mills have different capacities. The high capacity mills were found to be owned by institutions like cooperatives such as Mwea Rice farmers Cooperative; State Corporations such as the Mwea Rice Millers (MRGM) and Lake Basin Development Authority in Kisumu. From Table 1, the capacity of the medium and large mills varied from 1 to 22.5 tonnes/ hour. The average capacity of single pass small mills has been reported to be 0.5 tonnes per hour[8].Another player in milling was Dominion farm that had a rice mill with a capacity of 2.5 t/hr. The farm ceased operation in 2016 and sold its assets, including its milling installation

Most of the installed capacity of the mills was found to be underutilized principally due to lack of raw materials and in a few cases due to breakdowns. One reason that could explain the slack capacity in large scale public mills is the liberalization of the rice sector allowing entry of private millers which made large-scale millers to face stiff competition from small scale millers. The LBDA mill is an example of a large mill largely underutilized[4]. The MRM utilises only 5 tonnes/hour capacity of the existing 22.5 tonnes/hour due to lack of high volumes of paddy and breakdowns of some lines. These mills incur high overheads which ultimately reduces farmers' profits. To keep afloat, they have installed low capacity lines which mill low volumes. Some like Nice Millers and MRM, have resorted to purchasing paddy, milling and branding as own products. MRGM millers have also invested in high volume driers (with a capacity of 300 bags/hr) to reduce the cost of drying especially during wet weather.

Conservatively assuming one shift (8-hour operation) and 300 days working for all mills, the total installed capacity per year would be about 465,600 tonnes per annum translating to 23.6% utilization based on the current estimated production of 110,000 metric tonnes per annum.This would be 28.7% based on the currently used lines; and if a 24 hours operation for medium to large mills and 12 hours for small mills is assumed and considering all installation, this would translate to total of 936,000 tonnes or 11.7% capacity utilization.

Table1: Installed capacity, ownership and capacity utilization

	Mill	**Location**	**Details on lines/mills**	**Capacity (tonnes/hr)**		**Year installed and other details**
				Total capacity	Current operating mills capacity	
	Large and Medium Mills					
1	Mwea Rice Millers (MRM)	Mwea	5 lines of 2.5 2 lines of 5t/hr	22.5	5	1968 (3 lines of 2.5t/hr-not operational), 1972 (2 lines of 5t/hr-not

						operational because of high capacity), 2014(2 lines each 2.5t/hr 1 line of 2.5 not operational
2	Mwea Rice Growers Multipurpose Coop (MRGM)	Mwea	1 line of 1.5 1 line of 2.5 t/hr	4	2.5	Latest line-2012 Line of 1.5 not operational
3	Nice	Mwea	1 line	2.5	2.5	2012
4	Euros	Mwea	1 line	2.5	2.5	2010
5	Topgrade	Mwea	1 line	2.5	2.5	2016
6	Boma	Mwea	1 line	2.5	2.5	2015
7	TAI	Mwea	1 line	2.5	2.5	2016
8	Global	Mwea	1 line	2.5	2.5	2011
9	Bephero	Mwea	1 line	1	1	2011
10	Tana	Mwea	1 line	3	3	2016
11	Dozer	Mwea	1 line	1	1	2018
12	Capwell	Thika	1 line	2.5	2.5	Before 2008
13	TARDA	Garsen	2 lines of 7.5t/hr and 1t/hr	8.5	0	Latest line (7.5t.hr)-1996 Old line-1t/hr-before 1996. Lack of paddy to operate the mills
14	LBDC	Kisumu	2 lines of 1.5t/hr each	3	1.5	One line not operational Early 1990's
15	Western Kenya	Ahero	1	3	3	Early 1990's
16	NCPB	Sagana	1	2.5	2.5	2014
	Total Large and Medium Mills			**66.0**	**37.0**	
	Single Pass Mills					
1		Busia	4 mills	2	2	Magombe, Teso North/South
2		Siaya	2 mills	1	1	At Anyiko- JICA donated mills-operational
3		Kirinyaga	228 mills	114	114	All private
4		Lamu	4 mills	2	0	All Government issued, lack of paddy
5		Taveta	3 mills	1.5	0.5	All government issued, only 1 functional
		Kwale	9 mills	4.5	2.5	4 issued by Government and not working
7		Kaloleni	1 mill	0.5	0	Government issued, not working
11		Kisumu	5 mills	2.5	2.5	Ahero, Nyangande, Rabuor (private) Katito(CBO) All operational
		TOTAL	**256**	**128***	**122.5**	
	TOTAL			**194.0**	**159.5**	

*The average capacity of single pass mills estimated at 0.5t/hr (KENDAT, 2003)

These figures are lower than those from earlier studies and are way below the conventional levels for such investment.

However, despite the low utilization, some rice growing areas or potential rice growing, especially for upland rice, had very few or no mills. As an example, Kerio Valley, with high potential for paddy production, lacks rice mills.

The capacity utilization also doesn't capture other activities of the mills. The study found that some mills also handle other aspects of rice processing that do not utilise the locally produced paddy. One private mill was found to spend 42% of its operation time milling local while the rest of the time it handled other processing activities (polishing, cleaning and packaging) using already milled rice from local mills or imported rice. It was indicated that farmers and traders preferred selling milled rice to such factory. The milling of paddy rice was found to be mainly to white rice with little brown rice. One mill for example, utilised only 3.3% of its mills on brown rice.

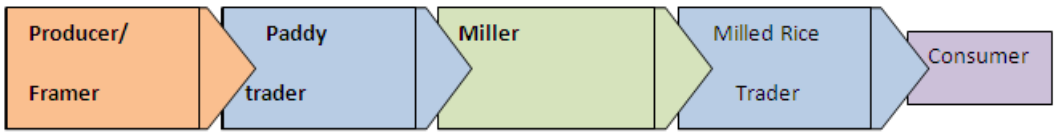
Paddy to rice conversion ratio (paddy: white rice) was found to be about 2: 1 in the small-scale mills and 5: 3 in large scale mills. The remaining portions comprises husk, bran and broken grains. This relates with other studies; for example, the recovery factor of rice in Kenya was reported[22] to range from 58% to 75%.
The rice milling investment is on average not old with most of the mills averaging between less than 1 and 10 years old (table 1). The only exception is some of the large mills like MRM, TARDA and LBDC, where some lines are between 20 and 50 years old; with some of these lines being unutilised. However, age of the mills is not the main contributing factor to this; lack of paddy and high volumes requirements for operation are the main factors. TARDA for example, is totally not utilized due to lack of paddy in the scheme; Tana river changed its course rendering Gamba scheme unutilized for paddy production. The service conditions for nearly all the mills were reported to be fair to good[4].

The private medium and large mills are increasing handling more rice. According to one study[15], Nice Rice Millers was handling a substantial volume of the rice annually produced in Mwea. The company is involved in both rice milling for traders and independent paddy purchase, milling, branding and marketing. The study indicated that with a milling capacity of 150 tonnes/day, it was milling about 70 tonnes per day. However, the company currently faces stiff competition from three newly installed medium mills (Boma, Top grade and TAI) strategically installed within advantage proximity.

3.3 Millers Incomes and Margins

3.3.1 Distribution of Incomes between Various Levels

Figure 4 indicates an estimate of the costs and margins generated per Kg of milled rice from updated, analysed and descriptive information from Rice Value Chain Study and from VCA analysis results of data collected from the study. The calculations are on the basis of average production cost and yield taken on all data collected per value chain. Margins were determined by factoring proportion production of irrigated and lowland rice, with the cost of producing a kg of paddy rice being 22.9 and 13.3 for irrigated and lowland rice respectively, while the price was Kshs 56.3 and 31.3 respectively. The proportion of irrigated rice was 84% from irrigated areas of Central Kenya, Nyanza, Coast and Western Kenya and 16% from lowland areas. At producers' level, a translation factor from paddy to saleable products of 90% is approximated given that other products other than whole and broken rice are sold from paddy.



Sales price	58.1	64.8	80.9	102
Cost	23.7	5	4.1	3.8
Margins	34.4	1.7 and 3	12	17.3
Distribution in %				
-Value Added	56.9	6.6	15.8	20.7
-of margins	52.6	2.6	18.3	26.5

Figure 4: Margins and value added per kg of milled rice

The millers' revenue of Kshs 80.9 per kg of milled rice indicated in Figure 4 is the average and weighted value of both large and small millers. This sales revenue comprises; sale of rice (96.0%), broken rice (1.5%), chicken feed (0.2%), bran-husk (0.6%) and milling service charge (1.7%). The farmers act also as first trader since they deliver paddy direct to millers, hence the sales price of Kshs 64.8 is the average price of the trader and farmer; however, the cost and margin of Kshs 3 under trader is what was captured for the traders. A final price of Kshs 102 has been used based on weighted price contribution on retail prices of Kshs 125 and 80/Kg of Basmati and other varieties respectively, which are the current and common average peak harvest prices to farmers. A price contribution of 48% from Basmati rice and 52% from other varieties is used based on the fact that the yield per acre in Mwea area, where Basmati is mainly grown was about 22 bags per acre, compared to average of 16 bags per acre in other areas. Also 36.4% grew Basmati and the rest, other varieties[4]. This is also based on an average acreage of rice of 2.2 acres per farmer for Bismati farmers and 1.9 acres for other varieties[19]. The rice traders comprise different layers and types of traders, hence the value of Kshs 102 price by final trader to consumer and the margins of Kshs 17.3 is distributed amongst various milled rice traders. The millers engaged in trading also have a share of margins and value added in these margins. Value added is worked out assuming all costs reported goes into products value addition or production.

As shown along the rice value chain (Figure 4), the total value added is Kshs 102. The miller in general adds value of 15.8 % of total value added and gets a margin of 18.3%. The net incomes realized by farmer, first trader, millers' chain, and second trader are 52.6, 2.6, 18.3 and 26.5% of total income respectively. This

compares fairly well with other countries; for example, in Vietnam, the farmer, miller chain, retailer and whole-seller margins constituted, 33, 5, 29, and 33% of total net incomes realized in the mechanized value chain respectively. In the traditional system the margins for farmers and miller were different at 23 and 15% respectively; with the miller, transporter and collector taking 8, 5 and 2% respectively, of the 15% miller chains margins[3]. The income of the second trader in figure 4 is shared by different levels of traders, whereas some of the farmers' incomes constitute part of paddy traders' income. The income and value added are comparable for the four agents.

Most small, medium and large millers provide more prompt rice milling service at 3ksh/kg. Large private mills like Nice Rice Millers offer means of transport and storage facilities, which are important for small farmers/traders having no means of transportation. It also advertises the farmers' rice at no cost throughout the country. In addition, it has for a long time ingeniously provided a sales space for farmers and traders to sell milled rice. This model of free storage and space for sale of rice has since been emulated by all medium and large mills in Mwea. The cost of milling experienced by the large and small millers is indicated in Figures 5, 6 and 7.

3.3.2 Cost and Margins in Milling

The major cost for large scale millers (69%) is cost of paddy, while the other costs account for 3% (Figure5). The margins are therefore about 28%. The major cost includes bags, electricity and transport (Figure 6). The final average sale price is about Kshs 125 and includes cost and margins. Figure 8 indicates the proportion of cost and margins realized by small scale millers. The margins are about 20% of the Kshs 3 service charged per Kg of rice. Electricity comprises 29%, while other major cost includes; casual labour, and management.

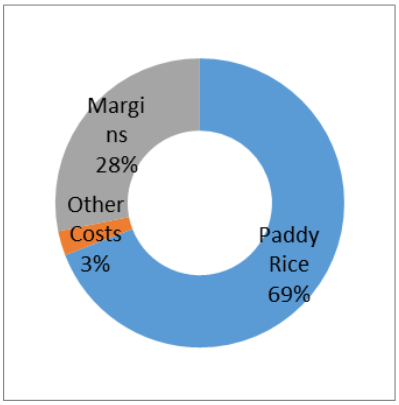


Figure5 Cost and margins for large millers

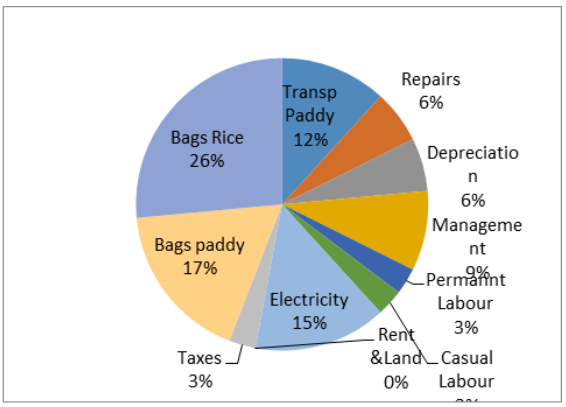


Figure6: Proportion of other costs for large scale millers

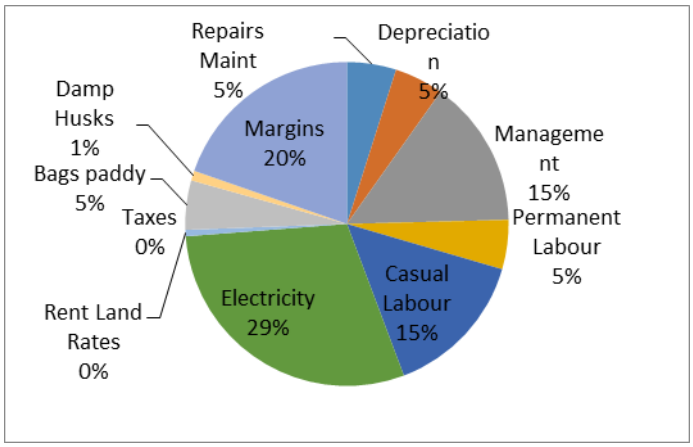


Figure8: Cost and margins breakdown for small scale millers

3.4 SWOT Analysis of the Rice Millers' Chain

Strengths

There exists idle capacity, of about 76%, that can support expanded rice production. There also exist skills in operation and maintenance of mills in the rice growing areas. The margins realized in milling are as from the study good. Affordable technology of rice hulling from China is also available. According to the rice

value chain study[4], 62.2 % and 12.5% of the milling technologies used in Kenya has been imported from China and Germany respectively. However, a few mills have technology from India and Brazil. This compares well with other countries in the region. According to a study[22], China dominates as the supplier of rice milling machines to Uganda (78%), other are Japan (4%) and India/England/Brazil (3%). In Kenya the main source of power for rice milling machines is electricity and this is readily available; this compares well with Uganda where 70% of mills were electricity operated, while the rest used fossil fuels[22]. The government of Kenya, through National Rice Development Strategy (NRDS) 2014-2018, and other supportive policies, has continuously supported the milling sub-sector.

Weaknesses

There is low supply of paddy due to low production to support the mills establishment, despite the high demand for milled rice. The production is lower than in a number of countries in the region. One study[10]indicated that when Kenya produced 100,000 tonnes of rice against a demand of 370,000 tonnes, in Tanzania it was 1.0 million ad 1.18 million tonnes respectively, while in Uganda it was 130,000 and 167, 000 tonnes respectively. In Kenya this has led to lower capacity utilization and higher cost due to idle and depreciating systems. The causes of low supply are diverse but include; limited supply due to lack of water and drought; low yielding rice varieties; poor agronomical practices, poor postharvest practices and birds damage amongst other reason. Inter border paddy flight in Western Kenya is currently a major issue, which has rendered Lake Basin and WKM mills largely un-operational.

The biggest challenge for Kenyan food processing is the high production costs resulting from the relatively high cost of labour, unstable electric power supply, poor transportation infrastructure, inefficient logistics and high raw material import costs[15]. One study indicated that Kenya isbarely competitive in rice production given the high milling costs[5]. The study indicated that the cost of milling was however lower than in neighbouring Uganda where a kg of rice milled by medium mills was charged Kshs 4/kg compared to Kshs 2/kg in Kenya for medium and small-scale mills. In Kenya, medium millers incurred 143% more overhead costs compared to their counterparts in Uganda (Kshs 281.4 and 115.5 per 80Kg/bag respectively). Labour constituted the highest cost incurred in Kenya (50.3%) while in Uganda it was electricity (82.3%). Other costs for Kenya were; electricity (19.2%), rent (17.8%) maintenance (7.6%), storage (4.4%) and license fees 0.7%. In Uganda, labour cost was 2.6%, rent 6.1%, maintenance 0.9% and license fees was 7.8%. For Kenya the small-scale millers made 58% and 59% profit from the sale of aromatic and non-aromatic rice, respectively. These comprised; selling price per/kg of 110 and 65, purchase price/kg of 40 and 20, milling cost/kg of 2 and 2, overhead cost/kg of 5 and 5 for aromatic and non-aromatic respectively

The usage of poor milling technologies that are not cost effective and are inefficient, is high in Kenya. This is due to the predominant use of single pass mills with lower recovery rates.

There are limitations of consistent and accurate data on capacities, capacity utilizations, performance, losses, volumes milled, number of mills which limits planning for the milling sub-sector. The sub sector is characterized by high postharvest losses which add to 15 to 50% of the market value of production. These figures are however estimations with little studies in support. The problem of losses is compounded by the fact that some of the harvesting is done in April and May during the rainy season. Poor grain drying systems lead to losses through sprouting, and the drying is often done in unhygienic conditions such as on roads, play grounds and walking paths (Figure 9).

Figure9: Drying of rice in open fields in Ahero(left) and Mwea (right)

There are also insufficient storage facilities (especially among the small farmers) and limited value addition technologies such as good quality milling, parboiling, beverages and cookies.

The high cost of electricity and fuels, high cost of maintenance due to breakdown arising from aging mills and lack of spare parts make Kenyan millers inefficient. This makes locally grown rice not competitive

with imports thus lowering farmers and traders' incomes. The situation is compounded by the low investment in modern mills, stiff competition from cheap rice imports and lack of a reliable source of energy for mill operation. Most operations in the rice sub-sector are also manual and labor-intensive with a consequently low productivity and high operation costs.

Opportunities

There is an opportunity to learn from other countries in the region and others, like the Asian Countries, in their efforts to upscale and modernize the milling sector; for example, the Government of Rwanda, through the National Rice Program, modernized hullers/mills followed by privatization of the same when the mills aged. They were sold to the cooperatives and private actors. However, farmers continued to prefer working with the small-scale millers. This forced the Government to ban use of small hullers, despite protests. Only 10% of the farmers consequently supplied rice to the protected mills. This led to low capacity utilization and increased costs of operation of the privatized mills[21].

The rice sector in the region and in the East African countries have received stakeholders support to develop it, these has helped the sector to grow. Efforts have also been there to modernize and improve the milling sub sector.

There is need to promote use of automatic and multi pass mills with higher overall recovery of white rice, higher percentage of head rice and lower percentage of broken rice. A multi-pass rice mill has a 65%-70% recoveryrate of un-husked rice, as opposed to single passmills which have a 50%-57% recovery rate.Comparatively, single pass mills have about 27.4% broken rice for two stage mills and 45.5% for the Engelberg type. Automatic mills however have a lower percentage of only 14.7% broken rice[3]. In these endeavour, possible approaches have been suggested[3] and these can be adopted; these includes supplyingmulti stage village-level rice mills to farmer cooperatives; supplying village-level mills or mobile mills through rural social entrepreneur; supplying rice mills through an organizations working with millers to set up out-grower agreements with embedded services; partnership with a corporate using an out-grower scheme for rice sourcing to develop model to upgrade centralized or decentralized (local) milling technologies; supplying component technologies for automatic mills to large rice milling companies/exporters and development of appropriate decentralized power solutions.

Carrying out an inventory study of processing-milling, storage and other postharvest facilities for rice, assessment of losses; and other necessary information gathering would support planning and provision of government and the other stakeholders support to the sub-sector.

Development and promotion of better storage facilities(including hermetic systems) andappropriate models for warehouse and stores management and maintenanceis required. The latter is necessary since it has been observed that a certain level of storage costs would be generated even if a warehouse was jointly installed and this is a challenge given that farmers often borrow money to purchase fertilizers and agricultural chemicals and need cash immediately after harvesting rice to repay these loans; this dwindling the benefits that would be realised through such systems.

To support the milling industry further, there is need to enhance knowledge and skills on agronomic practices, postharvest technologies- including agro-processing and value addition in order to reduce losses. There is also need to promote irrigation practices that change the management of plants, soil, water and nutrients such as System of Rice Intensification (SRI), and which gives rice that is heavier, more yielding and with higher recovery rate. Coupled with this, is the need for identifying, developing and introducing appropriate harvesting and processing equipment; with private sector participation in technology development and transfer

To reduce on costs, focus should be in improving capacity utilizations; particularly for large mills, in order to reduce on depreciation costs through increased production and productivity in respective areas. Additionally, there is need for introduction of alternative energy and drying technologies; such as solar drying systems, especially hybrids that use rice straw/husks and solar, portable thermal dryers, collapsible dryer cases; and other technologies that utilise other renewable technologies. There should also be efforts towards installation of new, improved rice mills, mobile mills for out-grower rice areas; for example, there is a call for investing in processing plant (24 tonnes), to dry, mill and package NERICA rice, cultivated in the Perkerra and Kerio Valley NIB, as well as processing the by-products of rice production[16]. Another way to reduce cost is through utilizing by-products, particularly rice husks (which account for about 20% of rice produced), for production of briquettes, bio-fertilizers, and animal feeds.

There exists an opportunity of promoting processing in the rice value chain including: proven willingness by end users across the country to adopt economically beneficial technologies, fabricators who are able to produce low cost equipment at affordable prices, and willingness and capability among fabricators to copy machines that have a proven record of technical and financial success.

Threats

The milling sector faces threats from lower milling cost in other countries. Others threats include increased cost of electricity, reduced irrigation water supply due to climate change and increased pests and diseases that lower production, milling capacity utilization and hence leads to higher costs of operation

IV. Conclusion

This study provides an updated situation of the rice milling subsector in Kenya. It highlights and attempts to rectify the inconsistency in information on the sub sector particularly on numbers, capacities, and capacity utilization of rice mills. The existing capacity of the milling establishment is adequate to meet increased rice production in Kenya.

A number of challenges and opportunities have also been identified to improve the efficiency and competitiveness of the rice subsector particularly through improved capacity utilization and post-harvest technologies.

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References

[1]. ACDI/VOCA (2018). Easy dry M500 Maize Dryer. http://www.acdivoca.org/easydry/
[2]. AteraE. A., Onyancha F. N.,Majiwa E. B. O. (2017) Production and marketing of rice in Kenya: Challenges and opportunities. Journal of Development and Agricultural Economics. Vol. 10(3), pp. 64-70, March 2018 DOI: 10.5897/JDAE2017.0881 Article Number: 1820CDE55981 ISSN 2006-9774
[3]. Dalberg (2014). BoP Technology Study and Product Incubation: Agriculture Sector Phase 1: BoP Technology Selection.
[4]. Emongor A. R, Walela M.B, Ndirangu. S.N, Kitaka D. M, Atula D., Njoroge J.N (2010). (MOA). Rice Value Chain Study Report for Kenya. Ministry of Agriculture
[5]. Gitau R. Mburu S, Mathenge M.K and Smale M (2010). Trade and Agricultural Competitiveness for Growth, Food Security and Poverty Reduction: A Case of Wheat and Rice Production in Kenya. Tegemeo Institute of Agricultural Policy and Development. WPS 45/2011
[6]. GoK (Government of Kenya) (2017). Economic Survey, 2017
[7]. Kanali C, Kituu G, Mutwiwa U., Mung'atu J, Ronoh E, Ndirangu S, KamwereM,Mulamu L. (2017). Energy Efficient Rural Food Processing Utilising Renewable Energy to Improve Rural Livelihoods in Kenya
[8]. KENDAT (2003). Rural Transport Service Project for Kenya: Rice and Horticultural Case Study based on Mwea Irrigation Scheme,Project Report
[9]. KAAA (Kenya Agribusiness and Agro-industry Alliance) (2014). Agriculture Investment Opportunities in Kenya Rice Processing Investment Case
[10]. Kilimo Trust, 2014: Expanding Rice Markets in the EAC
[11]. KNBS (Kenya National Bureau of Statistics). (2018), Economic Survey 2018
[12]. Lele U. J (1970). Modernisation of the Rice Milling Industry: Lessons from past Performance: Economic and Political Weekly, Vol. 5, No. 28 pp. 1081+1083+1085+1087-1090
[13]. Muhunyu J. G (2012). Is Doubling Rice Production in Kenya by 2018 Achievable? Journal of Developments in Sustainable Agriculture. Vol. 7 No 1-pp 46-54
[14]. Obura J., Ombok B. O. and, Omugah G. (2017). Analysis of Rice Supply Chain in Kenya. International Journal of Managerial Studies and Research (IJMSR) Vol. No 8, PP 12-17 ISSN 2349-0330 (Print) & ISSN 2349-0349
[15]. Promar Consulting (2016). Promoting the Development of Food Value Chains in Africa 2015 – Kenya
[16]. RoK (Republic of Kenya), Ministry of Agriculture (2014). National Rice Development Strategy (2008 – 2018) Ministry of Agriculture, Livestock and Fisheries State Department of Agriculture. (Revised 2014)
[17]. RoK (Republic of Kenya), Ministry of Agriculture and JICA (2011). Guidelines to rice production in Kenya, pp1
[18]. RoK (Republic of Kenya), Ministry of Agriculture and KARI (2014). Rice value chain, pp 6-8.
[19]. RoK (Republic of Kenya), Ministry of Agriculture (2017). Rice Value Chain Survey in Kenya (unpublished)
[20]. Short C., Mulinge W., Witwer M. (2012). Analysis of incentives and disincentives for rice in Kenya. Technical notes series, MAFAP, FAO, Rome
[21]. Stryker J. D (2010). Developing competitive rice value chains. Presented in the Second Africa Rice Congress, Bamako, Mali, 22–26 March 2010: Innovation and Partnerships to Realize Africa's Rice Potential. Associates for International Resources and Development (AIRD), 60 Bartlett Avenue, Arlington, MA 02476, USA
[22]. Tokida K. Haneishi Y, Tsuboi T., AseaG.andKikuch M. (2014) Evolution and prospects of the rice mill industry in Uganda. African Journal of Agricultural Research. Vol. 9(33), pp. 2560-2573, DOI: 10.5897/AJAR2014.8837 Article Number: 392EFDD46599 ISSN 1991-637X
[23]. USAID COMPETE, 2010. Staple Foods Value Chain Analysis: Kenya Country Report
[24]. Walker S., Wolfe B., and Davies B. (2017). Feasibility of Up-scaling the EasyDry M500 Portable Maize Dryer to Rwanda. http://www.acdivoca.org/wp-content/uploads/2017/05/Feasibility-of-Upscaling-the-EasyDry-M500-to-Rwanda.pdf
[25]. Wanjogu R.K (2017). Situation and Challenges of Food Production Policy in Kenya: Supply, Demand and Import of Rice. http://www.maff.go.jp/primaff/koho/seminar/2017/attach/pdf/171030_02.pdf

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