

**PERCEPTION AND KNOWLEDGE OF RICE VALUE CHAIN ACTORS ON THE
EFFECT OF IMPROVED PRACTICES ON YIELD AND MILLING
CHARACTERISTICS OF RICE IN THE SAGNARIGU AND KUMBUNGU
DISTRICTS OF GHANA**

ABSTRACT

A survey was carried out to gather fundamental data on the farmers' improved practices and perceptions for cultivating, milling, and marketing of rice in the Sagnarigu and Kumbungu districts in the Northern Region of Ghana. The survey was conducted from January to March 2021. In addition, information was gathered on farmers' perceptions of the practices they undertake in cultivating, processing, and marketing rice in the two districts. A multi-stage sampling methodology was used in this study and a well-structured questionnaire was used to gather primary data through face-to-face interviews. Those interviewed were 134 rice farmers, 82 rice processors, and 22 rice marketers. Results showed that 54.7% of the farmers used local varieties such as Moses, Bumbass, Mandii, Bazolgu, Salimasaa, and Assemblyman. 54.5% of the farmers planted their seeds using the broadcasting method. Only 18% of the sample population practiced line transplanting with well-defined spacing. Majority of those who transplanted did it when the seedlings were at least 4 weeks old. At the end of the survey, it was concluded that rice production is hindered by poor variety, poor spacing, poor timing of transplanting and low soil fertility in both low land and irrigated rice ecosystems in the Sagnarigu and Kumbungu districts.

Key words: variety, spacing, amendment, milling characteristics, transplanting and rice.

1.Introduction

In Africa, for the sake of ensuring food security, rice has taken on a very strategic and important role. The rapid urbanization, high rates of population increase, and changes in eating patterns have increased the consumption of rice more quickly than that of any other major staple on the continent (Seck et al., 2013). The food staple with the fastest growth rate in Africa is rice (IRRI, 2013). It ranks third in importance for all of Africa and is the single most significant source of dietary energy in West Africa (Seck et al., 2013).

A major issue for the rice industry in Africa as a whole is that local supply has never caught up with demand, despite the fact that local rice output expanded quickly following the 2007–2008 food crisis (Seck *et al.*, 2013). According to Muthayya *et al.* (2014), only 54% of the rice consumed is produced domestically. As a result, the continent still depends on imports to satisfy its rising rice demand. The domestic production of rice only provides 60–80% of domestic demand, which results in 10–12 t of imports which equates to one-third of the rice traded on the global market (Macauley, 2015).

Africa's rice production faces several challenges, including the need for additional support to establish effective rice seed systems, spread climate-resilient rice varieties across the continent, promote good agricultural practices (GAP) to close yield gaps, enhance quality management along the value chain, and invest in infrastructure for rice production and processing (Macauley, 2015).

According to MoFA (2011), Savannah Agricultural Research Institute (SARI), and International Food Policy Research Institute (IFPRI), Ghana's rice producing area has significant opportunity to reach potentially achievable yields of 6-8 t/ha (Ragasa, et al., 2013).

Ghana has the ideal agronomic conditions for year-round rice production (Addai *et al.*, 2022). Ghana has a total land area of 238,539 km², of which 57%, or approximately 136,000 km², is categorized as "agricultural land area"; of this, 58,000 km² (24.4%) is under cultivation, and 11,000 hectares are irrigated (McCarthy, 2020).

In Ghana, 36.9% of districts had rice yields that were higher than the country 3-year average in 2018 (MoFA, 2019). The highest average yield performance was reported by NingoPrampram in the Greater Accra Region (6.35), which accounted for 214.47 percent of the national average and 105.81 percent of prospective yields (MoFA, 2019). However, yields below the national average were reported in 63.1% of districts. Ahanta West in the Western Region had the lowest yield performance for the time period (0.85), only contributing 28.60 percent of the national average and 14.11 percent of prospective yields. While the northern region produced 24.57% of the country's rice, the Volta region produced 36.67% of it (MoFA, 2019).

The average yearly yield of rice in 2018 was 2.96 t/ha. When compared to the national average and the potential yield of 6 t/ha, the northern region's rice yield of 2.62 t/ha was low. Additionally, the northern region has the potential to produce the most rice in the nation. For instance, in 2012, the Northern region was the top producer (37%) of the nation's rice (Ragasa, *et al.*, 2013). In 2011, rice output declined in the Northern and Upper East regions whereas it increased in the Volta region (Ragasa *et al.*, 2013).

No district in the northern region outperformed the national average. East Mamprusi had the lowest performance in the north, with a district average of 1.71 t/ha, while West Mamprusi had the highest performance with 2.71 t/ha (MoFA, 2019). Sagnarigu Municipal recorded an average yield of 2.60 t/ha. (MoFA, 2019).

Majority of the rice is grown in lowland or irrigated areas in northern Ghana. While non-irrigated yields are typically 2 tons per ha, the Kpong Irrigation Project (KIP), where producers take advantage of good irrigation, grow consumer-preferred fragrant rice varieties, use certified seeds, and adopt a well-developed set of agronomic practices that are shared through an effective extension system, has achieved yields on average of 5.5 tons per ha (Takeshima *et al.* 2013). The fertility of the soils used to grow crops has likewise decreased,

indicating that fertilization is very important to sustain production (Azumah and Adzawla, 2017). Meanwhile, the northern region of Ghana encounters several obstacles in the production of rice, such as low adoption of modern farm technologies, restricted availability of fertilizers, low-yielding varieties, and lack of credit facilities (Tanko *et al.*, 2016). These elements play a part in Ghana's generally low yield of rice, which is roughly 50% below the demand from consumers.

Although it is anticipated that the adoption of these improved practices will increase productivity, this expectation cannot be proven without empirical investigation. As a result, the goal of this study is to investigate the perception and knowledge of rice value chain actors on the effect of improved practices on yield and milling characteristics of rice in the Sagnarigu and Kumbungu Districts of Ghana

2. Materials and methods

2.1 Study area

The survey was conducted from January to March 2021 in the Sagnarigu and Kumbungu districts in the Northern region of Ghana.

2.2 Sampling techniques and data collection

A multi-stage sampling methodology was used in this study. SagnariguKukuo and Bontanga were chosen for the first stage using the purposive sample technique because they are among the major rice-producing localities in the northern region of Ghana. In the second stage, stratified sampling was employed to divide the population into three primary categories and their subgroups: (a) producers, consisting of irrigated and rain-fed farmers, (b) processors, and (c) marketers. Then, 134 farmers from the two strata—69 in the rain-fed condition and 65 in the irrigated condition—were chosen using simple random sampling. Simple random sampling was also used in the selection of 22 marketers and 82 processors. A well-structured questionnaire was used to gather primary data through face-to-face interviews.

2.3 Data analysis

The SPSS statistical analysis program was used to compile all the responses into a datasheet, and the means were then separated using LSD at 5%.

3. Results

3.1 Gender

Table 1: Gender of farmers, processors, and marketers

Gender	Farmers		Processors		Marketers	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Male	126	94.0	6	7.3	3	13.6
Female	8	6.0	76	92.7	19	86.4
Total	134	100.0	82	100.0	22	100.0
Mean	1.06		1.93		1.86	
SEM	.021		.029		.075	
Std. Deviation	.238		.262		.351	
Variance	.057		.069		.123	

134 farmers, 82 processors, and 22 marketers who consist of 94 %, 7.3%, and 13.6 males and 6%, 92.7% and 86.4 % females respectively were interviewed from the two districts (Table 1).

3.2 Age

Table 2: Age of farmers, processors and marketers

Age	Farmers		Processors		Marketers	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
18 – 24	16	11.9	1	1.2	1	4.5
25 – 35	33	24.6	10	12.2	0	0
36 – 45	49	36.6	43	52.4	10	45.5
46– 70	36	26.9	28	34.1	11	50.0
Total	134	100.0	82	100.0	22	100.0
Mean	3.78		4.20		4.45	
SEM	0.084		0.077		0.127	

SD	0.976	0.693	0.355	
Var.	0.953	0.480	1	4.5

36.6% of the farmers fell within the age range of 36 to 45 years (Table 2). whereas 11.9% of the respondents were within the 18 to 24 age brackets. 52.4% of the rice processors in the study area fell within the age brackets 36 – 45 (Table 2). The least age bracket was 18 – 24 which was made up of 1.2% of the sample population. 50.0% of the rice marketers in the study were within the age brackets 46- 70 years old (Table2). The age range with the least population (4.5 %) was from years. 18- 24 years

3.3 Education

Table 3: Education of farmers, processors and marketers

Educational level	Farmers		Processors		Marketers	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
No formal educ.	84	62.7	76	92.7	22	100.0
Primary	11	8.2	1	1.2		
JHS/Middle Sch.	13	9.7	4	4.9		
SSS/SHS	12	9.0				
Tertiary	14	10.4	1	1.2		
Total	134	100.0	82	100.0		
Mean	1.96		1.16		1.00	
Std. Error of Mean	.123		.068		.000	
Std. Deviation	1.427		.618		.000	
Variance	2.036		.382		.000	

62.7 % of the farmers had no formal education while 10.4 % of them had received tertiary education (Table 3).

92.7% of the processors had no formal education (Table 3). whereas 1.2% of the population had either primary school education or tertiary education.

All the marketers had no formal education (Table 3).

3.4 Seed source

Table 4: Seed source

Seed source	Fre	%	Reasons for choice	Fre	%
Cheaper than certified seeds	8	6.0	Cheaper than certified seeds	8	6.0
Readily available	11	8.2	Readily available	11	8.2
Higher yield obtained from the previous season	21	15.7	Higher yield obtained from previous season	21	15.7
Certified seeds are costly	65	48.5	Certified seeds are costly	65	48.5
To supply certified seeds to farmers	4	3.0	To supply certified seeds to farmers	4	3.0
Higher yield	10	7.5	Higher yield	10	7.5
Own seeds performed well	11	8.2	Own seeds performed well	11	8.2
High yield obtained from the farmer	4	3.0	High yield obtained from the farmer	4	3.0
Total	134	100.0	Total	134	100.0
Mean	4.04		Mean	4.04	
Std. Error of Mean	.139		Std. Error of Mean	.139	
Std. Deviation	1.608		Std. Deviation	1.608	
Variance	2.584		Variance	2.584	

Only 8.2 % of the farmers in the study area used certified seed in cultivating rice (Table4).

75.4 % of the farmers used their seed in cultivating rice in the 2020 cropping season.

The majority of the farmers (54.5 %) from the study area did not use the certified seed because the certified seeds were costly (Table 4). 15.7 % of the farmers were contended with the yields they had the previous season and continued with their seed.

3.5 Variety cultivated in the 2020 cropping season

Table 5: Variety cultivated, processed or marketed in 2020 in Sagnarigu and Kumbungu districts in the noethern region of Ghana

Variety	Farmers		processors			Marketers		
	Fre	%	Variety	Fre	%	Variety	Fre	%
Bumbas	7	5.2	Gbewaa rice	10	12.2	Gbewaa rice	6	27.3
Moses	32	23.9	Agra rice	53	64.6	Agra rice	2	9.1
Digang	6	4.5	Moses	4	4.9	Moses	2	9.1
Mandii	9	6.7	Digang	2	2.4	Digang	1	4.5
Bazolgu	3	2.2	Gomma	2	2.4	Gomma	2	9.1
Salimasaa	4	3.0	Mandee	1	1.2	Mandee	1	4.5
Assemblyman	3	2.2	Tops	1	1.2	Tops	1	4.5
Kuradoo	2	1.5	Anofula	1	1.2	Anofula	1	4.5
Tox	1	.7	Bazolgu	8	9.8	Amaru	1	4.5
Digang	2	1.5				Bazolgu	3	13.6
Agra	50	37.3				Faaro	1	4.5
Gbewaa rice	15	11.2				GR18	1	4.5
Total	134	100.0	Total	82	100.0	Total	22	100.0
Mean	8.19		Mean	3.37		Mean	6.18	
SEM	.453		SEM	.384		SEM	1.086	
Std. D	5.248		Std. D	3.477		Std. D	5.096	
Variance	27.541		Variance	12.08		Variance	25.965	
				7				

The variety that was used the most in the 2021 cropping season in the study area was Agra, 37.3 % of the farmers used this variety in the 2021 cropping season (Table 5). This was followed by the Moses variety as 23.9% of the farmers planted this variety. These were followed by Gbewaa rice, mandi, Bumbass, Digang, and salimasaawith the respective percentage of farmers' usage of 11.2 %, 6.7 %, 5.2 %, 4.5 %, and 3.0 %.

64.6% of the rice processors in the study area prefer Agra rice to Paddy for processing (Table 5). 12.2% of the respondents prefer Gbewaa rice as their paddy for processing while 9.8% of the respondents prefer Balzogu rice variety as their raw material for processing4.9% of them

prefer Moses, 2.4% of them prefer Digam or Gomma and 1.2% of them prefer Mandii, Tops, Anofula as paddy processing.

27.3% of the rice marketers in the study area preferred Gbewaa rice as paddy for marketing (Table 5). 13.6 % of the marketers preferred Bazolgu in doing their business. 9.1% of the respondents preferred either Agra rice, Moses rice, or Gomma rice as their paddy for marketing while 4.5% of the respondents preferred either Digang rice, Mandii rice, Tops rice, Anofula rice, Amaru rice, Faaro rice or GR18 paddy or milled rice for marketing.

3.6 Reason for choice of the variety

Table 6: Reason for choice of the variety in cultivating in the 2020 cropping season

Reason for choice of variety	Frequency	Percent
Seeds are available	1	.7
Change of variety	4	3.0
High yielding	122	91.0
Good price for the paddy	4	3.0
Milled grains are of good quality	2	1.5
Recommended by MoFA or other institutions	1	.7
Total	134	100.0
Mean	4.03	
Std. Error of Mean	.044	
Std. Deviation	.505	
Variance	.255	

The majority (91 %) of the farmers selected varieties based on the yield (Table 6). However, most of the farmers at Bontanga selected the Moses variety due to not only its high-yielding ability but also its good milling qualities when harvested at 12 % moisture content.

3.7 Method of planting the rice

Table 7: Method of planting the rice

Method of planting	Fre	%		Fre	%
Broadcasting haphazardly	73	54.5	Carrying out cultural practices is easy	5	3.7
Transplanting seedlings without a definite distance or space between plants	38	28.4	Transplanting is costly	6	4.5
Hand drilling in rows without approximate spacing	1	.7	Inadequate tractor services	1	.7
Dibbling without approximate spacing	4	3.0	Transplanting is faster	29	21.6
Line transplanting	18	13.4	Broadcasting is faster	3	2.2
			Less costly	45	33.6
			Higher yield	18	13.4
			Less labour	17	12.7
			No labor available for transplanting	2	1.5
			Right plant population	8	6.0
Total	134	100.0	Total	134	100.0
Mean	2.06			5.83	
Std. Error of Mean	.146			.180	
Std. Deviation	1.685			2.083	
Variance	2.839			4.339	

54.5 % of the farmers planted their seeds using the broadcasting method (Table 7). The majority of these farmers were from lowland rain-fed ecology. While the majority of the farmers under irrigated ecology nursed and transplanted their rice seedlings. 28.4 % of the respondents transplanted seedlings without a definite distance or space between plants. However, 13.4 % of the sample population practiced line transplanting with well-defined spacing. Most of the farmers selected broadcasting because they could not afford the cost involved in transplanting and those who selected transplanting indicated that transplanting gave them better yield (Table 7).

3.8 Age of seedling at transplanting

Table 8: Age of seedling at transplanting

Age of seedling	Frequency	Percent
2 weeks after nursing seeds	2	1.5
3 weeks after nursing seeds	15	11.2
4 weeks after nursing seeds	8	6.0
5 weeks after nursing seeds	10	7.5
6 weeks after nursing seeds	14	10.4
More than 6 weeks after nursing seeds	7	5.2
N/A	78	58.2
Total	134	100.0
Mean	5.63	
Std. Error of Mean	.163	
Std. Deviation	1.891	
Variance	3.574	

The 41.8% of the farmers in the study area, who practiced transplanting, transplanted at different ages of the seedlings (Table 8). Only 12.7% of the sample population transplanted when the seedlings were 2 and 3 weeks old. 6 % and 7.5 % of the sample population were transplanted when the seedlings were at least 4 weeks and 5 weeks old respectively. 10.4 % and 5.2 % of the farmers transplanted when the seedlings were 6 or more weeks old respectively. It is worth noting that 58.2 % of the farmers did not use transplanting in planting their rice.

3.9 Rate and type of fertilizer application

Table 9: Rate and types of fertilizer application and reason for the choice

Rate/type of fertilizer	Fre	%	Reason	Fre	%
Only basal application of chemical fertilizer	59	44.0	Recommended by MoFA	27	20.1
Only the second application of chemical fertilizer	12	9.0	Cannot afford the recommended rate	5	3.7
Application of self-prepared organic manure (compost) or farm yard manure	1	.7	Can only afford the basal application	9	6.7
No fertilizer application	1	.7	Can only afford a second	2	1.5

			application		
Chemical fertilizer (solid) application at the recommended rate	59	44.0	Higher yield	76	56.7
Both chemical and compost fertilizer applications at recommended rates	2	1.5	Chemical fertilizer application is costly	14	10.4
			Less costly	1	.7
Total	134	100	Total	134	100.0
Mean	2.98		Mean	4.73	
Std. Error of Mean	.170		Std. Error of Mean	.190	
Std. Deviation	1.971		Std. Deviation	2.204	
Variance	3.887		Variance	4.860	

Coincidentally, 44 % of the farmers applied only the basal application of chemical fertilizer, and chemical fertilizer at the recommended rate (Table 9). Only 1.5% of the farmers applied both compost and chemical fertilizer. 9.0 %, 0.7 %, and 0.7 % of the farmers in the study area applied only a second application of chemical fertilizer, self-prepared organic manure (compost), or farm yard manure, and no fertilizer respectively.

56.7 % of the farmers in the study area choice of the type and rate of fertilizer application was tied to higher yield (Table 9). Most of the farmers who could not apply the recommended rate linked it to their inability to afford it.

3.10 Qualities that influence the choice of paddy

Table 10: Qualities that influence the choice of paddy for processing and marketing

Qualities	Processors		Marketers		
	Fre	%	Fre	%	
Unbroken grains	20	24.4	Unbroken grains	2	9.1
Aromatic grains	4	4.9	Long grains	4	18.2
Uniformity of grains	28	34.1	Broken grains	3	13.6
Cooking characteristics	22	26.8	Aromatic grains	3	13.6
The moisture content of grains	8	9.8	Uniformity of grains	4	18.2

			Cooking characteristics	5	22.7
			The moisture content of grains	1	4.5
Total	82	100.0	Total	22	100.0
Mean	4.90		Mean	4.32	
Std. Error of Mean	.285		Std. Error of Mean	.485	
Std. Deviation	2.580		Std. Deviation	2.276	
Variance	6.657		Variance	5.180	

34.1% of the rice processors in the study area made their choice of a variety of paddy based on the uniformity of the grains (Table 10). 26.8 % and 24.4 % of these processors made their choice based on the cooking characteristics and the percentage of unbroken grains respectively. Those who made their choice based on the moisture content of grains and aromatic characteristics of the grains were 9.8 % and 4.9% of the processors respectively. 22.7 % of the rice marketers in the study area made their choice of a variety of paddy based on the cooking characteristics (Table 10). 18.2 % of the rice marketers made their choice of paddy based on long grains or uniformity of grains. 13.6 % of these marketers made their choice based on broken grains or aromatic grains. 9.1 % of the marketers preferred unbroken grains. Finally, 4.5 % of the marketers in the study area made their choice based on the moisture content of grains.

4. Discussion

4.1 Gender of farmers, processors and marketers

94 % of the farmers interviewed were males (Table 1). This shows that the male folk still dominate rice cultivation in the two districts. This claim is supported by Addison *et al.* (2023) findings, which revealed that male farmers have historically dominated rice production in Northern Ghana. The population of females involved in rice production is low and does not auger well for rice productivity in the study area as females play crucial roles in rice production, processing, and marketing. On the other hand, 92.7% of the processors from the study area were females (Table 1). This shows that females dominate in rice processing in the

study area. Lelea's (2020) finding is similar as she revealed that one of the most popular processing tasks undertaken by women in Northern Ghana is the parboiling of rice.

86.4 % of the marketers interviewed were females (Table 1). This shows that the female folk still dominate rice marketing in the two districts. The population of males involved in rice marketing is low and does not auger well for rice marketing in the study area as the males play crucial roles in rice production. Addison et al. (2014) finding is in line with this result as they revealed that women work primarily in post-harvest tasks including threshing, winnowing, and drying, and to a lesser extent, selling rice.

4.2 Age of farmers, processors, and marketers

36.6 % of the farmers fell within the age range of 36 to 45 years whereas 11.9 % of the respondents were within the 18 to 24 age brackets (Table 2). According to MoFA (2013), farmers in Ghana are 55 years old on average. This shows that the majority of the active youth are into rice cultivation. However, rice production enterprises in the two districts are not attracting the very young ones who are 24 years and below.

52.4% of the rice processors in the study area fell within the age brackets

36 – 45 (Table 2). The least age bracket was 18 – 24 which was made up of 1.2% of the sample population. The average age of the rice processor was 46 years. Coincidentally, Frimpong *et al.* (2023) also reported 46 years as the average age of the rice processor in the northern region of Ghana. This age is within the agricultural productive age in Ghana. Henceforth, this is good for rice processing in the country.

50.0% of the rice marketers in the study area fell within the above 45 years brackets (Table 2).

The average age of the marketer is 51 years. Rice marketing in the study area is not attracting young ones

4.3 Education of farmers, processors, and marketers

62.7 % of the farmers have no formal education while 10.4 % of them have received tertiary education (Table 3). In contrast, File and Nhamo (2023), reported that 46% of farmers in the northern region lacked formal education. This result is not good for technology transmission and subsequently adoption as the majority of them do not have formal education. Tanko and Ismaila (2021) support this assertion by indicating that there is evidence to suggest that farmers with lower levels of education may have less access to technical information and training, which could result in a slower uptake of current agricultural production technology.

92.7% of the processors had no formal education. whereas 1.2% of the population had either primary school education or tertiary education (Table 3). This shows that the majority of the rice processors in the study area had no formal education and are most unlikely to adopt technologies in rice processing. Similarly, Adams *et al.* (2019) report that approximately 85% of rice processors in Ghana's northern region lack a formal education.

All the respondents had no formal education (Table 3). This happening is not good for not only rice marketing but also rice production in the area.

Community

4.4 Seed source

Only 8.2 % of the farmers in the study used certified seed in cultivating rice (Table 4). Ragasa *et al* 2013 corroborated this by indicating that 54.5 % of the farmers from Ghana used their rice seeds in planting while 31.1 % of them sourced their rice seeds for planting from other farmers. The low adoption of certified seed is a recipe for low production, as there is a decline in varietal purity and positive varietal traits such as high yielding associated with the farmers' seeds.

4.5 Reasons for Seed Source

The majority of the farmers (48.5%) from the study area did not use the certified seed because the certified seeds were costly (Table 4). According to Ragasa and Chapoto (2017), one of Ghana's biggest obstacles to rice production is the high cost of hybrid rice seeds.

4.6 Choice of variety

The variety that was used the most in that season was Agra, 37.3 % of the farmers used this variety in the 2021 cropping season (Table 5). This was followed by the Moses variety as 23.9% of the farmers planted this variety. Farmers were still using local seeds a lot in producing rice, approximately 54.7% of the farmers used local varieties which were Moses, Bumbass, Mandii, Bazolgu, Salimasaa, and Assemblyman. Most of the farmers at Bontanga prefer Moses because of its ready market when harvested with at least 12 % moisture content in addition to its high-yielding ability.

64.6% of the rice processors in the study area prefer Agra rice to Paddy for processing (Table 5). Azumahet *et al.* (2022) reported similar results as they indicated that farmers in the area have embraced improved rice varieties like Agra, Sakai, Jasmine 85, Afife Jasmine 85, and Afife. Adams *et al.* (2019) also reported that women in the northern region primarily engage in parboiling rice, with Jasmine and AGRA rice being the two processed varieties most frequently used.

27.3% of the rice marketers in the study area preferred Gbewaa rice as paddy for marketing (Table 5). Asante *et al.* (2013) and Adams *et al.* (2019) corroborated this by revealing that Jasmine and Agra rice are the most processed rice varieties in the northern region of Ghana. These varieties have qualities such as aroma, grain size, and better cooking characteristics that consumers prefer. Ayeduvor (2018) supports this when he found that the characteristics of local rice in Ghana that influence preference and consumption are grain size, aroma, and cooking quality

4.7 Reason for choice of the variety

The majority of the farmers, that is 91 % of the farmers selected varieties based on the yield (Table 6). However, most of the farmers at Bontanga selected the Moses variety due to its good milling qualities when harvested at 12 % moisture content after its high-yielding ability. Similarly, Bissahet *al.*, (2022) report that Ghanaian farmers have a preference for certain rice varieties because of their good taste (83% of respondents), aroma (87% of respondents), and high-yielding potential (78% of respondents).

4.8 Method of planting

54.5% of the farmers planted their seeds using the broadcasting method (Table 7). The majority of these farmers were from lowland rain-fed ecology. While the majority of the farmers under irrigated ecology nursed and transplanted their rice seedlings. However, most of these farmers transplanted without definite spacing. Only 18% of the sample population practiced line transplanting with well-defined spacing. The adoption of line transplanting is still low in the study area. Ragasa *et al* (2013) corroborated that by indicating that most farmers in the northern region use broadcasting to plant rice.

4.9 Reason for choice of method of planting

Most of the farmers selected broadcasting because they could not afford the cost involved in transplanting and those who selected transplanting indicated that transplanting gave them better yield (Table 7). Similarly, Hindersahet *al.* (2022) revealed that while the transplanting method can yield higher productivity, the broadcasting method is the choice for rice farmers in the northern region of Ghana because it is simpler, less expensive, and requires less labor.

4.10 Age of seedling at transplanting

41.8% of the farmers, who practiced transplanting, transplanted at different ages of the seedlings (Table 8). The majority of them transplanted when the seedlings were at least 4

weeks old. Only 12.7% of the sample population transplanted when the seedlings were 2 and 3 weeks old. Studies have shown that early transplanting reduces transplanting shock which leads to better establishments and consequently higher productivity. Koudjega *et al.* (2019) support this statement by recommending transplanting rice seedlings at any age between 8 and 15 days as Reuben *et al.* (2016) indicated that earlier transplanting (8-12 days) gives superior crop growth performance.

4.11 Rate and type of fertilizer application

Farmers who applied only the basal application of fertilizer were at par with those who applied the chemical fertilizer at the recommended rate i.e. both basal and topdressing with a percentage of 44% (Table 9). Only 1.5% of the farmers applied both compost and chemical fertilizer. The adoption of the recommended rate of chemical fertilizer was not the best. The application compost was the worst. (Table 9). reveals that on average, a farmer applied 2.34 bags per acre or 5.84 per ha of fertilizer on their rice farm. This data suggests that rice farmers did not use the recommended quantities of fertilizer on their fields, which is consistent with findings from Ragasa *et al.* (2013) regarding low fertilizer usage among farmers in northern Ghana. Tetteh *et al.* (2002) also support this assertion that the recommended dosages are typically broad and out of date.

4.12 Reason for choice of type and rate of application

76% of farmers in the study area's choice of the rate of fertilizer application was tied to higher yield (Table 9). Addison *et al.* (2023) corroborating with this revealed that to increase food security, increase operators' income, and lower the rate of poverty in rural Ghana, the government should offer subsidies to rice farmers so they can engage in modern rice cultivation.

4.13 Qualities that influence the choice of paddy for processing

34.1% of the rice processors in the study area made their choice of a variety of paddy based on the uniformity of the grains. 26% and 24% of these processors made their choice based on the cooking characteristics and the percentage of unbroken grains respectively (Table 10). 4.9% of the processors preferred aromatic grains. Processors have these qualities at the back of their minds when purchasing paddy for processing and they impress on the producers to cultivate the right varieties. Asante et al. (2013) reported that rice varieties with excellent grain quality including how delicious it is and high yield potential are the basis for the selection of a variety for rice cultivation in the Ashanti region of Ghana.

5. Conclusion and recommendation

5.1 Conclusion

Results of the survey indicated the following:

54.7% of the farmers used local varieties which were Moses, Bumbass, Mandii, Bazolgu, Salimasaa, and Assemblyman.

54.5% of the farmers planted their seeds using the broadcasting method.

Only 18% of the sample population practiced line transplanting with well-defined spacing. Majority of those who transplanted did it when the seedlings were at least 4 weeks old.

44% of the farmers either applied only the basal application of chemical fertilizer or applied the chemical fertilizer at the recommended rate i.e. both basal and topdressing. Only 1.5% of the farmers applied both compost and chemical fertilizer.

34.1% of the rice processors in the study area made their choice of a variety of paddy based on the uniformity of the grains.

26% and 24% of these processors made their choice based on the cooking characteristics and the percentage of unbroken grains respectively.

22.7% of the rice marketers in the study area made their choice of a variety of paddy based on the cooking characteristics.

18.2% of the rice marketers made their choice of paddy based on long grains or uniformity of grains.

13.6% of these marketers made their choice based on broken grains or aromatic grains. 9.1% of the marketers preferred unbroken grains.

5.2 Recommendation

Rice production, processing, and marketing are mainly characterized by indigenous practices which has contributed to making the local rice business unattractive in Ghana. To boost the adoption of improved practices along the rice value chain, certain misconceptions or perceptions concerning the practices should be known and tackled diligently. Other variables or indicators of the adoption of technologies should be tackled head-on. Gender, educational level, and age of the farmers, processors, and marketers were not at the best in promoting technology adoption. The population of females involved in rice production is low and does not auger well for rice productivity in the study area as females play crucial roles in rice production, processing, and marketing. The rice production enterprise in the two districts is not attracting the very young ones who are 24 years and below. 62.7 % of the farmers have no formal education.

The processors were made up of 86.4 % females and 3 (13.6%) males. The lowest age bracket of the processors was 25 – 35 which formed 4.5% of the sample population.

Some of the perceptions they held were not also helping in enhancing technology adoption. Value chain actors compromised convenience for quality or higher production. Others went back to their indigenous ways due to the unaffordability of the technology. The majority of the farmers (54.5 %) from the study area did not use the certified seed because the certified seeds were costly. The majority (91 %) of the farmers selected varieties based on their yield. Most of the farmers selected broadcasting because they could not afford the cost involved in transplanting.

Training and empowerment of the producers, processors, and marketers by stakeholders in the rice value chain through policy-making, policy enforcement, empowerment training, and packages is recommended. Further research is needed to rope in the value chain actors in introducing and enhancing improved practices through field experiments or trials and consequently through laboratory tests to ascertain the effects of the field practices on the milling qualities of the rice produced. The practices that will ensure the local rice produced meets the international standard should not be compromised.

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